APPENDIX A SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

NSW GOVERNMENT | Planning & Environment

Contact: Kelly McNicol
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Mr Gordon Cameron
Principal Waste and Environmental Engineer
Port Macquarie-Hastings Council
PO Box 84
PORT MACQUARIE NSW 2444

SSD 5792

Dear Mr Cameron

Request for Extension to Secretary's Environmental Assessment Requirements
Cairncross Waste Management Facility, 8395 Pacific Highway, Pembrooke (SSD 5792)

I refer to your email of 31 January 2017 seeking an extension to the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the above State Significant Development (SSD) application.

The Department notes that SEARs were issued in February 2013, and reissued in May 2015 for the Cairncross Waste Management Facility. Given the SEARs were originally issued in 2013, please ensure the EIS is prepared in accordance with the most recent policies, plans and guidelines. It is noted that the EPA has released updated versions of the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* and *Environmental Guidelines: Solid Waste Landfills*.

Further, the Department requests the EIS includes the following:

- A preliminary risk assessment is conducted in accordance with *State Environmental Planning Policy No 33 – Hazardous and Offensive Development*; and
- A detailed site history is included, including development consents.

The Department has reviewed your request and considers that the SEARs remain valid, subject to the above. As such, the SEARs will be extended for an additional six months. Please note that if you do not lodge an application under Section 78A (8) of the *Environmental Planning and Assessment Act 1979* by **November 2017**, you must consult with the Secretary in relation to any further requirements for lodgement.

It would be appreciated if you could contact the Department at least two weeks before you propose to submit the development application and EIS for your development. The Department can then:

- Confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- Determine the number of copies (hard copy and electronic) of the EIS required for review.

Should you have any further enquiries, please contact Kelly McNicol on the contact details above.

Yours sincerely

C. Ritchie

Chris Ritchie
Director
Industry Assessments
as delegate of the Secretary

20/2/17

NSW GOVERNMENT | Planning & Environment

Contact: Emma Barnet
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Mr Gordon Cameron
Principal Waste and Environmental Engineer
Port Macquarie-Hastings Council
PO Box 84
Port Macquarie NSW 2444

Dear Mr Cameron

Secretary's Environmental Assessment Requirements
Cairncross Waste Management Facility, Port Macquarie-Hastings (SSD 13_5792)

Thank you for your letter dated 24 February 2015 seeking to amend the development description and consult further with Secretary in respect of the environmental assessment requirements issued to Port Macquarie Hastings Council on 14 February 2013. I have attached a copy of amended requirements for the development proposal

These amended requirements are based on the information you have provided to date. You should also refer to the government agency submissions submitted for the original environmental assessment requirements.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the development within two years. Once lodged, the Department will review your EIS carefully before putting it on public exhibition, and will require you to submit an amended EIS if it does not adequately address the requirements.

The Department notes that the proposed landfill would have capacity to operate for over 79 years at the predicted rate of waste input. This time frame raises some issues about whether the design and operational parameters of the landfill might begin to fall behind the community's expectation for such facilities after 20 to 30 years or so; and whether such capacity may slow or discourage continued development of waste recovery so that the amount of landfill waste is minimised.

Both waste recovery and best practice landfill design and operation are matters for consideration under clause 123 of the *State Environmental Planning Policy (Infrastructure) 2007*. Consequently, these matters will require expert analysis in the EIS. The proposed development of the landfill must be justifiable against the NSW Government's waste policy. Consideration should be given to a staged approach to developing the landfill so that the design and operation of future components can be reviewed in-line with future community's expectations and best practice.

When preparing the landfill proposal and justification, the Department would like to request that Council consult extensively with both the EPA's Waste Strategy Team and the Department's Industry Assessment Team to ensure that the issues surrounding long term best practice and waste recovery are given robust consideration.

The Department also notes that the site currently operates under a separate consent. The Department prefers operations like the Cairncross Waste Management Facility to operate under a single, modern planning approval. Consequently, the Department encourages you to develop the project with this preference in mind, and to consider surrendering all of the existing planning approvals for the facility if the project is approved.

I wish to emphasise the importance of effective and genuine community consultation and the need for proposals to proactively respond to the community's concerns. Accordingly a comprehensive, detailed and genuine community consultation and engagement process must be undertaken during preparation of the EIS. This process must ensure that the community is both informed of the proposal and is actively engaged in issues of concern to them. Sufficient information must be provided to the community so that it has a good understanding of what is being proposed and of the potential impacts.

Your proposal may require a separate approval under Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). If an EPBC Act approval is required, I would appreciate it if you would advise the Department accordingly, as the Commonwealth approval process may be integrated into the NSW approval process, and supplementary DGR's may need to be issued.

I would appreciate it if you would contact the Department at least two weeks before you propose to submit the development application and EIS for your development. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*);
- consultation and public exhibition arrangements; and
- determine the number of copies (hard-copy and CD-ROM) of the EIS required for review.

If you have any enquiries about these requirements, please contact Emma Barnet on the details above.

Yours sincerely,

C. Ritchie

Chris Ritchie 7/5/15.
Manager
Industry Assessments
As delegate of the Secretary

Secretary's Environmental Assessment Requirements

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 13_5792
Development	The Cairncross Waste Management Facility which involves extending the operational life of the existing Cairncross landfill, and includes: • the staged construction of new landfill cells; and • progressively increasing the annual waste acceptance rate at the landfill.
Location	8395 Pacific Highway, Telegraph Point, NSW (Lot 5 DP 1041766, Lot 6 DP 1106420 and Part Lot 7 DP1106420)
Applicant	Port Macquarie-Hastings Council
Date of Issue	May 2015
General Requirements	The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In addition, the EIS must include a: • clear description of the existing operations carried out on the site and how the site operates lawfully under the *Environmental Planning and Assessment Act 1979;* • detailed description of the development, including: – need for the proposed development having particular regard to the aims, objectives and guidance in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021*; – justification for the proposed development; – likely staging of the development - including construction, and operational stage/s; – likely interactions between the development and existing, approved and proposed operations in the vicinity of the site; and – plans of any proposed building works. • consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments; • risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment; • detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: – a description of the existing environment, using sufficient baseline data; – an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; – a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and

	• a consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS. The EIS must also be accompanied by a report from a qualified quantity surveyor providing: • a detailed calculation of the capital investment value (as defined in clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; • a close estimate of the jobs that will be created by the development during the construction and operational phases of the development; and • certification that the information provided is accurate at the date of preparation.
Key Issues	The EIS must address the following specific matters: • **Strategic Landuse Planning** – including: – demonstration that the proposal is generally consistent with the aims and objectives of all relevant environmental planning instruments and strategies including, but not limited to, *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP), the *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021*, *NSW State Plan 2021 – Goal 23*, the *Waste Avoidance and Recovery Act 2001*, the *National Waste Policy*, *Port Macquarie-Hastings Local Environment Plan 2011, Waste and Resource Management Strategy 2011-15* (Port Macquarie-Hastings Council), and relevant Development Control Plans; – justification for any inconsistency between the proposed development and these plans; – consideration of the NSW government's investment in new technologies and infrastructure to drive recycling and reuse under the Waste Less, Recycle More Initiative; – demonstration that the landfill construction and operation can be staged to ensure that the design remains current and in line with best practice at the time; and – details on the suitability of the site for the proposed development. • **Waste Management** – including: – identification, classification and quantification of the likely waste streams that would be handled/stored/disposed of at the facility; – a description of how this waste would be treated, stored, used, disposed and handled on site, and transported to the site, and the potential impacts associated with these issues; – an analysis of whether the development is consistent with Clause 123 of the Infrastructure SEPP; – a description of all reasonable and feasible measures that have been or would be implemented to maximise resource recovery from the waste stream and reduce the disposal of waste to landfill in line with the aims, objectives and guidance in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021*, the EPA's *Guidelines for Composting and Related Organics Processing Facilities*, Council's adopted Waste Strategy, and other government policy; – details of the landfill cell design and integrity in accordance with best practice industry standard guidelines such as the EPA's

	Environmental Guidelines: Solid Waste Landfills; – a description of the staged approach to developing the landfill so that the design and operation of future components can be reviewed in-line with future community's expectations and best practice; and – operational measures to manage litter and waste that is illegally dumped on adjacent properties including Rawdon Creek Nature Reserve. • **Flora and Fauna** – including: – an assessment of the proposal under the Framework for Biodiversity Assessment (Oct 2014) including an assessment of any potential impacts on riparian vegetation and groundwater dependant ecosystems. • **Soil, Water and Leachate** – including: – the proposed erosion and sediment controls during construction and operation; – consideration of potential acid sulfate soils, salinity, soil contamination; – a site water balance, including a detailed description of the measures to minimise the water use at the site; – a detailed assessment of the potential impacts of the project on the quantity, quality and long-term integrity of the surface and groundwater resources in the area, including baseline data of existing conditions, potential flooding impacts and potential impacts on Rawdon Creek; – the proposed stormwater management system, including the capacity of onsite detention systems, and measures to treat, reuse or dispose of water; and – the proposed leachate management system including the capacity of the system to treat and dispose of leachate. • **Air Quality and Odour** – including: – a quantitative assessment of the potential air quality and odour impacts of the development on surrounding receivers, including impacts from construction, operation and transport; and – details of the proposed mitigation, management and monitoring measures. • **Noise and Vibration** – including: – quantitative assessment of potential construction, operational and transport noise and vibration impacts, including potential impacts on nearby sensitive receivers; and – details of the proposed noise management and monitoring measures. • **Traffic** – including: – details of all traffic types and volumes likely to be generated; – assessment of predicted impacts on road safety and the capacity of the road network to accommodate the project; and – assessment of where off site infrastructure works are required as a result of traffic impacts. • **Greenhouse Gas** – including: – a quantitative assessment of the scope 1, 2 and 3 greenhouse gas emissions of the project; and – a detailed description of the measures that would be implemented to minimise the methane emissions of the proposed landfill operations and ensure that the project is energy efficient. • **Rehabilitation** – including:

	– a detailed description of how the site would be progressively rehabilitated, revegetated, and integrated into the surrounding landscape, including measures to ensure that the final landform is free draining; – a justification for the proposed final landform and use, taking into consideration any relevant strategic land use planning or resource management plans or policies; and • a detailed description of the measures that would be put in place to ensure sufficient resources are available to implement the proposed rehabilitation measures, and the ongoing management of the site following the cessation of landfilling activities. • **Heritage** - both Aboriginal and non-Aboriginal; • **Visual impacts;** • **Hazards and risks;** and • **Biosecurity, pests and vermin.**
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents.
Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with: • Environment Protection Authority; • Office of Environment and Heritage; • Department of Primary Industries; • Roads and Maritime Services; and • the local community and stakeholders. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.
Further consultation after 2 years	If you do not lodge an EIS for the development within 2 years of the issue date of these DGRs, you must consult with the Director-General in relation to the requirements for lodgement.
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, Attachment 1 contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this development.

ATTACHMENT 1
Technical and Policy Guidelines

The following guidelines may assist in the preparation of the Environmental Impact Statement. This list is not exhaustive and not all of these guidelines may be relevant to your proposal.

Many of these documents can be found on the following websites:
http://www.planning.nsw.gov.au
http://www.bookshop.nsw.gov.au
http://www.publications.gov.au

Policies, Guidelines & Plans

Aspect	Policy /Methodology
Risk Assessment	
	AS/NZS 4360:2004 Risk Management (Standards Australia)
	HB 203: 203:2006 Environmental Risk Management – Principles & Process (Standards Australia)
Waste	
	Waste Avoidance and Resource Recovery Strategy 2007 (DECC)
	State Environmental Planning Policy (Infrastructure) 2007
	Environmental Guidelines: Solid Waste Landfills (NSW EPA)
	Environmental Guidelines: Composting and Related Organics Processing Facilities (NSW EPA)
	Environmental Guidelines: Assessment Classification and Management of Non-Liquid and Liquid Waste (NSW EPA)
	Guideline for the Use and Disposal of Biosolids Products (NSW EPA)
	Waste and Resource Management Strategy 2011-15 (Port Macquarie-Hastings Council)
Biodiversity	
	State Environmental Planning Policy No 44– Koala Habitat Protection (SEPP 44)
	Draft Guidelines for Threatened Species Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979* (DEC)
	DECCW's Threatened Species Assessment Guidelines – Assessment of Significance (2007).
	Policy & Guidelines - Aquatic Habitat Management and Fish Conservation (NSW Fisheries)
	The NSW State Groundwater Dependent Ecosystem Policy (NOW)
	NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development and State Significant Infrastructure Projects (OEH 2011b)
	Principals for the Use of Biodiversity Offsets in NSW (OEH)
	Biobanking Assessment Methodology 2008 (DECC)
	Biobanking Assessment Methodology and Credit Calculator

	Operational Manual 2009 (DECC)
Soil and Water	
Soil	Rural Land Capability Mapping (DLWC)
	Agricultural Land Classification (DPI)
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC & NHMRC)
	National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Managing Land Contamination – Planning Guidelines SEPP 55 – Remediation of Land (DOP)
	Design Manual for Soil Conservation Works - Technical Handbook No. 5 (DWE)
	Acid Sulfate Soil Manual (ASSMAC)
Surface Water	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Use of Reclaimed Water (ARMCANZ/ANZECC)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC)
	State Water Management Outcomes Plan
	NSW Government Water Quality and River Flow Environmental Objectives (DECC)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC)
	Managing Urban Stormwater: Soils & Construction (Landcom)
	Managing Urban Stormwater: Treatment Techniques (DECC)
	Managing Urban Stormwater: Source Control (DECC)
	Technical Guidelines: Bunding & Spill Management (DECC)
	Environmental Guidelines: Use of Effluent by Irrigation
	Floodplain Management Manual (DNR)
	Floodplain Risk Management Guideline: Practical Consideration of Climate Change (DECC)
Groundwater	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	NSW State Groundwater Policy Framework Document (DWE)
	NSW State Groundwater Quality Protection Policy (DWE)
	NSW State Groundwater Quantity Management Policy (DWE) Draft
	NSW Salinity Strategy (DWE)
Air Quality & Odour	
	Protection of the Environment Operations (Clean Air) Regulation

	2002
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DECC)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DECC)
	Assessment and Management of Odour from Stationary Sources in NSW (DECC)
Noise & Vibration	
	NSW Industrial Noise Policy (DECC)
	Road Noise Policy (EPA)
	Environmental Noise Control Manual (DECC)
	Assessing Vibration: A Technical Guideline (DECC)
Traffic	
	Guide to Traffic Generating Development (RTA)
	Austroads Guide to Road Design (AUSTROADS)
Greenhouse Gas	
	National Greenhouse Accounts (NGA) Factors
	Guidelines for Energy Savings Action Plans (DEUS)
Heritage	
Aboriginal	Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC)
	Aboriginal Cultural Heritage Standards and Guidelines Kit (NSW EPA)
Non-Indigenous	NSW Heritage Manual (NSW Heritage Office & DUAP)
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Applying SEPP 33: Hazardous And Offensive Development Application Guidelines (DUAP)
	Hazardous Industry Planning Advisory Paper No. 6 (HIPAP No 6): *Guidelines for Hazardous Analysis*, (DUAP)
	Multi-Level Risk Assessment (DUAP)
	Planning for Bush Fire Protection (NSW Rural Fire Service)
Visual	
	Control of Obtrusive Effects of Outdoor Lighting (AS 4282)

APPENDIX B CONCEPT DESIGN REPORT: CAIRNCROSS WASTE MANAGEMENT FACILITY



Cairncross Waste Management Facility
Concept Design Report
2017

PORT MACQUARIE HASTINGS

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REVISION HISTORY

No	Issue Date	Revision Notes	Prepared By	Approved By
1	19/12/2016	Draft - stakeholder review	B. Farr	G. Cameron
2	20/02/2017	Final Draft	B. Farr	G. Cameron
3	10/03/2017	Final	B. Farr	G. Cameron

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1. INTRODUCTION

Port Macquarie-Hastings Council (PMHC) has prepared this concept design for the Cairncross Waste Management Facility.

This report details the existing landfill stage and the concept design of the future stages of the landfill to supplement an Environmental Impact Statement (EIS) for a State Significant Development (SSD) application (SSD13-5792).

1.1 Background

The Cairncross Waste Management Facility (CWMF) was granted approval for the current stage (Stage E) in 1999 and commenced operations in September 2001, however the approval was time limited to 20 years. In February 2013, an extension of 5 years was sought on the original approval and subsequently granted. The current approval is now due to conclude in 2026.

Council is now seeking an approval for all future landfill stages shown in the **Appendix C - Future Stage Concept Plans**. This report details the concept design of the future stages of the landfill and has been prepared to supplement the State Significant Development application.

1.2 Scope of Report

The purpose of this report is to:

- Detail the information used to produce the concept design
- Outline the assumptions used in the concept design
- Specifically the report details:
    - The updated design elements so as to comply with the EPA's *Environmental Guidelines: Solid Waste Landfills (2016).*
    - Reviews staging boundaries based on topographical and operational requirements.
    - Confirms the landfill volumes including earthworks balance.
    - Confirms stormwater management and sediment basin sizes.
    - Confirms leachate management including collection and disposal.

The report structure is generally set out in accordance with the EPA's *Environmental Guidelines: Solid Waste Landfills (2016).*

2. SITE OVERVIEW

2.1 Site Location

The CWMF landfill area is located on Lot 7, DP 1041766, and the site is owned and operated by Port Macquarie-Hastings Council (PMHC). The site is zoned SP2 (Waste or Resource Management Facilities) by the *Port Macquarie-Hastings Local Environment Plan 2011*. The site location is shown in **Figure 1** below.

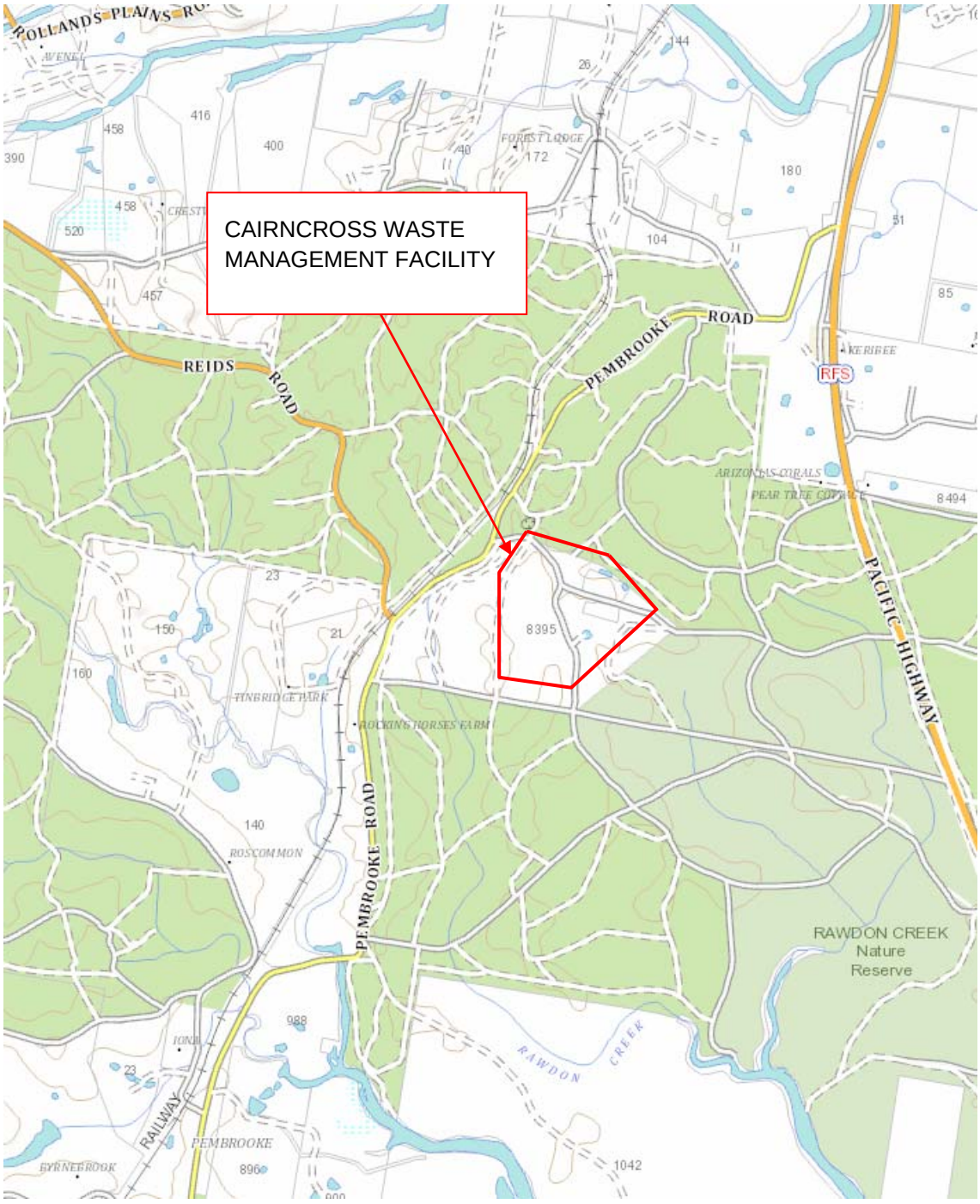


Figure 1: Site Location (SIX Maps, 2016)

2.2 Topography and Drainage

The existing capped and grassed landfill area slopes to the north and west via ephemeral gullies C and D.

To the south are the future landfill areas which slope to the south and south east and are drained by ephemeral gullies A and B. Gullies A and B both drain to Rawdon Creek via ephemeral watercourses and join approximately 2.0 km to the south of the CWMF.

Site slopes are generally in the range of 1% to 10%.

Refer to **Figure 2** for the overall topography of the site.

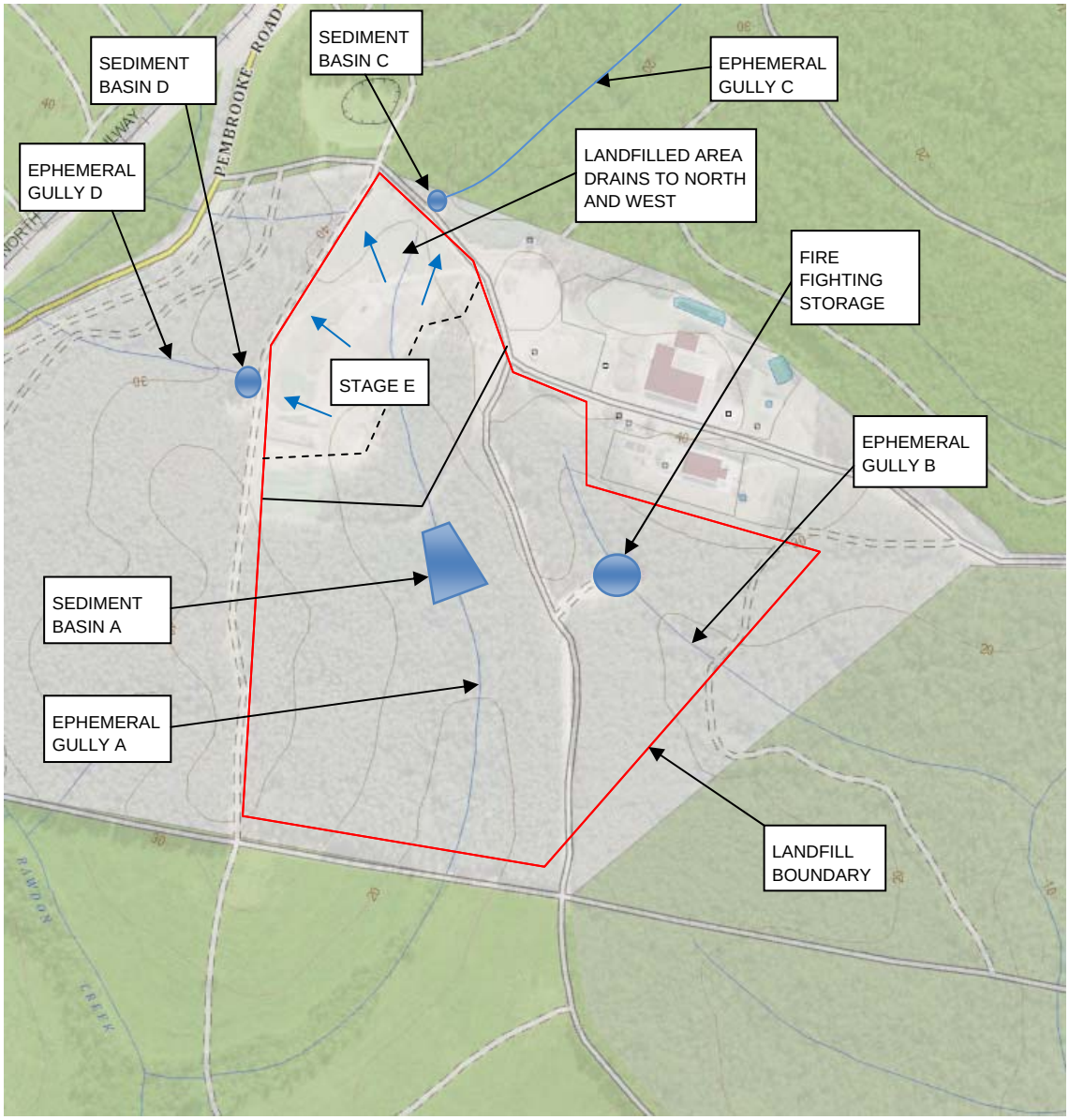


Figure 2: Site Topography (*Six Maps, 2016*)

The underlying site soils are generally clayey with low permeability and high potential for runoff.

The completed capped and grassed areas of the existing landfill stage (Stage E) generally drain to the west and north to small sediment basins (Sediment Basins C and D) which discharge to ephemeral gullies C and D. Once completed, the eastern corner of Stage E will drain to the existing fire fighting storage and then into ephemeral gully B. The Stage E operational area drains to Sediment Basin A which in turn discharges to ephemeral gully A. Refer to Table 1 for details on each sediment basin.

A leachate collection system services the active landfill area.

Table 1: Existing Sediment Basin Details

Sediment Basin	Area (m^2)	Estimated Depth (m)	Estimated Capacity (m^3)
A	4,500	1.2	5,200
C	350	1.5	525
D	800	1.5	1200
Fire Storage	1300	2.0	2600

Refer to **Appendix A - Stage E (Existing) Concept Plan** for additional details.

2.3 Geology and Soils

A geotechnical investigation was undertaken by GHD-Longmac Pty Ltd in 1998. The report (*Hydrogeological Investigation of Proposed Cairncross landfill*) described the regional geology as follows:

> *The regional geology within the vicinity of the site consists of Quartenary Alluvial material and sedimentary bedrock (Refer to the Tamworth-Hastings 1:250,000 metallogenic sheet). The Quartenary Alluvial material consists of mud, silt, sand and gravel deposits. The sedimentary bedrock consists of rock types of the early permian to carboniferous age of the Hastings Block. This comprises the Macleay Group, Byabarra beds, and the Youdale, Kullatine, Majors Creek, Mingaletta and Cooperabung formations. The rock types within these units include the lithic sandstone, mudstone, calcareous mudstone, siltstone, limestone, conglomerate and tuff.*

The investigation revealed the following subsurface conditions for the landfill site:

- Topsoil of 0.1m to 0.2m depth was encountered across the site and consisted primarily of medium plasticity clay.
- Residual Clays of high plasticity were encountered to depths of 1.5m to 2.0m on the ridges, and up to 5.0m within the lower areas and gullies.
- Siltstone bedrock was encountered below the residual clays across the site. The siltstone was generally highly weathered and very weak to weak in strength. The siltstone stratum was in the range of 4m to 5m thick.
- Shale bedrock of weak to medium strength was encountered below the siltsone.

Excavations within Stage E of the landfill has found the sub-surface soils to be consistent with the geotechnical report by GHD-Longmac Pty Ltd, and therefore no further geotechnical investigations were considered necessary for the concept design of future landfill stages.

2.4 Groundwater

A further hydrogeological assessment for the site was completed by Trace Environmental (*Hydrogeological Assessment - Cairncross Landfill Expansion*) in October 2016.

The assessment addressed the following:

- Regional and local groundwater system characterisation
- Depth to groundwater across the site
- Details of the site monitoring network and monitoring program
- Assessment of the predicted inflow rates into the proposed landfill cells

- Impact of the proposed landfill expansion on groundwater heads and groundwater quality on the groundwater systems, ecosystems, surface water system (Rawdon Creek) and groundwater users
- Landfill design with respect to groundwater
- Description of trigger levels for groundwater quality and head monitoring
- Recommendations for future monitoring and reporting
- Project compliance with State and Commonwealth regulations.

A summary of the findings is presented below:

- Three geological units are identified within the landfill site, namely clay/colluvium (silty clay), weathered rock (siltstone) and fractured rock (shale).
- The weathered rock and fractured rock represent one hydrostratigraphic unit.
- The clay is discontinuous across the site. Its major characteristic is the retardation of recharge to the underlying aquifer.
- Groundwater recharge occurs via minor seepage through the clay or lateral flow through the shale/siltstone unit. The groundwater flow direction is from the north and west to the east and south-east, with average velocity of 0.008m/day.
- Based on the groundwater chemistry it is concluded that there is presently no mixing of leachate with groundwater.
- Identified sensitive receptors within a 3km radius of the landfill are private groundwater bores, surface water bodies, and areas with moderate potential for groundwater interaction with the presence of surface Groundwater Dependent Ecosystems (GDEs) that rely on subsurface expression of groundwater.

2.5 Climate

The Port Macquarie-Hastings area has a warm temperate climate with warm wet summers and mild dry winters. The closest historical rainfall gauge is located at Farawells Road, Telegraph Point [Bureau of Meteorology (BOM) Station 60031]. The average annual rainfall for this gauge is 1,317mm. The mean monthly rainfall is shown in **Table 2**.

Table 2: Mean Monthly Rainfall - Telegraph Point

Month	Median Rainfall (mm)	Month	Median Rainfall (mm)
January	139	July	67
February	176	August	59
March	164	September	60
April	128	October	83
May	105	November	110
June	109	December	115

Average areal potential evapotranspiration for the site has been estimated from BOM online mapping and is presented in **Table 3**.

Table 3: Average Areal Potential Evapotranspiration (Monthly)

Month	Average Areal Potential Evapotranspiration (mm)	Month	Average Areal Potential Evapotranspiration (mm)
January	150	July	55
February	125	August	85
March	115	September	100
April	95	October	125
May	65	November	135
June	55	December	155

The predominant winds on the site are from the north-east in the spring and summer and from the west and south-west during winter. Autumn is a transitional season with the majority of winds from the south and west.

3. EXISTING SITE OPERATIONS

The following section describes the existing landfill operations (Stage E) as approved in 1999.

3.1 Site Access

Access to the CWMF is from the Pacific Highway via a sealed private access road. NB: the new Pacific Highway is under construction and when complete the existing highway will become a local council road.

Main internal roads are sealed through to the main facility including the weighbridge, Organic Resource Recovery Facility (ORRF), Material Recycling Facility (MRF), transfer station and to the site work shed.

The landfill area is accessed via gravel roads/tracks from the site work shed, which are maintained to an all weather two wheel drive vehicle standard. A wheel wash is located at the exit from the landfill.

3.2 Waste Filling Operations

The existing Stage E cell has a total landfill volume of approximately 1,436,000m^3 and is expected to be completed in 2019.

Refer to **Appendix A - Stage E (Existing) Concept Plan**.

The earthworks materials balance and landfill volume for Stage E is detailed in **Table 4**.

Table 4: Materials Balance Summary for Stage E

Description	Quantity
Area (m2)	102,063
Topsoil Stripping Volume (m3) (1)	30,619
Clay Excavation Volume (m3)	554,362
Leachate Barrier Clay Vol (m3)	91,857
Cap Clay Volume (m3)	81,650
Vegetation Layer Topsoil Vol (m3)	30,619
Landfill Void Volume (m3)	1,435,997
Day Cover Clay Required (m3) (10% of void) (2)	143,600
Actual Landfill Void Volume (m3) (less day cover volume)	1,292,397
Total Clay Required (m3)	317,107
Clay Balance (m3) (-ve = deficit)	237,255

(1) Assumes 300mm depth of topsoil
(2) Based on actual measured volumes within Stage E needed to achieve 150mm daily cover

The excavation of sub-cells is undertaken progressively with excavated clay stockpiled for future use as cell liner, day cover, intermediate cover and final capping material.

Waste is placed in layers and compacted. The *Cairncross Waste Management Facility Landfill Environment Management Plan (2001)* detailed a landfill compaction density of 850kg/m^3 for

the site. Field testing indicates that this level of compaction has been achieved in completed landfill cells.

The capping layer for Stage E comprises a 600mm compacted clay layer which is topped by a 500mm topsoil layer. The compacted clay is to have a permeability of less than $1x10^{-8}$m/s.

The existing landfill stage commenced in the north of the site and is progressing south. Stage E is due for completion in 2019.

3.3 Leachate Management

A leachate barrier system is installed within the floor of all Stage E sub-cells to restrict the migration of leachate to groundwater, soils and substrata. The leachate barrier comprises compacted clay 900mm thick with maximum permeability of $1x10^{-9}$m/s.

A leachate collection system comprising a series of slotted drainage lines (2 x 100mm PVC) will convey leachate to a collection tank where leachate is pumped to leachate infiltration basins in the crown of the landfill. Leachate is recirculated through the landfill via these infiltration basins to provide biological and chemical treatment. When leachate volumes exceed infiltration capacities, leachate is transported off site to a sewer treatment plant (STP). Volumes transported off site are recorded.

The existing leachate collection tank location is being encroached by the landfill and construction of new leachate collection tanks was commenced in 2016 and is expected to be completed in early 2017. This new location (within Stage 2) is in accordance with the *Cairncross Waste Management Facility Landfill Environment Management Plan (2001)* and *Cairncross Waste Management Facility Operational Environment Management Plan (2008),* and is expected to be operational for the remainder of Stage E and Stage 1 filling operations. The new leachate tanks are sized for two (2) days storage at the maximum predicted leachate flow ($39.45m^3$/day or $1.64m^3$/hr).

The leachate tanks will initially be pumped via rising main to the existing infiltration basins. However, PMHC will shortly commence construction of a new sewerage treatment plant (STP) to be built within the CWMF Industrial Precinct. Once complete, the leachate from Stage E (and future stages) will be pumped to the STP for treatment and disposal from the site.

3.4 Stormwater Management

There are currently a number of surface water management features in place at the site. The primary objective of the surface water management features are to ensure that relevant water quality objectives are achieved for stormwater discharged from the site. The following is a summary of the existing surface water management features in place at the site:

- Internal roads are gravelled to prevent softening and erosion during wet weather.
- Roadside table drains and drainage channels are constructed where required to direct stormwater away from erosion prone areas.
- Table drains and channels are grassed or rock armoured to prevent scouring.
- Sediment traps are used where possible to collect sediment prior to stormwater reaching the sediment basin.
- A large sediment basin is utilised as end-of-line treatment for all stormwater runoff from the site. The basin outlet is controlled via a manual valve which is generally released five (5) days after a rainfall event to ensure maximum sediment capture. The basin is cleaned as required.
- Covering of waste (day cover) is completed with compacted clay, trimmed and graded to encourage runoff of rainwater.
- Final contouring of landfill areas is designed to assist water runoff and direct water to relevant stormwater sediment basins before being discharged from the site.

- Maintenance is carried out on all stormwater infrastructure to ensure control measures are operational prior to rainfall events.
- Clearing and stripping of new landfill sub-cells is done progressively to limit runoff and control sediment runoff.

3.5 Water Quality Monitoring

The following section details the existing water quality monitoring program.

3.5.1 Leachate Monitoring

PMHC currently undertakes routine leachate composition monitoring on a quarterly basis by sampling and testing leachate from the main collection tank within Stage E and infiltration basins. The sampling locations are shown on the **Appendix B - Water Quality Monitoring Locations**, and are identified as CL1, CL2 and CL3. PMHC's *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 18 (SOP27) details the sampling and field procedures.

Parameters tested are generally in accordance with the EPA's *Environmental Guidelines, Solid Waste Landfills*. **Table 5** details the current leachate monitoring parameters.

Table 5: Leachate Monitoring Parameters

Parameter		
Temperature	Potassium (dissolved)	1.1-Dichloropropylene
pH	Manganese (dissolved)	Carbon Tetrachloride
Electrical Conductivity	Iron (dissolved)	1.2-Dichloroethane
Electrical Conductivity	Fluoride	Trichloroethene
Hydroxide Alkalinity as CaCO3	Ammonia as N	Dibromomethane
Carbonate Alkalinity as CaCO3	Nitrite as N	1.1.2-Trichloroethane
Bicarbonate AlkalinityasCaCO3	Nitrate as N	Dibromochloromethane
Total Alkalinity as CaCO3	Nitrite + Nitrate as N	Bromoform
Sulfate as SO4	Total Anions	1.3-Dichloropropane
Chloride	Total Cations	Tetrachloroethene
Calcium (dissolved)	Ionic Balance	1.1.1.2-Tetrachloroethane
Magnesium (dissolved)	Total Organic Carbon (TOC)	trans-1.4-Dichloro-2-butene
Sodium (dissolved)	Phenols (Total)	Bromodichloromethane
2.2-Dichloropropane	cis-1.4-Dichloro-2-butene	Iodomethane
1.2-Dichloropropane	1.1.2.2-Tetrachloroethane	trans-1.2-Dichloroethene
cis-1.3-Dichloropropylene	1.2.3-Trichloropropane	1.1-Dichloroethane
trans-1.3-Dichloropropylene	Pentachloroethane	cis-1.2-Dichloroethene
1.2-Dibromoethane (EDB)	1.2-Dibromo-3-chloropropane	1.1.1-Trichloroethane
Dichlorodifluoromethane	Hexachlorobutadiene	1.2-Dichlorobenzene
Chloromethane	Chlorobenzene	1.2.4-Trichlorobenzene
Vinyl chloride	Bromobenzene	1.2.3-Trichlorobenzene
Bromomethane	2-Chlorotoluene	Chloroform
Chloroethane	4-Chlorotoluene	Bromodichloromethane
Trichlorofluoromethane	1.3-Dichlorobenzene	-----
1.1-Dichloroethene	1.4-Dichlorobenzene	-----

3.5.2 Stormwater Monitoring

Appendix B - Water Quality Monitoring Locations show the locations of surface water monitoring undertaken on the site. Sampling is undertaken on a quarterly basis when surface water is present.

PMHC's *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 18 (SOP38) details the sampling and field procedures.

The current minimum stormwater parameters are identified in **Table 6**.

Table 6: Surface Water Monitoring Parameters

Parameter	
Volatile halogenated compounds	Nitrate
Alkalinity	pH
Ammonia	Total phenolics
Calcium	Potassium
Chloride	Sodium
Fluoride	Sulphate
Iron	Total Organic Carbon
Magnesium	Total Suspended Solids
Manganese	---

3.5.3 Groundwater Monitoring

Nine (9) groundwater monitoring bores are currently located within CWMF and are monitored on a quarterly basis. PMHC's *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 18 (SOP18) details the sampling and field procedures.

Refer to **Appendix B - Water Quality Monitoring Locations** for details of the groundwater monitoring bore locations.

The current minimum groundwater parameters are identified in **Table 7**.

Table 7: Groundwater Monitoring Parameters

Parameter	
Absorbable organic halogens (AOX)	Manganese
Alkalinity	Nitrate
Ammonia	pH
Calcium	Total phenolics
Chloride	Potassium
Fluoride	Sodium
Iron	Sulphate
Magnesium	Total Organic Carbon

3.5.4 Landfill Gas Management and Monitoring

Landfill gas surface emissions monitoring, sub-surface monitoring and gas accumulation monitoring is currently undertaken at CWMF.

PMHC's *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 19 (SOP19) details the landfill gas monitoring procedures including use of the gas monitoring equipment (eg. detector, wind speed monitor) and EPA reporting threshold levels.

Sub-surface monitoring is currently undertaken on a quarterly basis within groundwater monitoring boreholes. Groundwater monitoring boreholes range in depth from 10m to up to 30m and have been considered a suitable 'surrogate' for gas monitoring bores. Refer to **Appendix B - Water Quality Monitoring Locations** for details of the groundwater monitoring bore locations. Detection of methane above 1.25% (12,500 ppm) (v/v) requires notification to the EPA, further investigation and potential corrective action.

Surface monitoring is undertaken using a 25m grid survey over completed (capped and grassed) landfill areas. Surface monitoring is undertaken on a monthly basis. The threshold concentration for closer investigation is 0.05% (500 ppm) (v/v) of methane at any point on the landfill surface.

Accumulation monitoring also occurs within structures located within 250m of deposited waste. Detection of methane above 1.25% (12,500 ppm) (v/v) notification to the EPA, further investigation and potential corrective action.

EPA's *Environmental Guidelines, Solid Waste Landfills (2016)* has revised the threshold levels as follows:

- **Sub-surface monitoring:** 1.0% methane (v/v) and 1.5% carbon dioxide (v/v).
- **Surface monitoring**: 1.0% methane (v/v).
- **Accumulation monitoring**: 1.0% methane (v/v).

PMHC's *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 19 (SOP19) will be revised to reflect the new threshold levels.

4. CONCEPT DESIGN

The following section describes the proposed concept design for Stages 1, 2, and 3.

4.1 Landfill Capacity

The CWMF landfill has been divided into four (4) main cells (stages). **Figure 3** shows the existing landfill (Stage E), and future Stages 1, 2 and 3.

The staging boundaries have been modified from the original design contained within the *Cairncross Waste Management Facility Landfill Environment Management Plan (2001)* to better reflect the natural, final and floor levels of the landfill site, expected waste volumes and operational requirements. A general equal/even distribution of area was also considered in the final stage layout.

The area consisting of Stage 1 and Stage 2 are within a catchment that drains south to land owned by State Forests NSW (Forestry Corp). The area within Stage 3 is located in a catchment which drains to the east through Rawdon Creek Nature Reserve. The final leachate collection system also dictated the need to split catchments and define stages as shown below.

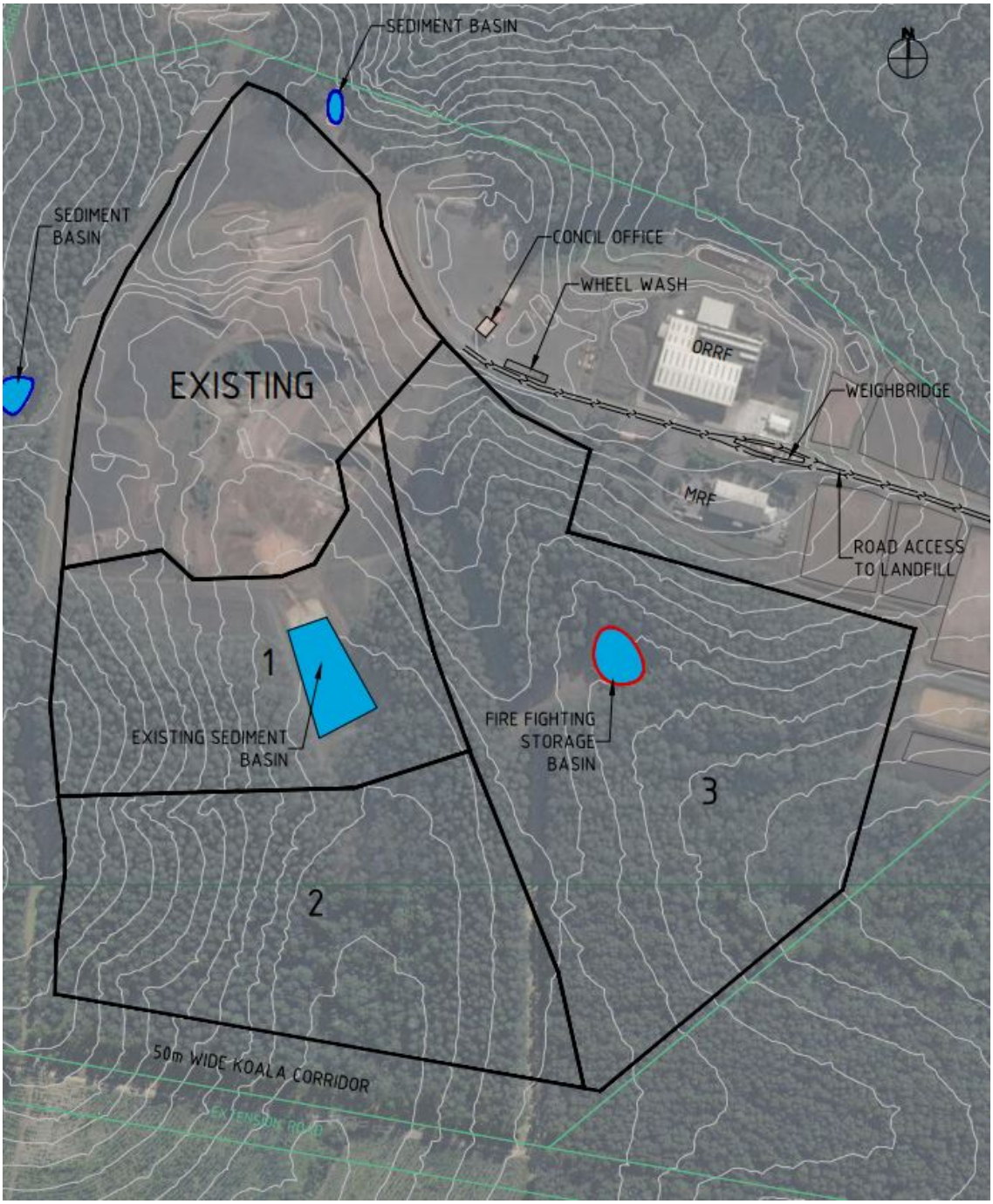


Figure 3: Site Layout

The staging boundaries have also been modified to allow for a 50m wide Koala corridor to allow for the movement of Koalas in the south-east to the north-west of the site.

Refer to **Appendix C - Future Stage Concept Plans** for details of the future stages.

The Stage E land is progressing south and is due for completion in 2019.

The *Cairncross Landfill Expansion, Future Disposal Capacity Requirements* (2016) report details a range of scenarios incorporating potential increases in waste generation, changes to diversion rates and the potential for CWMF to accept tonnages from outside its local government area.

Table 8 shows the estimated landfill volumes for each stage and the estimated completion year based on 'Scenario 4'. Scenario 4 assumes PMHC would, *achieve 75% kerbside diversion rate by 2015-16 and 40% diversion of C&I by 2021-22; no change to C&D / Other MSW diversion rates*. Scenario 4 was considered the most 'likely' and has been adopted for this design.

The estimated completion year for Stages 1, 2 and 3 are 2040, 2047 and 2056 respectively.

Table 8: Landfill Stage Volumes

Stage	Landfill Void Volume (m^3)	Estimated Completion Year
Existing	1,436,000	2019
1	1,610,000	2040
2	1,017,000	2047
3	1,542,000	2056

4.2 Sequencing of Stages

Landfill excavation, liner construction and the installation of the leachate collection systems will continue to be undertaken in a staged manner to allow progressive capping of the previous landfill cell. To manage the operational aspects of this process, each stage has been further divided into sub-stages. Refer to **Appendix D - Future Stage Concept Plans - Sub Stages**.

The sub-stage areas have been selected based on operation experience gained from Stage E. The timeframes are considered suitable to be operationally efficient for clearing, excavation, liner preparation, waste filling, capping and closure (of the relevant sub-cell).

The sub-stages also include the benefit of minimising disturbed areas by reducing stormwater runoff and erosion, and limiting leachate generation by controlling the active landfill area.

A 'typical' development sequence is detailed in **Figure 4** below.

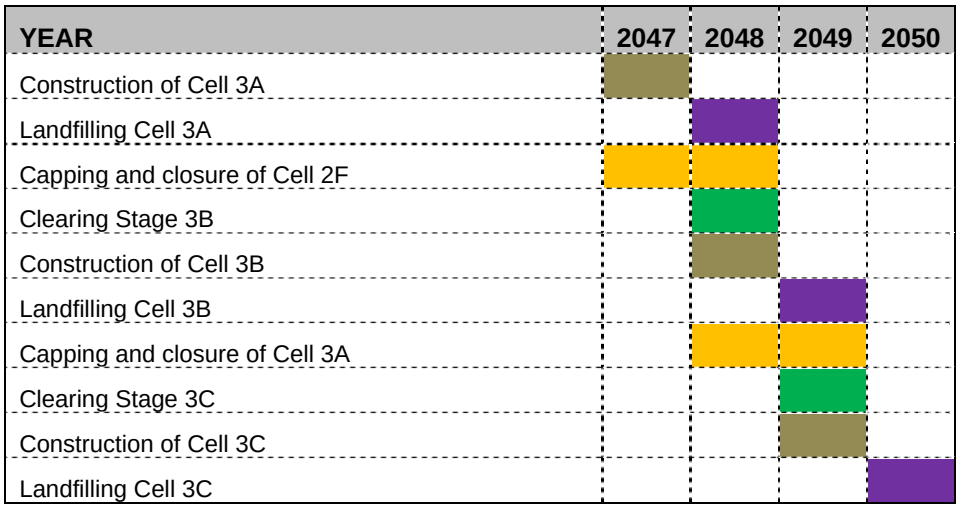


Figure 4: Typical Development Sequence

4.3 Landfill Floor Level

The landfill floor level for Stages 1, 2 and 3 has been modified from the original design contained within the *Cairncross Waste Management Facility Landfill Environment Management Plan (2001)* to better reflect groundwater conditions, maximisation of landfill void volume, and longitudinal/transverse floor gradients.

Trace Environmental prepared the *Hydrogeological Assessment, Cairncross Landfill Expansion (2016)* report, that identifies 'average' long term groundwater and 'maximum' groundwater levels across the site. The adjusted floor level was set a minimum of 2.0m above the average long term groundwater level. This design parameter is in accordance with best practice requirements from the Victorian EPA guidelines, *Siting, Design, Operation and Rehabilitation of Landfills; Best Practice Environmental Management, Publication 788.3 (August 2015)*. See

Victorian EPA document link:- http://www.epa.vic.gov.au/~/media/Publications/788%203.pdf. The Victorian EPA guidelines were used given NSW EPA did not have any groundwater clearance/buffer guidelines at the time.

Floor levels were further adjusted where possible to maximise the landfill void volume whilst maintaining longitudinal gradients >1%, and transverse gradients >3%.

Refer to **Appendix E - Landfill Floor Excavation Levels**.

4.4 Groundwater Interception

As noted in Section 4.3 above, the revised landfill floor level was generally set at 2.0m above the 'average' long term groundwater level as detailed in the *Hydrogeological Assessment, Cairncross Landfill Expansion (2016)*.

During above 'average' groundwater level conditions, Trace Environmental (2016) identified that the excavation of the landfill cells may intercept groundwater, particularly in the south western corner of the site (Stages 1 and 2).

Figure 5 shows the estimated depths and locations where groundwater may be encountered by the landfill excavation.

In order to avoid any risk of groundwater infiltration into the landfill cells, a gravel/rubble trench is proposed around the perimeter of the landfill at locations where groundwater may be encountered (refer to **Figure 5**). The gravel trench will drain to the landfill low point at the southern perimeter, and prevent groundwater from entering the landfill cell during excavation and filling operations. The gravel trench is to remain operational following the closure of the landfill to prevent groundwater impacting the closed landfill.

The gravel trench will be typically 900mm wide with 100mm gravel installed with a geofabric surround. Depth of the trench will be to the 'average' groundwater level. Refer to **Figure 6** for the typical cross section of the groundwater interception trench.

For further information on groundwater conditions refer to *Hydrogeological Assessment, Cairncross Landfill Expansion* (2016).

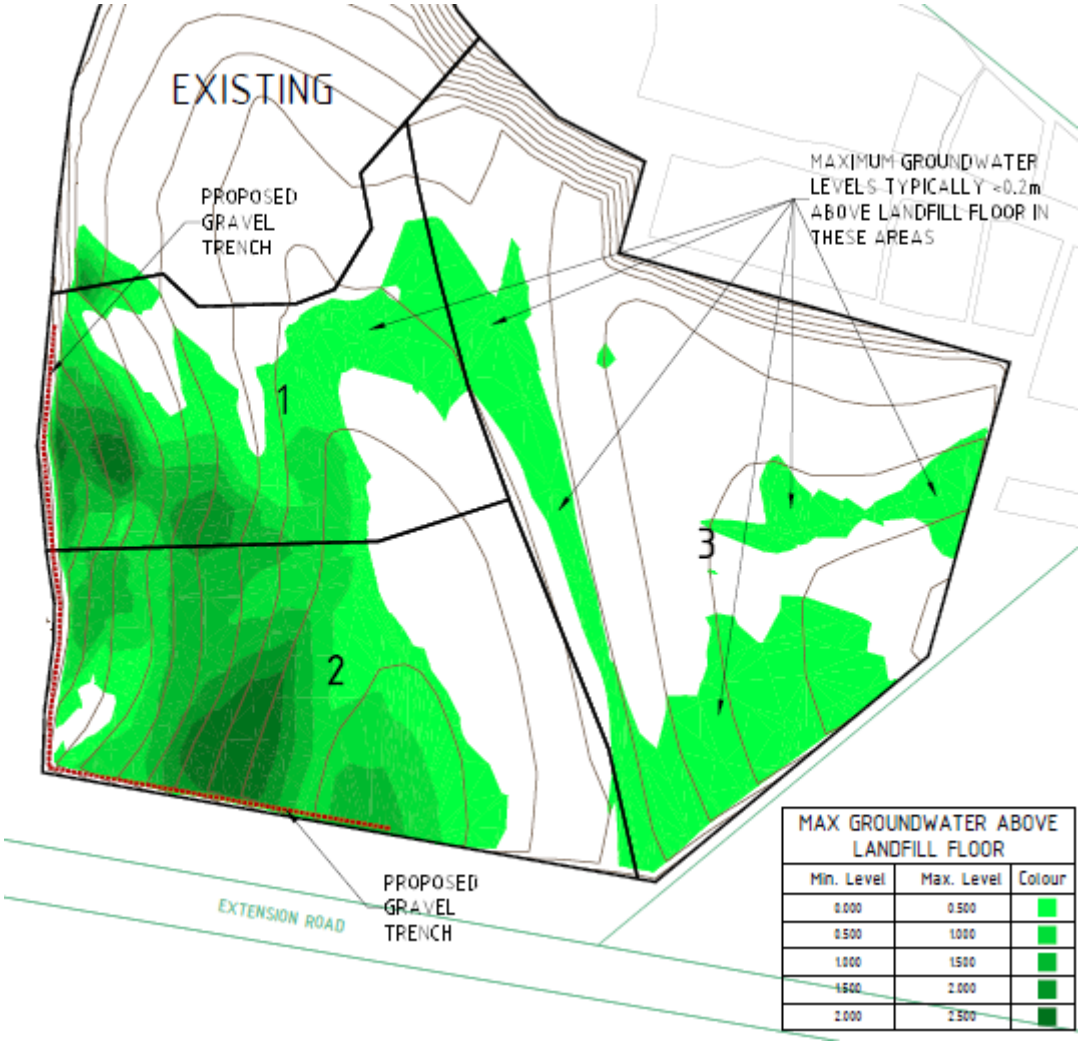


Figure 5: Areas where maximum groundwater levels are above the landfill floor level

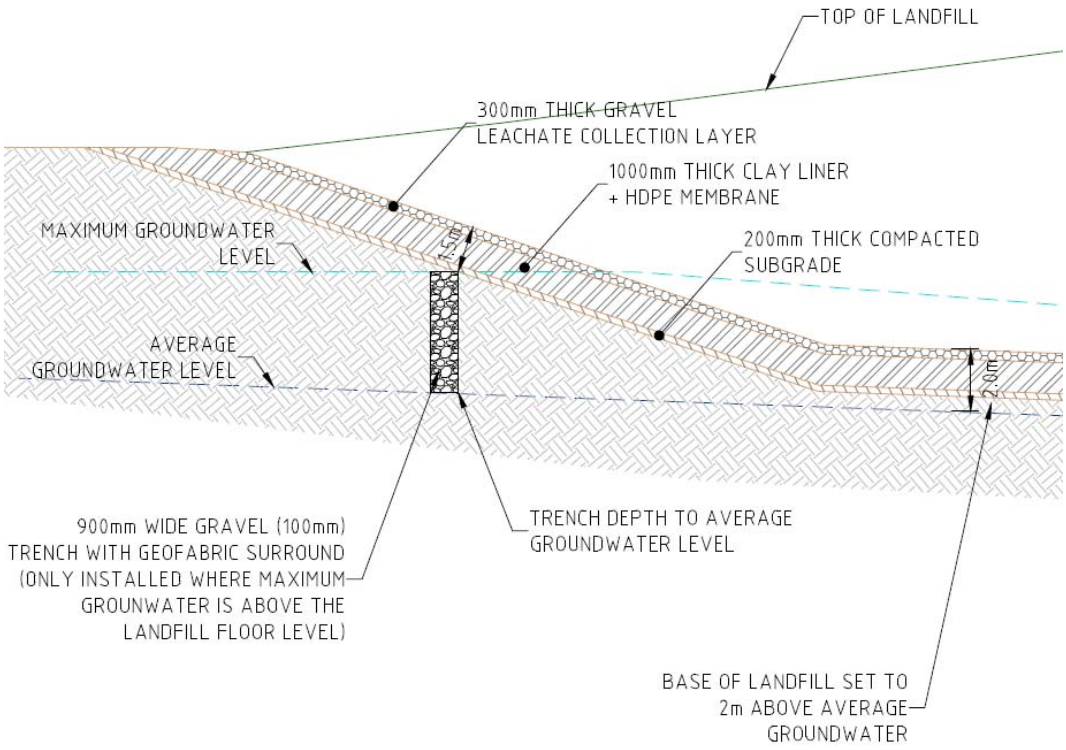


Figure 6: Groundwater Interception Trench - Typical Cross Section

4.5 Final Waste Landform

The original final landform for the existing and future stages was presented in the *Cairncross Waste Management Facility Landfill Environment Management Plan (2001)*. This final landform profile has been reviewed and generally adopted for future Stages 1, 2 and 3 given it maintains a similar profile to the surrounding landscape and is lower than the surrounding tree top canopy ensuring the landfill continues to be screened.

The following slope criteria were used to refine the final landform design:

- Maximum finished landform slope of 1V:4H to allow maintenance (mowing) of finished surface after capping.
- Minimum finished landform slope of 1V:25H (4% grade) to ensure rainfall sheds from the surface and does not infiltrate the landfill.
- A temporary batter of 1V:4H will be used between stages to ensure leachate and waste is contained appropriately and to limit the use of excess fill.

Refer to landfill typical sections in **Appendix C - Future Stage Concept Plans** and **Appendix F - Landfill Final Landform Levels.**

4.6 Earthworks and Materials Balance

Table 9 presents the estimated earthworks and materials balance for the existing and future landfill stages. While every care has been taken to estimate these volumes, actual volumes may vary following the detailed design and construction.

Table 9: Materials Balance Summary

Stage	E	1	2	3
Area (m^2)	102,063	79,453	103,992	168,907
Topsoil Stripping Volume (m^3) (1)	30,619	23,836	31,198	50,672
Clay Excavation Volume (m^3)	554,362	290,668	285,817	705,181
Leachate Barrier Clay Vol (m^3)	91,857	79453	103992	168907
Cap Clay Volume (m^3)	81,650	127,125	166,387	270,251
Vegetation Layer Topsoil Vol (m^3)	30,619	23,836	31,198	50,672
Landfill Void Volume (m^3)	1,435,997	1,610,181	1,016,705	1,541,718
Day Cover Clay Required (m^3) (10% of void) (2)	143,600	161,018	101,671	154,172
Actual Landfill Void Volume (m^3) (less day cover volume)	1,292,397	1,449,163	915,035	1,387,546
Total Clay Required (m^3)	317,107	367,596	372,050	593,330
Clay Balance (m^3) (-ve = deficit)	237,255	-76,925	-86,233	111,851

(3) Assumes 300mm depth of topsoil
(4) Based on actual measured volumes within Stage E needed to achieve 150mm daily cover

A summary of each stage's earthworks is presented below:

Stage E

- Excess clay excavated is in the order of 237,000m^3. This clay is presently stockpiled on site for use within future stages.

Stage 1

- Clay deficit for this stage is due to reduced excavation depth, increased final capping thickness and higher day cover volume (compared with Stage E)
- The estimated clay deficit will be addressed by the excess clay stockpile from Stage E.

Stage 2

- Clay deficit is due to reduced excavation depth, increased final capping thickness (compared with Stage E)
- Reduced landfill void volume due to floor and final landform intersecting existing ground levels.
- The estimated clay deficit will be addressed by the excess clay stockpile from Stage E.

Stage 3

- Excess clay excavated from this stage is in the order of 112,000m^3.
- Overall excess clay from all stages expected to be in the order of 186,000m^3. PMHC anticipate this excess VENM will be removed from site and used on future council civil or road work projects.

5. LEACHATE BARRIER SYSTEM

The following section describes the proposed leachate barrier system for Stages 1, 2, and 3.

5.1 Landfill Cell Liner Details

The landfill cell liner (leachate barrier system) is to be constructed in accordance with the NSW EPA's *Environmental Guidelines, Solid Waste Landfills* (2016). The liner is to comprise of the following:

- 200mm thick compacted clay sub-base
- 1,000mm thick compacted clay liner (hydraulic conductivity $<1x10^{-9}$m/s)
- 2mm thick HDPE flexible membrane liner
- Cushion geotextile fabric to protect the HDPE liner
- 300mm thick gravel leachate collection drainage layer including leachate collection pipes (2 x 100mm slotted PVC at intervals of 25m). NB: Refer to Pacific Environment Limited report *Cairncross Landfill Leachate Generation Modelling (2016)* for sizing details.
- Separation geotextile fabric to reduce the ingress of fines from the overlying waste.

Refer to **Figure 7** for a typical section of the proposed leachate barrier system.

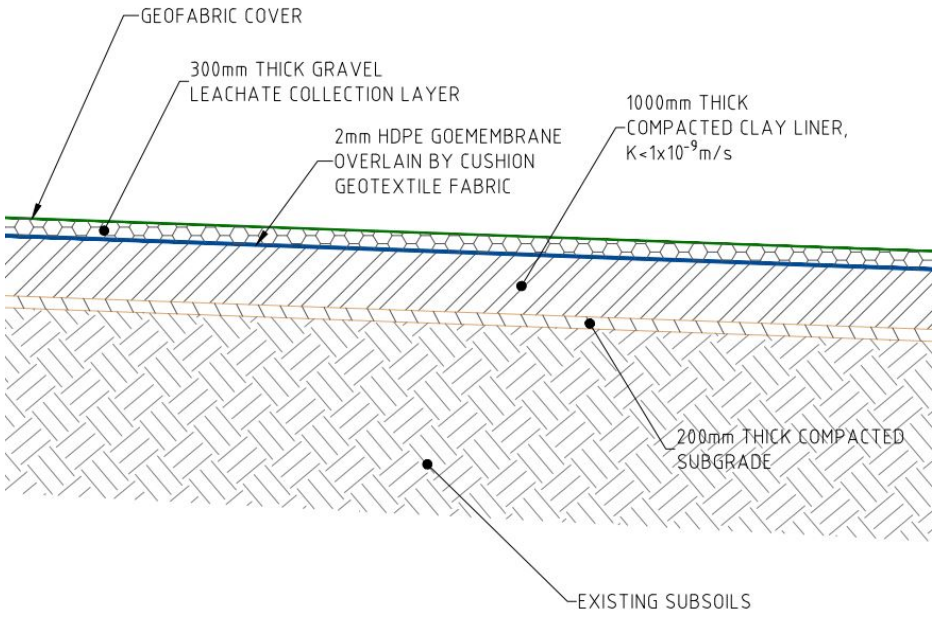


Figure 7: Cell Liner Typical Section

5.2 Leachate Collection

The leachate collection network has been designed in accordance with the NSW EPA's *Environmental Guidelines, Solid Waste Landfills (2016)*. Refer to **Appendix C - Future Stage Concept Plans** for the leachate collection system layout.

The *Cairncross Landfill Leachate Generation Modelling (2016)* report has assessed slotted PVC pipe sizes and confirmed; *that leachate reticulation pipes utilised for Stage E (2 x 100mm diameter pipes), will be suitable for all future stages with regards to discharge velocity and flow rate.*

The *Cairncross Landfill Leachate Generation Modelling (2016)* report also provides information on leachate flow rates for each stage/catchment. These flow rates are summarised in **Table 10**.

Table 10: Leachate Flow Rates

Catchment	Flow Rate (m3/day)	Flow Rate (L/s)
Stage E, 1 & 2	39.45	0.45
Stage 3	36.58	0.42

As such, 2 x 100mm slotted PVC pipes has been adopted. NB: 2 x 100mm slotted PVC pipes has been adopted due to local supply constraints sourcing 150mm PVC slotted pipe.

The leachate collection system will comprise a network of 2 x 100mm slotted PVC pipes within a 300mm thick gravel layer covering the landfill liner. The slotted PVC pipes will complying with the requirements of *Australian Standard AS 2566.1-1998 (Buried flexible pipelines – Structural design)*.

The maximum spacing of leachate pipes will be 25m, laid at longitudinal grades of >1%, and >3% transverse grade.

6. LEACHATE STORAGE AND DISPOSAL

The *Cairncross Landfill Leachate Generation Modelling (2016)* report detailed the following with respect to leachate storage:

> *It is recommended that leachate is stored in above ground bunded tanks in preference to sumps. Above ground bunded tanks must have sufficient leachate storage volume, as determined by using a water balance methodology. The bunded tanks must have a visible marker to indicate the bottom depth of the required freeboard. If the freeboard is exceeded, the occupier must re-establish and maintain the required freeboard. The tanks and associated connection points must be surrounded by a bund with a capacity of at least 110% of the tanks volume.*

The leachate collection system for each stage will drain by gravity via a series of slotted pipes (2 x 100mm PVC) to a leachate tank and pump system. Refer to **Appendix C - Future Stage Concept Plans**.

The leachate storage tanks are sized to accommodate two (2) days storage of leachate at the maximum predicted leachate flow rate detailed in the *Cairncross Landfill Leachate Generation Modelling (2016)* report. Refer to **Table 10** for a summary of flow rates.

Figure 8 presents a typical layout and section for the proposed leachate storage tanks.

Construction commenced in 2016 for a new leachate tank location to serve the remainder of Stage E and for Stage 1. **Table 11** details the proposed leachate storage tank capacities for each stage.

Table 11: Leachate Tank Capacities

Stage	Capacity (m3)
Remainder of Stage E & Stage 1	76
Stage 2	77
Stage 3	74

PMHC will shortly commence construction of a new sewerage treatment plant (STP) to be built within the CWMF Industrial Precinct. Once complete, all leachate from Stages E, 1, 2 and 3 will be pumped via a 110mm HDPE rising main to the STP for treatment and disposal from the site.

The new STP will be managed by PMHCs Water and Sewer section and is being specifically designed to accommodate the leachate characteristics and estimated flow rates. The new STP will provide sufficient treatment to allow disposal of effluent (including treated leachate) to the environment in accordance with the *Protection of the Environment Operations Act 1997* (POEO Act) administered by the NSW EPA.

Leachate volumes will be measured by flow meters before entering primary holding tanks within the STP. These holding tanks are expected to provide further storage capacity if required.

Figure 8 presents a typical layout and section for the proposed leachate storage tanks.

Figure 9 and **Figure 10** present the STP functional layout and process diagram indicating the leachate input. NB: the plant may change based on tenders received and possible different configurations proposed by tenderers.

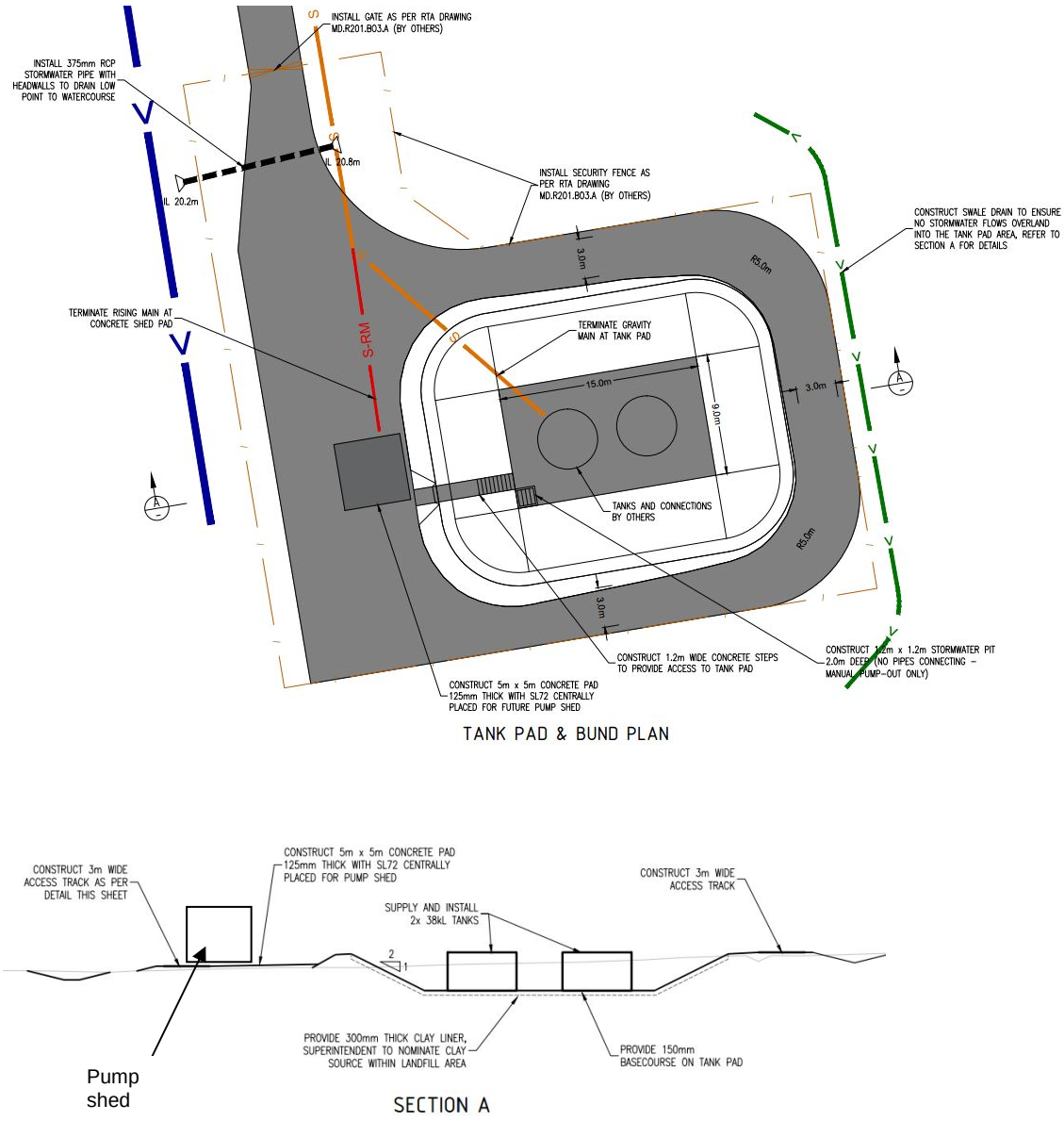


Figure 8: Typical Drawing - Leachate Collection Tank

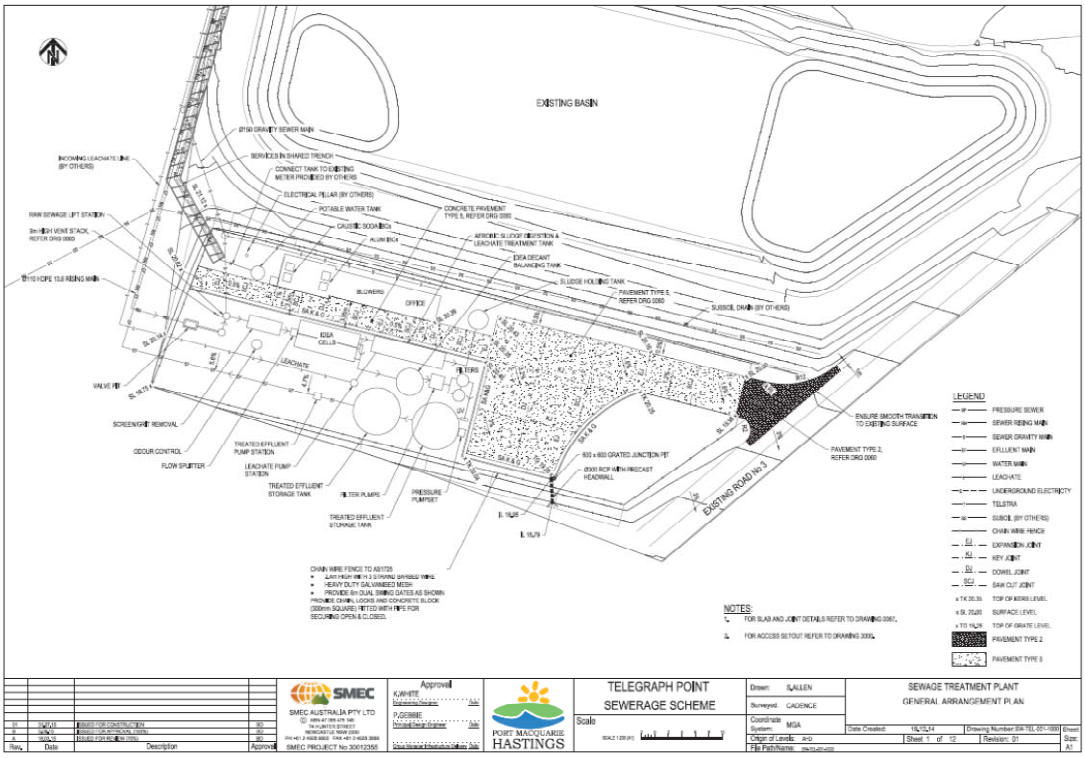


Figure 9: Sewer Treatment Plan - Layout

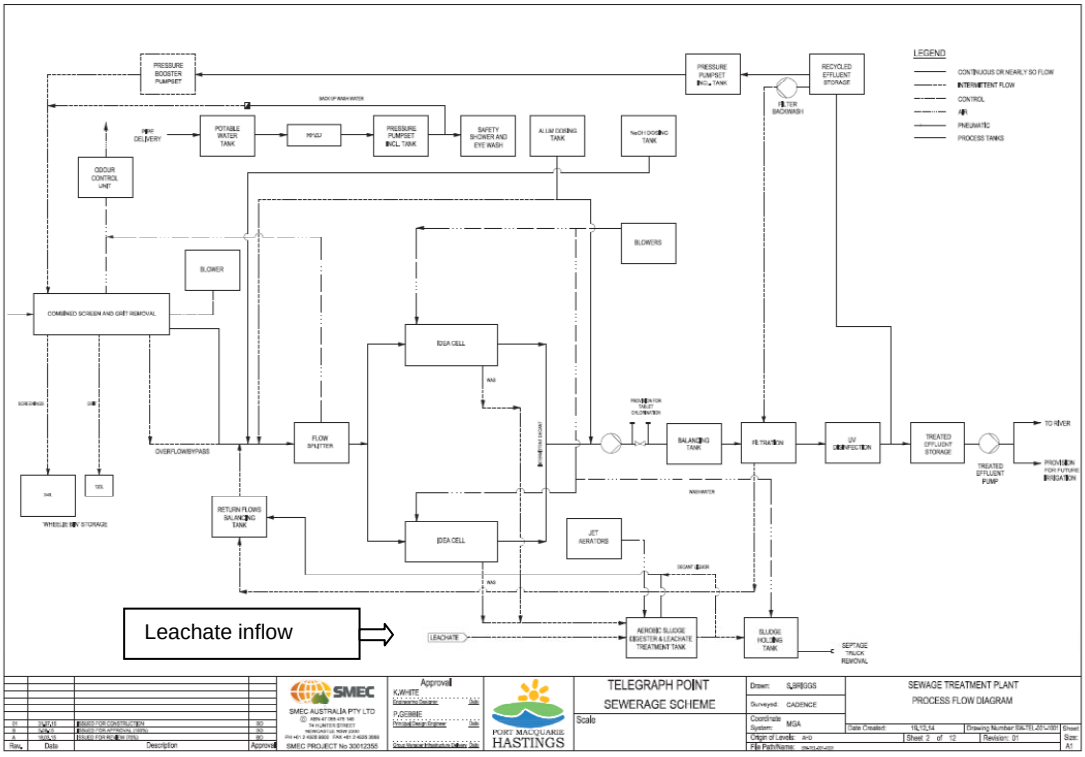


Figure 10: Sewer Treatment Plan - Process Diagram

7. STORMWATER MANAGEMENT

The following section describes the proposed stormwater management system for the CWMF landfill.

7.1 Stormwater Concept Designs

Appendix C - Future Stage Concept Plans includes stormwater management details for all future stages.

Stage 1 and Stage 2 drain via a broad ephemeral gully (A) south via a culvert under Extension Road to land owned by State Forests NSW (Forestry Corp). While Stage 3 drains via an ephemeral gully (B) to Rawdon Creek Nature Reserve in the east.

The final landform (Refer to **Appendix F - Landfill Final Landform Levels**) will redirect stormwater runoff from the western ephemeral gully (A) to the eastern ephemeral gully (B). At the completion of filling operations approximately 4.3ha will be redirected from the eastern ephemeral gully A catchment to the eastern ephemeral gully B catchment.

This small redirection of stormwater runoff is not considered to be significant and not expected to impact the downstream environments given both gullies (A) and (B) ultimately drain to Rawdon Creek approximately 2km to the south of the CWMF via generally ephemeral watercourses. In addition, the overall catchment size is approximately 1,000ha, and the redirection of 4.3ha represents only 0.4% reduction in the local sub-catchment.

The stormwater management strategy for Stage 1, 2 and 3 will maintain existing techniques successfully implemented in the existing Stage E area. The general approach for stormwater management at each future stage will include the following aspects:

- Internal roads are gravelled to prevent softening and erosion during wet weather.
- Roadside table drains and drainage channels are constructed where required to direct stormwater away from erosion prone areas.
- Table drains and channels are grassed or rock armoured to prevent scouring.
- Sediment traps are used where possible to collect sediment prior to stormwater reaching the sediment basin.
- A large sediment basin is utilised as end-of-line treatment for all stormwater runoff from the site. The basin outlet is controlled via a manual valve which is generally released five (5) days after a rainfall event to ensure maximum sediment capture. The basin is cleaned as required.
- Covering of waste (day cover) is completed with compacted clay, trimmed and graded to encourage runoff of rainwater.
- Final contouring of landfill areas is designed to assist water runoff and direct water to relevant stormwater sediment basins before being discharged from the site.
- Maintenance is carried out on all stormwater infrastructure to ensure control measures are operational prior to rainfall events.
- Clearing and stripping of new landfill sub-cells is done progressively to limit runoff and control sediment runoff.

7.2 Stormwater Management Strategy (Water Balance)

Arcadis completed a water balance investigations for the expansion of CWMF (*Memo - Carincross Landfill Expansion - Site Water Balance*, August 2016). The water balance considered rainfall and runoff for the existing and proposed stormwater storage basins within the site, along with the water demands on the site for dust suppression etc. The results of the water balance are summarised in the extract below:

The results show that, in all months with average rainfall conditions, there is a surplus of water available for dust suppression. This applies throughout all stages of the proposed landfill operation. Under average rainfall conditions, the driest month is September, and this corresponds with the minimum surplus of approximately 200 m^3/month during Stage 1, for the fire fighting storage dam on its own. If all four basins are considered, there is a surplus of more than 4,600m^3 across the site for the same month.

The results also show that under 10th percentile rainfall conditions there is a potential water deficit during July and August in all three stages. A deficit of similar magnitude is also predicted by the water balance for the existing landfill for 10th percentile rainfall conditions. Discussions with Council identified that a water deficit has not previously been experienced at the landfill, even when there have been serious rainfall deficiencies (eg; August and September 2009 were consecutive months of less than 10th percentile rainfall). This is most likely due to the significant water storage provided in the existing basins. The existing fire fighting basin alone has a storage volume of approximately 3,000m^3, which is well in excess of the required fire fighting storage requirement of 100m^3 and also the maximum monthly water demand of 1,200m^3. The minimum proposed total water storage capacity, including settling zone volume within the sediment basins which could also be used as a water source, is approximately 8,300 m^3 (during Stage 3).

The investigation found that a water deficit is considered unlikely to occur except in extreme drought conditions, and could be mitigated by the ability to draw water from all storage basins.

Refer to **Appendix H - Site Water Balance** for details.

7.3 Erosion Control

The following measures are to be implemented to minimise the volume of sediment-laden stormwater generated from the disturbed areas of the site during rainfall events:

Minimise the area of exposed soils - The disturbed area (cleared, exposed and un-vegetated) should be minimised to reduce areas that can generate suspended solids when water runs over the areas.

Stabilise exposed areas - Exposed areas should be stabilised as soon as possible. All completed areas of the landfill should be progressively revegetated. Note that stormwater runoff from rehabilitated areas where approximately 70% of the groundcover has been re-established is considered to be 'clean' runoff and does not need further treatment. Other stabilisation measures include the use of mulching, etc.

Reduce erosive effect of stormwater. Concentrated stormwater flows can be managed by using diversions, armouring channels to provide scour protection (e.g. with rip rap), check dams, batter drains, grade control structures and flumes, outlet dissipation structures, and revetments.

Protect stockpiles - Stockpiles should be located away from concentrated stormwater flow. They should be protected by up-slope diversion banks, be stabilised with vegetative cover or mulches or matting products, and be provided with sediment control fencing.

Manage unsealed roads - Erosion potential from internal roads should be minimised by considering:

- route selection,
- construction and post-construction erosion control measures,
- undertaking design which includes consideration of road grades, clearing widths, batters, surface drainage, table drains, culverts, revegetation, road surface materials.

Detailed guidance on erosion and sediment control for access tracks is provided in *Managing Urban Stormwater: Soils and Construction Volume 2C Unsealed Roads* (NSW DECC, 2008b).

Landfill exit controls - A permanent submerged shaker pad and wheel wash is located adjacent to the PMHC works shed and used to prevent transport of sediment off site. This submerged shaker pad and wheel wash will operate for all future stages.

Maintenance - All erosion control structures must be maintained. Controls must be inspected regularly and after any significant rainfall (more than 10 mm in a day), and must be repaired as necessary.

7.4 Sediment Control

The main source of sediment control for the CWMF is generally provided by sediment basins and staged clearing of landfill areas. The staged clearing minimises disturbed areas by reducing stormwater runoff and erosion. Other measures may include vegetative buffers and silt fences.

7.4.1 Sediment Basin Design Requirements

Sediment control for the landfill area needs to consider the staging of the filling operations. For each stage a sediment basin is to be implemented to ensure stormwater discharged from the site is of suitable quality.

The EPA's *Environmental Guidelines, Solid Waste Landfills (2016)* requires that sediment basins are designed in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (the Blue Book). The following design parameters have been adopted for the sediment basins:

- The sediment basin to be designed to capture and treat all sediment-laden runoff during a 90th-percentile 5-day rainfall event.
- The settling volume shall be such that the suspended solids settle out to a concentration of less than 50mg/L before the treated stormwater is discharged.
- The water level should be drawn down to a level just above the sediment storage zone within five (5) days of the end of any significant rainfall to restore the basin's capacity to contain runoff from the next rainfall event.

Managing Urban Stormwater: Soils and Construction Volume 2B Waste Landfills also contains relevant information for the design of sediment control measures. Refer to **Table 12** for the minimum design criteria as recommended by Volume 2B.

Table 12: Recommended minimum design criteria for sediment control measures at waste landfill sites

Table 6.1 Recommended minimum design criteria for temporary erosion and sediment control measures at waste landfill sites

	Minimum average recurrence interval (ARI) of design storm event (unless otherwise indicated)							
Duration of disturbance	**< 6 months**		**6–12 months**		**1–3 years**		**> 3 years**	
Sensitivity of receiving environment ('standard' or 'sensitive')[1]	**standard**	**sensitive**	**standard**	**sensitive**	**standard**	**sensitive**	**standard**	**sensitive**
Temporary drainage (erosion) controls[2]								
– designed to have a non-erosive hydraulic capacity to convey	2 yrs	5 yrs	5 yrs	10 yrs	10 yrs	20 yrs	20 yrs	20 yrs
Temporary sediment control measures[3]								
– should be constructed to remain structurally sound in:	2 yrs	5 yrs	5 yrs	10 yrs	10 yrs	20 yrs	20 yrs	20 yrs
Type C sediment retention basin								
– designed to achieve required water quality for flows up to:	0.5 x 1 yr	1 yr	1 yr	2 yrs	1 yr	2 yrs	1 yr	2 yrs
– embankment and spillway designed to be structurally sound in[4]:	10 yrs	20 yrs	20 yrs	50 yrs	50 yrs	100 yrs	50 yrs	100 yrs
Type F or D Sediment retention basin								
– designed to achieve required water quality for storms up to nominated five-day duration percentile event:[5]	75th	80th	80th	85th	80th	85th	90th	95th
– designed to achieve required water quality for storms up to nominated five-day duration percentile event with enhanced erosion controls[6]:	75th	75th	75th	80th	75th	80th	90th	95th
– embankment and spillway designed to be structurally sound in[4]:	10 yrs	20 yrs	20 yrs	50 yrs	50 yrs	100 yrs	50 yrs	100 yrs

[1] A 'sensitive' receiving environment is one that has a high conservation value, or supports human uses of water that are particularly sensitive to degraded water quality.
[2] e.g. diversion banks, perimeter banks, catch drains, level spreaders, check dams, batter drains and chutes.
[3] e.g. sediment fences, stacked rock sediment traps etc. on small catchments where used as a 'last line of defence' (i.e. without a down-slope sediment basin).
[4] This is indicative only – consider the risks of basin failure for each basin to determine appropriate spillway design flow.
[5] For a five-day management period. Adjustment factors to the five-day volumes for alternate management periods are 85% for two-days, 125% for 10 days and 170% for 20 days.
[6] Enhanced erosion controls are described on **vol.1** section 6.3.4(g).

Table 12 confirms that for disturbance of >3 years, Type F or D sediment basins should be designed for the 90th-percentile 5-day rainfall event (standard receiving environment). A *standard* receiving environment was selected due to the considerable logging operations undertaken in the downstream catchment. The catchment is considered 'modified' due to these historical and current operations.

Sediment basins will be designed without a low level outflow, so as to capture the entire storm event and allow settlement of sediment prior to release to the downstream environment. For storm events larger than the basins design capacity, a weir or spillway is provided to release the stormwater without causing damage to the basin.

7.4.2 Sediment Basin Design Parameters

A geotechnical investigation was completed at the CWMF in June 2013 by Regional Geotechnical Solutions (*RGS20194.2-AC*). This investigation revealed conditions consistent with the report by Longmac (1998).

Site soils are generally clayey with low potential for infiltration. The geotechnical investigation results are presented in **Table 13**.

Table 13: Soil Analysis

Parameter	Value
% sand (faction 0.02 to 2.00 mm	10%
% silt (fraction 0.002 to 0.02 mm)	16%
% clay (fraction finer than 0.002 mm)	73%
Dispersion percentage	11%
Soil Erodibility K-Factor	0.042
Soil Texture Group	F

Additional sediment basin design parameters are shown in **Table 14**.

Table 14: Sediment Basin Design Parameters

Parameter	Value	Reference
The 90th-percentile 5-day rainfall event	70mm	BOM IFD data
Rainfall intensity for 2 year 6 hour storm	14.9mm/h	BOM IFD data
Erosion Control Practice P-Factor	1.3	Blue Book
Ground Cover C-Factor	1.0	Blue Book

Table 15 provides the specific design parameters for each catchment. Refer to **Appendix C - Future Stage Concept Plans** for details of each Stage, including the catchment boundaries, overland flow paths, and sediment basin locations.

Based on existing practical operational experience, it is assumed that at any one time a maximum disturbed area of 6.0 ha would be serviced by a basin. With the implementation of the erosion control methods detailed in **section 7.3**, this area is likely to be reduced, however 6.0 ha is considered a conservative area.

Table 15: Catchment Parameters

Parameter	Stage 1	Stage 2	Stage 3
Grassed Catchment Area (capped landfill) (ha)	7.4	10.6	17.0
Forested Catchment Area (ha)	7.7*	0	0
Impervious Catchment Area (ha)	0	0	0.6
Disturbed Catchment Area (ha)	6.0	6.0	6.0
Total Catchment Area (ha)	21.1	16.6	23.6
Slope Length (m)	700	400	400
Slope Gradient (%)	4	1.3	3
Length/Gradient LS-Factor	2	0.35	1.3

* Assumed 80% of forested area is diverted around basin (clean water) for calculations shown in Table 16.

7.4.3 Sediment Basin Design

Sediment basin sizes were calculated using the spreadsheet method supplied with *Managing Urban Stormwater: Soils and Construction Volume 2B Waste Landfills* (the Blue Book). Detailed calculations are presented in **Appendix G - Blue Book Spreadsheet Calculations.**

Table 16 summarises the sediment basin sizes.

All basins are sized based on a 12 month de-silting period.

Table 16: Sediment Basin Size Summary

Volume	Stage 1	Stage 2	Stage 3
2 month sediment storage volume (m^3)	422	74	275
12 month sediment storage volume (m^3)	2532	444	1650
Settling Zone Volume (m^3)	5229	5810	8260
Total Basin Volume (m^3)	7761	6254	9910

7.5 Flooding

7.5.1 Hastings River Floodplain

The *Hastings River Flood Study (2006)* identifies the lower tributaries of Rawdon Creek as affected by backwater flooding from the Hastings River during a 100 year ARI (average recurrence interval) flood event. This flooding occurs approximately 2.0 km downstream from the site and as such the site is considered flood free from river flooding.

7.5.2 Local (Stormwater) Flooding

The proposed sediment basis will also provide a stormwater detention function.

An analysis of the performance of the sediment basins for Stages 1, 2 and 3 (in Table 16) with respect to pre and post development flows from the site, was undertaken using *DRAINS* stormwater modelling software. *DRAINS* is an industry standard stormwater modelling and design program and is generally accepted throughout Australia.

Stages 1, 2 and 3 were modelled using the catchment data defined in **Table 15**. Industry standard Mannings 'n' values were adopted and are shown in **Table 17**.

Table 17: Mannings 'n' Values for Overland Flow

Catchment Type	Mannings 'n'
Forested (undeveloped area)	0.10
Grassed (capped landfill)	0.08
Impervious (buildings, roads)	0.02
Disturbed (operational area)	0.035

Storm events for the 1, 2, 5, 10, 20, 50 and 100 year ARI were calculated for storm durations up to 6 hours. The critical *time of concentration* (Tc) for the subject catchments was calculated to be less than 6 hours and therefore peak flow rates for each storm event will occur within the 6 hour storm duration period. The results are shown **Table 18**.

Table 18: Pre and Post Development Storm Events

Storm Event (ARI)	Outflow from development to Rawdon Creek catchment (m^3/s)								
	Stage 1			Stage 2			Stage 3		
	Pre-Dev	Post-Dev	% increase	Pre-Dev	Post-Dev	% increase	Pre-Dev	Post-Dev	% increase
1 year	1.11	0.17	-85%	0.53	0.23	-57%	0.87	0.21	-76%
2 year	1.62	0.75	-54%	0.77	0.58	-25%	1.28	0.68	-47%
5 year	2.42	1.61	-33%	1.13	1.07	-5%	1.89	1.39	-26%
10 year	2.92	2.28	-22%	1.36	1.40	3%	2.28	1.92	-16%
20 year	3.62	3.23	-11%	1.68	1.85	10%	2.81	2.64	-6%
50 year	4.59	4.41	-4%	2.06	2.34	14%	3.60	3.57	-1%
100 year	5.29	5.35	1%	2.40	2.84	18%	4.18	4.32	3%

Table 18 shows that for 1 to 5 year ARI storm events, the post development peak flows are estimated to generally reduce in the range of -5% to -85%. The greatest reduction in peak flow is estimated for very frequent events such as the 1 and 2 year ARI events.

For Stages 1 and 3, minor increases (+1% to +3%) in flows are estimated during the less frequent 100 year ARI event. For all other events (10 to 50 year ARI) the peak flows from the site post development are estimated to be reduced.

An increase in post development peak flows is estimated for major events (10 to 100 year ARI) within Stage 2 within the range +3% to +18%.

The primary purpose of the basins is to capture sediment, however they also provide an on-site detention (OSD) function. The results above in **Table 18** show that the size of the sediment basins generally provides effective OSD for events up to the 100 year ARI for Stages 1 and 3, and up to the 10 year ARI for Stage 2. Due to the infrequent nature of these major events, and the estimated minor increase in peak flow, the sediment basin design is considered appropriate in terms of providing sediment control and OSD.

Spillways are to be provided to the sediment basins and designed for major storm events (up to 100 year ARI).

Refer to **Figure 11** and **Figure 12** for typical sediment basins plan and cross sections.

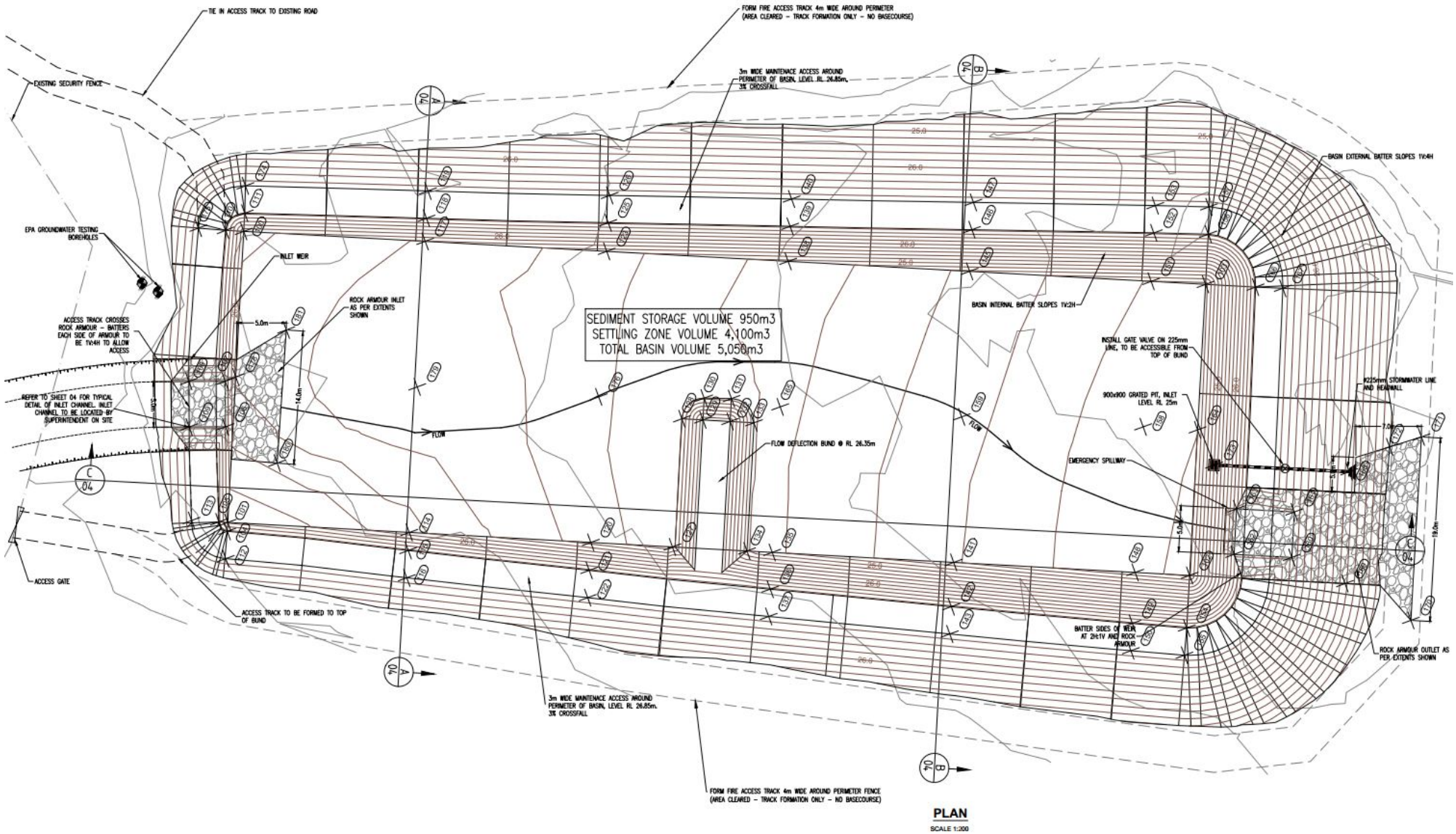


Figure 11: Typical Sediment Basin Plan

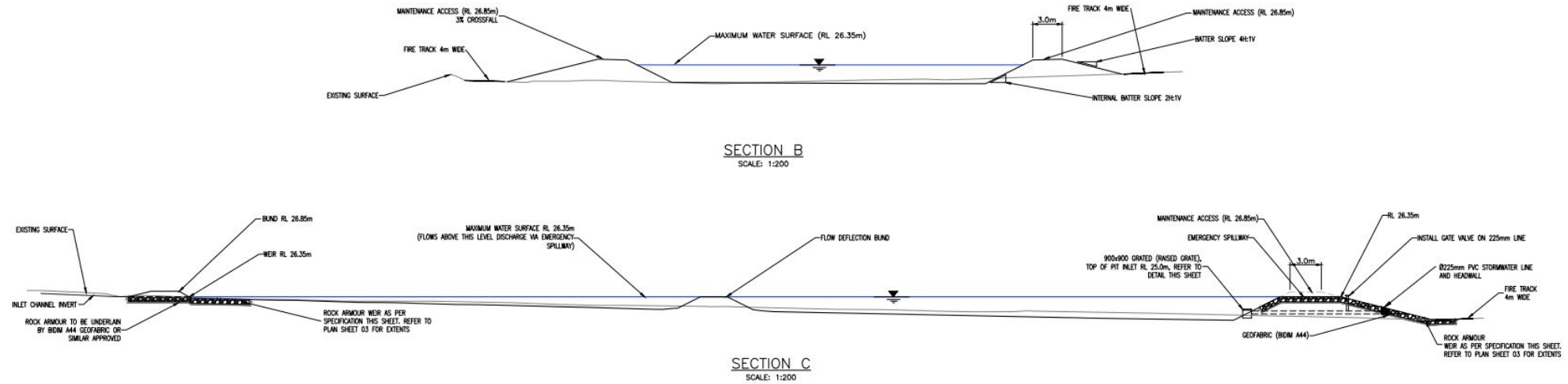


Figure 12: Sediment Basin Typical Sections

8. WATER QUALITY MONITORING

The following section describes the proposed water quality monitoring program for the CWMF landfill. The monitoring program will address ground water, surface water and leachate quality.

8.1 Leachate Monitoring

PMHC (water and sewer section) will shortly commence construction of a new sewerage treatment plant (STP) to be built within the CWMF Industrial Precinct. Once complete, the leachate from the site will be pumped to the STP for treatment and disposal.

Leachate flow and volume monitoring will be undertaken in accordance with the requirements of the STP licence. In addition leachate composition monitoring will also be undertaken to ensure the proper operation of the STP.

PMHC (waste section) currently undertakes routine composition (laboratory) monitoring on a quarterly basis by sampling and testing leachate from the main collection tank site within Stage E. This program will continued for Stages 1, 2 and 3 as each stage is activated and leachate collection tanks are constructed.

Parameters tested are generally in accordance with the EPA's *Environmental Guidelines, Solid Waste Landfills*. **Table 5** details the current leachate monitoring parameters.

A leachate extraction and level-control system will be considered within future stages to include a collection sump and leachate riser(s) to facilitate extraction of leachate from each cell. The leachate extraction system is designed to achieve a maximum level of leachate of 300 mm over the upper liner and be able to continue to function effectively until the landfill is considered stable.

8.2 Stormwater Monitoring

PMHC currently undertakes routine surface water monitoring on a quarterly basis in main sediment and stormwater basins by sampling and testing when surface water is present. The stormwater monitoring program seeks to detect cross contamination of stormwater with landfill leachate.

The existing program will continue for Stages 1, 2 and 3 as each stage is activated and stormwater basins are constructed.

Parameters tested are generally in accordance with the EPA's *Environmental Guidelines, Solid Waste Landfills*. Typically the monitoring will include; total suspended solids (or related measures such as turbidity) and indicators of leachate contamination (e.g. ammonia, total organic carbon and conductivity). **Table 6** details the current surface water monitoring parameters.

8.2.1 Sediment Basins

In addition to routine composition testing, PMHC will also monitor sediment basins to ensure excess sediment loads in the stormwater are captured and not leaving the site.

- **Sampling from sediment basins**: The contents of sediment basins will be monitored quarterly to demonstrate that the size and design of the dam are adequate
- **Discharges from sediment basins**: Manually drained discharges will be periodically sampled before release off-site to ensure that discharge criteria are met. Uncontrolled overflows will be sampled (where practicable). Records will be kept detailing uncontrolled overflows, including time, duration and estimated volume, as well as the rainfall event preceding each overflow.

8.2.2 Ambient Surface Water Monitoring

An ambient (surrounding area) surface water monitoring program will be developed to detect any contamination in off-site surface water bodies by leachate or by sediment-laden stormwater from the landfill.

The ambient surface water monitoring program will need to consider the ephemeral nature of downstream watercourses and the difficulty sampling if rainfall has not occurred. Where sampling is not possible within downstream water bodies, sampling within the on-site sediment basins will be reviewed to ensure water quality discharges to downstream watercourses is appropriate.

8.3 Groundwater Monitoring

Nine (9) groundwater monitoring bores are currently located within CWMF. Groundwater monitoring is currently undertaken at CWMF in accordance with PMHC's *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 18 (SOP18). Groundwater parameters tested are presented in Table 7.

Trace Environmental prepared *Hydrogeological Assessment, Cairncross Landfill Expansion (October 2016)* report and recommended that the current groundwater monitoring program is slightly altered in terms of frequency and parameters analysed to ensure consistency with the EPA's *Environmental Guidelines, Solid Waste Landfills (2016).* Refer to **Table 19** for the monitoring schedule and parameters to be tested.

Table 19: Monitoring Schedule for Groundwater (*Trace Environmental 2016*)

Period	Location	Parameters	Frequency
Excavation Stages 1-3	All groundwater monitoring bores	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	Selected groundwater monitoring bores*	Groundwater head monitoring	Monthly
	Groundwater monitoring bores CG9 and CG10	Groundwater head monitoring	Quarterly
	Drainage trench monitoring location (CG15)	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	In pit sump	Volumes	in accordance with DPIWater licensing requirements
	Leachate at each of the sumps in each of the Stages	As per current water quality sampling parameters plus level and flow monitoring, in accordance with any applicable TWA/EPL	Quarterly
Operation Stages 1-3	All groundwater monitoring bores	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	All groundwater monitoring bores and drainage trench monitoring point (CG15)	Groundwater head monitoring	Quarterly

	Drainage trench monitoring location (CG15)	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	Leachate	• As per current water quality sampling parameters, plus level and flow monitoring, in accordance with any applicable TWA/EPL	Quarterly
	All groundwater monitoring bores and drainage trench location (CG15)	Metals: aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, and zinc, and organic contaminants: phenols, petroleum hydrocarbons, PAH, monoaromatic hydrocarbons	Annually
Post closure Stages 1-3	All groundwater monitoring bores and drainage trench monitoring point (CG15)	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous) Note: this can and will likely be modified based on the performance during the operational stages and following a groundwater performance report.	Quarterly
	All groundwater monitoring bores and drainage trench monitoring point(CG15)	Metals: aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, and zinc, and organic contaminants: phenols, petroleum hydrocarbons, PAH, monoaromatic hydrocarbons	Annually
	All groundwater monitoring bores and drainage trench monitoring point(CG15)	Groundwater head monitoring	Quarterly
	Leachate at the sump at each of the Stages 1 to 3	As per current water quality sampling parameters plus level and flow monitoring, in accordance with any applicable TWA/EPL	Quarterly

In addition, Trace Environmental recommended the installation of an additional four (4) groundwater bores at the south-western and south-eastern boundary of Stages 2 and 3, respectively. A monitoring point in the gravel drainage trench was also recommended, prior to commencement of Stage 1. The additional bores should form part of the total monitoring network.

A groundwater assessment report was recommended to be prepared at least once every five (5) years, or should the groundwater monitoring program detect a possible failure of the leachate containment system.

9. LANDFILL GAS MANAGEMENT AND MONITORING

The following section describes the proposed landfill gas management and monitoring program for the CWMF landfill.

9.1 Landfill Gas Control

In December 2012, Mike Ritchie and Associates completed a *Carbon Pricing Mechanism and Council Landfill* report for the Midwaste Regional Waste Group (of which PMHC is a member). The purpose of the report was to estimate landfill emissions and investigate the potential liabilities and opportunities presented to Midwaste Councils as a result of the *Clean Energy Act 2012* (now repealed).

The report identified the following with respect to CWMF:

- Legacy waste emissions would not exceed 25,000t CO_2-e.
- Greenhouse gas emissions from the future landfilling would peak in 2084 at approximately 86,000t CO2-e for the year.

In March 2016, Arcadis completed a *Preliminary Greenhouse Gas Assessment* for the Cairncross Landfill Expansion EIS. The results from the assessment found that:

- Legacy waste (in this case referring to waste disposed of prior to the proposed landfill expansion commencing) would generate approximately 25,000 tCO_2-e per year in the period 2016-2019.
- Greenhouse gas emissions from the proposed landfill expansion would peak in 2067, with approximately 218,000 t CO_2-e generated in that year.

Since the landfills inception in 2000, all domestic organic material has been processed in the Organics Resource Recovery Facility (ORRF). In addition an Alternate Waste Technology (AWT) facility also operated until 2012. The AWT treated organic material in the general waste stream to create an “inert” material that was then placed in landfill.

As such the existing landfill is not “typical” and therefore the methane generation rate is difficult to predict. The above variations in assessment of future greenhouse gas emissions highlighted the difficulty in modelling the emissions, and the need for a landfill gas pumping trial at CWMF.

PMHC are currently conducting a landfill gas pumping trial at CWMF. The pumping trial is being conducted to assess the actual rate of methane generation from a ‘typical’ zone within the landfill, the concentration of methane during active extraction, and will provide a forecast of future extraction rates / concentrations within the landfill. The trial will also make recommendations on the future landfill gas management at the site. It is expected that the trial will be completed by mid 2017.

The extent of gas controls to be designed and implemented for the existing and future stages of landfill will be guided by the results of the gas pumping trial. PMHC will develop a landfill gas management plan based on the findings of the trial.

9.2 Landfill Gas Monitoring

Landfill gas surface emissions monitoring, sub-surface monitoring and gas accumulation monitoring is currently undertaken at CWMF.

PMHC’s *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 19 (SOP19) details the landfill gas monitoring procedures including use of the gas monitoring equipment (eg. detector, wind speed monitor) and EPA reporting threshold levels.

Sub-surface monitoring is currently undertaken on a quarterly basis within groundwater monitoring boreholes. Groundwater monitoring boreholes range in depth from 10m to up to 30m and have been considered a suitable ‘surrogate’ for gas monitoring bores. Refer to **Appendix B**

- Water Quality Monitoring Locations for details of the groundwater monitoring bore locations. Detection of methane above 1.25% (12,500 ppm) (v/v) requires notification to the EPA, further investigation and potential corrective action.

Surface monitoring is undertaken using a 25m grid survey over completed (capped and grassed) landfill areas. Surface monitoring is undertaken on a monthly basis. The threshold concentration for closer investigation is 0.05% (500 ppm) (v/v) of methane at any point on the landfill surface

Accumulation monitoring also occurs within structures located within 250m of deposited waste. Detection of methane above 1.25% (12,500 ppm) (v/v) notification to the EPA, further investigation and potential corrective action.

EPA's *Environmental Guidelines, Solid Waste Landfills (2016)* has revised the threshold levels as follows:

- **Sub-surface monitoring:** 1.0% methane (v/v) and 1.5% carbon dioxide (v/v).
- **Surface monitoring**: 1.0% methane (v/v).
- **Accumulation monitoring**: 1.0% methane (v/v).

PMHC's *Operational Policies, Standard Operating Procedures and Safe Work Method Statements (February 2013)*, Standard Operation Procedure 19 (SOP19) will be revised to reflect the new threshold levels.

It is proposed to maintain the landfill gas monitoring program for Stages 1, 2 and 3 as each stage is activated.

However, following the gas pumping trial and the development of a landfill gas management plan, based on the findings of the trial, it is anticipated that future stages will require the implementation of specific gas monitoring boreholes around the perimeter of the landfill area. The assessment and future design of a gas monitoring bore network will be in accordance with the EPA's *Environmental Guidelines, Solid Waste Landfills (2016)*.

10. COVERING OF WASTE

The following section describes the proposed covering of waste at the CWMF landfill.

10.1 Daily Cover

In order to minimise odour, litter, dust, the presence of scavengers/vermin, fire, infiltration of rainfall and emissions of landfill gas, daily cover will be applied to the waste each day before the close of business.

Daily cover comprises natural site soils and is applied at a minimum thickness of 150mm. Existing daily cover is sourced from clay stockpiled from the Stage E landfill excavation. During filling of Stages 1 and 2, a clay deficit is expected for each stage, however clay stockpiled from Stage E will be available for daily cover during filling of Stages 1 and 2. For Stage 3, sufficient clay is expected to be available for daily cover from the landfill excavation.

Refer to **Table 9** for details on the overall site material balance.

10.2 Intermediate Cover

Intermediate cover may be required occasionally where a cell will not receive additional waste (or will not be finally capped) for some time. Any waste-filled areas that have not been filled for more than 90 days will have intermediate cover applied that will meet the following requirements:

- Minimum 300mm thick clay (VENM)
- Saturated hydraulic conductivity of less than $1x10^{-5}$m/s
- Compaction 95% SMDD (standard maximum dry density).

Refer to **Table 9** for details on the overall site material balance.

11. FINAL CAPPING AND REVEGETATION

All completed landfill cells are to be capped and revegetated within six (6) months of the final delivery of waste to the cell. The following section describes the final capping and revegetation program for the CWMF landfill.

11.1 Capping Details

The final landfill cap is to be constructed in accordance with the NSW EPA's *Environmental Guidelines, Solid Waste Landfills* (2016), and is to comprise the following:

- 300mm thick seal bearing surface (compacted clay)
- 600mm thick composite sealing layer of (compacted clay hydraulic conductivity $<1x10^{-9}$m/s)

Appendix D - Future Stage Concept Plans - Sub Stages details the staged approach used at the CWMF. This staging will allow for the progressive excavation and capping of the previous sub-stage while the current sub-stage is being filled. A 'typical' development sequence is detailed in **Figure 4**.

Material volume calculations estimate sufficient capping material for Stages 1, 2 and 3. Refer to **Table 9** for details on the overall site material balance.

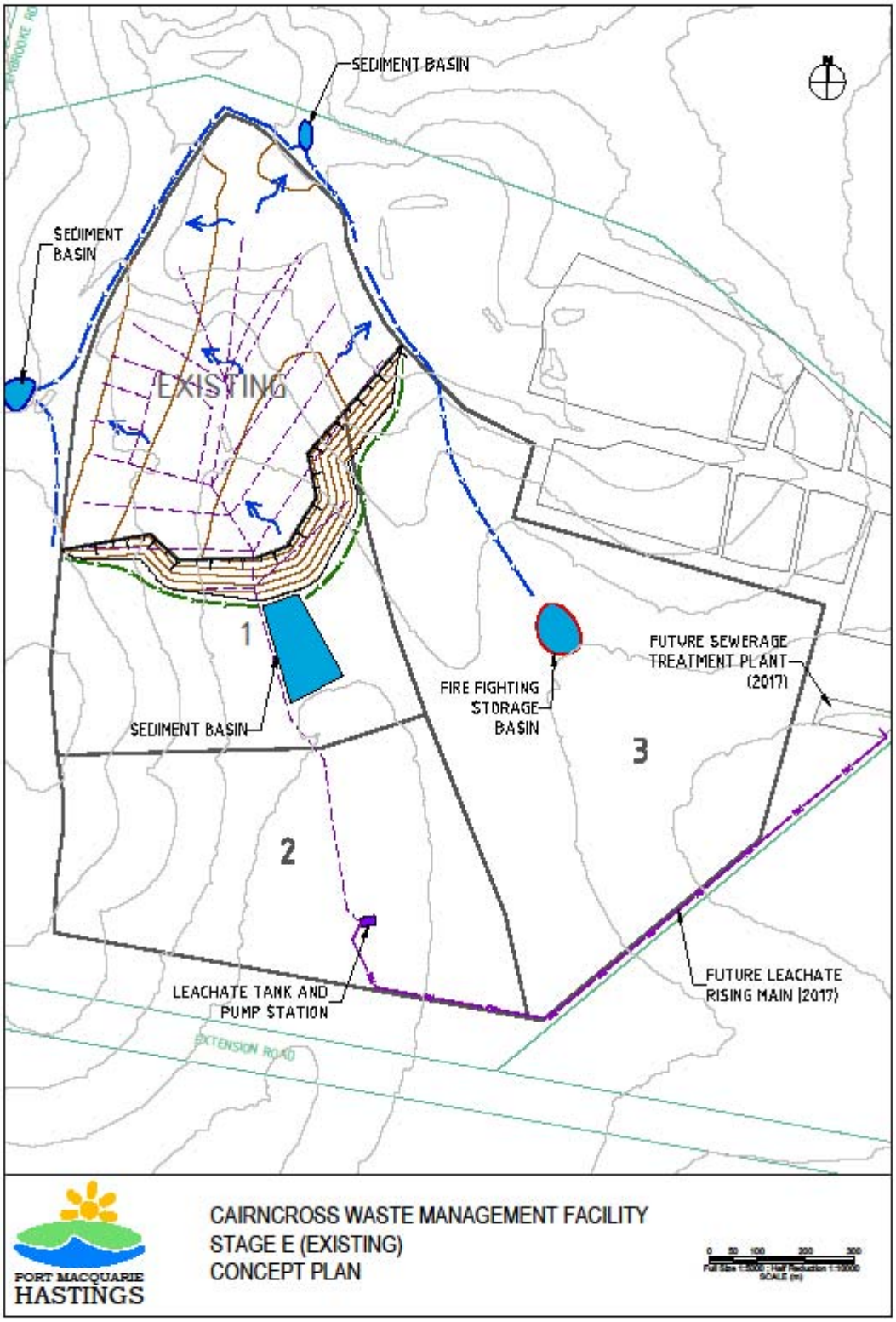
11.2 Revegetation

A revegetation layer is to be placed over the clay capping layer and will be in accordance with the NSW EPA's *Environmental Guidelines, Solid Waste Landfills* (2016). The revegetation layer is to comprise the following:

- 1,000mm thick revegetation layer comprising 700mm clay (lower) and 300mm topsoil (upper)
- Revegetation is to comprise grass cover of suitable native species.

Refer to **Table 9** for details on the overall site material balance.

APPENDIX A - STAGE E (EXISTING) CONCEPT PLAN

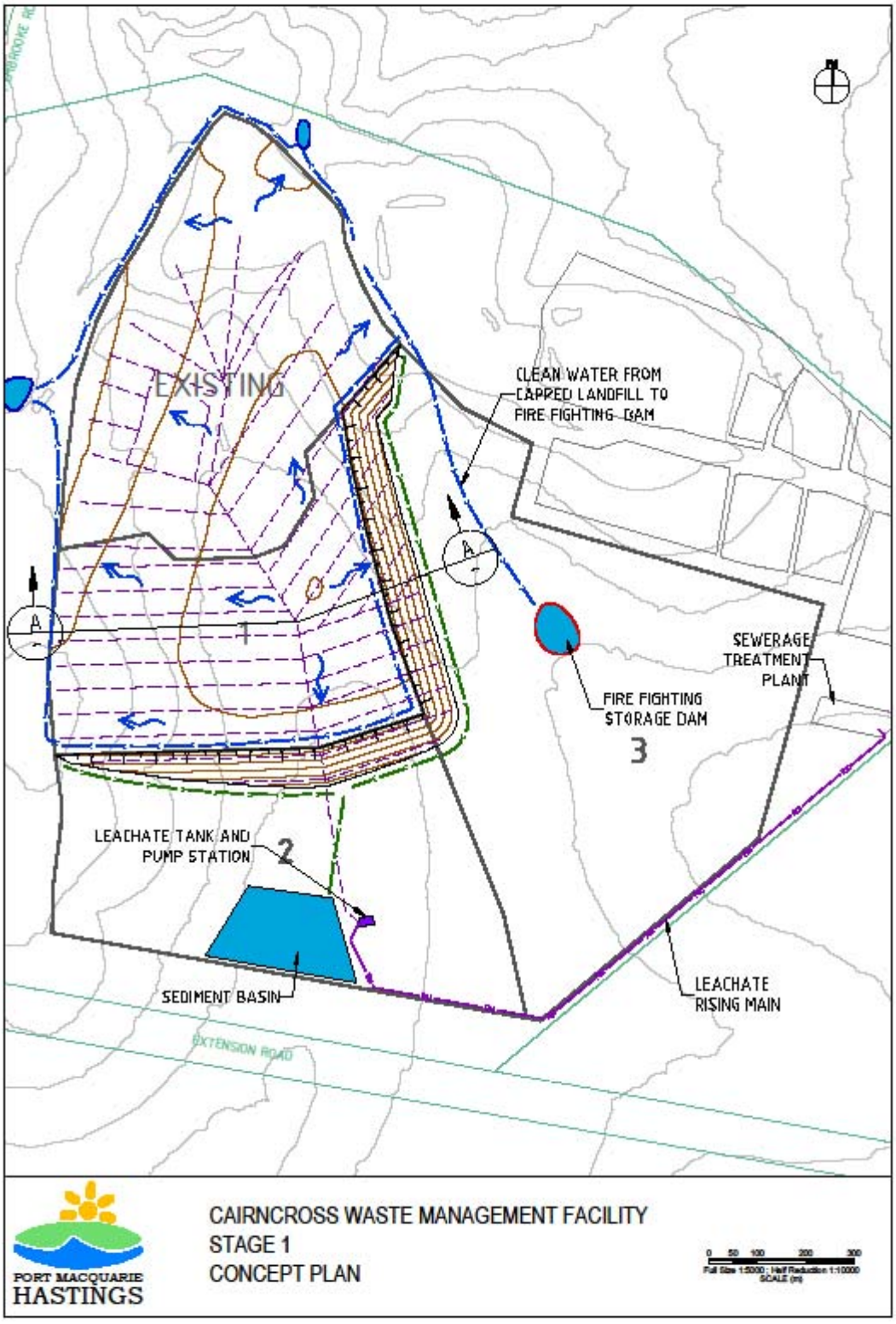


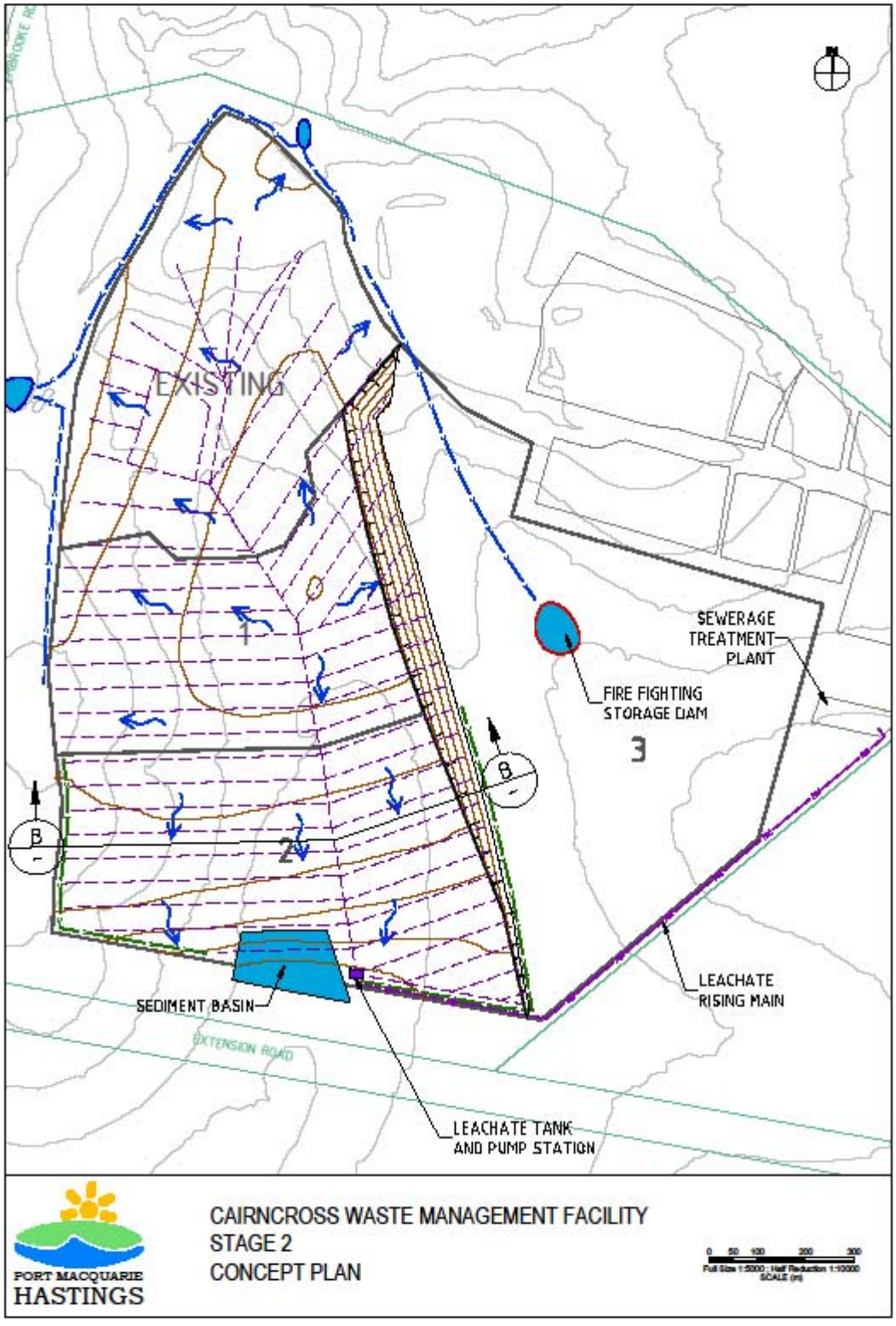
APPENDIX B - WATER QUALITY MONITORING LOCATIONS

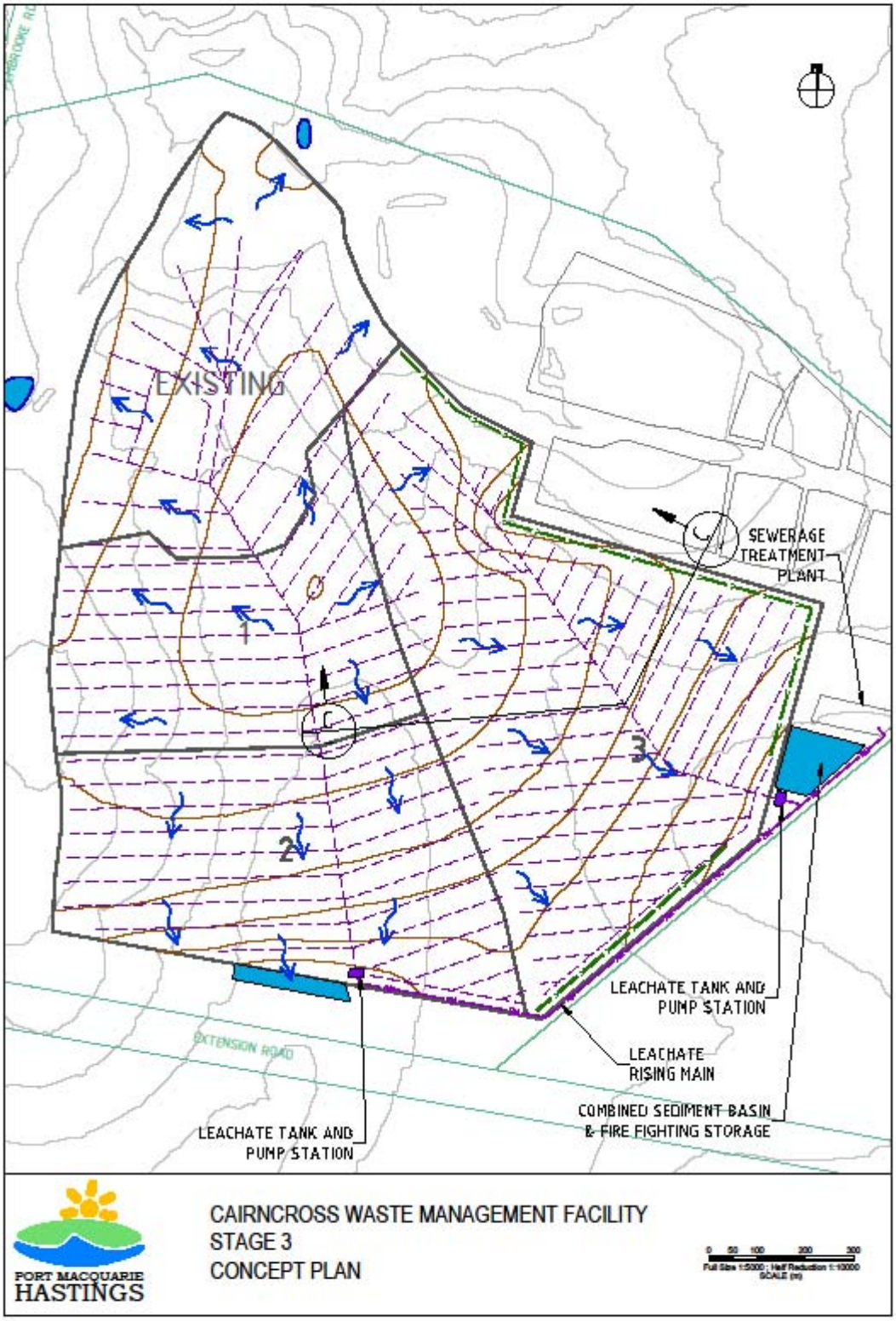
Cairncross Landfill - Bore and Surface Water Monitoring Point Locations

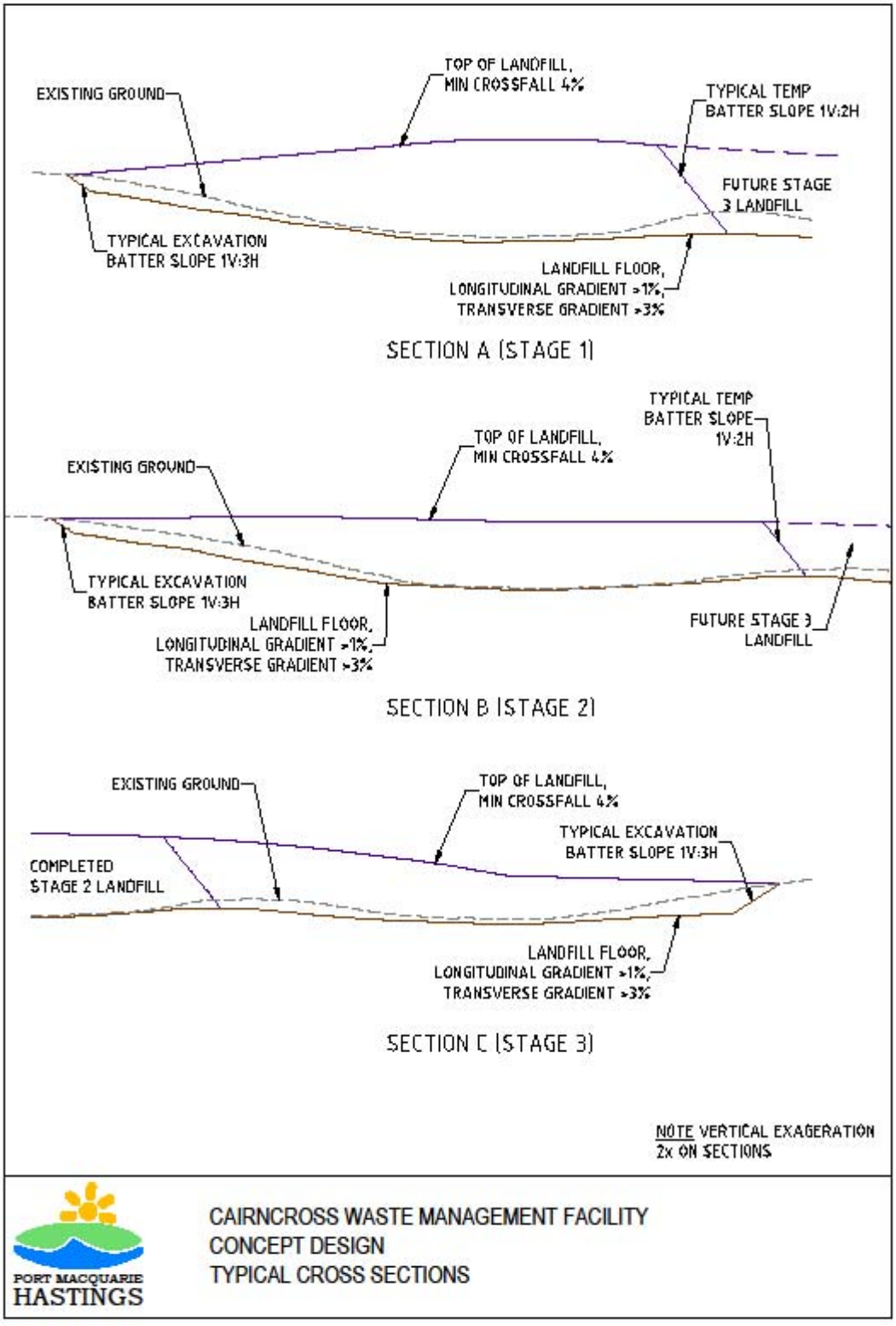


APPENDIX C - FUTURE STAGE CONCEPT PLANS

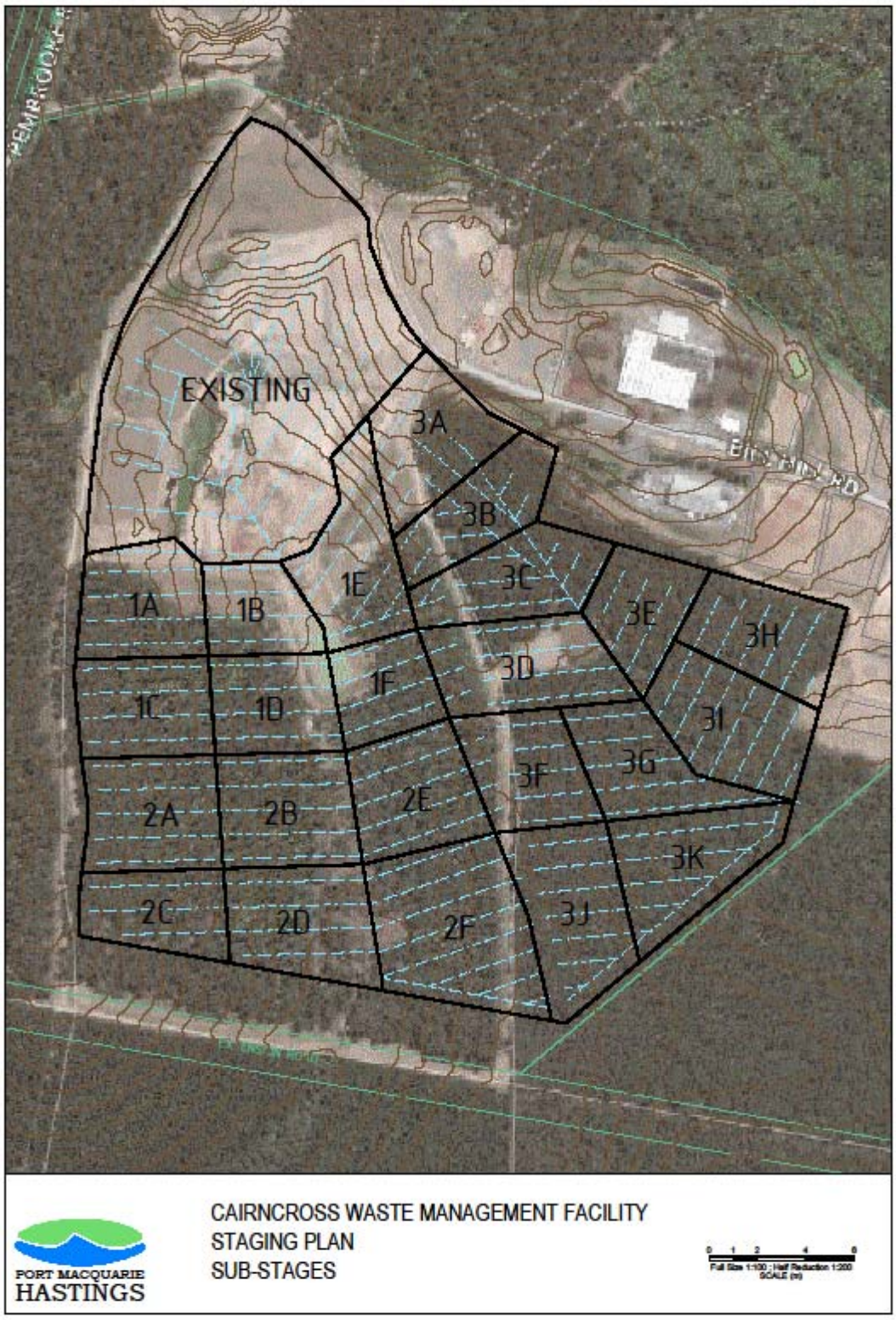



EXISTING
1
2
3
B
B
SEWERAGE
TREATMENT
PLANT
FIRE FIGHTING
STORAGE DAM
LEACHATE
RISING MAIN
SEDIMENT BASIN
EXTENSION ROAD
LEACHATE TANK
AND PUMP STATION
PORT MACQUARIE
HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 2
CONCEPT PLAN

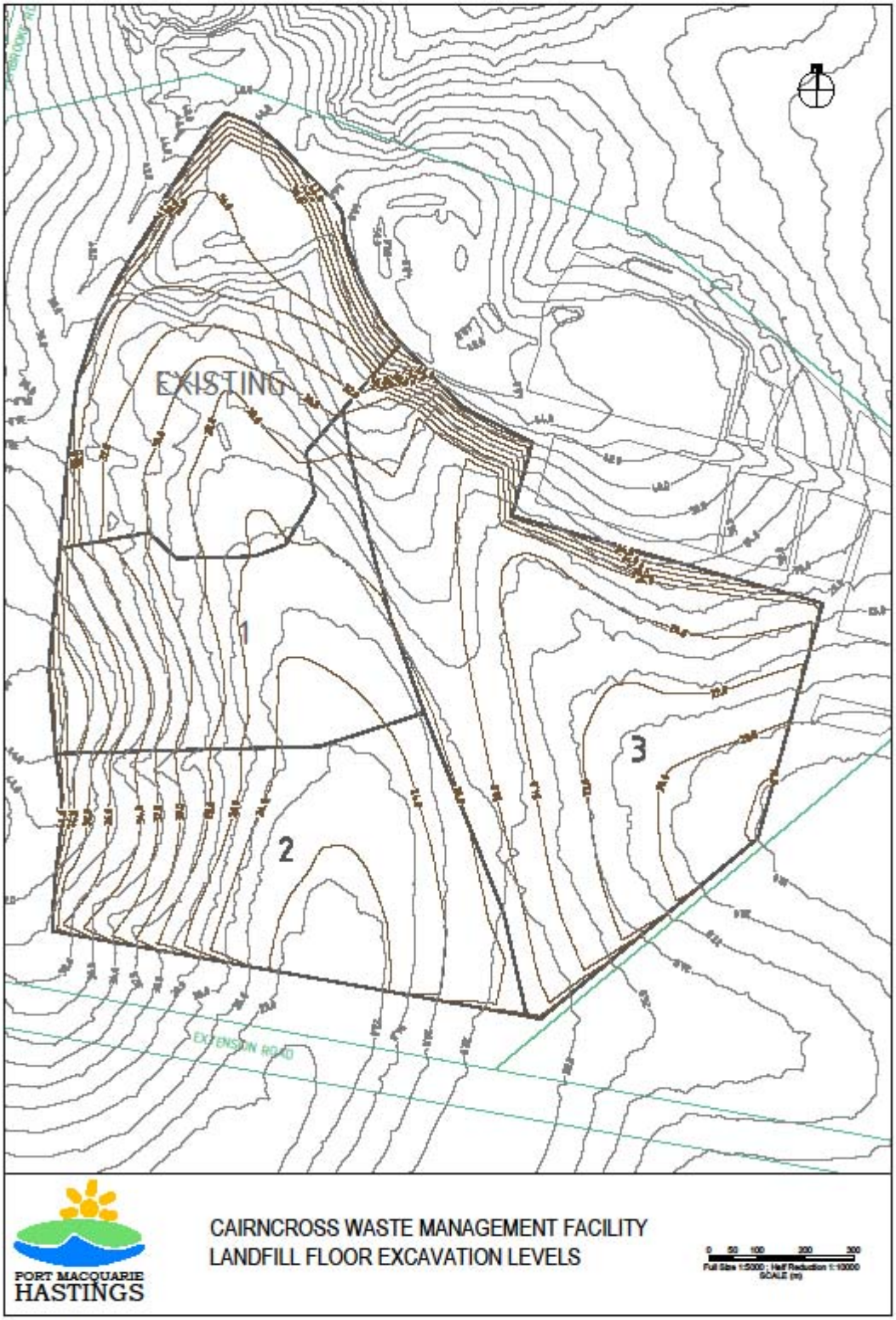

EXISTING
1
2
3
SEWERAGE
TREATMENT
PLANT
LEACHATE TANK AND
PUMP STATION
LEACHATE
RISING MAIN
COMBINED SEDIMENT BASIN
& FIRE FIGHTING STORAGE
LEACHATE TANK AND
PUMP STATION
EXTENSION ROAD
PORT MACQUARIE
HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 3
CONCEPT PLAN


EXISTING GROUND
TOP OF LANDFILL, MIN CROSSFALL 4%
TYPICAL TEMP BATTER SLOPE 1V:2H
FUTURE STAGE 3 LANDFILL
TYPICAL EXCAVATION BATTER SLOPE 1V:3H
LANDFILL FLOOR, LONGITUDINAL GRADIENT >1%, TRANSVERSE GRADIENT >3%
SECTION A (STAGE 1)
TYPICAL TEMP BATTER SLOPE 1V:2H
TOP OF LANDFILL, MIN CROSSFALL 4%
EXISTING GROUND
TYPICAL EXCAVATION BATTER SLOPE 1V:3H
LANDFILL FLOOR, LONGITUDINAL GRADIENT >1%, TRANSVERSE GRADIENT >3%
FUTURE STAGE 3 LANDFILL
SECTION B (STAGE 2)
EXISTING GROUND
TOP OF LANDFILL, MIN CROSSFALL 4%
TYPICAL EXCAVATION BATTER SLOPE 1V:3H
COMPLETED STAGE 2 LANDFILL
LANDFILL FLOOR, LONGITUDINAL GRADIENT >1%, TRANSVERSE GRADIENT >3%
SECTION C (STAGE 3)
NOTE VERTICAL EXAGERATION 2x ON SECTIONS
PORT MACQUARIE HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
CONCEPT DESIGN
TYPICAL CROSS SECTIONS

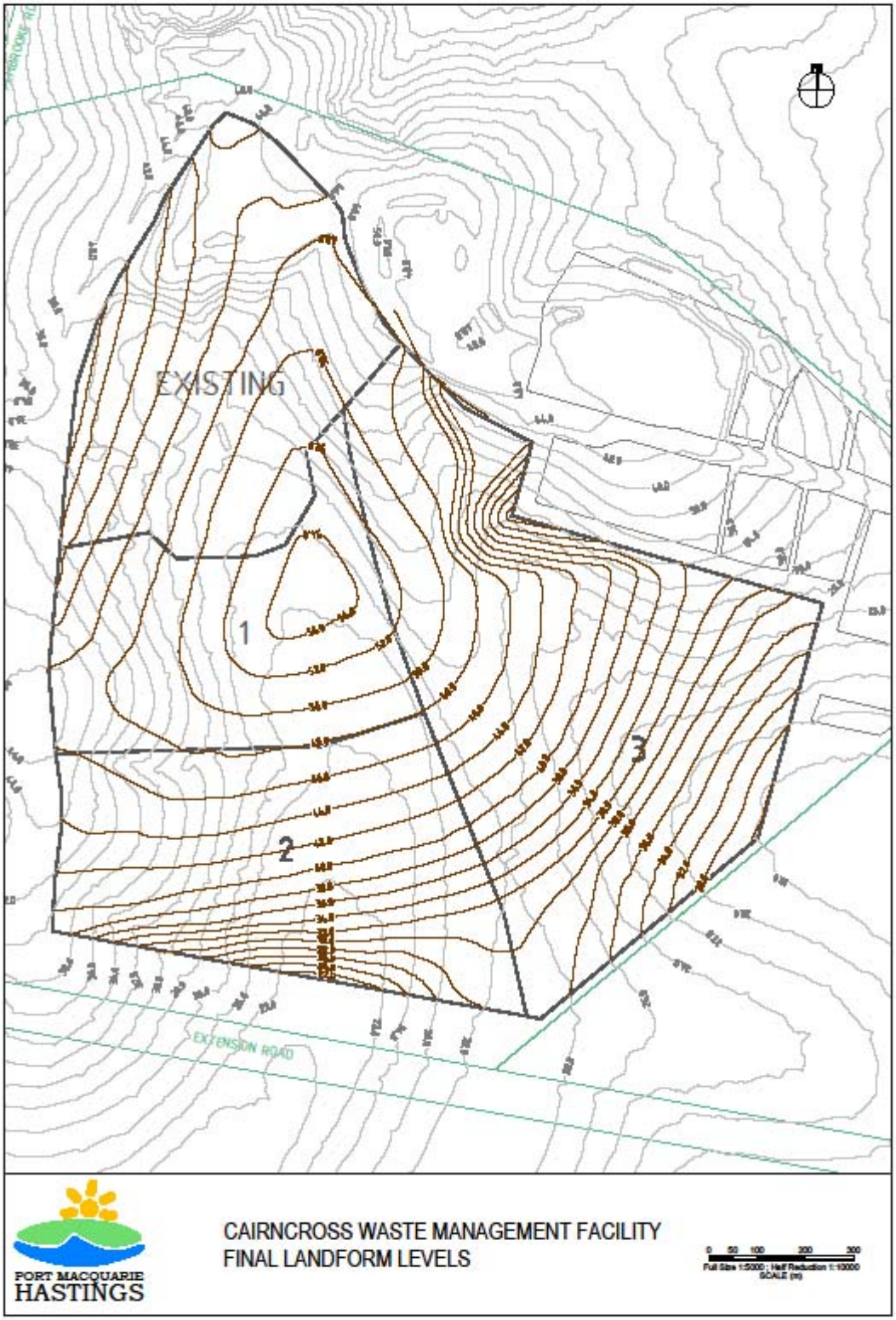
APPENDIX D - FUTURE STAGE CONCEPT PLANS - SUB STAGES



APPENDIX E - LANDFILL FLOOR EXCAVATION LEVELS



APPENDIX F - LANDFILL FINAL LANDFORM LEVELS



APPENDIX G - BLUE BOOK SPREADSHEET CALCULATIONS

SWMP Commentary, Detailed Calculations

Note: These "Detailed Calculation" spreadsheets relate only to high erosion hazard lands as identified in figure 4.6 or where the designer chooses to use the RUSLE to size sediment basins. The "Standard Calculation" spreadsheets should be used on low erosion hazard lands as identified by figure 4.6 and where the designer chooses not to run the RUSLE in calculations.

1. Site Data Sheet

Site Name: CAIRNCROSS

Site Location:

Precinct:

Description of Site: LANDFILL EXPANSION

Site area	Site						Remarks
	1	2	3				
Total catchment area (ha)	21.1	16.6	23.6				
Disturbed catchment area (ha)	6	6	6				

Soil analysis

% sand (faction 0.02 to 2.00 mm	10	10	10				Soil texture should be assessed through mechanical dispersion only. Dispersing agents (e.g. Calgon) should not be used
% silt (fraction 0.002 to 0.02 mm)	16	16	16				
% clay (fraction finer than 0.002 mm)	73	73	73				
Dispersion percentage	11.0	11.0	11.0				E.g. enter 10 for dispersion of 10%
% of whole soil dispersible	8.91	8.91	8.91				See Section 6.3.3(e)
Soil Texture Group	F	F	F				See Section 6.3.3(c), (d) and (e)

Rainfall data

Design rainfall depth (days)	5	5	5				See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	90	90	90				See Sections 6.3.4 (f) and (g)
x-day, y-percentile rainfall event	70	70	70				See Section 6.3.4 (h)
Rainfall intensity: 2-year, 6-hour storm	14.9	14.9	14.9				See IFD chart for the site

RUSLE Factors

Rainfall erosivity (*R*-factor)	4930	4930	4930				Automatic calculation from above data
Soil erodibility (*K*-factor)	0.042	0.042	0.042				RUSLE data can be obtained from Appendixes A, B and C
Slope length (m)	700	400	400				
Slope gradient (%)	4	1.3	3				
Length/gradient (*LS*-factor)	2	0.35	1.3				
Erosion control practice (*P*-factor)	1.3	1.3	1.3				
Ground cover (*C*-factor)	1	1	1				

Calculations

Soil loss (t/ha/yr)	538	94	350				
Soil Loss Class	5	1	3				See Section 4.4.2(b)
Soil loss (m^3/ha/yr)	414	72	269				
Sediment basin storage volume, m^3	422	74	275				See Sections 6.3.4(i) and 6.3.5 (e)

Spreadsheet Detailed_BF 1

2. Storm Flow Calculations

Peak flow is given by the Rational Formula:

$$Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,tc} \times A$$

where:

- Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pilgrim (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pilgrim (1998) and construction runoff coefficients are given in Appendix F
- F_y is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pilgrim (1998) while urban coefficients are given in Volume 1, Book VIII, Table 1.6 of Pilgrim (1998)
- A is the catchment area in hectares (ha)
- $I_{y,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs (Volume 1, Book IV of Pilgrim, 1998)

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent.

Peak flow calculations, 1

Site	A (ha)	tc (mins)	Rainfall intensity, I, mm/hr						C_{10}
			$1_{yr,tc}$	$5_{yr,tc}$	$10_{yr,tc}$	$20_{yr,tc}$	$50_{yr,tc}$	$100_{yr,tc}$	
1	21.1	25	49	84	96	115	137	155	0.9
2	16.6	23	53	94	107	125	146	166	0.9
3	23.6	26	57	98	112	131	156	176	0.9

Peak flow calculations, 2

ARI (yrs)	Frequency factor (F_y)	Peak flows						Comment
		1 (m^3/s)	2 (m^3/s)	3 (m^3/s)	(m^3/s)	5 (m^3/s)	(m3/s)	
1 yr,tc	0.67	1.733	1.475	2.255				
5 yr,tc	0.92	4.080	3.592	5.324				
10 yr,tc	1	5.068	4.444	6.613				
20 yr,tc	1.07	6.496	5.555	8.277				
50 yr,tc	1.11	8.028	6.731	10.225				
100 yr,tc	1.18	9.656	8.136	12.263				

4. Volume of Sediment Basins, *Type D* and *Type F* Soils

Basin volume = settling zone volume + sediment storage zone volume

Settling Zone Volume

The settling zone volume for *Type F* and *Type D* soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle and can be determined by the following equation:

$$V = 10 \times C_v \times A \times R_{x\text{-day, y-\%ile}} \ (m^3)$$

where:

10 = a unit conversion factor

C_v = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period

$R_{x\text{-day, y-\%ile}}$ = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 6.3.4(d), (e), (f), (g) and (h)).

A = total catchment area (ha)

Sediment Storage Zone Volume

In the detailed calculation on Soil Loss Classes 1 to 4 lands, the sediment storage zone can be taken as 50 percent of the settling zone capacity. Alternately designers can design the zone to store the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(ii)). However, on Soil Loss Classes 5, 6 and 7 lands, the zone must contain the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(iii).

Place an "X" in the box below to show the sediment storage zone design parameters used here:

	50% of settling zone capacity,
X	2 months soil loss calculated by RUSLE

Total Basin Volume

Site	C_v	$R_{x\text{-day, y-\%ile}}$	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)
1	0.50	70	21.1	7385	422	7807
2	0.50	70	16.6	5810	74	5884
3	0.50	70	23.6	8260	275	8535

APPENDIX H - SITE WATER BALANCE

MEMO

ARCADIS Design & Consultancy for natural and built assets

Date	31/08/2016
To	Brad Farr (PMHC)
From	David Stone (Arcadis)
Copy to	Zoe Wood (Arcadis), Bradley Searle (Arcadis), Danielle Haynes (Arcadis), Gordon Cameron (PMHC)
Subject	Cairncross Landfill Expansion - Site Water Balance

Brad

The purpose of this memo is to document the recent site water balance investigations that Arcadis has undertaken to support the concept design prepared by Council for the Cairncross Landfill Expansion.

The aim of the water balance is to estimate the water demands for operational uses and the potential availability of water to meet these demands. The outcome of the investigation will inform the stormwater management strategy for the site.

1.1 Introduction

The proposed stormwater management strategy for the site is documented in the concept staging plans prepared by Port Macquarie Hastings Council (refer **Attachment A**). The proposed landfill expansion involves three Stages and the staging plans include three sediment basins and a firefighting storage dam. A site water balance was prepared to assess the ability of the proposed basins to provide a suitable source of water for the proposed development.

For the purpose of this memo and the attached water balance calculations, the basins are referred to as 'North', 'South', 'West' and 'Fire'. The North and West basins are existing basis and will remain in their current locations for the duration of the landfill operations. The Fire basin is an existing basin and will remain in its current location during Stage 1 and 2, being relocated to the eastern side of Stage 3 prior to commencement of landfilling in the Stage 3 area. The South basin is an existing basin and will be relocated to the southern boundary of the Stage 2 area prior to commencement of landfilling in the Stage 1 area (see figures in **Attachment A**).

1.2 Methodology

A spreadsheet water balance was established using Excel. The key calculations undertaken for each basin are:

(i) *Basin Inflow = Catchment Area x Rainfall Depth x Runoff Coefficient*

(ii) *Basin Inflow – Demand – Pond Evaporation = Water Surplus/Deficit*

The balance was undertaken at a monthly time step for each of the proposed development stages and utilised local climate data, catchment and basin parameters derived from the concept design and predicted water demands.

Climate data included:

- Monthly average and 10 percentile rainfall data from Bureau of Meteorology (BoM) gauge 'Telegraph Point (Farrawells Road)' (Gauge no. 060031) for the 30 year period 1961-1990.
- Monthly average pan evaporation data derived from BoM gridded data.

- Monthly mean number of days with rainfall >= 10 mm for BoM gauge Port Macquarie Airport AWS (Gauge no. 060139).

Catchment and basin parameters included:

- Catchment areas derived from the concept design (refer **Attachment B**).
- Runoff coefficients representative of expected surface conditions.
- Pond evaporation for the proposed basins was estimated by dividing the monthly average pan evaporation data by a factor of 1.3 (a typical factor quoted in most textbooks to account for the extra heat taken in through the sides of a pan).

The only significant water demand for the site is expected to be for dust suppression. Consultation with Council officers suggested that current average daily demand is 25 m^3/day during dry periods and that this is expected to be similar for future operations. In a worst case scenario, the maximum daily demand is expected to be 40 m^3/day. The water balance calculations adopt a demand of 25 m^3/day, however the maximum demand (40 m^3/day or 1,200 m^3/month) has also been considered.

For the purpose of the water balance it was assumed that no watering for dust suppression purposes would be required when rainfall is >=10mm/day.

For all stages, demand was assumed to be supplied from the firefighting storage dam (storage for dust suppression would be provided in addition to firefighting storage requirements of 100 m^3).

1.3 Results

The results of the water balance for each of the proposed stages are included in **Attachment C** and are discussed below in relation to average and 10th percentile rainfall scenarios.

The results show that, in all months with average rainfall conditions, there is a surplus of water available for dust suppression. This applies throughout all stages of the proposed landfill operation. Under average rainfall conditions, the driest month is September, and this corresponds with the minimum surplus of approximately 200 m^3/ month during Stage 1, for the firefighting storage dam on its own. If all four basins are considered, there is a surplus of more than 4,600 m^3 across the site for the same month.

The results also show that under 10th percentile rainfall conditions there is a potential water deficit during July and August in all three stages. A deficit of similar magnitude is also predicted by the water balance for the existing landfill for 10th percentile rainfall conditions. Discussions with Council identified that a water deficit has not previously been experienced at the landfill, even when there have been serious rainfall deficiencies (eg; August and September 2009 were consecutive months of less than 10th percentile rainfall). This is most likely due to the significant water storage provided in the existing basins. The existing firefighting basin alone has a storage volume of approximately 3,000 m^3, which is well in excess of the required firefighting storage requirement of 100 m^3 and also the maximum monthly water demand of 1,200 m^3. The minimum proposed total water storage capacity, including settling zone volume within the sediment basins which could also be used as a water source, is approximately 8,300 m^3 (during Stage 3). Maximum water demands and minimum storage volumes are summarised in Table 1.

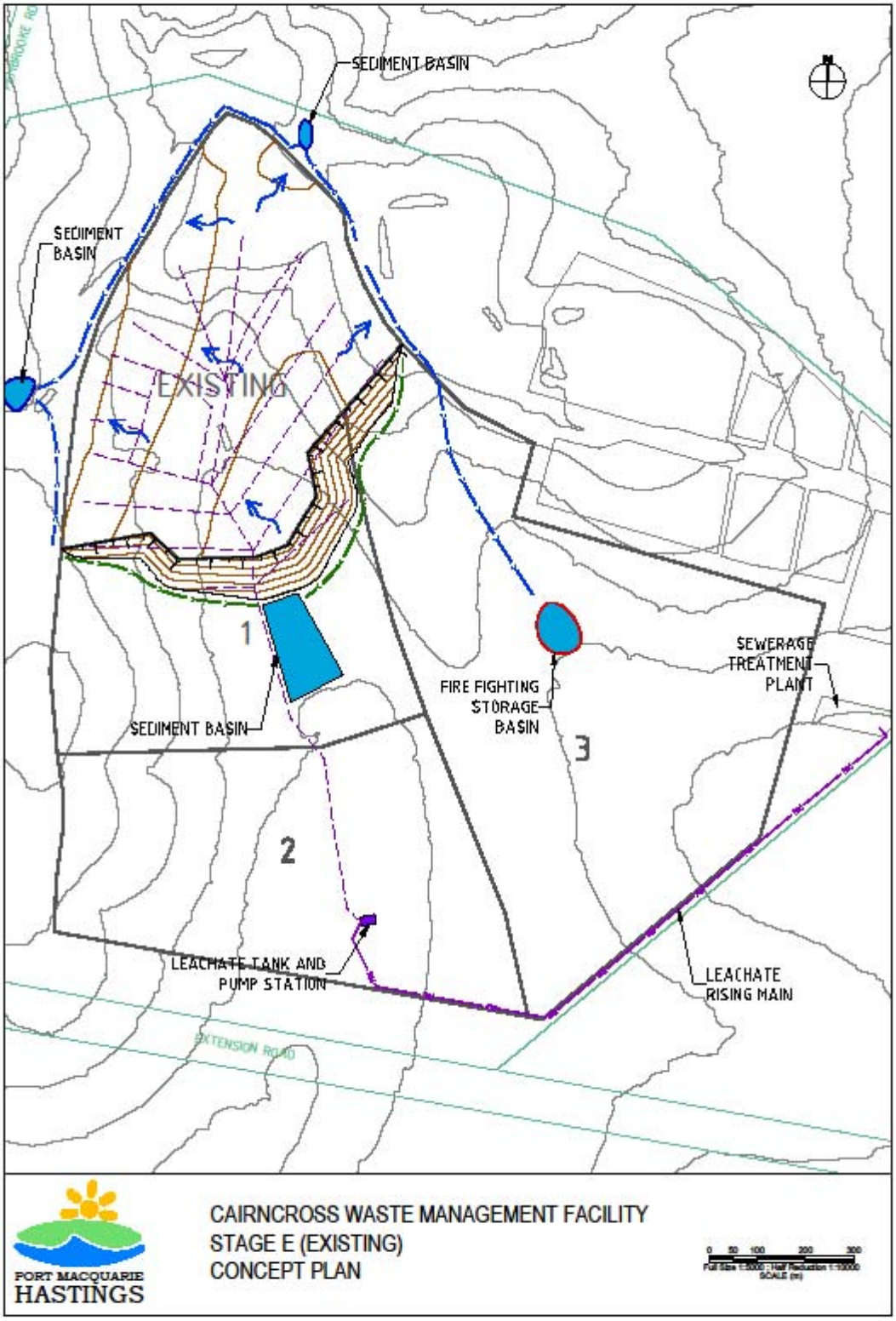
Table 1: Maximum demand and minimum storage volumes

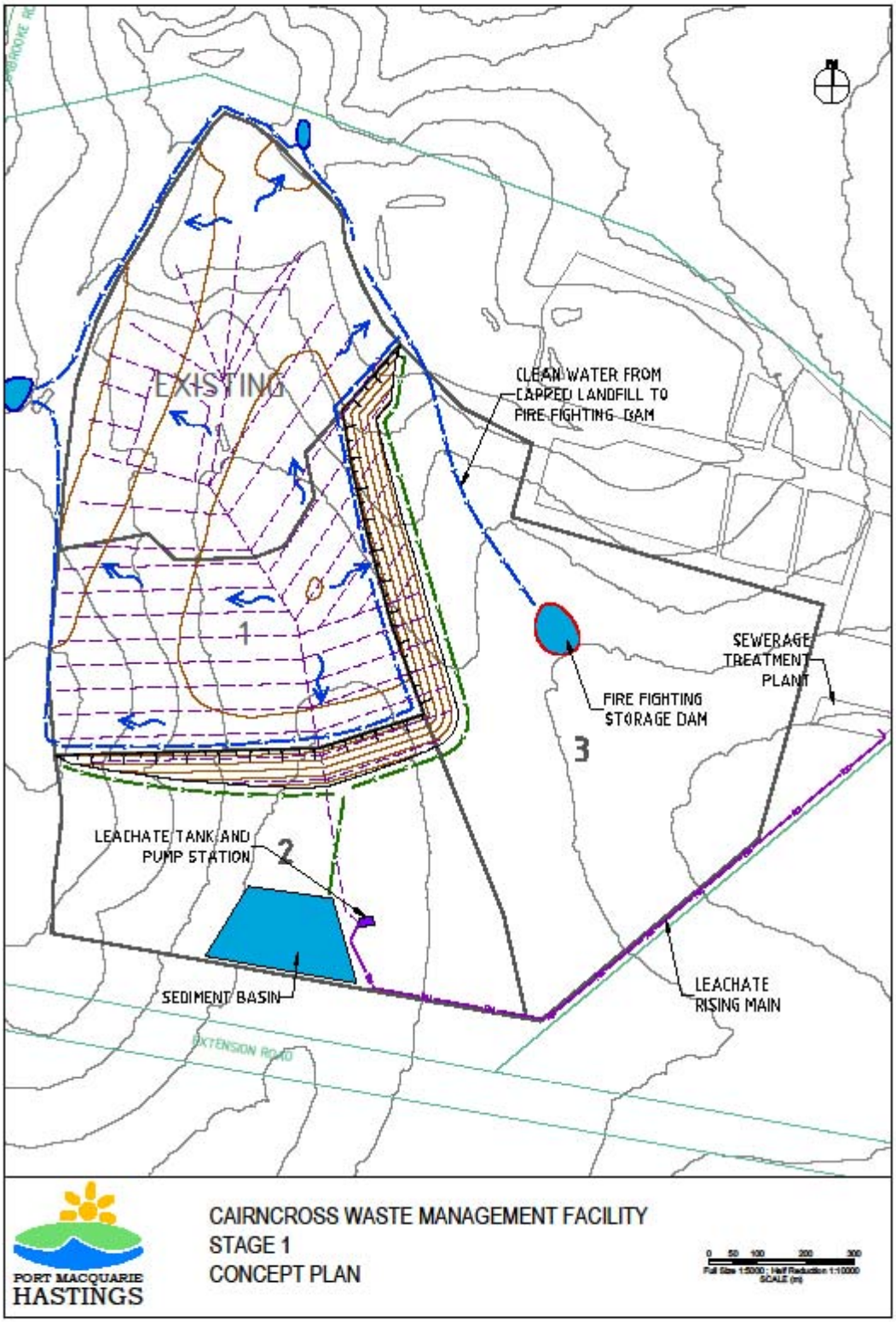
Maximum monthly water demand	Firefighting water storage requirements	Minimum proposed total water storage capacity
1,200 m^3	100 m^3	8,300 m^3

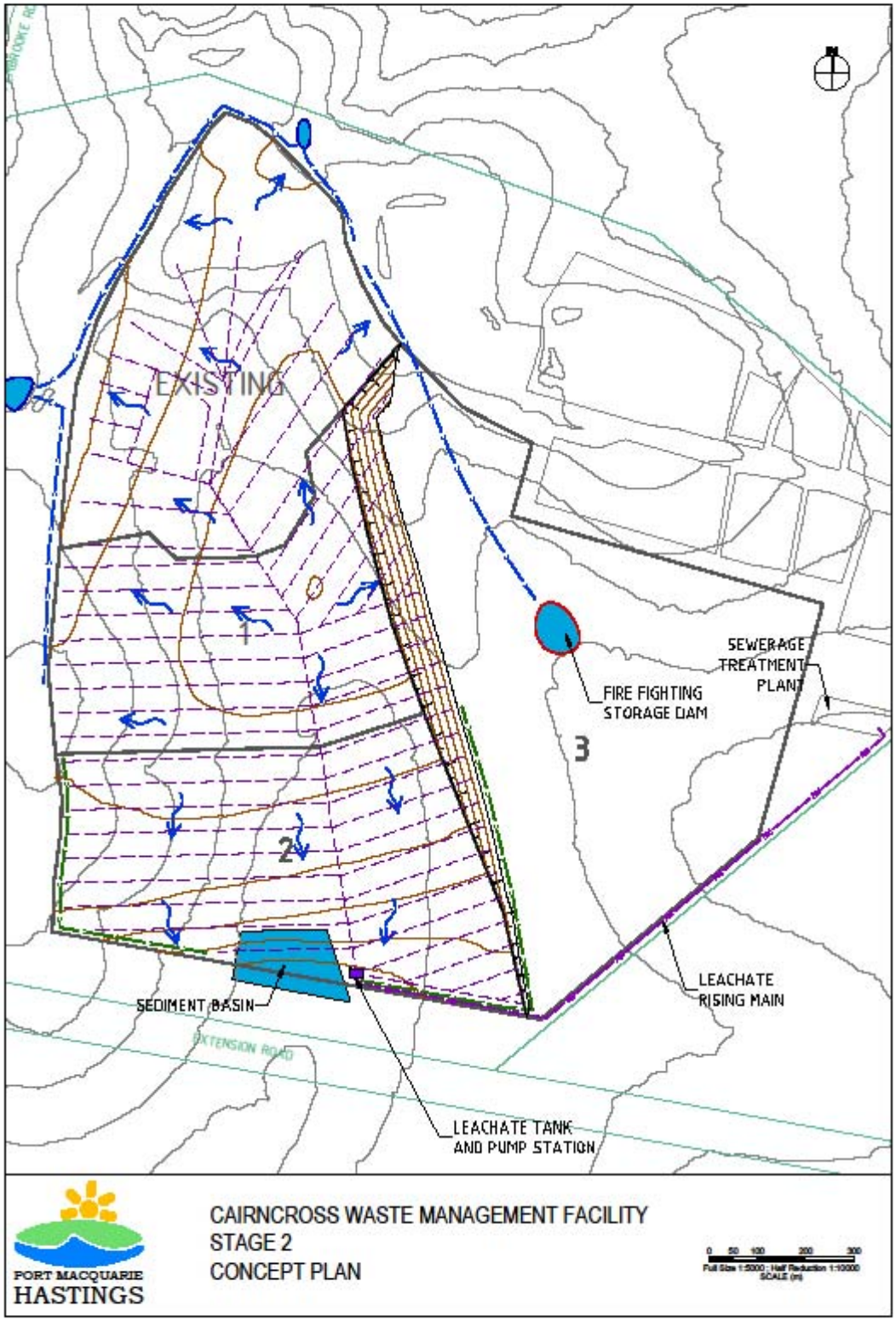
Based on the water balance results and past experience at the landfill, a water deficit is considered unlikely to occur, except in extreme drought conditions. To minimise the risk of experiencing a deficit, which would require water to be imported to the site, it is recommended that the capability to draw water from all basins be continued.

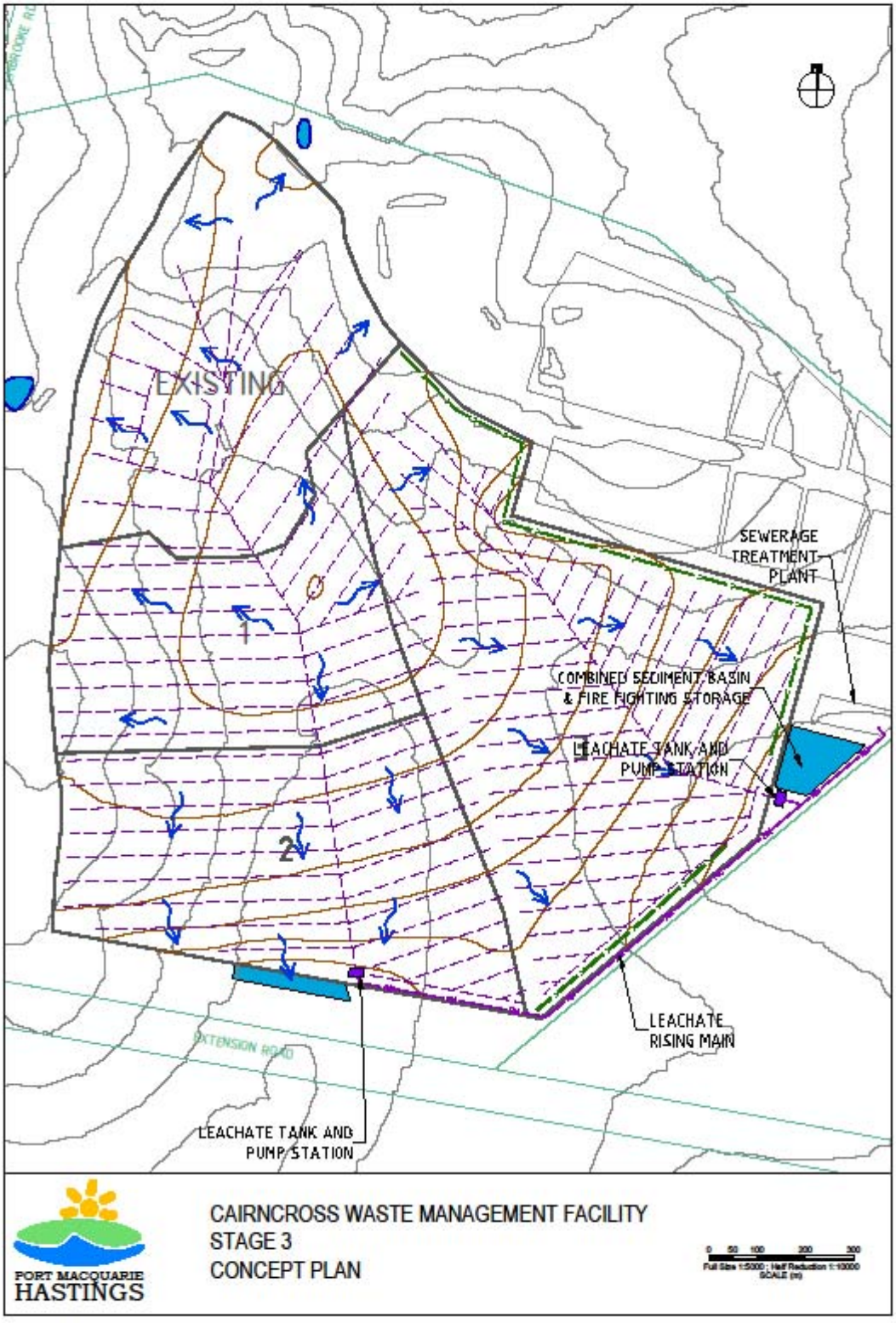
ATTACHMENT A CONCEPT DESIGNS

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SEDIMENT BASIN
SEDIMENT BASIN
EXISTING
1
SEDIMENT BASIN
FIRE FIGHTING STORAGE BASIN
SEWERAGE TREATMENT PLANT
3
2
LEACHATE TANK AND PUMP STATION
LEACHATE RISING MAIN
EXTENSION ROAD
PORT MACQUARIE HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE E (EXISTING)
CONCEPT PLAN

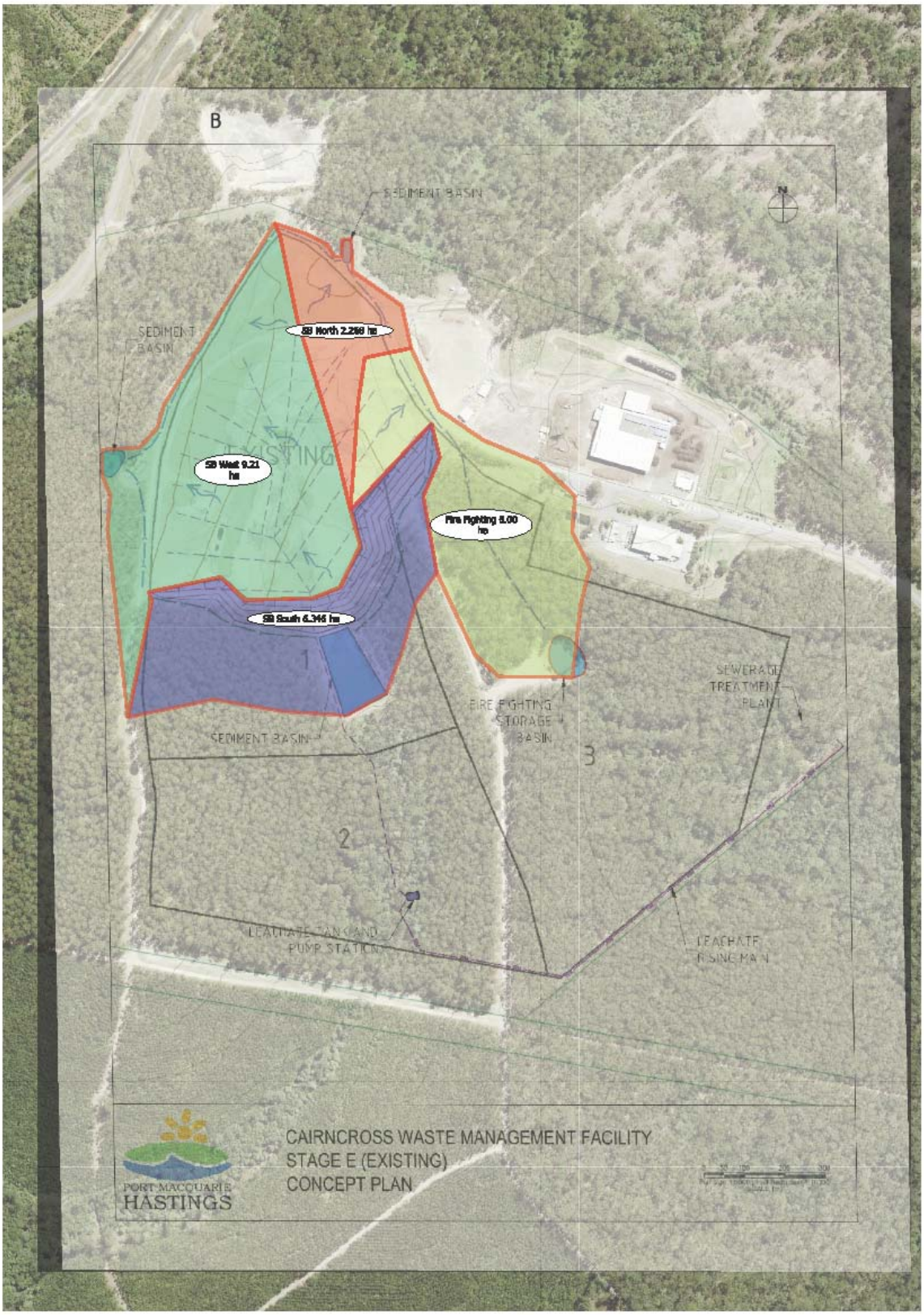

EXISTING
CLEAN WATER FROM CAPPED LANDFILL TO FIRE FIGHTING DAM
SEWERAGE TREATMENT PLANT
FIRE FIGHTING STORAGE DAM
LEACHATE TANK AND PUMP STATION
SEDIMENT BASIN
LEACHATE RISING MAIN
EXTENSION ROAD
1
2
3
PORT MACQUARIE HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 1
CONCEPT PLAN

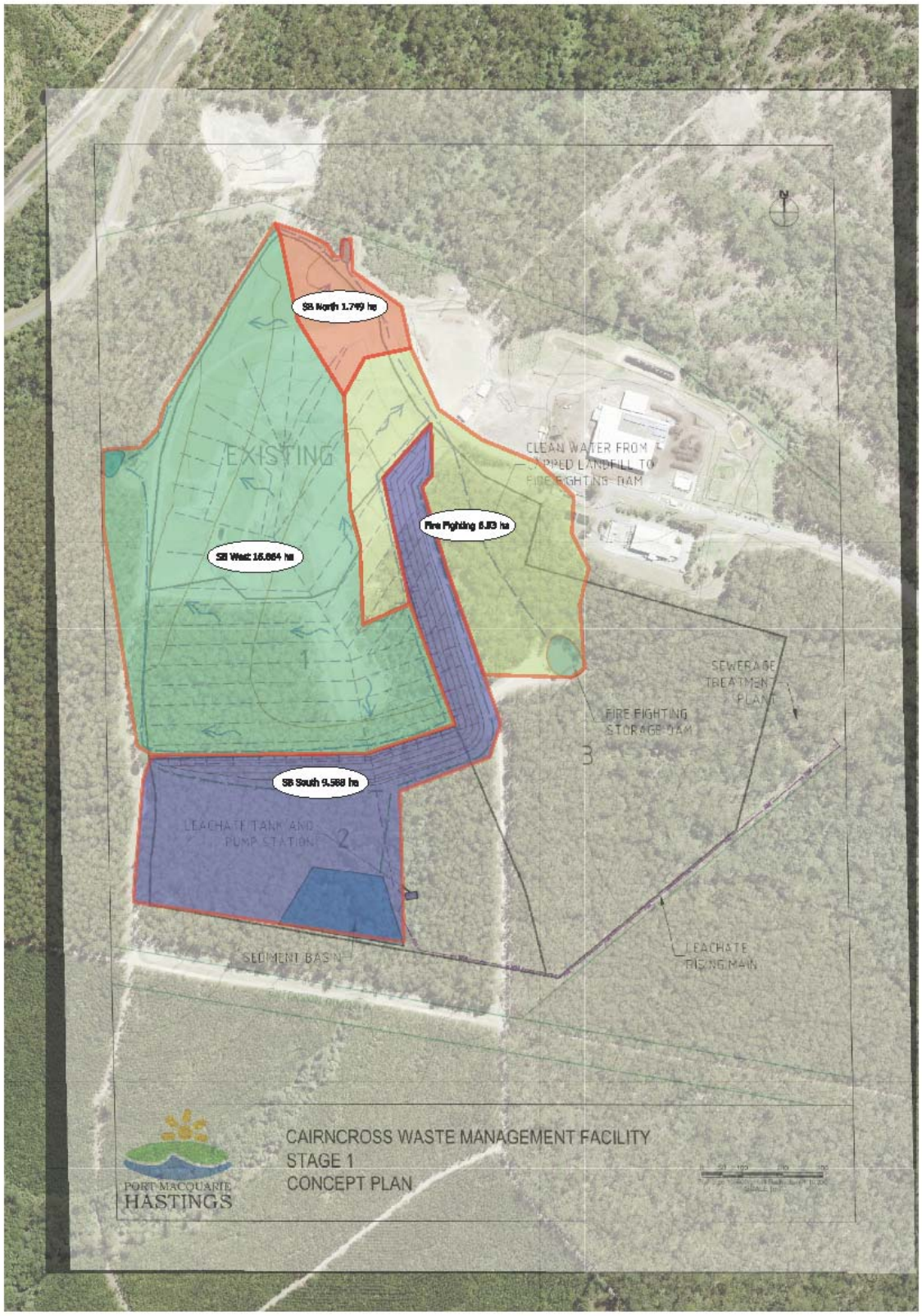

EXISTING
1
2
3
SEWERAGE
TREATMENT
PLANT
FIRE FIGHTING
STORAGE DAM
LEACHATE
RISING MAIN
SEDIMENT BASIN
EXTENSION ROAD
LEACHATE TANK
AND PUMP STATION
PORT MACQUARIE
HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 2
CONCEPT PLAN

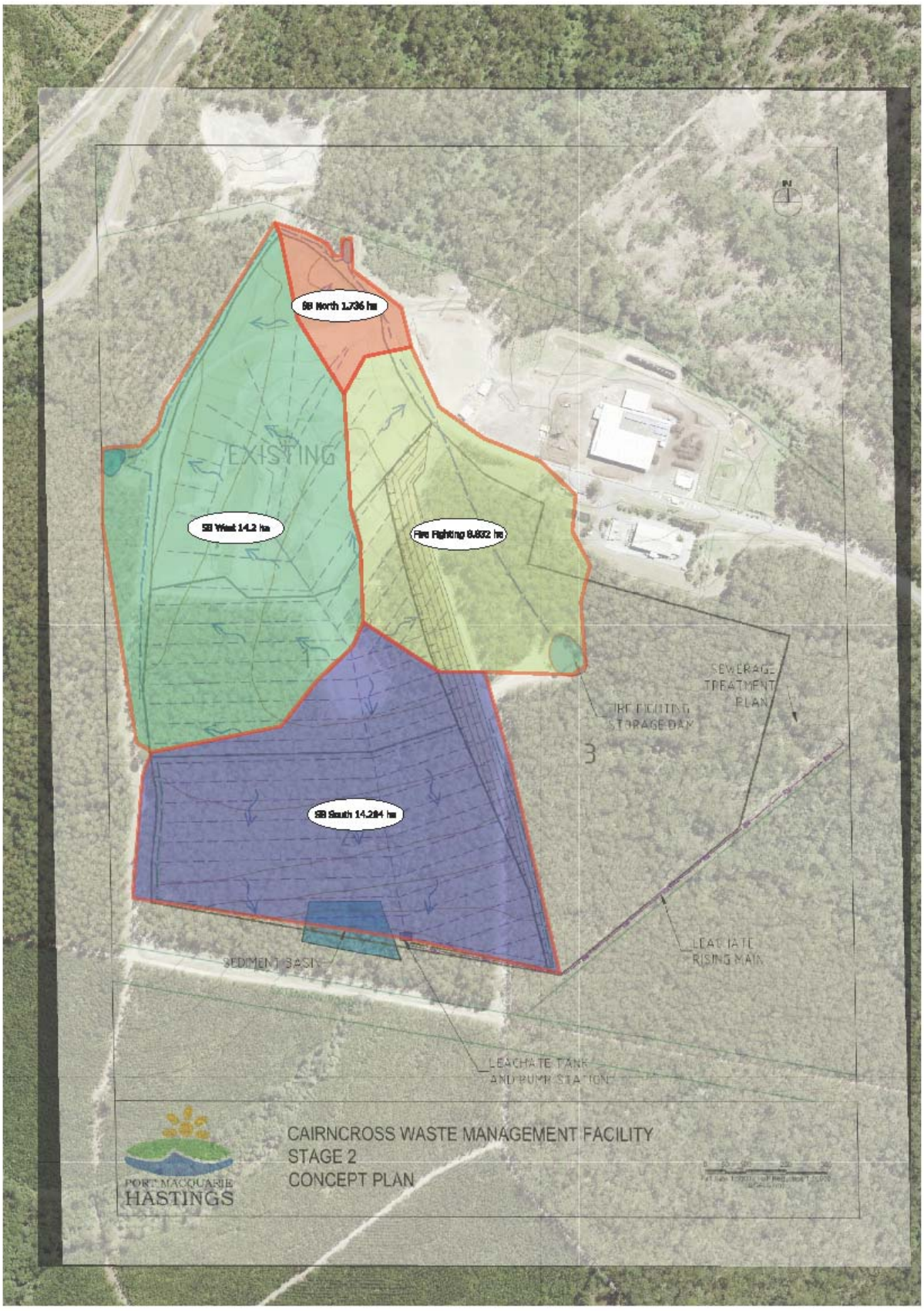

EXISTING
1
2
SEWERAGE TREATMENT PLANT
COMBINED SEDIMENT BASIN & FIRE FIGHTING STORAGE
LEACHATE TANK AND PUMP STATION
LEACHATE RISING MAIN
LEACHATE TANK AND PUMP STATION
PORT MACQUARIE HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 3
CONCEPT PLAN

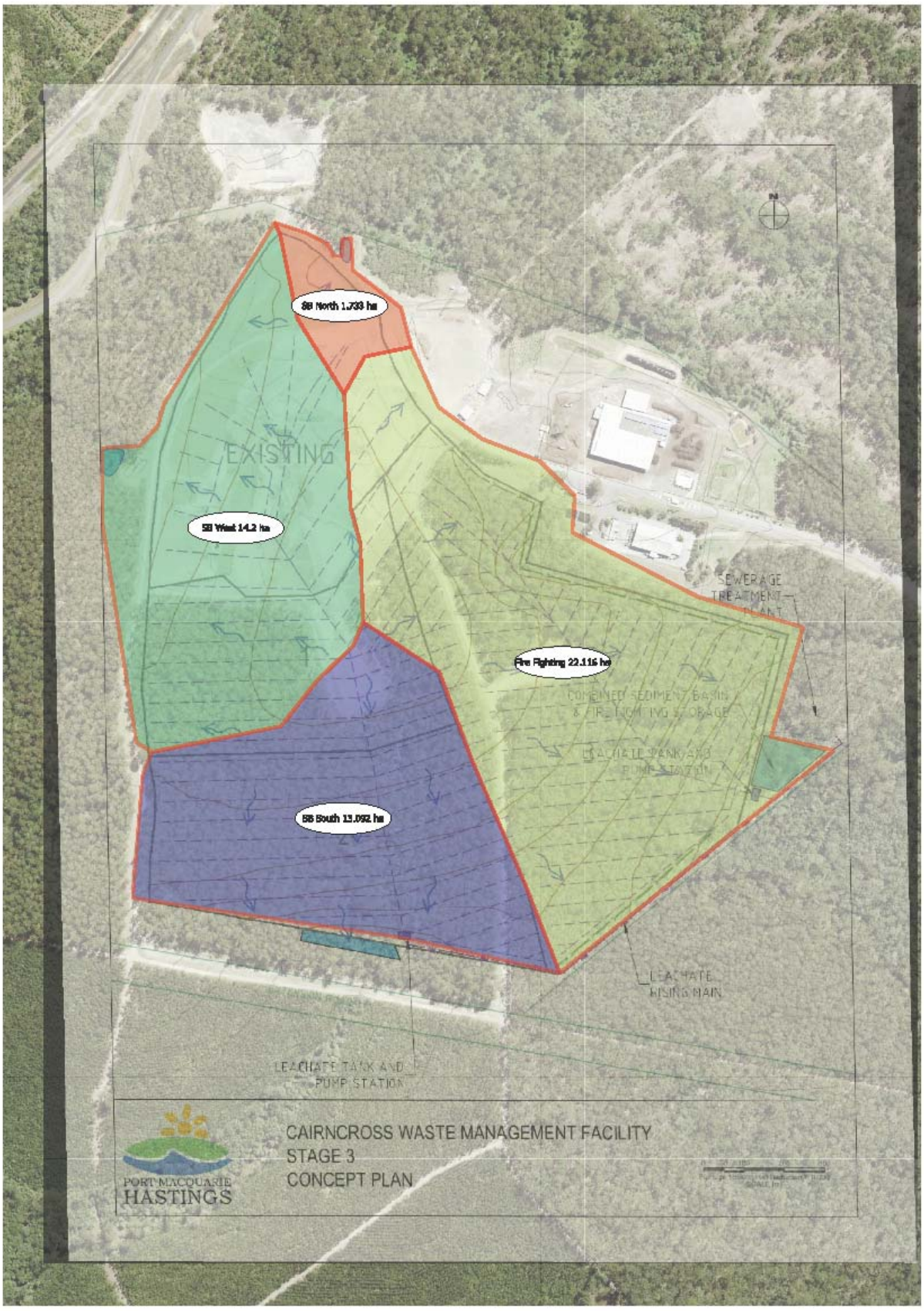
ATTACHMENT B CATCHMENT AREAS

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B
SEDIMENT BASIN
N
SEDIMENT BASIN
SB North 2.288 ha
SB West 9.21 ha
Fire Fighting 8.00 ha
SB South 6.346 ha
1
SEWERAGE TREATMENT PLANT
FIRE FIGHTING STORAGE BASIN
SEDIMENT BASIN
3
2
LEACHATE TANK AND PUMP STATION
LEACHATE RISING MAIN
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE E (EXISTING)
CONCEPT PLAN
PORT MACQUARIE HASTINGS


SB North 1.749 ha
EXISTING
SB West 16.864 ha
Fire Fighting 8.83 ha
CLEAN WATER FROM
PIPED LANDFILL TO
FIRE FIGHTING DAM
SEWERAGE
TREATMENT
PLANT
FIRE FIGHTING
STORAGE DAM
SB South 9.588 ha
LEACHATE TANK AND
PUMP STATION
SEDIMENT BASIN
LEACHATE
RISING MAIN
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 1
CONCEPT PLAN
PORT MACQUARIE
HASTINGS


SB North 1.736 ha
EXISTING
SB West 14.2 ha
Fire Fighting 0.6832 ha
SEWERAGE TREATMENT PLAN
REFUELLING STORAGE BAY
SB South 14.284 ha
SEDIMENT BASIN
LEACHATE RISING MAIN
LEACHATE TANK AND PUMP STATION
PORT MACQUARIE HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 2
CONCEPT PLAN


SB North 1.733 ha
EXISTING
SB West 14.2 ha
SEWERAGE TREATMENT PLANT
Fire Fighting 22.116 ha
SB South 13.092 ha
LEACHATE RISING MAIN
LEACHATE TANK AND PUMP STATION
PORT MACQUARIE HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 3
CONCEPT PLAN

ATTACHMENT C WATER BALANCE

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C

Existing average

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	60,000	63,000	92,000	23,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	1,850	4,900	850	350
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,970	3,150	3,672	3,114	2,304	2,178	936	1,044	918	1,944	1,998	2,286
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	178	145	135	107	78	73	78	112	148	174	167	192
Surplus (+ve)/Deficit(-ve) (m3)	2,117	2,405	2,887	2,357	1,526	1,455	133	207	70	1,045	1,182	1,394

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	5,198	5,513	6,426	5,450	4,032	3,812	1,638	1,827	1,607	3,402	3,497	4,001
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	471	384	358	283	207	192	207	298	392	460	441	509
Surplus (+ve)/Deficit(-ve) (m3)	4,726	5,128	6,068	5,167	3,825	3,619	1,431	1,529	1,215	2,942	3,056	3,492

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	7,590	5,513	6,426	5,450	4,032	3,812	1,638	1,827	1,607	3,402	3,497	4,001
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	82	67	62	49	36	33	36	52	68	80	77	88
Surplus (+ve)/Deficit(-ve) (m3)	7,508	5,446	6,364	5,400	3,996	3,778	1,602	1,775	1,539	3,322	3,420	3,912

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,898	2,013	2,346	1,990	1,472	1,392	598	667	587	1,242	1,277	1,461
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	34	27	26	20	15	14	15	21	28	33	32	36
Surplus (+ve)/Deficit(-ve) (m3)	1,864	1,985	2,320	1,969	1,457	1,378	583	646	559	1,209	1,245	1,424

Total Site Surplus (+ve)/Deficit(-ve) (m3)	16,216	14,964	17,639	14,894	10,804	10,231	3,749	4,157	3,382	8,519	8,902	10,222

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Existing 10th percentile

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	60,000	63,000	92,000	23,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	1,850	4,900	850	350
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	756	972	594	594	360	252	72	90	342	306	882	576
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	178	145	135	107	78	73	78	112	148	174	167	192
Surplus (+ve)/Deficit(-ve) (m3)	-97	227	-191	-163	-418	-471	-731	-747	-506	-593	66	-316

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,323	1,701	1,040	1,040	630	441	126	158	599	536	1,544	1,008
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	471	384	358	283	207	192	207	298	392	460	441	509
Surplus (+ve)/Deficit(-ve) (m3)	852	1,317	681	757	423	249	-81	-140	207	76	1,103	499

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,932	1,701	1,040	1,040	630	441	126	158	599	536	1,544	1,008
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	82	67	62	49	36	33	36	52	68	80	77	88
Surplus (+ve)/Deficit(-ve) (m3)	1,850	1,634	977	990	594	408	90	106	531	456	1,467	920

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	483	621	380	380	230	161	46	58	219	196	564	368
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	34	27	26	20	15	14	15	21	28	33	32	36
Surplus (+ve)/Deficit(-ve) (m3)	449	594	354	359	215	147	31	36	191	163	532	332

Total Site Surplus (+ve)/Deficit(-ve) (m3)	3,055	3,771	1,822	1,944	814	333	-691	-746	422	101	3,167	1,434

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Stage 1 average

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	69,000	96,000	169,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	3,416	3,623	4,223	3,581	2,650	2,505	1,076	1,201	1,056	2,236	2,298	2,629
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2,548	2,866	3,427	2,816	1,865	1,776	267	354	196	1,323	1,468	1,721

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	7,920	8,400	9,792	8,304	6,144	5,808	2,496	2,784	2,448	5,184	5,328	6,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	7,439	8,008	9,427	8,016	5,932	5,612	2,284	2,480	2,048	4,715	4,878	5,577

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	13,943	8,400	9,792	8,304	6,144	5,808	2,496	2,784	2,448	5,184	5,328	6,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	13,846	8,008	9,427	8,016	5,932	5,612	2,284	2,480	2,048	4,715	4,878	5,577

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,403	1,488	1,734	1,471	1,088	1,029	442	493	434	918	944	1,080
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	1,354	1,448	1,697	1,442	1,067	1,009	421	463	394	871	899	1,028

Total Site Surplus (+ve)/Deficit(-ve) (m3)	25,188	20,329	23,977	20,288	14,797	14,009	5,257	5,777	4,685	11,624	12,122	13,902

Stage 1 10th percentile

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	69,000	96,000	169,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	869	1,118	683	683	414	290	83	104	393	352	1,014	662
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2	361	-113	-82	-371	-439	-727	-743	-467	-561	184	-245

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,016	2,592	1,584	1,584	960	672	192	240	912	816	2,352	1,536
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	1,535	2,200	1,219	1,296	748	476	-20	-64	512	347	1,902	1,017

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	3,549	2,592	1,584	1,584	960	672	192	240	912	816	2,352	1,536
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	3,453	2,200	1,219	1,296	748	476	-20	-64	512	347	1,902	1,017

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	357	459	281	281	170	119	34	43	162	145	417	272
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	309	420	244	252	149	99	13	12	122	98	372	220

Total Site Surplus (+ve)/Deficit(-ve) (m3)	5,299	5,180	2,568	2,760	1,275	612	-753	-859	679	230	4,360	2,008

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Stage 2 average

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	88,000	143,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	4,356	4,620	5,386	4,567	3,379	3,194	1,373	1,531	1,346	2,851	2,930	3,353
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	3,489	3,863	4,589	3,802	2,595	2,466	563	685	486	1,939	2,100	2,445

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	11,798	12,513	14,586	12,370	9,152	8,652	3,718	4,147	3,647	7,722	7,937	9,081
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	11,317	12,120	14,221	12,081	8,940	8,455	3,506	3,843	3,247	7,253	7,487	8,561

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	11,715	12,513	14,586	12,370	9,152	8,652	3,718	4,147	3,647	7,722	7,937	9,081
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	11,619	12,120	14,221	12,081	8,940	8,455	3,506	3,843	3,247	7,253	7,487	8,561

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,403	1,488	1,734	1,471	1,088	1,029	442	493	434	918	944	1,080
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	1,354	1,448	1,697	1,442	1,067	1,009	421	463	394	871	899	1,028

Total Site Surplus (+ve)/Deficit(-ve) (m3)	27,779	29,552	34,728	29,406	21,542	20,386	7,997	8,834	7,373	17,315	17,972	20,595

Stage 2 10th percentile

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	88,000	143,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,109	1,426	871	871	528	370	106	132	502	449	1,294	845
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	241	669	75	106	-257	-359	-704	-715	-358	-464	464	-63

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	3,003	3,861	2,360	2,360	1,430	1,001	286	358	1,359	1,216	3,504	2,288
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	2,522	3,469	1,994	2,071	1,218	805	74	54	959	746	3,054	1,769

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,982	3,861	2,360	2,360	1,430	1,001	286	358	1,359	1,216	3,504	2,288
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	2,886	3,469	1,994	2,071	1,218	805	74	54	959	746	3,054	1,769

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	357	459	281	281	170	119	34	43	162	145	417	272
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	309	420	244	252	149	99	13	12	122	98	372	220

Total Site Surplus (+ve)/Deficit(-ve) (m3)	5,958	8,026	4,307	4,500	2,329	1,350	-542	-595	1,680	1,126	6,942	3,695

Stage 3 average

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	221,000	131,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	3,500	2,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	10,940	11,603	13,525	11,470	8,486	8,022	3,448	3,845	3,381	7,160	7,359	8,420
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	337	275	256	202	148	137	148	213	280	328	315	363
Surplus (+ve)/Deficit(-ve) (m3)	9,928	10,728	12,619	10,618	7,638	7,235	2,575	2,908	2,401	6,107	6,394	7,357

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	10,808	11,463	13,362	11,332	8,384	7,926	3,406	3,799	3,341	7,074	7,271	8,319
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	10,615	11,306	13,216	11,216	8,299	7,847	3,321	3,677	3,181	6,886	7,091	8,111

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	11,715	11,463	13,362	11,332	8,384	7,926	3,406	3,799	3,341	7,074	7,271	8,319
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	11,619	11,306	13,216	11,216	8,299	7,847	3,321	3,677	3,181	6,886	7,091	8,111

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,403	1,488	1,734	1,471	1,088	1,029	442	493	434	918	944	1,080
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	1,354	1,448	1,697	1,442	1,067	1,009	421	463	394	871	899	1,028

Total Site Surplus (+ve)/Deficit(-ve) (m3)	33,516	34,787	40,749	34,492	25,304	23,938	9,638	10,725	9,156	20,751	21,474	24,606

Stage 3 10th percentile

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	221,000	131,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	3,500	2,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,785	3,580	2,188	2,188	1,326	928	265	332	1,260	1,127	3,249	2,122
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	337	275	256	202	148	137	148	213	280	328	315	363
Surplus (+ve)/Deficit(-ve) (m3)	1,773	2,706	1,282	1,336	478	141	-608	-606	280	74	2,284	1,058

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,751	3,537	2,162	2,162	1,310	917	262	328	1,245	1,114	3,210	2,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2,559	3,380	2,015	2,046	1,225	839	177	206	1,085	926	3,030	1,888

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,982	3,537	2,162	2,162	1,310	917	262	328	1,245	1,114	3,210	2,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2,886	3,380	2,015	2,046	1,225	839	177	206	1,085	926	3,030	1,888

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	357	459	281	281	170	119	34	43	162	145	417	272
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	309	420	244	252	149	99	13	12	122	98	372	220

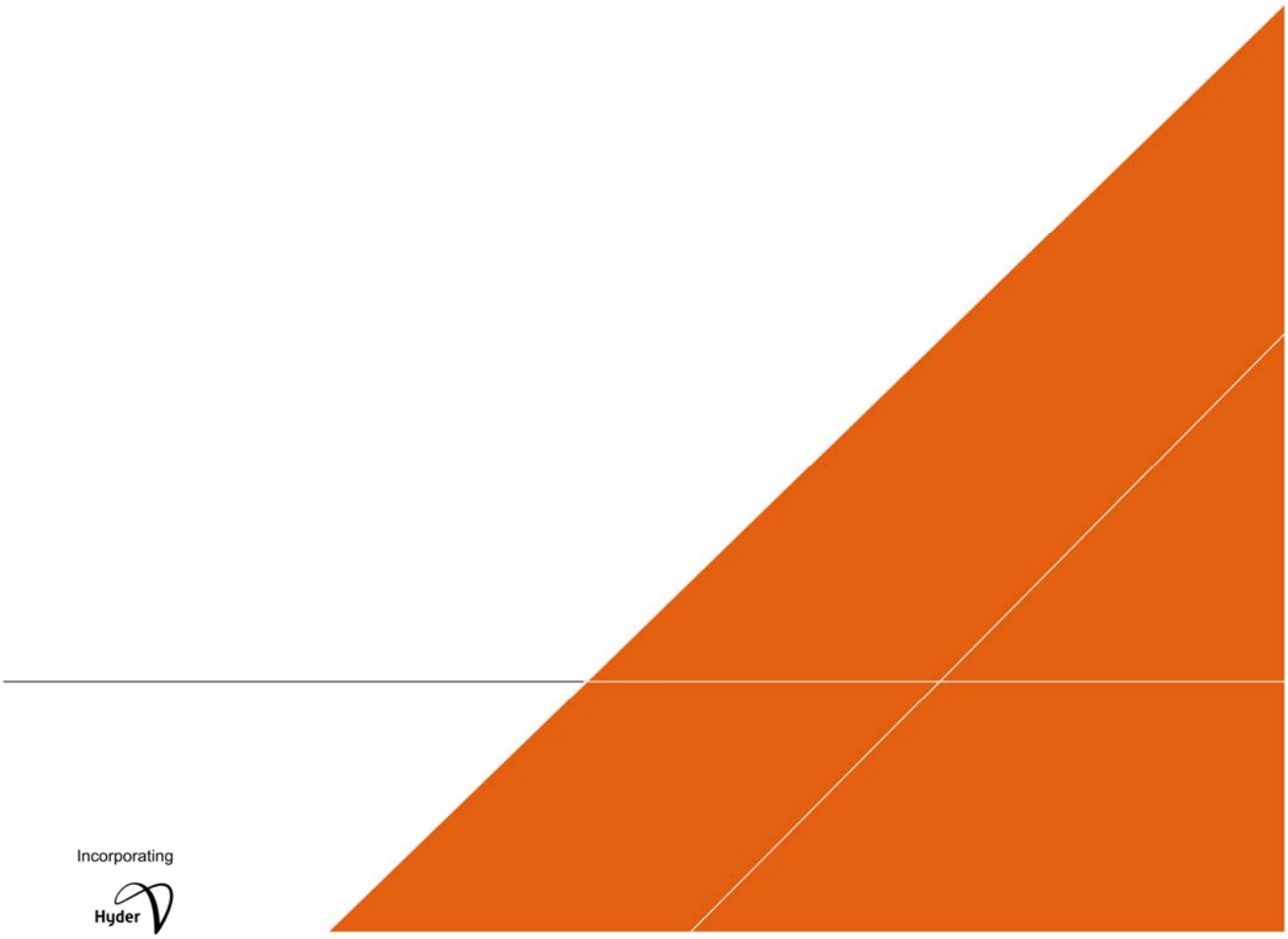
Total Site Surplus (+ve)/Deficit(-ve) (m3)	7,527	9,886	5,557	5,680	3,078	1,917	-240	-182	2,570	2,023	8,714	5,055

APPENDIX C FUTURE DISPOSAL CAPACITY REQUIREMENTS REPORT

ARCADIS Design & Consultancy for natural and built assets

CAIRNCROSS LANDFILL EXPANSION

Future disposal capacity requirements



Incorporating Hyder

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PORT MACQUARIE-HASTINGS COUNCIL CAIRNCROSS LANDFILL EXPANSION

Future disposal capacity requirements

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This report has been prepared for Port Macquarie-Hastings Council in accordance with the terms and conditions of appointment for Cairncross Landfill Expansion dated 15 October 2014. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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Appendix A - Landfill Staging Plan

1 SUMMARY

Port Macquarie Hastings Council (PMHC) operates a licensed landfill site at the Cairncross Waste Management Facility (WMF). The current approved area of the landfill is nearing the end of its capacity and PMHC is planning to seek approval to expand the landfill.

PMHC commissioned Arcadis to undertake an assessment of the likely landfill disposal requirements of the region in order to determine the most appropriate airspace requirement and planning horizon for the landfill expansion.

Arcadis undertook modelling on a range of scenarios, incorporating potential increases in waste generation, changes to diversion rates and the potential for Cairncross WMF to accept tonnages from outside its local government area (LGA).

Table 1 shows the modelling results under an 'ideal' diversion scenario (Scenario 2, which is based on the State target for local governments), and a 'likely' diversion scenario (Scenario 4, which PMHC will reasonably be able to achieve according to planned recovery activities), under a moderate waste generation growth model.

The results show that under either scenario, Stage 1 of the planned expansion (which would need to be operational by around 2020) has an estimated lifespan of 20 years; Stage 2 a subsequent estimated lifespan of seven to eight years and Stage 3 approximately eight to nine years.

Table 1 – Modelling results for an 'ideal' and 'likely' diversion scenario

Scenario	Description	Year in which Stage 1 is estimated to be complete	Year in which Stage 2 is estimated to be complete	Year in which Stage 3 is estimated to be complete
Scenario 2 ('ideal')	Achieve 70% diversion of residential waste by 2021-22, no change to C&I / C&D / Other MSW diversion rates	2039-40	2047-48	2056-57
Scenario 4 ('likely')	Achieve 75% kerbside diversion rate by 2015-16 and 40% diversion of C&I by 2021-22; no change to C&D / Other MSW diversion rates	2039-40	2046-47	2055-56

Should PMHC not receive planning approval for all landfill stages, it would be without disposal capacity in its LGA from around 2020. This would have significant initial and ongoing financial impacts on PMHC and increase Council's operational risks. Planning approval would provide certainty for Council and industry, while limiting costs to the community.

2 INTRODUCTION

Port Macquarie-Hastings Council (PMHC) operates a licensed landfill site at the Cairncross Waste Management Facility (WMF) which receives putrescible and non-putrescible waste from within the Port Macquarie Hastings local government area (LGA), being a mixture of both commercial and municipal waste.

The current approved area of the landfill is nearing the end of its capacity and PMHC is now planning to seek approval to expand the landfill. The original intention was to seek approval for the remaining landfill stages in accordance with the original concept design, to provide disposal capacity well into the future (estimated at around 90-100 years, i.e. around 2100). However, the long lifespan of the proposed approval was raised as an issue by the Department of Planning and Environment (DPE) in recent discussions.

DPE indicated that they were likely to have difficulties in assessing the project over such a long period given future changes that may occur in environmental assessment practices and the emergence of new landfill design technologies over that period. As such DPE has encouraged Council to undertake further work in building an evidence base to determine and support the most appropriate planning horizon for the proposed landfill expansion.

As part of the initial review phase of the current environmental impact statement (EIS) project in late 2014, Arcadis undertook a high level review of the existing landfill concept design documentation for the expansion. The concept design dates from 1999 and Arcadis identified that the existing concept design was based on waste input projections from 1997 baseline data and that there would be a benefit to Council in updating the waste flow projections.

Subsequently, PMHC commissioned Arcadis to update waste input projections and undertake an assessment of the likely landfill disposal requirements of the region in order to provide strategic justification for the landfill expansion planning horizon.

This report presents the modelling results and assumptions of the disposal requirements analysis which shows the likely filling rates for the planned landfill stages, an assessment of an alternative scenario should approval not be received and an outline of the appropriate planning horizon for subsequent development of the landfill based on the modelling analysis.

Based on the assessment herein and the ‘likely’ diversion scenario, the revised planning horizon is 36 years, with Stage 3 of the proposed landfill expansion being complete in approximately 2056.

3 WASTE FLOW PROJECTIONS

Future disposal requirements within the PMHC LGA were modelled according to a number of scenarios. As Cairncross WMF is the key landfill within the LGA, disposal requirements for Municipal Solid Waste (MSW),[1] Commercial and Industrial (C&I) waste and Construction and Demolition (C&D) waste were considered. Future changes in waste generation and diversion rates were considered, as was the potential need for Cairncross WMF to act as a regional facility, to be used by neighbouring LGAs.

After analysing a number of potential scenarios, the scenarios outlined in Table 2 were shortlisted for consideration within this report. These scenarios consider State diversion targets, likely diversion rates based on PMHC's current and planned recovery activities and potential tonnages from Greater Taree City Council (see Section 5 for a discussion on regional needs).

Modelling data and assumptions are outlined in Section 5.

Table 2 – Description of modelling scenarios

Scenario	Description
1	Business As Usual (BAU) – no changes to current diversion rates
2	Achieve 70% diversion of Residential Waste by 2021-22,[2] no change to C&I / C&D / Other MSW diversion rates
3	Achieve 75% diversion across all waste streams by 2021-22[2]
4	Achieve 75% kerbside diversion rate by 2015-16 and 40% diversion of C&I by 2021-22; no change to C&D / Other MSW diversion rates[3]
5	Scenario 4 plus Taree's waste (based on current input into their landfill, in 20 years' time)

Each scenario was modelled using three waste generation rates, as follows:

- Low waste generation growth – generation increases in line with population growth only
- Moderate waste generation growth – generation increases in line with population growth + 2.5% per annum[4]
- High waste generation growth – generation increases in line with population growth + 5% per annum[5].

[1] Divided into two categories – 'Residential Waste' and 'Other MSW'

[2] Based on the diversion targets in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-21*.

[3] The introduction of the food and garden organics (FOGO) collection in 2014-15 was calculated to have increased the kerbside diversion rate from 60.0% to approximately 69.5% (incorporating an assumption that the collection had been in place for the whole year); therefore it was assumed that PMHC could reasonably achieve a 75% kerbside diversion rate in 2015-16, with further embedding of the collection. It was also assumed that PMHC could reasonably increase the diversion rate of C&I waste from 18% (in 2014-15) to 40% by 2021-22 through behaviour change programs and/or additional recovery infrastructure.

[4] This projection is in line with the average CPI increase per annum in Australia between June 2010 and June 2015. This growth rate was chosen over the medium growth rate of 3% in the *National Waste Report 2010* (see p. 22-23 and Appendix D Part 1) in order to be conservative.

[5] This projection is in line with the high growth scenario in the *National Waste Report 2010* (see p. 22-23 and Appendix D Part 1).

Scenarios were modelled against the capacity of the future landfill stages, in order to project when each stage would reach capacity. The landfill stages are outlined in Table 3 and the staging plan is contained within Appendix A.

Table 3 – Estimated volume and tonnage capacity of future stages at Cairncross landfill[6]

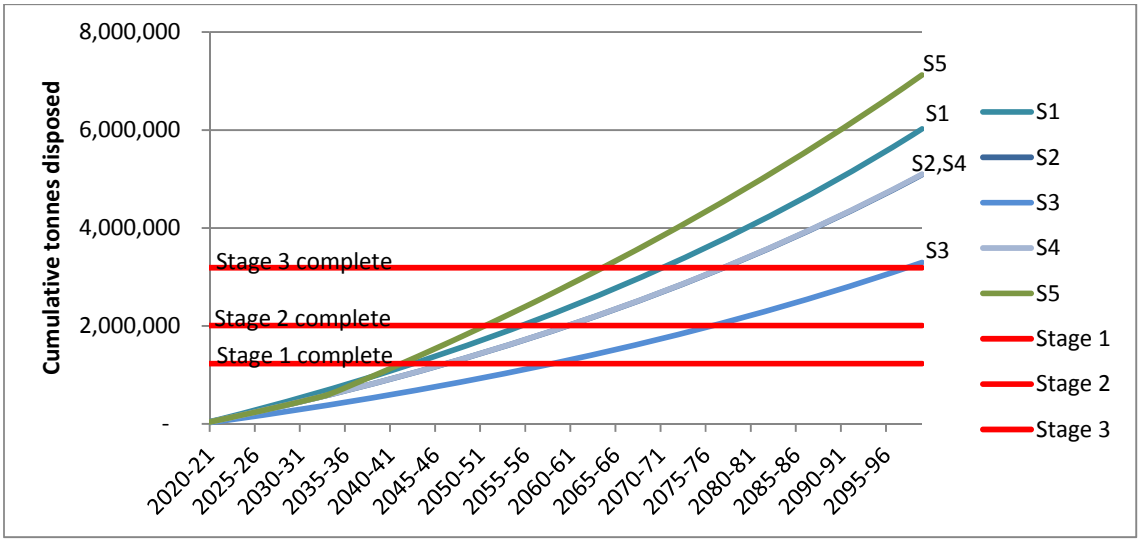
Stage	Estimated volume (m^3)	Estimated volume ex. allowance for daily cover	Estimated tonnage capacity (t)
1	1,610,181	1,449,163	1,231,789
2	1,016,705	915,035	777,779
3	1,541,718	1,387,546	1,179,414
TOTAL	**4,168,604**	**3,751,744**	**3,188,982**

3.1 Modelling results

The figures below demonstrate estimated projected tonnages disposed to Cairncross WMF over time, against the capacity of each landfill stage.[7]

Using the low waste generation growth rate, Figure 1 shows that Stage 1 is estimated to reach completion in 2043-54 under Scenario 1 (BAU), 2047-48 under both Scenario 2 (70% diversion of Residential Waste) and Scenario 4 (likely diversion scenario), 2059-60 under Scenario 3 (75% diversion across all streams) and 2042-43 under Scenario 5 (includes Taree). Stage 3 is estimated to be complete by 2071-72 under Scenario 1, 2077-78 under Scenarios 2 and 4, 2098-99 for Scenario 3 and 2064-65 for Scenario 5.

Figure 1 – Modelling results, low waste generation growth rate

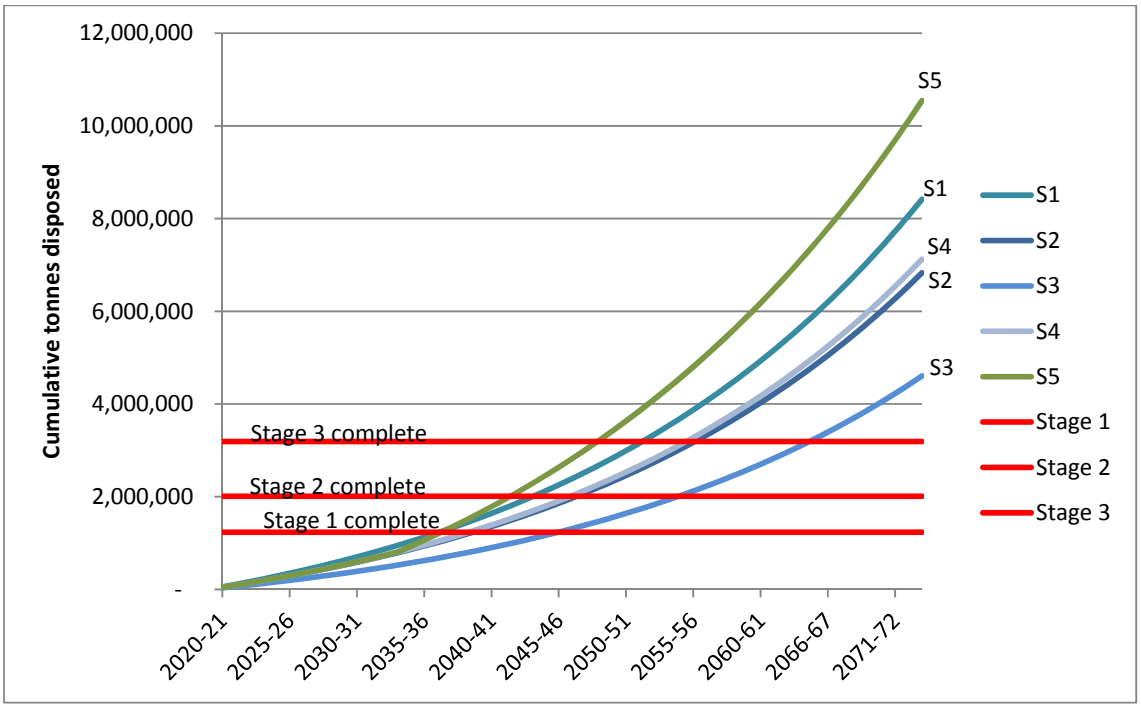


[6] Estimated volumes and stages provided by PMHC. Daily cover was assumed to utilise 10% of the available cell volume. Estimated tonnage capacity utilises a compaction rate of 850kg/m^3.

[7] Assumes that the current cell will be completed by the start of the 2020-21 period.

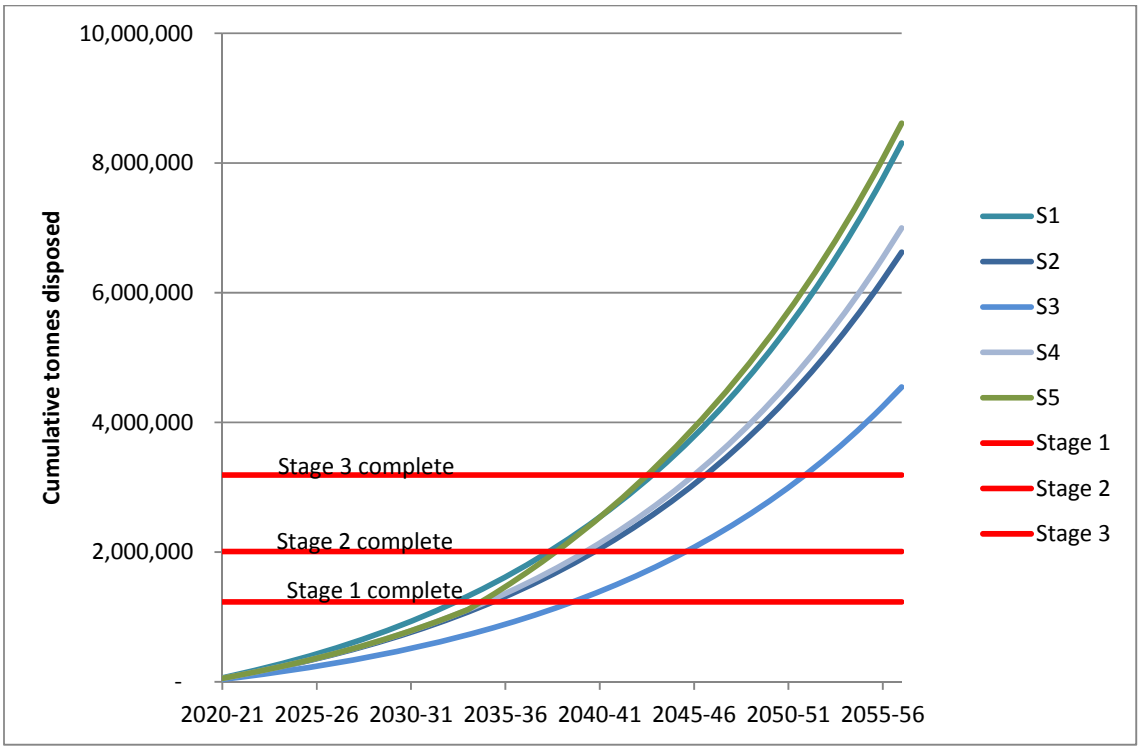
Using the moderate waste generation growth rate, Figure 2 demonstrates that Stage 1 is estimated to be complete by 2037-38 under Scenario 1 (BAU) and Scenario 5 (includes Taree), 2039-40 under Scenario 2 (70% diversion of Residential Waste) and Scenario 4 (likely diversion scenario), and 2045-46 under Scenario 3. Stage 3 is estimated to be complete by 2052-53 under Scenario 1, 2056-57 under Scenario 2, 2065-66 under Scenario 3, 2055-56 under Scenario 4 and 2048-49 under Scenario 5.

Figure 2 – Modelling results, moderate waste generation growth rate



Using the high waste generation growth rate, Figure 3 shows that Stage 1 is estimated to be complete by 2033-34 under Scenario 1 (BAU), 2035-36 under Scenario 2 (70% diversion of Residential Waste), 2039-40 under Scenario 3 (75% diversion across all streams), and 2034-35 under Scenario 4 (likely diversion scenario) and Scenario 5 (includes Taree). Stage 3 is estimated to be complete by 2043-44 under Scenarios 1 and 5, 2046-47 under Scenario 2, 2051-52 under Scenario 3, and 2045-46 under Scenario 4.

Figure 3 – Modelling results, high waste generation growth rate



3.2 Discussion

A number of scenarios and waste generation growth rates were modelled in order to show the range of filling rate possibilities for the Cairncross landfill expansion. However, the scenarios which are of particular interest are scenarios 2 and 4. Scenario 2 represents the 'ideal' scenario (NSW councils are encouraged to achieve an MSW recycling rate of 70% by 2021-22), while scenario 4 represents the 'likely' scenario (incorporating planned diversion activities by PMHC).

Although the low waste generation model represents the actual growth (or lack of) in PMHC's tonnage per capita rate between 2011-12 and 2014-15, the moderate waste generation model represents a more conservative projection of the life of the landfill stages.

Table 4 demonstrates the ideal and likely diversion scenarios under the conservative moderate waste generation model. It can be seen that under these scenarios, Stage 1 of the planned expansion (which would need to be operational by around 2020) has an estimated lifespan of 20 years; Stage 2 a subsequent estimated lifespan of seven years and Stage 3 approximately nine years.

Table 4 – Modelling results for an 'ideal' and 'likely' diversion scenario

Scenario	Description	Year in which Stage 1 is estimated to be complete	Year in which Stage 2 is estimated to be complete	Year in which Stage 3 is estimated to be complete
Scenario 2 ('ideal')	Achieve 70% diversion of residential waste by 2021-22, no change to C&I / C&D / Other MSW diversion rates	2039-40	2047-48	2056-57
Scenario 4 ('likely)	Achieve 75% kerbside diversion rate by 2015-16 and 40% diversion of C&I by 2021-22; no change to C&D / Other MSW diversion rates	2039-40	2046-47	2055-56

4 ALTERNATIVE SCENARIO

If planning approval for subsequent landfill stages was not obtained, PMHC would be without disposal capacity within its LGA by around 2020. Some of the likely impacts of this scenario upon PMHC would include:

- The need for the development of a transfer facility at Cairncross WMF, through which residual waste could be compacted and then transferred to a facility outside the PMHC LGA
- Loss of income associated with the landfill operations
- Increased gate fees to the PMHC community due to transfer costs
- Heightened risk of maintaining a local avenue for management of residual waste, due to reliance on other councils and the transport network.

As outlined in Section 5, there are a number of landfills in the region which may be able to accept waste from PMHC. Greater Taree and Kempsey are the closest LGAs to Port Macquarie and therefore represent the likeliest options to accept PMHC's waste, should a commercial arrangement be made with one of those councils.

A high level cost estimate was undertaken to demonstrate the additional costs to PMHC associated with not receiving approval for subsequent landfill stages. Note that the costs outlined in Table 5 are an indication only, and are subject to development of concept and detailed design, technology and transportation options available in 2020-21, and the commercial arrangement made with the alternative disposal facility.

The cost impact of not having future disposal capacity at Cairncross WMF would be a significant liability to PMHC, with initial capital costs of around $3-6 million and then ongoing transfer costs of at least $1.8 million per year. It is also likely that PMHC would face additional disposal costs at an alternative landfill in comparison to the cost of operating the Cairncross landfill.

Table 5 – Estimated additional costs for bulking and transfer of residual waste

Cost Type	Description	Additional costs
Capital costs	Costs would include a facility capable of processing at least 40-50,000tpa, a compactor and loading plant.	Initial cost of $3-6 million (however, a cost comparison should be conducted should transfer be required in order to establish whether it would be more cost-effective for the collection vehicles to travel directly to the end destination)
Operational costs	For simplicity, it was assumed for the purposes of this assessment that costs of operating the transfer facility would be similar to the costs of operating the landfill.	N/A
Transport costs	Utilising quotes recently obtained for waste transfer in the Port Macquarie area, a cost of $0.89 / t / km was estimated for transfer of waste in 2020-21 (however future costs will be dependent upon waste transport contractors available in the area at that time). The distance between Cairncross WMF and Taree's landfill is approximately 87km, and the distance to Kempsey's landfill is approximately 40km.	Assuming 50,000tpa is transferred, the following costs were estimated: Taree: $3.9m / yr Kempsey: $1.8m / yr
Disposal costs	While the terms of a future commercial arrangement for an alternative landfill are very uncertain, it was assumed that there would be an additional cost for disposal to another landfill.	An additional 3% on Cairncross' disposal costs

5 DATA AND ASSUMPTIONS

This Section outlines the data used and the assumptions made for modelling purposes.

Population

Table 6 – Historic and forecast population for Port Macquarie-Hastings area[8]

Year	Population	*Year*	Population
2011-12	75,722	*2036-37*	104,139
2012-13	76,279	*2037-38*	105,365
2013-14	77,079	*2038-39*	106,607
2014-15	78,053	*2039-40*	107,862
2015-16	79,144	*2040-41*	109,133
2016-17	80,261	*2041-42*	110,419
2017-18	81,457	*2042-43*	111,719
2018-19	82,622	*2043-44*	113,036
2019-20	83,960	*2044-45*	114,367
2020-21	85,280	*2045-46*	115,714
2021-22	86,481	*2046-47*	117,078
2022-23	87,617	*2047-48*	118,457
2023-24	88,822	*2048-49*	119,852
2024-25	90,070	*2049-50*	121,264
2025-26	91,276	*2050-51*	122,693
2026-27	92,410	*2051-52*	124,138
2027-28	93,557	*2052-53*	125,600
2028-29	94,683	*2053-54*	127,080
2029-30	95,885	*2054-55*	128,577
2030-31	97,072	*2055-56*	130,092
2031-32	98,297	*2056-57*	131,624
2032-33	99,482	*2057-58*	133,175
2033-34	100,681	*2058-59*	134,744
2034-35	101,803	*2059-60*	136,331
2035-36	102,926	*2060-61*	137,937

[8] Years 2011-12 to 2035-36 sourced from forecast.id (website accessed 30/06/2015). Annual growth rate for the years following 2035-36 assumed to be the average growth rate used by forecast.id between 2031 and 2036 (1.18%).

Tonnages

Table 7 – Historical tonnages, using weighbridge codes, 2011-12 to 2014-15[9]

	2011-12	2012-13	2013-14	2014-15
Residential	**43,217**	**48,203**	**46,781**	**51,169**
Landfill	*17,180*	*20,947*	*20,956*	*22,357*
Council transfer bins pre Oct	1,426			
Dead animals	7	7	6	7
Domestic kerbside waste		12,238	12,600	10,204
Domestic waste	8,208			
Dunbogan landfill	2,417	2,568	2,100	2,624
Kerbside junk collection		765		
Kerbside junk collection & dumping				2,654
Processed waste (MRF/ORRF)		1,019	843	839
Processed waste (MSW/ORRF/MRF)	5,122			
Transfer bins		4,350	5,408	6,028
Recycling	*26,037*	*27,256*	*25,825*	*28,812*
Batteries		20	25	36
Domestic drop off		242	225	224
Drop off	147			
Ewaste		94	65	50
Gas bottles	9	9	17	14
Greenwaste	2,853			
Hazardous waste	26			
Hazardous waste (other)		6	9	10
Hazardous waste (paint)		20	30	37
Matthews metal	844			
Matthews MM Ewaste	73			
Mattresses	160			
Mattresses (PM,W,D)		210	77	254
Oil		4	21	12

[9] Contaminated soil in the 2013-14 period was excluded for modelling purposes as this was specific to a construction project at the time, with no future loads of contaminated soil expected in the near future. The tonnages under the codes 'Processed waste (MRF/ORRF)' and 'Processed waste (MSW/MRF/ORRF)' were split between the residential and C&I sectors according to each sector's proportion to the contribution of incoming waste into the MRF and ORRF. The 'Kerbside junk & dumping' code was assigned to the residential sector as the proportion of illegal dumping tonnages was unknown.

Oil (estimate)	2			
PMHC Domestic orgs	11,960	10,746	10,462	12,446
PMHC domestic recycling	8,717			
PMHC kerbside recycling		8,453	8,425	8,788
Scrap metal		700	585	1,373
Sharps	1	0	0	1
Transfer mulch	1,201	6,689	5,836	5,521
Tyres	45	61	48	46
Other MSW	**7,121**	**8,493**	**8,426**	**9,154**
Landfill		*1,412*	*914*	*1,176*
Council litter collection		1,412	914	1,176
Recycling	*7,121*	*7,081*	*7,511*	*7,979*
Biosolids	7,121	7,081	7,511	7,979
C&I	**23,954**	**21,746**	**18,762**	**19,662**
Landfill	*19,635*	*18,103*	*15,396*	*15,792*
C&I mixed waste	13,298	16,062	14,909	15,186
Community group (charity) waste		1,745	225	312
Community group waste	291			
Processed waste (MRF/ORRF)		296	262	293
Processed waste (MSW/ORRF/MRF)	6,046			
Recycling	*4,318*	*3,643*	*3,366*	*3,870*
C&I processed out	113			
C&I recovered		197	66	
C&I recycling		2,459	2,616	3,068
Commercial organics	1,134	984	683	800
DrumMuster	357	4	0	2
General C&I recycling	2,715			
C&D	**14,931**	**13,172**	**10,537**	**11,860**
Landfill	*4,931*	*3,172*	*3,830*	*1,860*
Asbestos	376	610	*3,293*[10]	715
C&D all	2,628	1,967	299	988
Clean fill	775	596	238	156

[10] This was Naturally Occurring Asbestos and was excluded from the analysis as it was an atypical waste stream and would skew the averages.

Contaminated soil			*14,155 t*[11]	
Road material	1,152			
Recycling	*10,000*	*10,000*	*10,000*	*10,000*
Port Macquarie concrete	10,000			
Concrete and masonry recycling		10,000	10,000	10,000

Table 8 – Historical tonnages, by source, 2011-12 to 2014-15[12]

Tonnages	2011-12	2012-13	2013-14	2014-15
Generated				
Residential	43,217	48,203	46,781	51,169
Other MSW	7,121	8,493	8,426	9,154
C&I	23,954	21,746	18,762	19,662
C&D	14,931	13,172	10,537	11,860
Disposed				
Residential	17,180	20,947	20,956	22,357
Other MSW	-	1,412	914	1,176
C&I	19,635	18,103	15,396	15,792
C&D	4,931	3,172	537	1,860
Recycled				
Residential	26,037	27,256	25,825	28,812
Other MSW	7,121	7,081	7,511	7,979
C&I	4,318	3,643	3,366	3,870
C&D	10,000	10,000	10,000	10,000
Outside LGA	4,220	7,168	5,134	5,325

[11] The contaminated soil was excluded from the analysis as it was an atypical waste stream and would skew the averages.

[12] Data sourced from tonnage spreadsheets provided by PMHC. 58t disposed in 2012-13 from Kempsey was excluded. 14,155 t of contaminated soil and 3,293 t of asbestos disposed in 2013-14 were excluded, as these were atypical quantities.

Table 9 – Historical tonnage data, tonnes per capita[13]

Tonnes / capita	2011-12	2012-13	2013-14	2014-15	Used for modelling purposes (as 2014-15 data)
Generated					
Residential	0.57	0.63	0.61	0.66	0.63
Other MSW	0.09	0.11	0.11	0.12	0.11
C&I	0.32	0.29	0.24	0.25	0.26
C&D	0.20	0.17	0.14	0.15	0.16
Disposed					
Residential	0.23	0.27	0.27	0.29	0.28
Other MSW	-	0.02	0.01	0.02	0.02
C&I	0.26	0.24	0.20	0.20	0.21
C&D	0.07	0.04	0.01	0.02	0.03

Diversion rates

Table 10 - Historical diversion rates, by source, 2014-15[14]

Tonnages	2011-12	2012-13	2013-14	2014-15	Used for modelling purposes (as 2014-15 data)
Diversion Rate					
Residential	60%	57%	55%	56%	56%
Other MSW	100%	83%	89%	87%	87%
C&I	18%	17%	18%	20%	18%
C&D	67%	76%	95%	84%	81%

[13] The data used for modelling purposes for all streams, except for C&D, is an average of the periods 2012-13, 2013-14 and 2014-15. The 2011-12 data was excluded due to data anomalies arising from a materials recovery trial during that period. The C&D stream uses 2011-12, 2012-13, 2013-14 and 2014-15, as the C&D stream was not affected by the materials recovery trial.

[14] Diversion rates used for modelling purposes for the Other MSW and C&I streams were the averages across the periods 2012-13, 2013-14 and 2014-15 (see footnote above; the residential diversion rate utilised the 2014-15 diversion rate (considering that additional recovery through the FOGO collection was achieved in this period); the C&D stream used the average across 2011-12, 2012-13, 2013-14 and 2014-15. Note that the residential diversion rate here includes kerbside collections, clean-up and drop-off material.

All PMHC waste	57%	53%	53%	55%	54%

Table 11 - Scenario diversion rates - total PMHC waste[15]

Scenario	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022 onwards
1	54%	54%	54%	54%	54%	54%	54%	54%
2	55%	56%	57%	58%	59%	60%	61%	61%
3	57%	60%	63%	66%	69%	71%	75%	75%
4	57%	58%	59%	59%	60%	61%	61%	61%
5	57%	58%	59%	59%	60%	61%	61%	61%

Table 12 - Scenario diversion rates – residential waste[16]

Scenario	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022 onwards
1	56%	56%	56%	56%	56%	56%	56%	56%
2	58%	60%	62%	64%	66%	68%	70%	70%
3	60%	63%	66%	70%	73%	76%	81%	81%
4	61%	61%	61%	61%	61%	61%	61%	61%
5	61%	61%	61%	61%	61%	61%	61%	61%

Table 13 - Scenario diversion rates - Other MSW waste

Scenario	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022 onwards
1	87%	87%	87%	87%	87%	87%	87%	87%
2	87%	87%	87%	87%	87%	87%	87%	87%
3	87%	87%	87%	87%	87%	87%	87%	87%
4	87%	87%	87%	87%	87%	87%	87%	87%
5	87%	87%	87%	87%	87%	87%	87%	87%

[15] Scenario 3 – diversion rate assumed to increase linearly between 2014-15 and 2021-22.

[16] For Scenario 3, assumed that the Residential diversion rate was the balance to achieve 75% diversion across all streams by 2021-22 (based on Other MSW diversion rate not changing; the C&D diversion rate increasing from 81% to 85% by 2021-22; and the C&I diversion rate increasing from 18% to 50% by 2021-22).The residential diversion rate for Scenario 4 assumed that the kerbside diversion rate was increased from 69.5% to 75% through further embedding of the FOGO collection, while diversion of other residential streams (clean-up and drop-off materials) remained steady.

Table 14 - Scenario diversion rates - C&I waste[17]

Scenario	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022 onwards
1	18%	18%	18%	18%	18%	18%	18%	18%
2	18%	18%	18%	18%	18%	18%	18%	18%
3	23%	27%	32%	36%	41%	45%	50%	50%
4	21%	24%	28%	31%	34%	37%	40%	40%
5	21%	24%	28%	31%	34%	37%	40%	40%

Table 15 - Scenario diversion rates - C&D waste[18]

Scenario	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022 onwards
1	81%	81%	81%	81%	81%	81%	81%	81%
2	81%	81%	81%	81%	81%	81%	81%	81%
3	81%	82%	82%	83%	84%	84%	85%	85%
4	81%	81%	81%	81%	81%	81%	81%	81%
5	81%	81%	81%	81%	81%	81%	81%	81%

[17] Scenarios 3, 4 and 5 - diversion rate assumed to increase linearly between 2014-15 and 2021-22.

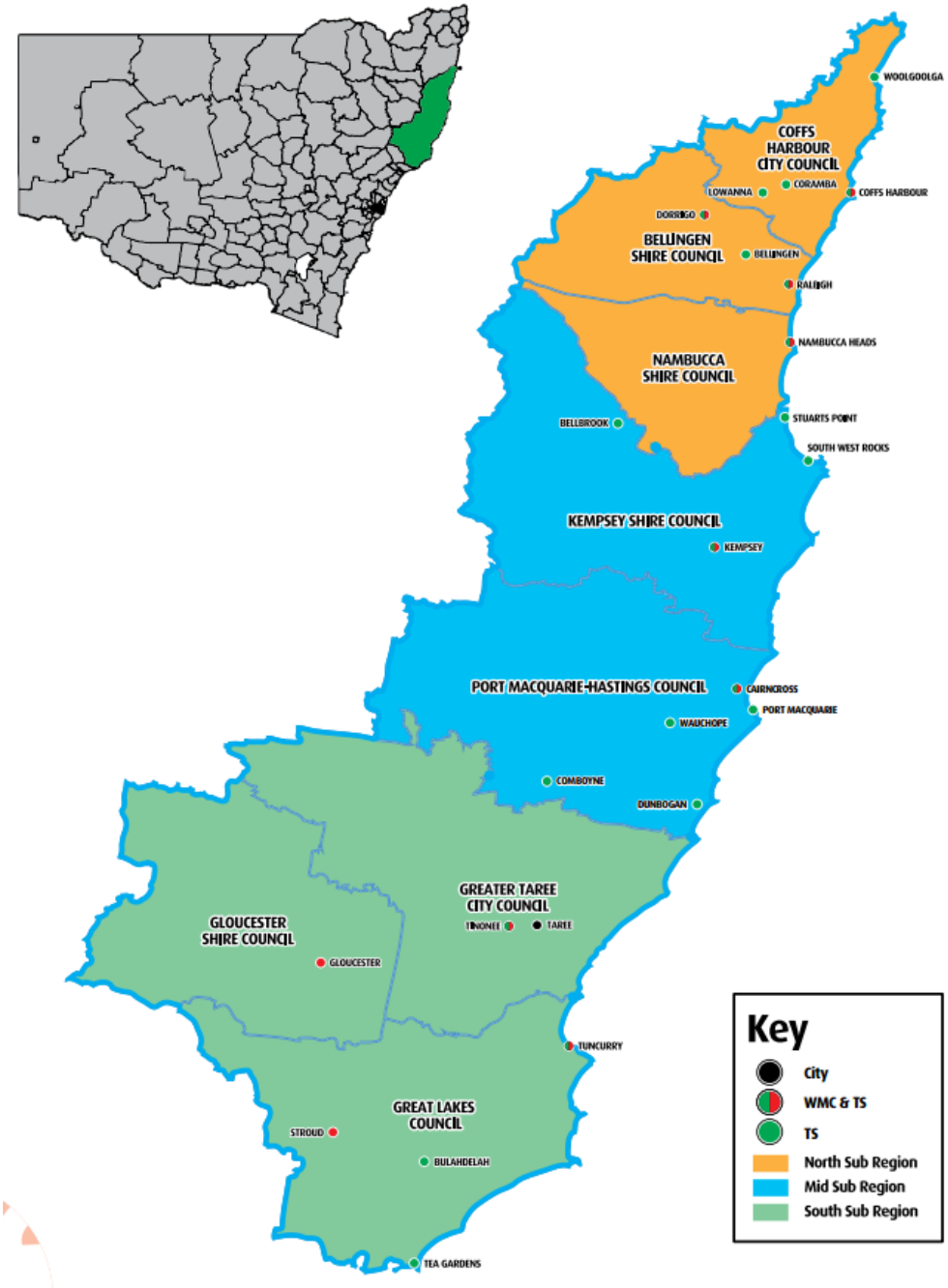
[18] Scenario 3 - diversion rate assumed to increase linearly between 2014-15 and 2021-22.

Regional context

When considering future disposal requirements at Cairncross WMF, the disposal needs of the region were taken into account.

PMHC is part of the Midwaste group of councils (a regional alliance of councils focusing on waste avoidance and minimisation), which is shown in Figure 4. The closest large regional centre to the west of PMHC is Tamworth, approximately 270km away, hence the analysis focused on the coastal LGAs within the Midwaste region.

Figure 4 - The Midwaste group of councils
Image source: Midwaste Regional Waste Avoidance and Resource Recovery Strategy 2014-2021



Landfills in the Midwaste region are outlined in Table 16 (a search of the NSW EPA's environmental protection database confirmed that these landfills were the only licensed landfills in the region).

Utilising distances between town centres and neighbouring landfills (see Table 17), and estimated landfill lifespans, the following assumptions were made for the future regional use of regional landfills:

- It is very unlikely that Great Lakes Council (GLC) would need to use Cairncross WMF as it is in the process of constructing a new landfill at Minimbah.
- The recently released *Coffs Coast Region Resource Recovery and Waste Management Strategy 2015-2017* (which incorporates Coffs Harbour, Nambucca and Bellingen councils) lists as a key action to secure enough landfill capacity for the next 50 years, including looking at expanding existing landfills, securing a new regional landfill, or the transfer of waste out of the Coffs Coast Region. Should the Coffs Coast councils decide to transfer waste out of their region, it is unlikely they would send their waste to Cairncross WMF as there are closer potential options (such as Grafton or Kempsey).
- Greater Taree City Council (GTCC) has around 20 years life remaining in its landfill, and Cairncross WMF is close enough to be a disposal option for this council (although Minimbah Landfill is closer).
- Kempsey Shire Council (KSC) has nearly 30 years' life remaining in its landfill, and Cairncross WMF is close enough to be a disposal option, should it be required.
- Gloucester Shire Council (GSC) may require a disposal alternative in approximately 25 years, however it is more likely to use Great Lakes' Minimbah Landfill which is much closer than Cairncross WMF.

Table 16 - Landfills in the Midwaste region, outside PMHC[19]

Landfill Facility	LGA	Type	Estimated Remaining Lifespan	Licensed Filling Rate
Buckets Way Waste Management Centre	Greater Taree City Council	Putrescible and non-putrescible	20 years	30,000tpa (EPL no. 6262)
Thunderbolts Way Landfill	Gloucester Shire Council	Putrescible and non-putrescible	Minimal for current cell. Overall capacity for 20 to 25 years.	5,000tpa (EPL no. 13100)
Stroud Landfill	Great Lakes Council	Putrescible and non-putrescible	20 years	5,000tpa (EPL no. 13110)

[19] Kempsey and Bellingen landfill lifespans provided by the respective councils. Taree landfill lifespan supplied by the Midwaste Regional Coordinator. Nambucca landfill lifespan obtained from the *Draft Coffs Coast Region resource Recovery and Waste Management Strategy 2015-2027*. Great Lakes and Coffs Harbour landfill lifespans sourced from the respective councils' websites. Gloucester information from *Gloucester Shire Waste Strategy 2014-2018*.

Landfill Facility	LGA	Type	Estimated Remaining Lifespan	Licensed Filling Rate
Tuncurry Waste Management Centre	Great Lakes Council	Putrescible and non-putrescible	Minimal	40,000tpa (EPL no. 5951)
Minimbah Landfill	Great Lakes Council	Putrescible and non-putrescible	40 years	No limits on disposal in EPL (EPL no 12885)
Crescent Head Waste Management Centre	Kempsey Shire Council	Putrescible and non-putrescible	28 years	10,000 tpa (EPL no. 6269)
Raleigh Waste Management Facility	Bellingen Shire Council	Putrescible and non-putrescible	18 years	8,000tpa (EPL no. 5896)
Dorrigo Waste Management Facility	Bellingen Shire Council	Putrescible and non-putrescible	10 years	5,000tpa (EPL no. 13105)
Englands Road Landfill	Coffs Harbour City Council	Putrescible and non-putrescible	Minimal	No limits on disposal in EPL (EPL no. 6267)
Old Coast Road Landfill	Nambucca Shire Council	Putrescible and non-putrescible	20 years (plus potential expansion giving another 80 years)	20,000tpa (EPL no. 11386)

Table 17 - Road distances from Midwaste council regional centres to Cairncross WMF[20]

Council	Distance to Cairncross WMF
Bellingen	133km from Bellingen to Cairncross WMF
Coffs Harbour	145km from Coffs Harbour to Cairncross WMF
Great Lakes	113km from Forster to Cairncross WMF

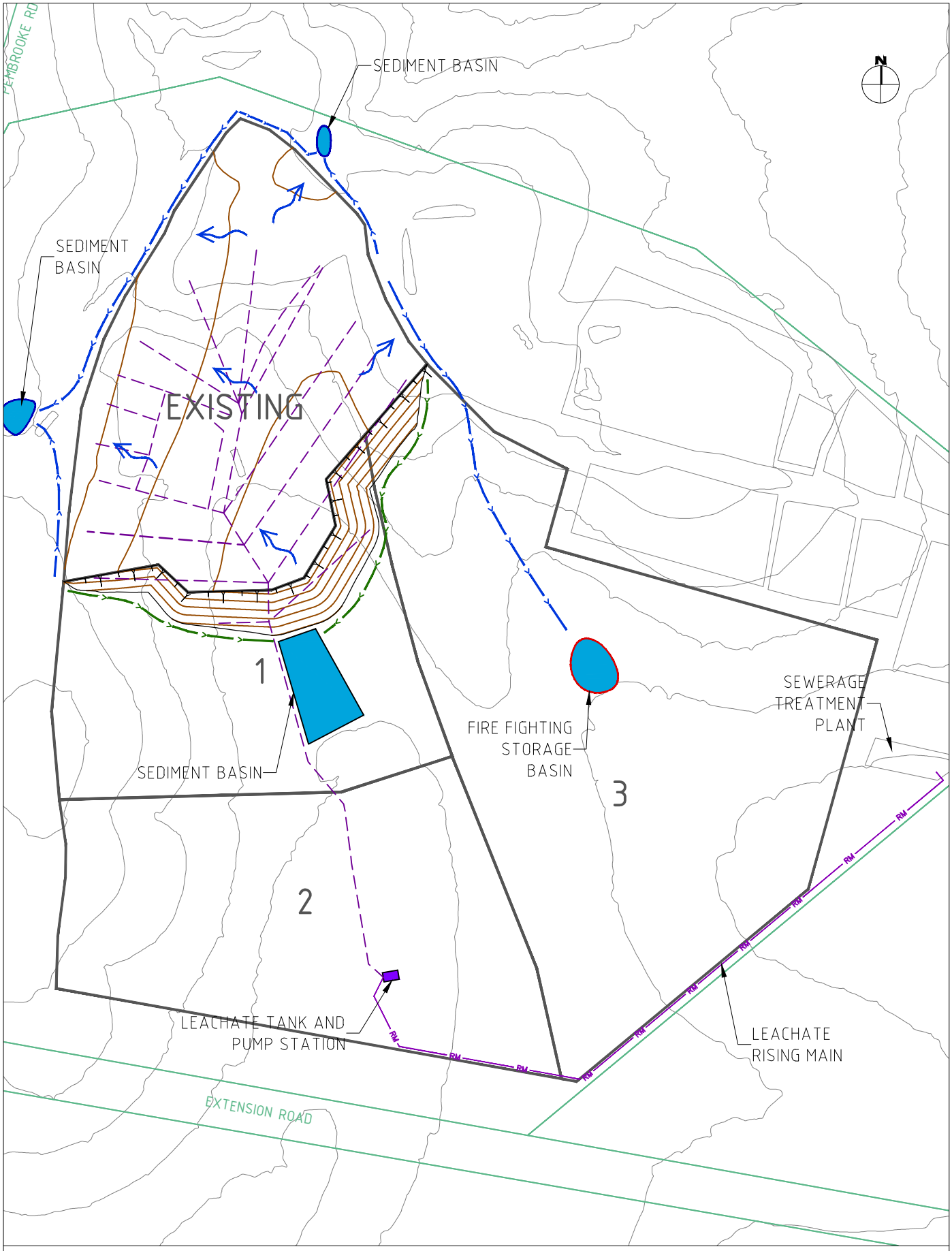
[20] Distances sourced from Google Maps.

Council	Distance to Cairncross WMF
Greater Taree	87km from Taree to Cairncross WMF 33km from Taree to Minimbah
Gloucester	156km from Gloucester to Cairncross WMF
Kempsey	37km from Kempsey to Cairncross WMF
Nambucca	100km from Nambucca Heads to Cairncross WMF

Of the Midwaste councils, GTCC is the most likely to potentially use Cairncross WMF within the next thirty years (without taking into account any of GTCC's future plans). For this reason, a scenario including GTCC was modelled (scenario 5).

APPENDIX A

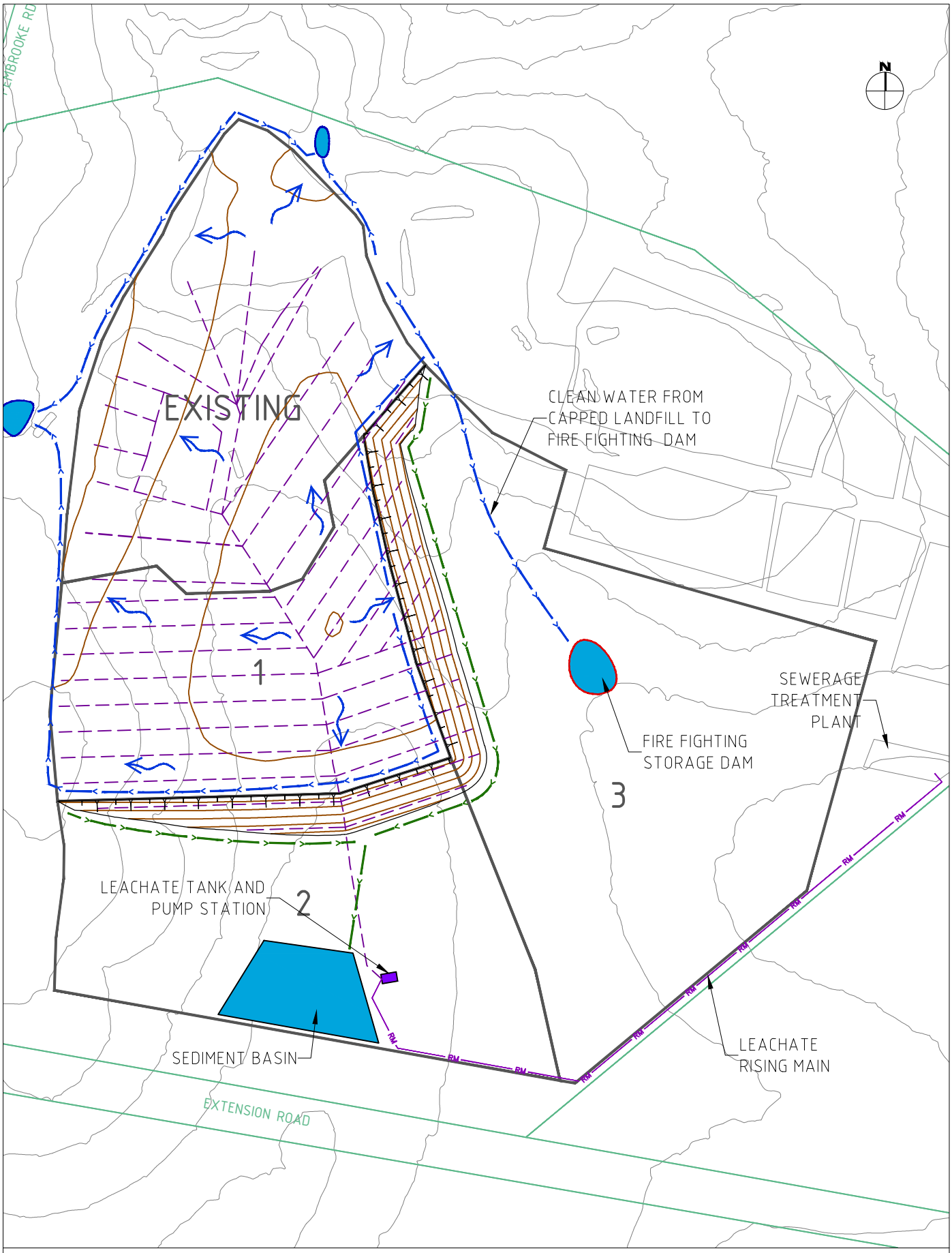
Landfill Staging Plan



PORT MACQUARIE HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE E (EXISTING)
CONCEPT PLAN

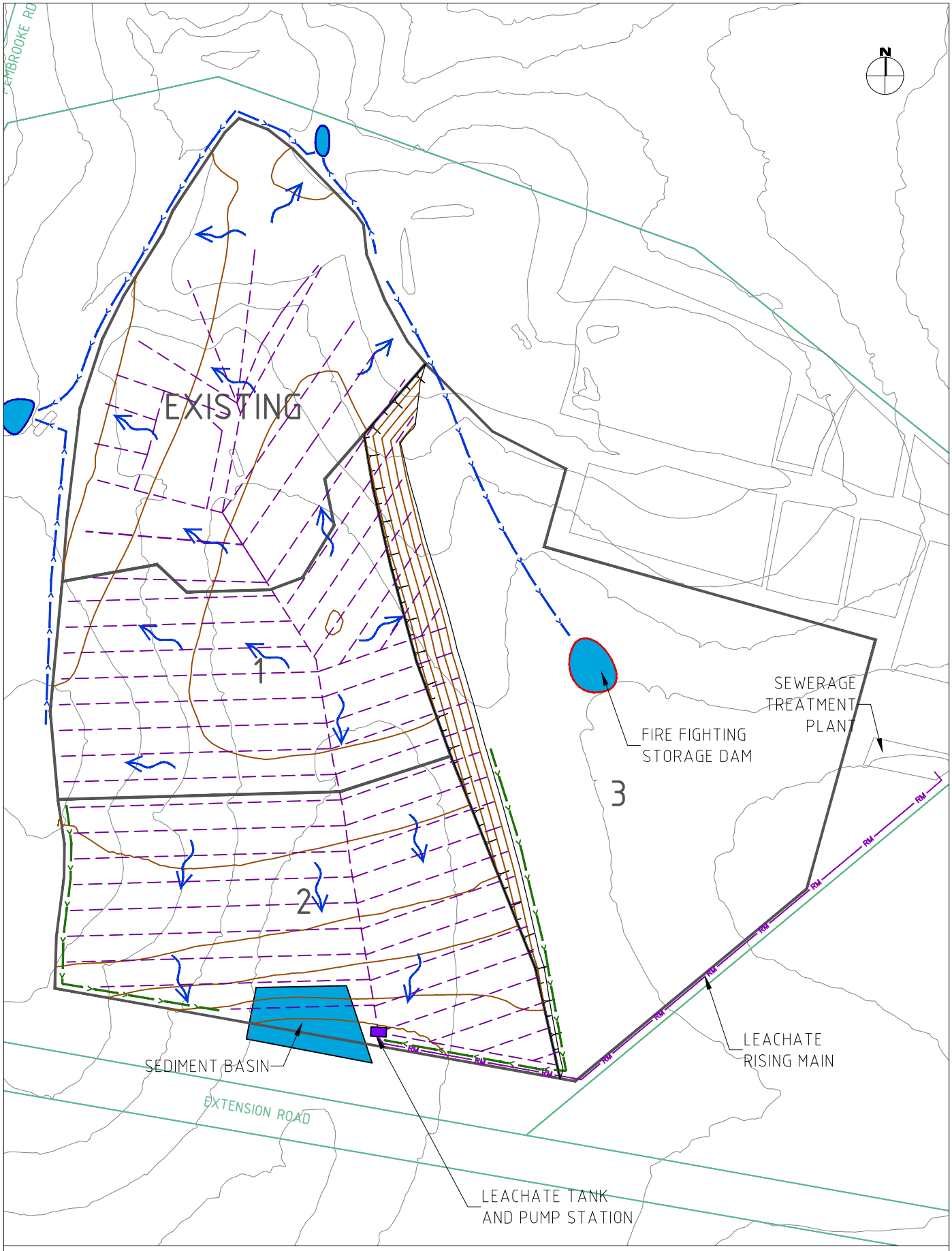
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PORT MACQUARIE
HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 1
CONCEPT PLAN

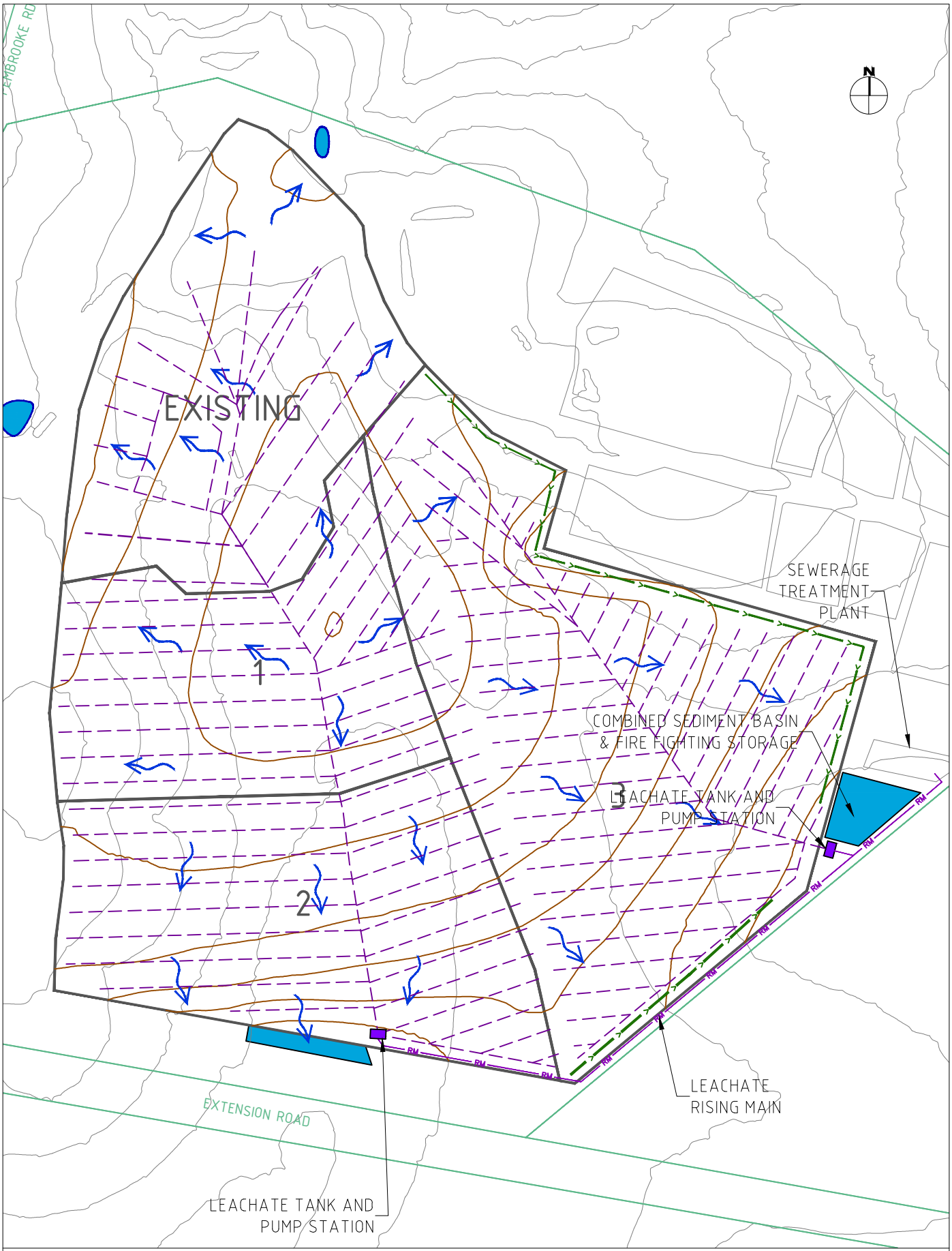
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PORT MACQUARIE
HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 2
CONCEPT PLAN

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SCALE (m)



PORT MACQUARIE
HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 3
CONCEPT PLAN

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SCALE (m)

ARCADIS Design & Consultancy for natural and built assets

APPENDIX D CAPITAL INVESTMENT VALUE QUANTITY SURVEYOR'S REPORT

WT PARTNERSHIP

wtpartnership.com.au

Mr Gordon Cameron (Principal Waste and Environmental Engineer)
Port Macquarie-Hastings Council
PO Box 84
Port Macquarie
NSW 2444

29 March 2017

Dear Mr Cameron,

CAIRNCROSS WASTE MANAGEMENT FACILITY
CAPITAL INVESTMENT VALUE QUANTITY SURVEYOR'S REPORT

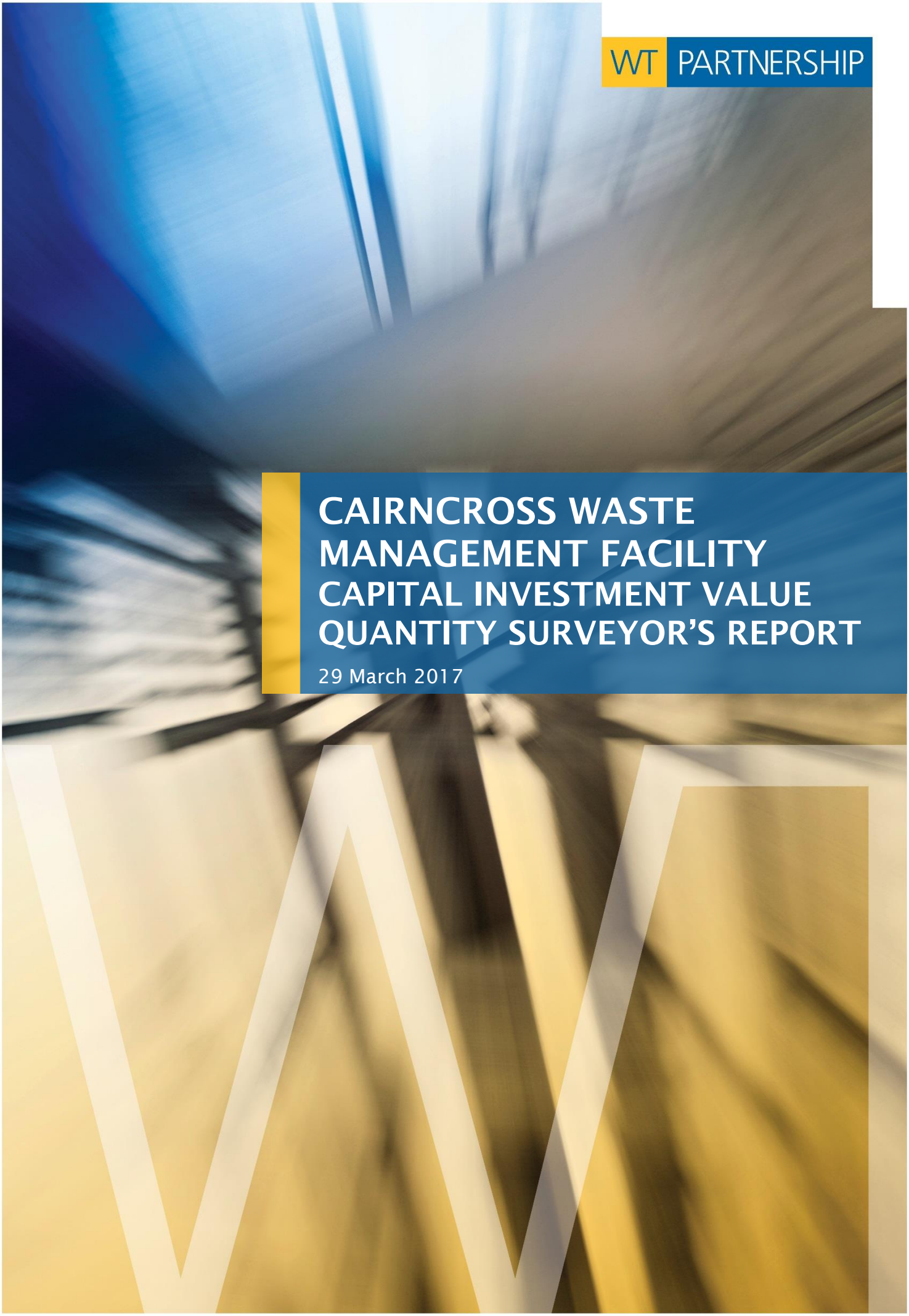
As requested WT Partnership has prepared a Capital Investment Value (CIV) Report for the works at the above and advise that the estimated CIV, for all stages, at rates current at March 2017 is $56,908,691.00 exclusive of GST.

We refer you to the attached report which provides an Executive Summary, Introduction, Main Summary of Costs together with Schedule of Information Used, Assumptions and Exclusions.

Should you require any further information or wish to discuss any aspect of the attached please do not hesitate to contact us.

Yours faithfully,
WT Partnership

KEVIN DAVIS
National Director
(kdavis@wtpartnership.com.au)



WT PARTNERSHIP

CAIRNCROSS WASTE MANAGEMENT FACILITY CAPITAL INVESTMENT VALUE QUANTITY SURVEYOR'S REPORT

29 March 2017

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3	CIV CALCULATION	6
4	ASSUMPTIONS AND/OR EXCLUSIONS	7
5	EMPLOYMENT/JOBS	7

APPENDIX A COST PLAN

1 EXECUTIVE SUMMARY

As requested WT Partnership (WTP) has prepared this Capital Investment Value (CIV) of the project in accordance with the definition contained in the State Environmental Planning Policy (Major Development) 2005. Under this policy, the CIV has the same meaning as in the Environmental Planning Assessment Regulation 2000 amended 7 May 2010 to the following

Capital investment value of a development or project includes all costs necessary to establish and operate the project, including the design and construction of buildings, structures, associated infrastructure and fixed or mobile plant and equipment, other than the following costs:

a) amounts payable, or the cost of land dedicated or any other benefit provided, under a condition imposed under Division 6 or 6A of Part 4 of the Environmental Planning and Assessment Act or a planning agreement under that Division

b) costs relating to any part of the development or project that is the subject of a separate development consent or project approval

c) land costs (including any costs of marketing and selling land)

d) GST (as defined by A New Tax System (Goods and Services Tax) Act 1999 of the Commonwealth).

Based upon the above definition we estimate the CIV for the project to be $56,908,691, excluding GST, as summarised below

	$
STAGE 1	12,172,049
STAGE 2	13,771,727
STAGE 3	26,565,673
SUB TOTAL	52,509,449
DESIGN FEES	4,200,756
LONG SERVICE LEVY	198,486
TOTAL (EXCL GST)	56,908,691

We estimate the number of jobs created by the project to be 8 no. noting that permanent operating staff will also be engaged in the construction of the facility on an ongoing basis.

2 INTRODUCTION

Port Macquarie-Hastings Council (PMHC) proposes to expand the existing landfill (Cairncross Landfill) at the Cairncross Waste Management Facility (WMF), located at 8395 Pacific Highway, Telegraph Point, NSW on Lot 1 / DP 1202080. PMHC is seeking development approval to extend Cairncross Landfill to cover the remaining area identified for landfilling in the Environmental Impact Statement (EIS) that was prepared by ERM in 1999 to support the development application for the first stage of the landfill (the 1999 EIS).

The proposal would involve the progressive construction, operation and rehabilitation of three landfill stages (Stages 1-3), following a staged approach with implementation over approximately 36 years. Stage 1 would commence construction/operation in approximately 2019/2020 respectively and Stage 3 would reach capacity in approximately 2056 with a landfill closure period to follow.

The proposal site is located south-west of Telegraph Point, approximately 2 kms west of the Pacific Highway. The proposal site covers an area of approximately 40.2 ha (including the landfill and ancillary areas such as access roads and a biodiversity corridor) and is owned by PMHC. The proposal site is within the broader Cairncross WMF which is bordered by the Rawdon Creek Nature Reserve to the south-east, by Cairncross State Forest to the north and south and by farmland to the west.

The Proposal will receive waste from all areas within the Port Macquarie-Hastings local government area (LGA) including the major townships of Port Macquarie, Wauchope and Camden Haven. Waste will include general solid waste (i.e. putrescible and non-putrescible materials) and asbestos from domestic and commercial and industrial (C&I) sources.

The key works for which approval is sought include:

- Progressive landfill cell construction, operation and rehabilitation of three landfill stages (Stages 1-3)
- Clearing of 3.4 ha of existing vegetation
- Construction of access tracks
- Earthworks for cell formation including extraction and stockpiling of materials and the reapplication to form the leachate barrier (cell liner) as well as for daily, intermediate and final cover
- Installation of leachate management structures including the leachate barrier, collection, storage and disposal system
- Construction of a rising main to transfer leachate to the adjacent sewerage treatment plant
- Installation of a stormwater management system
- Progressively increasing the annual waste acceptance rate at the landfill
- Signage and other ancillary works
- Rehabilitation of closed cells
- Delineation and ongoing management of an approximately 50 m wide Koala connectivity corridor around the south-western border of the site.

3 CIV CALCULATION

The CIV estimate is summarised in the table below.

REF	ELEMENT	STAGE 1	STAGE 2	STAGE 3	TOTAL
E	Site Preparation and Earthworks	3,753,204	3,749,888	8,961,478	16,464,570
L	Leachate Management	5,554,395	7,118,030	11,487,455	24,159,880
D	Drainage	183,600	72,000	231,000	486,600
C	Capping	1,233,902	1,206,267	2,871,418	5,311,587
O	Other	142,800	150,000	168,000	460,800
P	Preliminaries & Margin	1,304,148	1,475,542	2,846,322	5,626,012
	Sub total	**12,172,049**	**13,771,727**	**26,565,673**	**52,509,450**
	Design Fees	973,764	1,101,738	2,125,254	4,200,756
	Long Service Levy	46,010	52,057	100,418	198,486
	TOTAL (excl GST)	**13,191,823**	**14,925,523**	**28,791,345**	**56,908,691**

The full cost plan can be found in Appendix A.

4 ASSUMPTIONS AND/OR EXCLUSIONS

The CIV estimate is subject to the following assumptions and exclusions in accordance with the NSW Government Planning Circular, PS 10-008, *New definition of capital investment*, issued 10 May 2010.

ASSUMPTIONS

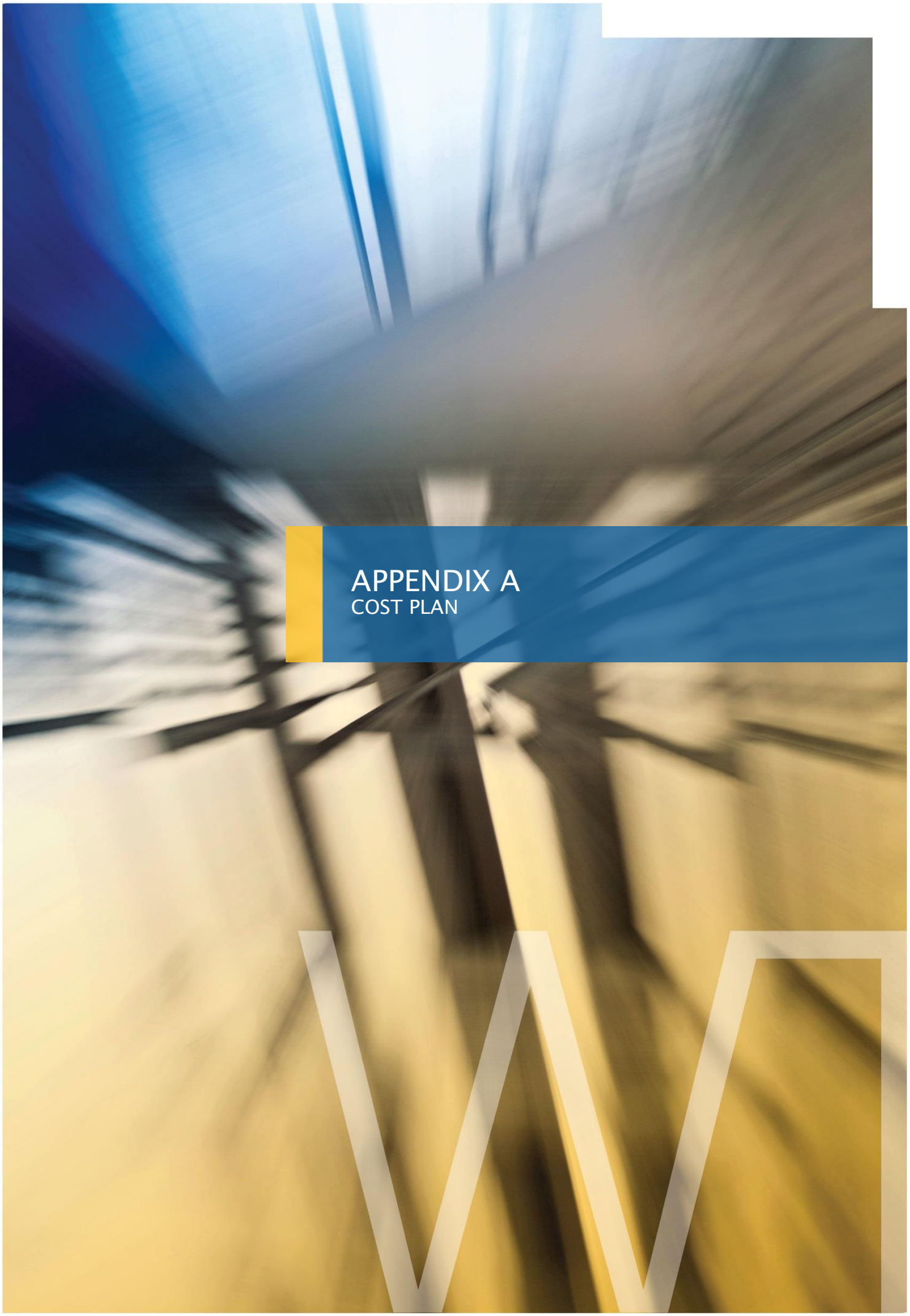
- We have relied on quantification prepared by Port Macquarie – Hastings Council. Where we were able, these quantities have been checked and we are satisfied that our quantities are within a reasonable tolerance of those provided.
- We have relied on historical data provided by Port Macquarie – Hastings Council in respect of the estimate of jobs created by the development.
- We have made allowance for relocation of the leachate tank and pump station within Stage 2.
- Excavated material retained on site.
- The base date for the estimate is March 2017.
- Allowance made for Preliminaries and Margin.
- Long service levy calculated at 0.35%.

EXCLUSIONS

- Goods and Service Tax (GST)
- Disposal off site of surplus excavated material
- Escalation beyond March 2017
- Project Management fees
- Development Application and Construction Certificate fees
- Land costs
- Finance costs
- Authority fees and charges

5 EMPLOYMENT/JOBS

We estimate the number of jobs created by the project to be 8 no. noting that permanent operating staff will also be engaged in the construction of the facility on an ongoing basis.



APPENDIX A
COST PLAN

BILL OF QUANTITIES/ COST ESTIMATE
CAIRNCROSS LANDFILL
STAGE 1

CAPEX

ITEM	DESCRIPTION	RATE	UNIT	UNIT	QUANTITY	TOTAL
Site Preparation and Earthworks						**$ 3,753,204**
E1	Vegetation and tree removal	$ 2.00	m^2	m^2	71,453	$ 142,906
E2	Topsoil stripping to stockpile	$ 8.00	m^3	m^3	23,836	$ 190,688
E3	Clay excavation to stockpile	$ 12.00	m^3	m^3	211,215	$ 2,534,580
E4	Clay excavate and recompact for leachate barrier	$ 10.00	m^2	m^2	79,453	$ 794,530
E5	Supply, place and compact sub-base DGS40 for access tracks	$ 90.00	m^3	m^3	450	$ 40,500
E6	Erosion and sediment control	$ 50,000.00	item	item	1	$ 50,000
E7	Disposal of surplus material		item	item	1	excluded
Leachate Management						**$ 5,554,395**
L1	Construct leachate collection gravel layer	$ 65.00	m^2	m^2	79,453	$ 5,164,445
L2	Construct leachate drainage lines including trenches	$ 50.00	m	m	4,239	$ 211,950
L3	Construct leachate pits at junctions	$ 2,000.00	ea	ea	14	$ 28,000
L4	Construct leachate storage tanks, pumpstation, gravity mains & rising mains	$ 150,000.00	item	item	1	$ 150,000
Drainage						**$ 183,600**
D1	Sediment basin vegetation clearing	$ 2.00	m^2	m^2	10,000	$ 20,000
D2	Sediment basin earthworks	$ 12.00	m^3	m^3	7,800	$ 93,600
D3	Sediment basin ancillary infrastructure	$ 20,000.00	item	item	1	$ 20,000
D4	Allowance for construction of table drains, culverts and scour	$ 50,000.00	item	item	1	$ 50,000
Capping						**$ 1,233,902**
C1	Construct 300mm thick clay seal bearing surface	$ 10.00	m^3	m^3	21,436	$ 214,359
C2	Construct 600mm thick clay sealing layer	$ 10.00	m^3	m^3	42,872	$ 428,718
C3	Construct 700mm thick clay revegetation layer	$ 8.00	m^3	m^3	50,017	$ 400,137
C4	Construct 300mm thick topsoil revegetation layer	$ 8.00	m^3	m^3	23,836	$ 190,688
Other						**$ 142,800**
O1	Fencing	$ 90.00	m	m	920	$ 82,800
O2	Air monitoring	$ 50,000.00	item	item	1	$ 50,000
O3	PPE	$ 10,000.00	item	item	1	$ 10,000
Preliminaries & Margin						**$ 1,304,148**
P1	Allowance		item	12%	920	$ 1,304,148
	Sub total					**$ 12,172,049**
	Design Fees					**$ 973,764**
	Long Service Levy					**$ 46,010**
	TOTAL (excl GST)					**$ 13,191,823**

BILL OF QUANTITIES/ COST ESTIMATE
CAIRNCROSS LANDFILL
STAGE 2

CAPEX

ITEM	DESCRIPTION	RATE	UNIT	UNIT	QUANTITY	TOTAL
Site Preparation and Earthworks						**$ 3,749,888**
E1	Vegetation and tree removal	$ 2.00	m^2	m^2	93,992	$ 187,984
E2	Topsoil stripping to stockpile	$ 8.00	m^3	m^3	31,198	$ 249,584
E3	Clay excavation to stockpile	$ 12.00	m^3	m^3	181,825	$ 2,181,900
E4	Clay excavate and recompact for leachate barrier	$ 10.00	m^2	m^2	103,992	$ 1,039,920
E5	Supply, place and compact sub-base DGS40 for access tracks	$ 90.00	m^3	m^3	450	$ 40,500
E6	Erosion and sediment control	$ 50,000.00	item	item	1	$ 50,000
E7	Disposal of surplus material		item	item	1	excluded
Leachate Management						**$ 7,118,030**
L1	Construct leachate collection gravel layer	$ 65.00	m^2	m^2	103,992	$ 6,759,480
L2	Construct leachate drainage lines including trenches	$ 50.00	m	m	3,731	$ 186,550
L3	Construct leachate pits at junctions	$ 2,000.00	ea	ea	11	$ 22,000
L4	Construct leachate storage tanks, pumpstation, gravity mains & rising mains	$ 150,000.00	item	item	1	$ 150,000
Drainage						**$ 72,000**
D2	Sediment basin earthworks to reduce volume	$ 12.00	m^3	m^3	1,000	$ 12,000
D3	Sediment basin upgrade infrastructure	$ 10,000.00	item	item	1	$ 10,000
D4	Allowance for construction of table drains, culverts and scour	$ 50,000.00	item	item	1	$ 50,000
Capping						**$ 1,206,267**
C1	Construct 300mm thick clay seal bearing surface	$ 10.00	m^3	m^3	31,198	$ 311,976
C2	Construct 600mm thick clay sealing layer	$ 10.00	m^3	m^3	6,235	$ 62,352
C3	Construct 700mm thick clay revegetation layer	$ 8.00	m^3	m^3	72,794	$ 582,355
C4	Construct 300mm thick topsoil revegetation layer	$ 8.00	m^3	m^3	31,198	$ 249,584
Other						**$ 150,000**
O1	Fencing	$ 90.00	m	m	1,000	$ 90,000
O2	Air monitoring	$ 50,000.00	item	item	1	$ 50,000
O3	PPE	$ 10,000.00	item	item	1	$ 10,000
Preliminaries & Margin						**$ 1,475,542**
P1	Allowance		item	12%	1,000	$ 1,475,542
	Sub total					**$ 13,771,727**
	Design Fees					**$ 1,101,738**
	Long Service Levy					**$ 52,057**
	TOTAL (excl GST)					**$ 14,925,523**

BILL OF QUANTITIES/ COST ESTIMATE
CAIRNCROSS LANDFILL
STAGE 3

CAPEX

ITEM	DESCRIPTION	RATE	UNIT	UNIT	QUANTITY	TOTAL
Site Preparation and Earthworks						**$ 8,961,478**
E1	Vegetation and tree removal	$ 2.00	m^2	m^2	160,497	$ 320,994
E2	Topsoil stripping to stockpile	$ 8.00	m^3	m^3	50,672	$ 405,376
E3	Clay excavation to stockpile	$ 12.00	m^3	m^3	536,274	$ 6,435,288
E4	Clay excavate and recompact for leachate barrier	$ 10.00	m^3	m^3	168,907	$ 1,689,070
E5	Supply, place and compact sub-base DGS40 for access tracks	$ 90.00	m^3	m^3	675	$ 60,750
E6	Erosion and sediment control	$ 50,000.00	item	item	1	$ 50,000
E7	Disposal of surplus material		item	item	1	excluded
Leachate Management						**$ 11,487,455**
L1	Construct leachate collection gravel layer	$ 65.00	m^2	m^2	168,907	$ 10,978,955
L2	Construct leachate drainage lines including trenches	$ 50.00	m	m	5,690	$ 284,500
L3	Construct leachate pits at junctions	$ 2,000.00	ea	ea	37	$ 74,000
L4	Construct leachate storage tanks, pumpstation, gravity mains & rising mains	$ 150,000.00	item	item	1	$ 150,000
Drainage						**$ 231,000**
D1	Sediment basin vegetation clearing	$ 2.00	m^2	m^2	13,000	$ 26,000
D2	Sediment basin earthworks	$ 12.00	m^3	m^3	10,000	$ 120,000
D3	Sediment basin ancilliary infrastructure	$ 20,000.00	item	item	1	$ 20,000
D4	Allowance for construction of table drains, culverts and scour	$ 65,000.00	item	item	1	$ 65,000
Capping						**$ 2,871,418**
C1	Construct 300mm thick clay seal bearing surface	$ 10.00	m^3	m^3	50,672	$ 506,721
C2	Construct 600mm thick clay sealing layer	$ 10.00	m^3	m^3	101,344	$ 1,013,442
C3	Construct 700mm thick clay revegetation layer	$ 8.00	m^3	m^3	118,235	$ 945,879
C4	Construct 300mm thick topsoil revegetation layer	$ 8.00	m^3	m^3	50,672	$ 405,376
Other						**$ 168,000**
O1	Fencing	$ 90.00	m	m	1,200	$ 108,000
O2	Air monitoring	$ 50,000.00	item	item	1	$ 50,000
O3	PPE	$ 10,000.00	item	item	1	$ 10,000
Preliminaries & Margin						**$ 2,846,322**
P1	Allowance		item	12%	1,200	$ 2,846,322
	Sub total					**$ 26,565,673**
	Design Fees					**$ 2,125,254**
	Long Service Levy					**$ 100,418**
	TOTAL (excl GST)					**$ 28,791,345**



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APPENDIX E ABORIGINAL AND NON-ABORIGINAL CULTURAL HERITAGE ASSESSMENT

CAIRNCROSS LANDFILL EXPANSION

PORT MACQUARIE-HASTINGS LGA, NSW MID-NORTH COAST

Aboriginal and Non-Aboriginal Cultural Heritage Assessment

December 2016

Prepared for:

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EXECUTIVE SUMMARY

Port Macquarie-Hastings Council (PMHC) proposes to expand the landfill at the Cairncross Waste Management Facility (CWMF), situated near Telegraph Point on the NSW mid-north coast. The proposal involves the staged development of three landfill cells covering approximately 35 hectares ('the project area'), and would extend the facility until approximately 2056. The proposal is a designated State Significant Development (SSD), and requires approval from the NSW Department of Planning and Environment under Part 4, Division 4.1 of the *EP&A Act 1979.*

This report was commissioned by Arcadis on behalf of PMHC, and forms the cultural heritage component of an EIS to be submitted in support of the development application. As per the Secretary's Environmental Assessment Requirements (SEARs) for the EIS, the report presents an assessment of both Aboriginal and non-Aboriginal cultural heritage. It also addresses recommendations made by the Office of Environment and Heritage (OEH) in relation to Aboriginal heritage concerns.

The project area is located in the sub-coastal hinterland, where it encompasses two ridge spurs separated by the heads of intervening drainage basins, based on erosional and residual soil landscape units with acid to strongly acid soils that are not conducive to the preservation of organic archaeological materials. The original vegetation was cleared to make way for hardwood forestry plantations established during the 1970s. The locality is devoid of rock outcrops that might have been used for Aboriginal occupation, art production, the construction of stone arrangements, tool grinding or quarrying.

Implementation of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* resulted in the registration of two Aboriginal parties (Birpai Local Aboriginal Land Council and the Dunghutti Elders Council Aboriginal Corporation). Consistent with cultural information disclosed for an assessment undertaken in 1998 prior to initial development of the CWMF, Aboriginal informants advised that the landfill expansion would not adversely affect any known sites, places or resources of traditional, historic or contemporary social/cultural attachment or significance.

There are three Aboriginal sites registered on the OEH Aboriginal Heritage Information Management System (AHIMS) within the project area: CWD 1, CWD 3 and CWD 4. CWD 1 was destroyed under a Consent to Destroy (with Salvage) issued to PMHC on the 5th of June 2000 (#N37/CDS/2000) under Section 90 of the *National Parks and Wildlife Act 1974*. CWD 3 and CWD 4 were recorded in 1998 as part of the investigations for the existing landfill. These sites together comprised four visible artefacts (all unmodified flakes), in a disturbed condition on and beside a forestry road, and were assessed to be of low scientific/archaeological significance. The present assessment found CWD 3 and CWD 4 to have been further disturbed by more recent road upgrading, with an absence of detectable artefacts either on the road, the road verges or adjacent clearings. These recent findings support the 1998 contention that sites CWD 3 and CWD 4 have limited archaeological potential and low scientific/archaeological significance. Nevertheless, the recorded CWD 3 and CWD 4 artefacts are expected to remain somewhere within each of the registered localities and would be destroyed by the proposed landfill expansion.

Background research and heritage register searches revealed that the project area was never developed in terms of the built or farming environments, and does not contain or encroach upon any non-Aboriginal heritage registered/listed sites, places or relics. However, the project area was traversed by an 'old road,' believed to have been constructed by Port Macquarie convicts in 1828. A past inspection failed to find any physical traces of this road on the CWMF property.

Field survey of the project area was conducted with nominated representatives of the registered Aboriginal parties (Birpai LALC sites officer Jason Holten and Dunghutti Elder Bob Mumbler) on the 13th of May and 20th of June 2016. Owing to negligible surface visibility and exposure within the forest, the survey focused on roads, trails and their immediately adjoining land, plus visual scanning to locate any 'old growth' trees and tree stumps with the potential for cultural marking. The AHIMS registered sites (CWD 1, CWD 3 and CWD 4) were also inspected. A follow-up inspection of the mapped historical 'old road' alignment was later undertaken by the consultant. No Aboriginal 'objects', non-Aboriginal 'relics' or potential archaeological deposits (PADs) were detected, either on or near sites CWD 1, CWD 3 and CWD 4, within the 'old road' corridor or elsewhere within the project area.

In light of all available evidence it is concluded that the project area has no potential for the survival of *in situ* Aboriginal artefacts or sub-surface archaeological deposits, but that some undetected small displaced/dispersed Aboriginal stone artefacts may well occur (such as those that may occur on sites CWD 3 and CWD 4). Given the extent and degree of the existing forestry disturbance, it is considered that sub-surface testing, more comprehensive sub-surface investigations, and/or monitoring of project earthworks would be highly unlikely to result in the detection/salvage of significant (if any) artefacts and that these management strategies are not warranted. It is also concluded that the project area has a negligible chance of containing significant (or indeed any) tangible non-Aboriginal relics, and that the proposed landfill expansion would not impact upon non-Aboriginal cultural heritage values.

On the basis of this assessment, and as endorsed by the Birpai LALC and the Dunghutti Elders, it is recommended that:

1) No further heritage investigation or development monitoring be required in conjunction with project approval.
   However, Recommendations 2 and 3 should be implemented as a precaution against harming cultural heritage materials.

2) Prior to their on-site involvement, all personnel engaged for tree clearing and topsoil stripping should undergo a general site induction that provides information on legal obligations with respect to Aboriginal objects and non-Aboriginal relics, including 'stop-work' conditions applicable in the event that any identified or suspected heritage objects/relics are discovered (see Recommendation 3).

3) In the event that any identified or suspected Aboriginal objects or historical relics are detected at any time, all disturbance work should immediately cease within 20m of the find and temporary protective fencing erected around this 'no-go zone' pending further management advice from the OEH (Planning and Aboriginal Heritage Section, North Coast Region). If the find consists of or includes human remains, the NSW Police Department and the OEH Environmental Line (ph 131 555) should also be notified as soon as practicable. Works may not recommence within the designated 'no-go zone' until formal written clearance to do so has been given by the OEH in consultation with the registered Aboriginal parties and the NSW Police Department (if applicable).

4) PMHC provide the OEH AHIMS Registrar with Aboriginal Site Impact Recording Forms for sites CWD 3 and CWD 4 once these sites are affected by the project. Even though an AHIP is not required for projects approved under Part 4 of the *EP&A Act 1979*, reporting on the location and condition of Aboriginal sites/objects remains a mandatory legal obligation.

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ABBREVIATIONS USED

AC	Aboriginal Corporation
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
CEO	Chief Executive Officer
CWD 1	AHIMS registered Aboriginal site #30-3-0238
CWD 2	AHIMS registered Aboriginal site #30-3-0239
CWD 3	AHIMS registered Aboriginal site #30-3-0241
CWD 4	AHIMS registered Aboriginal site #30-3-0242
CWMF	Cairncross Waste Management Facility
DA	Development Application
DECCW	Department of Environment, Climate Change and Water NSW (now OEH)
DPE	Department of Planning and Environment NSW
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
ESD	Ecologically sustainable development
LALC	Local Aboriginal Land Council
LGA	Local Government Area
NPW Act	*National Parks and Wildlife Act 1974*, as amended
NPWS	NSW National Parks and Wildlife Service
NTSCorp	Native Title Services Corporation NSW
OEH	Office of Environment and Heritage, Department of Premier and Cabinet NSW
PAD	Potential Archaeological Deposit
PMHC	Port Macquarie-Hastings Council
SEARs	Secretary's Environmental Assessment Requirements
SHR	NSW State Heritage Register
SSD	State Significant Development

1 INTRODUCTION

1.1 Background and purpose of this assessment

The Cairncross Waste Management Facility (CWMF) is zoned SP2 Infrastructure (Waste Management Facility) under Port Macquarie Hastings LEP 2011, and is the primary centre for waste operations overseen by Port Macquarie-Hastings Council (PMHC). The CWMF includes a landfill, waste transfer station, organics resource recovery facility and a material recovery facility. Following completion of a comprehensive EIS for the entire CWMF proposal (ERM Mitchell McCotter 1999), approval was granted for development of Stage 1 of the landfill (now referred to as the existing landfill or Stage E) and operations commenced in 2001.

PMHC is now seeking approval to extend the Cairncross Landfill to cover the remaining three landfill cells (Stages 1-3; Figure 2) identified in the 1999 EIS. The proposed landfill expansion is considered State Significant Development, and requires approval from the NSW Department of Planning and Environment (DPE) under Part 4, Division 4.1 of the *EP&A Act.*

This report was commissioned by Arcadis on behalf of PMHC, and forms the cultural heritage component of an updated EIS to be submitted in support of the landfill expansion DA. As per the Secretary's Environmental Assessment Requirements for the EIS (DPE 2015; Appendix A), the report presents an assessment of both Aboriginal and non-Aboriginal cultural heritage. The non-Aboriginal heritage component was guided by the *NSW Heritage Manual* (Department of Urban Affairs and Planning 1996) and more recent associated documents and guidelines. Consistent with recommendations made by the OEH in correspondence to the DPI (now DPE) in 2013 (Appendix B), the Aboriginal cultural heritage section of the report includes:

- Documentation as required by the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011).
- A description of how the requirements for consultation with Aboriginal people as specified in clause 80C of the *National Parks and Wildlife Regulation 2009* have been met.
- Details and results of a field survey undertaken with representatives of the registered Aboriginal parties.
- An assessment of the nature and extent of impacts on Aboriginal heritage significance values, and a description and justification for strategies proposed to avoid or minimise these impacts.
- An assessment of the proposed project impacts in the context of inter-generational equity and cumulative impact.

1.2 Project location and proposal

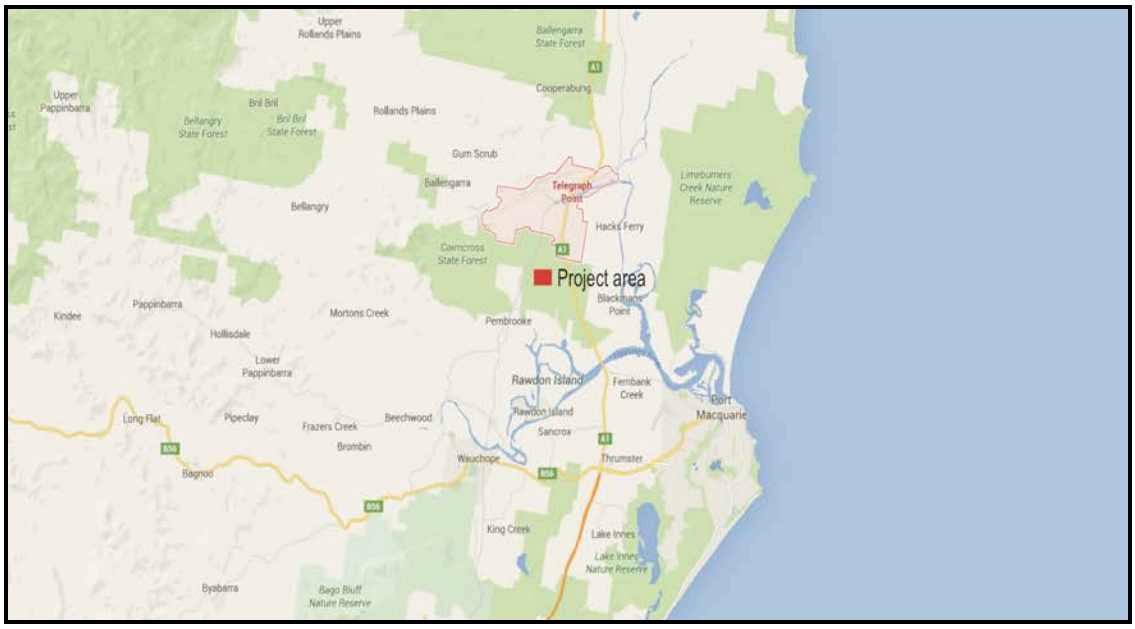


Figure 1. General location of the project area south of Telegraph Point (Source: Google map data 2016)

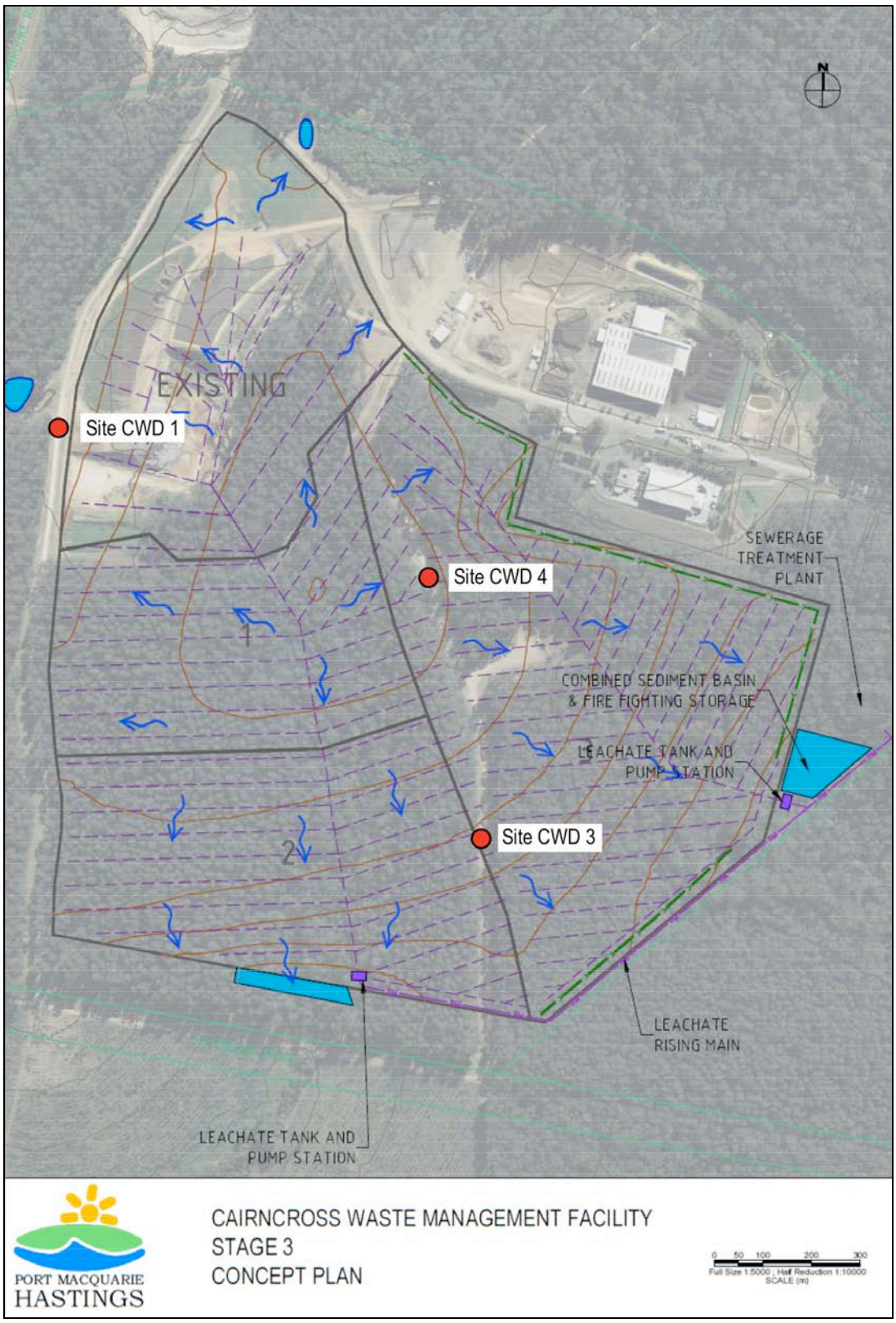


Figure 2. Project proposal and registered Aboriginal site locations (Proposal map source: PMHC 2016)

The proposed landfill expansion encompasses approximately 35ha of land within County Macquarie, Parish Cairncross ('the project area'), situated 13km inland of North Shore Beach, 15km north-west of Port Macquarie and approximately 4km south of the Wilson River Bridge at Telegraph Point on the NSW mid-north coast (Figure 1). The area is bounded by the existing landfill and other

approved CWMF operations to the north and north-east (Figure 2), Rawdon Creek Nature Reserve to the south-east, Extension Road/Cairncross State Forest to the south, and former NSW State Forest Trail 9.1 and thence compensatory habitat managed by PMHC to the west.

The proposal involves the progressive development, operation and rehabilitation of landfill cells (Stages 1-3) on an incremental, sub-stage basis and would require:

- Clearing of all vegetation.
- Construction of access tracks.
- Earthworks for cell formation, including removal of the topsoil overburden, which would be stockpiled for on-site reapplication.
- The installation of erosion/sediment controls, stormwater diversion drains, and a rising main connecting with a proposed adjacent sewage treatment plant.
- Fencing and signage as necessary.

It is anticipated that the Stage 1 landfill cell would operate from approximately 2020 to 2040, the Stage 2 landfill cell from 2040 to 2047, and the Stage 3 landfill cell from 2047 to 2056.

1.3 Assessment personnel

Background research, field survey and assessment was conducted by qualified cultural heritage consultant/archaeologist Jacqueline Collins (MAACAI), assisted and informed by Birpai Local Aboriginal Land Council senior sites officer Jason Holten and Dunghutti Elder Bob Mumbler. The report was written by Jacqueline Collins and was reviewed by the Birpai Local Aboriginal Land Council and the Dunghutti Elders Council Aboriginal Corporation prior to finalisation.

2 PRIMARY LEGISLATIVE CONTEXT AND COMPLIANCE

2.1 Environmental Planning and Assessment Act 1979

The *EP&A Act 1979* requires that environmental impacts, including impacts upon cultural heritage, are duly considered in landuse planning. Part 4 of the Act governs the manner in which consent authorities determine development applications and outlines those that require an EIS.

Under Part 4, Division 4.1 of the *EP&A Act,* a development may be declared a State Significant Development (SSD) if it meets certain criteria. The consent authority for a SSD is the Minister for Planning, but the Minister may delegate consent authority function to the Planning Assessment Commission, the DPE Secretary, or another public authority. An Aboriginal Heritage Impact Permit (AHIP) under section 90 the *NPW Act 1974*, or an approval under Part 4 or an Excavation Permit under section 139 of the *Heritage Act 1977* is not required for SSD that is authorised by a development consent. Neither does Part 6, Division 8 (ie controlling and restricting harm to buildings, works, relics and places not subject to interim heritage orders or State heritage listing) of the *Heritage Act 1977* apply (*EP&A Act*, section 89J). However, an EIS that fulfills the Secretary's Environmental Assessment Requirements (SEARs) needs to be submitted along with the development application. The management of heritage sites would follow identified mitigation measures and conditions of development approval.

The proposed landfill expansion constitutes a SSD. SEARs for the EIS were first provided to PMHC on the 14th of February 2013 and reissued on the 7th of May 2015, upon provision of an amended development description (application #SSD 13_5792). The SEARs require that both Aboriginal and non-Aboriginal heritage issues are addressed (Appendix A). In relation to the SEARs, the OEH recommended that "the proponent consider any potential impacts of the proposal on … known Aboriginal sites/objects, the sensitivity and significance of these sites to the traditional knowledge holders and any relationship that may exist between these sites and any Aboriginal cultural heritage values of the project area", and called for the implementation of a set of standard EIS requirements (Appendix B). Compliance with each aspect of the SEARs and OEH recommendations, as per information provided in this report, is outlined in Table 1.

Table 1. Compliance with the heritage components of the SEARs and OEH recommendations

Requirement		Section as addressed in this report
SEARs- Aboriginal heritage		4, 5, 7.2, 8.1, 9
SEARs- Non-Aboriginal heritage		6, 7.2, 8.2, 9
OEH	Address and document the information requirements set out in the draft *Guidelines for Aboriginal cultural heritage impact assessment and community consultation* (since superceded by the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*).	3, 4, 5, 7, 8.1, 9
	Surveys by suitably qualified archaeological consultants in consultation with all of the local Aboriginal knowledge holders.	7
	Identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area and clearly articulate strategies proposed to avoid/minimise these impacts. If impacts are proposed by the final development, provide clear justification for these impacts.	5.2, 5.3, 7.2, 8.1
	Assess and document the archaeological and Aboriginal significance of the site's Aboriginal cultural heritage values.	5.2, 8.1
	Describe actions that will be taken to avoid or mitigate impacts of the project on Aboriginal cultural heritage values, including an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented. Any methodology for Aboriginal cultural heritage investigation should reflect best practice standards recommended by the OEH in the *Code of practice for archaeological investigation of Aboriginal objects in NSW.*	8.1, 9
	Provide documentary evidence to demonstrate that effective Aboriginal community consultation has been undertaken in assessing impacts, developing protection and mitigation options and making final recommendations. OEH supports broad-based Aboriginal community consultation as per the *Aboriginal cultural heritage consultation requirements for proponents 2010*.	Appendix C, D, E, F, G, H, I, J
	If impacts on Aboriginal cultural heritage values are proposed as part of the final development, an assessment of the proposed impacts in the context of inter-generational equity and cumulative impact must be undertaken, including cultural and archaeological perspectives at the local and regional level.	8.1

2.2 National Parks and Wildlife Act 1974

The *NPW Act 1974* (as amended) is administered by the Office of Environment and Heritage (OEH), and forms the primary basis for the statutory protection and management of Aboriginal cultural heritage in NSW. Part 6 of the Act provides specific protection for Aboriginal objects and declared Aboriginal places by making it an offence to harm them unless authorised by a duly approved Aboriginal Heritage Impact Permit (AHIP). As per section 90(3) of the *National Parks and Wildlife Amendment Act 2010,* an AHIP "may be issued in relation to a specified Aboriginal object, Aboriginal place, land, activity or person or specified types or classes of Aboriginal objects, Aboriginal places, land, activities or persons."

The *NPW Act* defines an 'Aboriginal object' as-

> 'Any deposit, object or material evidence (that is not a handicraft made for sale) relating to Aboriginal habitation of NSW, before or during the occupation of that area by persons of non-Aboriginal extraction (and includes Aboriginal remains).'

The provisions of the Act apply to all Aboriginal objects, regardless of whether or not they have been registered with the OEH, or whether they occur on private or public land. Except where destruction of an Aboriginal object is or will be demonstrably unavoidable it is OEH policy to require conservation in its original location and context.

Places in the landscape of significance to Aboriginal people, which may be devoid of 'Aboriginal objects', can only be protected under the Act (section 84) via declaration as an Aboriginal place. For the purposes of the Act, an 'Aboriginal place' is defined as a place that-

> 'in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture'.

The *National Parks and Wildlife Amendment Act 2010* made some significant changes to the provisions of the *NPW Act 1974*, including the introduction of a 'strict liability' offence (section 86[2]) for instances where impacts to Aboriginal objects/places were not covered by an AHIP and objects/places were accidentally or otherwise unknowingly harmed.
It is a defence to prosecution under the Act if:

- the defendant can demonstrate that they exercised 'due diligence' to reasonably determine that no Aboriginal objects would be harmed; or
- any disturbance is prescribed by the *National Parks and Wildlife Amendment [Aboriginal Objects and Aboriginal Places] Regulation 2009* as a low impact act or omission (as listed and described in section 80B of the Regulation).

Under section 85A of the Act, the Director General of the Department of Premier and Cabinet may transfer Aboriginal objects to a person or organisation for safekeeping. The subject person or organisation must enter into a formal care agreement with the OEH, which sets out the obligations of the OEH and the person/organisation for the long-term safekeeping of the transferred object(s).

Whilst an AHIP is not required to authorise impacts to Aboriginal objects and places for projects approved under Part 4 of the *EP&A Act* (including the SSD subject of this report), there are other sections of the *NPW Act* that remain valid. These include the need to obtain a Care Agreement for salvaged objects (section 85A), and the need to report the location of Aboriginal objects to the OEH (section 89A). Although no Aboriginal objects requiring either a Care Agreement or new site registration were identified during the course of this assessment, the OEH Aboriginal Heritage Information Management System (AHIMS) Registrar has been provided with updated information for sites CWD 1 (#30-3-0238), CWD 3 (#30-3-0242) and CWD 4 (#30-32-0241) previously registered within the project area.

2.3 Heritage Act 1977

The *Heritage Act 1977* (as amended) is administered by the OEH, and is the primary statutory control in relation to non-Aboriginal cultural heritage in NSW. Section 31 of the Act provides that a State Heritage Register (SHR) is to be maintained by the Heritage Council of NSW. Under Part 4, section 57(1) a person must not harm a place, building, work, relic, moveable object, precinct, or land listed on the SHR without Heritage Council approval, but exemptions to this requirement can be granted by the Minister (section 57[2]). An on-line search (cf Section 6.2) revealed that the CWMF property does not contain items, precincts or land listed on the SHR.

Part 6, Division 9 of the *Heritage Act 1977* protects archaeological 'relics' from being "exposed, moved, damaged or destroyed" by the disturbance or excavation of land. This protection extends to instances where a person has reasonable cause to suspect that archaeological remains may be affected, and applies to all land in NSW that is not included on the SHR.

A 'relic' is defined by the *Heritage Act* as-

> 'Any deposit, object or material evidence which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and has local or state significance.'

Section 139 of the Act requires any person who knows or has reasonable cause to suspect that their proposed works would expose or disturb a 'relic' to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to section 140), unless there is an applicable exception (pursuant to section 139[4]).

Approval under Part 4 and Excavation Permits under section 139 of the *Heritage Act 1977* are not required for a project approved under Part 4, Division 4.1 of the *EP&A Act* (including the SSD subject of this report). Even so, the obligation to report the discovery of a relic remains operative, and an EIS must outline proposed heritage mitigation and management measures. However, no relics were identified during the course of this assessment, nor is it considered likely that undiscovered relics will occur within the project area.

2.4 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Act 1999* (as amended) is the Federal Government's central piece of environmental legislation, and protects heritage places of national significance as well as those under commonwealth ownership. This Act also provides protection to properties included on the World Heritage List. Recent amendments created the Commonwealth Heritage List and National Heritage List. Any actions likely to have a significant impact upon any listed items must be referred to the Department of Sustainability, Environment, Water, Population and Communities for consideration.

On-line searches (Section 6.2) revealed that the CWMF property does not contain or encroach upon sites, places or land listed on the World Heritage List, Commonwealth Heritage List or the National Heritage List.

3 ENVIRONMENT AND LANDUSE EFFECTS

3.1 General setting

The Wilson River is a major secondary tributary of the Hastings River, and flows into the Maria River just below the village of Telegraph Point. The Maria River then enters the Hastings at Blackmans Point some 7km south-east of the CWMF. The CWMF lies on a belt of undulating hill country sandwiched between the Wilson and Hastings Rivers. The undulating terrain extends for a considerable distance south and west, becoming more precipitous in the vicinity of Mount Cairncross, which rises to 536m AHD 8km inland of the project area. East of the nearby Pacific Highway, the Wilson and Maria River floodplains form extensive and often swampy alluvial and sand flats that stretch east to the coastal dune system.

The lower Hastings River catchment experiences a humid sub-tropical climate, characterised by relatively high summer and low winter/spring rainfalls. Average daily temperatures are conducive to year-round human occupation, and range from a maximum of 25.8º to a minimum of 17.0º Celsius in summer, and 17.8º to 7.1º Celsius in winter (ERM Mitchell McCotter 1999:5.2-5.5).

3.2 The project area

The project area falls within the 'coastal ranges' landsystem (Packard 1992) and includes the heads of two minor drainage basins, which direct stormwater runoff into Rawdon and Tommy Owens Creeks and thence the Hastings River at Freemans Bay 3.5km further south. These basins contain ephemeral water and form relatively broad, gently inclined valleys, separated by two ridge spurs that fall gradually southward from an elevation of 52m AHD on the ridge summit partially impacted by development of the existing CWMF, to Extension Road on the southern project boundary.

The project area straddles the erosional Euroka soil landscape unit (rolling low hills) and the residual Kundabung soil landscape unit (undulating rises with broad crests, extensive footslopes and drainage plains) (Atkinson 1999a). Both of these soil landscapes are based on Permian mudstones of the Kempsey and Beechwood Beds, which have decomposed to produce acid to strongly acid soils (Atkinson 1999b). The locality is devoid of rock outcrops that might have been used for Aboriginal occupation, art production, the construction of stone arrangements, tool grinding or quarrying. As reported by Collins (1998:13), natural stone is restricted to scattered angular fragments of disintegrating siltstone, small isolated mudstone, milky quartz and chert pebbles, and small quartz crystals.

Prior to transfer of ownership to PMHC, the project area comprised part of compartments 8 and 9 of Cairncross State Forest. The natural open dry sclerophyll forest (Atkinson 1999b:42) was cleared to make way for hardwood plantations established between 1974 and 1977 (Figure 5). It is understood that the clearing of plantation plots was undertaken by bulldozer (Collins 1998:26). The plantations have since been subject to logging (Appleton 1996a:8), burning and thinning (Milledge 1998), and now support an open understorey of shrubs, with a dense ground cover dominated by bladey grass, lomandra and bracken fern.



Plate 1. Western boundary road south (former forestry Trail 9.1)



Plate 2. Surface exposure on margin of western boundary road south (former forestry Trail 9.1)



Plate 3. Thurlings Road



Plate 4. Surface exposure on margin of Thurlings Road



Plate 5. Extension Road on southern project boundary



Plate 6. Northern boundary road



Plate 7. Surface exposure on margin of northern boundary road



Plate 8. Former forestry Trail 8.2

In addition to impacts sustained by establishment of the hardwood plantations and subsequent silviculture practices, the project area has been affected by the construction and maintenance of a number of former forestry roads/trails. These include a road on the western boundary of the existing and proposed Stage 1 and Stage 2 landfill cells (former forestry Trail 9.1; Plate 1), and Thurlings Road (Plate 3), which runs south through the proposed Stage 1 landfill and thence roughly between proposed landfill Stages 2 and 3. The western boundary road and Thurlings Road generally follow the crests of the ridge spurs. Other roads/trails on the northern (Plate 6) and southern project boundaries (Extension Road; Plate 5), and within the eastern section of the project area (former forestry Trail 8.2; Plate 8), traverse a cross-section of landforms. Surface exposures caused by recent disturbance occur beside the western boundary road (Plate 2), Thurlings Road (Plate 4) and Extension Road (Plate 5).

4 ABORIGINAL INVOLVEMENT AND CONSULTATION

4.1 Compliance with the ***Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010***

To ensure a transparent consultation process and demonstrate that effective Aboriginal community consultation was undertaken "in assessing impacts, developing protection and mitigation options and making final recommendations" (OEH correspondence, Appendix B), the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010a) were implemented for this assessment. A full record of Aboriginal consultation is presented in Appendix C.

4.1.1 Stage 1 – Notification of project proposal and registration of interest

In accordance with Stage 1, Step 4.1.2 of the consultation requirements (DECCW 2010a:10), letters (with attached maps) were sent to the following organisations, requesting the names and contact details of any known Aboriginal parties who may have an interest in the project area, and hold knowledge relevant to determining the cultural significance of Aboriginal objects and/or places that may occur (cf Appendix D):

- Office of Environment and Heritage (OEH)
- Birpai Local Aboriginal Land Council (concurrent with Stage 1, Step 4.1.3)
- The registrar, *Aboriginal Land Rights Act 1983 (NSW)*
- National Native Title Tribunal
- Native Title Services Corporation Ltd (NTSCorp)
- Port Macquarie-Hastings Council

Responses are reproduced in Appendix E (note that the Northern Rivers Catchment Management Authority was absorbed into North Coast Local Land Services in 2014. Under the new charter, culture and heritage is now managed by the OEH, such that a Stage 1 letter was not sent).

In the absence of any relevant entries in relation to Native Title, any Registered Aboriginal Owners pursuant to Division 3 of the *Aboriginal Land Rights Act 1983* and any response from Port Macquarie-Hastings Council, letters inviting registration of interest, including all required project information (as per Stage 1, Step 4.1.3 of the consultation requirements), were mailed to the following potential knowledge-holder organisations advised by the OEH:

- Birpai Local Aboriginal Land Council (LALC)
- Saltwater Tribal Council
- Ghinni Ghinni Youth and Culture Aboriginal Corporation
- Bindi Aboriginal Heritage and Cultural Centre Inc.
- Sunrise Guiwan Biripi Elders Corporation
- Lakkari NTCG

Copies of these letters are reproduced in Appendix F.

A newspaper notice was published in the *Port Macquarie News* (26th of June 2015) and the *Camden Haven Courier* (1st of July 2015), inviting interested Aboriginal parties with cultural knowledge of the project area to contact the consultant to formally register their interest in the assessment (Appendix F).

No expressions of interest were lodged within the formal registration period, which ended on the 10th of July 2015. On the 18th of August 2015, the Dunghutti Elders Council Aboriginal Corporation lodged a verbal (phone) expression of interest.

As required, copies of the Stage 1, Step 4.1.3 notification letters and newspaper notice were forwarded to the OEH and the Birpai LALC. In this correspondence the Birpai LALC was advised that if no objection was received, the assessment would be undertaken with the assistance and advice of Birpai knowledge-holder (former Land Council sites officer) Lindsay Moran. Acting CEO Mike Vegter responded that the (Stage 1, Step 4.1.3) letter dated 16th of June 2015 to the recently resigned CEO had not been received, but that "Lindsay Moran would probably be the proper person to assist you, and we have no objection to that happening" (Appendix G). A phone call thereafter made to Lindsay Moran confirmed his wish to be involved in the assessment. Upon experiencing a major and on-going ill health issue which prevented him from assisting with the field survey and participating further in the assessment, Lindsay Moran withdrew his expression of interest on the 6th of June 2016.

In view of the extended time period over which the consultation process was conducted, the Birpai LALC was again contacted in June 2016 to explain the project and enquire whether the Land Council now wished to be involved. Newly appointed CEO David Carroll subsequently lodged an expression of interest on behalf of the Land Council (phone, 10/06/2016).

The Aboriginal consultation and involvement outlined in this report thus proceeded (from their date of registration) with the participation of the following registered Aboriginal parties:

- Birpai Local Aboriginal Land Council
- Dunghutti Elders Council Aboriginal Corporation ('Dunghutti Elders').

4.1.2 Stage 2 – Presentation of information about the proposed project

Upon their registration of interest, letters providing details of the proposed landfill expansion (including maps) and the purpose, scope and draft methodology of this cultural heritage assessment were sent to Lindsay Moran and the Dunghutti Elders, requesting review and advice regarding any required amendments (Appendix H).

Oral information about the proposed project was delivered to Dunghutti Elder Bob Mumbler and Birpai LALC senior sites officer Jason Holten via on-site tours conducted by PMHC Principal Waste and Environmental Engineer Gordon Cameron prior to their field inspection.

4.1.3 Stage 3 – Gathering information about cultural significance

The draft methodology for this assessment was provided in writing to then registered Aboriginal parties Lindsay Moran and the Dunghutti Elders (Appendix H) and was accepted unchanged.

In addition to field survey with Bob Mumbler (Dunghutti Elder) and Jason Holten (Birpai LALC senior sites officer) for the purposes of recording Aboriginal objects and PADs, consultation was undertaken with these Aboriginal party representatives to determine:

- whether any sites/places or resources of special attachment or cultural heritage value occur within the project area;
- the level of socio-cultural significance attributed to the identified sites/places;
- if the divulged cultural information is suitable for general public access. If not, what aspects of this information should be withheld, and/or not shared with other Aboriginal parties, administrative authorities/others; and
- management strategies to be implemented in relation to the proposed future landfill.

The representatives of the registered Aboriginal parties advised that the cultural information disclosed in Section 5.2 of this report is not sensitive or private, nor should it be flagged for restricted public access.

4.1.4 Stage 4 – Review of draft cultural heritage assessment report

Draft copies of this report were sent to the Birpai LALC and Dunghutti Elders for review and comment prior to its finalisation. As per correspondence attached at Appendix J, neither party required amendment of the draft report.

5 ABORIGINAL CULTURAL HERITAGE

5.1 Ethno-history

The first written account of Aboriginal people in the Port Macquarie district comes from the journal of Surveyor-General John Oxley (1820), whose exploration party travelled down the Hastings River valley from the west in 1818. Oxley (1820:307-328) observed "abundant signs" of Aborigines and their camps along the full length of the valley, and noted that "the natives in the vicinity (of Port Macquarie) appeared very numerous", where "a great many natives' canoes were seen on the river".

During later trips up the river, early British investigators reported an encampment of 25 Aboriginal people on Blackmans Point, at the confluence of the Hastings and Maria Rivers (Parker King 1822:168), and "some natives" on the western end of Rawdon Island (5km south of the project area; Macquarie 1956:209).

On the basis of Oxley's (1820:318, 329) description, the lower Hastings locality was exceptionally rich in food resources- "the port abounds with fish" and "the forest hills and other rising grounds … are covered with large kangaroos, and the marshes which in some

places border the port, afford shelter and support innumerable wild fowl. Independent of the Hastings River, the whole country is generally well-watered". Even though remote from permanent water, the coastal ranges (Packard 1992), including the present project area, still offer a range of plants and animals that could have supplied a ready source of food, medicine and raw materials to traditional Aboriginal groups residing in or passing through (Collins 1998:14).

Estimates for the lower Macleay River valley to the north place the pre-contact Aboriginal population at between three and six persons per 2km^2 of coastal lands (Coleman 1981:1), and at least this density of traditional settlement can be expected for the lower Hastings. However, the Aboriginal population of the Hastings region reportedly halved between 1825 and 1845 owing to deaths caused by influenza, smallpox and other introduced diseases (Grey 1845:25, cited in Godwin 1990:110).

Over the course of everyday traditional life, resource exploitation appears to have been undertaken on a family basis (Henderson 1851), and several extended families would often co-operate to form a highly flexible band that would gather and then disperse as conditions demanded. Away from the immediate coast shifting camp occurred "about monthly as the game in the immediate vicinity became exhausted … it took several months to give each ground in the locale its turn" (McFarlane 1934-5). In historical times prior to 1886, the 'Rollands Plains tribe' often camped at Allendale, on the northern side of the Wilson River approximately 14km north-west of the project area (Mackay 1956a). This group of between 40 and 50 individuals resided in "sorry constructions of bushes and pieces of bark", and seldom stayed more than two or three weeks in one place. "When they shifted to a fresh hunting ground, they never used the old camp site" (Mackey 1956a,b). Other post-contact campsites were reportedly situated at the junction of Tommy Owens and Rawdon Creeks, and Rawdon Creek and the Hastings River (Freemans Bay), some 2km and 3.5km respectively south of the CWMF (Collins 1998:10).

Most of the region's material culture items (eg shields, spears, boomerangs, clubs, digging sticks, canoes, containers, and woven nets and bags) were made from wood or other vegetative material. Although represented in museum collections (eg Gordon and White 1995), these rarely survive in an archaeological context. A limited assemblage of items more conducive to long-term preservation was also used, including flaked and/or ground stone axes and bone and stone spear barbs (Fitzpatrick 1914).

Myths, or sacred stories, accounted for the existence of both traditional Aboriginal people and their environment, providing tangible links between the two. According to mythology, Mount Cairncross is associated with the arrival of the first man (Ulitarra/Birigundah) "from whom the present Aborigines say they are descended … In the beginning there was no sea or water, except in a deep hole or well on a mountain, which Ulitarra had made … This well or hole was by him named Koolabulamba, and means hole or well where the eagles drink" (McDougall 1900:116). Due to its sacred nature, only men who had attained an acceptable level of initiation were allowed to camp in the immediate vicinity of Mount Cairncross and to access its summit (pers comm., the late William Holten Senior to Collins 1998:10). This mountain is held to have been a ceremonial centre, visited by participants from as far afield as the New England Tableland (Collins 1998:10; Appleton 1996b:2). Coastal groups are said to have accessed Mount Cairncross via a track from Blackmans Point that utilised the ridge now occupied by Reids Road, 1-2km west of the CWMF (Appleton 1996a:12).

The frontier of European settlement jumped north from Newcastle upon the 1821 establishment of a penal settlement at Port Macquarie. Violence between the newcomers and Aboriginal inhabitants soon followed, especially in the 'up-river' country around Rollands Plains (Blomfield 1992). As early as 1822, attempts were made to placate and control the traditional people at Port Macquarie, including presentation of a brass breastplate to Monunggal, proclaiming him 'Chief of the Port Macquarie Blacks' (McLachlan 1988:86; Sheather 1982:38). A breastplate was also presented to 'Bunyah Jimmey, King of the Hastings River' in the mid-1800s (Troy 1993:130; Port Macquarie News 2004).

The NSW Aborigines Protection Board was set up in 1882. Between this time and 1920, 41 official Aboriginal Reserves and stations were gazetted on the NSW mid and north coasts. Amongst these were a small Aboriginal Reserve (#19474) on the southern bank of the Wilson River little more than 1.5km north-west of the CWMF, where a camp comprising a number of bark huts was still used into the 1930s (Collins 1998:10), and a 35ha Aboriginal Reserve (#2598) at Rollands Plains (10.2km north-west of the project area), gazetted on 30/10/1886 (McGuigan 1984:42). Male residents of the Rollands Plains Reserve cut timber around Mount Cairncross, at which time many Aboriginal families still lived in the surrounding bush (pers comm., the late Pat Preece to Collins 1998:10).

5.2 Cultural heritage information disclosed for this assessment

Whilst set within a wider cultural landscape that includes Mount Cairncross, traditional transit routes, post-contact camping places, places of work, and at least two reported massacre sites, Aboriginal informants consulted for both the former (Collins 1998) and present assessments advised that the CWMF property itself is not known to contain sites, places or resources of traditional, historic or contemporary socio-cultural attachment or significance.

5.3 Archaeological context

5.3.1 Registered sites and places

OEH Aboriginal Heritage Information Management System

An extensive search of the Aboriginal Heritage Information Management System (AHIMS) performed on the 17th of June 2015 (AHIMS client service #177757) revealed 29 registered sites within a 5km radius of the project area. A cross-check with site cards obtained from AHIMS Web Services showed that two of these sites had been doubly registered, and that the four listed 'Art (Pigment or Engraved)' sites were stone artefact scatters. Upon enquiry to OEH, the map grid reference for one known site within the CWMF (CWD 1), which did not appear on the extensive search, was found to have been incorrectly entered on the database. Advice in relation to these identified database errors was provided to the AHIMS Registrar.

A second extensive AHIMS search was undertaken on the 18th of June 2016 (AHIMS client service #230327) and is attached at Appendix K. The search revealed the identified database errors to have been rectified, and that no additional sites had been recorded in the past year. Of the 28 separate sites registered within 5km of the CWMF, 10 are isolated stone artefacts and 18 are stone artefact scatters/open campsites (including two initially recorded as potential archaeological deposits [PADs] but confirmed as containing sub-surface materials through test excavation). Details of these sites are summarised in Table 2, as per available information compiled through reference to AHIMS site cards and relevant archaeological reports. This information indicates that while some large open campsites occur on elevated terrain bordering the rivers, sites within the intervening forested hinterland contain a small number of stone artefacts only. The hinterland sites (scatters and isolated finds) most often occur on the crests and/or upper slopes of ridges and spurs, followed by valley flats and ridge/spur footslopes.

Three of the registered sites (stone artefact scatters CWD 1, CWD 3 and CWD 4) lie within the project area. A fourth site (isolated artefact CWD 2) is located on the CWMF property but outside the project area. Sites CWD 1 and CWD 2 were destroyed by development of the existing facility, as authorised by Consent to Destroy (with Salvage) issued to PMHC on the 5th of June 2000 (#N37/CDS/2000) under Section 90 of the *National Parks and Wildlife Act 1974.* Care and Control Permit #N39/CC/2000 was concurrently issued to the Birpai LALC to allow the Land Council to keep the salvaged artefacts (Appendix L).

The locations of sites CWD 1, CWD 2, CWD 3 and CWD 4 and other sites registered in the Cairncross/Telegraph Point locality are plotted on Figure 3.

Other heritage registers

On-line searches of the Australian Heritage Database, NSW State Heritage Register and Inventory, and Schedule 5 (Environmental Heritage) of Port Macquarie Hastings LEP 2011, performed on the 24th of June 2016, revealed no listed Aboriginal heritage sites or places within or near the CWMF.

Table 2. Aboriginal sites registered on the AHIMS database within 5km of the project area

AHIMS ID	Site name	Site type	Landform	# identified artefacts
30-3-0143	Extension Rd 2-1	Isolated artefact	Mid-slope	1
30-3-0146	Waterfall Rd 1-1	Open artefact scatter	Ridgeline saddle	2
30-3-0147	Waterfall Ck 2-1	Isolated artefact	Ridge footslope	1
30-3-0101	Telegraph Point	Open artefact scatter	Footslope/valley flat	5
30-3-0316	7-11 Trail #1	Open artefact scatter	Low ridgeline	2
30-3-0317 30-3-0293	7-12 Trail #1	Open artefact scatter	Low ridgeline	6
30-3-0318 30-3-0294	7-2 Trail #1	Open artefact scatter	Low ridgeline	2
30-3-0298	17-3 Trail 1	Open artefact scatter	Valley flat	2
30-3-0299	Ramp Rd #1	Isolated artefact	Low ridgeline	1
30-3-0295	Waterfall Rd #3	Open arefact scatter	Low ridgeline	
30-3-0296	Waterfall Rd #4	Open artefact scatter	Ridge crest	
30-3-0306	Waterfall Rd #2	Open artefact scatter	Ridge footslope	
30-3-0307	Waterfall Rd #5	Open artefact scatter	Ridge footslope	
30-3-0308	Waterfall Rd #1	Open arfefact scatter	Ridge footslope	2
30-3-0300	7-2 Trail #2	Open artefact scatter	Low ridgeline	3
30-3-0351	6-8 TR	Isolated artefact	Creek/river flat	1
30-3-0392	OHK 46/A	Open artefact scatter	Spur crest above river	99 (test excavations)
30-3-0396	OHK 219	Open artefact scatter	Spur crest	2
30-3-0401	OHK 54	Isolated artefact	Spur crest	1
30-3-0386	KPM-IF2	Isolated artefact	Valley flat	1
30-3-0391	OHK 47/A	Open artefact scatter	Spur slope above river	43 (test excavations)
30-3-0238	***CWD 1***	***Open artefact scatter***	***Spur crest saddle***	***6***
30-3-0239	*CWD 2*	*Isolated artefact*	*Ridge upper slope*	*1*
30-3-0241	***CWD 4***	***Open artefact scatter***	***Spur crest***	***2***
30-3-0242	***CWD 3***	***Open artefact scatter***	***Spur crest***	***2***
30-3-0344	3.2 Trail 2	Isolated artefact	Footslope	1
30-3-0345	Swamp Rd 3	Isolated artefact	Valley flat	1
30-3-0346	3.4 Trail 1	Isolated artefact	Valley flat	1

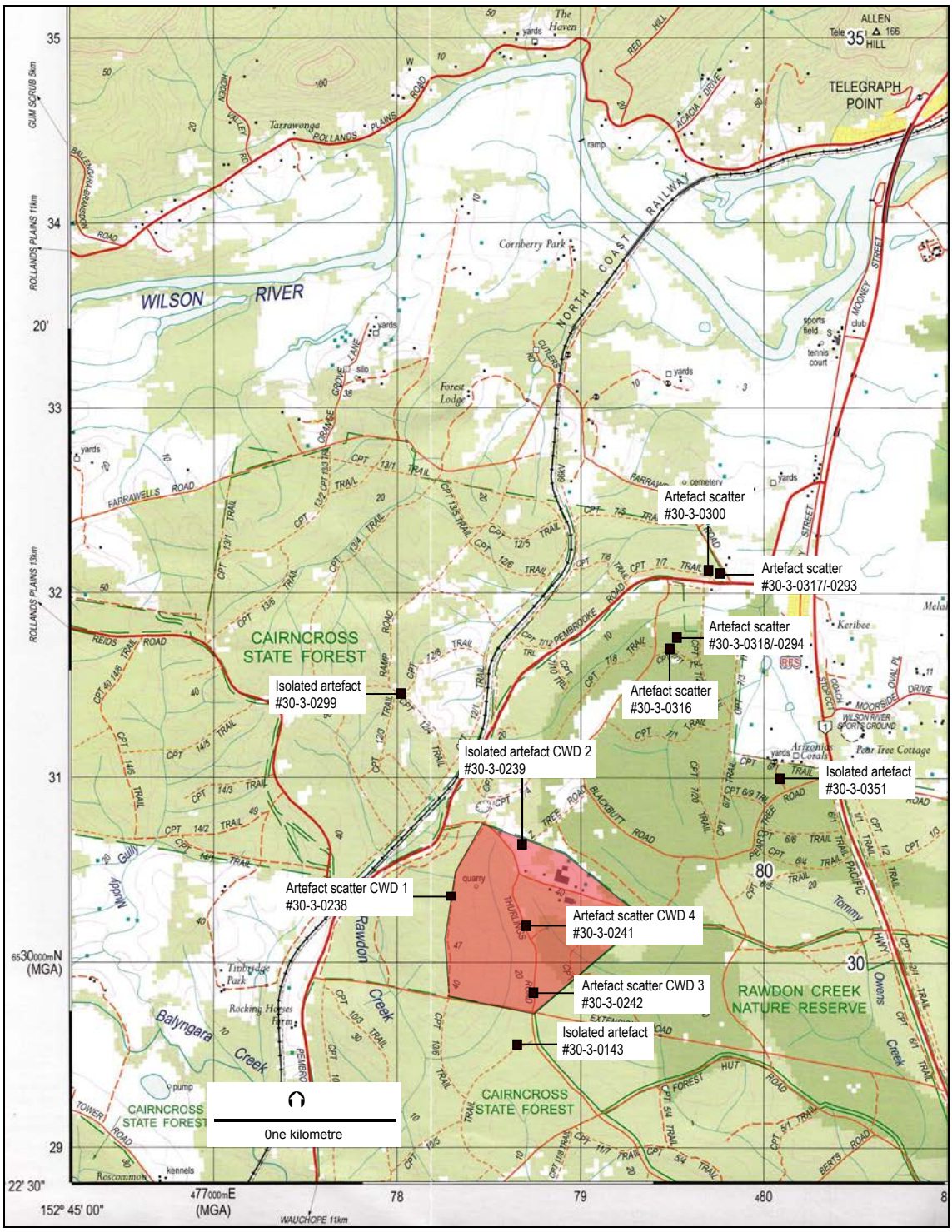


Figure 3. Location of Aboriginal sites registered on the AHIMS database in the project locality (CWMF property shaded red)
(Base map excerpt from 1:25,000 scale topographic map, Telegraph Point 9435-2N, Department of Finance and Services 2012)

5.3.2 Past Aboriginal heritage assessments of the project area

Appleton 1996

Appleton (1996a) completed a preliminary assessment of four sites shortlisted for potential development of the Port Macquarie-Hastings waste management facility, including the CWMF. The assessment provided a comparative rating of cultural heritage sensitivity, based upon "a consideration of vegetation type, degree of disturbance, topography, context, the distribution and types of known archaeological types in the local area, and consultation with the local Aboriginal community" (Appleton 1996a:1). Additional oral

history research was undertaken with Baldwin family informants, long-term non-Aboriginal residents of Pembrooke (Appleton 1996b).

No Aboriginal sites/artefacts were detected during field inspections of the four shortlisted sites. However, on the basis of his overall findings, Appleton (1996a:15-16) concluded that the present CWMF site ('Area 10') represented that "to which least objection is likely to be raised on either cultural or archaeological grounds, although not entirely devoid of Aboriginal associations- probably being adjacent to the ridgeline route taken by Aboriginals travelling to and from Mount Cairncross".

Collins 1998

A comprehensive Aboriginal heritage assessment of the CWMF property was undertaken by Collins in 1998, and formed part of the EIS prepared by ERM Mitchell McCotter (1999). Collins' assessment included consultation with local Aboriginal Elders/knowledge-holders, and field inspection of a network of forestry tracks/trails and wider landforms of potential archaeological sensitivity. Three small stone artefact scatters (CWD 1, CWD 3 and CWD 4) and an isolated artefact (CWD 2; outside the present project boundary) were recorded. Summary details of these sites are given in Table 3.

Considering their small size, high-level disturbance and lack of any realistic opportunities for further research, the four recorded sites were assessed to be of low social/cultural and scientific/archaeological significance. No unmodified sites/places of special cultural value were identified by the Aboriginal informants.

Collins (1998:46) concluded that although "there is a high probability of a low-density distribution of undiscovered small artefact scatters and isolated artefacts occurring in off-track situations along the higher parts of the toposequence ... given the disturbance history (of the CWMF locality) there is virtually no chance that any of these sites will be *in situ* or that they could offer anything more than a minimal level of research potential". It was recommended that an AHIP be sought to allow collection of the CWD 1 and CWD 2 artefacts in the event that these could not be avoided by initial development of the CWMF. PMHC subsequently applied for and was granted a Consent to Destroy (with Salvage) (#N37/CDS/2000). The artefacts were collected and handed to the Birpai LALC under a Care and Control Permit (#N39/CC/2000) (pers comm. L. Moran, former Birpai LALC senior sites officer, 25/10/2016).

Due to their setting within proposed future landfill stages, it was recommended that sites CWD 3 and CWD 4 remain in their recorded locations until such time as it became necessary to extend the landfill southward. To determine whether or not additional artefacts were present at either site, and assess the way that survey results are affected by differences in field conditions, it was further recommended that all available ground exposures along the crest of the ridge spurs (followed by Thurlings Road and 9.1 Trail) be re-inspected in conjunction with any future development application. This latter recommendation was fulfilled by the field survey described in Section 7 of this report, which did not result in the identification of additional Aboriginal sites/artefacts.

Table 3. Aboriginal sites recorded by Collins 1998

AHIMS ID	Site name	# Identified artefacts	Exposure type	Disturbance conditions	Potential for additonal artefacts	Likely PAD	CWMF context
30-3-0238	CWD 1	6	Vehicle track (9.1 Trail)	Recently logged forestry plantation	Limited	No	Within project area on boundary of existing landfill - Consent to Destroy #N37/CDS/2000 issued to PMHC 5/06/2000
30-3-0239	CWD 2	1	Logging disturbance	Forestry plantation	No	No	Within existing facility- Consent to Destroy #N37/CDS/2000 issued to PMHC 5/06/2000
30-3-0242	CWD 3	2	Vehicle track (Thurlings Road)	Forestry plantation	Limited	No	Within proposed Stage 3 landfill area
30-3-0241	CWD 4	2	Vehicle track (Thurlings Road)	Forestry plantation	Limited	No	Within proposed Stage 3 landfill area

5.3.3 Summary of relevant past nearby Aboriginal heritage assessments

Packard 1992

In 1992, Packard completed a broad-scale archaeological assessment of the Kempsey-Wauchope State Forest Management Areas. The 315,000ha study area included Cairncross State Forest (of which the CWMF property then formed a part). The assessment aimed to gain an understanding of archaeological site distributions to inform and refine a predictive model of site location suitable for planning and management of forestry activities. The field survey employed an opportunistic sampling strategy, predominantly targeting vehicle track exposures within the full range of available environmental contexts.

Of the 55 archaeological sites detected by Packard, all but one (a rockshelter with occupation deposit) comprised scatters or isolated stone artefacts. Caincross State Forest fell within Packard's 'coastal ranges' landsystem, where open artefact sites were found at a density of 1.7 per kilometre of linear survey route ('trajectory'), equating to a density of 3.05 artefacts per 100m^2 (Packard 1992:Table 1).

Eleven forestry trails with a total length of 5km were surveyed within Cairncross State Forest, including two adjoining Extension Road. One isolated artefact (#30-3-0143) was recorded on the mid-slope of the Thurlings Road spur 225m south of the present project boundary. Two isolated artefacts and five small scatters containing between two and 14 visible artefacts were recorded in more dissected terrain closer to Mount Cairncross.

With respect to the Kempsey-Wauchope State Forests as a whole, Packard concluded that the crests and upper slopes of ridges and spurs have the highest overall level of archaeological sensitivity, and suggested that this distribution may be attributable to a concentration of traditional Aboriginal activities near or on ridgeline transit routes. Even so, Packard (1992:68-69) points out that the ridge/spur footslopes "have the highest … potential value, as any site located within them has more potential to be stratified or have intact subsurface elements."

Collins 1995, 2005

In 1995, Collins surveyed a 10% representative sample of 2,775ha of largely undeveloped terrain encompassing the Hastings River floodplain, drainage depressions and undulating hills as part of an Environmental Study of an area ('Area 13') targeted for urban expansion inland of Port Macquarie. The survey aimed to provide information on site types, density, distribution and content, and establish the potential for different topographic units to contain both well-preserved and exposed (and thus detectable) sites.

Seventeen isolated stone artefacts, 30 artefact scatters, one midden scatter and three scarred trees were recorded. Aboriginal consultation revealed two places of traditional ceremonial significance and one site of historical significance in the area. Characteristics of the recorded artefact occurrences were analysed to detect environmental preferences in relation to Aboriginal landuse and site placement, allowing the following predictive statements to be made (Collins 1995:67):

- Further artefact occurrences will occur throughout Area 13 but these will vary widely in size, content and complexity. Site locations are likely to occur with significantly higher frequency on lands based on fault zone geological formations than on those based on Permian sedimentaries.
- Artefact occurrences will generally be found on slopes of 10° and less, with the majority of site locations and the greatest artefact frequencies occurring on flat or gently inclined land (≤5°). In particular, the larger complex sites will be associated with the lower gradients.
- Artefact occurrences will generally be found within 350m of a water source, with greatest site and artefact frequencies within 350m of swamps. Most of the larger and more complex sites will occur on the very edge of the water source.
- Artefact occurrences will generally be found on natural levees along the banks of the Hastings River, and on the footslopes and crests of ridges and spurs.
- Artefact occurrences will occur at all elevations but most will be found at elevations below 10m AHD. Sites will occur with second greatest frequency above 20m AHD.
- Artefact occurrences will occur on land within the full circle of aspects, but most artefacts and site locations will face between north-west and north-east.

A later inspection of all previously unsurveyed landforms (excluding the Oxley Highway upgrade corridor) of predicted high archaeological sensitivity, along with a sample of previously unsurveyed landforms of predicted moderate and low sensitivity within a 780ha portion of 'Area 13', resulted in the recording of four isolated stone artefacts and three small artefact scatters on footslopes and valley flats adjacent to swamps and streams. Two extensive open campsites/artefact scatters were also recorded, both on the terminal ends of low spurs extending into swamps (Collins 2005).

Collins 2003, 2004, 2012

A route selection study for an upgrade of the Oxley Highway between Wrights Road and the Pacific Highway intersection west of Port Macquarie was completed in 2003 (Collins 2003) and involved a selective inspection of three corridor options. Three low-density artefact scatters (one with PAD), an isolated artefact and a stand alone PAD were recorded. Of the artefact scatters, two occurred on low-gradient footslopes adjacent to swamps and the other on a ridge crest.

A comprehensive survey of the preferred upgrade corridor subsequently undertaken as part of a Review of Environmental Factors for the Oxley Highway project resulted in the recording of an additional scatter of five artefacts on a broad level hill crest (Collins 2004). A further scatter of eight stone artefacts was exposed on the gentle mid-slope of a ridgeline upon initial construction-related vegetation clearing (Collins 2012:28-31).

Sub-surface testing of a PAD, located on an alluvial terrace adjacent to one of the footslope artefact scatters, was undertaken ahead of road construction. The investigation involved the mechanical excavation (and dry sieving) of nine 1m x 2m test pits spaced at 10m intervals across the PAD. As far as possible, sediments were removed from each test pit in 10cm spits, through the topsoil and into the underlying clay. Five stone artefacts were recovered, demonstrating the presence of a low-density artefact occurrence that did not warrant further investigation or salvage (Collins 2012:24-28).

Of the 21 stone artefacts salvaged in conjunction with the Oxley Highway upgrade project, 10 were collected from the surface, five were recovered during the sub-surface testing, four were recovered during Aboriginal monitoring of vegetation clearing, and two during monitoring of drainage and fencing excavations. The total assemblage was overwhelmingly dominated by unmodified flakes and flake fragments, followed by cores and core fragments. Although featuring a range of locally available raw materials, more than half of the artefacts were made on mudstone/siltstone and meta-sedimentary stones (Collins 2012:42-44).

Kuskie 2010

Following on from an initial desktop study and Aboriginal community consultation to assist with the selection of feasible route options (Kuskie 2005), Kuskie undertook a comprehensive field survey and sub-surface investigations within the Pacific Highway Oxley Highway to Kempsey upgrade corridor in 2010. Most of the upgrade (currently under construction) involves duplication of the existing highway, but major deviations occur in the vicinity of the Hastings and Wilson Rivers. The Wilson River deviation veers east from the existing highway near the CWMF entrance road and traverses low coastal hills and alluvial floodplain approximately 2km downstream of the present Telegraph Point bridge.

Despite constraints to survey access and visibility and the low overall level of effective coverage thus able to be achieved, eight archaeological sites and two PADs were recorded. The identified sites were located on ridge and spur crests (#5) and their adjoining simple slopes (#3), and comprised isolated stone artefacts and surface scatters of between two and eight artefacts (Kuskie 2010:Table 7-2). Of the total 31 surface artefacts recorded, all but two were unmodified flakes or flake fragments made primarily on volcanic raw stone materials (Kuskie 2010:Table 7-3). Five areas of cultural heritage sensitivity were identified by Aboriginal informants, including a ceremonial site, the Hastings and Maria Rivers, Dalhunty Island in the Wilson River, and an ochre resource, all of which lie well away from the CWMF.

On completion of the survey, sub-surface archaeological investigations were conducted on the PADs. One of the PADs was situated on a level-very gentle ridge spur crest and its adjoining gentle simple slope above the northern bank of the Hastings River. The second PAD comprised similar landform units immediately north of the Wilson River and encompassed five of the recorded surface artefact occurrences. The sub-surface investigations involved the shovel and trowel excavation (and wet sieving) of 1m x 1m test pits spaced at 5m intervals along two perpendicular transects.

Thirty test pits were excavated north of the Hastings River, from which 144 stone artefacts were recovered. Although containing a wide range of artefact types and raw stone materials, the assemblage was dominated by unmodified flakes and flake and lithic fragments made on volcanic stones (Kuskie 2010:Appendix G-12).

A total of 1,049 stone artefacts was recovered from 29 test pits excavated north of the Wilson River, including a number of stone tools (eg Bondi points and fragments thereof, geometric microliths, retouched flakes and a thumbnail scraper). Like that found near the Hastings River, the assemblage was dominated by unmodified flakes, flake fragments and other lithic fragments (Kuskie 2010: Appendix G-14-15).

Amongst other management strategies, Kuskie (2010:81-84) recommended that surface artefacts to be affected by the proposed highway upgrade be collected, and that the sites/PADs subject of his test excavations north of the Hastings and Wilson Rivers be further investigated/salvaged via surface scrapes and localised hand excavation of any identified features of potential significance.

Kelleher Nightingale Consulting 2012

Kelleher Nightingale Consulting was engaged by Roads and Maritime Services (RMS) to develop and execute a salvage methodology for Aboriginal sites and PADs to be impacted by the Pacific Highway Oxley Highway to Kempsey upgrade project. In addition to surface artefact collection, it was proposed to investigate PADs through the hand excavation (and wet sieving) of 1m x 1m squares spaced on a 15m grid system, followed up by open area excavation on identified sites as needed to recover a representative sample of cultural materials and determine the integrity, extent, spatial distribution and nature of any archaeological deposit (Kelleher Nightingale 2012:23).

It is understood that the salvage and associated investigations have been completed (RMS 2014:13). However, the salvage report is not publicly available and did not appear on a list of reports accessible through AHIMS Web Services.

5.4 Synthesis of available information and archaeological expectations for the project area

5.4.1 Aboriginal landuse and archaeological site distribution

The early historical record attests to traditional Aboriginal occupation of the Port Macquarie-Hastings hinterland between at least early spring (Oxley 1820:307-328) and late autumn (Parker King 1822:168). Past surveys reveal the local sub-coastal hill country to contain small scatters of stone artefacts and isolated artefacts situated primarily on the crests and/or upper slopes of ridges and spurs, but also on valley flats and ridge/spur footslopes (Table 2). Away from the river banks, the largest hinterland sites have been identified on the terminal ends of low spurs extending into swamps (Collins 2005).

Background information suggests the operation of a 'collector' type of landuse system (Binford 1980), revolving around the (possibly seasonal) use of base camps strategically placed close to the rivers, with a large number of smaller specialised-activity stations distributed throughout the intervening hill country, reflecting hunting and gathering excursions, and/or movement between base camps.

In the absence of substantial valley flats, swamp and any other reliable water source, the three (disturbed) small artefact scatters (CWD 1, CWD 3 and CWD 4) and the isolated artefact (CWD 2) previously registered on the CWMF property were all located on or near ridge/spur crests (Table 2), despite inspection of all available exposures on ridge/spur slopes and drainage depressions (Collins 1998: Table 6). Of the three sites falling within the present project area, one (CWD 1) was subject of legally authorised collection and destruction. The remaining two sites (artefact scatters CWD 3 and CWD 4) would be destroyed by the proposed landfill expansion (Sections 5.3.1, 5.3.2 and Figure 3). While providing evidence of traditional use, none of the registered CWMF sites point to anything other than the itinerant discard of stone artefacts, whether during the course of resource exploitation or transit.

The CWMF lies close to a traditional route reportedly taken to access the Mount Cairncross ceremonial centre (Appleton 1996a:12) and is also close to at least two remembered post-contact camping places (Collins 1998:10). The CWMF property itself is nevertheless not known to contain or encroach upon any sites, places or resources of traditional, historic or contemporary socio-cultural attachment or significance.

5.4.2 Predictive model of site type and location for the project area

The following predictive model is based upon the environmental and disturbance context of the project area, past survey/ investigation results, the distribution of registered sites, and information disclosed by Aboriginal party representatives.

- In the absence of rockshelters, stone or ochre outcrops, the project area will not contain occupation shelters, stone arrangements, stone or ochre quarries, axe grinding grooves or rock art.
- Due to the extent of past logging and clearing associated with the establishment of plantation forest, the project area is not expected to contain culturally modified trees.
- Traditional burials (if ever present) and other organic archaeological materials are highly unlikely to have survived the degrading effects of the acid soil conditions and disturbance caused by past forestry activities.
- Isolated stone artefacts, dispersed from their original place of deposition, may survive anywhere within the project area.
- Previously undetected stone artefacts, exposed since 1998, may occur within the registered site CWD 3 and CWD 4 localities on and beside Thurlings Road. Like those already recorded, any such artefacts will not be in a primary depositional context and are highly unlikely to have associated PADs.
- Stone artefacts not salvaged from site CWD 1 (if any) may occur within the registered site location on and surrounding the western boundary road (former forestry trail 9.1).

- Additional small scatters of stone artefacts may occur on the ridge spur crests, and on the level/low gradient spur footslopes. Any artefact scatters will have been highly disturbed/dispersed by road construction and other forestry activities and are highly unlikely to have associated PADs

6 NON-ABORIGINAL CULTURAL HERITAGE

6.1 Historical background

Port Macquarie was established as a penal settlement in 1821, and housed a maximum of 1,600 convicts in December 1825 (McLachlan 1988:228). Chief amongst the convict's tasks during the first year were crop cultivation, timber cutting for building construction, and cedar and rosewood getting from up to 40km inland along the Hastings River (Turner 1990). In late 1824, there were 1,111 convicts, including 73 in up-river cedar parties, 15 'procuring flooded gum', 37 sawyers and 18 'procuring tea-tree rafters, also bringing gum logs and shingles down river' (Sheather 1982:48-49).

A government farm was set up on fertile lowland at Ballengarra/Rollands Plains in 1825, employing 150 prisoners (McLachlan 1988:155). This farm lay on the southern side of the Wilson River (9km north-west of the project area), and included sugar, wheat, maize and tobacco plantations (Sheather 1982:54; Sydney Gazette 1825:2). Access to Rollands Plains was initially made by boat up the Hastings, Maria and thence Wilson Rivers. A convict-built track/road between a ferry punt at Blackmans Point and Ballengarra/Rollands Plains that traversed the project area was completed in February 1828 (McLachlan 1988:140). This road connected with the present Reids Road to the north-west, and is marked as the 'old road' on historical parish maps (Figure 4). According to available information (ERM Mitchell McCotter 1999:5.53) the road included culverts at creek crossings, and was apparently used by free settlers and their accompanied bullock drays until at least 1850 (Raymond 2010).

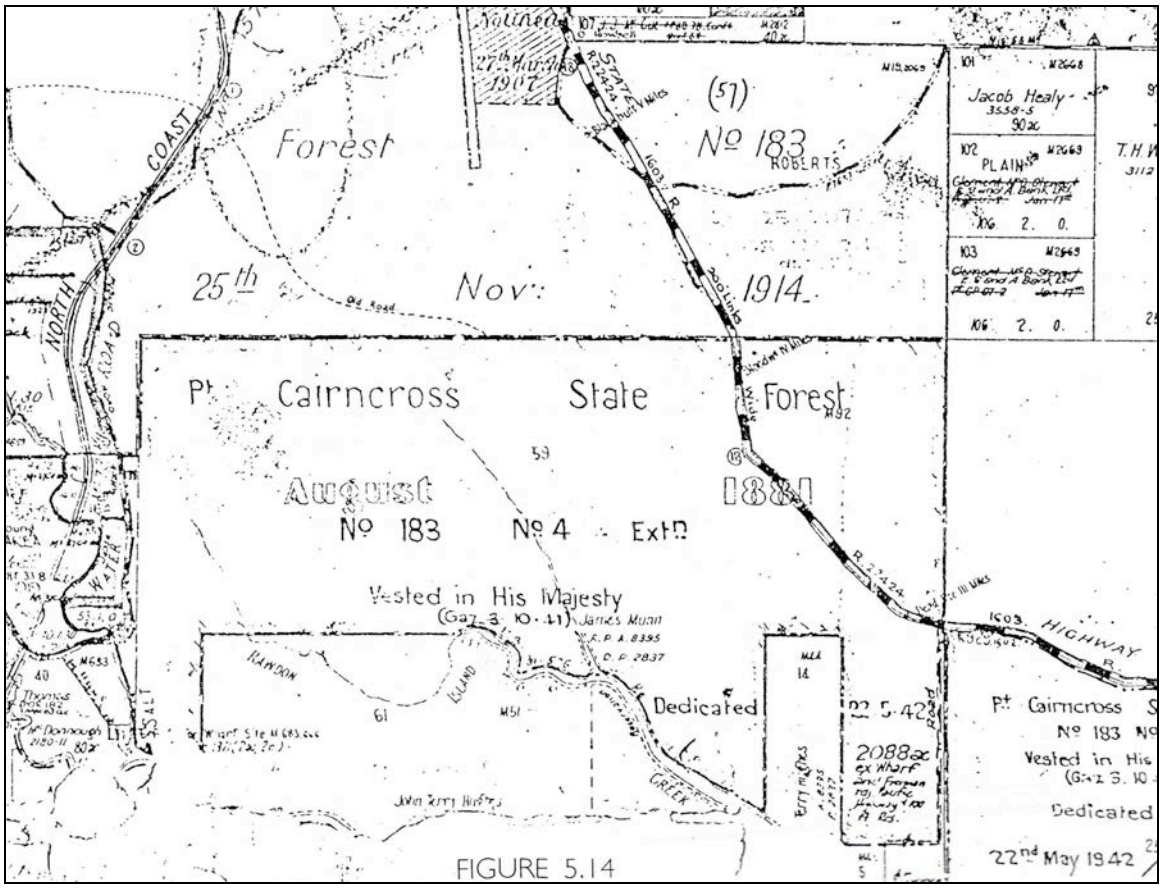


Figure 4. Excerpt of 1942 Land District map, Parish Cairncross (Source: ERM Mitchell McCotter 1999: Figure 5.14)

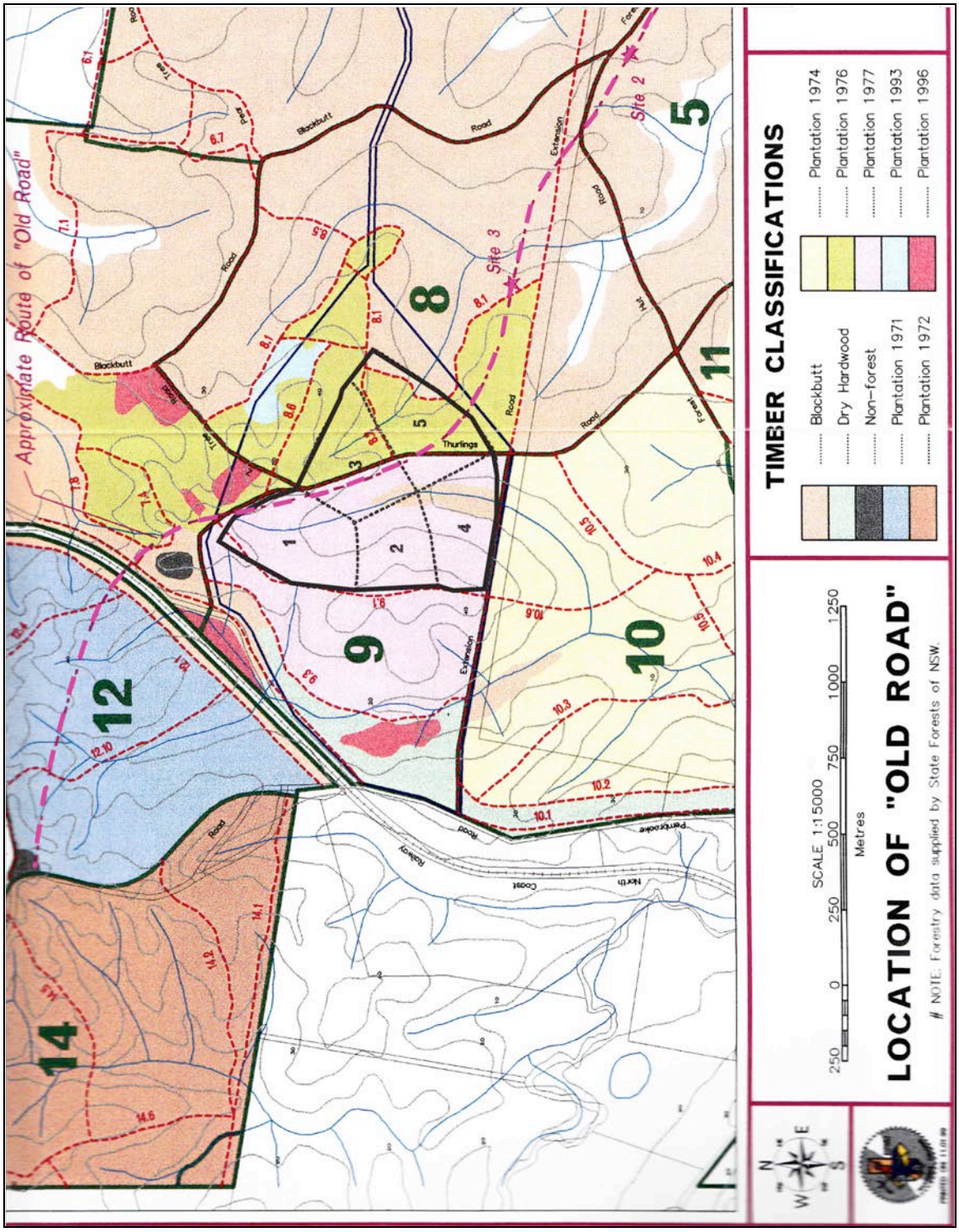


Figure 5. Approximate route of the 'old road' in relation to the proposed 1999 landfill boundary and timber classifications
(Source: ERM Mitchell McCotter 1999: Figure 5.15)

The Port Macquarie-Hastings region was opened to free settlement in 1830 and the last penal Commandant ended his period of administration in 1832 (McLachlan 1988; Turner 1990:6). By the late 1830s, a large proportion of traditional Aboriginal land along the margins of the Hastings, Maria and Wilson Rivers had been appropriated. Amongst the early selectors was James Munn, who was issued a primary grant of 1,036ha (property 'Irvine') in 1840, which straddled the current Pacific Highway and extended north from opposite Little Rawdon Island into the now Rawdon Creek Nature Reserve. This property was selected 'for timber alone' (Dawson 2014:3, 27-28).

The *Crown Lands Occupation Act* of 1861 allowed small farmers easy access to unsold Crown Land, and what little alluvial land that remained along the rivers was soon taken up. Upon acquisition by farmers, agricultural activities resumed at Rollands Plains, where a privately owned horse-driven flour mill was operating in 1864 to grind wheat and corn (Mills 1924). The sugar industry was also revived, such that by 1871 more than 400ha of cane, serviced by a dozen mills, was under cultivation upriver from Port Macquarie (Jeans 1972:243). Owing to the ravages of frosts, cane cultivation was eventually abandoned in favour of maize and the associated practice of pig farming (Turner 1990:8-9).

The first licences for cutting hardwoods in the local region were issued in 1863 for the primary purpose of exerting government control over timber-getting, and to collect fees due to the crown. The timber industry became increasingly important after 1870, as demand for housing timber escalated and an export trade in hardwoods developed, especially for railway sleepers. By the 1880s, timber mills were operating at Hibbard and Rawdon Island, and around a dozen ships ferried timber from Port Macquarie to Sydney (Turner 1990:14).

In 1876, the Forestry Conservancy was established as part of the Occupation of Lands Branch. Under the conservancy, provision was made for declaration of Class A state forests (lands where large areas could be allotted for the continuous removal of mature timber) and Class B timber reserves (localities where timber demand was small and confined to local requirements). This classification system was continued and expanded by the *Crown Lands Act 1884*. Under this Act, timber licences were sold by auction or tender, minimum girths of trees available for harvesting were set, and royalties were imposed for the different timber types removed. Further details were added to the Act in 1885: mining prop permits were issued, thinning out of trees could be authorised (Bickford *et al* 1998:3).

Redbank Forest Reserve, Extension 34, was set aside as a timber reserve in 1880, and encompassed the now CWMF property. Following the establishment of a Forestry Department, this area was declared part of Cairncross State Forest in 1914. In 1916 the NSW Forestry Commission, predecessor of the now NSW Forestry Corporation, was officially formed through enactment of the *Forestry Act 1916*. The Act aimed to protect forests from further unmanaged clearing and to ensure long-term sustainable management of the state's timber reserve (Forestry Corporation 2016). As outlined in Section 3.2 of this report and shown on Figure 5, most of the project area was cleared of natural forest to accommodate hardwood forestry plantations established between 1976 and 1977.

6.2 Registered sites and places

On-line searches of the World Heritage List, Commonwealth Heritage List, National Heritage List, the NSW State Heritage Register and Inventory, and Schedule 5 (Environmental Heritage) of Port Macquarie Hastings LEP 2011, performed on the 24th of June 2016, revealed no listed non-Aboriginal heritage sites, relics or places within or near the CWMF.

Although a number of historical structures at and near Telegraph Point are singled out for special heritage management under the LEP, none of these would be directly or indirectly affected by the proposed landfill expansion.

6.3 Past non-Aboriginal heritage assessments of the project area

The former EIS (ERM Mitchell McCotter 1999:5.52- 5.53) identified one possible significant historical site/relic within the project area, this being the apparent convict built 'old road' (cf Figures 4 and 5). Although three traces, "evidenced by marked depressions caused by use of the road and erosion" were identified between the Pacific Highway and the CWMF, it was concluded that most of this road had been obliterated by forestry activities. No evidence of the road was identified during a field inspection of that part of the alignment traversing the CWMF, including the present project area.

6.4 Summary of other relevant past non-Aboriginal heritage assessments

Suters Architects Snell 1991

In 1991, Suters Architects Snell completed a comprehensive non-Indigenous heritage study to assist PMHC with the planning and management of cultural heritage resources. The study included a thematic history (Turner 1990) along with background archaeological research and field inspection (Higginbotham 1991). It resulted in the production of a detailed inventory of 153 significant buildings, structures and archaeological sites/precincts for the LGA. A further 42 items were examined but not included in the final inventory. No items listed in either the preliminary or final inventories occur in or close to the CWMF.

The heritage study identified the following main themes that have influenced development of the Port Macquarie-Hastings LGA and its present identity:

- Penal settlement
- Port Macquarie town development
- Settlement or landscape archaeology
- Industry and manufacturing (dairy farming, forestry and timber mills, vineyards and extraction industries)
- Communications (bridges, railways, roads and navigation)
- Public utilities (street lighting, water supply and conservation)
- Cemeteries and monuments

Kuskie and Carter 2007

Kuskie and Carter assessed the non-Aboriginal cultural heritage values of the Pacific Highway Oxley Highway to Kempsey upgrade corridor in 2007. The assessment included heritage register searches, a review of local history records, field survey, and property owner consultation as needed to identify the extent, nature and significance of the recorded sites.

Three of the 16 historical sites identified along the 37km length of the upgrading corridor sit between the Hastings and Wilson Rivers. These comprised a tree stump with a survey mark near the existing highway (OKH2), five tree stumps with springboard notches indicative of past logging (OKH7), and a dairy complex (OHK9) on the southern bank of the Wilson River. OKH2 and OKH7 were assessed to be of nil heritage significance. The OKH9 dairy complex was assessed to be of local heritage significance. No evidence of the 'old road' between Blackmans Point and Ballengarra/Rollands Plains was identified.

6.5 Synthesis of available information and archaeological expectations for the project area

Available background information indicates that the project area was never developed in terms of the built or farming environments, and does not contain or encroach upon any heritage registered/listed sites, items or places. However, this area was traversed by a convict-built track/road (the 'old road') that was subsequently used by early free settlers to access farmland at Ballengarra/Rollands Plains. Other historical activities were confined to timber-getting, which probably commenced in the mid-1800s and continued with the establishment of Cairncross State Forest in 1914.

Most of the project area was cleared to make way for hardwood plantations between 1976 and 1977. Although some parts of the 'old road' were detected within natural (logged) forest further east, a former field survey found that no vestiges of the track/road had survived on the CWMF site, where the alignment lay totally within the plantation forest.

In view of its known limited historical non-Aboriginal landuses and extent of modern forestry disturbance, no significant historical sites/items were expected to occur within the project area. It was considered that any possible surviving historical evidence (if any) would be restricted to:

- Any previously undetected traces of the 'old road' (theme: Penal settlement)
- Tree stumps with springboard notches (theme: Industry and manufacturing [forestry])
- Moveable items associated with past timber harvesting (theme: Industry and manufacturing [forestry])

7 FIELD SURVEY

7.1 Conduct and coverage

A pedestrian survey of the project area was undertaken by the consultant with the assistance of Dunghutti Elder Bob Mumbler on the 13th of May 2016, and Jason Holten (Birpai LALC sites officer) on the 20th of June 2016. The consultant additionally inspected the route of the historic 'old road' in the vicinity of Extension and Thurlings Roads on the 26th of June 2016.

Due to negligible surface visibility and exposure within the forest, the survey focused on roads, trails and their immediately adjoining land, in conjunction with visual scanning to locate any 'old growth' trees and tree stumps with the potential for cultural marking. While including a sample of all individual landforms to be affected by the proposed landfill expansion, a proportional emphasis was placed upon spur crests and footslopes of possible archaeological sensitivity, as identified in the Section 5.5 predictive model. The three

previously registered Aboriginal artefact scatter locations within the project area (CWD 1, CWD 3 and CWD 4) were intensively searched.

For reporting purposes, the project area to be directly impacted by the proposed landfill expansion was divided into five separate survey units, delineated on the basis of a combination of landform and available road/trail alignments. Given that its continued use and maintenance would be required if proposed landfill Stages 1 and 2 are approved, the northern section of the western boundary road (former 9.1 Trail) adjacent to the existing landfill formed a sixth survey unit. Start and endpoints of survey units were recorded by a hand-held (non-differential) GPS (Garmin Oregon 650) set to supply GDA94/MGA94 map grid coordinates. The older AGD map grid coordinates given for registered Aboriginal sites CWD 1, CWD 3 and CWD 4 were converted to GDA94/MGA94 to assist with re-location of these sites (tool-online. com/index/sytemes-coodinates/australia.html).

Land covered by the detailed field survey was inspected by two surveyors spaced a maximum of 5m apart, and is indicatively mapped on Figure 6 and described in Table 4.

Table 4. Environmental context of survey units

Survey unit	Landform	Disturbance	Sources of exposure
Western boundary road south	Spur crest	Formed gravel road, table drains, roadside clearing and slashing	Road verges, table drains and adjacent clearings
Extension Road	Spur crests, hillslopes, drainage depression	Unformed road, some roadside clearing and slashing	Road formation, verges and adjacent clearings
Thurlings Road	Spur crest, hillslopes, drainage dpresssion	Formed and unformed gravel road, some roadside clearing and slashing	Road formation, verges and adjacent clearings
Nothern boundary road	Spur crest, hillslope, drainage depression	Unformed road, some roadside clearing	Road formation and adjacent clearings
Forestry trails	Spur crests, hillslope, drainage depression	Unformed vehicle tracks	Vehicle tracks
Western boundary road north	Spur crest	Formed gravel road, table drains, roadside clearing and slashing	Road verges, table drains and adjacent clearings

To provide data suitable for evaluating effectiveness of the survey, variables constraining artefact detection were estimated for each of the survey units. These include an estimation of the mean frequency with which surface exposures were encountered, as well as an estimation of the likelihood of those exposures revealing archaeological evidence on the present surface. Once the variables of visibility and exposure are taken into account, it is estimated that 50% of the survey sample (within the project area) was subject to effective coverage (Table 5), including 30.7% of spur crests, 68.7% of hillslopes and 47.9% of drainage depressions (Table 6). This amounts to effective coverage of 3.4% of the total 35ha project area.

Considering the topography and disturbance history of the project area, the distribution of ground covered on foot, and the environmental context of land that provided useable exposures, the effective survey sample is deemed to have been satisfactory for the purposes of assessing the nature and extent of the archaeological resource.

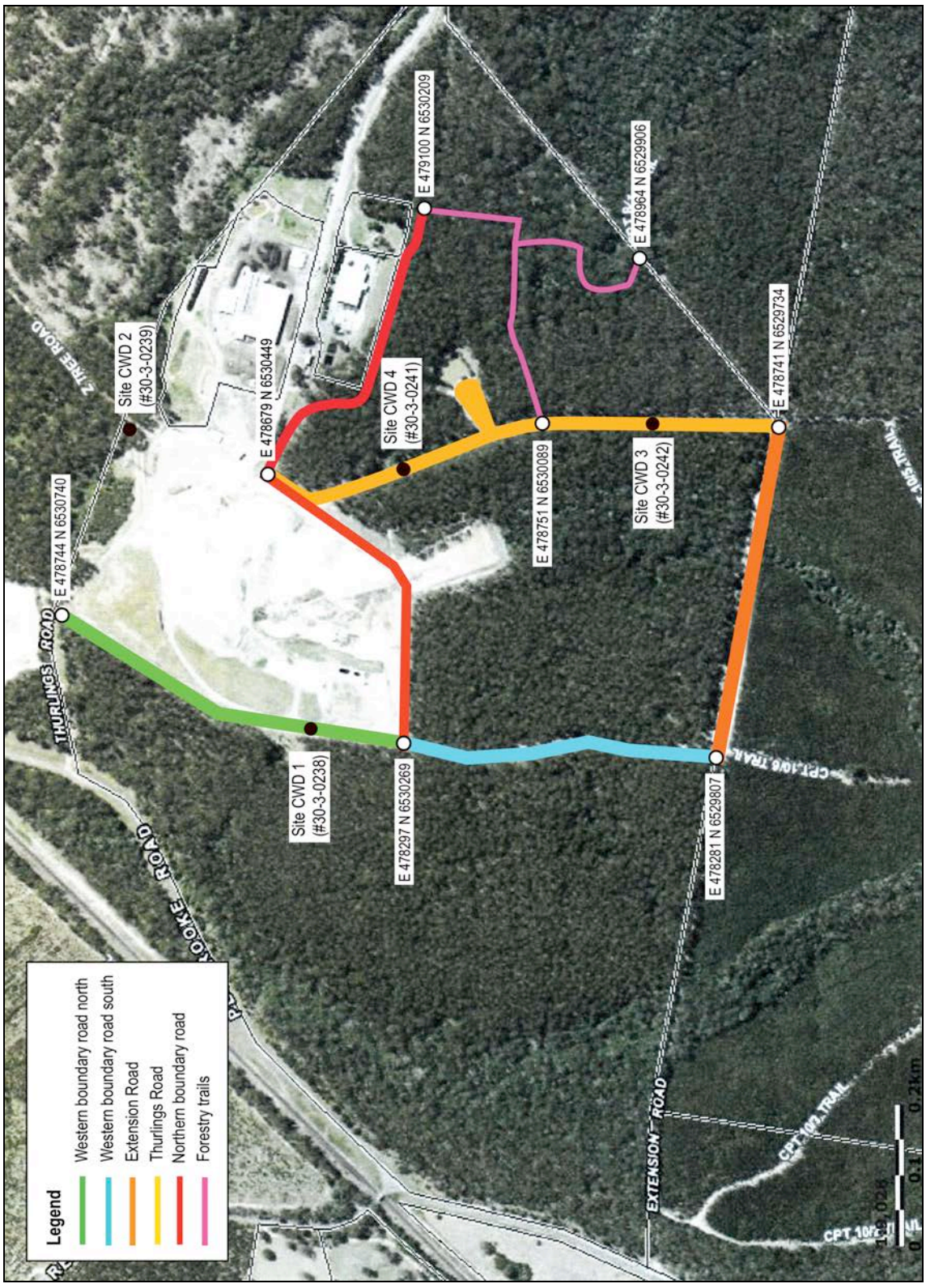


Figure 6. Field survey units and locations of previously registered Aboriginal sites (Base map source: SIX maps 2016)

Table 5. Survey coverage details

Survey unit/Landform	Unit area (m^2)	Visibility %	Exposure %	Effective coverage area (m2)	Effective coverage %
Within project area					
Western boundary road south					
Spur crest	5,000	80	30	1,200	24
Extension Road					
Spur crest	400	80	50	160	40
Hillslope	4,750	90	90	3,848	81
Drainage depression	1,000	20	50	100	10
Thurlings Road					
Spur crest	3,870	70	50	1,355	35
Hillslope	500	70	70	245	49
Drainage depression	1,500	80	90	1,080	72
Nothern boundary road					
Spur crest	750	70	70	368	49
Hillslope	4,150	90	80	2,988	72
Drainage depression	250	90	70	158	63
Forestry trails					
Spur crest	50	80	30	12	24
Hillslope	1,310	70	30	275	21
Drainage depression	60	50	30	9	15
Total	23,590			11,798	50
Outside project area					
Western boundary road north					
Spur crest	2,825	80	30	678	24

Table 6. Summary of survey coverage per landform type

Landform	Landform area (m^2)	Area effectively surveyed (m^2)	% of landform effectively inspected	Number of sites detected	Number of artefacts/features detected
Within project area					
Spur crest	10,070	3,095	30.7	0	0
Hillslope	10,710	7,356	68.7	0	0
Drainage depression	2,810	1,347	47.9	0	0
Total	23,590	11,798	50.0	0	0
Outside project area					
Spur crest	2,825	678	24.0	0	0

7.2 Results

7.2.1 Aboriginal cultural heritage

No evidence of Aboriginal occupation or use was detected during the field survey, nor were any PADs identified.

No traces of the two small stone artefact scatters CWD 3 and CWD 4 previously recorded along Thurlings Road within the project area were found despite repeated inspection of the site locations and their surrounds. It was evident that Thurlings Road had been

upgraded since the 1998 recording of these sites, which together comprised four visible artefacts, of which two were found on the road surface and two on the road margins (Collins 1998:39-40).

7.2.2 Non-Aboriginal cultural heritage

No evidence of the 'old road' (culverts, wheel ruts etc), or any other historical sites, relics or PADs were identified during the field survey.

8 SIGNIFICANCE AND IMPACT ASSESSMENT

Unlike aspects of the natural environment, cultural heritage sites and places are social constructs that have no intrinsic significance- "cultural heritage places are not alive in themselves, people give them 'life' and meaning by the way they treat them and by the way they think and feel about them. … their value lies entirely within human culture" (Byrne *et al* 2001:22-23). The degree and type of value of a place will be different for various groups and individuals. All places are not equally significant or important, and consequently are not equally worthy of conservation and management (Pearson and Sullivan 1999:17). Assessments of significance thus form the basis for management decisions and inform the development of impact mitigation strategies where these are warranted.

Significance assessments in Australia are guided by the ICOMOS Burra Charter, which defines cultural significance as the: ”aesthetic, historic, scientific, social or spiritual value for past, present or future generations” (Australia ICOMOS 2013).

8.1 Aboriginal cultural heritage

8.1.1 Principles and significance assessment process

As outlined by the OEH (2011) in relation to Aboriginal cultural heritage:

- Social/cultural value can only be identified through consultation with Aboriginal people, and refers to the spiritual, traditional, historical or contemporary associations and attachments that a place or area has for these people.
- Historic value refers to the associations of a place with an historically important person, event, phase or activity in an Aboriginal community. Historic places do not always have physical evidence of their historical importance.
- Scientific/archaeological value refers to the importance of a landscape, area, place or object because of its rarity, representativeness, and the extent to which it can contribute to further understanding and information.
- Aesthetic value refers to the sensory, scenic, architectural and creative aspects of the place.

Each of the above criteria is assessed in terms that allow a significance level (high, moderate or low) to be assigned.

8.1.2 The project area

As advised by representatives of the registered Aboriginal parties involved in this assessment (see Section 5.2) and Elders/ knowledge-holders consulted for the 1998 assessment (Collins 1998:9-10), the CWMF property, including the area to be affected by the proposed landfill expansion, does not contain or encroach upon any known modified or unmodified sites/places of special traditional, historic or contemporary Aboriginal social/cultural significance or attachment.

The field survey conducted for the previous EIS resulted in the recording/registration of three small stone artefact scatters (sites CWD 1, CWD 3 and CWD 4) within the present project area (Figure 6). All three of the artefact scatters had been disturbed by forestry roads/trails and were assessed to have a low level of scientific/archaeological significance (Collins 1998). The significance assessment was based upon the disturbance context of the sites, the small number and types of identified artefacts, the limited potential for the occurrence of additional undetected artefacts, and the associated lack of any further research potential. It was noted that numerous small artefact scatters have been recorded within the Port Macquarie Hastings State Forests, representative samples of which have been preserved within forestry protection (PMP) zones (Collins 1998:46).

The field survey undertaken for the current assessment found the then already disturbed CWD 3 and CWD 4 site locations to have been further affected by upgrading of Thurlings Road since 1998. Even if broken by construction machinery, the recorded (and any associated undetected) CWD 3 and CWD 4 artefacts are expected to survive (dispersed) somewhere within each of the registered localities. The absence of any detectable artefacts either on the road, the road verges or adjacent clearings nevertheless supports Collins' 1998 contention that sites CWD 3 and CWD 4 represent single-use activity locations only, and that both have limited further

archaeological potential. The survey findings, in liaison with advice from the Aboriginal field representatives, also support the 1998 report in assessing sites CWD 3 and CWD 4 to be of low social/cultural and scientific/archaeological significance.

Site CWD 3 (two unmodified flakes) and site CWD 4 (two unmodified flakes) would be destroyed by Stage 3 of the proposed landfill expansion (Table 3). Site CWD 1 was destroyed under a duly approved AHIP (Consent to Destroy [with Salvage] #N37/CDS/2000) during the course of initial development of the CWMF. The CWD 1 artefacts were reportedly collected by then Birpai LALC senior sites officer Lindsay Moran (pers comm. 25/10/2016) and retained by the Land Council under a Care and Control Permit (#N39/CC/2000).

The available background data and survey results indicate that the project area is highly unlikely to have ever contained large open campsites/dense artefact occurrences like those recorded near the banks of the Hastings and Wilson Rivers (Kuskie 2010). However, in view of the low overall effective survey coverage able to be achieved by the current and past field surveys, it is clear that some undetected small artefact scatters and isolated artefacts may be impacted by the proposed landfill expansion. All of these, if present, will have been displaced through development of forestry plantations, road/trail construction and related disturbances, such that there is negligible potential for the survival of *in situ* artefacts or sub-surface archaeological deposits of possible scientific/archaeological significance. Like sites CWD 1, CWD 3 and CWD 4, any undetected sites within the project area will have no aesthetic value.

In light of the assessment findings, it is concluded that sub-surface testing as permitted under the *Code of Practice for a Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010), more comprehensive sub-surface investigations, and/or monitoring of project earthworks would be highly unlikely to result in the detection/salvage of significant (if any) artefacts and that these management strategies are not warranted.

8.1.3 Consideration of the principles of ecologically sustainable development and cumulative harm

Ecologically sustainable development (ESD) requires the integration of economic, social and environmental considerations in decision-making processes (including decisions made by the OEH in relation to AHIP applications), and can be achieved through application of the following principles:

- the precautionary principle, which holds that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- inter-generational equity, which holds that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- conservation of biological diversity and ecological integrity; and
- improved valuation, pricing and incentive mechanisms such that environmental factors are included in property valuations.

Aboriginal heritage management is largely concerned with the principles of inter-generational equity, and the conservation of natural biological values that still play a central role in the maintenance of Aboriginal cultural identity and attachment to landscape.

The project area is not known as a place of special Aboriginal traditional, historic or contemporary importance. Virtually all of its original vegetation has been long-since replaced by plantation forest with low quality ecological productivity (ERM Mitchell McCotter 1999). It is acknowledged that the proposed development would terminally harm sites CWD 3 and CWD 4, as well as any undetected sites/artefacts that may occur within the new landfill cells. However, the project area represents a disturbed landscape with no realistic potential to contain artefacts or archaeological deposits that could provide any further useful information for the benefit of future generations. Neither does the project area contain visible surface objects or specific locations where archaeological excavation or earthworks monitoring would likely lead to the collection/salvage of artefacts/contextual information that could be used for future education and/or research purposes. Arefacts collected from site CWD 1 are legally held and curated by the Birpai LALC under Care and Control Permit #N39/CC/2000, and these already offer opportunities for Aboriginal community education and research as far as the project area is concerned.

Apart from its long-term capacity for waste disposal, the CWMF site was chosen from amongst a number of other viable options because it represented that least likely to harm the environment (ERM Mitchell McCotter 1999:5.81). Proper waste management is essential to the maintenance of a healthy society. The proposed landfill expansion would thus be of inter-generational benefit to the Aboriginal and non-Aboriginal community alike, and would reduce the foreseen need to develop an alternative landfill, which may well have higher cultural heritage and environmental values.

An assessment of the cumulative loss of Aboriginal artefact scatters like those previously recorded at sites CWD 3 and CWD 4 is constrained by the absence of reliable comparative baseline data. Even so, past archaeological surveys and AHIMS indicate that similar sites are reasonably common in both the local and regional contexts. In conjunction with the approved CWMF development, 30.7ha of forest adjoining the western boundary was set aside for conservation, and another 26ha to the south-east was incorporated into the Rawdon Creek Nature Reserve. Notwithstanding the reservation of these two areas and any artefacts they may contain, a sample of potentially less disturbed artefact scatters is extant within Cairncross State Forest, including eleven within 5km of the CWMF (Table 2).

Taking all factors into account, it is concluded that some aspects of Aboriginal inter-generational equity would be compromised by the landfill expansion, but that these have been mitigated by the conservation of adjacent forest, and would be further mitigated by the provision of a landfill that would not require alternative impact upon land of potentially higher cultural heritage value over the next 40 years. Considering the disturbance context of sites CWD 3 and CWD 4, and any undetected sites/artefacts that may occur, the available evidence (including that provided on behalf of the registered Aboriginal parties) indicates that the proposed landfill expansion would not unduly affect the local or regional archaeological record.

8.2 Non-Aboriginal cultural heritage

The project area encompasses part of the alignment of an 'old road' believed to have been constructed by convicts around 1828. Apart from this road and more recent forestry, the project area is not known to have been subject to historical development. Consistent with previous findings (ERM Mitchell McCotter 1999:5.52-5.53) and disturbance caused by plantation forest establishment, no physical evidence of the old road or historical timber harvesting was found during the field survey, nor is it likely that any undetected historical evidence will survive.

In terms of the guidelines for *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Branch 2009), it is concluded that the project area has a negligible chance of containing significant (or indeed any) non-Aboriginal sites or relics, and that the proposed landfill expansion would have no adverse impact upon non-Aboriginal cultural heritage values.

On the basis of this assessment, no further historical research, archaeological investigation and/or monitoring of project earthworks is considered to be warranted or necessary ahead of or in conjunction with project approval.

9 MANAGEMENT RECOMMENDATIONS

The following management recommendations were formulated in liaison with the registered Aboriginal party field representatives and have been endorsed by the Birpai Local Aboriginal Land Council and the Dunghutti Elders Council Aboriginal Corporation.

1) It is recommended that no further heritage investigation or development monitoring be required in conjunction with project approval. However, Recommendations 2 and 3 should be implemented as a precaution against harming archaeological materials.

2) Prior to their on-site involvement, all personnel engaged for tree clearing and topsoil stripping should undergo a general site induction that provides information on legal obligations with respect to Aboriginal objects and non-Aboriginal relics, including 'stop-work' conditions applicable in the event that any identified or suspected heritage objects/relics are discovered at any time (see Recommendation 3).

   A register should be kept of all persons inducted. The register should include dates, names and signatures of those inducted, the name of the person carrying out the induction, and an acknowledgement that heritage requirements have been explained and understood.

3) In the event that any identified or suspected Aboriginal objects or historical relics are detected at any time, all disturbance work should immediately cease within 20m of the find and temporary protective fencing erected around this 'no-go zone' pending further management advice from the OEH (Planning and Aboriginal Heritage Section, North Coast Region). If the find consists of or includes human remains, the NSW Police Department and the OEH Environmental Line (ph 131 555) should also be notified as soon as practicable.

   Works may not recommence within the designated 'no-go zone' until formal written clearance to do so has been given by the OEH in consultation with the registered Aboriginal parties and the NSW Police Department (if applicable).

4) PMHC should provide the OEH AHIMS Registrar with Aboriginal Site Impact Recording Forms for sites CWD 3 and CWD 4 once these sites these are affected by the project. Even though an AHIP is not required for projects approved under Part 4 of the *EP&A Act 1979*, reporting on the location and condition of Aboriginal sites remains a mandatory legal obligation.

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GLOSSARY

ARCHAEOLOGICAL SITE
A place containing cultural materials of sufficient quality and quantity to allow inferences about human behaviour at that location (Plog *et al* 1978:383).

ARTEFACT
An object or specimen produced by human agency. An artefact can usually be collected without being destroyed. This is in contrast to features, which are destroyed or dismantled after collection. All Aboriginal lithic debitage and tools are considered artefacts (Andrefsky 2005:252).

CHERT
A dense, extremely hard, microcrystalline or cryptocrystalline siliceous sedimentary rock, consisting mainly of inter-locking quartz crystals, sub-microscopic and sometimes containing opal (amorphous silica). Chert occurs mainly as nodular or concretionary aggregations in limestone and dolomite, and less frequently as layered deposits (banded chert). It may be an organic deposit (radiolarian chert), an inorganic precipitate (the primary deposit of colloidal silica), or a siliceous replacement of pre-existing rocks (Lapidus 1987:102).

CREST
Landform element standing above all or most points in the adjacent terrain. Usually smoothly convex (Speight 1990:13).

DRAINAGE DEPRESSION
A level to gently inclined, long, narrow, shallow open depression with smoothly concave cross-section, rising to moderately inclined side slopes, eroded or aggraded by sheet wash (Speight 1990:30).

FLAKE
A piece of stone detached from a larger mass by the application of force and having a feather, hinge or step termination and a bulb of percussion. A platform may be present if the proximal end is unbroken (Crabtree 1972:64).

FLAKED PIECE
Chipped artefacts with negative flake scars which cannot be classified as a flake, core or retouched flake (Hiscock 1988:64).

FOOTSLOPE
A moderately to very gently inclined waning lower slope resulting from aggradation or erosion from sheet flow, earth flow or creep (Speight 1990:31).

HILLSLOPE
A gently inclined to precipitous slope, commonly simple and maximal, eroded by sheet wash, creep, or water-aided mass movement (Speight 1990:31).

MUDSTONE
A commonly-used synonym for Mudrock. A fine-grained sedimentary rock composed chiefly of particles in the silt-clay size range. Mudrock/mudstone is a general term used to distinguish the finer-grained sedimentary rocks from sandstones or limestones (Lapidus 1987:362).

MULTI-PLATFORM CORE
A core with at least one negative scar running in a different direction to the remainder. Multi-directional scars indicate that the core has been rotated to get the most economical use of the raw material (Hiscock 1986:49).

OPEN DEPRESSION
A landform element with a lower outlet which stands below all, or almost all,
points in the adjacent terrain (Speight 1990:15).

RETOUCH
The intentional modification of a stone tool edge by either pressure or percussion flaking (Andrefsky 2005:260).

RIDGE
A compound landform element comprising a narrow spine crest and its immediately adjoining slope with the spine length being greater than the width (Speight 1990:19).

SCARRED TREE
Aboriginal scarred trees are trees that have been scarred by Aboriginal people through the removal of bark or wood for a variety of commonplace tasks, including the construction of bark shelters, watercraft and containers. Other forms of Aboriginal tree wounding include deliberate marking (such as tree carving), the removal of wood for artefact manufacture, and cuttings made to collect food and assist with tree climbing (toe-holds). Early European settlers also stripped bark from trees, though for a more limited range of uses, especially the weather-proofing of buildings and other structures (Long 2005:6-7).

SILTSTONE
A fine-grained sedimentary rock principally composed of silt-grade material. Intermediate between sandstone and shale, siltstone contains less clay than shale and lacks its fissility and fine laminations (Lapidus 1987:474).

SPUR
Landform element comprising a lower, subsidiary ridge leading down from a locally dominant ridge or crest (Packard 1992:100).

STONE ARTEFACT
A fragment of stone that generally possesses one or more of the following characteristics:
• Positive or negative ring crack
• Distinct positive or negative bulb of force
• Definite eraillure scar in position beneath a platform
• Definite remnants of flake scars (ie dorsal scars and ridges)
These traits indicate the application of an external force to a core, and are characteristic of the spalls removed by humans using direct percussion. Stone artefacts which have none of the above may be identified as such if they possess ground facet/s characteristic of human industry (Hiscock 1984:128).

VALLEY FLAT
A small, gently inclined to level flat, aggraded or sometimes eroded by channelled or over-bank stream flow, typically enclosed by hillslopes (Speight 1990:34).

VOLCANIC ROCK
Very fine-grained or glassy igneous rock produced by volcanic action at or near the earth's surface, either extruded as lava or expelled explosively (Lapidus 1987:535).

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APPENDIX A: DPE Secretary's Environmental Assessment Requirements (SEARs) for the EIS

NSW GOVERNMENT Planning & Environment

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Mr Gordon Cameron
Principal Waste and Environmental Engineer
Port Macquarie-Hastings Council
PO Box 84
Port Macquarie NSW 2444

Dear Mr Cameron

Secretary's Environmental Assessment Requirements
Cairncross Waste Management Facility, Port Macquarie-Hastings (SSD 13_5792)

Thank you for your letter dated 24 February 2015 seeking to amend the development description and consult further with Secretary in respect of the environmental assessment requirements issued to Port Macquarie Hastings Council on 14 February 2013. I have attached a copy of amended requirements for the development proposal

These amended requirements are based on the information you have provided to date. You should also refer to the government agency submissions submitted for the original environmental assessment requirements.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the development within two years. Once lodged, the Department will review your EIS carefully before putting it on public exhibition, and will require you to submit an amended EIS if it does not adequately address the requirements.

The Department notes that the proposed landfill would have capacity to operate for over 79 years at the predicted rate of waste input. This time frame raises some issues about whether the design and operational parameters of the landfill might begin to fall behind the community's expectation for such facilities after 20 to 30 years or so; and whether such capacity may slow or discourage continued development of waste recovery so that the amount of landfill waste is minimised.

Both waste recovery and best practice landfill design and operation are matters for consideration under clause 123 of the *State Environmental Planning Policy (Infrastructure) 2007*. Consequently, these matters will require expert analysis in the EIS. The proposed development of the landfill must be justifiable against the NSW Government's waste policy. Consideration should be given to a staged approach to developing the landfill so that the design and operation of future components can be reviewed in-line with future community's expectations and best practice.

When preparing the landfill proposal and justification, the Department would like to request that Council consult extensively with both the EPA's Waste Strategy Team and the Department's Industry Assessment Team to ensure that the issues surrounding long term best practice and waste recovery are given robust consideration.

Department of Planning & Environment
23-33 Bridge Street Sydney NSW 2000 | GPO Box 39 Sydney NSW 2001 | T 02 9228 6111 | F 02 9228 6455 | **www.planning.nsw.gov.au**

The Department also notes that the site currently operates under a separate consent. The Department prefers operations like the Cairncross Waste Management Facility to operate under a single, modern planning approval. Consequently, the Department encourages you to develop the project with this preference in mind, and to consider surrendering all of the existing planning approvals for the facility if the project is approved.

I wish to emphasise the importance of effective and genuine community consultation and the need for proposals to proactively respond to the community's concerns. Accordingly a comprehensive, detailed and genuine community consultation and engagement process must be undertaken during preparation of the EIS. This process must ensure that the community is both informed of the proposal and is actively engaged in issues of concern to them. Sufficient information must be provided to the community so that it has a good understanding of what is being proposed and of the potential impacts.

Your proposal may require a separate approval under Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). If an EPBC Act approval is required, I would appreciate it if you would advise the Department accordingly, as the Commonwealth approval process may be integrated into the NSW approval process, and supplementary DGR's may need to be issued.

I would appreciate it if you would contact the Department at least two weeks before you propose to submit the development application and EIS for your development. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*);
- consultation and public exhibition arrangements; and
- determine the number of copies (hard-copy and CD-ROM) of the EIS required for review.

If you have any enquiries about these requirements, please contact Emma Barnet on the details above.

Yours sincerely,

Chris Ritchie 7/5/15.
Manager
Industry Assessments
As delegate of the Secretary

Secretary's Environmental Assessment Requirements

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 13_5792
Development	The Cairncross Waste Management Facility which involves extending the operational life of the existing Cairncross landfill, and includes: • the staged construction of new landfill cells; and • progressively increasing the annual waste acceptance rate at the landfill.
Location	8395 Pacific Highway, Telegraph Point, NSW (Lot 5 DP 1041766, Lot 6 DP 1106420 and Part Lot 7 DP1106420)
Applicant	Port Macquarie-Hastings Council
Date of Issue	May 2015
General Requirements	The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In addition, the EIS must include a: • clear description of the existing operations carried out on the site and how the site operates lawfully under the *Environmental Planning and Assessment Act 1979;* • detailed description of the development, including: – need for the proposed development having particular regard to the aims, objectives and guidance in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021*; – justification for the proposed development; – likely staging of the development - including construction, and operational stage/s; – likely interactions between the development and existing, approved and proposed operations in the vicinity of the site; and – plans of any proposed building works. • consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments; • risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment; • detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: – a description of the existing environment, using sufficient baseline data; – an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; – a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and

	• a consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS. The EIS must also be accompanied by a report from a qualified quantity surveyor providing: • a detailed calculation of the capital investment value (as defined in clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; • a close estimate of the jobs that will be created by the development during the construction and operational phases of the development; and • certification that the information provided is accurate at the date of preparation.
Key Issues	The EIS must address the following specific matters: • **Strategic Landuse Planning** – including: – demonstration that the proposal is generally consistent with the aims and objectives of all relevant environmental planning instruments and strategies including, but not limited to, *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP), the *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021*, *NSW State Plan 2021 – Goal 23*, the *Waste Avoidance and Recovery Act 2001*, the *National Waste Policy*, *Port Macquarie-Hastings Local Environment Plan 2011*, *Waste and Resource Management Strategy 2011-15* (Port Macquarie-Hastings Council), and relevant Development Control Plans; – justification for any inconsistency between the proposed development and these plans; – consideration of the NSW government's investment in new technologies and infrastructure to drive recycling and reuse under the Waste Less, Recycle More Initiative; – demonstration that the landfill construction and operation can be staged to ensure that the design remains current and in line with best practice at the time; and – details on the suitability of the site for the proposed development. • **Waste Management** – including: – identification, classification and quantification of the likely waste streams that would be handled/stored/disposed of at the facility; – a description of how this waste would be treated, stored, used, disposed and handled on site, and transported to the site, and the potential impacts associated with these issues; – an analysis of whether the development is consistent with Clause 123 of the Infrastructure SEPP; – a description of all reasonable and feasible measures that have been or would be implemented to maximise resource recovery from the waste stream and reduce the disposal of waste to landfill in line with the aims, objectives and guidance in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-2021*, the EPA's *Guidelines for Composting and Related Organics Processing Facilities*, Council's adopted Waste Strategy, and other government policy; – details of the landfill cell design and integrity in accordance with best practice industry standard guidelines such as the EPA's

	Environmental Guidelines: Solid Waste Landfills; – a description of the staged approach to developing the landfill so that the design and operation of future components can be reviewed in-line with future community's expectations and best practice; and – operational measures to manage litter and waste that is illegally dumped on adjacent properties including Rawdon Creek Nature Reserve. • **Flora and Fauna** – including: – an assessment of the proposal under the Framework for Biodiversity Assessment (Oct 2014) including an assessment of any potential impacts on riparian vegetation and groundwater dependant ecosystems. • **Soil, Water and Leachate** – including: – the proposed erosion and sediment controls during construction and operation; – consideration of potential acid sulfate soils, salinity, soil contamination; – a site water balance, including a detailed description of the measures to minimise the water use at the site; – a detailed assessment of the potential impacts of the project on the quantity, quality and long-term integrity of the surface and groundwater resources in the area, including baseline data of existing conditions, potential flooding impacts and potential impacts on Rawdon Creek; – the proposed stormwater management system, including the capacity of onsite detention systems, and measures to treat, reuse or dispose of water; and – the proposed leachate management system including the capacity of the system to treat and dispose of leachate. • **Air Quality and Odour** – including: – a quantitative assessment of the potential air quality and odour impacts of the development on surrounding receivers, including impacts from construction, operation and transport; and – details of the proposed mitigation, management and monitoring measures. • **Noise and Vibration** – including: – quantitative assessment of potential construction, operational and transport noise and vibration impacts, including potential impacts on nearby sensitive receivers; and – details of the proposed noise management and monitoring measures. • **Traffic** – including: – details of all traffic types and volumes likely to be generated; – assessment of predicted impacts on road safety and the capacity of the road network to accommodate the project; and – assessment of where off site infrastructure works are required as a result of traffic impacts. • **Greenhouse Gas** – including: – a quantitative assessment of the scope 1, 2 and 3 greenhouse gas emissions of the project; and – a detailed description of the measures that would be implemented to minimise the methane emissions of the proposed landfill operations and ensure that the project is energy efficient. • **Rehabilitation** – including:

	– a detailed description of how the site would be progressively rehabilitated, revegetated, and integrated into the surrounding landscape, including measures to ensure that the final landform is free draining; – a justification for the proposed final landform and use, taking into consideration any relevant strategic land use planning or resource management plans or policies; and • a detailed description of the measures that would be put in place to ensure sufficient resources are available to implement the proposed rehabilitation measures, and the ongoing management of the site following the cessation of landfilling activities. • **Heritage** - both Aboriginal and non-Aboriginal; • **Visual impacts;** • **Hazards and risks;** and • **Biosecurity, pests and vermin.**
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents.
Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with: • Environment Protection Authority; • Office of Environment and Heritage; • Department of Primary Industries; • Roads and Maritime Services; and • the local community and stakeholders. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.
Further consultation after 2 years	If you do not lodge an EIS for the development within 2 years of the issue date of these DGRs, you must consult with the Director-General in relation to the requirements for lodgement.
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, Attachment 1 contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this development.

APPENDIX B: OEH recommendations for DPE Secretary's Environmental Assessment Requirements (SEARs) in relation to Aboriginal cultural heritage (excerpt from Attachment 1 of correspondence from OEH to DPI, 7th February 2013)

1. Whether the proposal is consistent with any floodplain risk management plans.
2. Whether the proposal is compatible with the flood hazard of the land.
3. Whether the proposal will significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties.
4. Whether the proposal will significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.
5. Whether the proposal incorporates appropriate measures to manage risk to life from flood.
6. Whether the proposal is likely to result in unsustainable social and economic costs to the community as a consequence of flooding.
7. The EIS needs to provide full details of the flood assessment and modelling undertaken in determining any design flood levels (if applicable), including the 1 in 100 year flood levels.
8. In addition, the assessment should include a sensitivity assessment of the potential impacts of an increase in rainfall intensity and runoff (10%, 20% and 30%) due to climate change on the flood behaviour for the 1 in 100 year design flood.
9. Surface water management controls, coupled with comprehensive leachate, groundwater and surface water monitoring programs must adequately demonstrate and have in place measures that prevent any poor water quality impacting the Hastings River Estuary.

5 Aboriginal Cultural Heritage

OEH recommends that the following Aboriginal cultural heritage issues be addressed by the proponent in preparing the EIS.

Existing Aboriginal cultural heritage values

OEH acknowledges the existence of numerous registered Aboriginal sites in the regional locality. These include culturally modified trees, isolated finds, camp sites, artefact scatters and Potential Archaeological Deposits (PADS). It is also acknowledged that the project area contains landforms which have yielded a significant volume of evidence of Aboriginal occupation. It is therefore recommended that the proponent consider any potential impacts of the proposal on these known Aboriginal sites/objects, the sensitivity and significance of these sites to the traditional Aboriginal knowledge holders and any relationship that may exist between these sites and any Aboriginal cultural heritage values of the project area.

Potential impacts of the project on Aboriginal cultural heritage values

Standard requirements:

1. The EIS must address and document the information requirements set out in the draft '*Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*' (Department of Environment and Conservation 2005). This document is available from Department of Planning and Infrastructure upon request.
2. The EIS must include surveys by suitably qualified archaeological consultants in consultation with all of the local Aboriginal knowledge holders.
3. The EIS should identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area and clearly articulate strategies proposed to avoid/minimise these impacts.

3

If impacts are proposed as part of the final development, clear justification for such impacts should be provided.

4. The EIS must assess and document the archaeological and Aboriginal significance of the site's Aboriginal cultural heritage values.

5. Describe the actions that will be taken to avoid or mitigate impacts of the project on Aboriginal cultural heritage values. This must include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented. Any proposed methodology for Aboriginal cultural heritage investigation should reflect best practice standards recommended by OEH in the '*Code of Practice for Archaeological Investigations of Objects in New South Wales (2010)*'.

6. The EIS must provide documentary evidence to demonstrate that effective community consultation with Aboriginal communities has been undertaken in assessing impacts, developing protection and mitigation options and making final recommendations. OEH supports broad-based Aboriginal community consultation and as a guide OEH's '*Aboriginal cultural heritage consultation requirements for proponents 2010*' provides a useful model to follow. This requirement is available on OEH's website at:
www.environment.nsw.gov.au/licences/consultation.htm.

7. If impacts on Aboriginal cultural heritage values are proposed as part of the final development, an assessment of the proposed impacts in the context of '*inter generational equity*' and cumulative impact must be undertaken. This assessment must examine both cultural and archaeological perspectives equally at both the local and regional levels, with consideration given to the site level and broader landscape level.

Note: If the EIS is relying on past surveys it is critical to confirm that the surveys are consistent with the requirements of the above Major Project application guidelines. Further, whilst there may be no requirement for obtaining an Aboriginal Heritage Impact Permit (AHIP) under Part 6 of the *National Parks and Wildlife Act 1974* (NPW Act) for projects approved under the provisions of Part 4 of the *Environmental Planning and Assessment Act 1979,* there are other sections of the NPW Act which remain valid. This includes the requirement to obtain a Care Agreement for salvaged objects (Section 85) and reporting to OEH on the status of new or impacted Aboriginal sites (Section 89A).

6 Biodiversity

OEH acknowledges that the proposal appears to only involve the clearing of plantation native vegetation (as stated in the Preliminary Environmental Assessment [PEA]). However, this may still provide habitat to threatened species and/or populations, and as such, where applicable, an appropriate assessment (including relevant surveys) must be conducted in accordance with the following recommendations. OEH considers surveys undertaken for the original EIS would now be out-dated and would need to be re-done in accordance with current guidelines and methodologies. Furthermore, OEH notes that the PEA indicates that as part of the original EIS carried out in 1999, it was determined that the proposal would not significantly impact on threatened species. OEH considers that this appraisal is now out-dated, given that it does not include taxa added to the *Threatened Species Conservation Act 1995* (TSC Act) after 1999. OEH recommends that an appropriate assessment of threatened species, populations, ecological communities and their habitats be conducted in accordance with the following guidance. The following should be used as guide where applicable.

Biodiversity impacts can be assessed using **either** the BioBanking Assessment Methodology (scenario 1) or a detailed biodiversity assessment (scenario 2). The requirements for each of these approaches are detailed below.

The BioBanking Assessment Methodology can be used **either** to obtain a BioBanking statement, or to assess impacts of a proposal and to determine required offsets without obtaining a statement. In the latter instances, if the required credits are not available for offsetting, appropriate alternative options may be developed in consultation with the OEH and in accordance with OEH policy.

Cairncross Landfill EIS- Aboriginal Consultation Log

Date	Stakeholder/other contact	Contact person	Summary of consultation
11/06/15	Office of Environment and Heritage	Rosalie Neve, Aborignial Heritage Planning Officer	Email requesting OEH list of Aboriginal parties who may have an interest in the Port Macquarie Hastings LGA for consultation purposes.
15/06/15	Office of Environment and Heritage	Dimitri Young, Team Leader Planning, NE Region	Email letter received with list of known Aboriginal parties that OEH considers likely to have an interest in the proposal. Hard copy later received by post.
	National Native Title Tribunal		Request for search of tribunal registers (on application form downloaded from website: nswenquiries@nntt.gov.au) emailed.
	Office of the Registrar, Aboriginal Land Rights Act 1983		Letters mailed with a brief oveview of the proposal, including a location map and the name and contact details of the proponent, requesting that each organisation notify the consultant of any Aboriginal parties who may have an interest in the proposal and hold knowledge relevant to determining cultural significance. Advice requested by mail or email by 06/07/15.
	NTSCorp Limited		
	Port Macquarie Hastings Council	The General Manager	
16/06/15	Birpai Local Aboriginal Land Council	Steven Miles, CEO	Letters mailed to all organisations on OEH list with a brief overview of the proposal, maps and additional information as per the Stage 1 ACH consultation requirements for proponents 2010. Stakeholder registration required in writing by 06/07/15.
	Saltwater Tribal Council		
	Ghinni Ghinni Youth and Culture Aboriginal Corporation		
	Bindi Aboriginal Heritage and Culture Centre Inc.		
	Sunrise Guiwan Biripi Elders Corporation		
	Lakkari NTCG	Mick Leon	
18/06/15	National Native Title Tribunal	Dianne Drake, Case Manager	Email response to register search request, advising no relevant entries in databases.
26/06/15	Port Macquarie News		Newspaper advertisement inviting registration of relevant Aboriginal knowledge-holders. Responses required by 10/07/15.
30/06/15	Office of the Registrar, Aboriginal Land Rights Act 1983	Sally Porter, Administration Officer	Mail response to letter dated 15/06/15, advising that the project area "does not appear to have Registered Aboriginal Owners pursuant to Division 3 of the Aboriginal Land Rights Act 1983 (NSW)". Suggested contact the Birpai LALC.
1/07/15	Camden Haven Courier		Repeat of newspaper advertisement inviting registration of relevant Aboriginal knowledge-holders. Responses required by 10/07/15.

Date	Stakeholder/other contact	Contact person	Summary of consultation
13/07/15	Office of Environment and Heritage	Dimitri Young, Team Leader Planning, NE Region	Letter mailed advising nil response to Stage 1 letters and newspaper advertisement (copies attached). Advised that due to his past experience, local knowledge-holder Lindsay Moran would be fully involved in the assessment.
	Birpai Local Aboriginal Land Council	Steven Miles, CEO	
15/07/15	Birpai Local Aboriginal Land Council	Mike Vegter, Actng CEO	Email advising resignation of CEO Steven Miles. No objection to participation of Lindsay Moran.
18/08/15	Dunghutti Elders Council	Ngaire Matthews, General Manager	Phone message advising Dunghutti Elders' wish to be involved in the assessment.
31/08/15	Dunghutti Elders Council	Ngaire Matthews, General Manager	Phone call to Ngaire Matthews advising that despite late response, the Dunghutti Elders Council will be included in forthcoming counsultation, including participation in the field survey.
15/09/15	Lindsay Moran	Birpai knowledge-holder	Phone call to Lindsay Moran inviting him to participate in the assessment, inlcuding the field survey. Advised wish to be involved.
9/10/15	Dunghutti Elders Council	Ngaire Matthews, General Manager	Letters mailed with overview of the development proposal (including maps), and draft assessment methodology for clearance or amendment before proceeding. Response to draft methodology required by 16/11/15.
	Lindsay Moran	Birpai knowledge-holder	
22/10/15	Lindsay Moran	Birpai knowledge-holder	Phone call supporting draft assessment methodology. No amendments required.
3/11/15	Dunghutti Elders Council	Ngaire Matthews, General Manager	Email advising Uncle Bob Mumbler will be involved in field survey on behalf of the Dunghutti Elders. Will hand on letter sent re draft methodology to Bob Mumbler for suggestions, if any.
13/11/15	Dunghutti Elders Council	Bob Mumbler	Phone message asking for return call.
16/11/15 17/11/15 18/11/15	Dunghutti Elders Council	Bob Mumbler	Phone calls to Bob Mumbler. No answer.
19/11/15	Dunghutti Elders Council	Bob Mumbler	Phone call from Bob Mumbler supporting draft assessment methodology. No amendment required. Scope, purpose and timing of the assessment discussed.
26/04/16	Dunghutti Elders Council	Ngaire Matthews, General Manager	Phone call to Ngaire Matthews advising project planning is now sufficiently advanced to undertake the field survey and wish to engage Bob Mumbler for the survey on 13/05/16. Ngaire recommended making arragements directly with Bob Mumbler.
	Dunghutti Elders Council	Bob Mumbler	Phone call to Bob Mumbler arranging field survey on 13/05/16.
	Lindsay Moran	Birpai knowledge-holder	Phone call to Lindsay Moran arranging field survey on 13/05/16.
13/05/16	Lindsay Moran	Birpai knowledge-holder	Early phone call from Lindsay Moran- cannot attend field survey due to ill health. Phone call response same day advising will arrange for Lindsay to instead come another day once health OK.
	Dunghutti Elders Council	Bob Mumbler	Field survey with Bob Mumbler. No artefacts/sites or PADs identified. No advised development constraints.

Date	Stakeholder/other contact	Contact person	Summary of consultation
6/6/16	Lindsay Moran	Birpai knowledge-holder	Phone call to Lindsay Moran enquiring whether he is yet fit enough for field survey. Advised that he had had a heart attack, was on medication, and would not be able to participate further in the assessment. Lindsay advised that on this basis he was withdrawing his registration of interest.
	Birpai Local Aboriginal Land Council	David Carroll, CEO	Phone call to David Carroll (1st day as CEO) explaining project and consultation undertaken to date, enquiring whether Land Council now wished to be involved. Advised that he will get back to me by the end of the week (10/06/16) with response.
10/6/16	Birpai Local Aboriginal Land Council	David Carroll, CEO	Phone call from David Carroll advising that Birpai LALC does wish to be involved. Ring Jason Holten (sites officer) to arrange inspection.
14/6/16	Birpai Local Aboriginal Land Council	Jason Holten, sites officer	Phone call to Jason Holten arranging field survey on 20/06/16.
20/6/16	Birpai Local Aboriginal Land Council	Jason Holten, sites officer	Field survey with Jason Holten. No artefacts/sites or PADs identified. No advised development constraints.
30/8/16	Birpai Local Aboriginal Land Council	David Carroll, CEO	Draft report posted for review and comment.
	Dunghutti Elders Council	Ngaire Matthews, General Manager	
12/9/16	Birpai Local Aboriginal Land Council	David Carroll, CEO	Letter received from Land Council advising that draft report has been reviewed- no amendments required.
15/9/16	Dunghutti Elders Council	Ngaire Matthews, General Manager	Phone call to Ngarie Matthews enquiring whether draft report received. Ngaire advised unable to find and requested it be re-sent by email.
			Draft report emailed to Ngaire Matthews.
21/9/16	Dunghutti Elders Council	Ngaire Matthews, General Manager	Phone call to Ngaire Matthews to check whether emailed draft report received. Ngaire confirmed received and will supply letter once reviewed.
7/10/16	Dunghutti Elders Council	Ngaire Matthews, General Manager	Letter received from Dunghutti Elders advising that draft report has been reviewed- no amendments required.
25/10/16	Lindsay Moran	Birpai knowledge-holder	Phone call to Lindsay Moran to inform the assessment results and enquire as to whether he had collected artefacts from the CWMF prior to its intitial development, in his then role as Birpai LALC sites officer. Lindsay advised that he had collected CWMF artefacts and handed them on for storage at the Birpai LALC premises. Also advised that the CWMF property not of particular cultural significance- probably marchland between Hastings and Wilson Rivers.

APPENDIX D: ***Aboriginal cultural heritage consultation requirements for proponents 2010***- Copy of letters sent in compliance with Stage 1, Step 4.1.2

From: Jacqueline Collins <jpollins@optusnet.com.au>
Date: 11 June 2015 7:01:44 PM AEST
To: Rosalie Neve <Rosalie.Neve@environment.nsw.gov.au>
Subject: **Cairncross Landfill Expansion**

Dear Ms Neve,

Port Macquarie Hastings Council proposes to extend landfill operations at the existing Cairncross Waste Facility, located within the Port Macquarie Hastings LGA, 3-4km south of Telegraph Point on the mid-north coast.

I have been engaged by Hyder Consulting to assess Aboriginal cultural heritage impacts with respect to the proposed landfill extension area. My assessment would form part of an EIS to be prepared by Hyder Consulting, and requires implementation of the 'Aboriginal cultural heritage consultation requirements for proponents 2010'. As such, I would appreciate if you could email the OEH list of Aboriginal groups/people who may have an interest in the Port Macquarie Hastings LGA and hold knowledge relevant to determining cultural significance values.

Yours Sincerely,



Jacqui Collins
Consultant Archaeologist
Email: jpollins@optusnet.com.au

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone 0427 599137 Email. jpollins@optusnet.com.au

15th June 2015

Office of the Registrar
Aboriginal Land Rights Act 1983
PO Box 112
GLEBE NSW 2037

Dear Sir/Madam,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council* is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility. The subject expansion area is located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point on the NSW mid-north coast (see attached map).

Port Macquarie Hastings Council has commissioned Hyder Consulting to address matters in relation to the proposal, including preparation of an Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the EIS.

To facilitate effective Aboriginal consultation, and in accordance with the *Aboriginal Cultural Heritage Community Consultation Requirements for Proponents 2010* (DECCW 2010), I am seeking your assistance and advice. To this end, I would be most grateful if you could supply me with a list of any 'Aboriginal owners' that you may have on your register for the Port Macquarie Hastings LGA by the 6th of July 2015 (please send your response to me at the letterhead mail or email address).

Yours faithfully,



Jacqui Collins
Consultant Archaeologist

- The General Manager
  Port Macquarie Hastings Council
  PO Box 84 (17 Burrawan Street)
  PORT MACQUARIE NSW 2444

National Native Title Tribunal

Request for Search of Tribunal Registers

*mandatory fields are marked with an asterisk

1. Your details*

NAME:	Jacqueline Collins
POSITION:	Consultant Archaeologist
COMPANY/ORGANISATION:	Adise Pty Ltd
POSTAL ADDRESS:	PO Box 6 Laurieton NSW 2443
TELEPHONE:	0427 599137
EMAIL:	jpollins@optusnet.com.au
YOUR REFERENCE:	Cairncross Waste Management Facility
DATE OF REQUEST:	16/06/2015

2. Reason for your request - please complete either Part A OR Part B*

Part A - Are you a party to a native title proceeding? ☐Yes ☒No

Please provide Federal Court/Tribunal file number/ or application name:

OR

Part B - Do you need to identify existing native title interests to comply with the *Native Title Act 1993* (Cth) or other State/Territory legislation? ☒Yes ☐No

Please provide brief details of these obligations here: Compliance with clause 80C of NPW Regulation 2009 for Aboriginal cultural heritage assessment

3. Identify the area to be searched – please complete either Part A OR Part B*

Part A - Mining tenure

Tenement ref/s:

State/Territory:

OR

Part B - Other tenure type

☒ Crown Land, crown reserve
☐ Agricultural/pastoral lease
☒ Freehold (privately owned)**

State/Territory: NSW

Local Government Area: Port Macquarie Hastings

4. Description (please provide as many details as possible)

Provide any additional details, including maps with landmarks clearly shown

Lot and plan details:	Lot 7 DP 1106420
Property name:	
Pastoral Lease number or name:	
County:	Macquarie
Parish:	Cairncross
Town:	
Section:	
Hundred:	
Northern Territory Portion:	

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone 0427 599137 Email. jpollins@optusnet.com.au

15th June 2015

Native Title Services Corporation Limited
PO Box 2105
Strawberry Hills NSW 2012

Dear Sir/Madam,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council* is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility. The subject expansion area is located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point on the NSW mid-north coast (see attached map).

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Yours faithfully,



Jacqui Collins
Consultant Archaeologist

- The General Manager
  Port Macquarie Hastings Council
  PO Box 84 (17 Burrawan Street)
  PORT MACQUARIE NSW 2444

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone 0427 599137 Email. jpollins@optusnet.com.au

15th June 2015

The General Manager
Port Macquarie Hastings Council
PO Box 84
PORT MACQUARIE NSW 2444

Dear Sir/Madam,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal Stakeholders for Cultural Heritage Assessment

As you are aware, Port Macquarie Hastings Council is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility.

Council has commissioned Hyder Consulting to address matters in relation to the proposal, including preparation of an Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the EIS.

To facilitate effective Aboriginal consultation, and in accordance with the *Aboriginal Cultural Heritage Community Consultation Requirements for Proponents 2010* (DECCW 2010), I am seeking your assistance and advice. To this end, I would be most grateful if you could supply me with details of any Aboriginal persons, groups and/or organisations known to Council, who may hold knowledge of/cultural attachments to the Pembrooke/Telegraph Point locality. I would require this information by the 6th of July 2015 (please send your response to me at the letterhead mail or email address).

Yours faithfully,



Jacqui Collins
Consultant Archaeologist

APPENDIX E: ***Aboriginal cultural heritage consultation requirements for proponents 2010***- Responses to letters sent in compliance with Stage 1, Step 4.1.2

NSW GOVERNMENT Office of Environment & Heritage

Our reference: DOC15/212365
Contact: Rosalie Neve (02) 6659 8221

Ms Jacqui Collins
Adise Pty Ltd
PO Box 6
Laurieton NSW 2443

Dear Ms Collins

RE: Aboriginal Cultural Heritage Impact Assessment – Cairncross Waste Facility**, NSW**

Thank you for your correspondence of 11 June 2015 to the Office of Environment and Heritage (OEH) regarding Aboriginal cultural heritage consultation for the proposed assessment of the abovementioned property which lies in the Port Macquarie Hastingslocal government area. I appreciate the opportunity to provide input.

Please find enclosed a list of known Aboriginal parties for the Port Macquarie Hastings local government area (**Attachment A**) that OEH considers likely to have an interest in the proposal. Note this is not necessarily an exhaustive list of all interested Aboriginal parties. Receipt of this list does not remove the requirement for a proponent/consultant to advertise the proposal in the local print media and contact other bodies and community groups seeking interested Aboriginal parties, in accordance with the OEH '*Aboriginal cultural heritage consultation requirements for proponents 2010*' (the CRs).

OEH would also like to take this opportunity to remind the proponent and consultant to:

- Ensure the project documents the full consultation process in the Aboriginal Cultural Heritage Assessment Report and to include copies of all correspondence sent to or received from all relevant stakeholders (including Aboriginal stakeholders and the agencies listed in section 4.1.2 of the CRs). Omission of these records in the final report may cause delays in the assessment of the Aboriginal Heritage Impact Permit application or require parts of the consultation process to be repeated if the evidence provided to OEH does not demonstrate that the consultation process has been fair, equitable and transparent.

- Ensure OEH is provided with evidence that reasonable attempts have been made to contact the relevant parties associated with the CRs. If this is not provided then OEH will deem that the consultation process has not complied with the CRs. OEH considers evidence of reasonable efforts to contact relevant parties would include, but not be limited to, multiple forms of communication; faxes (with confirmation slips demonstrating successful transmission), an e-mail log, registered post details, copies of letters and a phone call log.

Locked Bag 914, Coffs Harbour NSW 2450
Federation House Level 7, 24 Moonee Street,
Coffs Harbour NSW 2450
Tel: (02) 6651 5946 Fax: (02) 6651 6187
ABN 30 841 387 271
www.environment.nsw.gov.au

- Note that Appendix A of the CRs contains a map illustrating which Regional Office of OEH should be contacted regarding the AHIP application based on the local government area in which the project is located. Full details of the consultation requirements and the relevant Fact Sheets can be located on the OEH website at: www.environment.nsw.gov.au/licences/consultation.htm.

- Forward to OEH any changes to the contact details of interested Aboriginal parties, or information regarding additional parties, so that OEH can update its records.

- Ensure that consultation is fair, equitable and transparent. If the Aboriginal parties express concern or are opposed to parts of or the entire project, OEH expects that evidence will be provided to demonstrate the efforts made to find common ground between the opponents and the proponent.

If you require further information or clarification please do not hesitate to contact Ms Rosalie Neve, Aboriginal Heritage Planning Officer, on (02) 6659 8221.

Yours sincerely

Dimitri Young 12 June 2015

DIMITRI YOUNG
Senior Team Leader Planning, North East Region
Regional Operations

Enclosure: Attachment A

ATTACHMENT A: OEH Known Aboriginal Parties for the Port Macquarie Hastings Local Government Area

1.	Saltwater Tribal Council 18 Ronald Road TAREE, NSW 2430 Ph: (02) 65524440
2.	Ghinni Ghinni Youth and Culture Aboriginal Corporation PO Box 641 TAREE, NSW 2430 Ph: (02) 65512160 Ghinni_ghinni@hotmail.com
3.	Bindi Aboriginal Heritage and Cultural Centre Inc. 187 Beechwood Road WAUCHOPE, NSW 2446 Ph: (02) 65864560
4.	Sunrise Guiwan Biripi Elders Corporation Warner Saunders PO Box 129 CUNDLETOWN NSW 2430 Ph: 0487660726 Warner.saunders9@gmail.com
5.	Lakkari NTCG Mick Leon C/- Doo-wa-kee CHS 82 Victoria Street TAREE NSW 2430 Ph: (02) 65527835 Mob: 0402 751 584 doowakee@virginbroadband.com.au
6.	Birpi Local Aboriginal Land Council Steven Miles Lot 33 - Aston Street PORT MACQUARIE NSW 2444 Ph: (02) 6584 9066 Fax: (02) 6583 8172 birpailalc@midcoast.com.au

National Native Title Tribunal

Operations East, Sydney Office

Level 16, Law Courts Building, Queens Square
Sydney NSW 2000
GPO Box 9973
Sydney NSW 2001

Telephone (02) 9227 4000
Facsimile (02) 9227 4030

18 June 2015

Ms Jacqueline Collins
Consultant Archaeologist
Adise Pty Ltd
PO BOX 6
LAURIETON NSW 2443

Our Reference: Cairncross Waste Facility Reference
Your Reference: 728

Dear Ms Collins

Native Title Search Results for Port Macquarie-Hastings Local Government Area

Thank you for your search request received on 16 June 2015 in relation to the above area.

Search Results
The results provided are based on the information you supplied and are derived from a search of the following Tribunal databases:

Register Type	NNTT Reference Numbers
Schedule of Applications (unregistered claimant applications)	Nil
Register of Native Title Claims	Nil
National Native Title Register	Nil
Register of Indigenous Land Use Agreements	Nil
Notified Indigenous Land Use Agreements	Nil

At the time this search was carried out, there were **no relevant entries** in the above databases.

Please note: There may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed with the Federal Court may not appear on the Tribunal's databases.

Tribunal accepts no liability for reliance placed on enclosed information
The enclosed information has been provided in good faith. Use of this information is at your so risk. The National Native Title Tribunal makes no representation, either express or implied, as the accuracy or suitability of the information enclosed for any particular purpose and accepts n liability for use of the information or reliance placed on it.

If you have any further queries, please do not hesitate to contact me on the number below or on the free call number 1800 640 501.

Yours sincerely

Dianne Drake | CASE MANAGER
National Native Title Tribunal | Sydney Office, Operations East
Telephone (02) 9227 4007 | Facsimile (02) 9227 4030 | Email dianne.drake@nntt.gov.au
Freecall 1800 640 501 | www.nntt.gov.au

Shared country, shared future.

OFFICE OF THE REGISTRAR
ABORIGINAL LAND RIGHTS ACT 1983 (NSW)

11-13 Mansfield Street
Glebe NSW 2037
PO Box 112, Glebe NSW 2037
P. 02 9562 6327 F. 02 9562 6350

Jacqui Collins
Jacqueline Collins Consult Archaeologist
PO BOX 6
LAURIETON NSW 2443

Dear Jacqui

Re: Request - Search for Registered Aboriginal Owners

I refer to your fax dated 15 June 2015 regarding Aboriginal Cultural Heritage Assessment within the Pembrooke area.

I have searched the Register of Aboriginal Owners and the project area described *does not appear* to have Registered Aboriginal Owners pursuant to Division 3 of the *Aboriginal Land Rights Act* 1983 (NSW).

I suggest that you contact the Birapai Local Aboriginal Land Council. They will be able to assist you in identifying other Aboriginal stakeholders for this project.

Yours sincerely

SP

Sally Porter
Administration Officer
Office of the Registrar, *Aboriginal Land Rights Act* (1983)

APPENDIX F: ***Aboriginal cultural heritage consultation requirements for proponents 2010***- Copy of letters sent and newspaper advertisement in compliance with Stage 1, Step 4.1.3 and Step 4.1.6

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone 0427 599137 Email. jpollins@optusnet.com.au

16th June 2015

Steven Miles, CEO
Birpai Local Aboriginal Land Council
PO Box 876
PORT MACQUARIE NSW 2444

Dear Steven,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal Stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council* is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility, located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point.

An EIS was prepared for the entire waste facility site (including the currently proposed expansion area) in 1999, and approval was given for development of Stage 1. This approval is due to expire in 2026. Council now plans to submit a new Development Application to permit longer-term use of the Stage 1 area and development the remaining landfill stages (see attached map).

For Your Information- The 1999 EIS included an Aboriginal cultural heritage assessment (done by me). In addition to a field survey with Birpai LALC sites officer/knowledge holder Lindsay Moran, consultation was undertaken with the late Birpai Elders William Holten (Snr) and Pat Preece. No sites of special cultural significance where identified by the Elders. Four sites containing between one and six stone artefacts were detected during the field survey. Of these, two sites, each containing two stone artefacts, lie within the proposed landfill expansion area.

Port Macquarie Hastings Council has commissioned Hyder Consulting to address matters in relation to the current proposal, including preparation of an updated Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the new EIS.

In accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Office of Environment and Heritage), I am writing to notify you of the proposal, and to invite the Land Council to register an interest in the consultation and assessment process. I would also be grateful if you could advise the names and contact details of any Aboriginal persons that the Land Council may be aware of, who may hold knowledge of/cultural attachments to the Pembrooke/Telegraph Point locality.

The consultation process will assist Council in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application should this be warranted, and assist the Office of Environment and Heritage in its consideration and determination of any AHIP application.

To formally register your interest in the cultural heritage assessment, please do so in writing (letter or email) to the letterhead address to arrive by close of business 6th of July 2015. In the event that the Land Council registers an interest, please nominate a contact person who will provide input and advice on your behalf. Note that if the Land Council registers an interest, details of this registration will be forwarded to the Office of Environment and Heritage unless you specify that you do not want these details released.

If you require any further information at this time, please don't hesitate to contact me on the above phone number to discuss.

Yours sincerely,



Jacqui Collins
Consultant Archaeologist

- The General Manager
  Port Macquarie Hastings Council
  PO Box 84 (17 Burrawan Street)
  PORT MACQUARIE NSW 2444

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone/Fax (02) 6559 9138 jpollins@optusnet.com.au

16th June 2015

Saltwater Tribal Council
18 Ronald Road
TAREE NSW 2430

Dear Sir/Madam,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal Stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council (PO Box 84, Port Macquarie NSW 2444) is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility. The subject expansion area is located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point on the NSW mid-north coast.

Port Macquarie Hastings Council has commissioned Hyder Consulting to address matters in relation to the proposal, including preparation of an Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the EIS. My assessment would include consultation with Aboriginal people who have an interest in the Pembrooke/ Telegraph Point area and hold knowledge relevant to determining the cultural significance of Aboriginal objects and places that may be affected by the proposal, and to prepare an Aboriginal Cultural Heritage Assessment report that includes the process and outcomes of this consultation. The consultation will assist Port Macquarie Hastings Council in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application should this prove necessary, and assist the Office of Environment and Heritage in its consideration and determination of any AHIP application.

In accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water 2010), I am seeking the registration of Aboriginal persons/parties with knowledge relevant to assessing the cultural significance of Aboriginal objects and places within the area to be affected by the proposed landfill expansion, to take part in the consultation program.

Should the Saltwater Tribal Council have an interest in, and/or cultural knowledge of/attachments to the Pembrooke/Telegraph Point locality, please formally register this interest by close of business 6th of July 2015, by post, email or phone to me at the letterhead address. In the event that the Saltwater Tribal Council registers an interest, please nominate a contact person who will provide input on behalf of the organisation. Details of this interest will be forwarded to the Office of Environment and Heritage and the Birpai Local Aboriginal Land Council unless you specify that you do not want these details to be released.

If you require any further information at this time, please don't hesitate to contact me on the above phone number to discuss.

Yours faithfully,



Jacqui Collins
Consultant Archaeologist

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone/Fax (02) 6559 9138 jpollins@optusnet.com.au

16th June 2015

Ghinni Ghinni Youth and Culture Aboriginal Corporation
PO Box 641
TAREE NSW 2430

Dear Sir/Madam,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal Stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council (PO Box 84, Port Macquarie NSW 2444) is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility. The subject expansion area is located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point on the NSW mid-north coast.

Port Macquarie Hastings Council has commissioned Hyder Consulting to address matters in relation to the proposal, including preparation of an Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the EIS. My assessment would include consultation with Aboriginal people who have an interest in the Pembrooke/ Telegraph Point area and hold knowledge relevant to determining the cultural significance of Aboriginal objects and places that may be affected by the proposal, and to prepare an Aboriginal Cultural Heritage Assessment report that includes the process and outcomes of this consultation. The consultation will assist Port Macquarie Hastings Council in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application should this prove necessary, and assist the Office of Environment and Heritage in its consideration and determination of any AHIP application.

In accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water 2010), I am seeking the registration of Aboriginal persons/parties with knowledge relevant to assessing the cultural significance of Aboriginal objects and places within the area to be affected by the proposed landfill expansion, to take part in the consultation program.

Should the Ghinni Ghinni Youth and Culture Aboriginal Corporation have an interest in, and/or cultural knowledge of/attachments to the Pembrooke/Telegraph Point locality, please formally register this interest by close of business 6th of July 2015, by post, email or phone to me at the letterhead address. In the event that the Ghinni Ghinni Youth and Culture Aboriginal Corporation registers an interest, please nominate a contact person who will provide input on behalf of the organisation. Details of this interest will be forwarded to the Office of Environment and Heritage and the Birpai Local Aboriginal Land Council unless you specify that you do not want these details to be released.

If you require any further information at this time, please don't hesitate to contact me on the above phone number to discuss.

Yours faithfully,



Jacqui Collins
Consultant Archaeologist

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone/Fax (02) 6559 9138 jpollins@optusnet.com.au

16th June 2015

Bindi Aboriginal Heritage and Cultural Centre Inc.
187 Beechwood Road
WAUCHOPE NSW 2446

Dear Sir/Madam,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal Stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council (PO Box 84, Port Macquarie NSW 2444) is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility. The subject expansion area is located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point on the NSW mid-north coast.

Port Macquarie Hastings Council has commissioned Hyder Consulting to address matters in relation to the proposal, including preparation of an Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the EIS. My assessment would include consultation with Aboriginal people who have an interest in the Pembrooke/ Telegraph Point area and hold knowledge relevant to determining the cultural significance of Aboriginal objects and places that may be affected by the proposal, and to prepare an Aboriginal Cultural Heritage Assessment report that includes the process and outcomes of this consultation. The consultation will assist Port Macquarie Hastings Council in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application should this prove necessary, and assist the Office of Environment and Heritage in its consideration and determination of any AHIP application.

In accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water 2010), I am seeking the registration of Aboriginal persons/parties with knowledge relevant to assessing the cultural significance of Aboriginal objects and places within the area to be affected by the proposed landfill expansion, to take part in the consultation program.

Should the Bindi Aboriginal Heritage and Cultural Centre have an interest in, and/or cultural knowledge of/attachments to the Pembrooke/Telegraph Point locality, please formally register this interest by close of business 6th of July 2015, by post, email or phone to me at the letterhead address. In the event that Bindi Aboriginal Heritage and Cultural Centre registers an interest, please nominate a contact person who will provide input on behalf of the organisation. Details of this interest will be forwarded to the Office of Environment and Heritage and the Birpai Local Aboriginal Land Council unless you specify that you do not want these details to be released.

If you require any further information at this time, please don't hesitate to contact me on the above phone number to discuss.

Yours faithfully,



Jacqui Collins
Consultant Archaeologist

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone/Fax (02) 6559 9138 jpollins@optusnet.com.au

16th June 2015

Warner Saunders
Sunrise Guiwan Biripi Elders Corporation
PO Box 129
CUNDLETOWN NSW 2430

Dear Warner,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal Stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council (PO Box 84, Port Macquarie NSW 2444) is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility. The subject expansion area is located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point on the NSW mid-north coast.

Port Macquarie Hastings Council has commissioned Hyder Consulting to address matters in relation to the proposal, including preparation of an Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the EIS. My assessment would include consultation with Aboriginal people who have an interest in the Pembrooke/ Telegraph Point area and hold knowledge relevant to determining the cultural significance of Aboriginal objects and places that may be affected by the proposal, and to prepare an Aboriginal Cultural Heritage Assessment report that includes the process and outcomes of this consultation. The consultation will assist Port Macquarie Hastings Council in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application should this prove necessary, and assist the Office of Environment and Heritage in its consideration and determination of any AHIP application.

In accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water 2010), I am seeking the registration of Aboriginal persons/parties with knowledge relevant to assessing the cultural significance of Aboriginal objects and places within the area to be affected by the proposed landfill expansion, to take part in the consultation program.

Should you or any other members of the Sunrise Guiwan Biripi Elders Corporation have an interest in, and/or cultural knowledge of/attachments to the Pembrooke/Telegraph Point locality, please formally register this interest by close of business 6th of July 2015, by post, email or phone to me at the letterhead address. In the event that the Sunrise Guiwan Biripi Elders Corporation registers an interest, please nominate a contact person who will provide input on behalf of the organisation. Details of this interest will be forwarded to the Office of Environment and Heritage and the Birpai Local Aboriginal Land Council unless you specify that you do not want these details to be released.

If you require any further information at this time, please don't hesitate to contact me on the above phone number to discuss.

Kind regards as always,



Jacqui Collins- Consultant Archaeologist

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Telephone/Fax (02) 6559 9138 jpollins@optusnet.com.au

16th June 2015

Mick Leon
Lakkari NTCG
c/- Doo-wa-kee CHS
82 Victoria Street
TAREE NSW 2430

Dear Mick,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA. Identification of Aboriginal Stakeholders for Cultural Heritage Assessment

Port Macquarie Hastings Council (PO Box 84, Port Macquarie NSW 2444) is seeking approval from the NSW Department of Planning & Environment for a proposed expansion of the existing Cairncross Waste Management Facility. The subject expansion area is located on part Lot 7 DP 1106420, Pacific Highway, Pembrooke, approximately 3.8km south of the Wilson River at Telegraph Point on the NSW mid-north coast.

Port Macquarie Hastings Council has commissioned Hyder Consulting to address matters in relation to the proposal, including preparation of an Environmental Impact Statement (EIS). I have been engaged by Hyder Consulting to undertake a cultural heritage assessment of the proposed impact area to inform the EIS. My assessment would include consultation with Aboriginal people who have an interest in the Pembrooke/ Telegraph Point area and hold knowledge relevant to determining the cultural significance of Aboriginal objects and places that may be affected by the proposal, and to prepare an Aboriginal Cultural Heritage Assessment report that includes the process and outcomes of this consultation. The consultation will assist Port Macquarie Hastings Council in the preparation of an Aboriginal Heritage Impact Permit (AHIP) application should this prove necessary, and assist the Office of Environment and Heritage in its consideration and determination of any AHIP application.

In accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water 2010), I am seeking the registration of Aboriginal persons/parties with knowledge relevant to assessing the cultural significance of Aboriginal objects and places within the area to be affected by the proposed landfill expansion, to take part in the consultation program.

Should the Lakkari NTCG have an interest in, and/or cultural knowledge of/attachments to the Pembrooke/ Telegraph Point locality, please formally register this interest by close of business 6th of July 2015, by post, email or phone to me at the letterhead address. In the event that the Lakkari NTCG registers an interest, please nominate a contact person who will provide input on behalf of the organisation. Details of this interest will be forwarded to the Office of Environment and Heritage and the Birpai Local Aboriginal Land Council unless you specify that you do not want these details to be released.

If you require any further information at this time, please don't hesitate to contact me on the above phone number to discuss.

Kind regards as always,



Jacqui Collins
Consultant Archaeologist

Excerpt from Port Macquarie Hastings Council 'Council Matters', published in ***Port Macquarie News*** (26th June 2015). Also published in the ***Camden Haven Courier*** (1st July 2015)



COMMUNITY NEWS

UPDATED CAIRNCROSS WASTE MANAGEMENT FACILITY EIS-NOTIFICATION AND REGISTRATION OF INTEREST IN ABORIGINAL CONSULTATION

Port Macquarie Hastings Council has engaged Hyder Consulting to prepare an updated EIS for the expansion of Cairncross Waste Management Facility, located on part Lot 7 DP 1106420, County Macquarie, Parish Cairncross. Consultation with Aboriginal people as required by the National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010 is to be undertaken in conjunction with a cultural heritage assessment. Aboriginal people who hold cultural knowledge relevant to assessing the significance of Aboriginal objects and/or places within the Pembrooke/Telegraph Point locality are invited to register their interest in the community consultation process by registering. Details of registrations will be forwarded to the Office of Environment and Heritage and the Birpai Local Aboriginal Land Council. To register an interest, please forward your written submission by 10/7/2015 to: Jacqueline Collins (Consultant Archaeologist), PO Box 6, Laurieton NSW 2443. Email: jpollins@optusnet.com.au

4 Port Macquarie News Friday, June 26, 2015

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Tel. 0427 599137 Email jpollins@optusnet.com.au

13th July 2015
Your reference: DOC 15/212365

Dimitri Young
Senior Team Leader Planning, North East Region
Office of Environment and Heritage
Locked Bag 914
COFFS HARBOUR NSW 2450

Dear Mr Young,

Re: Aboriginal Cultural Heritage Assessment- Cairncross Waste Facility, NSW

As required under Section 4.1.6 of the *Aboriginal cultural heritage consultation requirements for proponents 2010*, find attached copies of notification letters sent out for the purposes of identifying Aboriginal parties who may hold cultural knowledge relevant to the Cairncross Waste Facility site (as per your letter dated 12th of June 2015).

A copy of the required newspaper advertisement, published in the *Port Macquarie News* (June 26, 2015) and the *Camden Haven Courier* (July 1, 2015) is also attached.

No Aboriginal organisations, groups or individuals responded to either the letters or the newspaper advertisement.

However, I have worked with the local Aboriginal people over a period of more than two decades, and am aware that Birpai knowledge-holder Lindsay Moran has cultural information handed down through the generations, is highly experienced in archaeological field survey, and has knowledge of the Cairncross Waste Facility site. Owing to the nil response from others, I propose to undertake the assessment with the assistance and advice of Lindsay Moran.

Please advise if any problem or if any further information is required.

Yours sincerely,



Jacqui Collins
Consultant Archaeologist

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Tel. 0427 599137 Email jpollins@optusnet.com.au

13th July 2015

Steven Miles, CEO
Birpai Local Aboriginal Land Council
PO Box 876
PORT MACQUARIE NSW 2444

Dear Steven,

Re: Re: Aboriginal Cultural Heritage Assessment- Cairncross Waste Facility, NSW

As required under Section 4.1.6 of the *Aboriginal cultural heritage consultation requirements for proponents 2010*, find attached copies of notification letters sent out for the purposes of identifying Aboriginal parties who may hold cultural knowledge relevant to the Cairncross Waste Facility site (as per my letter dated 16th of June 2015).

A copy of the required newspaper advertisement, published in the *Port Macquarie News* (June 26, 2015) and the *Camden Haven Courier* (July 1, 2015) is also attached.

No Aboriginal organisations, groups or individuals responded to either the letters or the newspaper advertisement.

However, I have worked with the local Aboriginal people over a period of more than two decades, and am aware that Birpai knowledge-holder Lindsay Moran has cultural information handed down through the generations, is highly experienced in archaeological field survey, and has knowledge of the Cairncross Waste Facility site. Owing to the nil response from others, I propose to undertake the assessment with the assistance and advice of Lindsay Moran.

Please advise if any problem or if any further information is required.

Yours sincerely,



Jacqui Collins
Consultant Archaeologist

APPENDIX G: ***Aboriginal cultural heritage consultation requirements for proponents 2010***- Response to letters sent and newspaper advertisement in compliance with Stage 1, Step 4.1.3

From: Michael Vegter <mvegterceo@gmail.com>
Date: 15 July 2015 3:43:58 PM AEST
To: jpollins@optusnet.com.au
Subject: **Cairncross Waste Facility**

Hello Jacqui,

I advise that Steven Miles has resigned from this Land Council, and I am Acting CEO until a new CEO is employed.

We received your letter dated 13 July, 2015 regarding Aboriginal Assessment of the Cairncross Waste Facility, along with copies of letters and advertisement.

Unfortunately we did not see the advertisement in the Port Macquarie News, nor did we receive the letter to us dated 16 June 2015, which you have provided a copy of.

Regardless of the above, Lindsay Moran would probably be the proper person to assist you, and we have no objection to that happening.

Regards,
Mike Vegter
Acting CEO
Birpai Local Aboriginal Land Council
PO Box 876, Port Macquarie NSW 2444
02 6584 9066

APPENDIX H: ***Aboriginal cultural heritage consultation requirements for proponents 2010***- Project information and draft assessment methodology supplied in compliance with Stage 2 and Stage 3, Step 4.3.1

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Tel. 0427 599137 Email. jpollins@optusnet.com.au

9th October 2015

Ngaire Matthews
General Manager
Dunghutti Elders Council (Aboriginal Corporation)
17/23 South Street
SOUTH KEMPSEY NSW 2440

Dear Ngaire,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA.
Scope of the proposed project and draft methodology for the cultural heritage assessment

Thanks again for expressing an interest in the above cultural heritage assessment on behalf of the Dunghutti Elders Council.

Background and current proposal

For your information, the Cairncross Waste Management Facility is zoned *SP2 Infrastructure (Waste Management Facility)* under Port Macquarie-Hastings LEP 2011, and is the primary centre for Council's waste operations. A comprehensive EIS prepared by ERM Mitchell McCotter in 1999 in conjunction with the initial planning process addressed construction and ongoing waste operations for the entirety of the proposed site (including landfill Stages 1-5). The 1999 EIS included an Aboriginal archaeological/cultural assessment prepared by me in liaison with then Birpai LALC sites officer Lindsay Moran, and also involved consultation with now deceased local Elders William Moran (Snr) and Pat Preece. No sites/places of special significance were identified by either Elder within or near the proposed waste management facility site. Four sites (CWD 1, 2, 3 and 4) containing between one and six Aboriginal stone artefacts were recorded during the field survey.

Stage 1 of the landfill, development of an adjacent organics resource recovery facility and other waste management activities were subsequently approved, and operations at Cairncross commenced in September 2001. The two recorded Aboriginal sites (CWD 1 [scatter of six stone artefacts], AHIMS #30-3-0238; and CWD 2 [isolated stone artefact], AHIMS #30-3-0239) adjacent to this development were not disturbed.

The current Stage 1 landfill approval is due to conclude in 2026, and approval for the expansion of landfill operations into the area covered by Stages 2-5 is yet to be sought. Port Macquarie-Hasting Council thus proposes to submit a development application to extend the operational life of the existing Stage 1 landfill, and permit staged construction of the remaining landfill cells (Stages 2-5). Expansion into the Stage 2-5 landfill cells would be undertaken on an incremental, sub-stage basis, and would require impact upon the two other registered Aboriginal sites (CWD 3, AHIMS #30-3-0242 and CWD 4, AHIMS #3-3-0241), each of which contain two identified artefacts.

An updated EIS is needed to accompany the proposed development application. I have been engaged by Arcadis (formerly Hyder Consulting) to undertake the new cultural heritage assessment.

Proposed methodology for the cultural heritage assessment

For your review and further input, my cultural heritage assessment methodology would include:

- Consultation with Aboriginal knowledge-holders (as per your advice) to identify the location, nature, extent and significance of any known sites/places of ceremonial, spiritual or other traditional, historic or contemporary socio-cultural value within and near the project area, and the impacts that the proposal may have on these values.
- A field inspection of the registered site locations and potentially sensitive landforms to be affected by the proposed landfill expansion, assisted by a Dunghutti knowledge holder/sites officer. The field inspection would be directed towards:
  - Determining where Aboriginal objects occur/are likely to occur, and assessing the existing preservation status of these objects.
  - Assessing the socio-cultural and archaeological significance of any identified and potential Aboriginal objects.

- Formulating management strategies designed to mitigate impacts of the proposal upon Aboriginal socio-cultural and archaeological values, including any required avoidance/site conservation/protection measures, subsurface investigations deemed necessary to provide further information, and/or recommended artefact salvage.

- Production of a report presenting all relevant information, including site significance assessments and management recommendations. No cultural information flagged as sensitive/for restricted access only will be divulged in the report. A draft copy of the report would be supplied for your review and comment prior to its finalisation. The final report would be changed as/if you require, and your comments incorporated.
- Submission of site recording forms (new sites) and extra information (previously registered sites) to the OEH Aboriginal Sites Registrar.

Before going ahead with arranging any consultation or fieldwork, I would be pleased if you could let me know, at your earliest convenience (email jpollins@optusnet.com.au or phone 0427 599137), whether the above proposed cultural heritage assessment methodology is OK, and if not, what else you would want included. I would appreciate this advice by the 16th of November 2015.

Kind regards and please phone if you need any further information in regard to this letter.



Jacqui Collins
Consultant Archaeologist

JACQUELINE COLLINS - *Consultant Archaeologist*
Adise Pty Ltd ABN 27 074 129 909
PO Box 6 Laurieton NSW 2443 Tel. 0427 599137 Email. jpollins@optusnet.com.au

9th October 2015

Lindsay Moran
Birpai Knowledge-holder
7365 Oxley Highway
Mount Seaview NSW 2446

Dear Lindsay,

Re: Proposed Expansion of Cairncross Waste Management Facility, Telegraph Point, Port Macquarie Hastings LGA.
Scope of the proposed project and draft methodology for the cultural heritage assessment

Thanks again for expressing an interest in the above cultural heritage assessment, and I look forward to working with you again.

Background and current proposal

For your information, the Cairncross Waste Management Facility is zoned *SP2 Infrastructure (Waste Management Facility)* under Port Macquarie-Hastings LEP 2011, and is the primary centre for Council's waste operations. A comprehensive EIS prepared by ERM Mitchell McCotter in 1999 in conjunction with the initial planning process addressed construction and ongoing waste operations for the entirety of the proposed site (including landfill Stages 1-5). The 1999 EIS included an Aboriginal archaeological/cultural assessment prepared by me in liaison with yourself, and also involved consultation with Birpai Elders Pat Preece and your dad William Moran (Snr). No sites/places of special significance were identified by either Elder within or near the proposed waste management facility site. As you already know, four sites (CWD 1, 2, 3 and 4) containing between one and six Aboriginal stone artefacts were recorded during the field survey.

Stage 1 of the landfill, development of an adjacent organics resource recovery facility and other waste management activities were subsequently approved, and operations at Cairncross commenced in September 2001. The two recorded Aboriginal sites (CWD 1 [scatter of six surface artefacts], AHIMS #30-3-0238; and CWD 2 [isolated stone artefact], AHIMS #30-3-0239) adjacent to this development were not disturbed.

The current Stage 1 landfill approval is due to conclude in 2026, and approval for the expansion of landfill operations into the area covered by Stages 2-5 is yet to be sought. Port Macquarie-Hasting Council thus proposes to submit a development application to extend the operational life of the existing Stage 1 landfill, and permit the staged construction of new landfill cells (Stages 2-5). Expansion into the Stage 2-5 landfill cells would be undertaken on an incremental, sub-stage basis and would ultimately require impact upon the two remaining known Aboriginal sites (CWD 3, AHIMS #30-3-0242 and CWD 4, AHIMS #3-3-0241), each of which contain two identified artefacts.

An updated EIS is needed to accompany the proposed development application. I have been engaged by Arcadis (formerly Hyder Consulting) to undertake the new cultural heritage assessment.

Proposed methodology for the cultural heritage assessment

For your review and further input, my cultural heritage assessment methodology would include:

- Consultation with Aboriginal knowledge-holders (including you and any others you are aware of) to identify the location, nature, extent and significance of any known sites/places of ceremonial, spiritual or other outstanding traditional, historic or contemporary socio-cultural value within and near the project area, and the impacts that the proposal may have on these values.
- A field inspection of the registered site locations and potentially sensitive landforms to be affected by the proposed landfill expansion (with your assistance). The field inspection would be directed towards:
  - Determining where Aboriginal objects occur/are likely to occur, and assessing the existing preservation status of these objects.
  - Assessing the socio-cultural and archaeological significance of any identified and potential Aboriginal objects.

- Formulating management strategies designed to mitigate impacts of the proposal upon Aboriginal socio-cultural and archaeological values, including any required avoidance/site conservation/protection measures, subsurface investigations deemed necessary to provide further information, and/or recommended artefact salvage.

- Production of a report presenting all relevant information, including site significance assessment/s and management recommendations. No cultural information flagged as sensitive/for restricted access only will be divulged in the report. A draft copy of the report would be supplied for your review and comment prior to its finalisation. The final report would be changed as/if you require, and your comments incorporated.
- Submission of site recording forms (new sites) and extra information (previously registered sites) to the OEH Aboriginal Sites Registrar.

Before going ahead with arranging any consultation or fieldwork, I would be pleased if you could let me know, at your earliest convenience (email jpollins@optusnet.com.au or phone 0427 599137), whether the above proposed cultural heritage assessment methodology is OK, and if not, what else you would require to be included. I would appreciate this advice by the 16th of November 2015.

Kindest regards as always, and please phone if you need any further information in regard to this letter.



Jacqui Collins
Consultant Archaeologist

APPENDIX I: ***Aboriginal cultural heritage consultation requirements for proponents 2010***- Response to draft assessment methodology supplied in compliance with Stage 3, Step 4.3.1

From: admin@decac.com.au
Subject: draft methodology
Date: 3 November 2015 10:05 am
To: jpollins@optusnet.com.au

Hi Jacqui,

Just to let you know, that Uncle Bob Mumbler, who will be attending the site on behalf of the Dunghutti Elders Council. Is not available till after the 6/11/15. I will be sure to hand this document to him for his suggestions (if any) and get back to you (if needed).

Regards,

Ngaire Matthews
General Manager
Email: admin@decac.com.au
Phone: 02 6562 2855

APPENDIX J: ***Aboriginal cultural heritage consultation requirements for proponents 2010***- Response received following registered Aboriginal party review of draft report in compliance with Stage 4

From: **David Carroll** dcarroll.birpai@gmail.com
Subject: Cultural Heritage Assessment for Cairncross Landfill Expansion
Date: 12 September 2016 11:10 am
To: Jacqueline Collins jpollins@optusnet.com.au
Cc: Birpai Land Council birpailalc@midcoast.com.au

Hi Jacqui

Sorry for the delay in replying. We have reviewed the draft Cultural Heritage Assessment for the Cairncross Landfill Expansion. Having reviewed the document it seems to be a very thorough and covers the areas of concern for the Birpai Local Aboriginal Land Council. Given the above and the input already provided by our Sites Officer Jason Holten, the Birpai Local Aboriginal Land Council will not be providing any further comments.

Thank you for your efforts and the opportunity to review the document.

David Carroll
CEO
Birpai Local Aboriginal Land Council
Ph 02 6584 9066

Birpai Local Aboriginal Land Council

This email has been checked for viruses by Avast antivirus software.
www.avast.com



From: **Dunghutti Elders Council Aboriginal Corp** admin@decac.com.au
Subject: Reply to Cairncross report.
Date: 7 October 2016 12:08 pm
To: Jacqueline Collins jpollins@optusnet.com.au

Hi Jacquie,

Following is the statement dictated by Uncle Bob,

I read the report right through....
Looked at comments re: forests and re growths. With the re growth's would of looked at artefacts' etc.....
Observation of plantation trees was the Pioneering Trees and how the proximity of Rolland Plains was brought into it. Something close to my heart as my ancestors reign from this area.
Also the closeness of Point Plomer the factory & quarry.
These 2 places would of played a significant role in the Hastings & Wilson river Catchment Areas.

Kind Regards

Ngaire Matthews
General Manager
Dunghutti Elders Council (Aboriginal Corporation) RNTBC
PH: 6562 2346
F: 6562 5742
M: 0448 111 284
I Pay my respect to Elders, Pass & Present.
I Acknowledge that I work & live on Dunghutti Traditional Lands....

Office of Environment & Heritage
NSW GOVERNMENT

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Cairncross Waste Facility
Client Service ID : 230327

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0143	Extension Rd 2-1;	AGD	56	478200	6529450	Open site	Valid	Artefact : -	Isolated Find	2598
	Contact	Recorders	Paul Packard					Permits		
30-3-0146	Waterfall Rd 1-1;	AGD	56	472950	6532650	Open site	Valid	Artefact : -	Open Camp Site	2598
	Contact	Recorders	Paul Packard					Permits		
30-3-0147	Waterfall Ck 2-1;	AGD	56	473600	6531650	Open site	Valid	Artefact : -	Isolated Find	2598
	Contact	Recorders	Paul Packard					Permits		
30-3-0101	Telegraph Point;	AGD	56	481820	6530550	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	I Cranwell					Permits		
30-3-0316	7-11 Trail#1	AGD	56	479410	6531490	Open site	Valid	Artefact : -		
	Contact	Recorders	Lindsay Moran					Permits		
30-3-0317	7-12 Trail#1	AGD	56	479600	6531900	Open site	Valid	Artefact : -		
	Contact	Recorders	Ray Fife,Lindsay Moran					Permits		
30-3-0318	7-2 Trail#1	AGD	56	479450	6531550	Open site	Valid	Artefact : -		
	Contact	Recorders	Ray Fife,Lindsay Moran					Permits		
30-3-0298	17-3 TRAIL 1	AGD	56	474648	6530632	Open site	Valid	Artefact : -		
	Contact	Recorders	Kevin Smith					Permits		
30-3-0299	RAMP ROAD #1	AGD	56	477854	6531300	Open site	Valid	Artefact : -		
	Contact	Recorders	Kevin Smith					Permits		
30-3-0293	7-12 Trail #1 duplicate of 30-3-0317	AGD	56	479600	6531900	Open site	Deleted	Artefact : -		
	Contact	Recorders	Ray Fife,Kevin Smith,W Moran					Permits		
30-3-0294	7-2 TRAIL #1 duplicate of 30-3-0318	AGD	56	479450	6531550	Open site	Deleted	Artefact : -		
	Contact	Recorders	Ray Fife,Kevin Smith,W Moran					Permits		
30-3-0295	WATERFALL ROAD #3	AGD	56	473310	6531220	Open site	Valid	Artefact : -		
	Contact	Recorders	Kevin Smith,Lindsay Moran					Permits		
30-3-0296	WATERFALL ROAD #4	AGD	56	473445	6531220	Open site	Valid	Artefact : -		
	Contact	Recorders	Kevin Smith,Lindsay Moran					Permits		
30-3-0306	Waterfall Road #2	AGD	56	473310	6531220	Open site	Valid	Artefact : -		
	Contact	Recorders	Kevin Smith					Permits		
30-3-0307	Waterfall Road #5	AGD	56	473445	6531220	Open site	Valid	Artefact : -		
	Contact	Recorders	Kevin Smith					Permits		
30-3-0308	Waterfall Road #1	AGD	56	473300	6531220	Open site	Valid	Artefact : -		
	Contact	Recorders	Kevin Smith					Permits		
30-3-0300	7-2 Trail#2	AGD	56	479525	6531890	Open site	Valid	Artefact : -		
	Contact	Recorders	Ray Fife,Kevin Smith,W Moran					Permits		

Report generated by AHIMS Web Service on 18/06/2016 for Jacqueline Collins for the following area at Datum :GDA, Zone : 56, Eastings : 473000 - 484000, Northings : 6524500 - 6535500 with a Buffer of 0 meters. Additional Info : Cultural heritage assessment to inform EIS for on-going use and expansion of Cairncross Waste Management Facility. Number of Aboriginal sites and Aboriginal objects found is 30

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Office of Environment & Heritage
NSW GOVERNMENT

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Cairncross Waste Facility
Client Service ID : 230327

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0351	6-8 TR	AGD	56	479990	6530810	Open site	Valid	Artefact : 1		
	Contact: T Russell	Recorders: Kevin Smith						Permits		
30-3-0392	OHK 46/A	GDA	56	482543	6525461	Open site	Valid	Artefact : -		
	Contact	Recorders: Mr.Peter Kuskie						Permits		
30-3-0396	OHK 219	AGD	56	481070	6528740	Open site	Valid	Artefact : 2		
	Contact	Recorders: Mr.Edward Clarke						Permits		
30-3-0401	OHK 54	AGD	56	482110	6526360	Open site	Valid	Artefact : 1		
	Contact	Recorders: Mr.Peter Kuskie						Permits		
30-3-0386	KPM-IF2	AGD	56	482616	6525780	Open site	Valid	Artefact : 1		
	Contact	Recorders: Doctor.Jodie Benton						Permits		
30-3-0391	OHK 47/A	GDA	56	482513	6525387	Open site	Valid	Artefact : -		
	Contact	Recorders: Mr.Peter Kuskie						Permits		
30-3-0238	CWD1	AGD	56	478210	6530200	Open site	Valid	Artefact : -	Open Camp Site	98467,102557
	Contact	Recorders: Ms.Jacqueline Collins						Permits		
30-3-0239	CWD2	AGD	56	478620	6530720	Open site	Valid	Artefact : -	Isolated Find	
	Contact	Recorders: Ms.Jacqueline Collins						Permits		
30-3-0241	CWD 4	AGD	56	478600	6530050	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders: Ms.Jacqueline Collins						Permits		
30-3-0242	CWD 3	AGD	56	478650	6529740	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders: Ms.Jacqueline Collins						Permits		
30-3-0344	3.2 Trail 2	AGD	56	482470	6526565	Open site	Valid	Artefact : 1		
	Contact: T Russell	Recorders: Kevin Smith						Permits		
30-3-0345	Swamp Road 3	AGD	56	482693	6526035	Open site	Valid	Artefact : 1		
	Contact: T Russell	Recorders: Kevin Smith						Permits		
30-3-0346	3.4 Trail 1	AGD	56	482380	6525900	Open site	Valid	Artefact : 1		
	Contact: T Russell	Recorders: Kevin Smith						Permits		

Report generated by AHIMS Web Service on 18/06/2016 for Jacqueline Collins for the following area at Datum :GDA, Zone : 56, Eastings : 473000 - 484000, Northings : 6524500 - 6535500 with a Buffer of 0 meters. Additional Info : Cultural heritage assessment to inform EIS for on-going use and expansion of Cairncross Waste Management Facility. Number of Aboriginal sites and Aboriginal objects found is 30

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APPENDIX L: Available documentary information for Consent to Destroy (with Salvage) #N37/CDS/2000

CONSENT #: N37/CDS/2000
(HO use only)

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTION 90

CONSENT

CONSENT TO CARRY OUT THE DESTRUCTION OF AN ABORIGINAL RELIC/PLACE

WHEREAS the Aboriginal relics described in Schedule "A" are situated upon the land described in Schedule "B", and which constitute relics within the meaning of Section 90 of *the National Parks and Wildlife Act 1974*, and WHEREAS application has been made by:

Geoffrey Noel Freeman
Director, Community & Recreational Services
of: Hastings Council
Cnr Lord & Burrawan Streets
PORT MACQUARIE NSW 2444

FOR CONSENT to destroy those Aboriginal relics in the course of:

Construction of the Cairncross Waste Depot

NOW I, Brian John Gilligan, Director-General of National Parks and Wildlife, in pursuance of Section 90 of the said Act, and subject to the Conditions hereunder set out DO HEREBY CONSENT to the destruction of the said relics by the said applicant.

TERMS AND CONDITIONS OF THIS CONSENT

This Consent is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as the Specific Terms and Conditions pertaining to Consents to destroy Aboriginal relics all of which conditions are detailed in the attached pages.

DATED at Sydney this 5th day of JUNE. , 2000

FOR Director-General of
National Parks and Wildlife Service

N23/CD/2000	Hills Plain Subdivision, Tamworth.	CDS	Tamworth	1807	Philip Chaseling, Forest Road, Tamworth.	29-02-0103	Open Campsite	D	28.04.2000	DM
N24/CC/2000	Hills Plain Subdivision, Tamworth.	CC	Tamworth	1807	Tamworth Local Aboriginal Land Council	29-02-0103	Open Campsite	D	28.04.2000	DM
N25/CC/2000	Packer's Golf Course, Elerston.	CC	Scone	1937	Wonnarua Tribal Council Inc.	29-6-0057, 29-6-0058	Open Campsites	D	14.04.2000	JLR
N26/CDS/2000	Corindi Park Residential Subdivision.	CDS	Ulmarra	1627	Anthony F Ferris	22-1-0087	Open Campsites, ISF	D	14.04.2000	MW
N27/PRP/2000	TransGrid - Texas to Armidale Interconnection - Section D	PRP	Dumaresq	1746	Vivienne Courto & Charles Dearling, Paton Archaeological Studies Pty Ltd	Pending: S60, S61, S7	Open Campsites	D	19.05.2000	MW
N28/CP/2000	TransGrid - Texas to Armidale Interconnection - Section D	CP	Dumaresq	1746	Vivienne Courto & Charles Dearling, Paton Archaeological Studies Pty Ltd	Pending: S55, 62, S64	Open Campsites	D	19.05.2000	JLR
N29/CC/2000	Corindi Park Residential Subdivision.	CC	Ulmara	1627	Yarrawarra Aboriginal Corporation	22-1-0087	Open Campsite, ISF	D	14.04.2000	JLR
N30/CD/2000	Cowarra Dam - Aboriginal Site 10.	CD	Hastings	1467	Hastings Shire Council	Pending: HVWS Site	Open Campsite	D	28.04.2000	MW
N31/CD/2000	Kwiambal National Park, Northern Tablelands.	CD	Inverell	1477	Bob Friederich, Bronwyn Johnson, National Parks & Wildlife Service.	11-2-0001; 11-2-0081	Open Campsite	D	28.04.2000	MW
N32/PRP/2000	TransGrid - Texas to Armidale Interconnection - Section D.	PRP	Guyra	1746	Clive Ahoy & David Crew of Banbai Cultural Resource Centre & Reginald Laing of TransGrid	PADs: SEN16, SEN17	PAD	D	19.05.2000	DM
N33/PRP/2000	ACI Sand Sampling Program at Williamstown.	PRP	Port Stephens	1917	Pam Dean-Jones of Umwelt (Australia) Pty Limited	PAD	Potential Archaeological Deposits	D	25.05.2000	JLR
N34/CDS/2000	TransGrid - Texas to Armidale Interconnection - Section D.	CDS	Guyra	1746	Clive Ahoy & David Crew of Banbai Cultural Resource Centre & Reginald Laing of TransGrid	PADs: Sen13, Sen13a	Open Campsites & Marked Tree	D	21.06.2000	JLR
N35/CP/2000	TransGrid - Texas to Armidale Interconnection - Section D.	CP	Dumaresq	1746	Vivian Courto, Paton Archaeological Studies Pty Ltd & Michael de Rome, TransGrid	Pending: S55	Isolated Find	D	13.06.2000	JLR
N36/CDS/2000	Kwiambal National Park, Northern Tablelands.	CDS	Inverell	1477	Bob Freiderich, Bronwyn Johnson, National Parks & Wildlife Service.	11-2-0082	Open Camsite	D	31.8.200	VNW
N37/CDS/2000	Calmcross Waste Depot.	CDS	Hastings	1467	Geoffrey Noel Freeman, Director, Community & Recreational Services	30-3-0238,30-3-0239,	Open Campsites and	D	5.06.2000	MW
N38/CDS/2000	Forster Bridge Tool Site Five Storey Residential Flats.	CDS	Great Lakes	1467	Alan Smith, Managing Director, ASCAD Design Pty Limited	38-3-280	Toolsite/Midden	B		MW
N39/CC/2000	Calmcross Waste Depot.	CC	Hastings	1467	Birpai Local Aboriginal Land Council	30-3-0238,30-3-0239	Open Campsites and	D	5.06.2000	MW
N40/CD/2000	TransGrid - Texas to Armidale Interconnection - Section D.	CD	Guyra	1746	Clive Ahoy of Banbai Cultural Resource Centre & Reginald Laing of TransGrid	Pending: S49	Scarred Tree	D	17.06.2000	JLR
N41/CD/2000	Avalon Forest Estate, New England Highway, Thorton.	CD	Maitland	1887	Graham Burns of Avalon Holdings Pty Ltd	Pending: IF2	Isolated Find	D	29.06.2000	JLR
N42/PRP/2000	ACI - North Dune, Tanilba Bay.	PRP	Port Stephens	1917	John Craib of Bonhomme & Craib	38-4-183	Midden/Open Campsite	D	26.06.2000	JLR
N43/CDS/2000	Emerald Moonee Sewerage Reticulation Scheme.	CDS	Coffs Harbour	1377	Ed Harvey, Dept. Public Works & Services	22-01-0093	Open campsite/Workshop	D	19.06.2000	REB
N44/CC/2000	TransGrid - Texas to Armidale Interconnection - Section D.	CC	Dumaresq	1746	Amidale Local Aboriginal Land Council, 172a Marsh Street, Armidale, 2350, NSW.	Pending: S65	Isolated Find	D	13.06.2000	JLR
N45/CDS/2000	TransGrid - Texas to Armidale Interconnection - Section D.	CDS	Dumaresq	1746	Mr Michael de Rome of TransGrid & Ms Vivienne Courto of Paton Archaeological Studies Pty	Pending: S60, S61, S7	Open Campsites	D	26.06.2000	JLR
N46/CC/2000	TransGrid - Texas to Armidale Interconnection - Section D.	CC	Dumaresq	1746	Amidale Local Aboriginal Land Council, 172a Marsh Street, Armidale, 2350, NSW.	Pending: S60, S61, S7	Open Campsites	D	26.06.2000	JLR
N47/CD/2000	Torrington State Recreation Area, NPWS.	CDS	Severn	1407	Bob Friederich, Northern Tablelands Region, NPWS.	OS1, OS2, OS#, OS$	Open Campsites, ISF	B		REB
N48/CC/2000	TransGrid - Texas to Armidale Interconnection - Section C.	CC	Guyra	1746	Guyra Local Aboriginal Land Council, 187 Falconer Street, Guyra, NSW.	11-3-0027, Sen13, Sen	Open Campsites	D	29.06.2000	JLR
N49/CC/2000	TransGrid - Texas to Armidale Interconnection - Section C.	CC	Guyra	1746	Guyra Local Aboriginal Land Council, 187 Falconer Street, Guyra, NSW.	Pending: S44	Marked Tree	A		JLR
N50/CD/2000	Taree to Coopernook Pacific Highway Upgrade.	CD & CC	Greater Taree	3051-4	RTA & Purfleet-Taree Local Aboriginal Land Council	Pending	Open Campsite	D	21/06/00	LTD
N51/PRP/2000	Woodville Rural Residential Subdivision.	PRP	Port Stephens	1917	Ray Fife of Umwelt (Australia) Pty Limited, Toronto.	No known sites	Potential Archaeological Deposit	B		JLR
N52/CC/2000	Woodville Rural Residential Subdivision.	CC	Port Stephens	1917	Mindaribba Local Aboriginal Land Council, 457 Chelmsford Drive, Metford, NSW.	No known sites	Potential Archaeological Deposits	E		JLR
N53/CDS/2000	Corindi Beach Midden.	CDS	Ulmarra	1627	Yarrawarra Aboriginal Corporation, Red Rock	22-1-0023	Midden/Open Campsite	D		VNW
N54/CC/2000	Wentworth Creek, Newcastle.	CC	Newcastle	1906	Awabakal Local Aboriginal Land Council, 127 Maitland Road, Islington, 2296, NSW.	Pending	Open Campsites	D	14.08.00	JLR
N55/CDS/2000	Memorial Drive, Forster - Five Storey Residential Flats.	CDS	Great Lakes	1437	Alan Smith, Managing Director, ASCAD Design Pty Limited	38-3-260	Toolsite/Midden	A		VNW
N56/CC/2000	Corindi Beach Midden.	CC	Ulmarra	1627	Yarrawarra Aboriginal Corporation, Red Rock	22-1-0023	Midden/Open Campsite	G	N/A	VNW
N57/CDS/2000	Jandra Quarry, CSR Readymix, Taree.	CDS	Greater Taree	1437	Mike Druce, CSR Readymix Taree	38-2-0107,38-2-0108,3	Open Campsites	D	5.10.2000	VNW
N58/PRP/2000	Blue Gum Vista Estate, Maryland, Newcastle.	PRP	Newcastle	1907	Bill Sarkis, Development Director Northern Landcorn.	Pending	Open Campsites	G	31-08-00	JLR
N60/CD/2000	Stormwater pipe replacement, Little St, Forster	CD	Great Lakes	1437	Harry Ibrahim, Great Lakes Council	38-3-281	Midden/Open Campsite	D	18.10.00	REB
N61/PRP/2000	Pee Wee Close, Woodbury	PRP	Maitland	1887	Angela Besant, Insite Heritage for Remnie Goldridge Pty Ltd	No known sites	Potential Cultural Heritage	D	20/11/00	MW
N62/PRP/2000	Howship Holdings Development - Fern Bay	PRP	Port Stephens		Jim Wheeler, ERM			D	17/11/00	LTD
N63/PRP/2000	Weakleys Flat Upgrade	PRP	Maitland		Paul Rheinberger, Umwelt (Australia) on behalf of RTA	No known sites	Potential archaeological	D	15/11/00	LTD
N64/PRP/2000	Kattang Nature Reserve, Pebbly Cove	PRP	Hastings	1467	Peter Clark, Mid North Coast Region, NPWS	Pending	Midden/Stone Artefacts/Scarred Tree	B	8-Dec	MW
N65/CP/2000	Booralbee 197	CP	Inverell	1477	Booralbee Aboriginal Corporation, Jacqueline Byrne	Pending	Open Campsites	G		JLR
N66/PRP/2000	Old Southern Cross Primary, East Ballina	PRP	Ballina	1317	Adrian Piper, Tweed Heads	38-3-281	Midden/Open Campsite	D	18.10.00	REB
N67/CDS/2000	Sand Extraction, Macquires Crossing	CDS	Kempsey	1487	Ellis Richard Walker	30-7-0012	Midden	B		REB
N68/CDS/2000	Burgess Beach, Cliff Road, Forster	CDS	Great Lakes	1437	Janne Yardy, Great Lakes Council, Forster	37-3-0280	Open Artefact Scatter	D	9/02/01	MW
N69/CC/2000	Old Southern Cross Primary, East Balina	CC	Ballina	1317	Jali Local Aboriginal Land Council	Pending	Midden	B		REB
N70/CDS/2000	Tallwoods Village Trunk Water Supply, Pipeline Route	CD	Greater Taree	1447	Michael Philpott, General Manager, Tallwoods Pty Ltd		Open Campsites (PAD's?)	B		REB
N71/PRP/2000	Blue Gum Vista Estate, Maryland, Newcastle	PRP	Newcastle	1907	Bill Sarkis, Development Director Northern, Landcorn.	Pending	Open Campsites	D		LTD

Key	
A = Awaiting Information	CC= Care and Control Permit
B = Processing	CD=Consent to Destroy
C = Yet to be submit	CDS=Consent to Destroy (With salvage)

APPENDIX F HYDROGEOLOGICAL ASSESSMENT, CAIRNCROSS LANDFILL EXPANSION

Hydrogeological Assessment

Cairncross Landfill Expansion

Port Macquarie Hastings Council

11 October 2016

TRACE Environmental
PO Box 422, Camperdown, NSW 1450

Hydrogeological Assessment

Cairncross Landfill Expansion

Prepared for:

Port Macquarie Hastings Council

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Report Issued: 11 October 2016

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Disclaimer: THIS DOCUMENT IS SUBJECT TO LIMITATIONS NOTED

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Executive Summary

Port Macquarie-Hastings Council (PMHC) manages the Cairncross Waste Management Facility located approximately 10 km northwest of Port Macquarie and 1.5 km west of the Pacific Highway. PMHC operates an existing landfill (referred to as Stage E) at this site and is preparing a Development Application for landfill expansion and development of Stages 1-3 under Part 4, Division 4.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act) as State Significant Development.

This hydrogeological assessment report forms part of the Environmental Impact Statement (EIS) for the Cairncross landfill expansion and presents the results of a detailed hydrogeological investigation undertaken at the site.

Three geological units are identified within the Landfill Site, namely clay/colluvium comprising silty medium to high plasticity clay, weathered rock represented by siltstone, and fractured rock represented by shale. Based on the groundwater response to rainfall recharge as observed in on-site groundwater bores, the weathered rock and fractured shale represent one hydrostratigraphic unit. The clay layer is discontinuous across the site with greater thickness in the valleys and lesser thickness at the ridges. Its major characteristic is the retardation of recharge to the underlying aquifer.

Groundwater responds quickly to recharge with significant fluctuations seen in the bores located at the elevated areas of the site, and minor fluctuations in the valleys where the thickness of the clay layer reaches approximately 5 m. The recharge therefore occurs directly at the outcrop, and where the clay layer exists, via minor seepage through the clay or lateral flow through the shale/siltstone unit. Discharge is in the low lying areas and regionally via lateral flow away from the site. The groundwater flow direction is from the north and west to the east, south and south-east, with an average groundwater velocity of 0.008 m/day. This estimate is based on the site determined hydraulic conductivity, measured groundwater gradient and estimated porosity for shale.

The groundwater chemistry indicates that a single groundwater type can be identified across the site, with water being brackish and having heavy metal and nutrient concentrations below the ANZECC (2000) guideline values for 95% protection of freshwater species. Geochemical characteristics of the clay layer have not been investigated as this layer is spatially discontinuous. The Stage E landfill leachate has an entirely different chemical composition to groundwater with high salinity, high nutrient load and measurable phenol concentrations. Pre-operational baseline data has similar geochemical composition to groundwater collected over the past 15 years. Based on the chemistry of leachate and baseline groundwater data, it is concluded that there is presently no mixing of leachate with groundwater occurring at the site.

The landfill floor elevation originally proposed for Stages 1 to 3, as defined in the 1999 EIS,[1] has been redesigned based on the observed groundwater head fluctuations over a 16 year period (2001 to 2016). In accordance with the EPA NSW (2016) and EPA Victoria (2015) guidelines, PMHC has adopted industry best practice for landfill design, such that the landfill floor will be elevated 2 m above the average long term groundwater head. Also, in most areas (with the exception of southwest corner of Stage 1 and 2, and southern part of Stage 1), the proposed floor is above the maximum groundwater head.

During excavation, the proposed landfill extension will intercept groundwater only during a period of maximum groundwater heads in Stages 1 and 2, and may result in groundwater inflow into the base of the excavated

[1] The 1999 EIS was prepared to support project approval for Stage E and also included the proposed future development of what are now referred as Stages 1-3.

area at a low rate of 0.015 L/s. The resulting drawdown is predicted to reach a maximum level of 0.1 m, and extend to a maximum distance of approximately 1 km from Stages 1 and 2.

No inflow is predicted to occur in Stage 3. Following the installation of a drainage trench along the western boundary of Stage 1 and 2, and southern boundary of Stage 2, no inflow is expected to occur into the landfill during the operational period. The drainage trench will divert groundwater from recharge areas to the south and east of Stages 1 and 2, and allow it to discharge via natural flow to the south.

In accordance with the Water Sharing Plan[2], the predicted groundwater interception will need to be licenced and volumes purchased on the market. The project satisfies the minimal harm criteria based on the assessment against the AIP[3] policy.

Identified sensitive receptors within a 3 km radius from the proposed landfill extension include private groundwater bores, surface water bodies, and areas with moderate potential for groundwater interaction with the presence of surface Groundwater Dependent Ecosystems (GDEs) that rely on the subsurface expression of groundwater. The proposed development is predicted to have negligible impact on the private groundwater bores and sensitive ecosystems (<0.1 m drawdown predicted at a distance of 1 km) during the period of excavation and construction (before the drainage trench is installed). The nearest surface water body is located away from the direct groundwater flow path at over 2 km from the landfill, and is not expected to be impacted by landfill operations.

Based on the findings, the proposed landfill extension is not expected to cause any adverse impacts during operation from a hydrogeological perspective, which is supported by the following factors:

- Low hydraulic conductivity of the shale, weathered siltstone and clay lithology at the site;
- The long term average groundwater head, which is 2 m below the floor of the proposed landfill extension;
- The long term maximum groundwater head, which is generally below the proposed landfill floor in Stages 1 to 3, with the exception of the natural slope and depression area in the southwest corner of Stage 1, and central and southwestern portion of Stage 2;
- Installation of the drainage trench to divert groundwater, during wet weather periods, from recharge areas to the south and east (i.e. away from Stage 1 and 2);
- Current site operation practices demonstrating effective management of landfill leachate; and
- A limited number of potential receptors, and considerable distance to these receptors of over 1 km.

It is recommended that the current groundwater head and quality monitoring program is slightly altered in terms of frequency and parameters analysed, as per the recommendations in the NSW EPA (2016) guidelines. Installation of an additional four (4) groundwater bores at the southwestern and southeastern boundary of Stages 2 and 3, respectively, and a monitoring point in the drainage trench is recommended prior to commencement of Stage 1 development, to monitor the groundwater downgradient in these areas. The additional bores should form part of the monitoring network.

A groundwater assessment report should be prepared at least once every five (5) years, or should the groundwater monitoring program detect a possible failure of the leachate containment system, to review the status of groundwater quality and heads, and any potential impacts from the landfill. Quarterly monitoring data should be reviewed when results are received, and compared against the trigger levels.

[2] Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources under the Water Management Act (2000).

[3] NSW Aquifer Interference Policy (AIP) (NSW Department of Primary Industries, September 2012).

Leachate monitoring needs to continue during and post operation, including collection of samples from the leachate sump, and monitoring of the leachate level to confirm that it is not accumulating above the liner. In additon, the volume of leachate needs to be monitored to ensure that the site water balance is realistic, and after completion of the respective Stage to assess the performance of the capping layer.

Following eventual decommisionining of landfill Stages 1-3, these areas will be filled and capped, thereby reducing water inflow and generation of leachate. Leachate will be collected from each Stage and transferred to one of PMHCs sewage treatment plants (STP). No ongoing groundwater interaction and geochemical changes are predicted to occur, however quarterly groundwater head and water quality monitoring should continue following decommissioning. The ongoing frequency of required monitoring should be assessed in a groundwater assessment report,based on the statistical variations of the montoring results over five consecutive years.

1 Introduction

1.1 Background

The Cairncross Waste Management Facility is located approximately 10 km northwest of Port Macquarie and 1.5 km west of the Pacific Highway (the Landfill Site). This facility includes the existing landfill, a Waste Transfer Station and an Organic Resource and Material Recovery Facility, and is managed by Port Macquarie-Hastings Council (PMHC).

The landfill has been operating since 2001 under approval granted in 1999 under Part 4 and Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act). This approval allowed the operation of Landfill Cell 1 (now known as Stage E) for a period of 20 years. In 2013 a Review of Environmental Factors (REF) was prepared to seek an extension to the original approval to 2026. PMHC approved the extension in October 2013.

PMHC is preparing a Development Application for Stages 1-3 under Part 4, Division 4.1 of the EP&A Act as State Significant Development. PMHC has contracted Arcadis to prepare the Environmental Impact Statement (EIS) in accordance with Secretary's Environmental Assessment Requirements (SEARs) for the Cairncross landfill expansion (the Project).

This hydrogeological assessment report forms part of the EIS and presents the results of a detailed hydrogeological investigation undertaken at the site. The following is addressed in order to provide the information required to support the development application for the project:

- Regional and local groundwater system characterisation;
- Details of the site monitoring network and monitoring program;
- Assessment of predicted inflow rates into the proposed landfill cells;
- Impact of the proposed Project on groundwater heads and groundwater quality on the groundwater systems, ecosystems, surface water system (Rawdon Creek) and groundwater users;
- Assistance with landfill design from the groundwater point of view;
- Description of trigger levels for groundwater quality and head monitoring;
- Recommendations for future monitoring and reporting; and
- Project compliance with State and Commonwealth regulations.

1.2 Regulatory Requirements and Best Practice Guidelines

1.2.1 Groundwater Licences

The Landfill Site is regulated by the Water Management Act 2000 in respect to groundwater and surface water. A North Coast Porous and Fractured Rock Groundwater water sharing plan has been in place since July 2016 and the groundwater source underlying the proposed development is New England Fold Belt Coast. Licences under the Water Management Act 2000 are required for interception of any aquifer underlying the landfill and for groundwater extraction. The Department of Primary Industry – Water (DPI Water) requirements under the Water Management Act 2000 have been addressed separately in Section 6 and have been structured around:

- Groundwater interception and inflows; and
- The aquifer interference policy.

1.2.2 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are ecosystems which have their species composition and their natural ecological processes determined wholly or partly by groundwater (ARMCANZ & ANZECC, 1996).

Risk assessment guidelines (DPI Water and the OEH, 2012) state that GDEs explicitly include any ecosystem that uses groundwater at any time or for any duration in order to maintain its composition and condition.

This report addresses the potential impact of the Project on GDEs. The identified GDEs within the vicinity of Project are discussed in **Section 2.4.2**.

1.2.3 Aquifer Interference Policy

Under the NSW Aquifer Interference Policy (AIP) (NSW Department of Primary Industries, September 2012), a water licence is required for any activity that "*penetrates, interferes, obstructs flow in aquifer or takes and disposes of water from aquifer during the activity*".

Where the activity causes the movement of water from one part of the aquifer to another or to and from a surface water body, a licence is also required. The AIP includes the concept of ensuring "no more than minimal harm" for both the granting of water access licences and the granting of licences and approvals. Water access licences will not be granted unless the Minister is satisfied that adequate arrangements are in force to ensure that no more than minimal harm will be done to any water source as a consequence of water being taken under the licence.

In order to address minimal harm criteria, groundwater sources have been divided into "highly productive" and "less productive" based on certain criteria which are detailed in the AIP. Compliance with the requirements of the AIP is addressed in **Section 6**.

1.2.4 Relevant Policy and Guidelines

This report addresses (as applicable) procedures from the relevant policies and guidelines:

- National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC, 1995);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand 2000);
- Australian and New Zealand Guidelines for Water Quality Monitoring (Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand 2000);
- NSW State Groundwater Policy Framework Document (DLWC, 1997);
- NSW State Groundwater Quantity Management Policy (DLWC,1998);
- NSW State Groundwater Quality Protection Policy (DLWC, 1998);

- NSW State Groundwater Dependent Ecosystem Policy (DLWC, 2002);
- Risk assessment guidelines for groundwater dependent ecosystems (DPI Water and OEH, 2012); and
- Environmental Guidelines: *Solid Waste Landfills* (NSW EPA, 2016).

In addition, Victorian EPA guidelines: *Variation to the Best Practice Environmental Management – Siting, Design, Operation and Rehabilitation of Landfills* (2015), were consulted during the preparation of this document.

2 Existing Environment

2.1 Topography

The Cairncross Landfill Site is located approximately 10 km northwest of Port Macquarie within the Cooperabung State Forest (**Figure 1**).

The Landfill Site is located within the eastern foothills of the State Forest covering the elevated ridge and a sloping area to the east. The State Forest bounds the Landfill Site to the north and east, while the Rawdon Creek Nature Reserve lies to the south.

A small ephemeral watercourse, Rawdon Creek, lies to the southwest of the Stage E area and with headwaters in the vicinity of the landfill (Figure 2). Rawdon Creek drains to the southwest and ultimately into the Hastings River located about 2 km southwest of the Landfill Site. A north-south ridge extends across the Site from a disused quarry on the top of the ridge in the north (Figure 3). The landfill mainly lies to the east of this ridge in an area draining to the southeast. Elevations across the Landfill Site vary from 50 mAHD at the top of the ridge to 20 mAHD along the incised Rawdon Creek bed and along the west-east Extension Road.

Figure 1 Site Location Map with Site Boundary

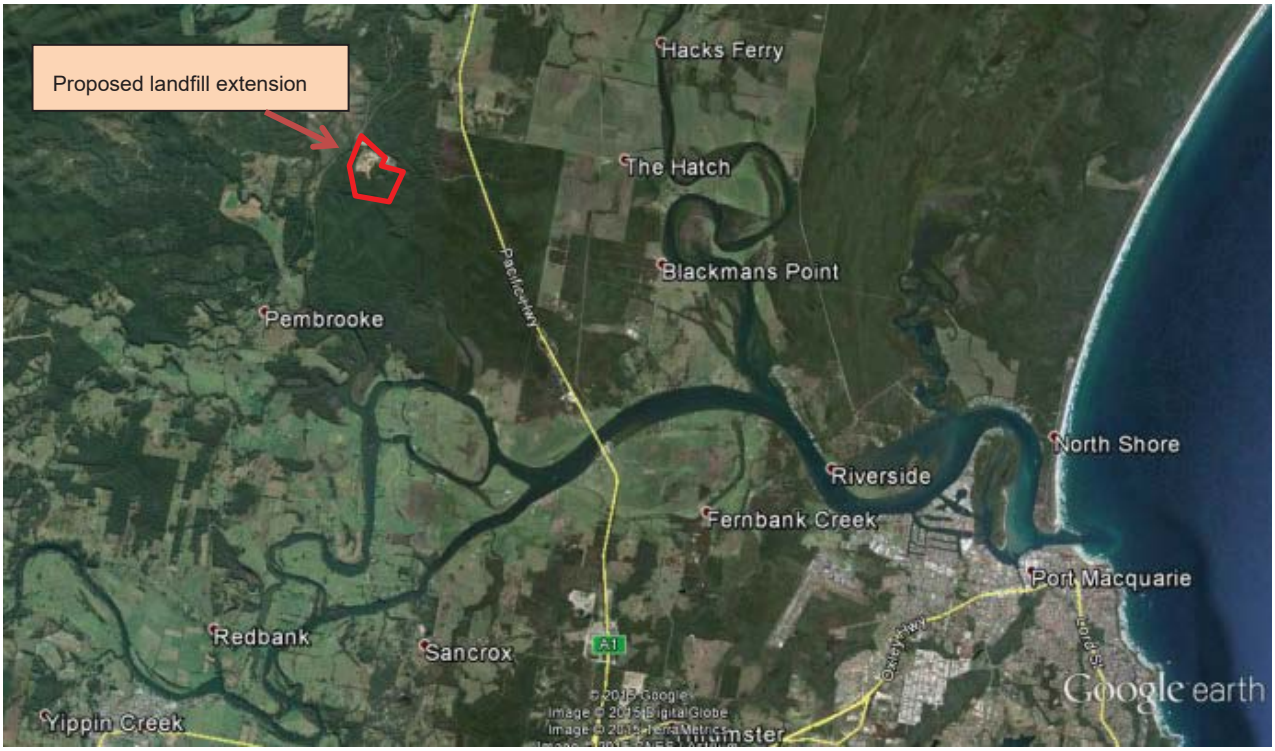
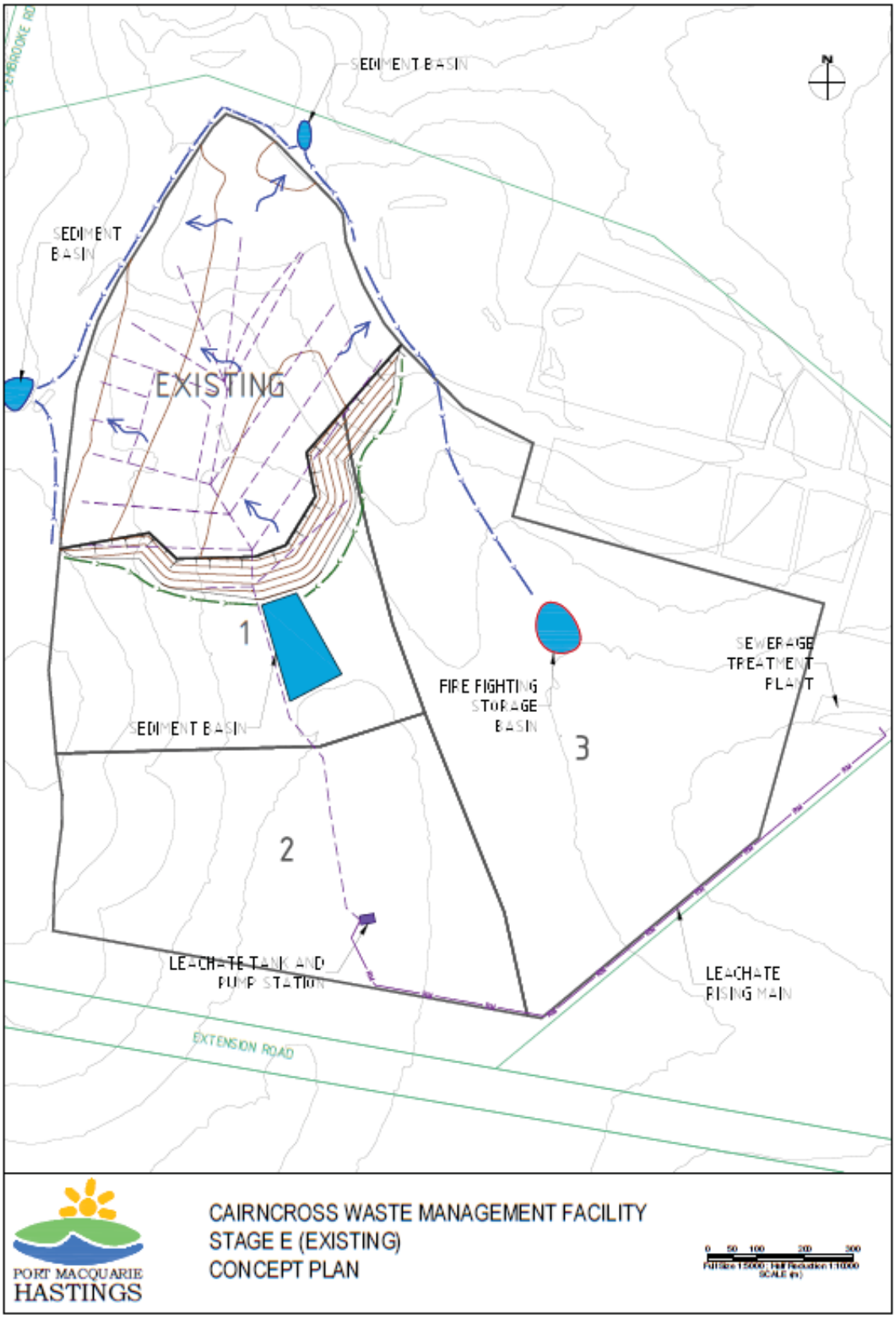


Figure 2 Site Aerial Map



Figure 3 Proposed Site Layout



2.2 Climate

The climate in the vicinity of Landfill Site is classified as temperate to subtropical (Koepen and Bureau of Meteorology (BoM) 2005). The mean annual rainfall, measured at Telegraph Point located 5 km northeast of the Landfill Site (station 060031) since 1910, is 1317 mm (**Table 1**). Summers are warm with average maximum temperatures of 27.5°C and winter maximum average of 18.7°C. Rainfall and temperature trends are seasonally distributed with the highest rainfall and the highest temperatures occurring in the summer months and the lowest rainfall and temperatures experienced during the winter months.

Daily Pan A evaporation has been recorded at Coffs Harbour (BOM Station no. 059040) located 111 km to the north of the Landfill Site where the data has been recorded for the last 41 years. The average monthly evaporation rate is presented in **Table 1**. The annual average daily Pan A evaporation rate is 4.4 mm/day. The evaporation rates exceed rainfall rates during most of the year with the exception of the period from February to June. This indicates the importance of evaporation and an overall moisture deficit.

Table 1 Average Monthly Rainfall and Evaporation Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm) (Station 060031)	138.6	176.0	164.7	128.0	104.1	107.9	68.3	58.1	60.3	83.4	108.4	114.1	1317.0
Evaporation (mm) (Station 059040)	186	168	144	114	84	69	75	102	135	159	171	186	1593

2.3 Geology and Hydrogeology

According to the current 1:250 000 Hastings geology map, the Landfill Site is underlain by Lower Permian Beechwood Beds comprising sandstone, siltstone, and mudstone (NSW Geological Survey, 1966). Port Macquarie Area coastal quaternary geology map 1:100 000 (Troedson and Hashimoto, 2005) identifies Carboniferous and Permian rock in the Project area. Several boreholes drilled across the Landfill Site indicate that the site is underlain by siltstone and shale and overlain by a clay layer. The clay layer appears to extend in several metre-wide strips in the northwest-southeast direction (pers. Comm. G. Cameron). Elsewhere on site it varies in thickness from 1 to 5 m, or is absent. **Figure 4** shows the typical site geology.

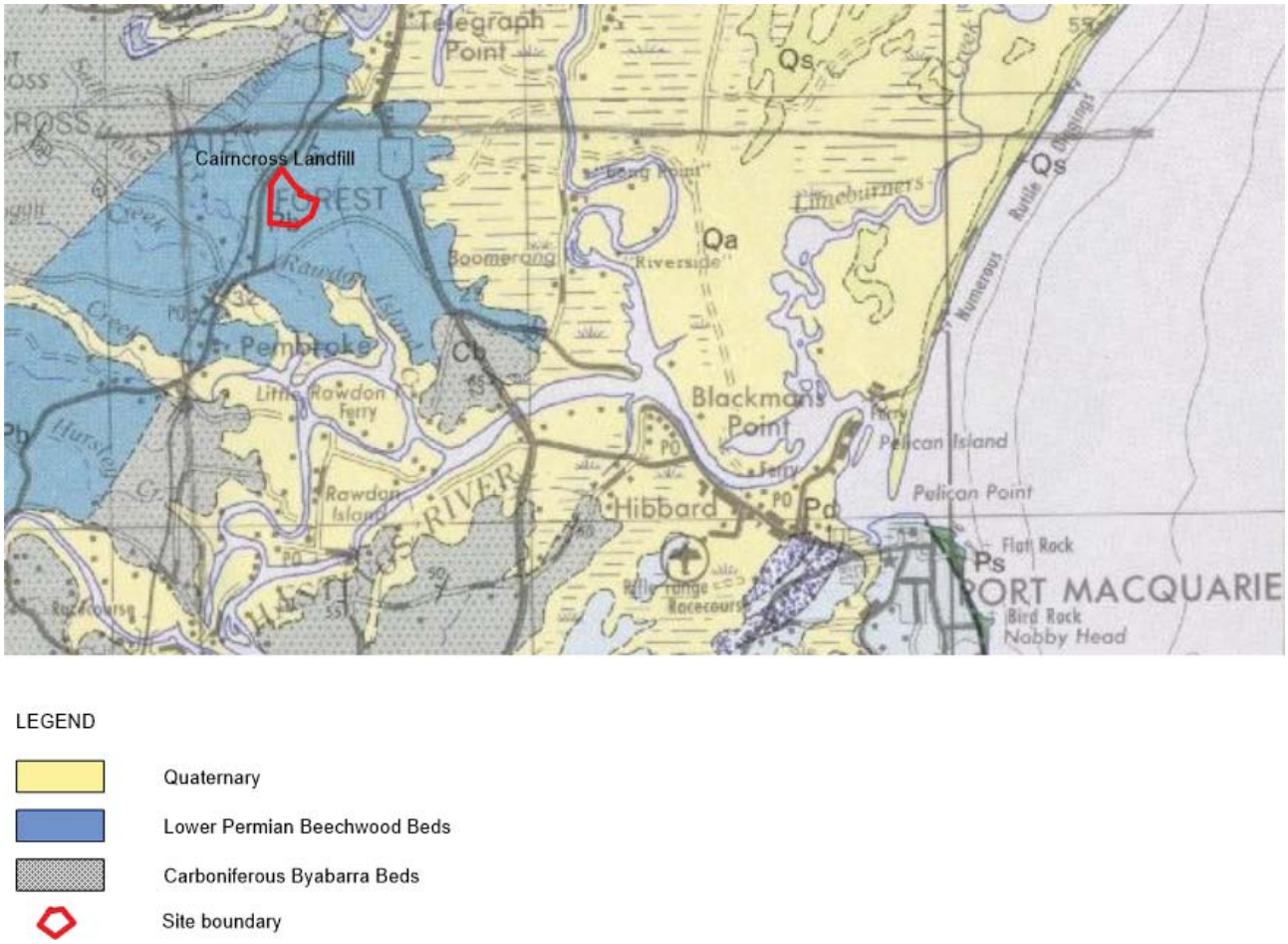
Two hydrostratigraphic units are identified within the Landfill Site, namely:

- Clay/colluvium – spatially discontinuous comprising silty medium to high plasticity clay; and
- Weathered and fractured rock – associated with siltstone and shale.

The alluvium on the Landfill Site has not been mapped as part of 1:25 000 and 1:100 000 Port Macquarie coastal geology map (Troedson and Hashimoto, 2005) nor is it mapped on the 1:250 000 Hastings geology map. Where it occurs locally, it is of very limited spatial extent and is associated with Rawdon Creek oriented north-south to the west of the current landfill area.

The boundary between the fractured rock and weathered unit depends on the depth and thickness of the overlying cover sediments.

Figure 4 Geology Map



Rawdon Creek to the west of the current landfill area (Stage E) is ephemeral and only flows following rainfall events. Fractured rock underlies the Landfill Site and occurs as fresh rock but is less competent in the upper part. The fractured rock is likely to be jointed and the presence of these joints may enhance permeability. However, at depth, due to higher pressure, it is expected that the fractures would close and therefore reduce hydraulic conductivity.

2.4 Environmental Values

2.4.1 Groundwater Users

A search of private water bores within 3 km radius from the Landfill Site was undertaken using the Groundwater explorer (DPI Water and BOM database, 2015). The search yielded ten bores (excluding those associated with operation of the Landfill Site). The bores are installed to depths ranging from 23 to 67 m and their purpose is mainly water supply, with one bore installed for stock and domestic purpose. The DPI Water database does not specify the purpose of those bores, however based on the salinity levels, the water is not suitable for drinking purposes. All bores are installed in hard rock aquifers either shale or basalt, with the yield ranging from 0.5 to 2.5 L/s. The water quality is marginal to brackish, ranging from 700 to 2500 mg/L.

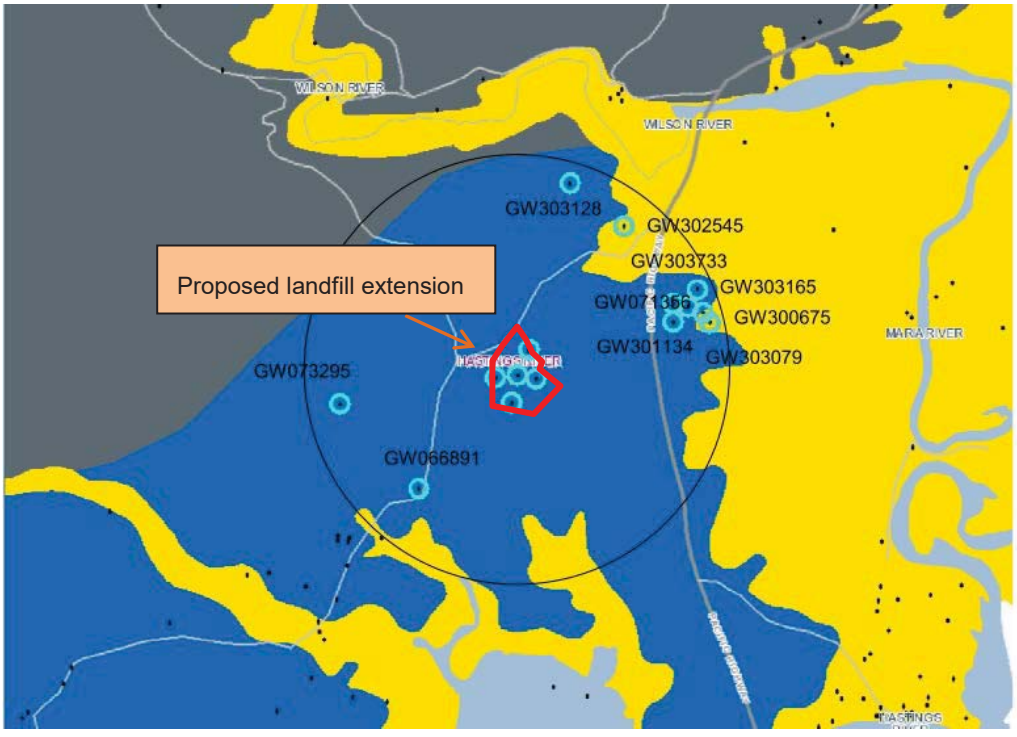
The summary of available bore installation details is provided in **Table 2,** and a map showing the locations of bores with respect to the Landfill Site is provided on **Figure 5**.

Table 2 Summary of Private Bores within 3 km Radius from the Landfill Site

Groundwater bore number	Bore Depth (m)	Screened unit	Bore Purpose	Yield (L/s)	Salinity (mg/L)
GW066891	42.7	Fractured rock	Water Supply	'-	'-
GW071356	29	Basalt	Water Supply	0.6	'-
GW073295	67	Fractured rock	Stock and Domestic	2.5	'-
GW300675	24	Shale	Water Supply	1.3	800
GW301134	26	Shale	Water Supply	0.5	900
GW302545	26	shale	Water Supply	1	1000
GW303079	29.1	basalt	Water Supply	0.6	2900
GW303128	40.5	Fractured rock	Water Supply	NA	NA
GW303733	36	Fractured rock	Water Supply	NA	NA
GW303165	23.1	Fractured rock	Water Supply	NA	NA

NA – information is not available

Figure 5 Private Bores within 3 km Radius from the Landfill Site



2.4.2 Groundwater Dependent Ecosystems

The GDE Atlas was consulted to check the presence of any GDEs in the vicinity of the Project. The National Atlas of Groundwater Dependent Ecosystems (BoM, 2012) presents the current knowledge and provides most comprehensive inventory of the location and characteristics of groundwater dependent ecosystems across Australia.

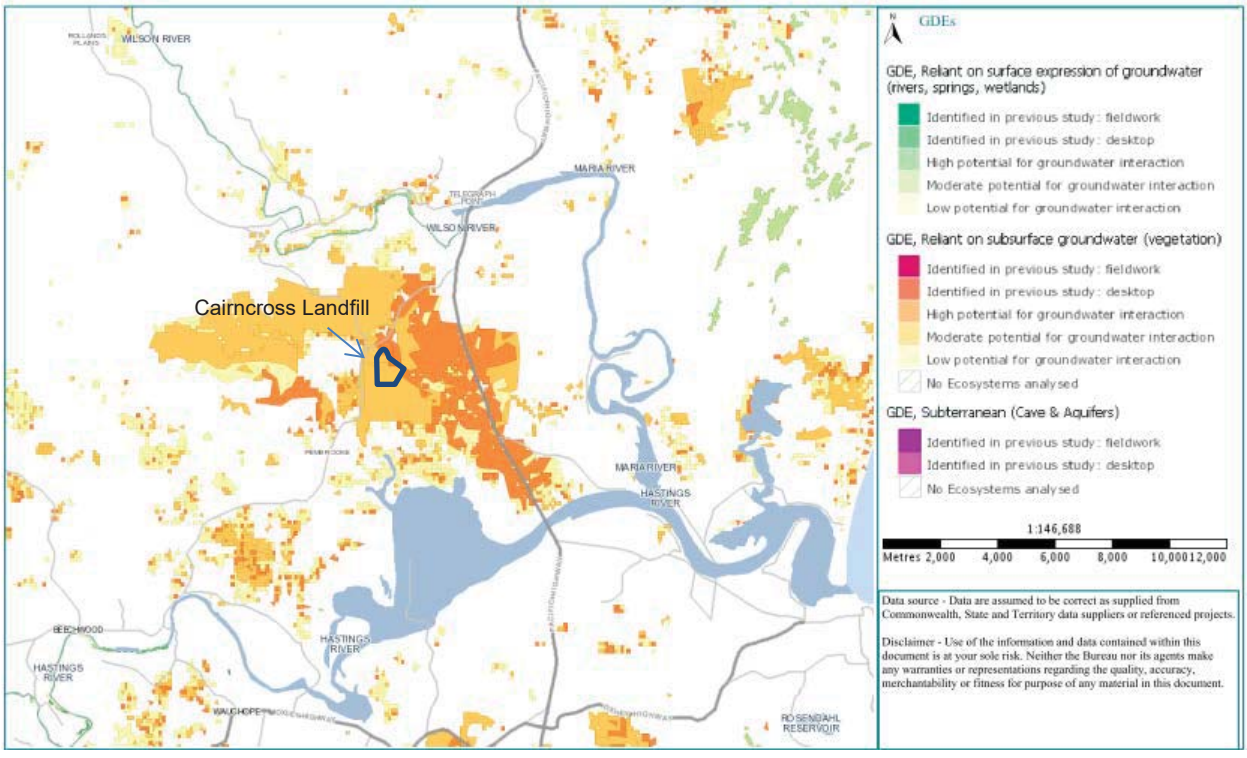
The Atlas shows ecosystems including springs, wetlands, rivers and vegetation that interact with:

- The subsurface presence of groundwater; and
- Other surface expression of groundwater.

In the vicinity of the Landfill Site, there are no ecosystems that interact with a surface expression of groundwater. However, the Landfill Site and surrounding area has been classified as having either a moderate or high potential for groundwater interaction with the presence of surface GDEs that rely on the subsurface expression of groundwater (Bureau of Meteorology, 2012) (**Figure 6).** The moderate potential indicates that groundwater is possibly present, and the ecosystem may use it. This includes GDEs which use groundwater after it has been discharged to the surface and includes all groundwater-fed surface water bodies, such as rivers, wetlands, lakes and springs (Eamus et al, 2006). This classification refers only to the aquatic (inundated) component of a system, and therefore excludes any vegetation which may have a fringe effect from a surface water body.

High potential for groundwater interaction indicates that groundwater is likely to be present, and the ecosystem is likely to be using it. The majority of data analysed and most reliable datasets indicated a high potential for groundwater interaction.

Figure 6 Location of GDEs in Relation to the Project (Source: Australian Government, BoM)



3 Baseline Data

3.1 Groundwater Monitoring Network

The Landfill Site has a comprehensive baseline groundwater monitoring network within and outside of the Stage E area comprising nine groundwater monitoring points (**Figure 7**). The monitoring network includes standpipe monitoring bores installed in the upper weathered and lower fractured rock horizon of a fractured rock hydrostratigraphic unit. Out of these, two nested piezometer sites comprise two monitoring bores each. These bores are installed as two separate, shallow and deep monitoring bores (CG04/05 and CG09/10 pairs). There are no bores installed in the overlaying clay layer as its thickness is not consistent and its spatial extent does not extend across the site. **Table 3** summarises the monitoring bores that are part of the monitoring network.

Table 3 Summary of Monitoring Bore Details

Monitoring Bore	Depth (m)	Hydrostratigraphic Unit	Groundwater Head (meters below ground level (mbgl)) Sept 2015	Comment
CG102	21.41	Fractured rock	7.78	
CG103	11.56	Weathered horizon	10.11	
CG104	24.15	Fractured rock	3.26	Nested site
CG105	9.85	Weathered horizon	3.31	
CG106	26.49	Fractured rock	4.05	
CG107	30+	Fractured rock	3.34	
CG108	30+	Fractured rock	2.78	
CG109	26.19	Fractured rock	7.93	Nested site
CG110	12.44	Weathered horizon	6.57	

3.2 Current Groundwater Monitoring Program

The aim of the groundwater monitoring program is to provide an understanding of the behaviour of hydrostratigraphic units and potential inflow into the landfill area when they are deepened. It also enables collection of groundwater head and quality information which is used to assess potential impacts from the existing Landfill Site and proposed expansion.

The groundwater monitoring program started in December 2001, and has expanded since, with some monitoring bores decommissioned and new ones installed. The groundwater monitoring program currently comprises:

- Quarterly groundwater head monitoring in all standpipe monitoring bores and two nested sites (with two separately installed monitoring bores) (**Figure 8**); and
- Comprehensive geochemical sampling and analysis is undertaken on a quarterly basis in all standpipe monitoring bores.

The following physical water quality parameters are measured in the field using a calibrated water meter: EC (µS/cm), temperature and pH. The laboratory analysis includes:

- Major ions (calcium, magnesium, sodium, potassium, chloride, bicarbonate, sulphate, fluoride);
- Alkalinity (bicarbonate and carbonate);
- Dissolved metals (manganese and iron);
- Inorganics - ammonia and nitrate;
- Hydrocarbons - halogenated aromatic and trihalomethanes (volatiles);
- TOC; and
- Phenols.

The samples are collected in suitably preserved containers provided by the laboratory and kept cool at below 4°C. Field sampling procedures conform to quality assurance/quality control protocols to prevent cross-contamination and preserve sample integrity.

In addition, continuous monitoring of groundwater heads in five monitoring bores was undertaken in 2015 for a period of two months using data loggers, which are set to record at four hour intervals, and measurement of barometric pressure at same time intervals (**Figure 9**).

3.3 Hydraulic Testing

In 1998 five monitoring bores were hydraulically tested using both Packer and slug tests. Packer testing involved testing of several intervals along the borehole depth. Some of the tests undertaken were not considered accurate as they were undertaken above the water table. Slug testing involves inserting or withdrawing a slug of water from the monitoring bore. This results in a groundwater head rise or decline which enables the calculation of hydraulic conductivity. Tests were undertaken as rising head tests.

In addition, constant head permeability test was undertaken on four soil samples collected from the test pits from up to 2 m depth. These tests were undertaken in a NATA accredited laboratory.

In 2015 as part of this project, further three bores were hydraulically tested. All three tests were rising head tests where a slug of water was removed from the bore and the recovery was monitored. The testing was undertaken in bores CG103, CG107 and CG108 to confirm the results obtained previously, as some were not considered accurate. The testing was also undertaken to gain better understanding into the hydraulic conductivity of this hydrostratigraphic unit which is fully saturated. Recovery in CG103 was too slow for any meaningful analysis indicating horizontal conductivity below 10^{-8} m/s.

Table 4 provides a summary of reliable hydraulic conductivity results undertaken across the Landfill Site, and **Appendix A** provides the analysis of three tests undertaken as part of this assessment.

Table 4 Summary of Hydraulic Conductivity across the Cairncross Landfill Site

Monitoring Bore	Test	Tested Unit	Adopted representative value (m/s)
CG103	Slug (rising head) 2015	Screened section	$<10^{-8}$
BH1 (CG107)	Packer test	Upper Fractured rock	2.1×10^{-6}
	Slug test	Lower fractured rock	1.1×10^{-7}
	Slug (rising head) 2015	Screened section	2.07×10^{-7}
BH3 (CG108)	Slug test	Lower Fractured rock	3.1×10^{-9}
	Slug (rising head) 2015	Screened section	1.67×10^{-8}
BH6	Packer test	Weathered horizon and upper fractured rock	3.8×10^{-8}
	Slug test	Fractured rock	2.1×10^{-8}
Test pit C	Constant head laboratory	Clay (1-2m)	1.67×10^{-10}
Test pit D	Constant head laboratory	Clay (1-2m)	2.12×10^{-10}
Test pit E	Constant head laboratory	Clay (1-2m)	3.98×10^{-10}
Test pit G	Constant head laboratory	Clay (1-2m)	7.77×10^{-10}

The range of values obtained by different test methods within the upper and lower fractured rock unit and the weathered horizon is typical of fractured rock aquifer.

3.4 Groundwater Heads and Flow

The groundwater heads in monitoring bores have been measured since December 2001 in four monitoring bores and in all nine bores since late 2013. For this study two months of continuous groundwater head monitoring was also undertaken in five groundwater bores (CG103-CG106 and CG110) across the Site during October and November 2015 (**Figure 7** and **Appendix B**). Current monitoring program includes quarterly groundwater head monitoring in all site bores.

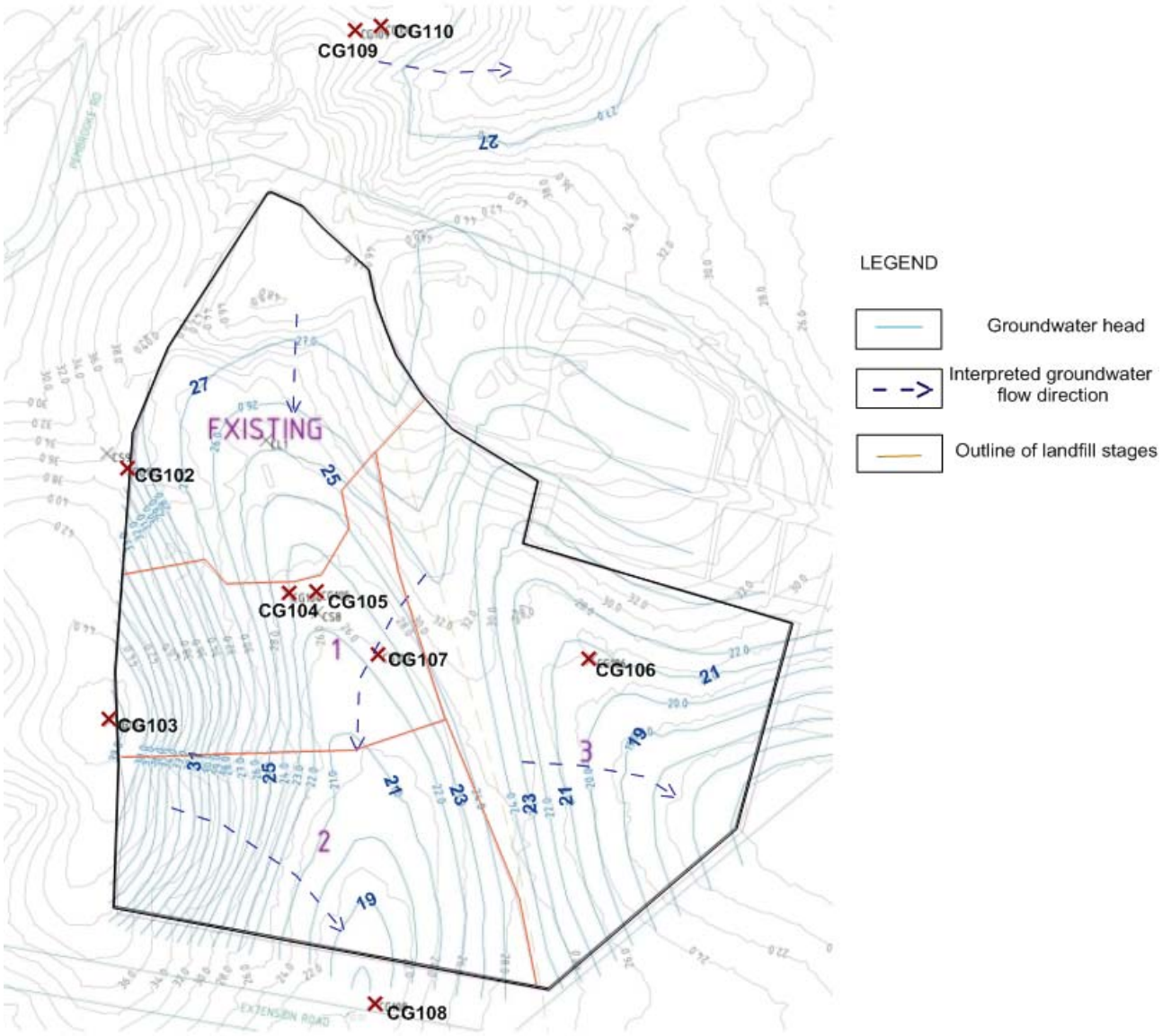
Historically, groundwater heads/pressures ranged from 2.8 mbgl in CG108 to just over 10 mbgl in CG103. Deepest piezometric heads are found at the ridges and the shallowest in the low laying areas. Therefore, at the ridges the fractured rock hydrostratigraphic unit is unconfined and within the low laying areas it is confined with groundwater head above the top of the hydrostratigraphic unit. The confinement is a result of topography.

Piezometric heads for the fractured rock hydrostratigraphic unit have been plotted for September 2015 and groundwater contours produced (**Figure 5**). This identified groundwater flow direction to be in an easterly and south-easterly direction. The flow in the fractured rock unit appears to follow the topography, with flow from elevated areas in the north and west to low lying areas in the south, southwest and southeast. Elevated groundwater heads occur in the northern and western part of the Project. Given that groundwater response in weathered siltstone and fractured shale is similar (**Figures 8** and **9**), these two geology units are considered as one hydrostratigraphic unit.

Time series piezometric head data for the period since 2001 have been plotted as shown on **Figure 8.** Also plotted is the rainfall residual mass, which represents monthly rainfall difference from the average monthly rainfall data taken from BOM rainfall station (60139) in Port Macquarie.

Long term records indicate that the groundwater bores respond in a similar manner to natural climate conditions, with a rise following the rainfall event and decline in head after a drier period with natural dissipation. Nested bores CG104 and CG105 located in the centre of the landfill have very similar groundwater heads although they are installed at two different depths. The difference in head at this location is about 0.1 m; however, the vertical difference in screened section is over 15 m. In addition, the hydrographs of these two bores show very similar response to climate events indicating that shallow and deep hydrostratigraphic unit are connected. The head at this location is downward from the shallow to the deep unit.

Figure 7 Loction of Groundwater Bores in Relation to the Proposed Landfill Development



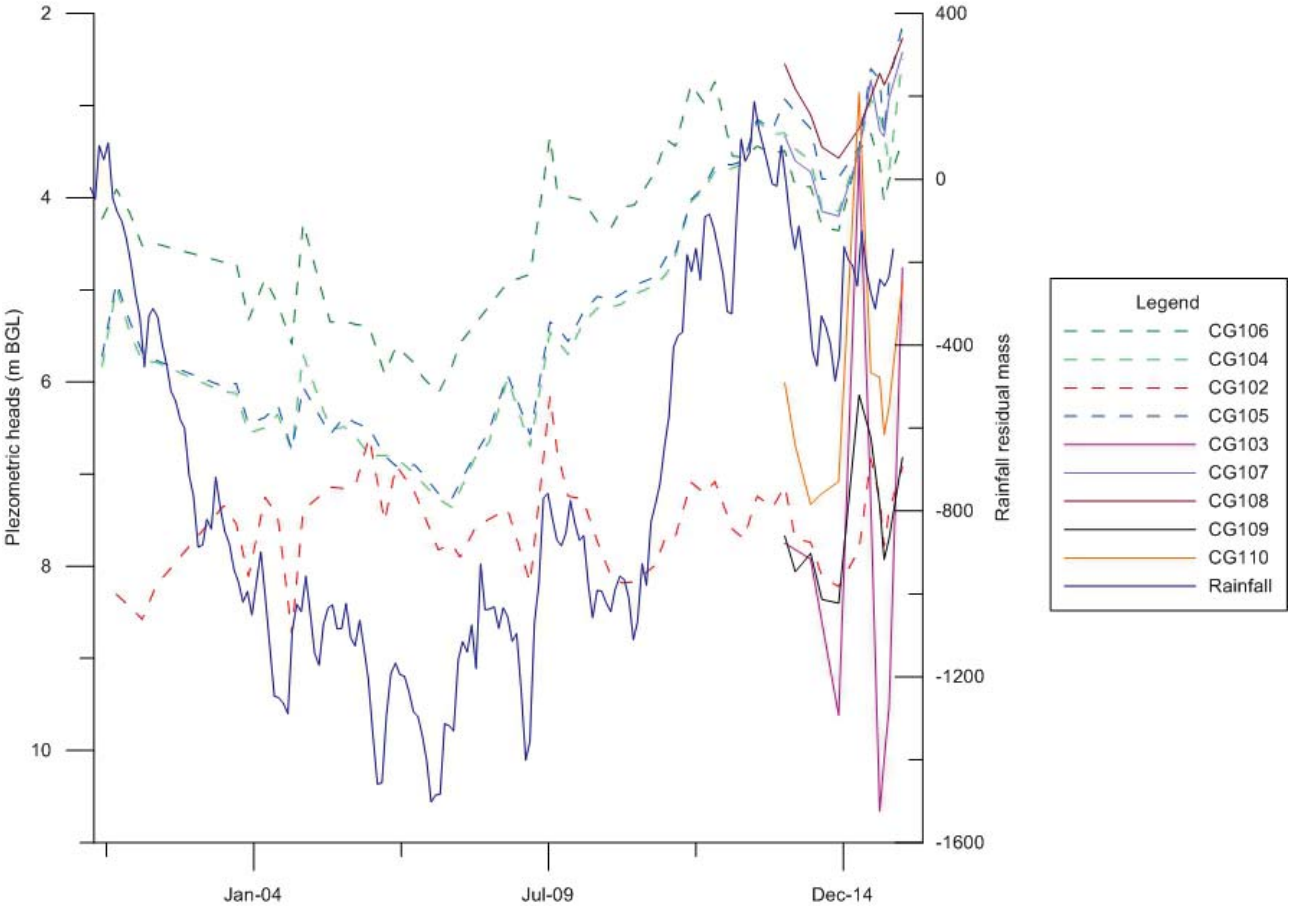
The hydrograph for CG102 located on the ridgeline at the western Project boundary shows more prominent but delayed response to rainfall recharge events. This is most likely due to the presence of the thin clay layer or its complete absence over the weathered rock horizon.

Hydrograph for CG106 located to the east shows a delay in response to rainfall events indicating that it is located within an area characterised by low hydraulic conductivity.

Hydrographs for other bores that have been monitored since late 2013 behave in a similar manner. Piezometer nest CG109 and CG110 installed on the top of the east-west trending ridge indicates downward groundwater gradient. The difference in vertical gradient here is about 1 m with a 14 m screen elevation difference. A slight delay is observed in the response of deep CG109 piezometer, most likely due to lower hydraulic conductivity of the overlaying weathered rock.

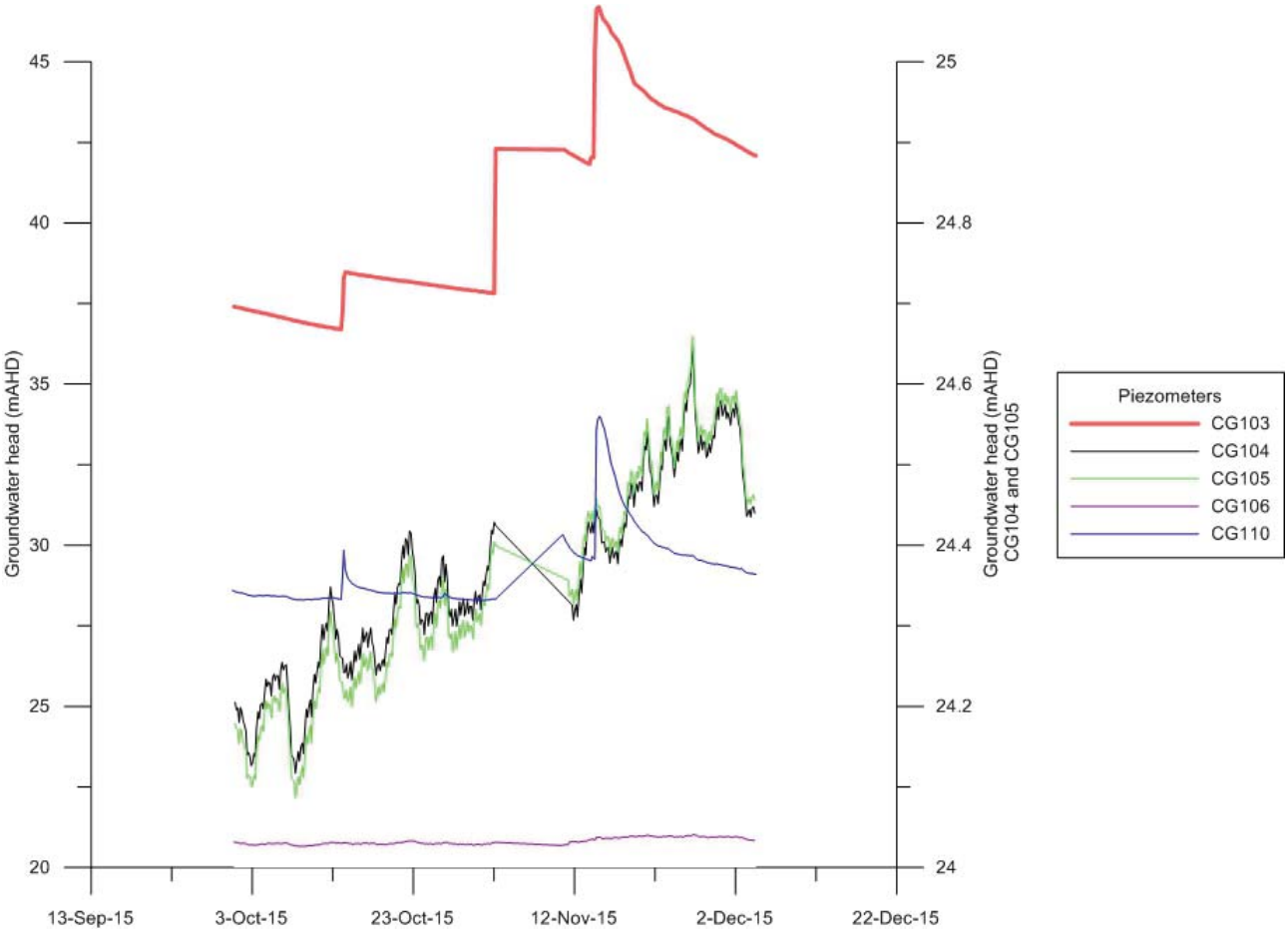
Further groundwater head analysis was undertaken using the detailed high density groundwater head recording obtained from data loggers for a period of two months (October/November 2015). These were installed in bores CG103 to CG106 and CG110 to understand the relationship between the deep and shallow unit and their connectivity and spatial changes in response to climate events.

Figure 8 Time Series Data for Site Piezometers (2001 to 2015) and Residual Rainfall Mass



CG103 and CG110 show highest fluctuations which are related to rainfall, however, with a delayed response in CG103. This indicates that the system at these locations is confined and the fluctuations are likely pressure response, rather than water movement. Bores CG104-CG106 show very minor response to rainfall with CG104/CG105 nested pair indicating slight upward groundwater gradient (**Figure 9**). Although there is a large vertical difference in the screen elevation between these two bores, there is minor difference in gradient indicating that the fractured system is not hydraulically separated from weathered strata.

Figure 9 Continuous Short Term Groundwater Head Records Collected During Oct & Nov 2015



3.5 Groundwater Quality

Groundwater quality samples have been collected during the period from December 2001 to 2015 from the originally installed bores in 1998 and new ones installed in the early 2000s (**Appendix B**). The samples have been collected on a quarterly basis by PMHC Environmental Laboratory. The sampling from newly installed bores CG103 and CG107-CG110 started in late 2013 and is available for a period of over two years. Long term sampling provides a good indication of the groundwater processes on-site.

The bores are generally purged until the field parameters (pH and EC) stabilise. This ensures that stagnant water is removed and the groundwater sample is representative of aquifer conditions.

All the water samples collected are analysed for a broad chemical suite designed specifically to assess the chemical characteristics of the water-bearing zone at the Landfill Site.

A full set of the chemical results is given in **Appendix B** and a summary of long term groundwater monitoring (2001 to 2016) is provided in **Table 5**. As the receiving environment is ultimately surface water (Rawdon Creek and other small unnamed tributaries, draining into Hastings River), the concentration of analytes was compared to the levels for 95% protection of freshwater ecosystems (ANZECC, 2000). Major ion chemistry is

shown on the Piper diagram in **Figure 8**. The chemical results for leachate for the period from 2002 to 2016 and baseline data collected from four bores in 1998 have also been provided in **Table 5** for comparison.

Table 5 Summary of Long Term Groundwater Quality across the Cairncross Landfill Site

Analytical Group	Analytes	ANZECC 2000 Guidelines (mg/L)**	CG106	CG102	CG104	CG105	CG103	CG107	CG108	CG109	CG110	Leachate	Baseline
			Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
			Range	Range	Range	Range	Range	Range	Range	Range	Range		
Physical Parameters	EC (µS/cm)	125-2200	2178	2597	2408	2212	243	3649	659	877	288	16282	
			1600-2410	1430-3880	709-2720	314-2800	138-364	3330-3910	161-3530	749-1070	91-578		
	pH (units)	6.5-8*	6.8	6.5	6.7	6.8	5.1	7.3	6.6	7.0	5.4	7.5	6.8
			6.2-7.8	6.1-7.1	6.1-7.2	5.9-7.8	4.9-5.4	6.9-7.5	6.4-7.1	6.9-7.1	5.3-5.6		
Metals	Iron	ID	1.93	1.93	2.33	0.85	1.08	0.99	0.26	0.77	1.81	25.00	10.77
			0-9	0-4.7	0-16.2	0-5.5	0.4-2.5	0.1-1.9	0.1-0.4	0.1-2.3	0.7-4.1		
	Manganese	1.9	0.34	1.11	0.35	0.38	0.00	0.16	0.04	0.65	0.25	1.01	0.81
			0-1.4	0-4.3	0-1.2	0-1	0	0-0.7	0-0.2	0-1.2	0.1-0.7		
Inorganics	Ammonia	0.9	0.26	0.13	0.13	0.06	0.06	0.19	0.34	0.15	0.09	940.98	0.62
			0-3.1	0-2.4	0-1.1	0-0.2	0-0.2	0-0.8	0-1.7	0-0.5	0-0.3		
	Nitrate	0.7	0.33	0.20	0.11	0.23	0.05	1.50	0.08	0.70	0.16	2.52	
			0-1.2	0-0.7	0-0.5	0-1.1	0-0.1	0.7-2	0-0.2	0-1.7	0-0.4		
Organic Contaminants	Phenols	0.32	0.11	0.14	0.16	0.14	<0.05	<0.05	<0.05	<0.05	<0.05	1.23	<0.01
			0.1-0.2	0.1-0.2	0.1-0.4	0.1-0.2	<0.05	<0.05	<0.05	<0.05	<0.05		

^Halogenated aromatic hydrocarbons are not included as they contain many different compounds not specifically analysed or included in the ANZECC (2000) guidelines
* Lowland River pH values
** 95% level protection for freshwater ecosystems
ID no criteria provided in the ANZECC (2000) guidelines
Highlighted values represent exceedances for groundwater samples above the ANZECC (2000) guidelines

Long term groundwater quality data indicates that groundwater quality is generally within the ANZECC (2000) water quality guidelines for 95% protection of freshwater species. Mean EC levels exceed the criteria in CG102, CG104, CG105 and CG107, which are all deep groundwater bores (except CG105), and most likely reflect the natural shale groundwater quality. It must be noted that high EC values are representative of the background values within the fractured rock aquifer. These concentrations are also encountered in private bores within 3 km radius from the Project (see **Section 2.4.1**). Typically, groundwater is pH neutral, however at CG110 and CG103 located on the ridge and at shallow depths approximately 10 m below ground level, it is slightly acidic. Low pH is not related to leachate as leachate is generally neutral at the site.

Average long term concentrations of dissolved metals, inorganics (ammonia and nitrate), phenols and pH have generally not exceeded the ANZECC (2000) guidelines with both the mean and the upper range being below the guideline levels over the last 14 years of monitoring. The exceptions are inorganics: nitrate, which exceeded the criterion in CG107 (average nitrate 1.5 mg/L) and in CG106, CG105, CG107, CG109 maximum nitrate was exceeded, and maximum ammonia concentrations recorded in CG102, CG106, CG104, CG108 (2.4, 3.1, 1.1 and 1.7 mg/L respectively). Manganese maximum concentrations were exceeded in CG102 (maximum 4.3 mg/L). Long term average concentrations of manganese and ammonia remain below the ANZECC (2000) guideline levels.

Compared to baseline data collected in 1998 prior to landfill operation, current groundwater quality results are either improved or within the range of values measured before the start of the operation.

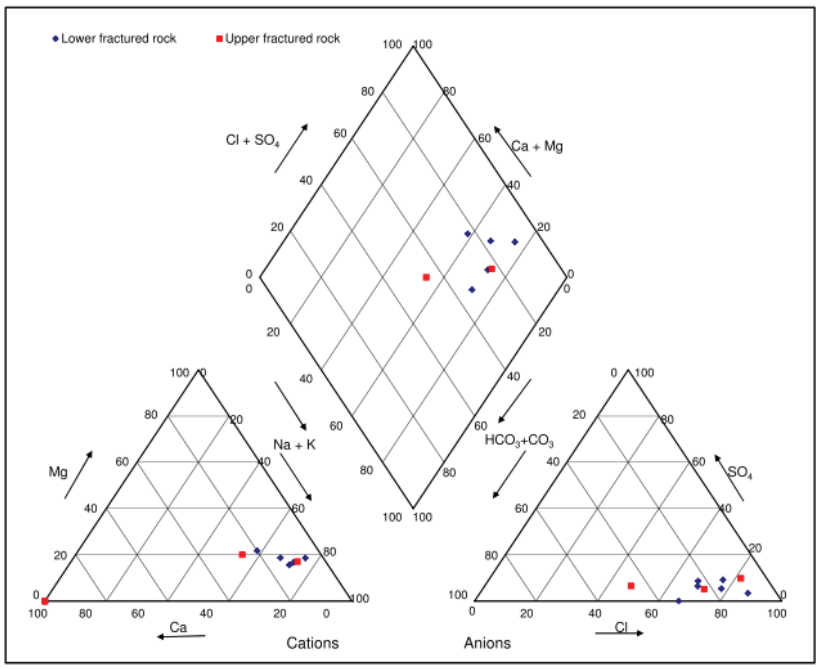
Leachate from Stage E is currently collected at the floor of the landfill cell and is returned to the top of the cell, in the leachate ponds. From here some leachate evaporates and some leaches down to the floor from where it is recirculated again. The chemical composition of leachate is very different from the groundwater composition, with high salinity, ammonia, nitrate, iron, phenols and biochemical oxygen demand (BOD 703 mg/L) reflecting polluted waters (**Table 5**). This difference in hydrogeochemistry confirms that no mixing is occurring and no leachate is entering groundwater system.

The Piper diagram (**Figure 10**) shows that one groundwater type can be distinguished within the Project area, although mixing is occurring between the upper and lower fractured rock horizons. The fractured rock system is typically sodium-chloride-bicarbonate (Na-Cl+HCO_3) dominated.

The main findings on water quality composition for the fractured rock hydrostratigraphic unit are as follows:

- pH is generally acidic to neutral and the mean varies from 5.0 to 7.3;
- Groundwater is typically fresh to brackish with mean EC varying from 183 µS/cm to 3757 µS/cm; and
- Major ion composition was Na-Cl+HCO_3, with some mixing between the upper and lower fractured rock.

Figure 10 Geochemical Composition of Groundwater across the Cairncross Landfill Site



3.6 Conceptual Groundwater Model

The groundwater system beneath the site comprises discontinuous clay sequence 2-5 m thick, underlain by 4-5 m thick weathered siltstone. This is underlain by fractured shale bedrock. The clay varies in thickness from 2 m at the ridges to 5 m in the valleys. Underlying siltstone can be found across the site and is relatively weathered (**Figure 4**).

Groundwater recharge occurs at the siltstone/shale outcrop at the elevated areas. Where the 5 m thick clay layer exists in the valleys, no direct recharge occurs vertically, rather slow seepage occurs through the clay layer to the underlying fractured shale. Discharge occurs in the low lying areas and via lateral flow through the fractured rock unit.

The groundwater table is not uniform across the site, with flow direction following the topography. The groundwater flow is from the elevated areas (CG109 and CG110) in the north toward the east and south, and from the west (CG102 and CG103) toward the southeast and east. The elevated ridge that extends across the site is likely to be a groundwater divide. The hydraulic gradient is relatively steep (1 m fall over 50 m). Based on the hydraulic conductivity, gradient and estimated shale porosity of 10%; the average groundwater velocity is approximately 0.0008 m/day.

At the elevated areas (CG109 and CG110) the vertical groundwater gradient is downward, with 1.6 m difference in gradient for around 14 m vertical spacing between the deep and shallow piezometer. However, in the valley the gradient is slightly upward with 0.03 m difference for 15 m vertical spacing between the deep and shallow piezometer. The reason for the change in vertical pressure is the elevation difference between the ridge and valleys.

The temporal changes in groundwater heads indicate that although there is a difference in geology and weathering between fresh/fractured shale and highly weathered siltstone, hydraulically they behave as one unit. This is evident from similar responses to rainfall events over the long and short term period (**Figures 8** and **9**).

The leachate is currently collected at the low point in Stage E and recirculated within the active cell. From collection point within Stage E, leachate is pumped to the leachate ponds located on the top of Stage E. From here some of the leachate evaporates and the remainder seeps through the landfill (Stage E) and is collected at the base.

4 Prediction of Groundwater Conditions

4.1 Existing Landfill Design

The 1999 EIS for Cairncross Landfill proposed that the bottom of the landfill extended to a depth ranging from about 34 mAHD at the northern end of Stage E to 20.5 mAHD at the southern end of Stages 2 and 3.

Based on the long term groundwater head data, the 1999 landfill design would have resulted in groundwater interception in Stages 1 and 2, with groundwater head about 2 m and up to 3 m above the floor level. Minor groundwater interceptions would have occurred in proposed Stage 3. Therefore, based on current groundwater knowledge, it is predicted that the elevation of the landfill floor (as designed in 1999) would result in groundwater inflow into these areas. To ensure stable landfill conditions during and post operation, the water table would in this case need to be lowered by around 3 m. This would require continued pumping and need for disposal of groundwater, both during operation and over the long term.

4.2 Redesign of Proposed Landfill

As part of this project, the proposed landfill was redesigned to comply with the best practice draft Solid Waste Landfill Guidelines (NSW EPA, 2016), Best Practice Environmental Management Guideline for Waste Management (EPA Victoria, 2015) and the NSW Water Quality Protection Policy (NSW DLWC, 1998).

An extensive consultation process was undertaken in the period from February to April 2016 with the PMHC to ensure that the proposed landfill design is managed in such a manner that it not only complies with best practice guidelines but also minimises any risk and potential for geotechnically unstable conditions and impact to the beneficial uses of groundwater.

During the consultation process, long term average groundwater heads were reviewed with the aim of reducing the potential for any groundwater interception. This resulted in redesigning the final landfill floor to be 2 m above the average groundwater head, which is in accordance with the Victorian EPA[4] guidelines.

Further consideration was also given to the landfill floor elevation by reviewing maximum groundwater heads measured over a period of 15 years (**Figure 11**). This period was considered long enough to include both dry (2004-2011) and wet (2012-2014) weather periods. Based on the interpreted maximum groundwater contours, the proposed redesigned floor level of Stage 3 will generally be above the maximum groundwater head with potential for maximum groundwater head interception in Stages 1 and 2 (**Figure 12**). Within those areas the maximum groundwater heads are likely to be generally <0.2 m above the floor level. The exceptions are the western part of Stages 1 and 2 which are topographically elevated areas sloping to the east and groundwater recharge zones. Here, the maximum groundwater head may exceed the landfill floor elevation by up to 2 m.

In accordance with the draft Solid Waste Landfill Guidelines (NSW EPA, 2016), and to prevent high groundwater heads affecting the performance of the landfill liner, it is proposed to install a drainage trench around the western and southern perimeter of Stages 1 and 2 (**Figure 13**). The drainage trench will enable groundwater drainage during the periods of above average rainfall and rising groundwater by diverting groundwater flow to the south and east along the high permeability gravel layer. The drainage layer will divert

[4] PMHC also consulted with the NSW EPA who advised that, in the absence of the recommended separation distance between groundwater and the landfill floor in the NSW guidelines, PMHC should adopt the 2 m separation distance recommended by the Victorian EPA guidelines.

groundwater from the recharge area to the west around the landfill, and provide natural downgradient discharge at the southern boundary of Stage 2.

Figure 11 Interpreted Long Term Maximum Groundwater Contours and Flow Direction

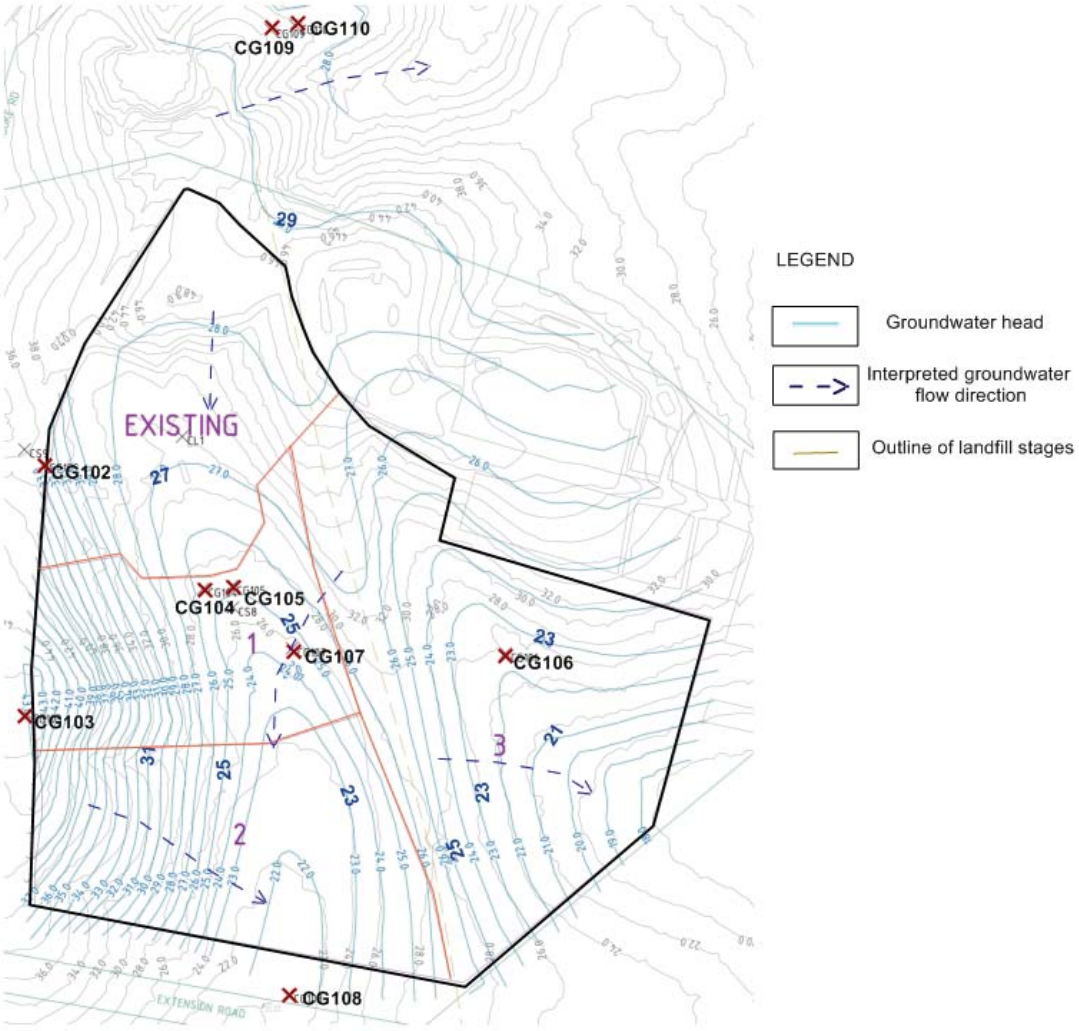
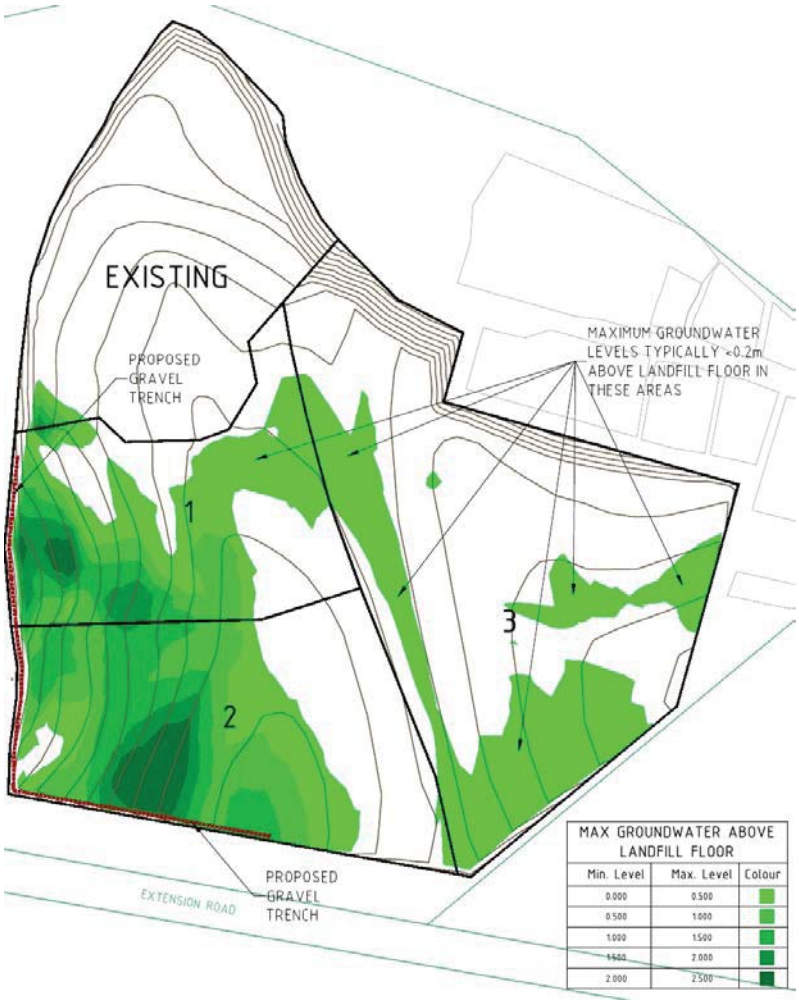


Figure 12 Elevation of Maximum Groundwater Heads above the Redesigned Landfill Floor & Location of the Drainage Trench



4.3 Groundwater Inflow

There will be no groundwater inflow to any of the proposed landfill Stages during periods of average groundwater heads as the floor of the landfill is 2 m above the average groundwater head.

However, should above average groundwater heads occur, the groundwater table will intersect the floor of the landfill. This would likely result in groundwater inflow (primarily during the excavation phase, i.e. before installation of the landfill lining and the drainage trench, but also to a lesser degree during the operational stage).

Analytical groundwater assessment was undertaken to estimate the short term inflow into the planned landfill cell during the periods of maximum groundwater heads before the drainage trench is put in place. This is considered to be a conservative worst case scenario and considers maximum groundwater head conditions for a period of 100 days. This is the assumed maximum period of time from the start of landfill cell development to completion of the trench construction. Projected dewatering rates were calculated assuming 1.2 m of saturation, and include the liner saturation of 1.2 m. Hydraulic conductivities vary across the site, ranging from 0.008 m/day to 0.0008 m/day (based on field obtained results). The Dupuit –Thiem modified equation (Fetter, 1994) for confined aquifer was used to calculate the long term steady state groundwater inflow into the proposed landfill development as follows:

$$Q = \frac{2\pi Kbs}{\ln(\frac{r_o}{r_w})}$$

Where K is hydraulic conductivity, b is the aquifer thickness, s is required depressurisation (0.2 m is used in this case), and r_o is the equivalent radius of influence calculated using the Kruseman and De Ridder (1994) approximation.

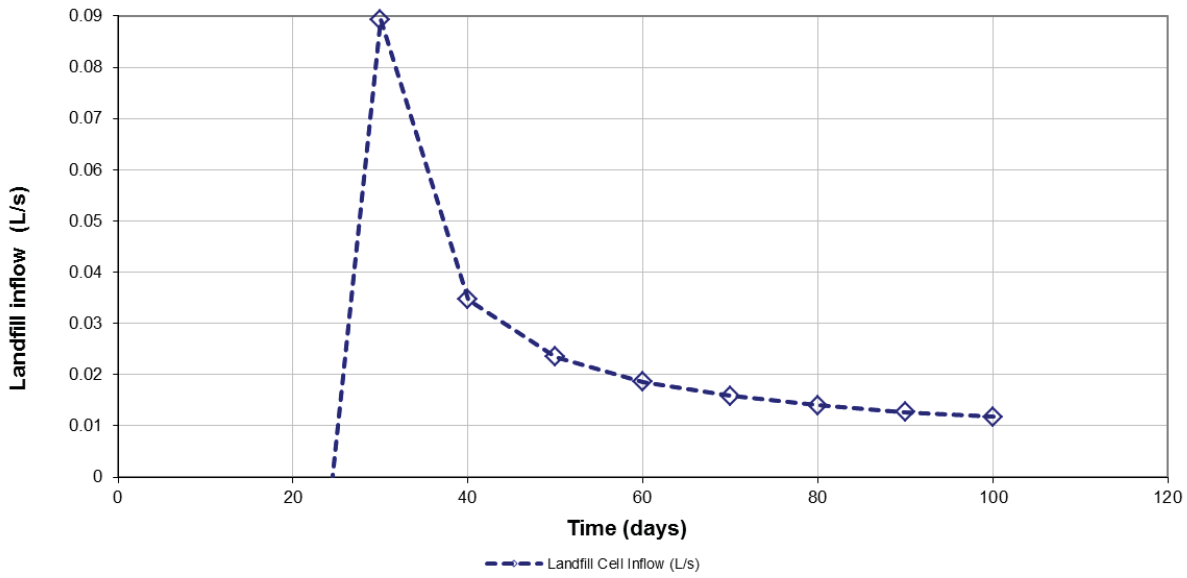
$$Ro=5755\ \sqrt{HK}$$

Over the short period of excavation of each Stage, the volume of inflow has been calculated for a maximum period of 100 days, as it is not considered likely that excavation of each Stage will exceed this time period. The inflow during the excavation period is predicted to be a maximum of 0.014 L/s (0.44 ML/year) and 0.016 L/s (0.53 ML/year) for Stages 1 and 2 respectively (Figure 13).

During the operational phase, the projected steady state inflow during maximum groundwater heads is calculated to be in the range of 0.0007 to 0.007 L/s (0.02 to 0.2 ML/year) for each of Stages 1 and 2. The predicted inflow in Stage 3 is considered negligible with the area of <0.2 m saturation covering less than 30% of the entire Stage 3 area. Elsewhere in Stage 3, the landfill floor will be above the maximum groundwater heads.

Groundwater inflows will be sourced entirely from the fractured rock unit during development of proposed Stages 1 and 2.

Figure 13 Predicted Change in Rate of Inflow into the Excavation of Stages 1 & 2 During the Period of Maximum Groundwater Head



5 Impact Assessment

5.1 Historical and Current Groundwater Inflows

The existing landfill (Stage E) is located above the groundwater table; therefore, there are no inflows from the bottom or the sides of the excavated area. All completed landfill areas contain clay capping, and any direct rainfall on the active areas of the landfill percolates down and is captured by the leachate system.

Groundwater chemistry indicates that there is no mixing between the groundwater and leachate.

5.2 Predicted Impacts

5.2.1 Impact on regional and local groundwater system and private groundwater bores during excavation and operation

A desk-top analysis was used to develop the groundwater predictions using the available baseline data collected at an appropriate frequency and scale. The proposed future landfill Stages 1-3 will have an excavated floor 2 m above the long-term average groundwater table and will therefore have no impact on the regional or local groundwater system or nearby bores.

During excavation it is possible that groundwater heads will be higher than average as a result of a long wet weather period. In this case, dewatering for Stages 1 and 2 may be required, with a predicted maximum pumping rate of 0.014 L/s and 0.016 L/s in Stages 1 and 2, respectively. This considers a 100 day period of maximum groundwater heads. It is proposed that any groundwater inflow will be gravity drained to a low point and pumped out directly to the sediment collection dam.

Groundwater inflow from these areas will result in drawdown impact extending within the shale aquifer to a maximum of 1 km after 100 days. During this period, the drawdown is predicted to be within the range of 0.01 m to 0.1 m.

During operation, any potential impacts from the landfill on the groundwater system will be further reduced by the proposed drainage trench which is to be installed at the western boundary of Stages 1 and 2, and southern boundary of Stage 3. It is assumed that the drainage trench will be constructed during the development of Stages 1 and 2, and within 100 days of the start of each of the stage excavations. The trench will reduce the possibility of groundwater head rise above the proposed landfill floor in a period of above average groundwater heads.

Within Stage 3 there is a very small area in which the maximum groundwater head will exceed 0.2 m above the average groundwater head (i.e. a maximum of 1.8 m below the landfill floor), and the inflows during excavation and operation are therefore considered negligible (0.001 L/s).

Given the minor predicted drawdown (max 0.1 m) in Stages 1 and 2, at a distance 1 km from the Landfill Site and the absence of private groundwater bores located downgradient (within 1 km of the Landfill Site), no groundwater impact is predicted to occur at any of the identified bores.

5.2.2 Impact on groundwater dependent ecosystems

Based on the groundwater Atlas, the area within approximately 3 km of the Landfill Site has been classified as having moderate to high potential for groundwater interaction with the presence of surface GDEs that rely on the subsurface expression of groundwater.

This study predicts the drawdown to be negligible at a distance of 1.2 km from the Site boundary (<0.001 m maximum drawdown during excavation).

A detailed ecological survey was undertaken across the Landfill Site (Arcadis, 2016) and needs to be referred to for further details on ecosystems reliant on surface expression of groundwater and potential impact.

5.2.3 Impact of development on surface water (Rawdon Creek)

There are no surface water bodies identified directly downgradient of the proposed Stages 1 to 3 of the Cairncross landfill. Rawdon Creek is located 2 km to the west of the landfill and drains south/south-east towards the Hastings River. The groundwater at the landfill flows towards the southeast. Unnamed small ephemeral tributaries that drain into Rawdon Creek downgradient of the site will be receiving the overland flow from the landfill stages during operation. A range of erosion and sediment control measures will be implemented to manage surface water quality from the site.

Given the ephemeral characteristics of Rawdon Creek and other unnamed tributaries, it is likely that creeks are discharging to groundwater. It is therefore predicted that there will be no change in surface water quality or flows as a result of the groundwater diversion, and predicted drawdown during the excavation phase related to this proposal.

5.2.4 Impacts on the groundwater system post landfill closure

As Stages 1 to 3 are filled, they will be subsequently covered by soil and capped. This will reduce the volume of surface water entering the system and therefore reduce the potential for leachate generation and subsequent leaching of any toxic substances to groundwater. All the proposed cells will be capped and rehabilitated, and the groundwater head is expected to remain as per pre-development heads i.e., at an average of 2 m below the cell floor.

The drainage trench will remain post landfill closure and will continue to divert groundwater around the southern and western perimeter of Stage 2, western side of Stage 1, and minimise groundwater head rise from the groundwater recharge areas. Therefore, the total groundwater inflow to Stages 1 to 3 following capping and closure of the landfill is predicted to be the same as during operation (i.e. 0.02 to 0.3 ML/year for each of Stages 1 and 2 and negligible for Stage 3).

6 Groundwater Licensing

Groundwater within the Site is governed by the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources under the Water Management Act (2000). The plan commenced in July 2016; it establishes rules for sharing water between different types of water users and provides users with opportunities to trade water through separation of land and water.

During the development of proposed Stages 1 to 3 there will be no groundwater inflow during the period of average groundwater heads as the landfill floor is designed to be 2 m above the average groundwater heads. During periods of maximum groundwater heads, it is predicted that the volume of groundwater inflow during excavation will be a maximum of 0.44 ML/year and 0.53 ML/year for Stages 1 and 2, respectively. During operation, groundwater inflow during maximum groundwater heads is predicted to range between 0.03 to 0.3 ML/year in each of Stages 1 and 2. However, during operation, it is expected that the construction of the proposed drainage trench will reduce this inflow to negligible levels. Negligible groundwater inflow (<0.003 ML/year) is expected during excavation and operation of the Stage 3 area, and during periods of maximum groundwater heads it is predicted to be minor (<0.03 ML/year).

There will be a requirement to license the seepage and purchase water on the open market for the volumes predicted to be extracted and intercepted during or post excavation of the proposed landfill cells. Predicted groundwater inflow volumes are given in **Table 6.**

Table 6 Predicted Groundwater Inflow Volumes for Licencing Purpose

Stage	Inflow (ML/year)	Period	Comment
Stage 1	0.44	Excavation	If maximum groundwater heads are encountered.
Stage 1	0.032	Operation	If maximum groundwater heads are encountered
Stage 2	0.53	Excavation	If maximum groundwater heads are encountered.
Stage 2	0.3	Operation	If maximum groundwater heads are encountered
Stage 3	<0.003	Excavation	If maximum groundwater heads are encountered
Stage 3	<0.03	Operation	If maximum groundwater heads are encountered

In accordance with the AIP, the water across the site is classified as “less productive” with average TDS over 1500 mg/L, and a yield (based on the yield in private bores installed in the shale aquifer) of less than 5 L/s. In accordance with the AIP there should be no more than 2 m cumulative pressure head decline and not more than a 2 m decline at any water supply work. This condition is satisfied as the predicted drawdown in the closest private bores from the proposed landfill is negligible. **Table 7** shows how the proponent will meet the requirements for the AIP for the take of water.

Table 7 Response to AIP requirements

	AIP requirement	Proponent response
1	Describe the water source(s) the activity will take water from?	**Fractured rock aquifer**
2	Predict the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity?	**See Table 6 and Section 4.4**
3	Predict the total amount of water that will be taken from each connected groundwater or surface water source after the closure of the activity?	**It is predicted that the activity will not take water from a surface water source. Groundwater will be sourced from fractured rock aquifer only, and the volumes are provided in Section 5.2.4 and Table 6**
4	Predictions in accordance with Section 3.2.3 of the AIP?	**Yes Sections 4.2, 4.4 and 5.2.1**
5	Describe how and in what proportions this take will be assigned to the affected aquifers and connected surface water sources?	**Yes Section 4.4, 5.2.1 and 5.2.4**
6	Describe how any licence exemptions might apply?	**N/A**
7	Describe the characteristics of the water requirements?	**N/A –water is not required, groundwater inflow to excavations will occur unintentionally as part of landfill cell construction**
8	Determine if there are sufficient water entitlements and water allocations that are able to be obtained for the activity?	**Relevant water sharing plan has sufficient allocation**
9	Consider the rules of the relevant water sharing plan and if it can meet these rules?	**Yes, there is over 24,000 ML of unassigned water in the groundwater source and water access licence maybe considered. No groundwater works are within the contaminated sources, GDEs or other production bores as per water sharing plan rules. ,**
10	Determine how it will obtain the required water?	**Purchase on open market in accordance with Water Management Act (2000)**
11	Consider the effect that activation of existing entitlement may have on future available water determinations?	**Minor, total of around 0.5 ML/year maximum groundwater interception**
12	Develop a strategy to account for any water taken beyond the life of the operation of the project?	**NA (Section 5.2.4)**
13	Considered any potential for causing or enhancing hydraulic connections, and quantified the risk?	**NA**
Will uncertainty in the predicted inflows have a significant impact on the environment or other authorised water users? NO If YES, items 14-16 must be addressed.		
14	Considered strategies for monitoring actual and reassessing any predicted take of water throughout the life of the project, and how these requirements will be accounted for?	**NA**

7 Monitoring and Reporting

Given the proximity of surface GDEs that rely on the subsurface expression of groundwater and groundwater bores which are installed in the same aquifer for water supply, it is necessary to ensure that groundwater monitoring is undertaken on a regular basis both in terms of heads and chemistry.

7.1 Requirements During Operation

During the excavation of the Stages 1 to 3 monitoring of groundwater heads and water quality in the site groundwater monitoring bores and inflow into the excavated area will be required (Table 8).

The current groundwater monitoring network (**Section 3.1**) comprises up-gradient bores CG102, CG103 and CG109/CG110, and downgradient bores CG104/105, CG106 to CG108. Two of these bore locations represent nested sites with a shallow and a deep bore. The monitoring network is suitable for monitoring during the landfill development and operation; however, it is recommended that one shallow and one deep bore be installed at the south-southwestern side of Stage 2 to monitor groundwater downgradient of landfill Stages 1 and 2 (**Figure 14**). The monitoring bores should be around 4 m and 12 m deep, respectively with at least 3 m slotted casing installed at the bottom and up to and above the unsaturated zone. In addition, it is recommended to install two bores at the southern boundary of Stage 3, with the aim of refining the groundwater contours and flow in the vicinity of the ridge, and detecting any potential contamination downgradient of Stage 3. A groundwater monitoring bore installation is recommended in the proposed trench to monitor the groundwater head on a monthly basis and water quality on a quarterly basis. The bores need to be constructed in accordance with Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee, 2012).

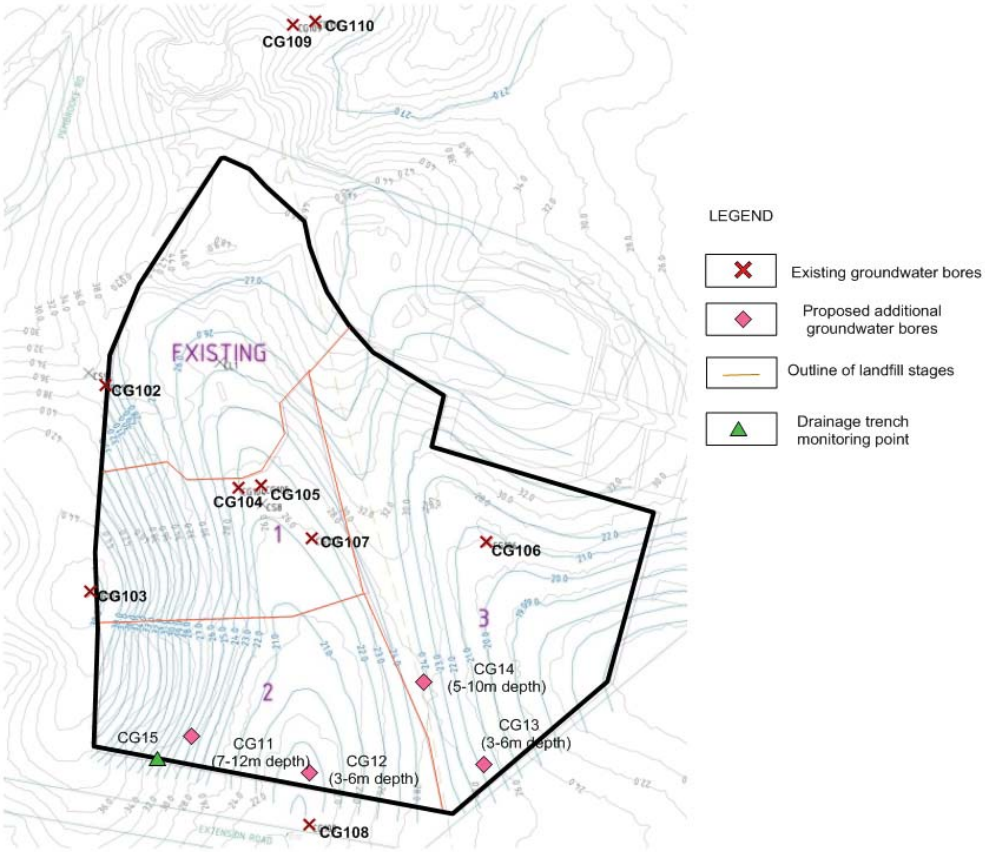
During the excavation phase, any potential groundwater inflow should be monitored by measuring the volume in accordance with DPI Water licensing requirements.

After the installation of the drainage trench (**Figure 15**) and during landfill operation, both the existing and new bores need to be monitored for groundwater heads and quality on a quarterly basis (**Figure 14**). Groundwater quality analysis should include all currently monitored parameters (**Section 3.5**). It is important to undertake annual measurement of bore depth and compare these with the installation depth to establish if any silt has accumulated in the bore. If this occurs, bores need to be developed to ensure that the screened section is open fully to the aquifer.

A sampling point included within the trench at the southern boundary will be used for both groundwater head and water quality monitoring during operation (Table 8 and Figure 14).

Sampling needs to be undertaken in accordance with the best practice, *Environmental Guidelines for Solid Waste Landfills* (NSW EPA, 2016) and Groundwater Sampling Guidelines (EPA Victoria, 2015).

Figure 14 Proposed Additional Groundwater Monitoring Bores



Groundwater heads should be monitored monthly during the excavation of Stages 1 and 2, to monitor for above average groundwater heads, the effectiveness of the trench and any potential drawdown outside the excavation (Table 8). Where possible, excavation in Stage 1 and 2 should be undertaken during dry weather period to reduce any impact of above average groundwater heads. For Stage 3 groundwater head monitoring can be undertaken on a quarterly basis, due to very small area likely to have maximum groundwater head above the landfill floor. Following the completion of excavation and construction of the drainage trench, the frequency of monitoring can decrease to quarterly.

Leachate monitoring needs to continue during operation, including collection of samples from the sump and monitoring of leachate levels quarterly in the main sump to confirm that it is not accumulating above the liner. In additon, the volume of leachate needs to be monitored (by using continous flow records) to ensure that the predicted leachate volumes and quality are not exceeded, and that the leachate management system is effective. Leachate water quality needs to be monitored on an annual basis in accordance with EPA NSW, 2016 guidelines. Leachate monitoring will ensure that after completion of the respective Stage, the performance of the capping layer can be assessed. The leachate will be transferred to one of PMHCs STPs under a trade waste agreement (TWA) and leachate quality monitoring will inform the suitability of the leachate for the STP.

During the excavation and operational period, groundwater monitoring results need to be reviewed on a quarterly basis and compared to trigger values. This will ensure that any potential exceedances are detected and checked, and if necessary, appropriate management strategies developed.

A groundwater assessment report should be prepared at least once every five (5) years, or should the groundwater monitoring program detect a possible failure of the leachate containment system. The assessment should be conducted by an appropriately qualified and experienced hydrogeologist. This report should comply with the requirements of the 2016 landfill guidelines.

The frequency of monitoring may be reduced if justified by data assessment; for example, where a landfill cell has been capped and revegetated for at least five (5) years and the data shows statistically constant low leachate pollutant concentrations after monitoring for at least five (5) consecutive years.

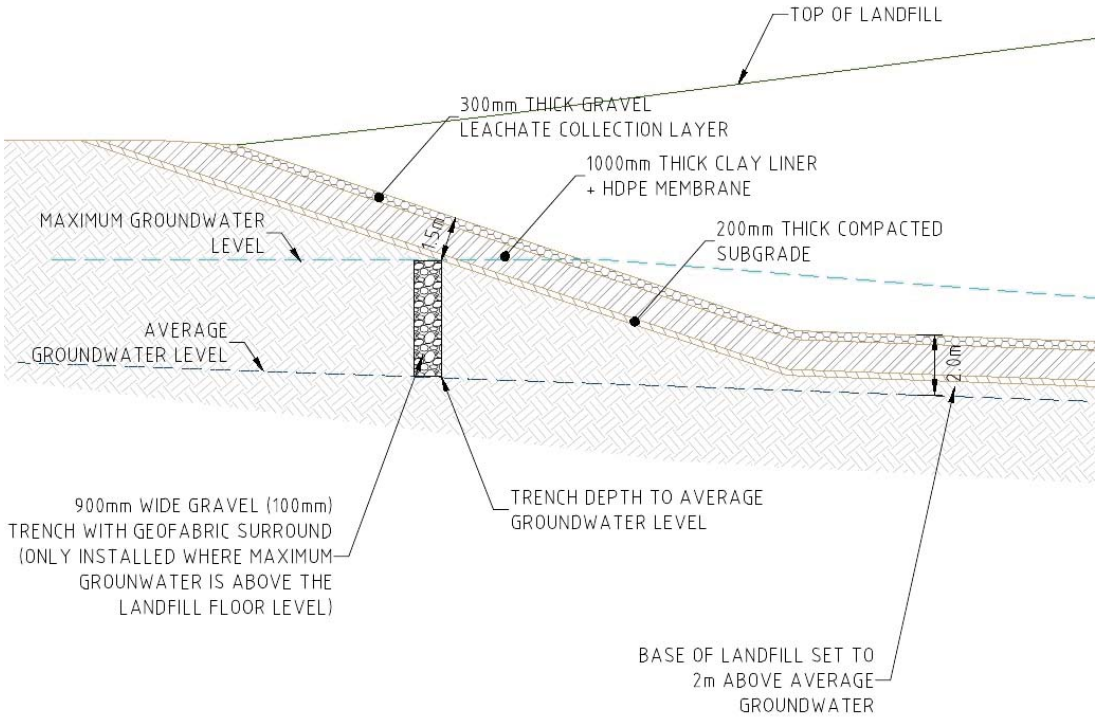
Table 8 Monitoring Schedule for Groundwater and Leachate

Period	Location	Parameters	Frequency
Excavation Stages 1-3	All groundwater monitoring bores	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	Selected groundwater monitoring bores*	Groundwater head monitoring	Monthly
	Groundwater monitoring bores CG9 and CG10	Groundwater head monitoring	Quarterly
	Drainage trench monitoring location (CG15)	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	In pit sump	Volumes	in accordance with DPIWater licensing requirements
	Leachate at each of the sumps in each of the Stages	As per current water quality sampling parameters plus level and flow monitoring, in accordance with any applicable TWA/EPL	Quarterly
Operation Stages 1-3	All groundwater monitoring bores	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	All groundwater monitoring bores and drainage trench monitoring point (CG15)	Groundwater head monitoring	Quarterly

	Drainage trench monitoring location (CG15)	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly
	Leachate	• As per current water quality sampling parameters, plus level and flow monitoring, in accordance with any applicable TWA/EPL	Quarterly
	All groundwater monitoring bores and drainage trench location (CG15)	Metals: aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, and zinc, and organic contaminants: phenols, petroleum hydrocarbons, PAH, monoaromatic hydrocarbons	Annually
Post closure Stages 1-3	All groundwater monitoring bores and drainage trench monitoring point (CG15)	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous) Note: this can and will likely be modified based on the performance during the operational stages and following a groundwater performance report.	Quarterly
	All groundwater monitoring bores and drainage trench monitoring point(CG15)	Metals: aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, and zinc, and organic contaminants: phenols, petroleum hydrocarbons, PAH, monoaromatic hydrocarbons	Annually
	All groundwater monitoring bores and drainage trench monitoring point(CG15)	Groundwater head monitoring	Quarterly
	Leachate at the sump at each of the Stages 1 to 3	As per current water quality sampling parameters plus level and flow monitoring, in accordance with any applicable TWA/EPL	Quarterly

* Existing and proposed as shown on Figure 14: CG102 to CG108, CG11 to CG15.

Figure 15 Drainage Trench Design



7.1.1 Groundwater trigger levels

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) (ANZECC) apply to the quality of both surface water and groundwater as they have been developed to protect environmental values relating to uses such as irrigation and stock use. The trigger values are not assessment criteria but are used to initiate investigations into the groundwater quality as reported by the monitoring program.

According to ANZECC (2000) and Australian guidelines for water quality monitoring and reporting, the recommended trigger-based approach for physio-chemical stressors is defined as follows:

> *A trigger for further investigation will be deemed to have occurred when the median concentration of a number of independent samples taken at a test site exceeds the eightieth percentile of the same indicator at a suitably chosen reference site.*

Trigger levels defined in such a way are statistically-based, accommodate site-specific anomalies and use a statistical measure to represent the variability of natural conditions. ANZECC (2000) recommends that wherever possible site-specific data are used to define trigger values for physical and chemical factors which can adversely impact the environment. A minimum of two years of monthly data at the reference site is required before a valid trigger value can be established. Longer monitoring periods allow for seasonal variation in data and detection of trends. However, the default values provided by ANZECC (2000) can be used where there is insufficient baseline data available.

The approach recommended by ANZECC (2000) for developing site-specific water quality trigger values is to formulate trigger values based on the 80th percentile of the site-specific monitoring data. Therefore, the trigger levels for EC are provided by calculating the 80th percentile i.e. upper trigger level while the trigger levels for pH have been determined by using 80th and 20th percentile, in accordance with the ANZECC (2000) guidelines and statistical analysis. The results of the baseline monitoring are discussed in **Section 3.5.** Site specific

trigger levels have been defined based on over 15 years of groundwater quality monitoring on site and are presented in **Table 9**.

Given that the maximum drawdown from the site boundary (within 1 km from the centre during excavation and high groundwater heads) is predicted to be approximately 0.01 m, the proposed trigger level is defined considering this drawdown, and the variation in long term seasonal fluctuations.

The trigger level is defined such that it is allowed to exceed the groundwater head by 0.05 m from the measured minimum, and by 0.1 m of the predicted maximum to allow for natural groundwater head fluctuations **(Table 9).** The threshold exceedance of minimum groundwater heads by 0.05 m is based on the seasonal fluctuations in groundwater heads and predicted drawdown at the Landfill Site boundary. The maximum threshold levels are defined based on the historical maximum groundwater heads and allowing for changes due to development. Therefore, should the groundwater head within the closest monitoring bore fall below or rise above the trigger level for remedial action, alternative options will need to be implemented to maintain the heads above this level. The trigger levels apply to both the excavation and operation stage of development of Stages 1 to 3.

Groundwater quality and head data from the proposed four additional bores, and within the trench, will need to be assessed against the ANZECC (2000) guidelines for 95% protection of freshwater ecosystems until two years of monitoring data is available. At that point in time, the site specific trigger levels can be set.

Table 9 Site Specific Trigger Levels

	Physical Parameters			Metals		Inorganics			Groundwater Head (mbgl)	
	EC	pH (units)		Iron	Manganese	Ammonia	Nitrate	Phenols*		
Trigger levels	80% percentile	20% percentile	80% percentile	80% percentile	80% percentile	80% percentile	80% percentile		Max	Min
CG106	2280	6.6	7.0	2.73	0.63	0.0288	0.148	0.32	2.64	6.17
CG102	3232	6.4	6.7	2.98	2.59	0.0208	0.052	0.32	6.06	8.785
CG104	2570	6.6	7.0	2.99	0.41	0.0216	0.0268	0.32	2.4	7.41
CG105	2522	6.6	7.0	0.94	0.58	0.024	0.048	0.32	2.03	7.32
CG103	334	5.0	5.4	1.52	0.01	0.02	0.02	0.32	3.44	10.71
CG107	3738	7.2	7.5	1.85	0.25	0.026	1.134	0.32	2.32	4.25
CG108	193.6	6.4	6.9	0.36	0.14	0.042	0.044	0.32	2.17	3.62
CG109	904	7.0	7.1	0.75	1.03	0.056	0.034	0.32	6.04	8.45
CG110	381.2	5.3	5.4	2.62	0.37	0.044	0.08	0.32	2.76	7.38

* ANZECC(2000) trigger level, as the results were consistently below this level

Groundwater quality and head data from the proposed four additional bores, and within the trench, will need to be assessed against the ANZECC (2000) guidelines for 95% protection of freshwater ecosystems until two years of monitoring data is available. At that point in time, the site specific trigger levels can be set

7.2 Requirements Post Closure

Following the excavation of Stages 1 to 3, these will be backfilled sequentially with waste and capped following completion. The drainage trench will be left in place and will continue to divert above average groundwater heads away from the landfill.

Ongoing monitoring requirements need to include monitoring of groundwater heads and quality in all groundwater monitoring bores and the drainage trench on a quarterly basis (**Table 10**). The frequency can be reduced if the data is found to be statistically constant with levels of analytes below the trigger levels, and low leachate pollutant concentrations over a five (5) year period. The current monitoring network (including additional bores as recommended in **Section 7.1**) is suitable for ongoing monitoring post operation, and should continue as per the current monitoring schedule.

Table 10 Post Operation Monitoring Requirements

Location	Parameters	Frequency	Comment
All groundwater monitoring bores* and drainage trench monitoring point (CG15)	As per EPA NSW (2016) guidelines: • Field parameters (pH, temperature and redox) and • Laboratory parameters (total dissolved solids, major anions and cations, total organic carbon, ammonia, nitrate, nitrite and phosphorous)	Quarterly	Can be reduced to six monthly or annually if the data is statistically constant with levels of analytes below trigger levels and overall low leachate pollutant concentrations over a five (5) year period.
All groundwater monitoring bores* and drainage trench monitoring point (CG15)	Metals: aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, and zinc, and organic contaminants: phenols, petroleum hydrocarbons, PAH, monoaromatic hydrocarbons	Annually	
All groundwater monitoring bores* and drainage trench monitoring point(CG15)	Groundwater head	Quarterly	Can be reduced to six monthly if the data is statistically constant with levels below trigger levels over a five (5) year period.
Leachate	As per current water quality sampling schedule parameters	As per TWA/EPL	

* Existing and proposed as shown on Figure 14: CG102 to CG110, CG11 to CG14.

8 Mitigation and Management Measures

In the event that landfill operations result in adverse impacts to the surrounding surface waters, ecosystems or groundwater, a series of appropriate response actions have been developed. **Table 11** summarises the potential water management issues that may arise and the appropriate response to be taken.

Table 11 Potential Management and Mitigation Measures

Potential Water Management Issues	Response
Water monitoring report results outside the groundwater impact assessment criteria	• investigate results and trends, considering any mitigating factors where applicable; • confirm the meteorological conditions at the time of the exceedance(s) (where relevant); • identify any potential contributing factors; • assess the monitoring results against background trends to identify any anomalies or causes; • if the exceedance is not attributable to the landfill operation the routine monitoring program will be assessed for its effectiveness; and • where the exceedance is potentially attributable to the landfill operation, appropriate mitigation and management strategies will be developed and implemented.
Exceedance of the predicted extraction volumes	• investigate and consider discharge downgradient to the same groundwater source; • investigate mitigating factors (including impacts outside of landfill operator control); and • if above the licensed volumes, following investigation of mitigating factors, additional volumes may need to be obtained. Consider engineering measures.
Receipt of community complaint	• investigate complaint, considering any mitigating factors and provide feedback to complainant.
Increased drawdown in groundwater bores	• investigate the cause of any increased drawdown; and • where relevant identify contingency measures such as installation of grout barriers or measures performing a similar function to seal off areas of higher permeability.
Loss of groundwater availability at private licensed bore	• investigate loss of groundwater availability, considering any mitigating factors where applicable; and • provide feedback to complainant.
Unforeseen impact	• conduct a preliminary review of the nature of the impact and commission an investigation by an appropriately qualified hydrogeologist.

8.1 Criteria Exceedance Protocol

The landfill operator will monitor groundwater in accordance with the Groundwater Monitoring Program (**Sections 7.1** and **7.2**). If the groundwater monitoring result(s) are outside the trigger values outlined in **Section 7.1.1** and **7.2** and further investigations are required, then the landfill operator will:

- Confirm the timing and general location of the exceedance(s);
- Confirm the meteorological conditions at the time of the exceedance(s) (where relevant);
- Identify any potential contributing factors;

- Assess the monitoring results against background trends to identify any anomalies or causes;
- If the exceedance is not attributable to the landfill operator the routine monitoring program will be assessed for its effectiveness;
- Where the exceedance is potentially attributable to the landfill operator appropriate mitigation and management strategies will be developed and implemented;
- Where mitigation and management strategies have been implemented additional monitoring and regular reviews will be undertaken to measure the effectiveness of the strategies undertaken; and
- Report the exceedance in accordance with the reporting mechanisms outlined in the Groundwater Monitoring Programs (**Section 7.1 and Table 9**).

9 Conclusions

This report provides a detailed hydrogeological assessment of the conditions encountered at the Cairncross landfill and predictions for the proposed landfill extension (Stages 1 to 3). The following are findings of the study:

- Three geological units are present within Stages 1-3 of the Cairncross landfill. These are:
  - Spatially discontinous clay unit;
  - Continous weathered siltstone; and
  - Fresh and slightly weathered shale.
- Long term groundwater monitoring data indicates that hydrostratigraphically, the siltstone and shale behave as one groundwater unit. Groundwater heads in both geological units respond similarily to climate events. There is minor vertical gradient between the shallow and deep unit, and this is a result of the difference in topography rather than different hydraulic properties;
- Groundwater recharge to the aquifer is rainfall dependent and it occurs directly at the outcrop in the elevated areas, where clay cover is absent or thin. Where the clay layer is thicker (such as in the valleys) the recharge occurs via slow seepage from the clay layer and via lateral flow from the distant area where the unit outcrops;
- Discharge occurs regionally via lateral flow and in the low lying areas, resulting in waterlogged clays in the valleys;
- The groundwater flow direction is from the north and west to the east, south and southeast, and generally follows the topography. Based on the site measured hydraulic conductivity, groundwater gradient and asumed porosity, the groundwater flow velocity is estimated at 0.008 m/day;
- Groundwater heads respond quickly to rainfall recharge, with a delay in response observed in bores where clay cover exists;
- Geochemical data collected over the past 15 years indicates that a single type of groundwater is present across the site. This is supported by the groundwater head data also indicating the presence of one hydrostratigraphic unit. The groundwater quality falls generally within the ANZECC (2000) water quality guidelines for 95% protection of freshwater species. The groundwater is slightly brackish and sodium-chloride-bicarbonate ($Na\text{-}Cl+HCO_3$) dominated;
- The leachate from the existing landfill (Stage E) has an entirely different chemical compositon; it is high in salinity, ammonia, nitrate, BOD and contains phenols. No mixing is observed to be occuring with the groundwater;
- Basline water quality data collected prior to landfill operation indicates that the water quality during operation has remained within the same range as pre-operational values;
- The proposed landfill extension is designed such that the landfill floor is 2 m above the average groundwater head, and will therefore not intercept groundwater in Stages 1 to 3 under these conditions;
- If excavation of Stages 1 and 2 is undertaken during periods of maximum groundwater heads, there is potential for groundwater to rise above the landfill floor level to an average of 1.2 m, with higher heads in the southern part of Stage 1 and southwestern part of Stage 2. These levels may require dewatering in Stages 1 and 2 to a maximum predicted rate of 0.014 and 0.016 L/s, which may induce drawdown of a maximum 0.1 m at a distance of 1000 m from the dewatering point (assuming 100 days of maximum groundwater heads). Negligible groundwater inflow is predicted in Stage 3 (<0.003 L/s);
- Any future rise in groundwater heads above the designed floor level during the operation period in Stages 1 and 2 will be minimised by groundwater diversion away from the landfill. This will be achieved by installation of the drainage trench. The trench is designed such that it will intercept groundwater in

the recharge zone above the average level. It is designed to then divert groundwater to the south and east where groundwater flows naturally downgradient;

- Drawdown is predicted to have no impact on the nearest private groundwater bores (<0.01 m) and local and regional groundwater systems. The reason for the predicted negligible impact is the very small dewatering volumes expected during the construction stage and distance to these features;
- The closest surface water (Rawdon Creek) is ephemeral and flows to the west of the landfill with drainage toward the south/south-east. roundwater flows to the southeast and Given the ephemeral characteristics of Rawdon Creek and other unnamed tributaries, it is likely that creeks are discharging to groundwater. It is therefore predicted that there will be no change in surface water quality or flows as a result of the groundwater diversion, and predicted drawdown during the excavation phase related to this proposal;
- Groundwater Atlas classified the area within approximately 3 km of the Landfill Site as having moderate to high potential for groundwater interaction with the presence of surface GDEs that rely on the subsurface expression of groundwater A detailed ecological survey of the Landfill Site (ARCADIS, 2016) provides further detail on the impact on GDEs related to this project;
- No other sensitive receptors have been identified in the vicinity and downgradient of the proposed landfill;
- The current groundwater monitoring network needs to be modified slightly so that it is consistent with the NSW EPA (2016) guidelines for groundwater monitoring during the development and operation of the extended landfill. Sampling frequency should occur with indicator parameters as specified in **Section 7.1 and 7.2**. However, it is recommended that an additional two bores be installed downgradient and at the southwest boundary of the Stage 2 and two downgradient of Stage 3 at the southern boundary. These bores should be installed prior to commencement of the development to monitor for any changes in groundwater chemistry and heads, and exceedance of the trigger levels downgradient of the extended landfill. These bores should be included in the regular monitoring program. In addition, it is recommended that a monitoring point is installed in the drainage trench at the southern boundary of the Stage 2 boundary to monitor the level and quality of diverted groundwater;
- The interception of groundwater during excavation and operation will require the Proponent to licence the groundwater and purchase the entitelments as regulated by applicable Water Sharing Plan;
- The project satisfies the minimal harm criteria based on the assessment against the AIP5 policy.
- Post operation the landfill will be capped. This will limit recharge and no impact is predicted during this period on the groundwater system or downgradient ecosystems;
- Leachate quality and volumes should be monitored as per **Section 7**; and
- Based on the low hydraulic conductivity of the shale, weathered siltstone and clay at the site, the landfill design with floor level 2 m above the long term average groundwater heads, in accordance with NSW EPA (2016) and Victoria EPA (2015) guidelines, the current operation and leachate management practices, predicted groundwater conditions during the proposed extension, and small number of potential sensitive receptors in the vicinity of the project, the landfill is considered suitable for the proposed development from a hydrogeological perspective.

[5] NSW Aquifer Interference Policy (AIP) (NSW Department of Primary Industries, September 2012).

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11 Limitations

This report has been prepared for Port Macquarie-Hastings Council and Arcadis, and for the specific purpose to which it refers. No responsibility is accepted to any third party and neither the whole of the report or any part or reference thereto may be published in any document, statement or circular nor in any communication with third parties without our prior written approval of the form and context in which it will appear.

TRACE Environmental has used a degree of skill and care ordinarily exercised by reputable members of our profession practicing in the same or similar locality. The conclusions presented in this report are relevant to the conditions of the site and the state of legislation currently enacted as at the date of this report. We do not make any representation or warranty that the conclusions in this report were applicable in the future as there may be changes in the condition of the site, applicable legislation or other factors that would affect the conclusions contained in this report.

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Appendix A

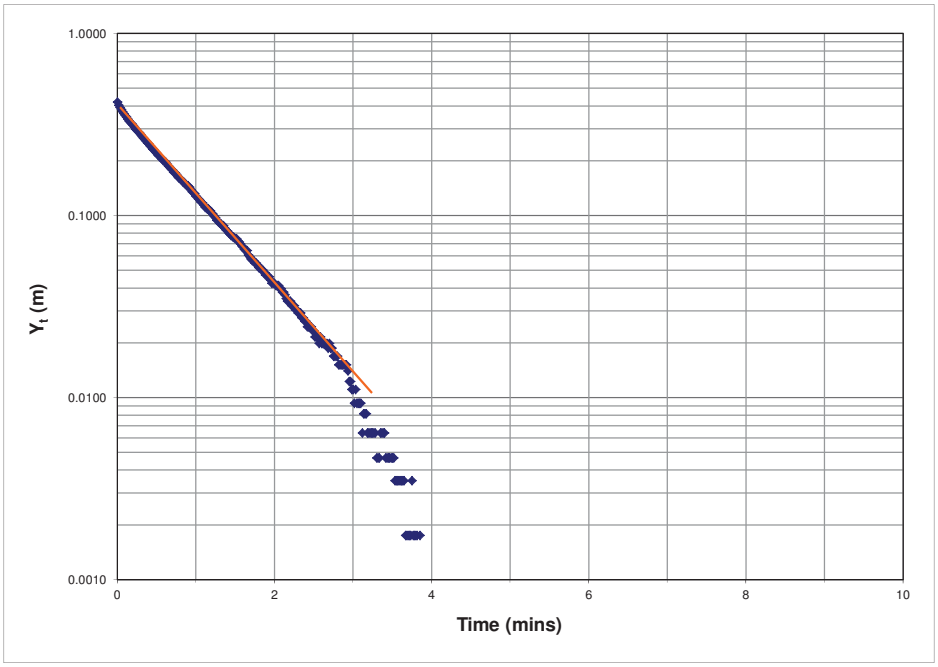
Aquifer Testing Results

Aquifer Test Solutions: CG107 — Slug Test

Project Name: Carincross Landfill
Client: Trace Environmental
Date: 4-Dec-15

Well No. / Name: CG107
Depth to equilibrium water level (m RL)**:** 3.15

Type of test: Falling head / Rising head ✓
Well Completion: Fully Penetrating / Partially Penetrating ✓



r_c =	casing radius	0.025
r_w =	radial distance between undisturbed aquifer and well centre	0.5
L_e =	length of intake	6
H =	saturated thickness of aquifer	40
L_w =	distance b/n water table and bottom of intake	30
R_e =	effective well radius	2.98
t =	time	1
Y_o =	initial drawdown	0.14
Y_t =	vertical distance between the water level in well at time t and equilibrium level	0.16
L_e/r_w =		12
A =	dimensionless co-efficient that is a function of L_e/r_w, and L_w < H	2
B =	dimensionless co-efficient that is a function of L_e/r_w, and L_w < H	0.5
C =	dimensionless co-efficient that is a function of L_e/r_w, and L_w = H	1.5

If L_w < H

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A + B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$$

$$= \mathbf{1.79}\ \text{m}$$

If L_w = H

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$$

$$= \mathbf{Lw < H}\ \text{m}$$

$$K = [r_c^2 \cdot \ln(R_e/r_w)]\ 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

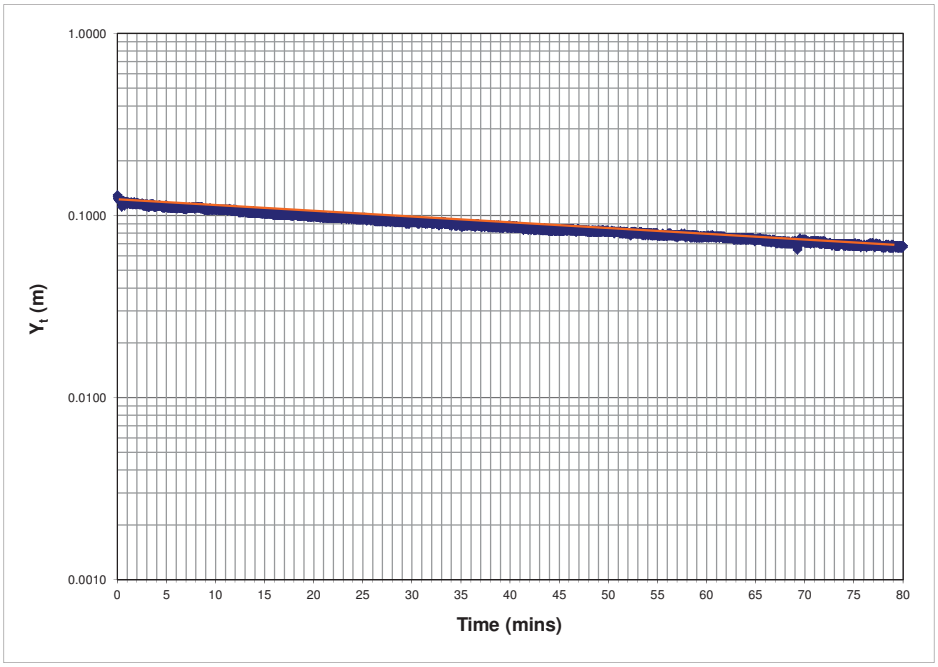
$$= 1.24\text{E-}05 \quad \text{m/min}$$

$$= \mathbf{1.79E\text{-}02} \quad \text{m/d}$$

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Aquifer Test Solutions: CG108 Slug Test

Project Name:	**Carincross Landfill**	Date:	4-Dec-15
Client:	**Trace Environmental**		
Well No. / Name:	**CG108**	**Depth to equilibrium water level** (m RL)**:**	3.07
Type of test:	Falling head / Rising head ✓	**Well Completion:**	Fully Penetrating / Partially Penetrating ✓



r_c =	casing radius	0.025
r_w =	radial distance between undisturbed aquifer and well centre	0.05
L_e =	length of intake	6
H =	saturated thickness of aquifer	60
L_w =	distance b/n water table and bottom of intake	30
R_e =	effective well radius	2.25
t =	time	85
Y_o =	initial drawdown	0.13
Y_t =	vertical distance between the water level in well at time t and equilibrium level	0.2
L_e/r_w =		120
A =	dimensionless co-efficient that is a function of L_e/r_w, and L_w < H	4.5
B =	dimensionless co-efficient that is a function of L_e/r_w, and L_w < H	1
C =	dimensionless co-efficient that is a function of L_e/r_w, and L_w = H	4

If L_w < H

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A + B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$$

$$= \mathbf{3.81}\ \text{m}$$

If L_w = H

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$$

$$= \mathbf{Lw < H}\ \text{m}$$

$$K = [r_c^2 \cdot \ln(R_e/r_w)]\ 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

$$= 1.00\text{E-}06 \quad \text{m/min}$$

$$= \mathbf{1.45\text{E-}03} \quad \text{m/d}$$

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Appendix B

Groundwater Monitoring Data

Cairncross Groundwater Monitoring Program																												
	Dec-01	Mar-02	Jun-02	Sep-02	Dec-02	Mar-03	Jun-03	Sep-03	Dec-03	Mar-04	Jun-04	Sep-04	Dec-04	Mar-05	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06	Sep-06	Jan-07	Mar-07	Jun-07	Sep-07	Nov-07	Feb-08	May-08	Sep-08
pH																												
CG6	7.03	6.62	6.72	7.13	6.77	6.65	6.85	6.34	6.85	6.74	6.61	6.9	6.55	6.83	6.83	6.56	7.02	6.78	6.65	6.45	6.94	6.8	6.68	6.21	6.68			
CG102	6.61	6.23	6.51	6.56	6.39	6.47	7.12	6.82	6.75	6.57	6.73	6.53	6.43	6.32	6.83	6.53	6.95	6.58	6.48	6.5	6.57	6.47	6.54	6.12	6.55	6.47	6.71	6.28
CG104	6.97	6.66	6.66	6.94	6.66	6.96	7.14	6.39	6.86	6.53	6.58	6.85	6.49	6.58	6.64	6.53	6.95	6.74	6.57	6.48	6.46	6.57	6.63	6.06	6.58	6.54	6.73	6.43
CG105	7.35	6.86	7.02	6.92	6.67	6.97	7.03	6.53	7.12	6.69	6.71	6.94	6.61	6.75	7.25	6.67	6.99	6.61	6.7	6.58	6.58	6.66	6.76	6.28	6.63	6.63	6.82	6.47
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Electrical Conductivity (uS/cm)																												
CG6	2110	2090	2030		2050	2130	2140	2190	2210	2140	2160	1600	2080	2180	1970	2390	2110	1970	2120	2100	2150	2130	2220	2110	2080			
CG102	2960	3240	3190		3230		3120	3320	3110	1940	1990	1460	1430	1490	1490	1700	1470	1470	1670	1680	1830	1860	1860	1860	1930	1960	2060	2350
CG104	2230	2270	2210		2240	2400	2340	2480	2480	2390	2450	1780	2420	2460	2250	2620	2300	2220	2340	2290	2380	2330	2500	2310	2380	2470	2450	2480
CG105	2260	2310	2280		2370	2430	2410	2530	2520	2430	2520	1800	2400	2510	2240	2690	2320	2250	2370	2290	2380	2420	2460	2260	2330	2450	2420	2470
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Calcium (mg/L) dissolved																												
CG6	68	66	80	68	62	59	60	60	59	63	64	60	69	62	58	63	65	63	68	58	63	59	64	67	67			
CG102	51	51	61	45	48	44	42	44	36	18	19	18	13	12	12	13	13	12	15	13	15	16	15	16	17	17	20	23
CG104	50	50	58	44	50	48	46	57	43	47	50	46	52	50	49	51	55	52	53	45	48	47	42	46	50	50	52	48
CG105	62	63	74	64	60	57	56	41	57	63	63	54	65	62	58	61	62	59	64	51	55	55	58	58	58	57	58	54
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Magnesium (mg/L) dissolved																												
CG6	47	48	48	50	47	46	47	47	47	47	47	47	50	48	44	47	47	47	50	47	50	48	50	54	51			
CG102	72	78	81	78	81	80	74	45	66	31	33	33	22	22	22	21	21	22	25	25	29	31	30	30	30	32	36	43
CG104	46	46	46	46	60	49	46	51	47	46	48	47	54	50	48	50	50	49	51	47	51	52	44	49	51	51	53	48
CG105	50	51	52	57	52	51	51	72	51	52	53	52	55	54	51	53	52	52	53	48	52	51	51	54	52	52	54	48
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												

Cairncross Groundwater Monitoring Program																												
	Dec-01	Mar-02	Jun-02	Sep-02	Dec-02	Mar-03	Jun-03	Sep-03	Dec-03	Mar-04	Jun-04	Sep-04	Dec-04	Mar-05	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06	Sep-06	Jan-07	Mar-07	Jun-07	Sep-07	Nov-07	Feb-08	May-08	Sep-08
Sodium (mg/L) dissolved																												
CG6	298	290	319	333	321	257	298	291	334	321	287	283	303	271	275	300	325	304	339	323	340	314	339	315	333			
CG102	508	528	569	542	558	462	496	358	516	369	313	301	236	220	259	249	269	270	307	314	350	341	395	339	341	365	388	413
CG104	390	364	393	400	407	342	378	355	419	401	372	371	376	350	361	388	408	384	439	412	436	418	457	394	412	432	442	422
CG105	364	371	382	424	390	321	374	474	409	392	364	328	359	346	352	372	398	386	437	400	431	401	441	405	405	420	434	416
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Potassium (mg/L) dissolved																												
CG6	13	5	5	5	3	3	4	3	4	2	4	9	3	3	3	3	7	3	3	3	3	3	2	6	2			
CG102	9	9	10	7	6	6	5	1	5	4	5	5	4	3	4	4	4	4	4	4	4	4	3	4	8	4	5	6
CG104	3	2	2	3	2	2	1	1	1	1	2	<1	<1	1	1	1	3	2	1	1	2	1	1	3	6	2	7	4
CG105	3	3	2	2	1	2	<1	6	2	1	2	1	2	1	2	2	3	1	1	1	1	1	1	1	1	3	7	2
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Alkalinity ($CaCO_3$) (mg/L) - Total																												
CG6	239	234	259	213	211	205	179	232	200	213	204	220	196	220	221	222	216	222	222	225	211	216	199	200	200			
CG102	184	190	204	183	183	169	179	171	135	151	144	156	126	125	132	128	127	133	138	143	147	159	151	148	150	155	152	156
CG104	303	310	328	301	302	270	321	304	298	342	298	329	298	319	279	328	327	333	336	350	346	340	321	320	323	324	323	317
CG105	131	312	334	320	321	305	334	313	318	343	323	354	336	341	295	348	344	356	367	368	352	334	338	340	346	344	344	338
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Sulfate (mg/L)																												
CG6	53	46	39	47	42	41	42	48	48	50	54	49	51	51	49	49	48	51	50	48	52	49	49	53	52			
CG102	76	72	70	58	59	52	50	55	64	37	42	36	29	29	15	29	29	32	32	30	39	38	37	36	38	39	40	43
CG104	59	58	57	51	90	53	53	57	59	67	65	63	60	61	60	60	60	65	61	56	64	63	56	56	62	62	62	57
CG105	63	62	62	61	56	56	55	75	62	64	71	68	67	69	65	66	68	74	73	67	75	70	73	74	72	74	77	69
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												

Cairncross Groundwater Monitoring Program																													
	Dec-01	Mar-02	Jun-02	Sep-02	Dec-02	Mar-03	Jun-03	Sep-03	Dec-03	Mar-04	Jun-04	Sep-04	Dec-04	Mar-05	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06	Sep-06	Jan-07	Mar-07	Jun-07	Sep-07	Nov-07	Feb-08	May-08	Sep-08
Chloride (mg/L)																												
CG6	524	548	597	576	539	464	523	473	573	567	514	528	584	535	441	533	623	553	561	588	552	579	617	642	538			
CG102	885	1000	1070	991	958	876	865	834	905	525	512	470	364	350	429	396	400	399	446	456	474	518	570	492	476	491	636	675
CG104	560	545	617	554	569	586	534	532	616	540	574	490	595	544	623	579	655	582	672	602	598	602	660	585	565	607	681	643
CG105	560	606	620	621	551	515	537	532	626	591	576	474	589	587	615	538	664	578	560	582	581	562	626	610	535	635	647	627
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Iron (mg/L) (dissolved)																												
CG6	9	3.08	2.9	1.2	2.08	1.7	1.53	2.71	1.57	1.52	0.02	1.3	0.9	0.87	<0.05	1.5	<0.05	0.12	2.77	1.98	<0.05	<0.05	<0.05	<0.05	<0.05			
CG102	1.25	1.22	1.9	0.1	1.24	2.3	2.58	1.91	1.49	0.52	0.04	<0.1	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
CG104	1.65	1.63	3	0.4	1.79	11.5	0.6	9.62	3.68	16.2	0.02	0.5	0.6	<0.1	<0.05	<0.05	0.56	<0.05	0.25	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.11	<0.05
CG105	0.57	0.25	0.4	0.8	0.76	0.9	0.65	1.33	1.45	1.97	0.02	<0.1	<0.1	0.19	0.2	0.55	<0.05	0.09	0.86	0.56	<0.05	0.21	0.91	0.94	1.1	0.73	0.73	0.11
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Manganese (mg/L) (dissolved)																												
CG6	1.36	1.1	0.786	0.627	0.613	0.68	0.67	0.64	0.41	0.63	0.56	1.07	0.38	0.379	0.595	0.598	0.236	0.087	0.662	0.494	0.106	0.024	0.262	0.741	0.541			
CG102	2.44	2.72	2.89	2.87	3.07	2.67	2.56	2.51	2.34	1.16	0.93	0.59	0.62	0.405	0.089	0.219	0.031	0.006	1.04	0.056	0.04	0.342	0.812	0.011	0.034	0.02	0.619	1.14
CG104	0.328	0.341	0.425	0.338	0.37	0.99	0.35	0.7	0.52	1.17	0.3	0.31	0.83	0.329	0.292	0.304	0.422	0.298	0.347	0.304	0.261	0.3	0.258	0.264	0.266	0.372	0.381	0.273
CG105	0.198	0.446	0.577	0.689	0.95	0.88	0.82	0.8	0.77	0.69	0.55	0.62	0.6	0.578	0.486	0.554	0.482	0.468	0.456	0.451	0.418	0.434	0.424	0.428	0.514	0.498	0.468	0.425
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Fluoride (mg/L)																												
CG6	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4	<0.1	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.3			
CG102	0.4	0.5	0.6	0.5	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.5	0.8	0.8	0.8	0.8	0.7	0.7	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7
CG104	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.6	0.6	0.4	0.7	0.6	0.7	0.7	0.6	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
CG105	0.5	0.5	0.6	0.6	0.7	0.6	0.6	0.6	0.6	<0.1	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												

Cairncross Groundwater Monitoring Program																												
	Dec-01	Mar-02	Jun-02	Sep-02	Dec-02	Mar-03	Jun-03	Sep-03	Dec-03	Mar-04	Jun-04	Sep-04	Dec-04	Mar-05	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06	Sep-06	Jan-07	Mar-07	Jun-07	Sep-07	Nov-07	Feb-08	May-08	Sep-08
Ammonia as N (mg/L)																												
CG6	2.27	2.22	3.08	0.27	0.13	0.58	0.29	0.28	0.03	0.19	0.33	0.26	0.1	0.076	0.25	0.361	0.053	0.073	0.248	<0.01	0.027	<0.010	0.055	0.055	<0.010			
CG102	<0.01	0.05	0.09	0.38	0.11	0.07	<0.01	<0.01	0.04	<0.01	0.05	0.04	0.04	0.017	0.036	0.059	2.36	0.04	0.033	<0.01	0.02	<0.010	0.022	<0.010	<0.010	<0.010	0.018	<0.01
CG104	<0.01	0.02	<0.01	0.02	0.06	0.06	<0.01	0.04	0.03	0.1	0.11	0.14	0.21	0.045	0.053	0.073	0.057	0.01	0.083	<0.01	0.05	<0.010	0.052	0.022	<0.010	<0.010	<0.010	<0.01
CG105	<0.01	<0.01	<0.01	0.03	0.03	<0.01	<0.01	0.03	<0.01	0.11	0.12	0.14	0.22	0.06	0.06	0.106	<0.01	<0.010	<0.01	<0.01	0.035	0.027	0.024	0.024	0.018	<0.010	<0.010	<0.01
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Nitrate as N (mg/L)																												
CG6	0.41	0.15	0.03	0.96	1.22	0.09	0.1	0.55	0.74	0.62	0.41	0.35	0.56	0.67	0.167	0.131	0.534	0.582	0.19	0.112	0.39	0.429	0.228	0.138	0.196			
CG102	0.15	0.05	0.73	0.29	0.11	0.07	0.04	0.04	0.06	0.02	0.03	0.07	0.03	0.013	0.064	0.086	0.138	0.232	0.131	0.094	0.105	0.118	0.02	<0.010	0.077	0.155	0.28	0.06
CG104	0.05	0.03	0.15	0.09	0.04	0.12	0.07	0.07	0.06	0.03	0.02	0.08	0.08	<0..01	0.026	0.028	0.018	0.225	0.023	0.013	0.017	0.064	0.017	0.033	<0.010	0.021	0.073	0.03
CG105	0.26	0.25	0.28	0.28	0.14	0.05	0.02	0.06	0.25	0.03	0.02	0.05	0.12	0.084	0.033	0.021	0.152	0.101	0.034	0.037	0.062	0.121	0.397	0.053	0.19	0.069	0.09	0.04
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Total Organic Carbon (mg/L)																												
CG6	6	3	16	8	7	12	8	<1	15	26	7	9	6	2	<1	<1	1	1	1	1	<1	<1	2	2	2			
CG102	2	<1	15	<1	7	18	9	<1	10	13	10	9	8	4	<1	3	2	3	2	2	1	2	3	3	4	4	3	2
CG104	<1	1	5	2	5	18	14	11	13	39	7	5	5	2	<1	<1	3	1	1	1	2	<1	1	3	3	1	1	<1
CG105	<1	<1	13	2	6	15	12	6	18	46	18	8	36	<1	<1	<1	1	1	<1	1	1	1	<1	2	2	2	<1	<1
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Phenols (mg/L)																												
CG6	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	0.24	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.05	<0.050	<0.050	<0.050	0.086	<0.050			
CG102	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.05
CG104	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	0.18	<0.05	<0.05	<0.05	<0.05	0.14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.142	<0.050	<0.050	<0.050	<0.05
CG105	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	0.093	0.131	<0.050	<0.050	<0.050	<0.05
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												

Cairncross Groundwater Monitoring Program																												
	Dec-01	Mar-02	Jun-02	Sep-02	Dec-02	Mar-03	Jun-03	Sep-03	Dec-03	Mar-04	Jun-04	Sep-04	Dec-04	Mar-05	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06	Sep-06	Jan-07	Mar-07	Jun-07	Sep-07	Nov-07	Feb-08	May-08	Sep-08
Absorbable Organic Halogens (ug/L)																												
CG6	19	19	13	32	34	24	19	22	21	21.1																		
CG102	33	28	18	34	35	32	32	37	50	19.7																		
CG104	19	19	10	24	31	29	21	38	23	24.5																		
CG105	25	35	11	41	41	29	31	26	44	24.6																		
	20-Mar-01	#######	#######	#######	######		######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######
Water level prior to purge (m from top of well)																												
CG6	4.23	3.911	4.167	4.521	4.5		4.7	4.71	5.325	4.88	5.15	5.593	4.274		5.35	5.345	5.375	5.400	5.912	5.612	5.8	5.95	6.12	5.83	5.58			4.92
CG102		8.305	8.438	8.574	8.205		7.341	7.54	8.11	7.25	7.45	8.735	7.3911		7.14	7.155	7.1	6.6	7.512	6.903	7.2		7.82	7.76	7.9	7.58	7.49	7.38
CG104	5.83	4.977	5.461	5.772	5.785		6.11	6.121	6.555	6.495	6.355	6.741	5.705		6.51	6.49	6.595	6.8	6.799	6.821	7	7.1	7.27	7.36	7.18	6.81	6.66	5.96
CG105	5.72	4.917	5.343	5.672	5.767		6.05	6.015	6.455	6.385	6.25	6.738	6.055		6.57	6.375	6.446	6.5	6.801	6.913	6.9	7	7.21	7.27	7.09	6.78	6.54	5.92
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Groundwater Depth (mAHD)																												
CG6	21.07	21.389	21.133	20.779	20.8		20.6	20.59	19.975	20.42	20.15	19.707	21.026	25.3	19.95	19.955	19.925	19.9	19.388	19.688	19.5	19.35	19.18	19.47	19.72	25.3	25.3	20.38
CG102																												
CG104																												
CG105																												
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Temperature (Deg. C.)																												
CG6																								16	15.4			
CG102																								17	17	21.7	20.5	20.8
CG104																								15.5	15.9	20.7	19	19.5
CG105																								15.8	15.6	20.1	19.4	19.3
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Halogenated Aromatic Hydrocarbons (ug/L)																												
CG6										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd			
CG102										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd		nd	nd	nd	nd
CG104										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd		nd	nd	nd	nd
CG105										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd		nd	nd	nd	nd
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												

Cairncross Groundwater Monitoring Program																													
	Dec-01	Mar-02	Jun-02	Sep-02	Dec-02	Mar-03	Jun-03	Sep-03	Dec-03	Mar-04	Jun-04	Sep-04	Dec-04	Mar-05	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06	Sep-06	Jan-07	Mar-07	Jun-07	Sep-07	Nov-07	Feb-08	May-08	Sep-08
Trihalomethanes (Volatiles) (ug/L)																												
CG6										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd		nd			
CG102										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd		nd	nd	nd	nd
CG104										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd		nd	nd	nd	nd
CG105										nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd		nd	nd	nd	nd
CG103																												
CG107																												
CG108																												
CG109																												
CG110																												
Data Checked (Analyst/Date)																												

Cairncross Groundwater Monitoring																							
		2010				2011						2012				2013				2014			
	Nov-09	Feb-10	Jun-10	Sep-10	Nov-10	Feb-11	Jun-11	Sep-11	Oct-11	Oct-11	Nov-11	Feb-12	May-12	Aug-12	Dec-12	Feb-13	May-13	Sep-13	Nov-13	Feb-14	May-14	Aug-14	Nov-14
pH																							
CG6	6.94	7.23	6.72	7.08	7.1	6.84	6.85	7.08			7.0	6.8	6.7	7.1	7.45	6.8	6.8	7.1	6.7	6.8	7.8	6.6	7.2
CG102	6.31	6.85	6.46	6.54	6.42	6.45	6.66	6.5			6.4	6.6	6.5	6.7	7.10	6.5	6.5	6.4	6.3	6.5	6.4	6.4	6.4
CG104	6.49	7.01	6.66	6.72	6.71	6.64	6.74	6.71			6.7	6.6	6.6	7.1	7.11	6.6	6.7	7.2	6.9	7.0	6.9	7.1	7.1
CG105	6.54	6.99	6.73	6.79	7.25	7.15			6.86	6.85	7.0	7.0	7.0	7.5	7.78	7.4	7.4	7.4	6.6	6.7	6.6	6.9	6.7
CG103																			5.0	NC	5.0	NC	4.9
CG107																			7.0	7.4	7.4	7.5	7.5
CG108																			6.4	6.5	6.4	6.7	6.7
CG109																			7.0	7.1	7.0	7.0	7.0
CG110																			5.3	5.3	5.5	5.4	5.4
Electrical Conductivity (uS/cm)																							
CG6	2230	2260	2120	2230	2330	2240	2310	2350			2280	2220	2160	2190	2230	2330	2290	2230	2200	2410	2370	2290	2160
CG102	2590	2690	2680	2690	2820	2840	3010	3080			3010	2950	3050	3000	3080	3380	3260	3210	3280	3550	3420	3400	3320
CG104	2470	2490	2460	2470	2570	2480	2650	2630			2570	2460	2440	2500	2520	2680	2640	2590	2500	2720	2680	2630	2460
CG105	375	874	1710	2310	2510	2430				2800	2500	2430	2400	2420	2470	2620	2570	2500	2590	2800	2770	2690	2570
CG103																			364	NC	307	NC	334
CG107																			3640	3910	3750	3730	3600
CG108																			161	186	196	190	180
CG109																			749	833	860	880	934
CG110																			302	578	226	500	261
Calcium (mg/L) dissolved																							
CG6	65	66	63	66	64	62	68	64			61	70	65	61	63	58	62	64	56	66	59	64	
CG102	27	27	26	27	30	27	33	31			32	35	33	32	33	34	37	37	34	39	37	40	
CG104	49	50	49	51	51	46	50	50			49	54	50	48	51	45	52	51	48	60	55	58	
CG105	13	24	39	53	56	54			55	52	53	59	55	51	54	49	55	56	46	56	51	55	
CG103																			<1	NC	<1	NC	
CG107																			128	146	132	152	
CG108																			4	5	4	4	
CG109																			30	41	40	48	
CG110																			2	3	<1	3	
Magnesium (mg/L) dissolved																							
CG6	51	51	50	51	49	51	53	50			48	53	50	47	50	50	48	49	46	51	48	50	
CG102	52	55	51	53	56	54	60	61			62	65	61	62	64	67	70	71	70	74	71	75	
CG104	52	52	51	52	52	49	53	52			49	55	52	48	52	53	54	53	48	53	52	54	
CG105	8	19	36	49	51	52			52	51	49	54	51	47	51	51	49	51	50	56	57	56	
CG103																			2	NC	<1	NC	
CG107																			83	88	87	92	
CG108																			3	4	3	3	
CG109																			16	19	19	20	
CG110																			6	15	4	11	

Cairncross Groundwater Monitoring																							
		2010				2011						2012				2013				2014			
	Nov-09	Feb-10	Jun-10	Sep-10	Nov-10	Feb-11	Jun-11	Sep-11	Oct-11	Oct-11	Nov-11	Feb-12	May-12	Aug-12	Dec-12	Feb-13	May-13	Sep-13	Nov-13	Feb-14	May-14	Aug-14	Nov-14
Sodium (mg/L) dissolved																							
CG6	314	350	324	339	377	341	341	341			330	343	333	347	340	310	315	335	290	338	325	310	
CG102	442	473	518	474	555	488	516	518			522	519	506	517	524	503	516	536	494	538	541	509	
CG104	419	424	463	412	479	415	438	433			421	438	420	420	444	397	417	424	376	426	426	392	
CG105	38	124	316	388	480	406			441	442	428	443	423	428	432	392	394	424	392	438	466	408	
CG103																			68	NC	48	NC	
CG107																			461	519	441	498	
CG108																			21	26	25	25	
CG109																			88	91	93	97	
CG110																			50	81	33	72	
Potassium (mg/L) dissolved																							
CG6	3	2	2	16	3	2	2	3			3	4	4	2	2	3	2	3	2	2	3	3	
CG102	4	4	20	15	7	5	5	5			6	8	6	6	5	6	6	6	6	6	6	6	
CG104	1	2	24	15	4	<1	3	1			2	2	2	2	1	1	1	1	1	2	2	2	
CG105	2	2	2	4	1	1			4	2	2	2	2	2	2	2	2	2	2	1	2	2	
CG103																			1	NC	1	NC	
CG107																			2	2	2	3	
CG108																			1	<1	2	1	
CG109																			5	4	7	5	
CG110																			1	<1	1	1	
Alkalinity ($CaCO_3$) (mg/L) - Total																							
CG6	207	195	208	190	193	183	186	182			178	187	211	221	190	199	192	193	183	179	211	210	
CG102	154	147	162	151	148	143	140	142			128	140	156	167	143	154	146	144	143	142	165	166	
CG104	312	316	331	294	303	297	348	287			285	288	324	350	297	317	299	301	305	305	349	354	
CG105	32	100	238	304	324	311			295	308	292	312	348	374	319	334	319	311	290	285	334	339	
CG103																			8	NC	13	NC	
CG107																			444	407	470	570	
CG108																			23	28	33	34	
CG109																			171	171	203	232	
CG110																			8	10	16	22	
Sulfate (mg/L)																							
CG6	57	52.3	38.5	48	42	50	49	50			40	50	46	52	48	50	50	49	49	50	53	49	
CG102	49	47.2	35.9	47	38	45	44	45			36	48	42	49	50	47	49	45	47	46	48	47	
CG104	62	47.9	36.9	60	46	57	57	56			44	53	49	59	55	59	58	56	68	65	73	78	
CG105	50	50.9	48	68	58	68			70	60	50	64	73	72	66	67	68	67	58	56	60	67	
CG103																			10	NC	12	NC	
CG107																			136	130	141	144	
CG108																			<1	2	<1	2	
CG109																			20	20	23	16	
CG110																			11	15	8	18	

Cairncross Groundwater Monitoring																							
		2010				2011						2012				2013				2014			
	Nov-09	Feb-10	Jun-10	Sep-10	Nov-10	Feb-11	Jun-11	Sep-11	Oct-11	Oct-11	Nov-11	Feb-12	May-12	Aug-12	Dec-12	Feb-13	May-13	Sep-13	Nov-13	Feb-14	May-14	Aug-14	Nov-14
Chloride (mg/L)																							
CG6	490	591	565	652	651	555	608	577			604	630	603	650	652	547	556	583	563	545	563	587	
CG102	666	746	743	878	852	775	828	837			855	906	863	936	971	806	840	910	905	853	902	923	
CG104	542	592	597	709	667	553	649	591			625	657	626	640	692	574	594	632	579	556	583	600	
CG105	50	159	389	596	636	532			618	602	597	624	600	648	650	544	560	593	624	589	620	651	
CG103																			98	NC	74	NC	
CG107																			846	791	817	845	
CG108																			38	37	38	39	
CG109																			114	118	123	126	
CG110																			80	155	49	128	
Iron (mg/L) (dissolved)																							
CG6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.93	<0.05	<0.05	<0.05	<0.05
CG102	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.49	0.66	2.14	4.35	4.67
CG104	<0.05	0.73	0.8	1.27	<0.05	1.12	0.53	<0.05			<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.40	<0.05	<0.05	<0.05	<0.05
CG105	0.93	0.78	3.42	5.51	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.18	<0.05	<0.05	0.06	<0.05
CG103																			2.49	NC	1.52	NC	1.07
CG107																			0.19	1.93	0.06	<0.05	<0.05
CG108																			0.37	0.14	0.21	0.18	0.43
CG109																			0.16	<0.05	<0.05	0.09	<0.05
CG110																			1.06	3.01	2.20	4.14	0.68
Manganese (mg/L) (dissolved)																							
CG6	0.02	0.023	0.148	0.055	0.025	0.007	0.004	0.03			0.016	0.012	0.004	0.003	0.012	0.008	0.002	<0.001	0.205	0.011	0.017	0.061	0.0
CG102	0.226	0.552	0.844	0.92	0.048	0.022	0.762	0.072			0.010	0.002	0.001	0.008	0.002	0.169	0.073	0.149	2.41	2.91	3.86	3.89	2.660
CG104	0.362	0.384	0.364	0.333	0.053	0.385	0.338	0.222			0.282	0.369	0.403	0.41	0.333	0.357	0.439	0.329	0.245	0.026	0.111	0.500	0.012
CG105	0.006	0.263	0.655	0.689	0.003	0.004			0.307	0.321	0.055	0.004	0.003	0.004	0.003	0.004	0.003	0.013	0.329	0.415	0.433	0.321	0.309
CG103																			0.008	NC	0.005	NC	0.008
CG107																			0.347	0.192	0.012	0.003	0.003
CG108																			0.016	0.017	0.019	0.016	0.007
CG109																			0.096	0.025	0.021	0.926	1.14
CG110																			0.171	0.514	0.177	0.720	0.1
Fluoride (mg/L)																							
CG6	0.4	0.26	0.17	0.3	0.4	0.4	0.4	0.4			0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	
CG102	0.6	0.42	0.29	0.6	0.6	0.5	0.6	0.6			0.7	0.8	0.6	0.6	0.6	0.5	0.6	0.7	0.6	0.6	0.6	0.6	
CG104	0.6	0.44	0.35	0.6	0.6	0.6	0.6	0.6			0.7	0.6	0.7	0.7	0.6	0.6	0.7	0.8	0.7	0.7	0.7	0.7	
CG105	<0.1	0.11	0.21	0.6	0.6	0.6			0.9	0.6	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.8	0.7	0.7	0.7	0.8	
CG103																			<0.1	NC	<0.1	NC	
CG107																			0.3	0.3	0.3	0.3	
CG108																			<0.1	<0.1	<0.1	<0.1	
CG109																			0.3	0.3	0.3	0.3	
CG110																			<0.1	<0.1	<0.1	<0.1	

Cairncross Groundwater Monitoring																							
		2010				2011						2012				2013				2014			
	Nov-09	Feb-10	Jun-10	Sep-10	Nov-10	Feb-11	Jun-11	Sep-11	Oct-11	Oct-11	Nov-11	Feb-12	May-12	Aug-12	Dec-12	Feb-13	May-13	Sep-13	Nov-13	Feb-14	May-14	Aug-14	Nov-14
Ammonia as N (mg/L)																							
CG6	<0.01	0.02	0.04	0.02	0.03	0.02	0.02	0.04			0.04	0.15	0.02	0.1	0.03	0.01	0.02	0.10	0.09	0.03	0.04	0.11	0.04
CG102	<0.01	0.02	0.03	0.03	0.13	0.1	0.02	0.03			0.02	0.17	0.02	0.04	0.01	0.03	0.03	0.05	0.09	0.15	0.22	0.28	0.19
CG104	0.29	1.07	0.92	0.66	0.1	0.48	0.22	<0.01			0.01	0.06	0.01	0.05	0.03	0.01	0.04	<0.01	0.06	0.05	0.04	0.06	0.01
CG105	<0.01	0.16	0.13	0.11	0.07	0.11			0.05	<0.01	<0.01	0.04	0.02	0.06	0.02	0.02	<0.01	<0.01	0.03	0.05	0.03	0.02	0.05
CG103																			0.05	NC	0.02	NC	0.18
CG107																			0.53	0.05	0.02	0.02	0.03
CG108																			0.04	0.08	<0.01	0.02	0.13
CG109																			0.10	0.06	0.02	0.13	0.46
CG110																			0.04	0.05	0.28	0.05	0.01
Nitrate as N (mg/L)																							
CG6	0.18	0.31	0.18	0.93	0.1	0.15	0.19	0.14			0.27	0.25	0.28	0.26	0.26	0.27	0.35	0.32	0.21	0.42	0.48	0.36	0.19
CG102	0.24	0.22	0.31	0.3	0.66	0.61	0.41	0.12			0.58	0.54	0.65	0.56	0.33	0.28	0.18	0.07	<0.01	0.04	0.08	0.04	0.07
CG104	0.03	0.02	0.03	0.04	0.54	0.14	0.16	0.03			0.11	0.06	0.14	0.06	0.02	0.11	0.13	0.06	0.17	0.40	0.46	0.33	0.23
CG105	0.29	1.08	0.67	0.13	0.3	0.65			0.28	0.34	0.20	0.51	0.33	0.29	0.30	0.64	0.90	0.30	0.03	0.13	0.37	0.29	0.04
CG103																			<0.01	NC	0.02	NC	0.02
CG107																			0.70	1.70	1.92	2.00	1.53
CG108																			0.04	0.09	0.09	0.07	0.06
CG109																			1.40	1.54	1.73	0.51	0.03
CG110																			0.44	0.08	0.16	0.16	0.18
Total Organic Carbon (mg/L)																							
CG6	<1	<1	<1	<1	<1	<1	<1	<1			<1	<1	<1	<1	<1	<1	1	2	3	25	2	3	<1
CG102	1	2	<1	<1	2	2	<1	2			2	<1	2	<1	2	<1	2	3	4	29	3	4	<1
CG104	1	9	<1	2	3	<1	2	<1			2	<1	<1	<1	1	<1	1	2	5	46	1	2	<1
CG105	7	5	4	2	<1	<1			1	3	<1	<1	<1	<1	<1	<1	1	<1	4	53	1	2	<1
CG103																			14	NC	16	NC	4
CG107																			8	15	2	2	<1
CG108																			10	10	7	9	7
CG109																			4	20	2	4	<1
CG110																			11	17	11	12	5
Phenols (mg/L)																							
CG6	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
CG102	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
CG104	<0.05	0.07	<0.05	<0.05	0.06	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
CG105	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
CG103																			<0.05		<0.05	NC	<0.05
CG107																			<0.05	<0.05	<0.05	<0.05	<0.05
CG108																			<0.05	<0.05	<0.05	<0.05	<0.05
CG109																			<0.05	<0.05	<0.05	<0.05	<0.05
CG110																			<0.05	<0.05	<0.05	<0.05	<0.05

Cairncross Groundwater Monitoring																							
		2010				2011						2012				2013				2014			
	Nov-09	Feb-10	Jun-10	Sep-10	Nov-10	Feb-11	Jun-11	Sep-11	Oct-11	Oct-11	Nov-11	Feb-12	May-12	Aug-12	Dec-12	Feb-13	May-13	Sep-13	Nov-13	Feb-14	May-14	Aug-14	Nov-14
Absorbable Organic Halogens (ug/L)																							
CG6					<5																		
CG102					<5																		
CG104					<5																		
CG105					<5																		
	######	#######	######	6-Sep-10	######	8-Feb-11	#######	#######	######	#######	########	######	#######	7-Aug-12	5-Dec-12	#######	21-May-13	#######	#######	4-Feb-14	#######	4-Aug-14	
Water level prior to purge (m from top of well)																							
CG6	3.99	4.03	4.26	4.32	4.1	4.08	3.72	3.37			3.44	2.77	2.98	2.74	3.55	3.56	3.44	3.52	3.49	3.87	3.88	4.31	
CG102	7.24	7.27	7.73	8.12	8.18	8.17	7.99	7.66			7.67	7.09	7.21	7.08	7.60	7.70	7.24	7.36	7.13	7.70	7.74	8.11	
CG104	5.7	5.36	5.2	5.19	5.15	5.05	4.95	4.83			4.62	4.04	3.91	3.71	3.68	3.63	3.17	3.31	3.30	3.47	3.60	4.11	
CG105	5.56	5.25	5.07	5.11	5.04	4.95	4.86	4.64	4.65	4.68	4.59	4.02	3.88	3.65	3.64	3.60	3.15	3.26	2.93	3.07	3.25	3.80	
CG103																			7.75		7.92		
CG107																			3.33	3.60	3.72	4.15	
CG108																			2.55	2.82	3.10	3.45	
CG109																			7.67	8.06	7.86	8.36	
CG110																			6.01	6.69	7.33	7.21	
Groundwater Depth (mAHD)																							
CG6	21.31	21.27	21.04	20.98	21.2	21.22	21.58	21.93	25.3	25.3	21.86	22.53	22.32	22.56	21.75	21.74	21.86	21.78	21.81	21.43	21.42	20.99	
CG102																							
CG104																							
CG105																							
CG103																				NC			
CG107																							
CG108																							
CG109																							
CG110																							
Temperature (Deg. C.)																							
CG6		19.8	19	19.2	20.4		16.9	18.9			21.0	22.8	19.2	17.5	20.1	21.2	19.8	19.6	19.6	21.1	23.0	19.3	
CG102		20.6	20.6	21.4	22.2		20	20.4			22.7	22.7	19.3	19.8	22.7	22.5	21.2	21.2	20.8	23.2	21.3	20.2	
CG104		19.2	19.5	20.9	20.7		19.5	19.7	18.3	19.2	22.5	22.7	19.1	18.3	20.3	22.4	20.8	19.6	21.0	22.6	21.6	19.7	
CG105		19.3	19.4	20.4	19.5	unable to collect		Not collected - bore damage			21.2	21.5	18.9	18	21.1	22.3	20.7	19.4	21.0	21.5	21.9	19.5	
CG103																			20.0		19.9		
CG107																			21.4	20.8	21.2	19.2	
CG108																			19.5	21.0	19.8	18.0	
CG109																			20.0	22.4	20.5	18.9	
CG110																			19.8	22.0	20.1	18.9	
Halogenated Aromatic Hydrocarbons (ug/L)																							
CG6	nd	nd	nd	nd							<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG102	nd	nd	nd	nd							<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG104	nd	nd	nd	nd							<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG105	nd	nd	nd	nd							<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG103																			<5	NC	<5	NC	<5
CG107																			<5	<5	<5	<5	<5
CG108																			<5	<5	<5	<5	<5
CG109																			<5	<5	<5	<5	<5
CG110																			<5	<5	<5	<5	<5

Cairncross Groundwater Monitoring																							
		2010				2011						2012				2013				2014			
	Nov-09	Feb-10	Jun-10	Sep-10	Nov-10	Feb-11	Jun-11	Sep-11	Oct-11	Oct-11	Nov-11	Feb-12	May-12	Aug-12	Dec-12	Feb-13	May-13	Sep-13	Nov-13	Feb-14	May-14	Aug-14	Nov-14
Trihalomethanes (Volatiles) (ug/L)																							
CG6											<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG102											<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG104											<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG105											<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CG103																			<5	NC	<5	NC	<5
CG107																			<5	<5	<5	<5	<5
CG108																			<5	<5	<5	<5	<5
CG109																			<5	<5	<5	<5	<5
CG110																			<5	<5	<5	<5	<5
Data Checked (Analyst/Date)											GC 15.8.12	LP 4.10.1	LP 13.9.12	LP 20.9.12	LP 10.1.13	IS 26.03.1	GC 02.07.13	C 18.10.1	C 06.02.1	KB 26/03/2014 dp. Adjusted NH3,NO3,TOC,depth	C 27/06/20	GC 08.09.14	

Cairncross Groundwater Monitoring							
	2015-2016						
	Apr-15	Jul-15	Nov-15	Feb-16			
pH					Min	Max	Mean
CG6	6.9	6.8	6.6	6.5	6.5	7.8	6.9
CG102	6.4	6.4	6.3	6.3	6.3	7.1	6.5
CG104	7.0	7.1	7.1	6.7	6.5	7.2	6.8
CG105	6.7	6.9	6.7	6.6	6.5	7.8	7.0
CG103	5.4	5.4		5.3	4.9	5.4	5.2
CG107	7.4	7.5	7.3	6.9	6.9	7.5	7.3
CG108	6.6		7.2	7.1	6.4	7.2	6.7
CG109	7.1	7.1	6.9	6.9	6.9	7.1	7.0
CG110	5.4	5.6	5.3	5.4	5.3	5.6	5.4
Electrical Conductivity (uS/cm)							
CG6	2020	2190	6.8	2080	6.8	2410.0	2149.1
CG102	3140	3430	6.5	3880	6.5	3880.0	2990.7
CG104	2400	2600	7.2	2450	7.2	2720.0	2442.7
CG105	2480	2620	6.8	2500	6.8	2800.0	2247.7
CG103	164	152		138	138.0	364.0	243.2
CG107	3330	3670	7.6	3560	7.6	3910.0	3244.2
CG108	170		7.4	3530	7.4	3530.0	577.6
CG109	884	1070	7.2	802	7.2	1070.0	779.9
CG110	91	105	5.4	241	5.4	578.0	256.6
Calcium (mg/L) dissolved							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							
Magnesium (mg/L) dissolved							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							

Cairncross Groundwater Monitoring							
	2015-2016						
	Apr-15	**Jul-15**	**Nov-15**	**Feb-16**			
Sodium (mg/L) dissolved							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							
Potassium (mg/L) dissolved							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							
Alkalinity ($CaCO_3$) (mg/L) - Total							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							
Sulfate (mg/L)							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							

Cairncross Groundwater Monitoring							
	2015-2016						
	Apr-15	**Jul-15**	**Nov-15**	**Feb-16**			
Chloride (mg/L)							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							
Iron (mg/L) (dissolved)					**Min**	**Max**	**Mean**
CG6	<0.05	<0.05	3.32	2.68	0.9	3.3	2.3
CG102	2.53	2.88	4.15	3.37	0.7	4.7	2.9
CG104	<0.05	<0.05	2.99	1.03	0.1	3.0	1.0
CG105	<0.05	<0.05	0.05	0.09	0.1	5.5	1.4
CG103	0.36	0.47		0.54	0.4	2.5	1.1
CG107	<0.05	<0.05	<0.05	1.79	0.1	1.9	1.0
CG108	0.35		0.1	0.15	0.1	0.4	0.2
CG109	0.75	2.25	0.61	0.61	0.1	2.3	0.7
CG110	0.86	0.84	2.36	1.66	0.7	4.1	1.9
Manganese (mg/L) (dissolved)							
CG6	0.007	0.21	0.522	0.521	0.0	0.5	0.1
CG102	3.46	4.32	2.6	2.25	0.0	4.3	1.3
CG104	0.007	0.155	1.49	0.486	0.0	1.5	0.3
CG105	0.112	0.187	0.576	0.355	0.0	0.7	0.2
CG103	0.002	<0.001		0.001	0.0	0.0	0.0
CG107	0.003	0.038	0.193	0.677	0.0	0.7	0.2
CG108	0.002		0.273	0.224	0.0	0.3	0.1
CG109	0.848	1.22	0.951	0.918	0.0	1.2	0.7
CG110	0.061	0.067	0.281	0.166	0.1	0.7	0.3
Fluoride (mg/L)							
CG6							
CG102							
CG104							
CG105							
CG103							
CG107							
CG108							
CG109							
CG110							

Cairncross Groundwater Monitoring							
	2015-2016						
	Apr-15	Jul-15	Nov-15	Feb-16			
Ammonia as N (mg/L)					**Min**	**Max**	**Mean**
CG6	0.03	0.02	0.21	0.11	0.0	0.2	0.1
CG102	0.19	0.22	0.08	0.01	0.0	0.3	0.1
CG104	0.10	0.03	0.04	<0.01	0.0	1.1	0.2
CG105	0.02	0.04	0.07	<0.01	0.0	0.2	0.1
CG103	0.03	0.02		0.06	0.0	0.2	0.1
CG107	0.06	0.04	0.2	0.80	0.0	0.8	0.2
CG108	0.05		1.2	1.73	0.0	1.7	0.5
CG109	0.17	0.24	0.14	0.05	0.0	0.5	0.2
CG110	0.11	0.10	0.2	<0.01	0.0	0.3	0.1
Nitrate as N (mg/L)							
CG6	0.18	0.19	<0.01	<0.01	0.1	0.9	0.3
CG102	<0.01	<0.01	<0.01	0.02	0.0	0.7	0.3
CG104	0.44	0.38	<0.01	<0.01	0.0	0.5	0.2
CG105	0.28	0.1	0.02	<0.01	0.0	1.1	0.4
CG103	0.12	<0.01		<0.01	0.0	0.1	0.1
CG107	1.76	1.62	0.87	<0.01	0.7	2.0	1.5
CG108	0.16		<0.01	0.03	0.0	0.2	0.1
CG109	0.17	0.04	0.01	<0.01	0.0	1.7	0.7
CG110	0.08	0.04	<0.01	<0.01	0.0	0.4	0.2
Total Organic Carbon (mg/L)							
CG6	<1			1			
CG102	2			5			
CG104	<1			<1			
CG105	2			<1			
CG103	9			19			
CG107	<1			4			
CG108	8			1			
CG109	3			3			
CG110	11			7			
Phenols (mg/L)							
CG6	<0.05	<0.05	<0.05	<0.05	0.1	0.1	0.1
CG102	<0.05	<0.05	<0.05	<0.05	0.0	0.0	#DIV/0!
CG104	<0.05	<0.05	<0.05	<0.05	0.1	0.1	0.1
CG105	<0.05	<0.05	<0.05	<0.05	0.0	0.0	#DIV/0!
CG103	<0.05	<0.05	<0.05	<0.05	0.0	0.0	0.0
CG107	<0.05	<0.05	<0.05	<0.05	0.0	0.0	0.0
CG108	<0.05			<0.05	0.0	0.0	0.0
CG109	<0.05	<0.05	<0.05	<0.05	0.0	0.0	0.0
CG110	<0.05	<0.05	<0.05	<0.05	0.0	0.0	0.0

Cairncross Groundwater Monitoring								
	2015-2016							
	Apr-15	**Jul-15**	**Nov-15**	**Feb-16**				
Absorbable Organic Halogens (ug/L)								
CG6								
CG102								
CG104								
CG105								
Water level prior to purge (m from top of well)								
CG6								
CG102								
CG104								
CG105								
CG103								
CG107								
CG108								
CG109								
CG110								9
Groundwater Depth (mAHD)								
CG6								
CG102								
CG104								
CG105								
CG103								8
CG107								
CG108								
CG109								
CG110								
Temperature (Deg. C.)								
CG6								7
CG102								
CG104								
CG105								
CG103								
CG107								
CG108								6
CG109								
CG110								
Halogenated Aromatic Hydrocarbons (ug/L)								
CG6	<5	<5	<5	<5				5
CG102	<5	<5	<5	<5				
CG104	<5	<5	<5	<5				
CG105	<5	<5	<5	<5				
CG103	<5	<5	<5	<5				
CG107	<5	<5	<5	<5				
CG108	<5	<5	<5	<5				4
CG109	<5	<5	<5	<5				
CG110	<5	<5	<5	<5				

Cairncross Groundwater Monitoring								
	2015-2016							
	Apr-15	**Jul-15**	**Nov-15**	**Feb-16**				
Trihalomethanes (Volatiles) (ug/L)								
CG6	<5	<5	<5	<5				
CG102	<5	<5	<5	<5				3
CG104	<5	<5	<5	<5				
CG105	<5	<5	<5	<5				
CG103	<5	<5	<5	<5				
CG107	<5	<5	<5	<5				
CG108	<5	<5	<5	<5				
CG109	<5	<5	<5	<5				2
CG110	<5	<5	<5	<5				
Data Checked (Analyst/Date)								1

CG103			
Date	mm above logger	temp	RL (mAHD)
30/09/2015 17:00	73.675	19.257	37.405
30/09/2015 21:00	72.858	19.257	37.39559
1/10/2015 1:00	71.917	19.257	37.38709
1/10/2015 5:00	71.067	19.257	37.37409
1/10/2015 9:00	69.767	19.257	37.37017
1/10/2015 13:00	69.375	19.257	37.36467
1/10/2015 17:00	68.825	19.257	37.35559
1/10/2015 21:00	67.917	19.257	37.34192
2/10/2015 1:00	66.55	19.263	37.33167
2/10/2015 5:00	65.525	19.257	37.31659
2/10/2015 9:00	64.017	19.257	37.30717
2/10/2015 13:00	63.075	19.257	37.30334
2/10/2015 17:00	62.692	19.257	37.29109
2/10/2015 21:00	61.467	19.257	37.27892
3/10/2015 1:00	60.25	19.257	37.274
3/10/2015 5:00	59.758	19.257	37.25875
3/10/2015 9:00	58.233	19.257	37.251
3/10/2015 13:00	57.458	19.263	37.24934
3/10/2015 17:00	57.292	19.257	37.23909
3/10/2015 21:00	56.267	19.257	37.23184
4/10/2015 1:00	55.542	19.257	37.21867
4/10/2015 5:00	54.225	19.257	37.20642
4/10/2015 9:00	53	19.257	37.19825
4/10/2015 13:00	52.183	19.257	37.19892
4/10/2015 17:00	52.25	19.257	37.18667
4/10/2015 21:00	51.025	19.257	37.177
5/10/2015 1:00	50.058	19.257	37.16267
5/10/2015 5:00	48.625	19.257	37.14859
5/10/2015 9:00	47.217	19.257	37.14517
5/10/2015 13:00	46.875	19.257	37.13625
5/10/2015 17:00	45.983	19.257	37.12692
5/10/2015 21:00	45.05	19.257	37.11609
6/10/2015 1:00	43.967	19.257	37.10492
6/10/2015 5:00	42.85	19.257	37.08967
6/10/2015 9:00	41.325	19.257	37.083
6/10/2015 13:00	40.658	19.257	37.07867
6/10/2015 17:00	40.225	19.257	37.06934
6/10/2015 21:00	39.292	19.257	37.05942
7/10/2015 1:00	38.3	19.257	37.0495
7/10/2015 5:00	37.308	19.257	37.03175
7/10/2015 9:00	35.533	19.257	37.02692
7/10/2015 13:00	35.05	19.257	37.0195
7/10/2015 17:00	34.308	19.257	37.0085
7/10/2015 21:00	33.208	19.257	36.99659
8/10/2015 1:00	32.017	19.257	36.98292
8/10/2015 5:00	30.65	19.257	36.97134
8/10/2015 9:00	29.492	19.257	36.96309
8/10/2015 13:00	28.667	19.257	36.95775
8/10/2015 17:00	28.133	19.257	36.94692
8/10/2015 21:00	27.05	19.257	36.93642
9/10/2015 1:00	26	19.257	36.92709
9/10/2015 5:00	25.067	19.257	36.91359
9/10/2015 9:00	23.717	19.257	36.90242
9/10/2015 13:00	22.6	19.257	36.90242
9/10/2015 17:00	22.6	19.257	36.89292
9/10/2015 21:00	21.65	19.257	36.88192
10/10/2015 1:00	20.55	19.257	36.87209
10/10/2015 5:00	19.567	19.257	36.8585
10/10/2015 9:00	18.208	19.257	36.85359
10/10/2015 13:00	17.717	19.257	36.85234
10/10/2015 17:00	17.592	19.257	36.8415
10/10/2015 21:00	16.508	19.257	36.8335
11/10/2015 1:00	15.708	19.257	36.82467
11/10/2015 5:00	14.825	19.257	36.81075
11/10/2015 9:00	13.433	19.25	36.80467
11/10/2015 13:00	12.825	19.257	36.80859
11/10/2015 17:00	13.217	19.257	36.79475
11/10/2015 21:00	11.833	19.257	36.78617
12/10/2015 1:00	10.975	19.257	36.78075
12/10/2015 5:00	10.433	19.25	36.76875
12/10/2015 9:00	9.233	19.25	36.76217
12/10/2015 13:00	8.575	19.25	36.76442

CG104			
Date	mm above logger	temp	RL (mAHD)
30/09/2015 17:00	451.617	19.497	
30/09/2015 21:00	449.108	19.497	24.205
1/10/2015 1:00	448.167	19.483	24.19559
1/10/2015 5:00	448.425	19.443	24.19817
1/10/2015 9:00	446.6	19.497	24.17992
1/10/2015 13:00	448.483	19.503	24.19875
1/10/2015 17:00	447.875	19.49	24.19267
1/10/2015 21:00	446.792	19.49	24.18184
2/10/2015 1:00	446.3	19.483	24.17692
2/10/2015 5:00	445.567	19.483	24.16959
2/10/2015 9:00	442.6	19.477	24.13992
2/10/2015 13:00	442.883	19.477	24.14275
2/10/2015 17:00	442.383	19.483	24.13775
2/10/2015 21:00	441.217	19.477	24.12609
3/10/2015 1:00	441.575	19.47	24.12967
3/10/2015 5:00	442.775	19.49	24.14167
3/10/2015 9:00	442.3	19.483	24.13692
3/10/2015 13:00	445.783	19.477	24.17175
3/10/2015 17:00	447.95	19.497	24.19342
3/10/2015 21:00	447.042	19.477	24.18434
4/10/2015 1:00	448.825	19.477	24.20217
4/10/2015 5:00	449.025	19.47	24.20417
4/10/2015 9:00	448.267	19.477	24.19659
4/10/2015 13:00	450.133	19.47	24.21525
4/10/2015 17:00	452.008	19.45	24.234
4/10/2015 21:00	451.075	19.483	24.22467
5/10/2015 1:00	451.625	19.457	24.23017
5/10/2015 5:00	451.475	19.457	24.22867
5/10/2015 9:00	449.892	19.463	24.21284
5/10/2015 13:00	452.175	19.463	24.23567
5/10/2015 17:00	452.625	19.463	24.24017
5/10/2015 21:00	451.808	19.477	24.232
6/10/2015 1:00	452.417	19.457	24.23809
6/10/2015 5:00	452.408	19.47	24.238
6/10/2015 9:00	450.708	19.423	24.221
6/10/2015 13:00	453.192	19.463	24.24584
6/10/2015 17:00	454.1	19.463	24.25492
6/10/2015 21:00	453.108	19.463	24.245
7/10/2015 1:00	453.633	19.457	24.25025
7/10/2015 5:00	453.808	19.47	24.252
7/10/2015 9:00	451.683	19.463	24.23075
7/10/2015 13:00	448.517	19.417	24.19909
7/10/2015 17:00	445.908	19.457	24.173
7/10/2015 21:00	442.533	19.437	24.13925
8/10/2015 1:00	442.333	19.45	24.13725
8/10/2015 5:00	441.783	19.45	24.13175
8/10/2015 9:00	440.275	19.457	24.11667
8/10/2015 13:00	441.725	19.45	24.13117
8/10/2015 17:00	443	19.443	24.14392
8/10/2015 21:00	441.8	19.443	24.13192
9/10/2015 1:00	443.55	19.47	24.14942
9/10/2015 5:00	444.075	19.437	24.15467
9/10/2015 9:00	442.725	19.45	24.14117
9/10/2015 13:00	445.575	19.457	24.16967
9/10/2015 17:00	448.258	19.45	24.1965
9/10/2015 21:00	447.25	19.443	24.18642
10/10/2015 1:00	448.6	19.443	24.19992
10/10/2015 5:00	449.425	19.443	24.20817
10/10/2015 9:00	447.25	19.423	24.18642
10/10/2015 13:00	450.55	19.443	24.21942
10/10/2015 17:00	452.583	19.423	24.23975
10/10/2015 21:00	451.5	19.443	24.22892
11/10/2015 1:00	452.858	19.39	24.2425
11/10/2015 5:00	454.133	19.423	24.25525
11/10/2015 9:00	453.383	19.437	24.24775
11/10/2015 13:00	456.742	19.43	24.28134
11/10/2015 17:00	458.767	19.43	24.30159
11/10/2015 21:00	456.858	19.443	24.2825
12/10/2015 1:00	458.158	19.443	24.2955
12/10/2015 5:00	458.958	19.43	24.3035
12/10/2015 9:00	457.933	19.397	24.29325
12/10/2015 13:00	461.475	19.43	24.32867

CG103			
Date	mm above logger	temp	RL (mAHD)
12/10/2015 17:00	8.8	19.257	36.75825
12/10/2015 21:00	8.183	19.25	36.75075
13/10/2015 1:00	7.433	19.257	36.73942
13/10/2015 5:00	6.3	19.25	36.72434
13/10/2015 9:00	4.792	19.257	36.7215
13/10/2015 13:00	4.508	19.257	36.72109
13/10/2015 17:00	4.467	19.257	36.71225
13/10/2015 21:00	3.583	19.257	36.7055
14/10/2015 1:00	2.908	19.257	36.69784
14/10/2015 5:00	2.142	19.257	37.2335
14/10/2015 9:00	55.708	19.25	38.28692
14/10/2015 13:00	161.05	19.25	38.46517
14/10/2015 17:00	178.875	19.25	38.46609
14/10/2015 21:00	178.967	19.25	38.45767
15/10/2015 1:00	178.125	19.25	38.44975
15/10/2015 5:00	177.333	19.25	38.43717
15/10/2015 9:00	176.075	19.25	38.42884
15/10/2015 13:00	175.242	19.25	38.42842
15/10/2015 17:00	175.2	19.25	38.42084
15/10/2015 21:00	174.442	19.25	38.41517
16/10/2015 1:00	173.875	19.25	38.40825
16/10/2015 5:00	173.183	19.25	38.393
16/10/2015 9:00	171.658	19.25	38.38517
16/10/2015 13:00	170.875	19.25	38.38767
16/10/2015 17:00	171.125	19.25	38.38267
16/10/2015 21:00	170.625	19.25	38.37375
17/10/2015 1:00	169.733	19.25	38.36875
17/10/2015 5:00	169.233	19.25	38.3535
17/10/2015 9:00	167.708	19.25	38.34859
17/10/2015 13:00	167.217	19.25	38.35209
17/10/2015 17:00	167.567	19.25	38.34525
17/10/2015 21:00	166.883	19.25	38.33584
18/10/2015 1:00	165.942	19.25	38.33025
18/10/2015 5:00	165.383	19.25	38.31817
18/10/2015 9:00	164.175	19.25	38.3115
18/10/2015 13:00	163.508	19.25	38.31084
18/10/2015 17:00	163.442	19.25	38.305
18/10/2015 21:00	162.858	19.25	38.29584
19/10/2015 1:00	161.942	19.25	38.29242
19/10/2015 5:00	161.6	19.25	38.27917
19/10/2015 9:00	160.275	19.25	38.272
19/10/2015 13:00	159.558	19.25	38.27684
19/10/2015 17:00	160.042	19.25	38.26959
19/10/2015 21:00	159.317	19.25	38.26192
20/10/2015 1:00	158.55	19.25	38.2555
20/10/2015 5:00	157.908	19.25	38.24125
20/10/2015 9:00	156.483	19.25	38.23642
20/10/2015 13:00	156	19.25	38.24225
20/10/2015 17:00	156.583	19.25	38.2335
20/10/2015 21:00	155.708	19.25	38.22909
21/10/2015 1:00	155.267	19.25	38.21842
21/10/2015 5:00	154.2	19.25	38.20767
21/10/2015 9:00	153.125	19.25	38.20217
21/10/2015 13:00	152.575	19.25	38.20725
21/10/2015 17:00	153.083	19.25	38.20192
21/10/2015 21:00	152.55	19.25	38.19725
22/10/2015 1:00	152.083	19.25	38.19375
22/10/2015 5:00	151.733	19.25	38.1865
22/10/2015 9:00	151.008	19.25	38.18192
22/10/2015 13:00	150.55	19.25	38.17692
22/10/2015 17:00	150.05	19.25	38.17275
22/10/2015 21:00	149.633	19.25	38.16559
23/10/2015 1:00	148.917	19.243	38.15917
23/10/2015 5:00	148.275	19.25	38.14934
23/10/2015 9:00	147.292	19.25	38.13834
23/10/2015 13:00	146.192	19.25	38.13967
23/10/2015 17:00	146.325	19.243	38.13434
23/10/2015 21:00	145.792	19.243	38.12742
24/10/2015 1:00	145.1	19.243	38.122
24/10/2015 5:00	144.558	19.25	38.11109
24/10/2015 9:00	143.467	19.243	38.1055
24/10/2015 13:00	142.908	19.243	38.10742

CG104			
Date	mm above logger	temp	RL (mAHD)
12/10/2015 17:00	463.45	19.423	24.34842
12/10/2015 21:00	462.075	19.423	24.33467
13/10/2015 1:00	461.383	19.41	24.32775
13/10/2015 5:00	459.258	19.423	24.3065
13/10/2015 9:00	456.933	19.437	24.28325
13/10/2015 13:00	458.167	19.423	24.29559
13/10/2015 17:00	457.133	19.43	24.28525
13/10/2015 21:00	454.908	19.437	24.263
14/10/2015 1:00	454.7	19.417	24.26092
14/10/2015 5:00	454.575	19.423	24.25967
14/10/2015 9:00	452.783	19.423	24.24175
14/10/2015 13:00	452.833	19.417	24.24225
14/10/2015 17:00	453.858	19.423	24.2525
14/10/2015 21:00	452.083	19.403	24.23475
15/10/2015 1:00	452.817	19.423	24.24209
15/10/2015 5:00	454.183	19.41	24.25575
15/10/2015 9:00	451.875	19.41	24.23267
15/10/2015 13:00	453.55	19.423	24.24942
15/10/2015 17:00	455.492	19.43	24.26884
15/10/2015 21:00	454.15	19.41	24.25542
16/10/2015 1:00	455.158	19.417	24.2655
16/10/2015 5:00	456.333	19.417	24.27725
16/10/2015 9:00	454.458	19.43	24.2585
16/10/2015 13:00	456.067	19.43	24.27459
16/10/2015 17:00	458.358	19.41	24.2975
16/10/2015 21:00	456.575	19.41	24.27967
17/10/2015 1:00	457.258	19.417	24.2865
17/10/2015 5:00	457.808	19.403	24.292
17/10/2015 9:00	455.933	19.397	24.27325
17/10/2015 13:00	457.308	19.41	24.287
17/10/2015 17:00	458.358	19.403	24.2975
17/10/2015 21:00	456.567	19.417	24.27959
18/10/2015 1:00	456.033	19.363	24.27425
18/10/2015 5:00	454.308	19.417	24.257
18/10/2015 9:00	452.458	19.41	24.2385
18/10/2015 13:00	453.542	19.41	24.24934
18/10/2015 17:00	453.942	19.403	24.25334
18/10/2015 21:00	453.008	19.403	24.244
19/10/2015 1:00	453.842	19.423	24.25234
19/10/2015 5:00	454.433	19.397	24.25825
19/10/2015 9:00	453.575	19.41	24.24967
19/10/2015 13:00	455.192	19.403	24.26584
19/10/2015 17:00	457.192	19.403	24.28584
19/10/2015 21:00	456.408	19.397	24.278
20/10/2015 1:00	458.092	19.37	24.29484
20/10/2015 5:00	458.208	19.403	24.296
20/10/2015 9:00	457.483	19.343	24.28875
20/10/2015 13:00	460.267	19.397	24.31659
20/10/2015 17:00	462.542	19.363	24.33934
20/10/2015 21:00	461.258	19.343	24.3265
21/10/2015 1:00	463.383	19.417	24.34775
21/10/2015 5:00	463.892	19.343	24.35284
21/10/2015 9:00	463.692	19.39	24.35084
21/10/2015 13:00	466.642	19.383	24.38034
21/10/2015 17:00	468.55	19.403	24.39942
21/10/2015 21:00	466.967	19.403	24.38359
22/10/2015 1:00	469.417	19.39	24.40809
22/10/2015 5:00	469.067	19.377	24.40459
22/10/2015 9:00	467.408	19.343	24.388
22/10/2015 13:00	470.392	19.39	24.41784
22/10/2015 17:00	470.067	19.35	24.41459
22/10/2015 21:00	467.958	19.343	24.3935
23/10/2015 1:00	466.95	19.377	24.38342
23/10/2015 5:00	465.142	19.377	24.36534
23/10/2015 9:00	461.358	19.377	24.3275
23/10/2015 13:00	461.892	19.39	24.33284
23/10/2015 17:00	461.208	19.35	24.326
23/10/2015 21:00	458.75	19.357	24.30142
24/10/2015 1:00	459.4	19.397	24.30792
24/10/2015 5:00	459.15	19.337	24.30542
24/10/2015 9:00	457.475	19.343	24.28867
24/10/2015 13:00	460.125	19.363	24.31517

CG103			
Date	mm above logger	temp	RL (mAHD)
24/10/2015 17:00	143.1	19.25	38.09875
24/10/2015 21:00	142.233	19.243	38.09334
25/10/2015 1:00	141.692	19.243	38.08584
25/10/2015 5:00	140.942	19.243	38.07142
25/10/2015 9:00	139.5	19.243	38.07025
25/10/2015 13:00	139.383	19.243	38.07259
25/10/2015 17:00	139.617	19.243	38.0635
25/10/2015 21:00	138.708	19.243	38.06017
26/10/2015 1:00	138.375	19.243	38.052
26/10/2015 5:00	137.558	19.243	38.0365
26/10/2015 9:00	136.008	19.243	38.03017
26/10/2015 13:00	135.375	19.243	38.03492
26/10/2015 17:00	135.85	19.243	38.02625
26/10/2015 21:00	134.983	19.243	38.01917
27/10/2015 1:00	134.275	19.243	38.01359
27/10/2015 5:00	133.717	19.243	38.00642
27/10/2015 9:00	133	19.243	37.99667
27/10/2015 13:00	132.025	19.243	37.9955
27/10/2015 17:00	131.908	19.243	37.98792
27/10/2015 21:00	131.15	19.243	37.98425
28/10/2015 1:00	130.783	19.243	37.97834
28/10/2015 5:00	130.192	19.243	37.967
28/10/2015 9:00	129.058	19.243	37.96284
28/10/2015 13:00	128.642	19.243	37.96042
28/10/2015 17:00	128.4	19.243	37.95534
28/10/2015 21:00	127.892	19.243	37.9495
29/10/2015 1:00	127.308	19.243	37.9455
29/10/2015 5:00	126.908	19.237	37.93567
29/10/2015 9:00	125.925	19.243	37.928
29/10/2015 13:00	125.158	19.243	37.92959
29/10/2015 17:00	125.317	19.243	37.92575
29/10/2015 21:00	124.933	19.243	37.92034
30/10/2015 1:00	124.392	19.237	37.91384
30/10/2015 5:00	123.742	19.237	37.90359
30/10/2015 9:00	122.717	19.243	37.897
30/10/2015 13:00	122.058	19.243	37.9035
30/10/2015 17:00	122.708	19.243	37.89967
30/10/2015 21:00	122.325	19.243	37.89425
31/10/2015 1:00	121.783	19.243	37.88575
31/10/2015 5:00	120.933	19.237	37.87225
31/10/2015 9:00	119.583	19.237	37.86567
31/10/2015 13:00	118.925	19.237	37.87392
31/10/2015 17:00	119.75	19.237	37.86467
31/10/2015 21:00	118.825	19.237	37.858
1/11/2015 1:00	118.158	19.237	37.85159
1/11/2015 5:00	117.517	19.237	37.83909
1/11/2015 9:00	116.267	19.237	37.83109
1/11/2015 13:00	115.467	19.237	37.83367
1/11/2015 17:00	115.725	19.237	37.82709
1/11/2015 21:00	115.067	19.237	37.82125
2/11/2015 1:00	114.483	19.237	37.8115
2/11/2015 5:00	113.508	19.237	42.29975
10/11/2015 17:00	562.333	19.227	42.27575
10/11/2015 21:00	559.933	19.227	42.24825
11/11/2015 1:00	557.183	19.227	42.22425
11/11/2015 5:00	554.783	19.227	42.191
11/11/2015 9:00	551.458	19.227	42.164
11/11/2015 13:00	548.758	19.227	42.14325
11/11/2015 17:00	546.683	19.227	42.121
11/11/2015 21:00	544.458	19.227	42.09667
12/11/2015 1:00	542.025	19.227	42.07767
12/11/2015 5:00	540.125	19.227	42.04467
12/11/2015 9:00	536.825	19.227	42.02492
12/11/2015 13:00	534.85	19.227	42.00359
12/11/2015 17:00	532.717	19.227	41.97884
12/11/2015 21:00	530.242	19.227	41.95609
13/11/2015 1:00	527.967	19.227	41.93434
13/11/2015 5:00	525.792	19.227	41.9025
13/11/2015 9:00	522.608	19.227	41.88775
13/11/2015 13:00	521.133	19.227	41.8645
13/11/2015 17:00	518.808	19.227	41.846
13/11/2015 21:00	516.958	19.227	41.819

CG104			
Date	mm above logger	temp	RL (mAHD)
24/10/2015 17:00	460.2	19.333	24.31592
24/10/2015 21:00	458.575	19.337	24.29967
25/10/2015 1:00	460.075	19.327	24.31467
25/10/2015 5:00	460.375	19.377	24.31767
25/10/2015 9:00	458.875	19.327	24.30267
25/10/2015 13:00	462.083	19.39	24.33475
25/10/2015 17:00	463.25	19.383	24.34642
25/10/2015 21:00	461.525	19.37	24.32917
26/10/2015 1:00	464.225	19.357	24.35617
26/10/2015 5:00	464.75	19.333	24.36142
26/10/2015 9:00	463.433	19.377	24.34825
26/10/2015 13:00	466.942	19.377	24.38334
26/10/2015 17:00	467.3	19.35	24.38692
26/10/2015 21:00	464.042	19.377	24.35434
27/10/2015 1:00	466.25	19.377	24.37642
27/10/2015 5:00	464.292	19.363	24.35684
27/10/2015 9:00	460.542	19.377	24.31934
27/10/2015 13:00	459.683	19.32	24.31075
27/10/2015 17:00	460.675	19.383	24.32067
27/10/2015 21:00	458.575	19.377	24.29967
28/10/2015 1:00	459.55	19.37	24.30942
28/10/2015 5:00	460.708	19.363	24.321
28/10/2015 9:00	458.525	19.35	24.29917
28/10/2015 13:00	459.683	19.363	24.31075
28/10/2015 17:00	461.6	19.37	24.32992
28/10/2015 21:00	459.925	19.37	24.31317
29/10/2015 1:00	461.15	19.363	24.32542
29/10/2015 5:00	461.975	19.363	24.33367
29/10/2015 9:00	459.825	19.377	24.31217
29/10/2015 13:00	460.458	19.363	24.3185
29/10/2015 17:00	461.725	19.307	24.33117
29/10/2015 21:00	460.117	19.313	24.31509
30/10/2015 1:00	461.033	19.363	24.32425
30/10/2015 5:00	461.025	19.363	24.32417
30/10/2015 9:00	459.3	19.377	24.30692
30/10/2015 13:00	461.5	19.357	24.32892
30/10/2015 17:00	462.908	19.37	24.343
30/10/2015 21:00	461.3	19.363	24.32692
31/10/2015 1:00	462.1	19.32	24.33492
31/10/2015 5:00	462.475	19.337	24.33867
31/10/2015 9:00	460.6	19.327	24.31992
31/10/2015 13:00	462.508	19.32	24.339
31/10/2015 17:00	464.15	19.32	24.35542
31/10/2015 21:00	463.575	19.37	24.34967
1/11/2015 1:00	465.008	19.37	24.364
1/11/2015 5:00	466.058	19.363	24.3745
1/11/2015 9:00	465.45	19.37	24.36842
1/11/2015 13:00	468.267	19.363	24.39659
1/11/2015 17:00	470.508	19.357	24.419
1/11/2015 21:00	470.025	19.357	24.41417
2/11/2015 1:00	471.483	19.357	24.42875
2/11/2015 5:00	471.033	19.32	24.42425
11/11/2015 17:00	461.167	19.343	24.32559
11/11/2015 21:00	459.292	19.327	24.30684
12/11/2015 1:00	460.417	19.32	24.31809
12/11/2015 5:00	461.258	19.337	24.3265
12/11/2015 9:00	459.708	19.337	24.311
12/11/2015 13:00	462.167	19.337	24.33559
12/11/2015 17:00	464.408	19.333	24.358
12/11/2015 21:00	462.633	19.337	24.34025
13/11/2015 1:00	464.967	19.327	24.36359
13/11/2015 5:00	468.333	19.313	24.39725
13/11/2015 9:00	467.367	19.35	24.38759
13/11/2015 13:00	469.917	19.337	24.41309
13/11/2015 17:00	471.558	19.32	24.4295
13/11/2015 21:00	470.7	19.32	24.42092
14/11/2015 1:00	470.1	19.327	24.41492
14/11/2015 5:00	471.517	19.32	24.42909
14/11/2015 9:00	470.1	19.35	24.41492
14/11/2015 13:00	471.583	19.333	24.42975
14/11/2015 17:00	473.142	19.337	24.44534
14/11/2015 21:00	472.183	19.337	24.43575

CG103			
Date	mm above logger	temp	RL (mAHD)
14/11/2015 1:00	514.258	19.227	42.02159
14/11/2015 5:00	534.517	19.227	42.04475
14/11/2015 9:00	536.833	19.22	42.02459
14/11/2015 13:00	534.817	19.227	45.30217
14/11/2015 17:00	862.575	19.22	46.6255
14/11/2015 21:00	994.908	19.207	46.6715
15/11/2015 1:00	999.508	19.213	46.70225
15/11/2015 5:00	1002.583	19.22	46.56809
15/11/2015 9:00	989.167	19.22	46.43634
15/11/2015 13:00	975.992	19.22	46.3365
15/11/2015 17:00	966.008	19.22	46.2805
15/11/2015 21:00	960.408	19.22	46.23392
16/11/2015 1:00	955.75	19.22	46.17784
16/11/2015 5:00	950.142	19.22	46.11642
16/11/2015 9:00	944	19.22	46.03309
16/11/2015 13:00	935.667	19.213	45.93167
16/11/2015 17:00	925.525	19.213	45.86667
16/11/2015 21:00	919.025	19.213	45.82059
17/11/2015 1:00	914.417	19.213	45.7695
17/11/2015 5:00	909.308	19.213	45.71084
17/11/2015 9:00	903.442	19.213	45.66134
17/11/2015 13:00	898.492	19.213	45.58609
17/11/2015 17:00	890.967	19.213	45.50242
17/11/2015 21:00	882.6	19.213	45.41009
18/11/2015 1:00	873.367	19.213	45.30409
18/11/2015 5:00	862.767	19.213	45.18017
18/11/2015 9:00	850.375	19.213	45.06709
18/11/2015 13:00	839.067	19.207	44.95675
18/11/2015 17:00	828.033	19.2	44.84367
18/11/2015 21:00	816.725	19.2	44.74092
19/11/2015 1:00	806.45	19.2	44.621
19/11/2015 5:00	794.458	19.2	44.49167
19/11/2015 9:00	781.525	19.2	44.35809
19/11/2015 13:00	768.167	19.2	44.30459
19/11/2015 17:00	762.817	19.2	44.27284
19/11/2015 21:00	759.642	19.207	44.24084
20/11/2015 1:00	756.442	19.207	44.207
20/11/2015 5:00	753.058	19.207	44.16875
20/11/2015 9:00	749.233	19.213	44.13992
20/11/2015 13:00	746.35	19.213	44.10767
20/11/2015 17:00	743.125	19.213	44.06667
20/11/2015 21:00	739.025	19.213	44.02059
21/11/2015 1:00	734.417	19.213	43.97434
21/11/2015 5:00	729.792	19.213	43.92334
21/11/2015 9:00	724.692	19.213	43.88609
21/11/2015 13:00	720.967	19.213	43.84584
21/11/2015 17:00	716.942	19.213	43.82009
21/11/2015 21:00	714.367	19.213	43.7995
22/11/2015 1:00	712.308	19.213	43.77125
22/11/2015 5:00	709.483	19.213	43.7355
22/11/2015 9:00	705.908	19.213	43.70075
22/11/2015 13:00	702.433	19.213	43.68042
22/11/2015 17:00	700.4	19.213	43.65792
22/11/2015 21:00	698.15	19.213	43.63142
23/11/2015 1:00	695.5	19.213	43.60409
23/11/2015 5:00	692.767	19.213	43.57609
23/11/2015 9:00	689.967	19.213	43.56284
23/11/2015 13:00	688.642	19.213	43.55234
23/11/2015 17:00	687.592	19.213	43.54184
23/11/2015 21:00	686.542	19.213	43.52359
24/11/2015 1:00	684.717	19.213	43.50909
24/11/2015 5:00	683.267	19.213	43.48934
24/11/2015 9:00	681.292	19.213	43.47034
24/11/2015 13:00	679.392	19.207	43.46175
24/11/2015 17:00	678.533	19.213	43.44925
24/11/2015 21:00	677.283	19.213	43.43375
25/11/2015 1:00	675.733	19.213	43.41725
25/11/2015 5:00	674.083	19.213	43.38859
25/11/2015 9:00	671.217	19.207	43.3755
25/11/2015 13:00	669.908	19.207	43.35942
25/11/2015 17:00	668.3	19.213	43.34367
25/11/2015 21:00	666.725	19.213	43.32792

CG104			
Date	mm above logger	temp	RL (mAHD)
15/11/2015 1:00	471.942	19.32	24.43334
15/11/2015 5:00	471.692	19.327	24.43084
15/11/2015 9:00	468.892	19.337	24.40284
15/11/2015 13:00	469.017	19.32	24.40409
15/11/2015 17:00	469.008	19.32	24.404
15/11/2015 21:00	467.725	19.327	24.39117
16/11/2015 1:00	468.2	19.32	24.39592
16/11/2015 5:00	468.367	19.32	24.39759
16/11/2015 9:00	466.367	19.333	24.37759
16/11/2015 13:00	467.425	19.337	24.38817
16/11/2015 17:00	468.367	19.327	24.39759
16/11/2015 21:00	467	19.32	24.38392
17/11/2015 1:00	467.525	19.327	24.38917
17/11/2015 5:00	467.9	19.327	24.39292
17/11/2015 9:00	466.292	19.32	24.37684
17/11/2015 13:00	468.517	19.32	24.39909
17/11/2015 17:00	469.392	19.327	24.40784
17/11/2015 21:00	468.433	19.32	24.39825
18/11/2015 1:00	470.108	19.327	24.415
18/11/2015 5:00	471.408	19.327	24.428
18/11/2015 9:00	470.8	19.327	24.42192
18/11/2015 13:00	472.908	19.32	24.443
18/11/2015 17:00	474.708	19.327	24.461
18/11/2015 21:00	474.367	19.327	24.45759
19/11/2015 1:00	476.342	19.327	24.47734
19/11/2015 5:00	475.842	19.343	24.47234
19/11/2015 9:00	473.35	19.32	24.44742
19/11/2015 13:00	475.217	19.327	24.46609
19/11/2015 17:00	476.225	19.32	24.47617
19/11/2015 21:00	475.267	19.327	24.46659
20/11/2015 1:00	476.442	19.327	24.47834
20/11/2015 5:00	476.442	19.327	24.47834
20/11/2015 9:00	475.358	19.32	24.4675
20/11/2015 13:00	478.892	19.32	24.50284
20/11/2015 17:00	480.917	19.327	24.52309
20/11/2015 21:00	480.433	19.327	24.51825
21/11/2015 1:00	482.708	19.327	24.541
21/11/2015 5:00	480.475	19.327	24.51867
21/11/2015 9:00	477.767	19.327	24.49159
21/11/2015 13:00	477.483	19.327	24.48875
21/11/2015 17:00	475.558	19.333	24.4695
21/11/2015 21:00	473.392	19.333	24.44784
22/11/2015 1:00	474.717	19.333	24.46109
22/11/2015 5:00	474.867	19.333	24.46259
22/11/2015 9:00	473.742	19.327	24.45134
22/11/2015 13:00	475.692	19.333	24.47084
22/11/2015 17:00	478.5	19.333	24.49892
22/11/2015 21:00	477.942	19.333	24.49334
23/11/2015 1:00	480.717	19.327	24.52109
23/11/2015 5:00	481.658	19.32	24.5305
23/11/2015 9:00	480.317	19.32	24.51709
23/11/2015 13:00	484.067	19.333	24.55459
23/11/2015 17:00	484.592	19.333	24.55984
23/11/2015 21:00	481.15	19.327	24.52542
24/11/2015 1:00	480.492	19.333	24.51884
24/11/2015 5:00	479.392	19.333	24.50784
24/11/2015 9:00	477.067	19.333	24.48459
24/11/2015 13:00	478.317	19.333	24.49709
24/11/2015 17:00	480.142	19.35	24.51534
24/11/2015 21:00	479.008	19.327	24.504
25/11/2015 1:00	480.842	19.337	24.52234
25/11/2015 5:00	481.758	19.333	24.5315
25/11/2015 9:00	480.292	19.333	24.51684
25/11/2015 13:00	483.65	19.333	24.55042
25/11/2015 17:00	486.242	19.333	24.57634
25/11/2015 21:00	485.192	19.333	24.56584
26/11/2015 1:00	487.35	19.333	24.58742
26/11/2015 5:00	488.15	19.333	24.59542
26/11/2015 9:00	488.608	19.337	24.6
26/11/2015 13:00	490.983	19.337	24.62375
26/11/2015 17:00	493.158	19.333	24.6455
26/11/2015 21:00	488.567	19.337	24.59959

CG103			
Date	mm above logger	temp	RL (mAHD)
26/11/2015 1:00	665.15	19.213	43.312
26/11/2015 5:00	663.558	19.207	43.28742
26/11/2015 9:00	661.1	19.207	43.26742
26/11/2015 13:00	659.1	19.207	43.25067
26/11/2015 17:00	657.425	19.207	43.22692
26/11/2015 21:00	655.05	19.207	43.20292
27/11/2015 1:00	652.65	19.207	43.17717
27/11/2015 5:00	650.075	19.207	43.14067
27/11/2015 9:00	646.425	19.207	43.10592
27/11/2015 13:00	642.95	19.207	43.08267
27/11/2015 17:00	640.625	19.207	43.05292
27/11/2015 21:00	637.65	19.207	43.02309
28/11/2015 1:00	634.667	19.207	42.99059
28/11/2015 5:00	631.417	19.207	42.95859
28/11/2015 9:00	628.217	19.207	42.92984
28/11/2015 13:00	625.342	19.207	42.90725
28/11/2015 17:00	623.083	19.207	42.88275
28/11/2015 21:00	620.633	19.207	42.85725
29/11/2015 1:00	618.083	19.207	42.82625
29/11/2015 5:00	614.983	19.207	42.795
29/11/2015 9:00	611.858	19.207	42.76592
29/11/2015 13:00	608.95	19.207	42.74717
29/11/2015 17:00	607.075	19.207	42.72792
29/11/2015 21:00	605.15	19.207	42.71742
30/11/2015 1:00	604.1	19.207	42.69817
30/11/2015 5:00	602.175	19.207	42.67667
30/11/2015 9:00	600.025	19.207	42.65259
30/11/2015 13:00	597.617	19.207	42.63984
30/11/2015 17:00	596.342	19.207	42.62084
30/11/2015 21:00	594.442	19.207	42.60059
1/12/2015 1:00	592.417	19.207	42.57734
1/12/2015 5:00	590.092	19.207	42.55134
1/12/2015 9:00	587.492	19.207	42.53309
1/12/2015 13:00	585.667	19.207	42.50825
1/12/2015 17:00	583.183	19.2	42.48725
1/12/2015 21:00	581.083	19.207	42.45925
2/12/2015 1:00	578.283	19.2	42.43425
2/12/2015 5:00	575.783	19.207	42.40575
2/12/2015 9:00	572.933	19.2	42.37542
2/12/2015 13:00	569.9	19.2	42.35692
2/12/2015 17:00	568.05	19.2	42.335
2/12/2015 21:00	565.858	19.2	42.31067
3/12/2015 1:00	563.425	19.2	42.28317
3/12/2015 5:00	560.675	19.2	42.25442
3/12/2015 9:00	557.8	19.2	42.23117
3/12/2015 13:00	555.475	19.2	42.20667
3/12/2015 17:00	553.025	19.2	42.18517
3/12/2015 21:00	550.875	19.2	42.16292
4/12/2015 1:00	548.65	19.2	42.13809
4/12/2015 5:00	546.167	19.2	42.11559
4/12/2015 9:00	543.917	19.2	42.09309
4/12/2015 13:00	541.667	19.2	42.09309

CG104			
Date	mm above logger	temp	RL (mAHD)
27/11/2015 1:00	484.358	19.333	24.5575
27/11/2015 5:00	482.542	19.337	24.53934
27/11/2015 9:00	480	19.337	24.51392
27/11/2015 13:00	480.783	19.333	24.52175
27/11/2015 17:00	482.25	19.333	24.53642
27/11/2015 21:00	480.442	19.337	24.51834
28/11/2015 1:00	481.425	19.333	24.52817
28/11/2015 5:00	481.442	19.333	24.52834
28/11/2015 9:00	479.467	19.333	24.50859
28/11/2015 13:00	479.8	19.337	24.51192
28/11/2015 17:00	481.217	19.337	24.52609
28/11/2015 21:00	480.108	19.333	24.515
29/11/2015 1:00	481.117	19.337	24.52509
29/11/2015 5:00	482.217	19.333	24.53609
29/11/2015 9:00	481.892	19.337	24.53284
29/11/2015 13:00	484.175	19.333	24.55567
29/11/2015 17:00	485.8	19.337	24.57192
29/11/2015 21:00	484.167	19.337	24.55559
30/11/2015 1:00	486.15	19.337	24.57542
30/11/2015 5:00	486.617	19.337	24.58009
30/11/2015 9:00	484.642	19.337	24.56034
30/11/2015 13:00	485.15	19.337	24.56542
30/11/2015 17:00	486.092	19.337	24.57484
30/11/2015 21:00	484.308	19.337	24.557
1/12/2015 1:00	485.142	19.337	24.56534
1/12/2015 5:00	484.508	19.337	24.559
1/12/2015 9:00	483.483	19.337	24.54875
1/12/2015 13:00	485.1	19.337	24.56492
1/12/2015 17:00	485.592	19.337	24.56984
1/12/2015 21:00	484.483	19.337	24.55875
2/12/2015 1:00	486.292	19.337	24.57684
2/12/2015 5:00	485.308	19.337	24.567
2/12/2015 9:00	483.625	19.337	24.55017
2/12/2015 13:00	483.333	19.343	24.54725
2/12/2015 17:00	481.017	19.343	24.52409
2/12/2015 21:00	477.425	19.337	24.48817
3/12/2015 1:00	476.45	19.337	24.47842
3/12/2015 5:00	474.575	19.337	24.45967
3/12/2015 9:00	472.167	19.343	24.43559
3/12/2015 13:00	472.525	19.337	24.43917
3/12/2015 17:00	473.05	19.337	24.44442
3/12/2015 21:00	472.067	19.343	24.43459
4/12/2015 1:00	473.167	19.343	24.44559
4/12/2015 5:00	473.425	19.343	24.44817
4/12/2015 9:00	472.575	19.343	24.43967

CG105			
Date	mm above logger	temp	RL (mAHD)
30/09/2015 21:00	278.95	19.303	24.179
1/10/2015 1:00	278.358	19.297	24.17308
1/10/2015 5:00	278.033	19.343	24.16983
1/10/2015 9:00	276.383	19.297	24.15333
1/10/2015 13:00	278.325	19.31	24.17275
1/10/2015 17:00	277.833	19.29	24.16783
1/10/2015 21:00	276.633	19.33	24.15583
2/10/2015 1:00	276.2	19.277	24.1515
2/10/2015 5:00	275.525	19.263	24.14475
2/10/2015 9:00	272.092	19.27	24.11042
2/10/2015 13:00	272.492	19.323	24.11442
2/10/2015 17:00	272.342	19.317	24.11292
2/10/2015 21:00	271.058	19.29	24.10008
3/10/2015 1:00	271.3	19.297	24.1025
3/10/2015 5:00	272.5	19.277	24.1145
3/10/2015 9:00	271.967	19.263	24.10917
3/10/2015 13:00	275.333	19.237	24.14283
3/10/2015 17:00	277.5	19.29	24.1645
3/10/2015 21:00	276.767	19.243	24.15717
4/10/2015 1:00	278.083	19.283	24.17033
4/10/2015 5:00	278.692	19.263	24.17642
4/10/2015 9:00	277.875	19.283	24.16825
4/10/2015 13:00	279.975	19.227	24.18925
4/10/2015 17:00	281.792	19.243	24.20742
4/10/2015 21:00	280.742	19.31	24.19692
5/10/2015 1:00	281.467	19.227	24.20417
5/10/2015 5:00	280.967	19.27	24.19917
5/10/2015 9:00	279.558	19.29	24.18508
5/10/2015 13:00	282.017	19.27	24.20967
5/10/2015 17:00	282.35	19.283	24.213
5/10/2015 21:00	281.533	19.27	24.20483
6/10/2015 1:00	282.083	19.243	24.21033
6/10/2015 5:00	281.667	19.257	24.20617
6/10/2015 9:00	280.375	19.263	24.19325
6/10/2015 13:00	282.625	19.257	24.21575
6/10/2015 17:00	284	19.237	24.2295
6/10/2015 21:00	282.658	19.243	24.21608
7/10/2015 1:00	283.183	19.263	24.22133
7/10/2015 5:00	283.358	19.237	24.22308
7/10/2015 9:00	281.058	19.277	24.20008
7/10/2015 13:00	278.183	19.263	24.17133
7/10/2015 17:00	275.633	19.257	24.14583
7/10/2015 21:00	272.2	19.277	24.1115
8/10/2015 1:00	271.942	19.27	24.10892
8/10/2015 5:00	271.625	19.23	24.10575
8/10/2015 9:00	269.65	19.257	24.086
8/10/2015 13:00	271.275	19.237	24.10225
8/10/2015 17:00	272.317	19.243	24.11267
8/10/2015 21:00	271.292	19.263	24.10242
9/10/2015 1:00	272.75	19.257	24.117
9/10/2015 5:00	273.567	19.27	24.12517
9/10/2015 9:00	272.158	19.2	24.11108
9/10/2015 13:00	274.892	19.243	24.13842
9/10/2015 17:00	277.458	19.22	24.16408
9/10/2015 21:00	276.392	19.243	24.15342
10/10/2015 1:00	277.742	19.243	24.16692
10/10/2015 5:00	278.742	19.227	24.17692
10/10/2015 9:00	276.45	19.237	24.154
10/10/2015 13:00	279.75	19.263	24.187
10/10/2015 17:00	281.783	19.23	24.20733
10/10/2015 21:00	280.758	19.283	24.19708
11/10/2015 1:00	281.883	19.23	24.20833
11/10/2015 5:00	283.333	19.23	24.22283
11/10/2015 9:00	282.758	19.25	24.21708
11/10/2015 13:00	286	19.23	24.2495
11/10/2015 17:00	288.258	19.263	24.27208
11/10/2015 21:00	286.233	19.263	24.25183
12/10/2015 1:00	287.358	19.207	24.26308
12/10/2015 5:00	288.392	19.25	24.27342
12/10/2015 9:00	287.308	19.207	24.26258
12/10/2015 13:00	290.85	19.227	24.298
12/10/2015 17:00	292.883	19.22	24.31833

CG106			
Date	mm above logger	temp	RL (mAHD)
30/09/2015 17:00	299.65	18.89	20.79
30/09/2015 21:00	299.258	18.903	20.78608
1/10/2015 1:00	297.592	18.887	20.76942
1/10/2015 5:00	298.092	18.887	20.77442
1/10/2015 9:00	296.083	18.89	20.75433
1/10/2015 13:00	294.592	18.897	20.73942
1/10/2015 17:00	295.817	18.88	20.75167
1/10/2015 21:00	296.275	18.897	20.75625
2/10/2015 1:00	295.067	18.89	20.74417
2/10/2015 5:00	294.7	18.897	20.7405
2/10/2015 9:00	293.358	18.897	20.72708
2/10/2015 13:00	290.433	18.89	20.69783
2/10/2015 17:00	291.6	18.88	20.7095
2/10/2015 21:00	291.317	18.897	20.70667
3/10/2015 1:00	290.408	18.897	20.69758
3/10/2015 5:00	290.875	18.89	20.70225
3/10/2015 9:00	290.408	18.887	20.69758
3/10/2015 13:00	290.042	18.88	20.69392
3/10/2015 17:00	290.908	18.887	20.70258
3/10/2015 21:00	292.183	18.897	20.71533
4/10/2015 1:00	292.983	18.88	20.72333
4/10/2015 5:00	293.367	18.867	20.72717
4/10/2015 9:00	293.233	18.897	20.72583
4/10/2015 13:00	292.558	18.887	20.71908
4/10/2015 17:00	293.708	18.89	20.73058
4/10/2015 21:00	295.425	18.89	20.74775
5/10/2015 1:00	296.15	18.88	20.755
5/10/2015 5:00	295.367	18.897	20.74717
5/10/2015 9:00	294.775	18.88	20.74125
5/10/2015 13:00	294.775	18.88	20.74125
5/10/2015 17:00	294.95	18.903	20.743
5/10/2015 21:00	295.383	18.88	20.74733
6/10/2015 1:00	296.383	18.873	20.75733
6/10/2015 5:00	296	18.89	20.7535
6/10/2015 9:00	294.933	18.89	20.74283
6/10/2015 13:00	295.05	18.867	20.744
6/10/2015 17:00	295.142	18.88	20.74492
6/10/2015 21:00	295.683	18.88	20.75033
7/10/2015 1:00	296.392	18.887	20.75742
7/10/2015 5:00	296.85	18.867	20.762
7/10/2015 9:00	294.642	18.897	20.73992
7/10/2015 13:00	294.192	18.86	20.73542
7/10/2015 17:00	292.675	18.88	20.72025
7/10/2015 21:00	290.325	18.903	20.69675
8/10/2015 1:00	289.675	18.873	20.69025
8/10/2015 5:00	289.4	18.887	20.6875
8/10/2015 9:00	286.958	18.88	20.66308
8/10/2015 13:00	287.208	18.887	20.66558
8/10/2015 17:00	287.392	18.88	20.66742
8/10/2015 21:00	285.642	18.897	20.64992
9/10/2015 1:00	286.392	18.873	20.65742
9/10/2015 5:00	287.275	18.88	20.66625
9/10/2015 9:00	285.467	18.853	20.64817
9/10/2015 13:00	286.017	18.873	20.65367
9/10/2015 17:00	288.358	18.867	20.67708
9/10/2015 21:00	287.15	18.897	20.665
10/10/2015 1:00	288.225	18.853	20.67575
10/10/2015 5:00	289.783	18.88	20.69133
10/10/2015 9:00	287.792	18.867	20.67142
10/10/2015 13:00	288.967	18.86	20.68317
10/10/2015 17:00	290.658	18.86	20.70008
10/10/2015 21:00	290.108	18.86	20.69458
11/10/2015 1:00	291.217	18.853	20.70567
11/10/2015 5:00	292.483	18.84	20.71833
11/10/2015 9:00	290.717	18.873	20.70067
11/10/2015 13:00	292.433	18.887	20.71783
11/10/2015 17:00	295.558	18.88	20.74908
11/10/2015 21:00	294.55	18.853	20.739
12/10/2015 1:00	295.033	18.847	20.74383
12/10/2015 5:00	296.65	18.86	20.76
12/10/2015 9:00	294.608	18.88	20.73958
12/10/2015 13:00	295.525	18.853	20.74875

CG105			
Date	mm above logger	temp	RL (mAHD)
12/10/2015 21:00	291.567	19.207	24.30517
13/10/2015 1:00	290.525	19.22	24.29475
13/10/2015 5:00	288.808	19.213	24.27758
13/10/2015 9:00	286.483	19.193	24.25433
13/10/2015 13:00	287.658	19.213	24.26608
13/10/2015 17:00	286.45	19.193	24.254
13/10/2015 21:00	284.342	19.227	24.23292
14/10/2015 1:00	284.017	19.213	24.22967
14/10/2015 5:00	283.95	19.22	24.229
14/10/2015 9:00	281.983	19.23	24.20933
14/10/2015 13:00	282.15	19.2	24.211
14/10/2015 17:00	283.117	19.237	24.22067
14/10/2015 21:00	281.575	19.207	24.20525
15/10/2015 1:00	282.25	19.227	24.212
15/10/2015 5:00	283.5	19.213	24.2245
15/10/2015 9:00	280.958	19.22	24.19908
15/10/2015 13:00	283.217	19.237	24.22167
15/10/2015 17:00	284.692	19.237	24.23642
15/10/2015 21:00	283.233	19.22	24.22183
16/10/2015 1:00	284.358	19.187	24.23308
16/10/2015 5:00	285.417	19.22	24.24367
16/10/2015 9:00	283.775	19.213	24.22725
16/10/2015 13:00	285.383	19.213	24.24333
16/10/2015 17:00	287.675	19.207	24.26625
16/10/2015 21:00	285.892	19.2	24.24842
17/10/2015 1:00	286.458	19.213	24.25408
17/10/2015 5:00	287.125	19.213	24.26075
17/10/2015 9:00	285.425	19.207	24.24375
17/10/2015 13:00	286.567	19.173	24.25517
17/10/2015 17:00	287.85	19.213	24.268
17/10/2015 21:00	285.708	19.2	24.24658
18/10/2015 1:00	285.583	19.2	24.24533
18/10/2015 5:00	283.567	19.23	24.22517
18/10/2015 9:00	281.6	19.2	24.2055
18/10/2015 13:00	282.567	19.227	24.21517
18/10/2015 17:00	283.608	19.193	24.22558
18/10/2015 21:00	282.5	19.213	24.2145
19/10/2015 1:00	283.275	19.207	24.22225
19/10/2015 5:00	283.925	19.213	24.22875
19/10/2015 9:00	282.775	19.193	24.21725
19/10/2015 13:00	284.567	19.23	24.23517
19/10/2015 17:00	286.567	19.18	24.25517
19/10/2015 21:00	285.9	19.187	24.2485
20/10/2015 1:00	287.467	19.237	24.26417
20/10/2015 5:00	287.7	19.193	24.2665
20/10/2015 9:00	287.15	19.207	24.261
20/10/2015 13:00	289.933	19.193	24.28883
20/10/2015 17:00	292.033	19.207	24.30983
20/10/2015 21:00	290.808	19.153	24.29758
21/10/2015 1:00	292.7	19.207	24.3165
21/10/2015 5:00	293.5	19.207	24.3245
21/10/2015 9:00	293.183	19.22	24.32133
21/10/2015 13:00	296.133	19.2	24.35083
21/10/2015 17:00	298.217	19.23	24.37167
21/10/2015 21:00	296.4	19.193	24.3535
22/10/2015 1:00	298.733	19.227	24.37683
22/10/2015 5:00	298.675	19.2	24.37625
22/10/2015 9:00	297.075	19.207	24.36025
22/10/2015 13:00	299.825	19.207	24.38775
22/10/2015 17:00	299.675	19.213	24.38625
22/10/2015 21:00	297.158	19.18	24.36108
23/10/2015 1:00	296.325	19.2	24.35275
23/10/2015 5:00	294.517	19.22	24.33467
23/10/2015 9:00	290.85	19.193	24.298
23/10/2015 13:00	291.267	19.2	24.30217
23/10/2015 17:00	290.7	19.193	24.2965
23/10/2015 21:00	288.067	19.193	24.27017
24/10/2015 1:00	288.717	19.207	24.27667
24/10/2015 5:00	288.292	19.213	24.27242
24/10/2015 9:00	286.675	19.18	24.25625
24/10/2015 13:00	289.325	19.18	24.28275
24/10/2015 17:00	289.692	19.213	24.28642

CG106			
Date	mm above logger	temp	RL (mAHD)
12/10/2015 17:00	298.692	18.853	20.78042
12/10/2015 21:00	298.508	18.813	20.77858
13/10/2015 1:00	298.15	18.867	20.775
13/10/2015 5:00	299.15	18.827	20.785
13/10/2015 9:00	295.633	18.84	20.74983
13/10/2015 13:00	295.875	18.847	20.75225
13/10/2015 17:00	297.783	18.853	20.77133
13/10/2015 21:00	296.017	18.88	20.75367
14/10/2015 1:00	295.05	18.867	20.744
14/10/2015 5:00	297.142	18.853	20.76492
14/10/2015 9:00	297.433	18.853	20.76783
14/10/2015 13:00	296.733	18.847	20.76083
14/10/2015 17:00	297.858	18.86	20.77208
14/10/2015 21:00	296.458	18.847	20.75808
15/10/2015 1:00	294.917	18.86	20.74267
15/10/2015 5:00	295.625	18.853	20.74975
15/10/2015 9:00	293.567	18.833	20.72917
15/10/2015 13:00	292.45	18.827	20.718
15/10/2015 17:00	295.208	18.833	20.74558
15/10/2015 21:00	295.025	18.847	20.74375
16/10/2015 1:00	293.933	18.84	20.73283
16/10/2015 5:00	295.758	18.853	20.75108
16/10/2015 9:00	293.967	18.84	20.73317
16/10/2015 13:00	293.017	18.853	20.72367
16/10/2015 17:00	295.667	18.853	20.75017
16/10/2015 21:00	296.708	18.853	20.76058
17/10/2015 1:00	295.575	18.827	20.74925
17/10/2015 5:00	297.233	18.853	20.76583
17/10/2015 9:00	295.267	18.84	20.74617
17/10/2015 13:00	294.067	18.827	20.73417
17/10/2015 17:00	296.042	18.847	20.75392
17/10/2015 21:00	296.333	18.84	20.75683
18/10/2015 1:00	295.65	18.84	20.75
18/10/2015 5:00	295.617	18.847	20.74967
18/10/2015 9:00	293.6	18.827	20.7295
18/10/2015 13:00	292.033	18.833	20.71383
18/10/2015 17:00	292.517	18.84	20.71867
18/10/2015 21:00	293.417	18.853	20.72767
19/10/2015 1:00	292.892	18.827	20.72242
19/10/2015 5:00	293.367	18.84	20.72717
19/10/2015 9:00	292.775	18.82	20.72125
19/10/2015 13:00	291.208	18.8	20.70558
19/10/2015 17:00	292.933	18.853	20.72283
19/10/2015 21:00	294.067	18.833	20.73417
20/10/2015 1:00	294.392	18.82	20.73742
20/10/2015 5:00	294.85	18.813	20.742
20/10/2015 9:00	294.858	18.827	20.74208
20/10/2015 13:00	294.075	18.827	20.73425
20/10/2015 17:00	295.808	18.827	20.75158
20/10/2015 21:00	297.167	18.833	20.76517
21/10/2015 1:00	298.2	18.827	20.7755
21/10/2015 5:00	298.175	18.84	20.77525
21/10/2015 9:00	297.7	18.853	20.7705
21/10/2015 13:00	298.242	18.827	20.77592
21/10/2015 17:00	299.35	18.847	20.787
21/10/2015 21:00	299.967	18.793	20.79317
22/10/2015 1:00	301.683	18.827	20.81033
22/10/2015 5:00	302.425	18.813	20.81775
22/10/2015 9:00	302.4	18.827	20.8175
22/10/2015 13:00	303.483	18.807	20.82833
22/10/2015 17:00	302.792	18.82	20.82142
22/10/2015 21:00	303.058	18.833	20.82408
23/10/2015 1:00	303.05	18.807	20.824
23/10/2015 5:00	302.317	18.827	20.81667
23/10/2015 9:00	299.258	18.807	20.78608
23/10/2015 13:00	298.717	18.827	20.78067
23/10/2015 17:00	297.917	18.82	20.77267
23/10/2015 21:00	296.183	18.807	20.75533
24/10/2015 1:00	296.658	18.827	20.76008
24/10/2015 5:00	296.233	18.827	20.75583
24/10/2015 9:00	293.917	18.833	20.73267
24/10/2015 13:00	294.258	18.847	20.73608

CG105			
Date	mm above logger	temp	RL (mAHD)
24/10/2015 21:00	288.067	19.16	24.27017
25/10/2015 1:00	289.567	19.207	24.28517
25/10/2015 5:00	289.808	19.193	24.28758
25/10/2015 9:00	288.075	19.173	24.27025
25/10/2015 13:00	291.283	19.22	24.30233
25/10/2015 17:00	292.567	19.207	24.31517
25/10/2015 21:00	290.842	19.193	24.29792
26/10/2015 1:00	293.717	19.227	24.32667
26/10/2015 5:00	294.242	19.213	24.33192
26/10/2015 9:00	293.217	19.207	24.32167
26/10/2015 13:00	296.375	19.193	24.35325
26/10/2015 17:00	296.908	19.213	24.35858
26/10/2015 21:00	293.592	19.18	24.32542
27/10/2015 1:00	295.683	19.187	24.34633
27/10/2015 5:00	293.725	19.213	24.32675
27/10/2015 9:00	290.208	19.22	24.29158
27/10/2015 13:00	289.467	19.207	24.28417
27/10/2015 17:00	290.167	19.207	24.29117
27/10/2015 21:00	287.775	19.173	24.26725
28/10/2015 1:00	288.983	19.2	24.27933
28/10/2015 5:00	290.375	19.173	24.29325
28/10/2015 9:00	288.075	19.173	24.27025
28/10/2015 13:00	289.467	19.193	24.28417
28/10/2015 17:00	291.208	19.2	24.30158
28/10/2015 21:00	289.417	19.22	24.28367
29/10/2015 1:00	290.817	19.25	24.29767
29/10/2015 5:00	291.758	19.207	24.30708
29/10/2015 9:00	289.608	19.213	24.28558
29/10/2015 13:00	290.358	19.207	24.29308
29/10/2015 17:00	291.625	19.2	24.30575
29/10/2015 21:00	290.25	19.227	24.292
30/10/2015 1:00	291.108	19.193	24.30058
30/10/2015 5:00	290.925	19.187	24.29875
30/10/2015 9:00	289.375	19.207	24.28325
30/10/2015 13:00	291.458	19.193	24.30408
30/10/2015 17:00	293.1	19.187	24.3205
30/10/2015 21:00	291.55	19.25	24.305
31/10/2015 1:00	291.942	19.23	24.30892
31/10/2015 5:00	292.608	19.23	24.31558
31/10/2015 9:00	291.025	19.213	24.29975
31/10/2015 13:00	292.758	19.207	24.31708
31/10/2015 17:00	294.167	19.22	24.33117
31/10/2015 21:00	293.592	19.2	24.32542
1/11/2015 1:00	295.142	19.22	24.34092
1/11/2015 5:00	296.192	19.23	24.35142
1/11/2015 9:00	295.525	19.243	24.34475
1/11/2015 13:00	298.517	19.227	24.37467
1/11/2015 17:00	300.583	19.2	24.39533
1/11/2015 21:00	299.983	19.213	24.38933
2/11/2015 1:00	301.5	19.18	24.4045
2/11/2015 5:00	300.992	19.23	24.39942
11/11/2015 5:00	296.717	19.193	24.35667
11/11/2015 9:00	294.733	19.22	24.33683
11/11/2015 13:00	294.892	19.2	24.33842
11/11/2015 17:00	295.617	19.193	24.34567
11/11/2015 21:00	293.683	19.227	24.32633
12/11/2015 1:00	294.983	19.187	24.33933
12/11/2015 5:00	295.533	19.207	24.34483
12/11/2015 9:00	294.042	19.22	24.32992
12/11/2015 13:00	296.733	19.243	24.35683
12/11/2015 17:00	298.975	19.207	24.37925
12/11/2015 21:00	297.2	19.193	24.3615
13/11/2015 1:00	299.475	19.2	24.38425
13/11/2015 5:00	302.317	19.18	24.41267
13/11/2015 9:00	301.583	19.2	24.40533
13/11/2015 13:00	304.367	19.187	24.43317
13/11/2015 17:00	305.25	19.23	24.442
13/11/2015 21:00	304.567	19.18	24.43517
14/11/2015 1:00	304.025	19.193	24.42975
14/11/2015 5:00	305.325	19.187	24.44275
14/11/2015 9:00	303.967	19.257	24.42917
14/11/2015 13:00	305.275	19.23	24.44225

CG106			
Date	mm above logger	temp	RL (mAHD)
24/10/2015 17:00	294.517	18.82	20.73867
24/10/2015 21:00	293.35	18.813	20.727
25/10/2015 1:00	294.758	18.82	20.74108
25/10/2015 5:00	294.975	18.813	20.74325
25/10/2015 9:00	292.367	18.8	20.71717
25/10/2015 13:00	293.308	18.827	20.72658
25/10/2015 17:00	295.65	18.793	20.75
25/10/2015 21:00	294.2	18.787	20.7355
26/10/2015 1:00	295.333	18.827	20.74683
26/10/2015 5:00	296.225	18.8	20.75575
26/10/2015 9:00	293.45	18.8	20.728
26/10/2015 13:00	295.242	18.833	20.74592
26/10/2015 17:00	297.583	18.82	20.76933
26/10/2015 21:00	297.892	18.807	20.77242
27/10/2015 1:00	298.375	18.8	20.77725
27/10/2015 5:00	299.075	18.833	20.78425
27/10/2015 9:00	295.6	18.8	20.7495
27/10/2015 13:00	294.35	18.813	20.737
27/10/2015 17:00	296.067	18.813	20.75417
27/10/2015 21:00	294.158	18.813	20.73508
28/10/2015 1:00	293.75	18.787	20.731
28/10/2015 5:00	295.3	18.8	20.7465
28/10/2015 9:00	292.175	18.807	20.71525
28/10/2015 13:00	291.325	18.793	20.70675
28/10/2015 17:00	293.692	18.8	20.73042
28/10/2015 21:00	293.4	18.827	20.7275
29/10/2015 1:00	292.875	18.8	20.72225
29/10/2015 5:00	294.258	18.807	20.73608
29/10/2015 9:00	292.108	18.827	20.71458
29/10/2015 13:00	290.458	18.807	20.69808
29/10/2015 17:00	293.175	18.813	20.72525
29/10/2015 21:00	293.658	18.813	20.73008
30/10/2015 1:00	292.417	18.807	20.71767
30/10/2015 5:00	293.408	18.793	20.72758
30/10/2015 9:00	291.217	18.82	20.70567
30/10/2015 13:00	289.55	18.787	20.689
30/10/2015 17:00	292.367	18.78	20.71717
30/10/2015 21:00	293.042	18.78	20.72392
31/10/2015 1:00	292.175	18.8	20.71525
31/10/2015 5:00	293.567	18.78	20.72917
31/10/2015 9:00	291.592	18.787	20.70942
31/10/2015 13:00	290.383	18.793	20.69733
31/10/2015 17:00	292.942	18.793	20.72292
31/10/2015 21:00	294.125	18.8	20.73475
1/11/2015 1:00	293.817	18.8	20.73167
1/11/2015 5:00	294.692	18.807	20.74042
1/11/2015 9:00	294.608	18.793	20.73958
1/11/2015 13:00	293.508	18.773	20.72858
1/11/2015 17:00	296	18.793	20.7535
1/11/2015 21:00	297.433	18.793	20.76783
2/11/2015 1:00	298.267	18.787	20.77617
2/11/2015 5:00	298.925	18.793	20.78275
10/11/2015 13:00	289.083	22.233	20.68433
10/11/2015 17:00	291.717	18.747	20.71067
10/11/2015 21:00	291.333	18.727	20.70683
11/11/2015 1:00	291.142	18.72	20.70492
11/11/2015 5:00	291.592	18.727	20.70942
11/11/2015 9:00	300.342	18.767	20.79692
11/11/2015 13:00	299.7	18.747	20.7905
11/11/2015 17:00	301.917	18.76	20.81267
11/11/2015 21:00	300.975	18.767	20.80325
12/11/2015 1:00	300.625	18.753	20.79975
12/11/2015 5:00	301.367	18.747	20.80717
12/11/2015 9:00	298.433	18.76	20.77783
12/11/2015 13:00	299.167	18.76	20.78517
12/11/2015 17:00	301.575	18.753	20.80925
12/11/2015 21:00	301.55	18.707	20.809
13/11/2015 1:00	301.425	18.753	20.80775
13/11/2015 5:00	303.675	18.747	20.83025
13/11/2015 9:00	301.617	18.747	20.80967
13/11/2015 13:00	302.325	18.753	20.81675
13/11/2015 17:00	305.883	18.747	20.85233

CG105			
Date	mm above logger	temp	RL (mAHD)
14/11/2015 17:00	306.833	19.23	24.45783
14/11/2015 21:00	305.7	19.23	24.4465
15/11/2015 1:00	305.925	19.213	24.44875
15/11/2015 5:00	305.5	19.193	24.4445
15/11/2015 9:00	302.992	19.193	24.41942
15/11/2015 13:00	303	19.187	24.4195
15/11/2015 17:00	302.817	19.18	24.41767
15/11/2015 21:00	301.533	19.25	24.40483
16/11/2015 1:00	302.067	19.18	24.41017
16/11/2015 5:00	302.058	19.18	24.41008
16/11/2015 9:00	300	19.237	24.3895
16/11/2015 13:00	301.35	19.207	24.403
16/11/2015 17:00	302	19.237	24.4095
16/11/2015 21:00	300.75	19.193	24.397
17/11/2015 1:00	301.275	19.213	24.40225
17/11/2015 5:00	301.592	19.2	24.40542
17/11/2015 9:00	300.217	19.193	24.39167
17/11/2015 13:00	302.442	19.193	24.41392
17/11/2015 17:00	303.375	19.237	24.42325
17/11/2015 21:00	302.417	19.18	24.41367
18/11/2015 1:00	303.858	19.213	24.42808
18/11/2015 5:00	305.217	19.2	24.44167
18/11/2015 9:00	304.9	19.27	24.4385
18/11/2015 13:00	306.892	19.2	24.45842
18/11/2015 17:00	308.925	19.243	24.47875
18/11/2015 21:00	308.408	19.27	24.47358
19/11/2015 1:00	310.325	19.277	24.49275
19/11/2015 5:00	309.883	19.213	24.48833
19/11/2015 9:00	307.45	19.227	24.464
19/11/2015 13:00	308.675	19.207	24.47625
19/11/2015 17:00	310.208	19.257	24.49158
19/11/2015 21:00	309.367	19.193	24.48317
20/11/2015 1:00	310.892	19.25	24.49842
20/11/2015 5:00	310.542	19.22	24.49492
20/11/2015 9:00	309.692	19.2	24.48642
20/11/2015 13:00	313.167	19.237	24.52117
20/11/2015 17:00	315.192	19.257	24.54142
20/11/2015 21:00	314.475	19.263	24.53425
21/11/2015 1:00	316.808	19.213	24.55758
21/11/2015 5:00	314.517	19.213	24.53467
21/11/2015 9:00	311.867	19.25	24.50817
21/11/2015 13:00	311.583	19.283	24.50533
21/11/2015 17:00	309.6	19.283	24.4855
21/11/2015 21:00	307.258	19.29	24.46208
22/11/2015 1:00	308.408	19.29	24.47358
22/11/2015 5:00	308.967	19.283	24.47917
22/11/2015 9:00	307.783	19.283	24.46733
22/11/2015 13:00	309.908	19.283	24.48858
22/11/2015 17:00	312.658	19.27	24.51608
22/11/2015 21:00	311.808	19.27	24.50758
23/11/2015 1:00	314.817	19.283	24.53767
23/11/2015 5:00	315.642	19.257	24.54592
23/11/2015 9:00	314.358	19.243	24.53308
23/11/2015 13:00	318.108	19.227	24.57058
23/11/2015 17:00	318.342	19.23	24.57292
23/11/2015 21:00	314.725	19.22	24.53675
24/11/2015 1:00	314.242	19.227	24.53192
24/11/2015 5:00	313.083	19.227	24.52033
24/11/2015 9:00	310.642	19.23	24.49592
24/11/2015 13:00	312.183	19.227	24.51133
24/11/2015 17:00	314.067	19.23	24.53017
24/11/2015 21:00	312.758	19.237	24.51708
25/11/2015 1:00	314.708	19.23	24.53658
25/11/2015 5:00	315.683	19.23	24.54633
25/11/2015 9:00	314.392	19.237	24.53342
25/11/2015 13:00	317.692	19.23	24.56642
25/11/2015 17:00	320.167	19.23	24.59117
25/11/2015 21:00	319.117	19.23	24.58067
26/11/2015 1:00	321.217	19.23	24.60167
26/11/2015 5:00	322.017	19.23	24.60967
26/11/2015 9:00	322.533	19.23	24.61483
26/11/2015 13:00	325.025	19.227	24.63975

CG106			
Date	mm above logger	temp	RL (mAHD)
13/11/2015 21:00	306.75	18.76	20.861
14/11/2015 1:00	307.358	18.747	20.86708
14/11/2015 5:00	308.658	18.747	20.88008
14/11/2015 9:00	307.267	18.773	20.86617
14/11/2015 13:00	305.558	18.747	20.84908
14/11/2015 17:00	314.508	18.753	20.93858
14/11/2015 21:00	314.75	18.72	20.941
15/11/2015 1:00	314.008	18.753	20.93358
15/11/2015 5:00	313.867	18.76	20.93217
15/11/2015 9:00	311.608	18.727	20.90958
15/11/2015 13:00	310.175	18.747	20.89525
15/11/2015 17:00	311.083	18.747	20.90433
15/11/2015 21:00	312.083	18.727	20.91433
16/11/2015 1:00	311.542	18.747	20.90892
16/11/2015 5:00	312.242	18.747	20.91592
16/11/2015 9:00	310.908	18.747	20.90258
16/11/2015 13:00	310.333	18.74	20.89683
16/11/2015 17:00	312.358	18.793	20.91708
16/11/2015 21:00	313.167	18.753	20.92517
17/11/2015 1:00	312.867	18.713	20.92217
17/11/2015 5:00	313.433	18.747	20.92783
17/11/2015 9:00	312.45	18.74	20.918
17/11/2015 13:00	311.733	18.767	20.91083
17/11/2015 17:00	312.708	18.733	20.92058
17/11/2015 21:00	313.858	18.753	20.93208
18/11/2015 1:00	314.708	18.753	20.94058
18/11/2015 5:00	314.642	18.727	20.93992
18/11/2015 9:00	314.375	18.747	20.93725
18/11/2015 13:00	313.933	18.747	20.93283
18/11/2015 17:00	316.017	18.753	20.95367
18/11/2015 21:00	317.758	18.74	20.97108
19/11/2015 1:00	318.35	18.767	20.977
19/11/2015 5:00	318.142	18.747	20.97492
19/11/2015 9:00	316.717	18.747	20.96067
19/11/2015 13:00	316.1	18.76	20.9545
19/11/2015 17:00	316.925	18.753	20.96275
19/11/2015 21:00	317.708	18.747	20.97058
20/11/2015 1:00	318.883	18.747	20.98233
20/11/2015 5:00	318.342	18.76	20.97692
20/11/2015 9:00	316.775	18.753	20.96125
20/11/2015 13:00	318.217	18.78	20.97567
20/11/2015 17:00	318.592	18.753	20.97942
20/11/2015 21:00	319.483	18.753	20.98833
21/11/2015 1:00	321.567	18.747	21.00917
21/11/2015 5:00	320.25	18.747	20.996
21/11/2015 9:00	318.442	18.733	20.97792
21/11/2015 13:00	319.075	18.76	20.98425
21/11/2015 17:00	317.625	18.733	20.96975
21/11/2015 21:00	316.258	18.747	20.95608
22/11/2015 1:00	317.217	18.747	20.96567
22/11/2015 5:00	315.983	18.753	20.95333
22/11/2015 9:00	314.317	18.74	20.93667
22/11/2015 13:00	314.792	18.753	20.94142
22/11/2015 17:00	315.333	18.76	20.94683
22/11/2015 21:00	315.225	18.767	20.94575
23/11/2015 1:00	317.525	18.767	20.96875
23/11/2015 5:00	317.433	18.753	20.96783
23/11/2015 9:00	315.558	18.773	20.94908
23/11/2015 13:00	317.667	18.76	20.97017
23/11/2015 17:00	318.942	18.747	20.98292
23/11/2015 21:00	318.325	18.74	20.97675
24/11/2015 1:00	318.192	18.753	20.97542
24/11/2015 5:00	317.933	18.753	20.97283
24/11/2015 9:00	314.508	18.74	20.93858
24/11/2015 13:00	314.65	18.753	20.94
24/11/2015 17:00	316.567	18.767	20.95917
24/11/2015 21:00	315.05	18.747	20.944
25/11/2015 1:00	316.45	18.773	20.958
25/11/2015 5:00	317.433	18.76	20.96783
25/11/2015 9:00	314.05	18.76	20.934
25/11/2015 13:00	315.408	18.767	20.94758
25/11/2015 17:00	318.533	18.767	20.97883

CG105			
Date	mm above logger	temp	RL (mAHD)
26/11/2015 17:00	327.025	19.227	24.65975
26/11/2015 21:00	322.608	19.227	24.61558
27/11/2015 1:00	318.225	19.237	24.57175
27/11/2015 5:00	316.175	19.257	24.55125
27/11/2015 9:00	313.983	19.263	24.52933
27/11/2015 13:00	314.825	19.25	24.53775
27/11/2015 17:00	316	19.23	24.5495
27/11/2015 21:00	314.542	19.237	24.53492
28/11/2015 1:00	315.35	19.237	24.543
28/11/2015 5:00	315.308	19.243	24.54258
28/11/2015 9:00	313.217	19.237	24.52167
28/11/2015 13:00	313.842	19.25	24.52792
28/11/2015 17:00	315.2	19.243	24.5415
28/11/2015 21:00	314.033	19.237	24.52983
29/11/2015 1:00	314.983	19.237	24.53933
29/11/2015 5:00	316.142	19.237	24.55092
29/11/2015 9:00	316.108	19.237	24.55058
29/11/2015 13:00	318.1	19.237	24.5705
29/11/2015 17:00	319.958	19.243	24.58908
29/11/2015 21:00	318.325	19.243	24.57275
30/11/2015 1:00	320.367	19.25	24.59317
30/11/2015 5:00	320.542	19.25	24.59492
30/11/2015 9:00	318.45	19.243	24.574
30/11/2015 13:00	319.133	19.243	24.58083
30/11/2015 17:00	319.958	19.243	24.58908
30/11/2015 21:00	318.525	19.25	24.57475
1/12/2015 1:00	319.533	19.25	24.58483
1/12/2015 5:00	318.667	19.243	24.57617
1/12/2015 9:00	317.467	19.243	24.56417
1/12/2015 13:00	319.433	19.243	24.58383
1/12/2015 17:00	319.575	19.243	24.58525
1/12/2015 21:00	318.467	19.243	24.57417
2/12/2015 1:00	320.275	19.243	24.59225
2/12/2015 5:00	319.117	19.243	24.58067
2/12/2015 9:00	317.842	19.25	24.56792
2/12/2015 13:00	317.2	19.25	24.5615
2/12/2015 17:00	315.058	19.25	24.54008
2/12/2015 21:00	311.292	19.25	24.50242
3/12/2015 1:00	310.375	19.25	24.49325
3/12/2015 5:00	308.442	19.25	24.47392
3/12/2015 9:00	306.033	19.25	24.44983
3/12/2015 13:00	306.567	19.25	24.45517
3/12/2015 17:00	306.917	19.25	24.45867
3/12/2015 21:00	306.108	19.25	24.45058
4/12/2015 1:00	307.092	19.25	24.46042
4/12/2015 5:00	307.292	19.257	24.46242
4/12/2015 9:00	306.617	19.257	24.45567

CG106			
Date	mm above logger	temp	RL (mAHD)
25/11/2015 21:00	318.492	18.753	20.97842
26/11/2015 1:00	319.208	18.76	20.98558
26/11/2015 5:00	320.833	18.733	21.00183
26/11/2015 9:00	317.992	18.753	20.97342
26/11/2015 13:00	319.442	18.767	20.98792
26/11/2015 17:00	323.1	18.78	21.0245
26/11/2015 21:00	322.15	18.753	21.015
27/11/2015 1:00	320.417	18.753	20.99767
27/11/2015 5:00	320.4	18.76	20.9975
27/11/2015 9:00	316.783	18.76	20.96133
27/11/2015 13:00	314.825	18.773	20.94175
27/11/2015 17:00	316.825	18.76	20.96175
27/11/2015 21:00	316.65	18.773	20.96
28/11/2015 1:00	316	18.753	20.9535
28/11/2015 5:00	316.283	18.773	20.95633
28/11/2015 9:00	314.492	18.767	20.93842
28/11/2015 13:00	312.367	18.767	20.91717
28/11/2015 17:00	314.958	18.753	20.94308
28/11/2015 21:00	315.4	18.78	20.9475
29/11/2015 1:00	314.592	18.773	20.93942
29/11/2015 5:00	315.133	18.76	20.94483
29/11/2015 9:00	314.617	18.78	20.93967
29/11/2015 13:00	313.525	18.773	20.92875
29/11/2015 17:00	315.517	18.773	20.94867
29/11/2015 21:00	316.075	18.787	20.95425
30/11/2015 1:00	316.333	18.767	20.95683
30/11/2015 5:00	316.875	18.767	20.96225
30/11/2015 9:00	315.825	18.76	20.95175
30/11/2015 13:00	314.225	18.747	20.93575
30/11/2015 17:00	315.525	18.76	20.94875
30/11/2015 21:00	316.392	18.76	20.95742
1/12/2015 1:00	316.133	18.78	20.95483
1/12/2015 5:00	316.492	18.767	20.95842
1/12/2015 9:00	314.742	18.78	20.94092
1/12/2015 13:00	313.625	18.773	20.92975
1/12/2015 17:00	314.667	18.773	20.94017
1/12/2015 21:00	316.117	18.787	20.95467
2/12/2015 1:00	316.558	18.773	20.95908
2/12/2015 5:00	315.567	18.773	20.94917
2/12/2015 9:00	315.05	18.76	20.944
2/12/2015 13:00	312.95	18.767	20.923
2/12/2015 17:00	314.083	18.787	20.93433
2/12/2015 21:00	313.05	18.793	20.924
3/12/2015 1:00	311.975	18.78	20.91325
3/12/2015 5:00	309.842	18.767	20.89192
3/12/2015 9:00	308.15	18.773	20.875
3/12/2015 13:00	306.417	18.773	20.85767
3/12/2015 17:00	305.475	18.76	20.84825
3/12/2015 21:00	305.483	18.767	20.84833
4/12/2015 1:00	305.75	18.773	20.851
4/12/2015 5:00	304.383	18.787	20.83733
4/12/2015 9:00	303.808	18.78	20.83158

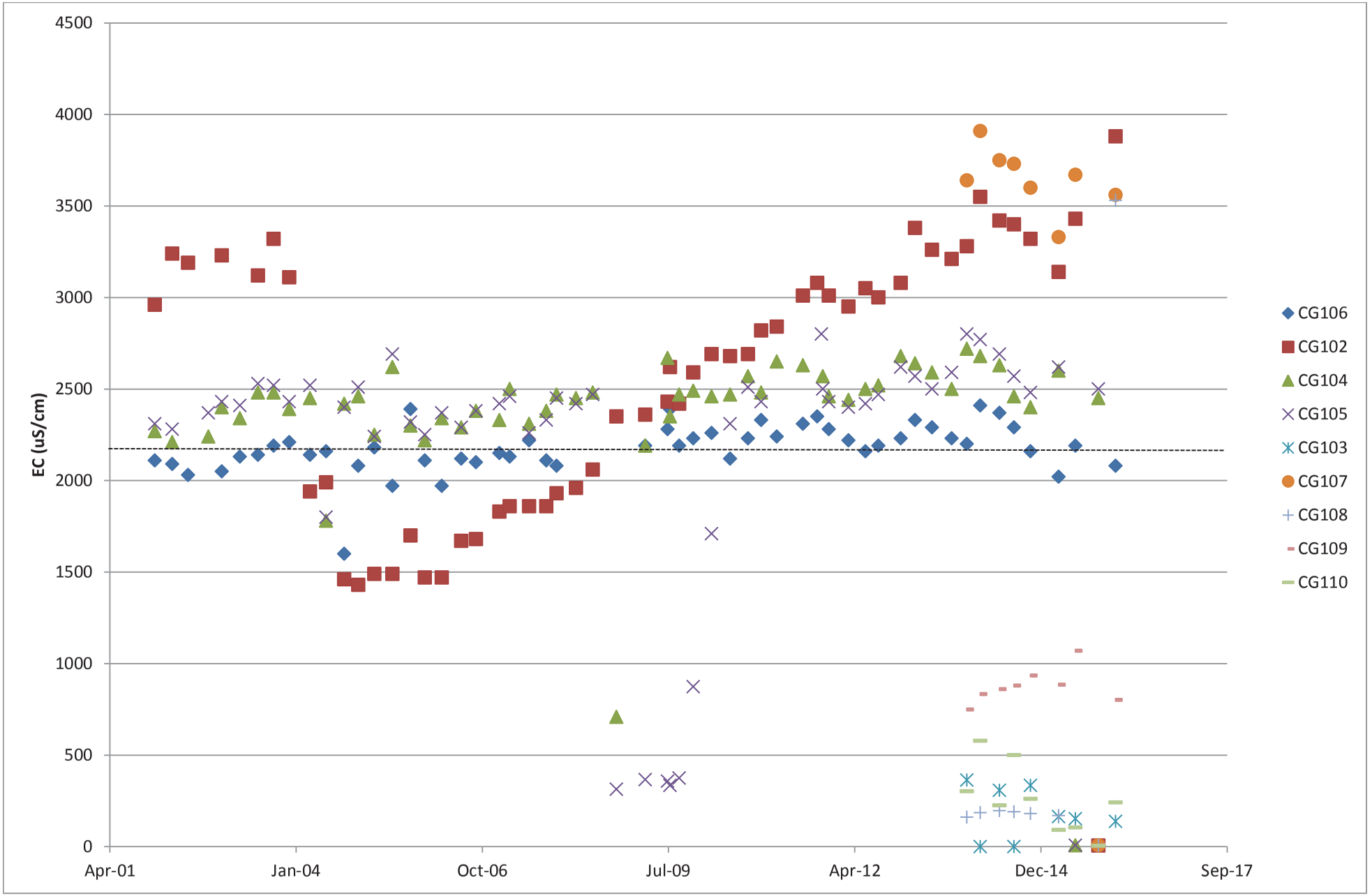
	CG110		
Date	mm above logger	temp	RL (mAHD)
30/09/2015 13:00	417.75	22.623	28.6
30/09/2015 17:00	415.858	19.273	28.58108
30/09/2015 21:00	413.525	19.267	28.55775
1/10/2015 1:00	412.408	19.267	28.54658
1/10/2015 5:00	411.908	19.267	28.54158
1/10/2015 9:00	409.908	19.267	28.52158
1/10/2015 13:00	410.333	19.26	28.52583
1/10/2015 17:00	409.9	19.26	28.5215
1/10/2015 21:00	408.35	19.26	28.506
2/10/2015 1:00	407.333	19.26	28.49583
2/10/2015 5:00	406.425	19.26	28.48675
2/10/2015 9:00	403.867	19.267	28.46117
2/10/2015 13:00	402.517	19.26	28.44767
2/10/2015 17:00	402.308	19.26	28.44558
2/10/2015 21:00	400.733	19.26	28.42983
3/10/2015 1:00	400.1	19.26	28.4235
3/10/2015 5:00	400.192	19.267	28.42442
3/10/2015 9:00	399.075	19.26	28.41325
3/10/2015 13:00	400.633	19.26	28.42883
3/10/2015 17:00	401.867	19.26	28.44117
3/10/2015 21:00	401.133	19.26	28.43383
4/10/2015 1:00	401.458	19.26	28.43708
4/10/2015 5:00	401.367	19.26	28.43617
4/10/2015 9:00	400.433	19.253	28.42683
4/10/2015 13:00	401.017	19.26	28.43267
4/10/2015 17:00	402.542	19.26	28.44792
4/10/2015 21:00	401.783	19.253	28.44033
5/10/2015 1:00	401.575	19.26	28.43825
5/10/2015 5:00	401.25	19.253	28.435
5/10/2015 9:00	399.667	19.26	28.41917
5/10/2015 13:00	400.725	19.26	28.42975
5/10/2015 17:00	401.117	19.253	28.43367
5/10/2015 21:00	400.358	19.253	28.42608
6/10/2015 1:00	399.975	19.253	28.42225
6/10/2015 5:00	399.675	19.247	28.41925
6/10/2015 9:00	398.325	19.247	28.40575
6/10/2015 13:00	399.35	19.247	28.416
6/10/2015 17:00	400.375	19.247	28.42625
6/10/2015 21:00	399.442	19.247	28.41692
7/10/2015 1:00	399.033	19.247	28.41283
7/10/2015 5:00	398.858	19.247	28.41108
7/10/2015 9:00	397.025	19.247	28.39275
7/10/2015 13:00	395.842	19.247	28.38092
7/10/2015 17:00	394.342	19.247	28.36592
7/10/2015 21:00	392.017	19.247	28.34267
8/10/2015 1:00	390.883	19.24	28.33133
8/10/2015 5:00	390.158	19.247	28.32408
8/10/2015 9:00	388.825	19.247	28.31075
8/10/2015 13:00	388.7	19.24	28.3095
8/10/2015 17:00	389.042	19.24	28.31292
8/10/2015 21:00	388.425	19.24	28.30675
9/10/2015 1:00	388.6	19.247	28.3085
9/10/2015 5:00	388.658	19.247	28.30908
9/10/2015 9:00	387.95	19.24	28.302
9/10/2015 13:00	388.292	19.24	28.30542
9/10/2015 17:00	389.983	19.233	28.32233
9/10/2015 21:00	389.325	19.233	28.31575
10/10/2015 1:00	389.392	19.233	28.31642
10/10/2015 5:00	389.575	19.24	28.31825
10/10/2015 9:00	388.217	19.24	28.30467
10/10/2015 13:00	389.3	19.24	28.3155
10/10/2015 17:00	390.983	19.233	28.33233
10/10/2015 21:00	390.25	19.233	28.325
11/10/2015 1:00	390.442	19.227	28.32692
11/10/2015 5:00	391.25	19.227	28.335
11/10/2015 9:00	390.558	19.227	28.32808
11/10/2015 13:00	392.283	19.227	28.34533
11/10/2015 17:00	394.133	19.227	28.36383
11/10/2015 21:00	393.217	19.227	28.35467
12/10/2015 1:00	393.583	19.227	28.35833
12/10/2015 5:00	393.917	19.227	28.36167
12/10/2015 9:00	393.358	19.227	28.35608

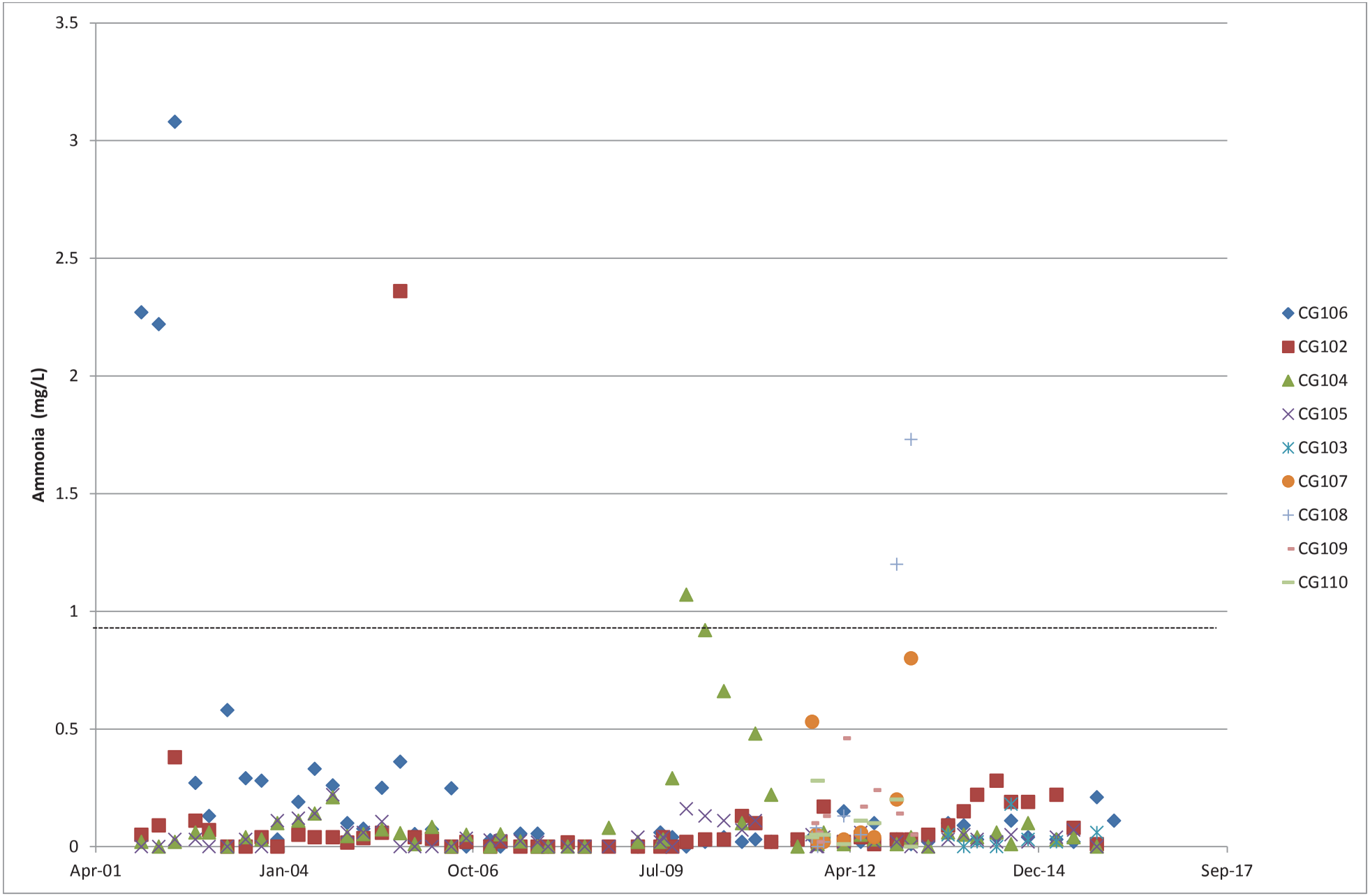
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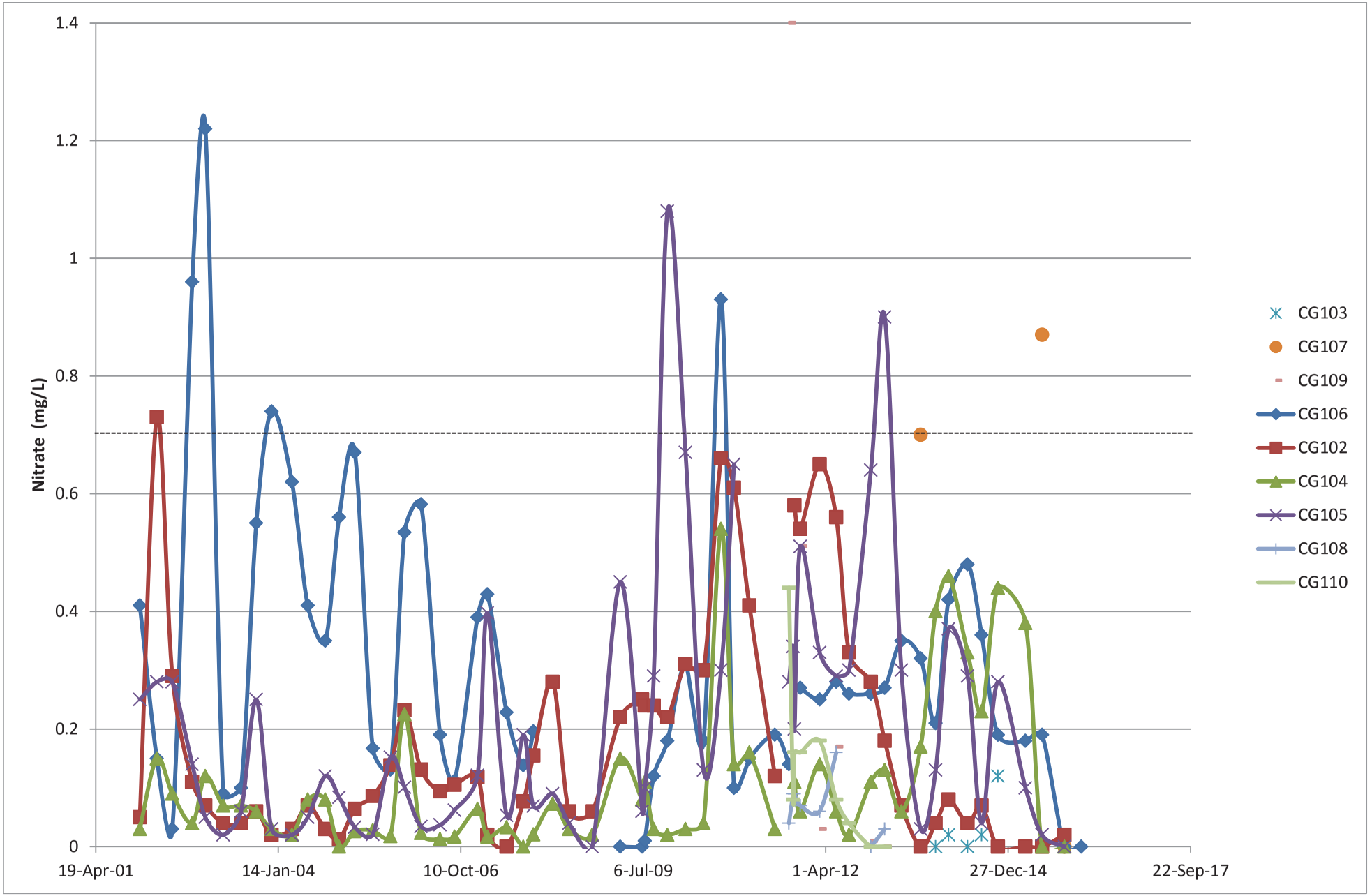
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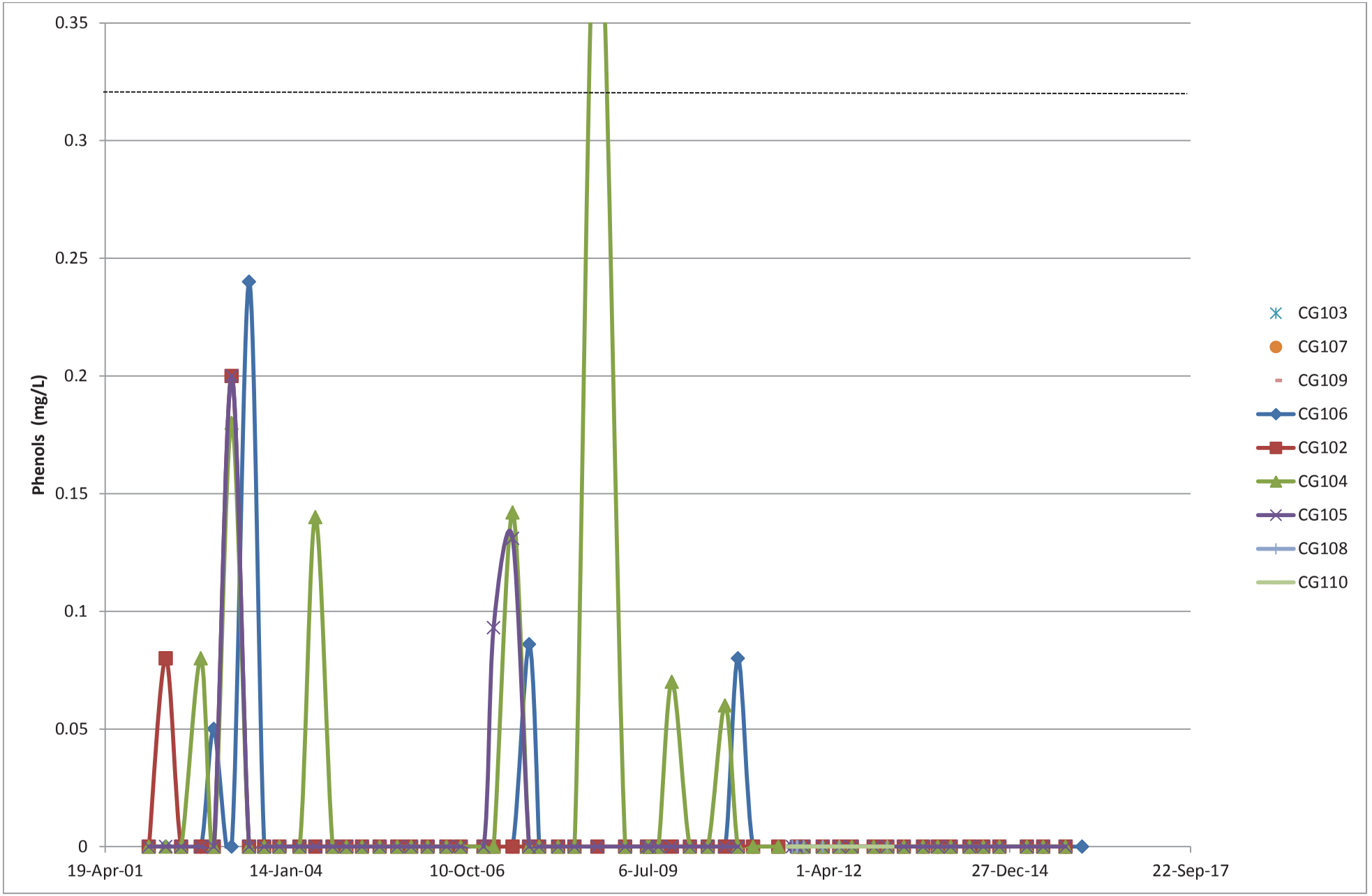
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4500
4000
3500
3000
2500
2000
1500
1000
500
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EC (uS/cm)
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
CG106
CG102
CG104
CG105
CG103
CG107
CG108
CG109
CG110


3.5
3
2.5
2
1.5
1
0.5
0
Ammonia (mg/L)
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
CG106
CG102
CG104
CG105
CG103
CG107
CG108
CG109
CG110


1.4
1.2
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0.8
0.6
0.4
0.2
0
Nitrate (mg/L)
19-Apr-01
14-Jan-04
10-Oct-06
6-Jul-09
1-Apr-12
27-Dec-14
22-Sep-17
CG103
CG107
CG109
CG106
CG102
CG104
CG105
CG108
CG110


0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Phenols (mg/L)
19-Apr-01
14-Jan-04
10-Oct-06
6-Jul-09
1-Apr-12
27-Dec-14
22-Sep-17
CG103
CG107
CG109
CG106
CG102
CG104
CG105
CG108
CG110

APPENDIX G CAIRNCROSS LANDFILL EXPANSION - SITE WATER BALANCE

MEMO

ARCADIS Design & Consultancy for natural and built assets

Date	31/08/2016
To	Brad Farr (PMHC)
From	David Stone (Arcadis)
Copy to	Zoe Wood (Arcadis), Bradley Searle (Arcadis), Danielle Haynes (Arcadis), Gordon Cameron (PMHC)
Subject	Cairncross Landfill Expansion - Site Water Balance

Brad

The purpose of this memo is to document the recent site water balance investigations that Arcadis has undertaken to support the concept design prepared by Council for the Cairncross Landfill Expansion.

The aim of the water balance is to estimate the water demands for operational uses and the potential availability of water to meet these demands. The outcome of the investigation will inform the stormwater management strategy for the site.

1.1 Introduction

The proposed stormwater management strategy for the site is documented in the concept staging plans prepared by Port Macquarie Hastings Council (refer **Attachment A**). The proposed landfill expansion involves three Stages and the staging plans include three sediment basins and a firefighting storage dam. A site water balance was prepared to assess the ability of the proposed basins to provide a suitable source of water for the proposed development.

For the purpose of this memo and the attached water balance calculations, the basins are referred to as 'North', 'South', 'West' and 'Fire'. The North and West basins are existing basis and will remain in their current locations for the duration of the landfill operations. The Fire basin is an existing basin and will remain in its current location during Stage 1 and 2, being relocated to the eastern side of Stage 3 prior to commencement of landfilling in the Stage 3 area. The South basin is an existing basin and will be relocated to the southern boundary of the Stage 2 area prior to commencement of landfilling in the Stage 1 area (see figures in **Attachment A**).

1.2 Methodology

A spreadsheet water balance was established using Excel. The key calculations undertaken for each basin are:

(i) Basin Inflow = Catchment Area x Rainfall Depth x Runoff Coefficient

(ii) Basin Inflow – Demand – Pond Evaporation = Water Surplus/Deficit

The balance was undertaken at a monthly time step for each of the proposed development stages and utilised local climate data, catchment and basin parameters derived from the concept design and predicted water demands.

Climate data included:

- Monthly average and 10 percentile rainfall data from Bureau of Meteorology (BoM) gauge 'Telegraph Point (Farrawells Road)' (Gauge no. 060031) for the 30 year period 1961-1990.
- Monthly average pan evaporation data derived from BoM gridded data.

- Monthly mean number of days with rainfall >= 10 mm for BoM gauge Port Macquarie Airport AWS (Gauge no. 060139).

Catchment and basin parameters included:

- Catchment areas derived from the concept design (refer **Attachment B**).
- Runoff coefficients representative of expected surface conditions.
- Pond evaporation for the proposed basins was estimated by dividing the monthly average pan evaporation data by a factor of 1.3 (a typical factor quoted in most textbooks to account for the extra heat taken in through the sides of a pan).

The only significant water demand for the site is expected to be for dust suppression. Consultation with Council officers suggested that current average daily demand is 25 m^3/day during dry periods and that this is expected to be similar for future operations. In a worst case scenario, the maximum daily demand is expected to be 40 m^3/day. The water balance calculations adopt a demand of 25 m^3/day, however the maximum demand (40 m^3/day or 1,200 m^3/month) has also been considered.

For the purpose of the water balance it was assumed that no watering for dust suppression purposes would be required when rainfall is >=10mm/day.

For all stages, demand was assumed to be supplied from the firefighting storage dam (storage for dust suppression would be provided in addition to firefighting storage requirements of 100 m^3).

1.3 Results

The results of the water balance for each of the proposed stages are included in **Attachment C** and are discussed below in relation to average and 10th percentile rainfall scenarios.

The results show that, in all months with average rainfall conditions, there is a surplus of water available for dust suppression. This applies throughout all stages of the proposed landfill operation. Under average rainfall conditions, the driest month is September, and this corresponds with the minimum surplus of approximately 200 m^3 / month during Stage 1, for the firefighting storage dam on its own. If all four basins are considered, there is a surplus of more than 4,600 m^3 across the site for the same month.

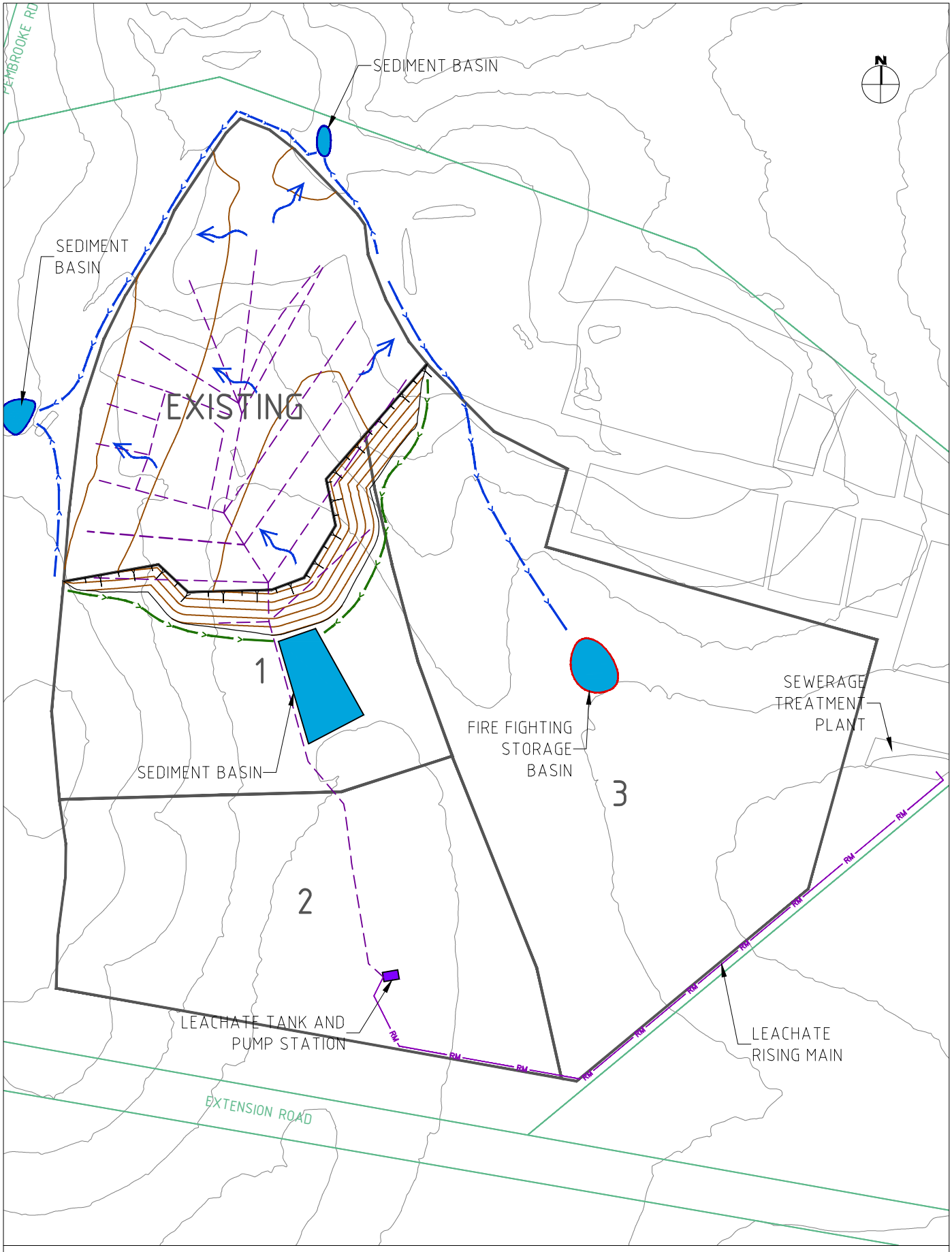
The results also show that under 10th percentile rainfall conditions there is a potential water deficit during July and August in all three stages. A deficit of similar magnitude is also predicted by the water balance for the existing landfill for 10th percentile rainfall conditions. Discussions with Council identified that a water deficit has not previously been experienced at the landfill, even when there have been serious rainfall deficiencies (eg; August and September 2009 were consecutive months of less than 10th percentile rainfall). This is most likely due to the significant water storage provided in the existing basins. The existing firefighting basin alone has a storage volume of approximately 3,000 m^3, which is well in excess of the required firefighting storage requirement of 100 m^3 and also the maximum monthly water demand of 1,200 m^3. The minimum proposed total water storage capacity, including settling zone volume within the sediment basins which could also be used as a water source, is approximately 8,300 m^3 (during Stage 3). Maximum water demands and minimum storage volumes are summarised in Table 1.

Table 1: Maximum demand and minimum storage volumes

Maximum monthly water demand	Firefighting water storage requirements	Minimum proposed total water storage capacity
1,200 m^3	100 m^3	8,300 m^3

Based on the water balance results and past experience at the landfill, a water deficit is considered unlikely to occur, except in extreme drought conditions. To minimise the risk of experiencing a deficit, which would require water to be imported to the site, it is recommended that the capability to draw water from all basins be continued.

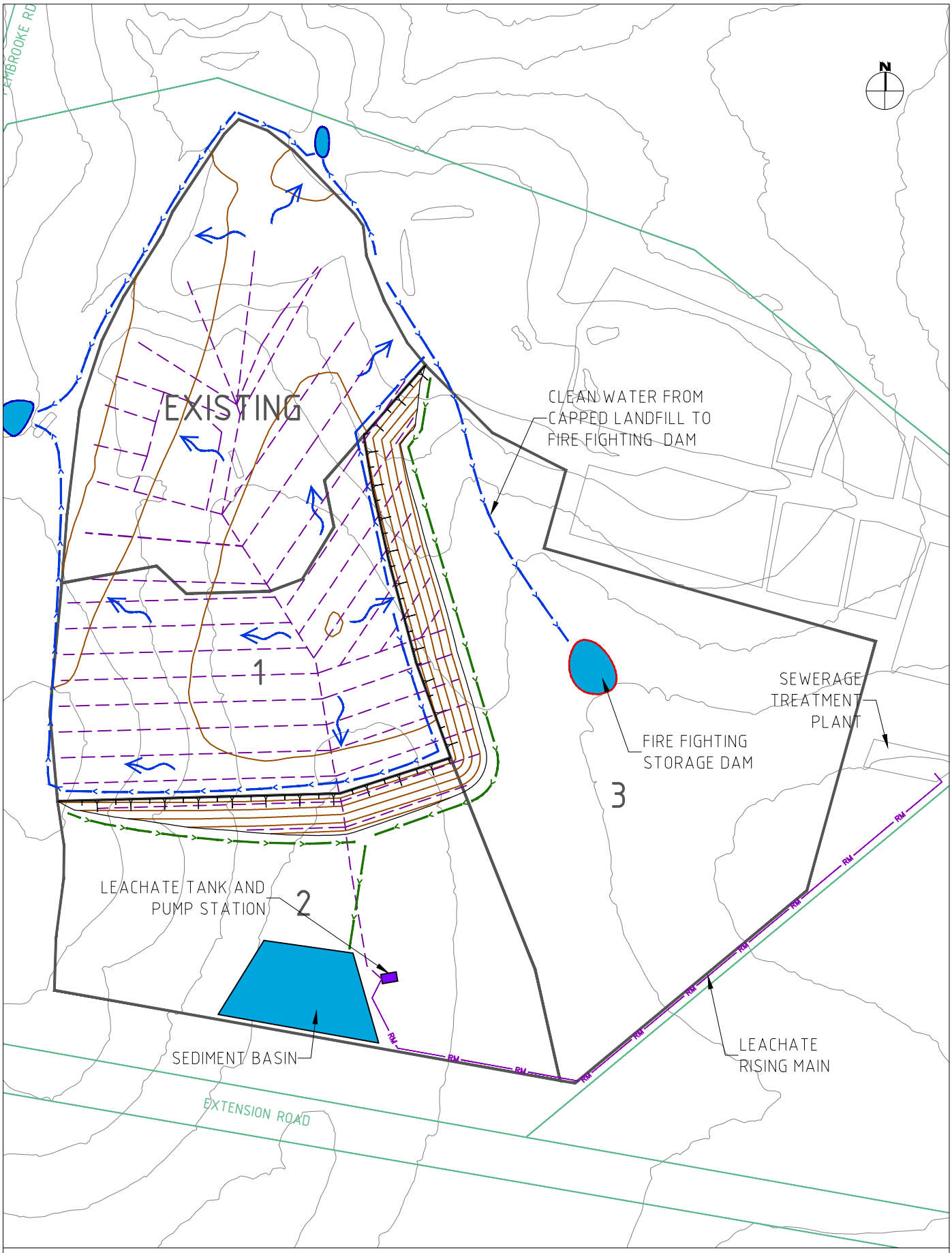
ATTACHMENT A CONCEPT DESIGNS



PORT MACQUARIE HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE E (EXISTING)
CONCEPT PLAN

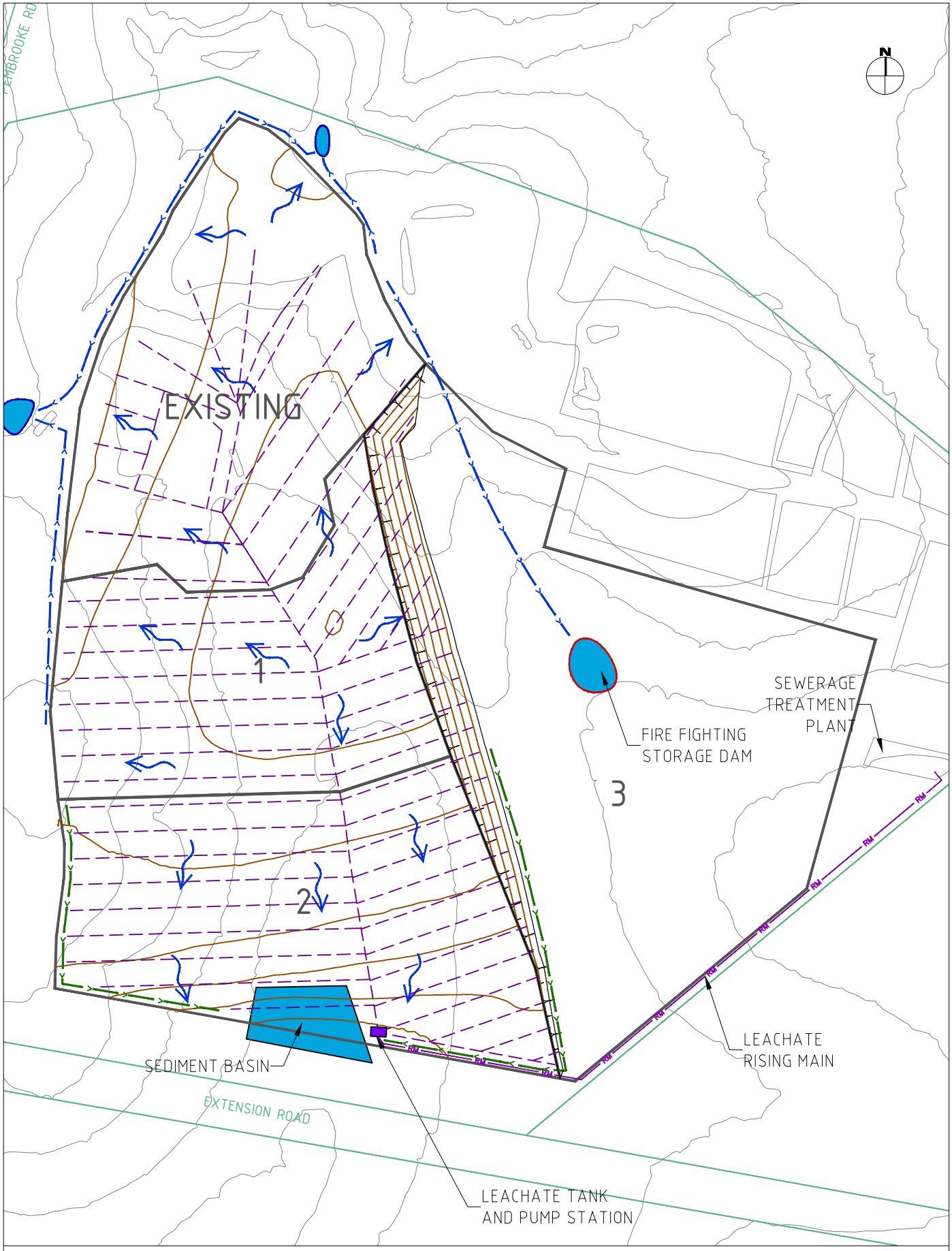
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SCALE (m)



PORT MACQUARIE
HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 1
CONCEPT PLAN

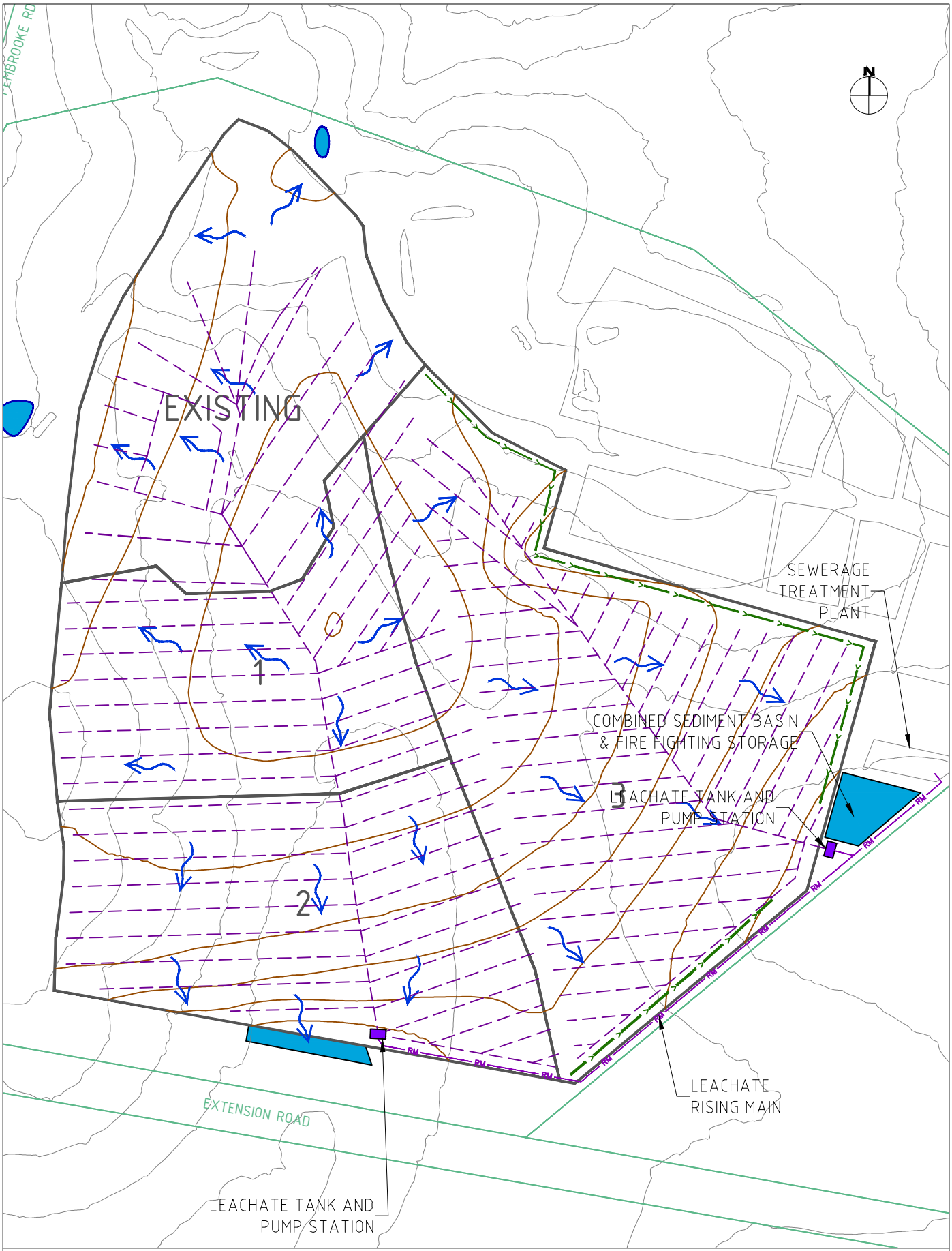
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SCALE (m)



PORT MACQUARIE
HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 2
CONCEPT PLAN

0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)



PORT MACQUARIE
HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 3
CONCEPT PLAN

0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)

ATTACHMENT B CATCHMENT AREAS

B

SEDIMENT BASIN

N

SEDIMENT BASIN

SB North 2.268 ha

EXISTING

SB West 9.21 ha

Fire Fighting 6.00 ha

SB South 6.346 ha

1

SEDIMENT BASIN

FIRE FIGHTING STORAGE BASIN

SEWERAGE TREATMENT PLANT

3

2

LEACHATE TANK AND PUMP STATION

RM

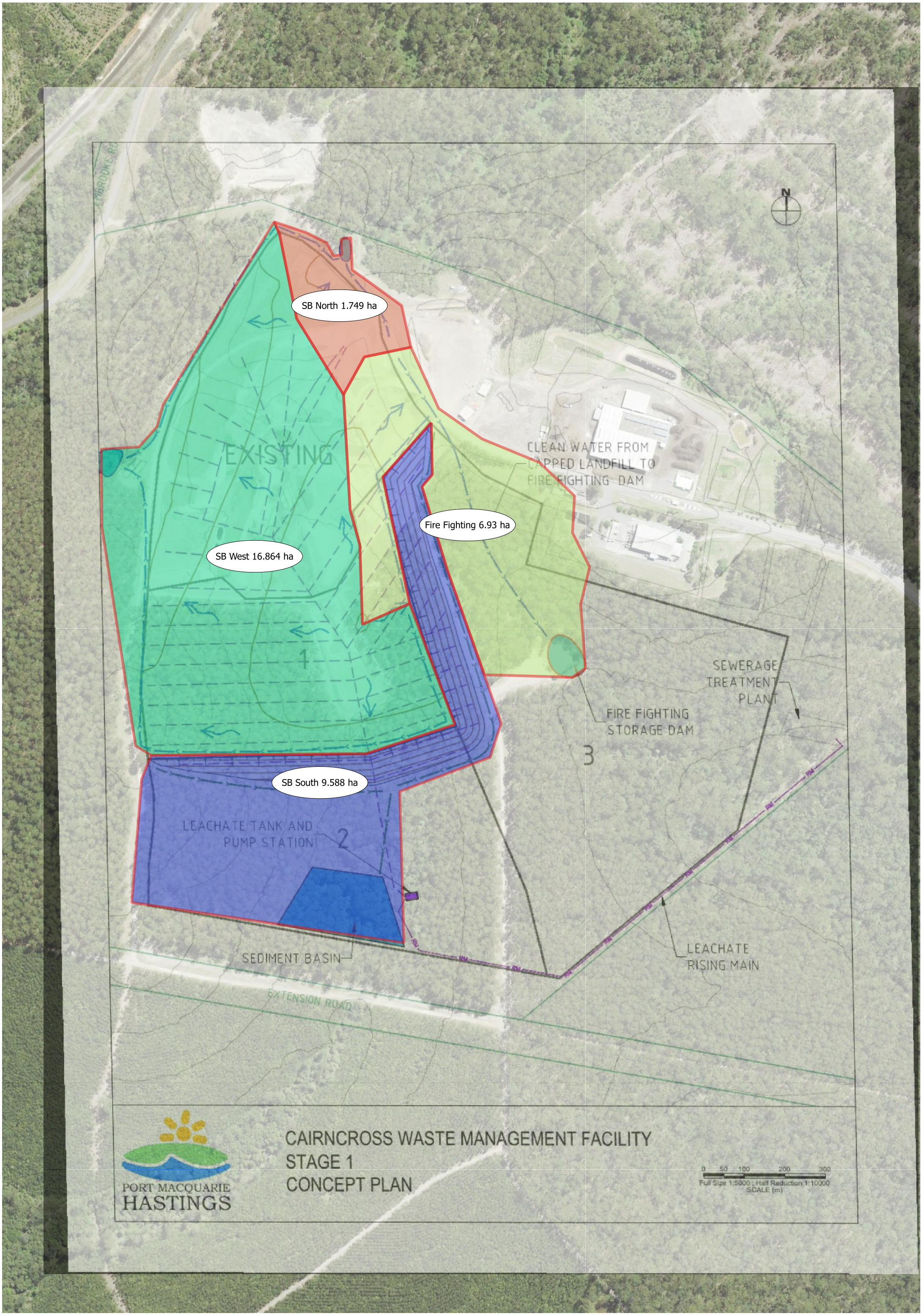
LEACHATE RISING MAIN

EXTENSION ROAD

PORT MACQUARIE HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE E (EXISTING)
CONCEPT PLAN

0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)


N
SB North 1.749 ha
EXISTING
SB West 16.864 ha
Fire Fighting 6.93 ha
SB South 9.588 ha
LEACHATE TANK AND
PUMP STATION
2
1
3
CLEAN WATER FROM
CAPPED LANDFILL TO
FIRE FIGHTING DAM
SEWERAGE
TREATMENT
PLANT
FIRE FIGHTING
STORAGE DAM
RM
SEDIMENT BASIN
LEACHATE
RISING MAIN
EXTENSION ROAD
PORT MACQUARIE
HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 1
CONCEPT PLAN
0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)

SB North 1.736 ha

SB West 14.2 ha

EXISTING

Fire Fighting 8.832 ha

SB South 14.284 ha

SEDIMENT BASIN

EXTENSION ROAD

FIRE FIGHTING
STORAGE DAM

SEWERAGE
TREATMENT
PLANT

LEACHATE
RISING MAIN

LEACHATE TANK
AND PUMP STATION

N

PORT MACQUARIE
HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 2
CONCEPT PLAN

0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)


N
SB North 1.733 ha
EXISTING
SB West 14.2 ha
Fire Fighting 22.116 ha
SEWERAGE TREATMENT PLANT
COMBINED SEDIMENT BASIN & FIRE FIGHTING STORAGE
LEACHATE TANK AND PUMP STATION
SB South 13.092 ha
EXTENSION ROAD
LEACHATE RISING MAIN
LEACHATE TANK AND PUMP STATION
PORT MACQUARIE HASTINGS
CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE 3
CONCEPT PLAN
0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)

ATTACHMENT C WATER BALANCE

C

Existing average

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	60,000	63,000	92,000	23,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	1,850	4,900	850	350
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	**Source**
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,970	3,150	3,672	3,114	2,304	2,178	936	1,044	918	1,944	1,998	2,286
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	178	145	135	107	78	73	78	112	148	174	167	192
Surplus (+ve)/Deficit(-ve) (m3)	2,117	2,405	2,887	2,357	1,526	1,455	133	207	70	1,045	1,182	1,394

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	5,198	5,513	6,426	5,450	4,032	3,812	1,638	1,827	1,607	3,402	3,497	4,001
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	471	384	358	283	207	192	207	298	392	460	441	509
Surplus (+ve)/Deficit(-ve) (m3)	4,726	5,128	6,068	5,167	3,825	3,619	1,431	1,529	1,215	2,942	3,056	3,492

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	7,590	5,513	6,426	5,450	4,032	3,812	1,638	1,827	1,607	3,402	3,497	4,001
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	82	67	62	49	36	33	36	52	68	80	77	88
Surplus (+ve)/Deficit(-ve) (m3)	7,508	5,446	6,364	5,400	3,996	3,778	1,602	1,775	1,539	3,322	3,420	3,912

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,898	2,013	2,346	1,990	1,472	1,392	598	667	587	1,242	1,277	1,461
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	34	27	26	20	15	14	15	21	28	33	32	36
Surplus (+ve)/Deficit(-ve) (m3)	1,864	1,985	2,320	1,969	1,457	1,378	583	646	559	1,209	1,245	1,424

Total Site Surplus (+ve)/Deficit(-ve) (m3)	16,216	14,964	17,639	14,894	10,804	10,231	3,749	4,157	3,382	8,519	8,902	10,222

Existing 10th percentile

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	60,000	63,000	92,000	23,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	1,850	4,900	850	350
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	**Source**
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	756	972	594	594	360	252	72	90	342	306	882	576
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	178	145	135	107	78	73	78	112	148	174	167	192
Surplus (+ve)/Deficit(-ve) (m3)	-97	227	-191	-163	-418	-471	-731	-747	-506	-593	66	-316

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,323	1,701	1,040	1,040	630	441	126	158	599	536	1,544	1,008
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	471	384	358	283	207	192	207	298	392	460	441	509
Surplus (+ve)/Deficit(-ve) (m3)	852	1,317	681	757	423	249	-81	-140	207	76	1,103	499

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,932	1,701	1,040	1,040	630	441	126	158	599	536	1,544	1,008
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	82	67	62	49	36	33	36	52	68	80	77	88
Surplus (+ve)/Deficit(-ve) (m3)	1,850	1,634	977	990	594	408	90	106	531	456	1,467	920

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	483	621	380	380	230	161	46	58	219	196	564	368
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	34	27	26	20	15	14	15	21	28	33	32	36
Surplus (+ve)/Deficit(-ve) (m3)	449	594	354	359	215	147	31	36	191	163	532	332

Total Site Surplus (+ve)/Deficit(-ve) (m3)	3,055	3,771	1,822	1,944	814	333	-691	-746	422	101	3,167	1,434

Stage 1 average

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	69,000	96,000	169,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	3,416	3,623	4,223	3,581	2,650	2,505	1,076	1,201	1,056	2,236	2,298	2,629
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2,548	2,866	3,427	2,816	1,865	1,776	267	354	196	1,323	1,468	1,721

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	7,920	8,400	9,792	8,304	6,144	5,808	2,496	2,784	2,448	5,184	5,328	6,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	7,439	8,008	9,427	8,016	5,932	5,612	2,284	2,480	2,048	4,715	4,878	5,577

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	13,943	8,400	9,792	8,304	6,144	5,808	2,496	2,784	2,448	5,184	5,328	6,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	13,846	8,008	9,427	8,016	5,932	5,612	2,284	2,480	2,048	4,715	4,878	5,577

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,403	1,488	1,734	1,471	1,088	1,029	442	493	434	918	944	1,080
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	1,354	1,448	1,697	1,442	1,067	1,009	421	463	394	871	899	1,028

Total Site Surplus (+ve)/Deficit(-ve) (m3)	25,188	20,329	23,977	20,288	14,797	14,009	5,257	5,777	4,685	11,624	12,122	13,902

Stage 1 10th percentile

Pond and Catchment Details	Fire	South	West	North
Catchment Area (m2)	69,000	96,000	169,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	869	1,118	683	683	414	290	83	104	393	352	1,014	662
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2	361	-113	-82	-371	-439	-727	-743	-467	-561	184	-245

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,016	2,592	1,584	1,584	960	672	192	240	912	816	2,352	1,536
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	1,535	2,200	1,219	1,296	748	476	-20	-64	512	347	1,902	1,017

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	3,549	2,592	1,584	1,584	960	672	192	240	912	816	2,352	1,536
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	3,453	2,200	1,219	1,296	748	476	-20	-64	512	347	1,902	1,017

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	357	459	281	281	170	119	34	43	162	145	417	272
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	309	420	244	252	149	99	13	12	122	98	372	220

Total Site Surplus (+ve)/Deficit(-ve) (m3)	5,299	5,180	2,568	2,760	1,275	612	-753	-859	679	230	4,360	2,008

Stage 2 average

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	88,000	143,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	4,356	4,620	5,386	4,567	3,379	3,194	1,373	1,531	1,346	2,851	2,930	3,353
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	3,489	3,863	4,589	3,802	2,595	2,466	563	685	486	1,939	2,100	2,445

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	11,798	12,513	14,586	12,370	9,152	8,652	3,718	4,147	3,647	7,722	7,937	9,081
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	11,317	12,120	14,221	12,081	8,940	8,455	3,506	3,843	3,247	7,253	7,487	8,561

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	11,715	12,513	14,586	12,370	9,152	8,652	3,718	4,147	3,647	7,722	7,937	9,081
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	11,619	12,120	14,221	12,081	8,940	8,455	3,506	3,843	3,247	7,253	7,487	8,561

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,403	1,488	1,734	1,471	1,088	1,029	442	493	434	918	944	1,080
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	1,354	1,448	1,697	1,442	1,067	1,009	421	463	394	871	899	1,028

Total Site Surplus (+ve)/Deficit(-ve) (m3)	27,779	29,552	34,728	29,406	21,542	20,386	7,997	8,834	7,373	17,315	17,972	20,595

Stage 2 10th percentile

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	88,000	143,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	2,000	5,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	**Source**
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,109	1,426	871	871	528	370	106	132	502	449	1,294	845
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	241	669	75	106	-257	-359	-704	-715	-358	-464	464	-63

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	3,003	3,861	2,360	2,360	1,430	1,001	286	358	1,359	1,216	3,504	2,288
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	481	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	2,522	3,469	1,994	2,071	1,218	805	74	54	959	746	3,054	1,769

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,982	3,861	2,360	2,360	1,430	1,001	286	358	1,359	1,216	3,504	2,288
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	392	365	288	212	196	212	304	400	469	450	519
Surplus (+ve)/Deficit(-ve) (m3)	2,886	3,469	1,994	2,071	1,218	805	74	54	959	746	3,054	1,769

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	357	459	281	281	170	119	34	43	162	145	417	272
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	309	420	244	252	149	99	13	12	122	98	372	220

Total Site Surplus (+ve)/Deficit(-ve) (m3)	5,958	8,026	4,307	4,500	2,329	1,350	-542	-595	1,680	1,126	6,942	3,695

Stage 3 average

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	221,000	131,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	3,500	2,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
Mean rainfall (mm)	165	175	204	173	128	121	52	58	51	108	111	127	1473	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	10,940	11,603	13,525	11,470	8,486	8,022	3,448	3,845	3,381	7,160	7,359	8,420
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	337	275	256	202	148	137	148	213	280	328	315	363
Surplus (+ve)/Deficit(-ve) (m3)	9,928	10,728	12,619	10,618	7,638	7,235	2,575	2,908	2,401	6,107	6,394	7,357

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	10,808	11,463	13,362	11,332	8,384	7,926	3,406	3,799	3,341	7,074	7,271	8,319
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	10,615	11,306	13,216	11,216	8,299	7,847	3,321	3,677	3,181	6,886	7,091	8,111

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	11,715	11,463	13,362	11,332	8,384	7,926	3,406	3,799	3,341	7,074	7,271	8,319
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	11,619	11,306	13,216	11,216	8,299	7,847	3,321	3,677	3,181	6,886	7,091	8,111

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	1,403	1,488	1,734	1,471	1,088	1,029	442	493	434	918	944	1,080
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	1,354	1,448	1,697	1,442	1,067	1,009	421	463	394	871	899	1,028

Total Site Surplus (+ve)/Deficit(-ve) (m3)	33,516	34,787	40,749	34,492	25,304	23,938	9,638	10,725	9,156	20,751	21,474	24,606

Stage 3 10th percentile

Pond ID/Catchment	Fire	South	West	North
Catchment Area (m2)	221,000	131,000	142,000	17,000
Runoff Coefficient	0.3	0.5	0.5	0.5
Pond Area (m2)	3,500	2,000	1,000	500
Dust Suppression Demand (m3/day)	25	0	0	0

Climate Data	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Source
10th percentile rainfall (mm)	42	54	33	33	20	14	4	5	19	17	49	32	1015	TELEGRAPH POINT (FARRAWELLS ROAD)
Mean Pan Evaporation (mm)	125	102	95	75	55	51	55	79	104	122	117	135	1115	BoM Map Grid
Mean Pond Evaporation (mm)	96	78	73	58	42	39	42	61	80	94	90	104	858	Derived from pan evaporation
Days in month	31	28	31	30	31	30	31	31	30	31	30	31		
Rainfall Days >= 10mm	4	4	5	4	3	4	2	2	2	2	4	3		Port Macquarie Airport AWS
Rainfall Days < 10mm	27	24	26	26	28	26	29	29	28	29	26	28		Port Macquarie Airport AWS

Fire	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,785	3,580	2,188	2,188	1,326	928	265	332	1,260	1,127	3,249	2,122
Dust Suppression Demand (m3/mth)	675	600	650	650	700	650	725	725	700	725	650	700
Pond Evaporation (m3)	337	275	256	202	148	137	148	213	280	328	315	363
Surplus (+ve)/Deficit(-ve) (m3)	1,773	2,706	1,282	1,336	478	141	-608	-606	280	74	2,284	1,058

South	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,751	3,537	2,162	2,162	1,310	917	262	328	1,245	1,114	3,210	2,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	192	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2,559	3,380	2,015	2,046	1,225	839	177	206	1,085	926	3,030	1,888

West	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	2,982	3,537	2,162	2,162	1,310	917	262	328	1,245	1,114	3,210	2,096
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	96	157	146	115	85	78	85	122	160	188	180	208
Surplus (+ve)/Deficit(-ve) (m3)	2,886	3,380	2,015	2,046	1,225	839	177	206	1,085	926	3,030	1,888

North	January	February	March	April	May	June	July	August	September	October	November	December
Inflow (m3)	357	459	281	281	170	119	34	43	162	145	417	272
Dust Suppression Demand (m3/mth)	0	0	0	0	0	0	0	0	0	0	0	0
Pond Evaporation (m3)	48	39	37	29	21	20	21	30	40	47	45	52
Surplus (+ve)/Deficit(-ve) (m3)	309	420	244	252	149	99	13	12	122	98	372	220

Total Site Surplus (+ve)/Deficit(-ve) (m3)	7,527	9,886	5,557	5,680	3,078	1,917	-240	-182	2,570	2,023	8,714	5,055

APPENDIX H CAIRNCROSS LANDFILL LEACHATE GENERATION MODELLING REPORT

Pacific Environment Limited

Consulting • Technologies • Monitoring • Toxicology



Report

Cairncross Landfill Leachate Generation Modelling

Arcadis

DLB3888_S005089

24th August 2016

PROJECT NAME:	Cairncross Landfill Leachate Generation Modelling
JOB ID:	DLB3888_S005089
PREPARED FOR:	Arcadis
APPROVED FOR RELEASE BY:	Aidan Marsh
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1 INTRODUCTION

Pacific Environment and DLA Environmental Services (DLA) has prepared this report to summarise the results of leachate generation modelling using the Hydrological Evaluation of Landfill Performance (HELP) program undertaken for the Cairncross Waste Management Facility, Telegraph Point, New South Wales (the Site).

1.1 Objectives

Arcadis has been commissioned to prepare an Environmental Impact Statement (EIS) in accordance with Secretary's Environmental Assessment Requirements (SEARs) for the Cairncross Landfill Expansion (SSD 13_5792).

This report presents leachate generation modelling undertaken in accordance with the requirements of the SEARs, to be used to inform the long-term leachate management strategy for the Cairncross Landfill Expansion by:

- Providing sufficient information to inform the progression of the landfill design, in accordance with industry best practice
- Being a sufficient level to support a project approval for completion of the existing landfill cell (Stage E) as well as for the three additional stages proposed (Stage 1, Stage 2 and Stage 3).

1.2 Scope of Work

The scope of work was developed in accordance with the relevant principles in Section 2.3 of the NSW *Environmental Guidelines: Solid Waste Landfills, Second Edition* (2016 NSW EPA) including:

- Modelling undertaken with the *Hydrological Evaluation of Landfill Performance* (HELP) model (version 3.95D; Berger, 2013).
- Model run over a monthly basis with 45 years of metrological data (1971 to 2015).
- Multiple climate scenarios were considered to develop the most conservative approach, including the 90th percentile and wettest years over the 45-year period.
- Potential leachate impacts presented as five scenarios based on landfill staging across the existing stage including present condition and future three stages, as well as at completion of all cells.
- Review of existing leachate discharge data (February to July 2016).
- Review of documentation relevant to the management of the site (in particular the waste covering and capping) including:
    - The Site's 2008 Environment Management Plan (EMP)
    - EPA Licence (11189; 9-Mar-2015) (the EPA Licence)
    - Cairncross Landfill Expansion - Future disposal capacity requirements (Arcadis 2015)
    - NSW Draft Environmental Guidelines: Solid Waste Landfills, 2016 Second Edition
    - Review of historical aerial images of the site (Google Earth)

2 METHODOLOGY

2.1 Model Selection

Leachate generation modelling was undertaken using the HELP Model version 3.95D (Berger 2013). HELP is a landfill rainfall infiltration model that incorporates climate, soil, waste type and landfill design data, and is recommended in Section 2.3 of the Draft Environmental Guidelines: Solid Waste Landfills, Second Edition 2015 (NSW EPA 2015) (NSW Guidelines) as a suitable leachate simulation program.

2.2 Model Inputs

Model inputs included daily weather data (average temperature, precipitation, solar radiation, average wind speed and average humidity) obtained from the Bureau of Meteorology from the nearby weather station located at Port Macquarie Airport. *Soil and Design Data* was determined from:

- Final capping, intermediate cover and daily cover specifications for Stage E are drawn from the EPA Licence (conditions O6.13 to O6.19).
- Estimations of slope angle (%) and length were obtained from the *Cairncross Waste Management Facility Environmental Management Plan* (July 2008).
- Final capping, interim and daily cover requirements for Stages 1-3 were obtained from the *NSW Environmental Guidelines: Solid Waste Landfills, Second Edition 2016*.
- Existing permeability and compaction testing results (*Provided by Port Macquarie-Hastings Council*).

2.3 Calibration Model Assumptions

Calibration assessment of the Stage E landfill was undertaken in order to validate the accuracy and assumptions used for HELP modelling and therefore assess whether the leachate management infrastructure will be adequate for future expansion stages.

2.3.1 Stage E Leachate Pump-Out Data

Section 2.3 of the NSW Guidelines recommends water balances should be validated from time to time using site specific data. In this case the HELP model was calibrated to Site specific characteristics using leachate pump out data (February to July 2016) supplied by Council (*Cairncross leachate pump out volumes and tank sizing*). The following data was obtained:

- A total leachate pump out volume of 2,138 m^3
- An average leachate pump out volume of 427 m^3/month; and
- An average leachate pump out volume of 14 m^3/day.

This data set is assumed to be suitably representative for the purpose of validation of this model.

2.3.2 Stage E Cell Area

Port Macquarie-Hastings Council (PMHC) has indicated the Stage E Cell is 10.2 ha in total area as shown in Appendix B. For modelling purposes, the Stage E Cell is assumed to be under 75% final cap based on the Cell opening in 2001 and due to be closed in 2020 (Arcadis, 2015). Final capping is progressive in operating cells (EMP, 2008). From aerial imagery, it was determined that the extent of grassed area is progressively capped (final cap) with 25% of the area being active and 75% finally capped. For calibration modelling purposes, Stage E was noted to contain the following areas as shown in **Table 1**:

Table 1 – Stage E – Landfill Area

Stage E	Area (ha)	Justification
Total area	10.2	Council data
Final Cap	7.55	Aerial imagery (26/03/15)
Intermediate Cap	2.45	Aerial imagery (26/03/15)
Daily Cover	0.2	Aerial imagery (26/03/15)

2.3.1 Stage E Waste Hydraulic Conductivity

PMHC have confirmed that the target waste density of 850 kg/m^3 noted within the Operational EMP (2008) is being achieved. It should be understood that due to the inherent heterogeneity of municipal waste it is difficult to accurately define the corresponding hydraulic properties of waste. It is likely this heterogeneity will result in some portions of the waste having a low density (high permeability) and other portions with no effective permeability and high compaction (dead zones).

Based upon a collation of studies, comparing hydraulic conductivity and dry density for a variety of waste types, an estimate of the expected hydraulic conductivity of landfilled waste for the modelled waste densities is presented in **Table 2**.

Table 2 – Estimated hydraulic conductivity of landfilled waste for the modelled waste densities

Waste Density (kg/m^3)	Hydraulic Conductivity (m/s)
700	1×10^{-6}
850	5×10^{-7}
1000	1×10^{-7}

Source: Landss University of Southampton, 2016

Based upon model calibration, three waste compaction densities (700 kg/m^3, 850 kg/m^3 and 1000kg/m^3) were assessed. Result presented herein are based on 850kg/m^3 as this compaction density was found to correlate best with actual leachate collection records.

2.3.2 Stage E Soil Properties

Baseline HELP soil permeability data (obtained from United States Department of Agriculture soil textures) were initially incorporated into the Stage E model as shown in **Table 3**.

Table 3 – Initial Assumptions

Layer	Soil type	Initial HELP Default Permeability (m/s)
Daily	Clay	1.7×10^{-7}
Interim	Sandy clay loam to silty loam	3.3×10^{-7}
Seal-bearing	Clay	6.8×10^{-9}
Sealing	Clay	6.8×10^{-9}
Revegetation	Sandy clay loam	1.0×10^{-5}

Daily and Interim Cover Calibration

Calibration was undertaken to assess the hydraulic performance of in-situ daily and interim cover soils on site by an iterative process. This was done by varying the performance (saturated hydraulic conductivity) of the soil type from the baseline initial assumptions. Changes to soil properties from the baseline HELP assumptions are validated on the basis that permeability information of cover materials and leachate pump-out data is known and can therefore be adjusted to more closely reflect actual Site conditions than what is assumed under baseline soil properties. It was found that a daily cover of 1.7×10^{-7} m/s (*no adjustment to baseline assumption*) and interim cover of 1.0×10^{-7} m/s (*minor adjustment*) correlated most closely with the actual leachate collection records to date.

Seal-bearing and Sealing Layer Calibration

Calibration was undertaken to assess the hydraulic performance of in-situ seal-bearing and sealing clay soils on site by an iterative process. This was done by varying the performance (saturated hydraulic conductivity) of the soil type from the baseline initial assumptions. Particular attention was given to performance of the final sealing (barrier) layers' hydraulic conductivity as it has the most influence on overall leachate generation rates. Cover material is sourced from excess excavated material from landfill cells and this material consists of clay with permeability ranging between 1.3×10^{-6} and 7.77×10^{-11} m/s (EMP, 2008). It is therefore possible that once this material is won and reworked that covering and capping material may exceed, (i.e. permeability be reduced), the assumptions defined in the baseline. The hydraulic conductivity for the barrier layer was determined to likely represent actual sealing layer field performance of 1×10^{-9} m/s – 1×10^{-10} m/s. It was found that a seal-bearing cover of 1.0×10^{-9} m/s and a sealing cover of 1.0×10^{-9} m/s correlated most closely with the actual leachate collection records to date.

Table 4 presents the soil hydraulic properties used in HELP modelling based upon Site permeability testing and calibration modelling.

Table 4 – Adopted Stage E Soil Properties

	Stage E	
Layer	Thickness (m)	Permeability (m/s)
Daily	0.15	1.0×10^{-7}
Interim	0.3	1.0×10^{-7}
Seal-bearing	0.3	1.0×10^{-9}
Sealing	0.3	1.0×10^{-9}
Revegetation	0.5	2.5×10^{-7}

Table 5 presents a summary of the HELP inputs utilised for Stage E calibration assessment.

Table 5 – Summary of the HELP inputs used for Stage E calibration assessment

Cover Type		Final Cap	Interim Cap	Daily Cover
SURFACE LAYER				
Slope % (length)		5% (200 m)	5% (100m)	1% (30m)
Approximate texture		Revegetation Layer (uncompacted Sandy Clay Loam)	Compacted sandy clay loam to silty loam	Uncompacted clay
Thickness	M	0.50	0.30	0.15
Porosity	VOL/VOL	0.471	0.437	0.475
Field capacity	VOL/VOL	0.342	0.373	0.378
Wilting point	VOL/VOL	0.210	0.266	0.265
Initial soil water content	VOL/VOL	0.388	0.3235	0.265
Saturated hydraulic conductivity	M/SEC	2.5×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
SEAL BEARING AND SEALING LAYER				
Thickness	M	0.60	NA	NA
Porosity	VOL/VOL	0.427		
Field capacity	VOL/VOL	0.418		
Wilting point	VOL/VOL	0.367		
Initial soil water content	VOL/VOL	0.427		
Sat hydraulic conductivity	M/SEC	1.0×10^{-9}		
WASTE				
Thickness	M	15.0	15.0	15.0
Porosity	VOL/VOL	0.168	0.168	0.168
Field capacity	VOL/VOL	0.073	0.073	0.073
Wilting point	VOL/VOL	0.019	0.019	0.019
Initial soil water content	VOL/VOL	0.073	0.073	0.073
Saturated hydraulic conductivity (850 kg/m^3)	M/SEC	5.0×10^{-7}	5.0×10^{-7}	5.0×10^{-7}

2.3.3 Stage E calibrated model output

Table 6 presents a summary of results from HELP modelling showing leachate generation rates over the calibration period (five months) for Stage E based on the assumptions previously discussed. The imbalance between modelled leachate generation and collection data is within variation (±64%) typically associated with HELP model outputs (Scanlon, B et al. 2002). This calibrated model is considered suitably conservative for the purpose of this investigation.

Table 6 – Stage E model estimation of leachate generation

Cap/Cover Type	Leachate Generation (mm)	Leachate Generation (m^3/Ha)	Area (ha)	Total leachate generated (m^3)
Final	21.8	217.9	7.55	1645.1
Interim	39.0	389.7	2.45	954.8
Daily	17.7	176.5	0.2	35.3
HELP Model Total (m^3)				**2635.2**
Actual Collected (m^3)				**2138**
Difference (%)**				**18.9**

*Soil hydraulic properties are described in Section 2.3.2

** Difference refers to the percentage difference between the HELP Model Result and Actual Collected.

3 LEACHATE GENERATION MODELLING

3.1 Climate Scenarios

Leachate generation modelling was undertaken based on both average (all years) and worse case (high rainfall) years over the 45-year period from FY1970/71 to FY2014/15. Worse cases presented include: 90th percentile rainfall; highest rainfall year; and the highest three year rolling average. The relevant climate scenarios are shown in **Table 7**.

Table 7 – Climate scenarios modelled

	Year	Rainfall (mm)
Average	1971-2015	1,370
90th Percentile	1989	1,784
Highest rainfall year	2009	2,314
Wettest Period (Highest three year rolling average)	1988-1990	1,795 (three-year average)

The HELP model results are presented in **Appendix A**, showing monthly leachate generation (mm) for each cover type and climate scenario. Of all scenarios tested, the highest three year rolling average consistently

provided the highest monthly and annual averages. In this period (1988 to 1990) all years recorded rainfall above the 87th percentile range.

3.2 Future Stage Assumptions

Model inputs for Stage 1-3, as agreed by Council and Arcadis, are depicted in **Table 8**.

Table 8 – Summary of the inputs utilised for Stage 1-3 HELP assessment

Layer	Thickness (m)	Permeability (m/s)	Rationale
Waste	Stage 1: 20m Stage 2: 10m Stage 3: 9m	5.0 x 10^{-7}	Based upon Stage E calibration modelling it was found that a waste compaction density of 850kg/m^3 is suitable for use in future stages.
Daily	0.15	1.0 x 10^{-5}	A conservative permeability of 1.0 x 10^{-5} m/s is deemed appropriate for future Stages 1-3 based upon calibration modelling and the utilisation of a clay based soil.
Interim	0.3	1.0 x 10^{-7}	A permeability of 1.0 x 10^{-7} m/s for an intermediate cover soil is deemed appropriate based upon Stage E calibration modelling and soil compaction efforts to this layer.
Seal-bearing	0.3	1.0 x 10^{-9}	As per Stage E calibration modelling results, a permeability of 1.0 x 10^{-9} m/s for a seal-bearing cover soil is appropriate.
Sealing	0.3	1.0 x 10^{-9}	As per Stage E calibration modelling results, a permeability of 1.0 x 10^{-9} m/s for a bearing cover soil is appropriate.
Revegetation	0.5	1.0 x 10^{-5}	As a light compaction effort is utilised for this layer and for conservative estimation of leachate generation, it is expected that this layer will perform similarly to a daily cover. It is therefore recommended that 1x10^{-5} is utilised.
Topsoil	0.2	1.0 x 10^{-3}	As no compaction effort is utilised for this layer and for conservative estimation of leachate generation, a highly permeable rate is recommended.

3.3 Leachate Generation: Operational Scenarios

Leachate generation rates were assessed under five scenarios based on landfill staging across the current and future staging areas and at completion of filling, expected in approximately 2056. Scenario one covers the staged development of the Stage E landfill. Scenarios two, three and four cover the staged development of the landfill (Stages 1, 2, 3) and Scenario five covers post completion of the landfill.

All scenarios consider leachate generation rates based on an average rainfall year, 90th Percentile rainfall year and an average wet period (1988-1990) within years 1971 to 2015. The scenarios consider the highest rate of leachate generation for each cell (i.e. when waste covers the full cell area).

3.3.1 Scenario 1

The first operational scenario modelled over three different climate scenarios is an active Stage E. Active Stage E composes of:

- 75% Final Cap
- 22.5% Interim Cover
- 2.5% Daily Cover

Table 9 describes Stage E areas which comprise Scenario 1.

Table 9 – Stage Areas modelled under Scenario 1 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	7.55	2.45	0.2	**10.2**

Table 10 Describes Scenario 1 - the expected leachate generation under an active Stage E cell.

Table 10 – Stage E leachate generation (m^3/month)

		Final Cap	Interim Cover	Daily Cover	Total
Stage E	**Area (ha)**	**7.55**	**2.45**	**0.2**	**10.2**
Climate Scenario	Average (m^3)	262.0	345.6	7.3	**614.9**
	90th Percentile (m^3)	295.5	360.0	5.9	**661.4**
	Highest Rainfall Year (m^3)	321.1	356.0	6.8	**683.9**

3.3.2 Scenario 2

Scenario 2 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap; and
- Active Stage 1 composing of:
  - No Final Cap in place
  - 97.5% Interim Cover
  - 2.5% Daily Cover

Table 11 describes both Stage E and Stage 1 areas which comprise Scenario 2.

Table 11 – Stage Areas modelled under Scenario 2 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	0.0	7.74	0.2	7.94
Combined Total (ha)	**10.2**	**7.74**	**0.2**	**18.13**

Table 12 Describes Scenario 2 - the expected leachate generation under a closed Stage E and an active Stage 1 cell.

Table 12 – Scenario 2 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	433.8	0.0	0.0	433.8
Stage 1	**Area (ha)**	**0.0**	**7.74**	**0.2**	**7.94**
Climate Scenario	Average (m^3)	0.0	1091.7	7.3	1099.0
	90th Percentile (m^3)	0.0	1137.3	5.9	1143.2
	Highest Rainfall Year (m^3)	0.0	1124.6	6.8	1131.4
Stage E and Stage 1 (Combined)	**Area (ha)**	**10.2**	**7.74**	**0.2**	**18.13**
Climate Scenario	Average (m^3)	354.0	1091.7	7.3	1453.0
	90th Percentile (m^3)	399.2	1137.3	5.9	1542.4
	Highest Rainfall Year (m^3)	433.8	1124.6	6.8	1565.2

3.3.3 Scenario 2A

Scenario 2A comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap; and
- Active Stage 1 composing of:
  - 75% Final Cap
  - 22.5% Interim Cover
  - 2.5% Daily Cover

Table 13 describes both Stage E and Stage 1 areas which comprise Scenario 2A.

Table 13 – Stage Areas modelled under Scenario 2

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	5.96	1.78	0.2	7.94
Combined Total (ha)	**16.15**	**1.78**	**0.2**	**18.13**

Table 14 Describes Scenario 2A - the expected leachate generation under a closed Stage E and an active Stage 1 cell.

Table 14 – Scenario 2 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**5.96**	**1.78**	**0.2**	**7.94**
Climate Scenario	Average (m^3)	206.9	251.1	7.3	465.2
	90th Percentile (m^3)	233.3	261.6	5.9	500.7
	Highest Rainfall Year (m^3)	253.5	258.6	6.8	518.9
Stage E and Stage 1 (Combined)	**Area (ha)**	**16.15**	**1.78**	**0.2**	**18.13**
Climate Scenario	Average (m^3)	560.9	251.1	7.3	819.3
	90th Percentile (m^3)	632.5	261.6	5.9	900.0
	Highest Rainfall Year (m^3)	687.3	258.6	6.8	952.7

3.3.4 Scenario 3

Scenario 3 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap;
- Closed Stage 1 with the assumption of 100% under a final cap; and
- Active Stage 2 composing of:
  - 75% Final Cap
  - 22.5% Interim Cover
  - 2.5% Daily Cover

Table 15 and **Table 16** describes both Stage E, Stage 1 and Stage 2 areas and leachate generation rates which comprise Scenario 3.

Table 15 – Stage Areas modelled under Scenario 3 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	7.94	-	-	7.94
Stage 2 (ha)	7.79	2.33	0.2	10.39
Combined Total (ha)	**25.93**	**2.33**	**0.2**	**28.53**

Table 16 – Scenario 3 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**7.94**	**-**	**-**	**7.94**
Climate Scenario	Average (m^3)	275.6	0.0	0.0	275.6
	90th Percentile (m^3)	310.8	0.0	0.0	310.8
	Highest Rainfall Year (m^3)	337.7	0.0	0.0	337.7
Stage 2	**Area (ha)**	**7.79**	**2.33**	**0.2**	**10.39**
Climate Scenario	Average (m^3)	270.4	328.6	7.3	606.3
	90th Percentile (m^3)	304.9	342.4	5.9	653.2
	Highest Rainfall Year (m^3)	331.3	338.5	6.8	676.7
Stage E, Stage 1 and Active Stage 2 (Combined)	**Area (ha)**	**25.93**	**2.33**	**0.2**	**28.53**
Climate Scenario	Average (m3)	900.0	328.6	7.3	1235.9
	90th Percentile (m3)	1014.9	342.4	5.9	1363.2
	Highest Rainfall Year (m^3)	1072.9	338.5	6.8	1418.2

3.3.5 Scenario 4

Scenario 4 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap;
- Closed Stage 1 with the assumption of 100% under a final cap; and
- Closed Stage 2 with the assumption of 100% under a final cap;
- Active Stage 3 composing of:
  - 75% Final Cap
  - 22.5% Interim Cover
  - 2.5% Daily Cover

Table 17 and **Table 18** describes both Stage E and Stage 1 areas and leachate generation rates which comprise Scenario 4.

Table 17 – Stage Areas modelled under Scenario 4 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	7.94	-	-	7.94
Stage 2 (ha)	10.39	-	-	10.39
Stage 3 (ha)	12.66	3.8	0.2	16.89
Combined Total (ha)	**41.19**	**3.8**	**0.2**	**45.44**

Table 18 – Scenario 4 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**7.94**	**-**	**-**	**7.94**
Climate Scenario	Average (m^3)	275.6	0.0	0.0	275.6
	90th Percentile (m^3)	310.8	0.0	0.0	310.8
	Highest Rainfall Year (m^3)	337.7	0.0	0.0	337.7
Stage 2	**Area (ha)**	**10.39**	**-**	**-**	**10.39**
Climate Scenario	Average (m^3)	360.6	0.0	0.0	360.6
	90th Percentile (m^3)	406.7	0.0	0.0	406.7
	Highest Rainfall Year (m^3)	441.9	0.0	0.0	441.9
Stage 3	**Area (ha)**	**12.66**	**3.8**	**0.2**	**16.89**
Climate Scenario	Average (m3)	439.4	536.0	7.3	982.7
	90th Percentile (m3)	495.5	558.4	5.9	1059.8
	Highest Rainfall Year (m^3)	538.5	552.1	6.8	1097.4
Stage E, Stage 1, Stage 2 and Active Stage 3 (Combined)	**Area (ha)**	**41.19**	**3.8**	**0.2**	**45.44**
Climate Scenario	Average (m^3)	1429.6	536.0	7.3	1972.9
	90th Percentile (m^3)	1612.2	558.4	5.9	2176.5
	Highest Rainfall Year (m^3)	1722.0	552.1	6.8	2280.9

3.3.6 Scenario 5

Scenario 5 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap;
- Closed Stage 1 with the assumption of 100% under a final cap; and
- Closed Stage 2 with the assumption of 100% under a final cap;
- Closed Stage 3 with the assumption of 100% under a final cap;

Table 19 and **Table 20** describes both Stage E and Stage 1 areas and leachate generation rates which comprise Scenario 5.

Table 19 – Stage Areas modelled under Scenario 4 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	7.94	-	-	7.94
Stage 2 (ha)	10.39	-	-	10.39
Stage 3 (ha)	16.89	-	-	16.89
Combined Total (ha)	**45.44**	**-**	**-**	**45.44**

Table 20 – Scenario 5 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**7.94**	**-**	**-**	**7.94**
Climate Scenario	Average (m^3)	275.6	0.0	0.0	275.6
	90th Percentile (m^3)	310.8	0.0	0.0	310.8
	Highest Rainfall Year (m^3)	337.7	0.0	0.0	337.7
Stage 2	**Area (ha)**	**10.39**	**-**	**-**	**10.39**
Climate Scenario	Average (m^3)	360.6	0.0	0.0	360.6
	90th Percentile (m^3)	406.7	0.0	0.0	406.7
	Highest Rainfall Year (m^3)	441.9	0.0	0.0	441.9
Stage 3	**Area (ha)**	**16.89**	-	-	**16.89**
Climate Scenario	Average (m3)	586.2	0.0	0.0	586.2
	90th Percentile (m3)	661.1	0.0	0.0	661.1
	Highest Rainfall Year (m^3)	718.4	0.0	0.0	718.4
Stage E, Stage 1, Stage 2 and Active Stage 3 (Combined)	**Area (ha)**	**45.44**	**-**	**-**	**45.44**
Climate Scenario	Average (m3)	1577.1	0.0	0.0	1577.1
	90th Percentile (m3)	1778.6	0.0	0.0	1778.6
	Highest Rainfall Year (m^3)	1932.8	0.0	0.0	1932.8

The results above demonstrate that leachate generation will vary based upon the total area of the final cap, interim cap, daily cover and total area. The maximum peak monthly leachate generation will occur under Scenario 4 of the landfilling operation with an average 1972 m^3/month of leachate generated and approximately 2280 m^3/month during a high rainfall year.

3.3.7 Leachate collection, storage and disposal system and spacing of discharge pipes

Based on leachate generation from a highest rainfall month, the following leachate flow rates are generated as described in **Table 21**. Stages E, 1 and 2 are grouped as they are within the one catchment and will drain to a central location. Stage 3 is presented independently as it is in a separate catchment and will drain to a separate location.

Table 21 – Leachate flow rates

Catchment	Leachate Generation m^3/Ha/month	Total ha	Flow Rate (m^3/month)	Flow Rate (m^3/d)	Flow Rate (m^3/hr)	Flow Rate (m^3/s)	Pipe Discharge Velocity (m/s)		
							200mm	150mm	2 x 100mm
Stage E, Stage 1 & 2	265.0	28.5	1183.5	39.45	1.64	0.00045	0.014	0.025	0.028
Stage 3		16.9	1097.4	36.58	1.52	0.00042	0.013	0.023	0.026

As described within **Table 21**, the modelled velocities are predicted to range from 0.013 m/s to 0.028 m/s. Based upon the Hazen-Williams formula, the following maximum water velocity and discharge rates were assessed for each pipe size as described within **Table 22**.

Table 22 – Maximum allowable velocity and flow rates

	200mm	150mm	2 x 100mm
Maximum allowable discharge velocity (m/s)	2.33	1.94	3.0
Maximum allowable discharge flow rate (m^3/s)	0.073	0.034	0.023

Based upon the findings contained within **Table 21**Table 22, the predicted flow rate and discharge velocities are considered to be well below the maximum allowable discharge velocity and flow rates shown in **Table 22**. It is therefore considered that leachate reticulation pipes utilised for Stage E (2 x 100mm diameter pipes), will be suitable for all future stages with regards to discharge velocity and flow rate.

Leachate collection pipes should be placed on the floor at intervals of not more than 25 m (running the length of the cell), and be laid at gradients of at least 1% longitudinally into the sump and 3% in transverse directions. (*NSW EPA Landfill Guidelines*, 2016).

The collection pipework should be perforated such that the size, frequency and layout of the perforations are sufficient to facilitate leachate inflow and extraction without clogging and prevent entry of drainage gravel and maintain adequate pipe strength complying with the requirements of Australian Standard AS 2566.1-1998 Buried flexible pipelines – Structural design.

The leachate extraction and level-control system should include a collection sump and leachate riser(s) to facilitate extraction of leachate from each cell. The riser should be stable under the load of the surrounding waste mass and should be able to withstand stresses due to settling of the surrounding waste. The leachate extraction system should be designed for a maximum level of leachate of 300 mm over the upper liner and be able to continue to function effectively until the landfill is considered stable.

It is recommended that leachate is stored in above ground bunded tanks in preference to sumps. Above ground bunded tanks must have sufficient leachate storage volume, as determined by using a water balance methodology. The bunded tanks must have a visible marker to indicate the bottom depth of the required freeboard. If the freeboard is exceeded, the occupier must re-establish and maintain the required freeboard. The tanks and associated connection points must be surrounded by a bund with a capacity of at least 110% of the tanks volume.

3.3.8 Discussion

The results presented in **Table 21** can be used to inform leachate system capacity requirements. In doing this it is important to consider statutory requirements along with the method of leachate management, disposal and any other contingency requirements.

The results of leachate generation modelling demonstrate the importance of quality capping materials and related site management practices. The requirements for final capping under the NSW Guidelines state that final caps must be completed to all *cells* within six months of final waste delivery. It is noted PMHC are progressively capping Stage E which is assumed to be in line with the EMP (2008) which requires capping to commence within 30 days of completion of a landfilling *area*. Whilst the current practices under the EMP appear to exceed the requirements of the NSW Guidelines, the extremely high rate of leachate generation modelled under Scenario 2A demonstrates the risk of maintaining interim stage capping until *cell* completion in accordance with the guidelines. It is therefore recommended that progressive capping along with the maintenance of minimal areas under interim and daily cover (assumed in this investigation) continue as per current practice.

4 LIMITATIONS

Whilst the HELP model is the industry standard for this application it should be recognised that it is a simplified version of the real situation and the results may deviate significantly from actual generation rates. The model can handle water routing through or storage in different waste layers and liner systems. However the model cannot simulate a capillary break or unsaturated lateral drainage. There are also simplifying assumptions or default values that may need to be incorporated into the model in the absence of real site data. Therefore any decision relating to final selection of leachate storage infrastructure should be cognisant of these limitations.

5 REFERENCES

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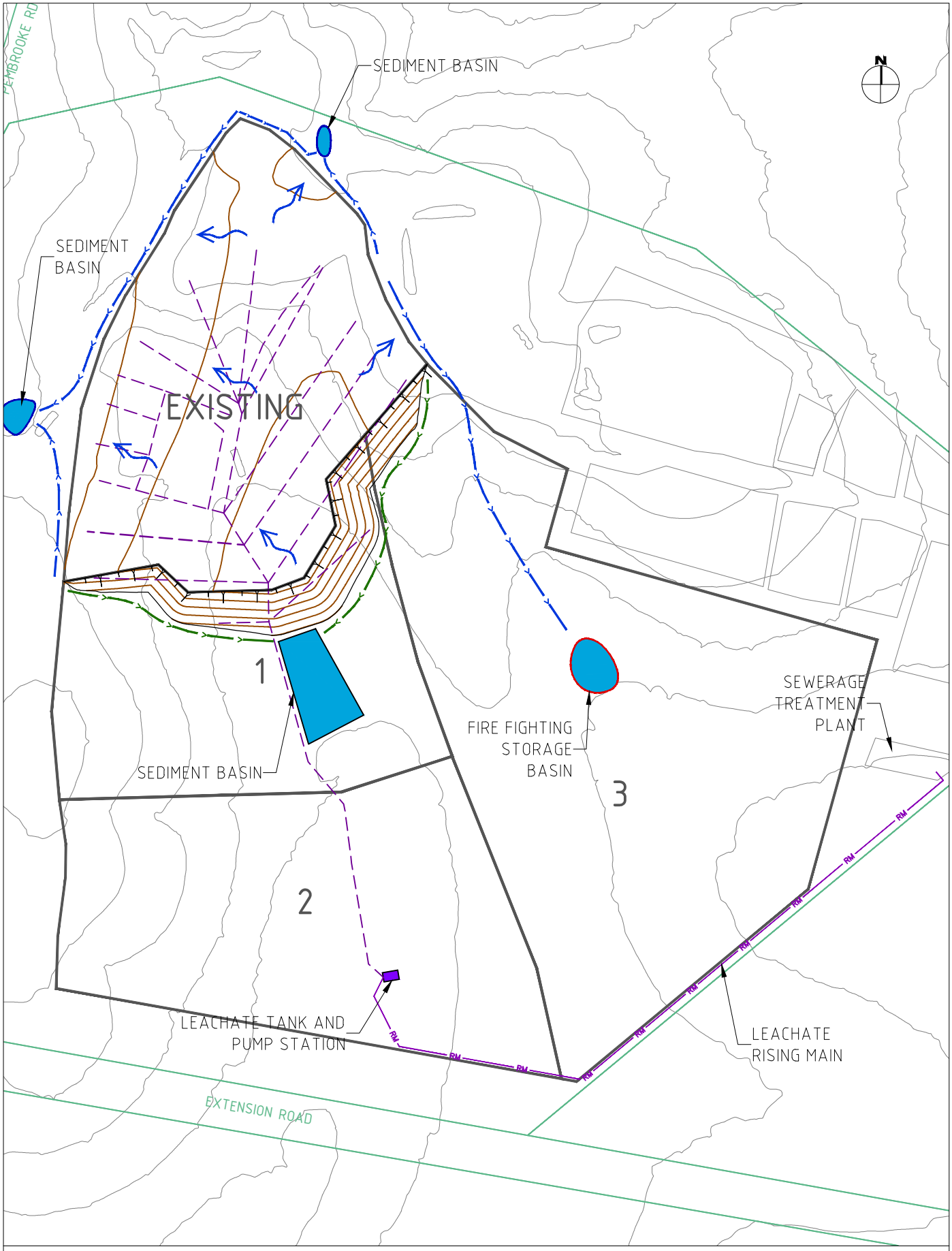
Appendix A CALIBRATED HELP 3.95D MODELLING RESULTS

Leachate Generation mm per month Final Cover 2014/15					
July	**August**	**September**	**October**	**November**	**December**
4.17	3.89	4.62	4.53	4.56	4.31
January	**February**	**March**	**April**	**May**	**June**
4.55	4.57	4.36	4.41	4.09	4.36
Average year					
July	**August**	**September**	**October**	**November**	**December**
3.44	3.12	3.42	3.35	3.52	3.57
January	**February**	**March**	**April**	**May**	**June**
3.67	3.62	3.48	3.57	3.4	3.49
Average					3.47
90th Percentile					
July	**August**	**September**	**October**	**November**	**December**
3.84	3.54	3.67	3.85	3.89	3.97
January	**February**	**March**	**April**	**May**	**June**
4.28	4.27	3.94	3.94	3.84	3.94
Average					3.91
Wettest year					
July	August	September	October	November	December
4.29	4.04	4.38	4.26	4.36	4.36
January	February	March	April	May	June
4.23	4.29	4.211	4.31	3.99	4.32
Average					4.25
Wettest period					
July	**August**	**September**	**October**	**November**	**December**
4.29	3.94	4.42	4.33	4.55	4.38
January	**February**	**March**	**April**	**May**	**June**
4.27	4.29	4.01	4.33	3.96	4.33
Average					4.26

Leachate Generation mm per month					
Interim Cover					
2014/15					
July	**August**	**September**	**October**	**November**	**December**
24.47	20.11	21.6	14.037	16.5	19.04
January	**February**	**March**	**April**	**May**	**June**
18.34	11.75	6.4	4.55	9.63	6.64
Average year					
July	**August**	**September**	**October**	**November**	**December**
12.6	13.7	18.72	18.41	19.1	14.34
January	**February**	**March**	**April**	**May**	**June**
13.16	13.77	10.87	10.65	10.72	13.22
Average					14.11
90th Percentile					
July	**August**	**September**	**October**	**November**	**December**
10.94	8.51	25.21	16.49	23.71	23.46
January	**February**	**March**	**April**	**May**	**June**
13.63	10.99	1.15	17.79	9.3	15.15
Average					14.69
Wettest year					
July	**August**	**September**	**October**	**November**	**December**
9.28	18.8	20.76	14.15	17.53	21.55
January	**February**	**March**	**April**	**May**	**June**
16.4	21.54	13.31	8.37	5.25	7.42
Average					14.53
Wettest period					
July	**August**	**September**	**October**	**November**	**December**
20.1	24.6	23.9	22.4	19.7	9.5
January	**February**	**March**	**April**	**May**	**June**
13.06	11.62	19.9	11.6	26.5	27.3
Average					19.18

Leachate Generation mm per month					
Daily Cover					
2014/15					
July	**August**	**September**	**October**	**November**	**December**
6.6	8.29	6.17	2.81	2.1	6.43
January	**February**	**March**	**April**	**May**	**June**
4.87	5.56	4.28	3.36	2.85	1.6
Average year					
July	**August**	**September**	**October**	**November**	**December**
3.31	2.64	3.28	4.06	4.87	4.49
January	**February**	**March**	**April**	**May**	**June**
3.86	4.27	3.78	3.39	2.69	2.94
Average					3.63
90th Percentile					
July	**August**	**September**	**October**	**November**	**December**
1.3	0.22	4.8	5.94	2.81	5.45
January	**February**	**March**	**April**	**May**	**June**
5.82	4.53	1.56	1.73	0.08	1.06
Average					2.94
Wettest year					
July	**August**	**September**	**October**	**November**	**December**
1.35	0.17	3.27	2.52	3.02	4.9
January	February	March	April	May	June
2.81	6.44	6.29	4.18	1.35	0.4
Average					3.06
Wettest period					
July	**August**	**September**	**October**	**November**	**December**
2.24	1.60	3.81	3.74	4.61	4.20
January	**February**	**March**	**April**	**May**	**June**
4.05	4.02	2.82	4.29	2.75	2.72
Average					3.40

Appendix B LANDFILL STAGING



PORT MACQUARIE HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE E (EXISTING)
CONCEPT PLAN

0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)

STAGE	STAGE AREA	AVERAGE TOPSOIL DEPTH	TOPSOIL STRIPPING VOL	NS vs LANDFILL BASE VOL	LEACHATE COLLECTION GRAVEL THICKNESS	ADDITIONAL EXCAVATION FOR LEACHATE COLLECTION	CLAY EXCAVATED	CLAY CAP DEPTH	VEGETATION LAYER CLAY DEPTH	TOTAL CAP CLAY VOL	VEGETATION LAYER TOPSOIL DEPTH	VEG LAYER TOPSOIL VOL	CUM LANDFILL BASE vs LANDFILL FINAL VOL	LANDFILL BASE vs LANDFILL FINAL VOL	LANDFILL VOID VOL	DAY COVER CLAY % WITHIN LANDFILL	DAY COVER CLAY REQUIRED	ACTUAL LANDFILL VOID VOL (REMOVES DAY COVER)	TOTAL CLAY REQUIRED (DAY COVER + CAP)	EARTHWORKS BALANCE (-VE = DEFICIT)
E	102,063	0.3	30,619	493,124	0.0	0	462,505	0.6	0.2	81,650	0.3	30,619	1,548,266	1,548,266	1,435,997	10%	143,600	1,292,397	225,250	237,255
1	79,453	0.3	23,836	211,215	0.3	23,836	211,215	0.9	0.7	127,125	0.3	23,836	3,309,408	1,761,142	1,610,181	10%	161,018	1,449,163	288,143	-76,928
2	103,992	0.3	31,198	181,825	0.3	31,198	181,825	0.9	0.7	166,387	0.3	31,198	4,523,698	1,214,290	1,016,705	10%	101,671	915,035	268,058	-86,233
3	168,907	0.3	50,672	536,274	0.3	50,672	536,274	0.9	0.7	270,251	0.3	50,672	6,386,339	1,862,641	1,541,718	10%	154,172	1,387,546	424,423	111,851
	454,415			1,422,438			1,391,819											5,044,141		185,945

APPENDIX I NOISE IMPACT ASSESSMENT

ACOUSTICS AND AIR

CAIRNCROSS LANDFILL

NOISE AND VIBRATION IMPACT ASSESSMENT

REPORT NO. 14289-N
VERSION B

JUNE 2017

PREPARED FOR

ARCADIS
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NORTH SYDNEY NSW 2060

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DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	25 April 2017	Nic Hall	John Wassermann
A	Final	4 June 2017	Nic Hall	John Wassermann
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Wilkinson Murray is an independent firm established in 1962, originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. 2010 saw the introduction of our Queensland office and 2011 the introduction of our Orange office to service a growing client base in these regions. From these offices, Wilkinson Murray services the entire Asia-Pacific region.

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APPENDIX A – Noise Measurement Results

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

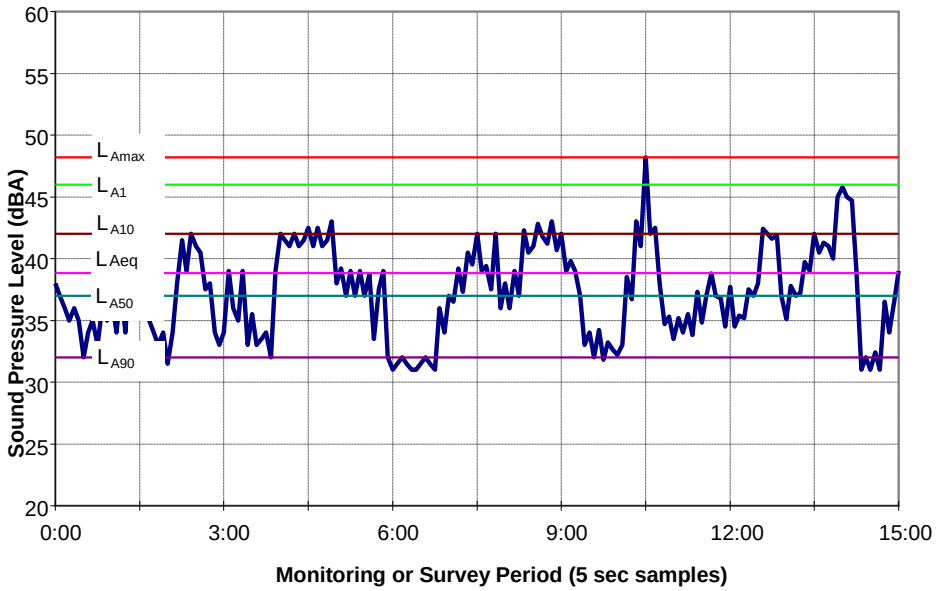
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Port Macquarie-Hastings Council (PMHC) oversees the operation of the Cairncross Waste Management Facility (Cairncross WMF), which includes the operation of a landfill, Waste Transfer Station (WTS), an Organics Resource Recovery Facility (ORRF) and a Material Recovery Facility (MRF). The Cairncross WMF was granted approval under Part 4 and Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for Stage 1 in 1999 (now referred to as the existing landfill or 'Stage E') and commenced operations in September 2001.

The Part 4 development approval (DA) for extractive industries for the current landfill operational area (Stage E), DA No. 1999/178, was limited to 20 years. In February 2013, an extension of five years was sought on the original approval and was subsequently granted by PMHC. The current Part 4 approval is now due to conclude in 2026.

A Part 5 approval (REF 1999-002) was granted in 1999 for landfilling activities on the site, which was also limited to 20 years. A Review of Environmental Factors (REF) was prepared by PMHC in 2013 (the 2013 REF), to support an application for extension of the approved operational life of the Stage E landfill to 2026. The 2013 REF was approved by PMHC in October 2013.

The existing (Stage E) landfill is expected to reach capacity in approximately 2020. PMHC is now seeking approval for three new landfill stages from the Department of Planning and Environment (the Department) as State Significant Development (SSD) under Part 4, Division 4.1 of the EP&A Act. This Proposal aims to provide the additional landfill capacity in the same geographical location identified in the 1999 EIS however proposes that future landfilling is undertaken in three stages rather than the four stages previously proposed.

Council is committed to the reduction of waste being directed to landfill. It should be noted that the proposed landfill facility is not being considered in isolation of other waste management efforts being considered by Council, including organics and materials recovery through the ORRF and MRF at the Cairncross WMF which aim to further increase resource recovery rates and thus to reduce waste to landfill volumes in the future.

Wilkinson Murray has been engaged by Arcadis, on behalf of PMHC, to prepare a Noise and Vibration Impact Assessment (NVIA) for the Proposal. This NVIA will form part of the EIS for the Proposal.

1.1 Assessment Requirements

This NVIA has been prepared to support the Environmental Impact Statement (EIS) for approval of the Proposal, and addresses the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 13-5792 and dated May 2015) for the Proposal. Table 1-1 provides a summary of the SEARs which are relevant to this report and the section where they have been addressed in this report.

Table 1-1 SEARs (SSD 13-5792) Compliance Table (Noise and Vibration)

SEARs	Where Addressed
A quantitative assessment of potential construction, operational and transport noise and vibration impacts, including impacts on nearby sensitive receivers.	Section 3 & Section 4
Details of the proposed noise management and monitoring measures.	Section 5

Due to the nearest receivers being located more than 700 metres from the Proposal site, vibration impacts are considered unlikely and are not investigated further in this assessment.

1.2 Proposal Overview

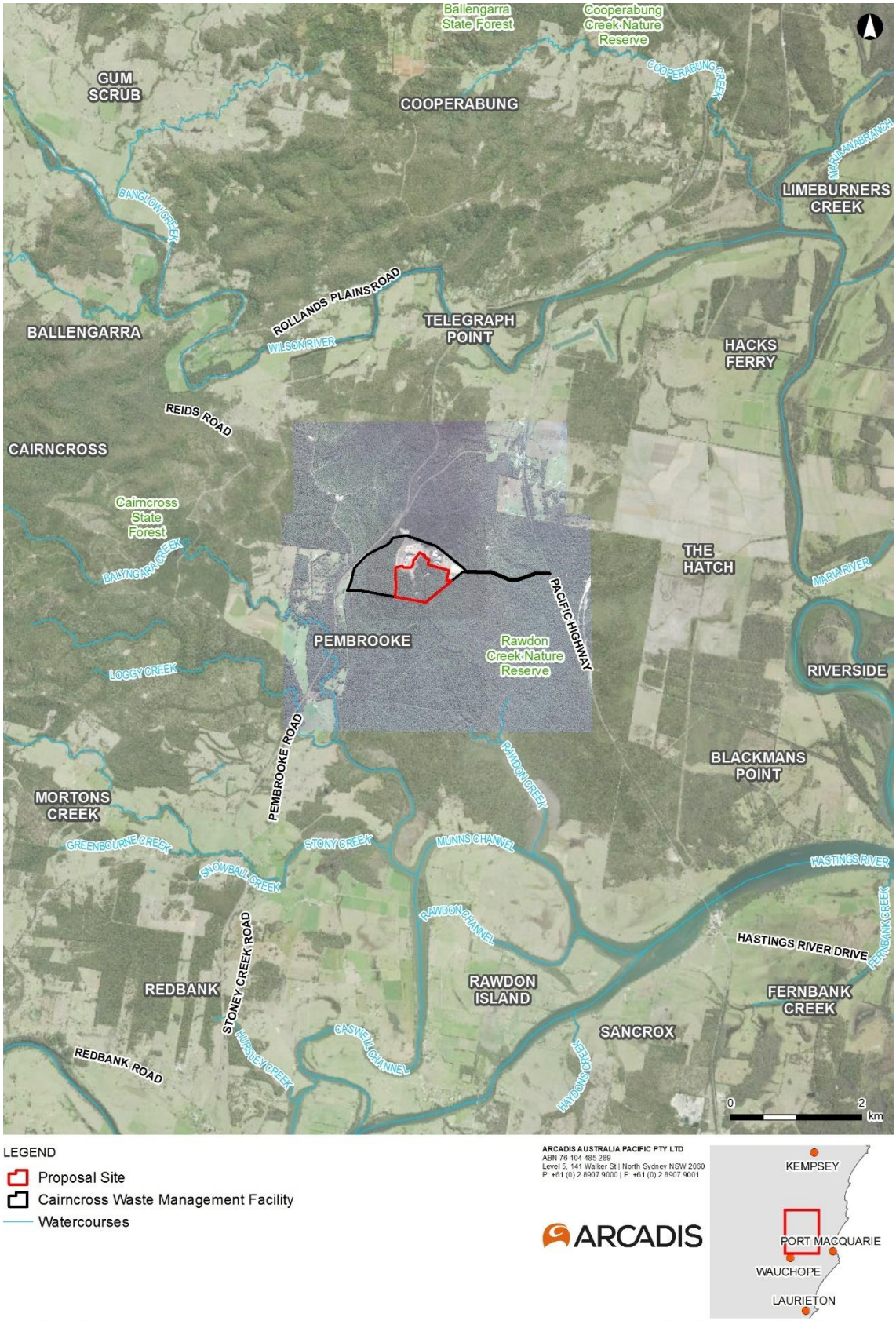
PMHC proposes to expand the existing landfill (Cairncross Landfill) at the Cairncross Waste Management Facility (WMF), located at 8395 Pacific Highway, Telegraph Point, NSW on Lot 1 / DP 1202080 (see Figure 1-1). PMHC is seeking development approval to extend Cairncross Landfill to cover the remaining area identified for landfilling in the Environmental Impact Statement (EIS) that was prepared by ERM in 1999 to support the development application for the first stage of the landfill (the 1999 EIS).

The Proposal would involve the progressive construction, operation and rehabilitation of three landfill stages (Stages 1-3), following a staged approach with implementation over approximately 36 years. Stage 1 would commence construction/operation in approximately 2019/2020 respectively and Stage 3 would reach capacity in approximately 2056 with a landfill closure period to follow. Despite recent and expected future increases in diversion of waste to landfill, the annual waste acceptance rate would progressively increase over the life of the Proposal due to predicted population and waste generation growth per capita.

The Proposal Site is defined as the area shown on Figure 1-1 and is located south-west of Telegraph Point, approximately 2 km west of the Pacific Highway. The Proposal Site covers an area of approximately 40.2 ha (including the landfill and ancillary areas such as access roads and a biodiversity corridor) and is owned by PMHC. The Proposal Site is within the broader Cairncross WMF which is bordered by the Rawdon Creek Nature Reserve to the south-east, by Cairncross State Forest to the north and south and by farmland to the west.

The Proposal will receive waste from all areas within the Port Macquarie-Hastings local government area (LGA) including the major townships of Port Macquarie, Wauchope and Camden Haven. Waste will include general solid waste (i.e. putrescible and non-putrescible materials) and asbestos from domestic and commercial and industrial (C&I) sources.

Figure 1-1 Site location



1.2.1 Proposal Staging

The Proposal stages are shown on Figure 1-2. The anticipated timeframes for the stages are provided in Table 1-2, and are based on indicative waste generation modelling undertaken for the PMHC LGA. The start and end dates for each stage represent the likely timeframe for accepting waste, however the preparatory and completion works for each stage (e.g. landfill cell construction, construction of leachate barrier systems, and final rehabilitation) may commence/conclude up to two years before/after the timeframes provided below. The filling rates and landfill capacity would be reviewed on an ongoing basis.

Table 1-2 Details of landfill stages

Stage	Timeframe[1]	Duration (years)	Activities
Stage 1	2020 – 2040	20	Progressive landfill cell construction, operation and rehabilitation.
Stage 2	2040 – 2047	7	
Stage 3	2047 – 2056	9	
Total	**2020 – 2056**	**36**	

1.2.2 Operating Hours

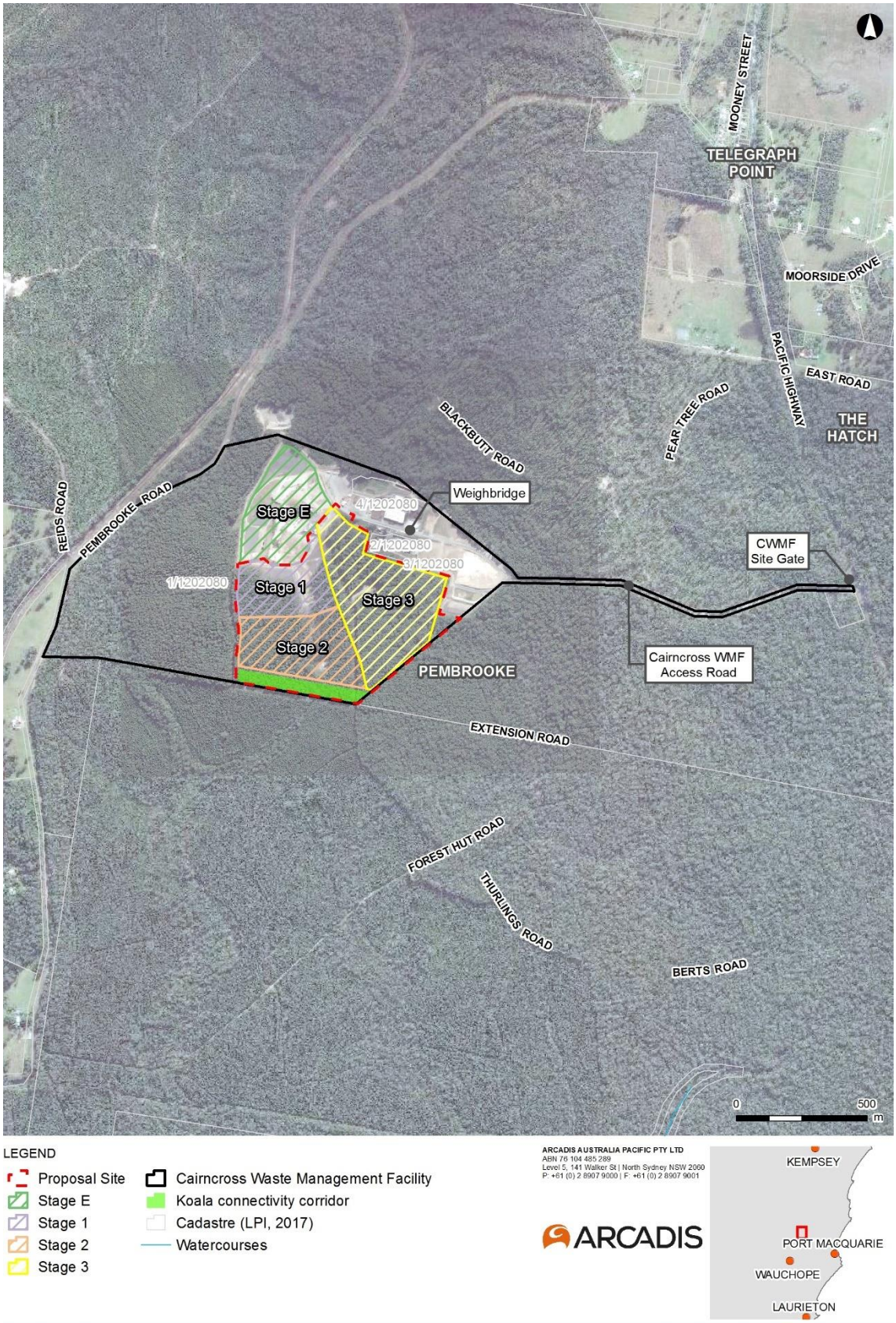
The landfill is open every day, with the exception of Good Friday and Christmas Day, and would continue to operate during the following hours:

- Monday to Friday: 7am – 5pm
- Saturday, Sunday, public holidays: 8am – 4pm.

Site management activities, such as covering operations, may continue one hour after closure.

[1] Timeframes are approximate and subject to change (e.g. based on altered resource recovery and waste generation rates which would influence landfill life expectancy)

Figure 1-2 Site layout



2 EXISTING ENVIRONMENT

2.1 Surrounding land use and sensitive receivers

The land use surrounding the Proposal is predominantly rural. The nearest, and most potentially affected, receivers are identified in Table 2-1 and shown on Figure 2-1.

Figure 2-1 Sensitive receivers

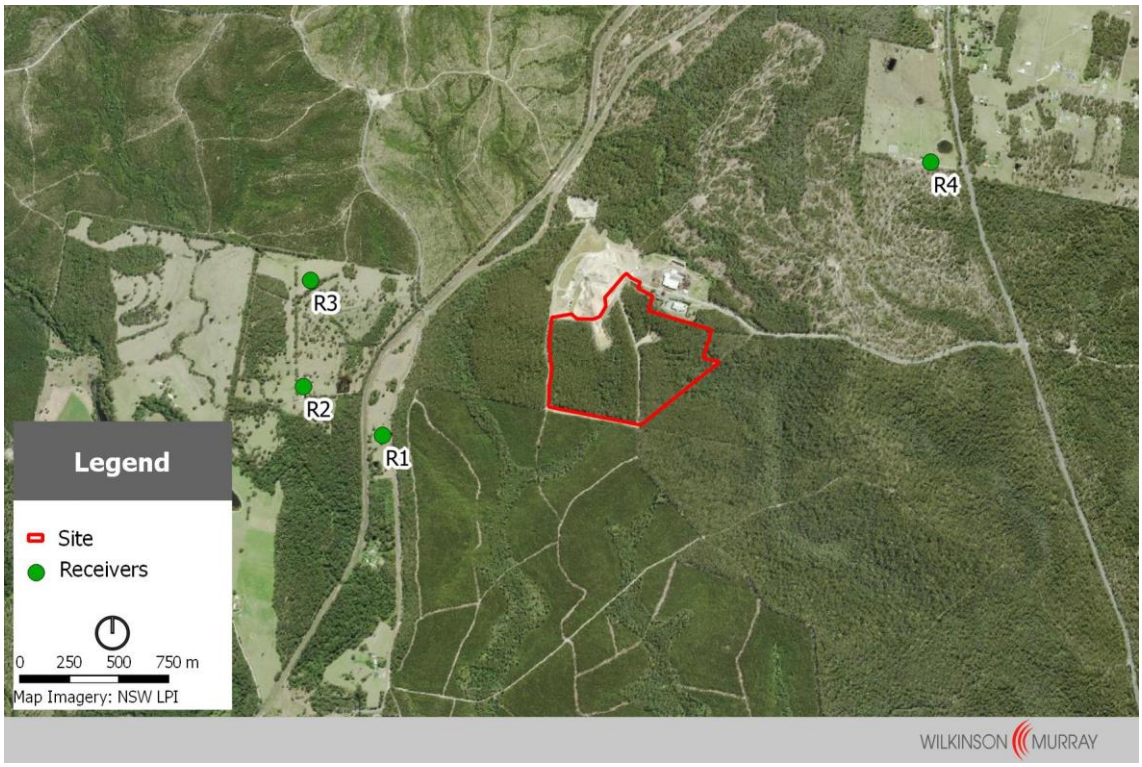


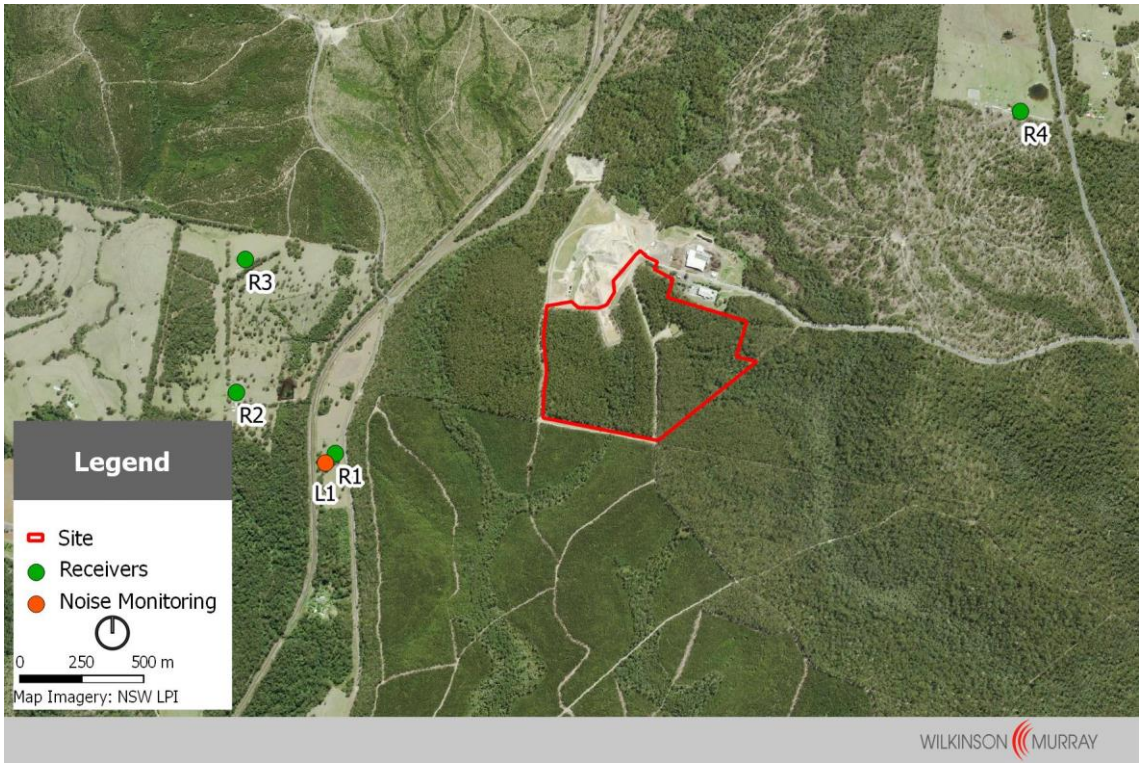
Table 2-1 Sensitive receivers

Receiver	Address	Distance to site boundary (m)
R1	1101 Pembrooke Road, Pembrooke	850
R2	21 Reids Road, Pembrooke	1,230
R3	23 Reids Road, Pembrooke	1,230
R4	8493 Pacific Highway, Telegraph Point	1,400

2.2 Existing ambient noise levels

To establish the existing noise levels at the most affected receivers near the Proposal, unattended noise monitoring was conducted between 28 November and 12 December 2014. Noise monitoring was conducted at 1101 Pembrooke Road (L1). The monitoring location is shown on Figure 2-2.

Figure 2-2 Noise Monitoring Location



The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-weighted, fast response. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

From the background noise levels (L_{A90}) the Rating Background Levels (RBLs) were determined using the methodology recommended in the NSW *Industrial Noise Policy*.

The existing ambient noise levels are presented in Table 2-2. Daily plots of the noise logger data are presented in Appendix A.

Table 2-2 Existing Ambient Noise Levels

Monitoring location	Time period[1]	Noise Levels (dBA)	
		RBL	L_{Aeq}
L1	Day	34	49
	Evening	34	54
	Night	34 (37)[2]	52

1. Day = 7:00am – 6:00pm, Evening = 6:00pm – 10:00pm, Night = 10:00pm – 7:00am
2. Night time RBL set to lowest of daytime and evening RBL in accordance with INP.

3 OPERATIONAL NOISE ASSESSMENT

3.1 Assessment Methodology

Unlike many infrastructure projects, which have discrete construction and operational phases, most landfills operate in a "staged" manner, whereby a new stage of the landfill is being constructed concurrently with the operation of another. This is somewhat inconsistent with the approach of a typical noise impact assessment under NSW Government guidelines, which would usually assume that the construction and operation of a proposal are distinct.

The methodology adopted for the assessment of noise impacts from the construction and operation of the Proposal was to combine all day-to-day on-site activities, and assess the noise levels associated with these activities as operational noise. This approach is conservative as noise goals for construction are generally more relaxed than those for operations.

While the Proposal will be developed in Stages (as described in Section 1.2.1), the timeframe adopted for analysis in this assessment is the year of closing (2056). The 2056 assessment year represents a worst-case scenario as this is the final year of operation whereby the highest number of traffic movements will occur on the site.

3.2 Operational Noise Criteria

The NSW *Industrial Noise Policy* (INP) provides the framework for establishing noise criteria and assessing impacts from sources of industrial noise. This policy seeks to promote environmental well-being through preventing and minimising noise.

There are two noise criteria which should be satisfied under the INP. The first being the "intrusiveness" criterion which assesses the likelihood of noise being intrusive above the ambient noise level. The intrusiveness criterion applies for residential receivers only.

The second noise criterion, known as the "amenity" criterion, ensures the total industrial noise from all sources in the area does not rise above a maximum acceptable level.

The INP stipulates that intrusiveness and amenity criteria are determined for the daytime (7:00am 6:00pm), evening (6:00pm 10:00pm) and night time (10:00pm 7:00am) periods, as relevant. The determined criteria apply at the most affected point on or within the receiver property boundary. As presented in Section 1.2.2, the Proposal will only operate during the daytime. Accordingly, operational noise criteria will be established for this period only.

3.2.1 INP Intrusiveness Criteria

The intrusiveness criterion requires that the L_{Aeq} noise level from the source being assessed, when measured over 15 minutes, should not exceed the Rating Background Noise Level (RBL) by more than 5 dBA.

Based on the established background noise levels, Table 3-1 summarises the intrusiveness noise criteria which apply to the identified receivers.

Table 3-1 Project specific intrusiveness criteria

Receiver	$L_{Aeq,15min}$ Intrusiveness Criterion (dBA)
	Day[1]
R1 – R4	34+5 = 39

1. Day = 7:00am – 6:00pm.

3.2.2 INP Amenity Criteria

The amenity criterion sets a limit on the total noise level from *all industrial noise sources* affecting a receiver. Different criteria apply for different types of receiver (e.g. residence, school classroom); different areas (e.g. rural, suburban); and different time periods, namely daytime (7:00am-6:00pm), evening (6:00pm-10:00pm) and night time (10:00pm-7:00am).

The noise level to be compared with this criterion is the L_{Aeq} noise level, measured over the time period in question, due to all industrial noise sources, but excluding non-industrial sources such as transportation.

Where a new noise source is proposed in an area with negligible existing industrial noise, the amenity criterion for that source may be taken as being equal to the overall amenity criterion. However, if there is significant existing industrial noise, the amenity criterion for any new source must be set at a lower value. If existing industrial noise already exceeds the relevant amenity criterion, noise from any new source must be set well below the overall criterion to ensure that any increase in noise levels is negligible. Methods for determining a source-specific amenity criterion where there is existing industrial noise are set out in the *INP*.

In accordance with the INP, all residential receivers identified in this assessment are classified as 'rural' residential receivers. The INP amenity criteria for residential receivers are shown in Table 3-2 with the criterion relevant to the Proposal **underlined and in bold**

Table 3-2 Amenity Criteria

Type of Receiver	Indicative Noise Amenity Area	Time of Day*	Recommended $L_{Aeq,\ period}$ Noise Level, (dBA)	
			Acceptable	Recommended Maximum
Residence	**Rural**	**Day**	**50**	**55**
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50

* Day = 7:00am – 6:00pm, Evening = 6:00pm – 10:00pm, Night = 10:00pm – 7:00am

During site visits, significant levels of industrial noise were not audible at sensitive receiver

locations. In accordance with the INP, no adjustment to the amenity criteria is warranted. Therefore, the relevant amenity criterion for the Proposal is 50 dBA.

3.2.3 Project-Specific Noise Levels

To simplify operational noise assessments, it is desirable to establish a single set of criteria for the relevant assessment periods. These criteria are referred to as the Project Specific Noise Levels (PSNL) and are equal to the most stringent of the established intrusiveness and amenity criteria for each assessment period.

Table 3-3 presents the INP criteria for this project, along with the PSNL. In this instance, the more stringent of the two noise criteria (intrusiveness and amenity) that will be adopted as the PSNL is 39 dBA.

Table 3-3 INP Criteria and Project Specific Noise Levels

Receiver	Time Period[1]	Criteria (dBA)		PSNL ($L_{Aeq, 15min}$)
		Intrusiveness ($L_{Aeq, 15min}$)	Amenity ($L_{Aeq, period}$)	
R1 – R4	Day	39	50	39

1. Day = 7:00am – 6:00pm.

3.3 Operational Noise Modelling Methodology and Assumptions

3.3.1 Noise Prediction Software

To predict the potential noise impacts from the operation and construction of the project an acoustic model, implementing the CONCAWE algorithms, has been prepared using the CadnaA environmental noise modelling software. Factors addressed in the noise model are:

- Equipment noise emissions and locations;
- Shielding from structures;
- Noise attenuation due to geometric spreading;
- Ground absorption;
- Atmospheric absorption; and,
- Wind.

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and winds. Where these factors are a feature of an area, their effect on resultant noise levels should be taken into account

The Project will operate during the hours 7:00am – 6:00pm. Temperature inversions do not typically occur during these times, and therefore do not require further consideration. To assess the effects of gradient winds, the default condition, recommended by the INP, of a 2 m/s source-to-receiver wind has been incorporated into the model.

3.4 Operational Noise Sources and Scenarios

The most significant sources of operational noise associated with the Proposal are the various items of mobile plant used in the day-to-day operation of the landfill, and the incoming waste trucks. Table 3-4 provides a summary of the key mobile plant items associated with the daily operation of the landfill, and their respective sound power levels (SWL). The source SWL for each plant item has been sourced from previous measurements conducted by Wilkinson Murray at similar sites.

Table 3-4 also presents the modelled SWL of the waste trucks, and the number of truck movements during the worst-case 15-minute period for the Proposal.

Table 3-4 Summary of Noise Source Levels

Plant Item	Quantity (per worst case 15 min period)	SWL per item (dBA)
Boggy tipper	1	105
Compactor	1	113
Excavator (20 tonne)	2	107
Water truck	1	105
Waste truck	6	103

To assess the operational noise levels from the Proposal against the established criteria, it is assumed that all plant items identified in Table 3-4 are operating simultaneously and continuously. It should be noted that, during actual operations, the activities on the Proposal site will be significantly less intense than those modelled for the majority of the time.

3.5 Predicted Operational Noise Levels at Sensitive Receivers

$L_{Aeq,\ 15min}$ operational noise levels at sensitive receivers have been predicted for the worst-case operational scenario, identified in Section 3.1 as the 2056 assessment year, and are presented in Table 3-5. Predicted noise levels below 20 dBA are not reported explicitly, as it is impractical to validate such low noise levels via measurements under real-world conditions.

Table 3-5 Predicted $L_{Aeq,\ 15min}$ Noise Levels (2056)

Receiver	Predicted $L_{Aeq,\ 15min}$ Noise Level (dBA)		Criterion	Complies?
	Calm winds	2 m/s source to receiver wind	Day[1]	
R1	22	27	39	Yes
R2	<20	22	39	Yes
R3	<20	23	39	Yes
R4	21	25	39	Yes

1. Day = 7:00am – 6:00pm

Review of Table 3-5 indicates that the predicted operational noise levels at nearby receivers comply with the established criteria during the proposed hours of operation.

3.6 Cumulative Noise Impacts

Since the predicted noise levels from the worst-case day-to-day site operations, which would include some construction activities, are 10 dBA below the established criterion at the most affected receiver under adverse meteorological conditions, the Proposal is considered unlikely to contribute to any cumulative noise impacts at nearby receivers.

4 ROAD TRAFFIC NOISE ASSESSMENT

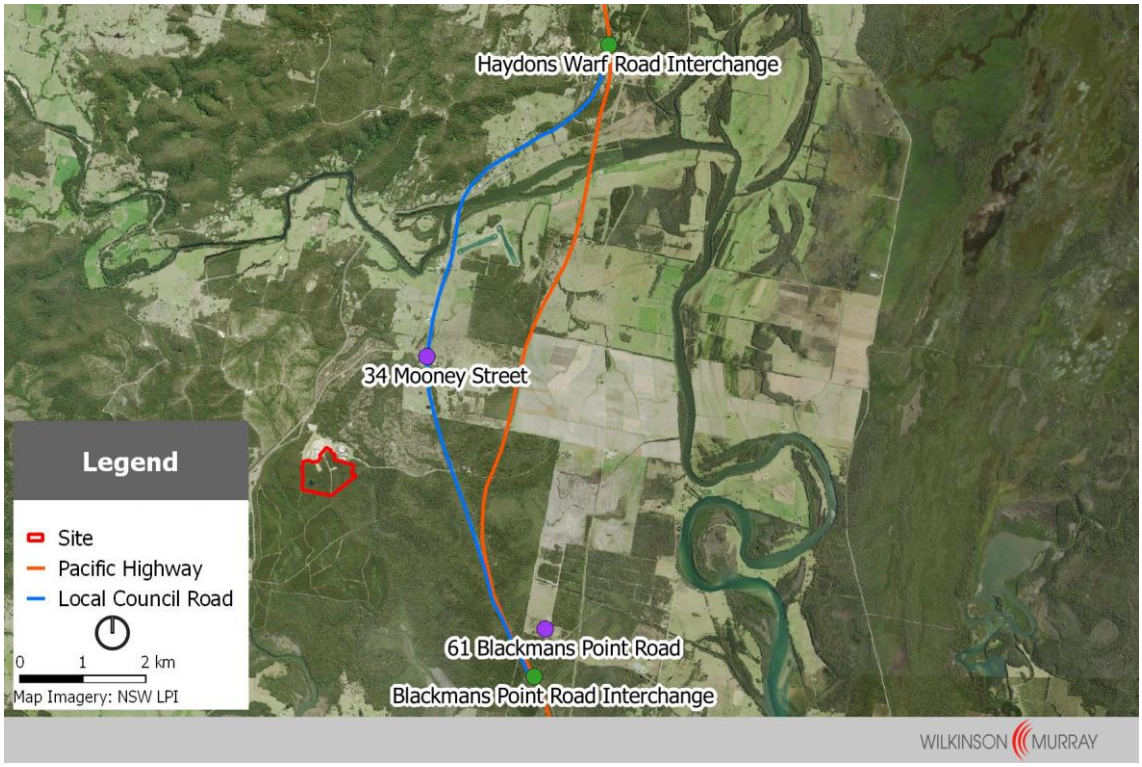
4.1 Assessment methodology

While the Proposal will be developed in Stages (as described in Section 1.2.1), the timeframes adopted for analysis in this assessment are the year of opening (2020) and the year of closing (2056). The 2056 assessment year represents a worst-case scenario as this is the final year of operation whereby the highest number of traffic movements will be generated to/from the Proposal site.

4.2 Sensitive Receivers

The current access to the Cairncross WMF is via the Pacific Highway. Prior to the operation of the Proposal, the section of the Pacific Highway between the Blackmans Point Road Interchange and the Haydons Wharf Road Interchange will be bypassed (i.e. realigned to the east, thereby diverting a significant volume of through-traffic to the new alignment) as shown on Figure 4-1. The most affected residential receivers to potential increases in road noise resulting from the Proposal are those residents located immediately adjacent to the bypassed section of the Pacific Highway, referred to herein as the "local council road". To the north of the Proposal site, 34 Mooney Street, Telegraph Point is considered representative of the most potentially affected receiver for road traffic noise impacts. The eastern façade of this residence is approximately 27 metres from the edge of the road. To the south of the Proposal site, 61 Blackmans Point Road, Blackmans Point is considered representative of the most potentially affected receiver for road traffic noise impacts from the Proposal. The western façade of this residence is approximately 500 metres from the local council road, and approximately 450 metres from the nearest edge of the new Pacific Highway alignment.

Figure 4-1 Points of Interest for Road Noise Assessment



4.3 Road Noise Criteria

Applicable noise criteria for proposals which have the potential to indefinitely increase traffic on roads are presented in the *NSW Road Noise Policy* (RNP) (DECCW, 2011).

This assessment is focused on noise impacts from traffic generated by the Proposal along the section of the Pacific Highway anticipated to be bypassed prior to the operation of the Proposal. This road, referred to as the "local council road" would still function as an arterial road. The *RNP* assessment criteria for residential land uses near the local council road are shown in Table 4-1.

Table 4-1 Road Noise Criteria

Road	Category	Assessment Criteria - dBA	
		Day (7am – 10pm)	Night (10pm – 7am)
Local Council Road	Arterial Road	$L_{Aeq,\ 15\ hour}$ 60 (external)	$L_{Aeq,\ 9\ hour}$ 55 (external)

With regard to the permissible increase in road traffic noise from a land use development the *RNP* states:

> "*For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*"

4.4 Traffic Generated by the Development

Arcadis has provided data for the traffic volumes along the local council road in the years 2020 and 2056, termed the "year of opening" and "year of closing", respectively. Data has been provided for both the "with the Proposal" or "Build" scenario and the "without Proposal" or "No-Build scenario.

The no-build and build traffic volumes, and percentage heavy vehicles along the local council road, for year of opening and year of closing, are presented in Table 4-2 and Table 4-3, respectively.

As outlined in Section 4.1, in the vicinity of the most potentially affected receivers to the south of the Proposal site, the local council road runs adjacent to the new alignment of the Pacific Highway. The total road noise levels at these receivers will be dominated by traffic on the Pacific Highway. Therefore, these traffic flows are presented in Table 4-2 and Table 4-3.

Table 4-2 Daily Traffic Volume and % Heavy Vehicles – Year of Opening (2020)

Road Section	Time[1]	No-Build scenario		Build scenario	
		Volume	%Heavy	Volume	%Heavy
Local Council Road (North of Cairncross WMF)	Day	2036	12	2082	13
Local Council Road (South of Cairncross WMF)	Day	2036	12	2172	17
Pacific Highway (near Blackmans Point Road)	Day	20134	24	20134	24

1. Day = 7.00am – 10.00pm

Table 4-3 Daily Traffic Volume and % Heavy Vehicles – Year of Closing (2056)

Road Section	Time[1]	No-build scenario		Build scenario	
		Volume	%Heavy	Volume	%Heavy
Local Council Road (North of Cairncross WMF)	Day	2304	14	2452	18
Local Council Road (South of Cairncross WMF)	Day	2304	14	2748	26
Pacific Highway (near Blackmans Point Road)	Day	26402	24	26402	24

1. Day = 7.00am – 10.00pm

4.5 Predicted Road Noise Levels

Using the data in Table 4-2 and Table 4-3, the increases in road noise levels at the most affected receivers have been calculated for the year of opening and year of closing of the Proposal, respectively. The calculations have been conducted using the *Calculation of Road Traffic Noise* (CORTN) algorithm, and are based upon the following assumptions:

- Vehicle speeds are 80 km/h along the local council road and 110 km/h along the Pacific Highway;
- Day time (7:00am – 10:00pm) traffic volumes account for 90% of the total volume;
- A +2.5 dBA correction has been applied for façade reflections;
- No road surface correction has been applied; and,
- A -1.7 dBA correction has been applied, to façade predictions, for Australian conditions.

The predicted road noise levels, under the "No-Build" and "Build" scenarios, in the year of opening and year of closing are shown in Table 4-4 and Table 4-5, respectively.

Table 4-4 Predicted Road Noise Levels – Year of Opening (2020)

Road Section	Time[1]	Predicted L_{Aeq} Noise Level (dBA)		Criteria (dBA)	Increase (dBA)
		No-Build	Build		
Local Council Road (North of Cairncross WMF)	Day	59.1	59.3	60	0.2
Local Council Road (South of Cairncross WMF)	Day	61.0	61.0	60	0.0

1. Day = 7.00am – 10.00pm

Table 4-5 Predicted Road Noise Levels – Year of Closing (2056)

Road Section	Time[1]	Predicted L_{Aeq} Noise Level (dBA)		Criteria (dBA)	Increase (dBA)
		No-Build	Build		
Local Council Road (North of Cairncross WMF)	Day	59.9	60.7	60	0.8
Local Council Road (South of Cairncross WMF)	Day	62.2	62.3	60	0.1

1. Day = 7.00am – 10.00pm

Table 4-4 and Table 4-5 show that the predicted daytime "No-Build" road noise levels at the most potentially affected receivers to the north and south of the Proposal site exceed the RNP assessment criteria in the year of opening and year of closing, respectively. Therefore, in accordance with the RNP, any increases in road noise levels due to a traffic generating development, such as the Proposal, should be limited to no more than 2 dB above the "No-Build" option.

Table 4-4 shows that the traffic generated by the Proposal, in the year of opening, is predicted to increase daytime road traffic noise levels at the most affected receivers to the north of the Proposal site by 0.2 dBA. No increase in traffic noise levels is predicted at receivers to the south of the Proposal site in the year of opening of the Proposal.

Table 4-5 shows that the traffic generated by the Proposal, in the year of closing, is predicted to increase daytime road traffic noise levels at the most affected receivers to the north and south of the Proposal site by 0.8 dBA and 0.1 dBA, respectively.

In accordance with the RNP, since any increase in road traffic noise due to the Proposal is less than 2 dBA, no mitigation of traffic noise levels, due to the operation of the Proposal, is warranted.

5 MANAGEMENT AND MITIGATION

Noise levels from the day-to-day operational activities within the Proposal site are predicted to comply with the established criterion at all nearby residential receivers. Notwithstanding, the following measures, which would further reduce noise emissions from the Proposal, should be considered:

- Ensuring that vehicles don't queue at the site entrance prior to opening;
- Limit unnecessary idling of plant;
- Ensure all plant items are in good working order, with silencers fitted where reasonably practicable;
- Consider Replace tonal reversing alarms with broadband devices on all site-owned plant;
- Provide the community with a complaints line, and respond to all complaints in a timely manner.

In addition to the measures recommended above, the complaints management procedures currently in place at the existing landfill would be continued for the future landfill stages, including maintenance of the existing "Complaints Register".

6 CONCLUSION

A Noise and Vibration Impact Assessment (NVIA) has been conducted for the landfill expansion at the Cairncross Waste Management Facility (Cairncross WMF) (the Proposal).

Potential noise impacts associated with the day-to-day operational activities for the Proposal have been assessed in general accordance with the *NSW Industrial Noise Policy*. The predicted operational noise levels at all sensitive receivers comply with the established criteria.

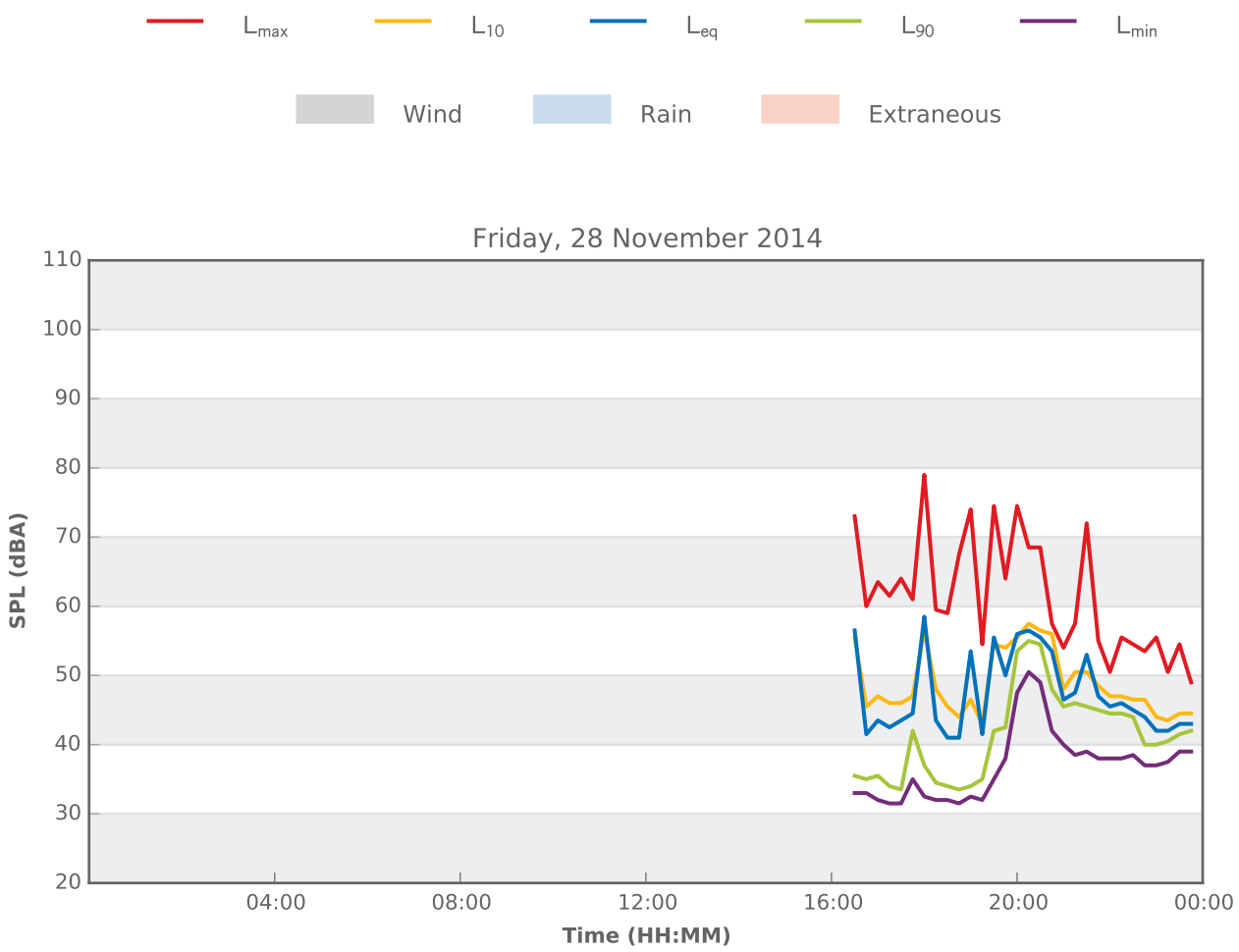
Potential road traffic noise impacts associated with traffic generated by the Proposal have been assessed in general accordance with the *NSW Road Noise Policy* (RNP). Any increases in road traffic noise levels, associated with the Proposal, are predicted to be well below 2 dBA, and, in accordance with the RNP, no mitigation is necessary.

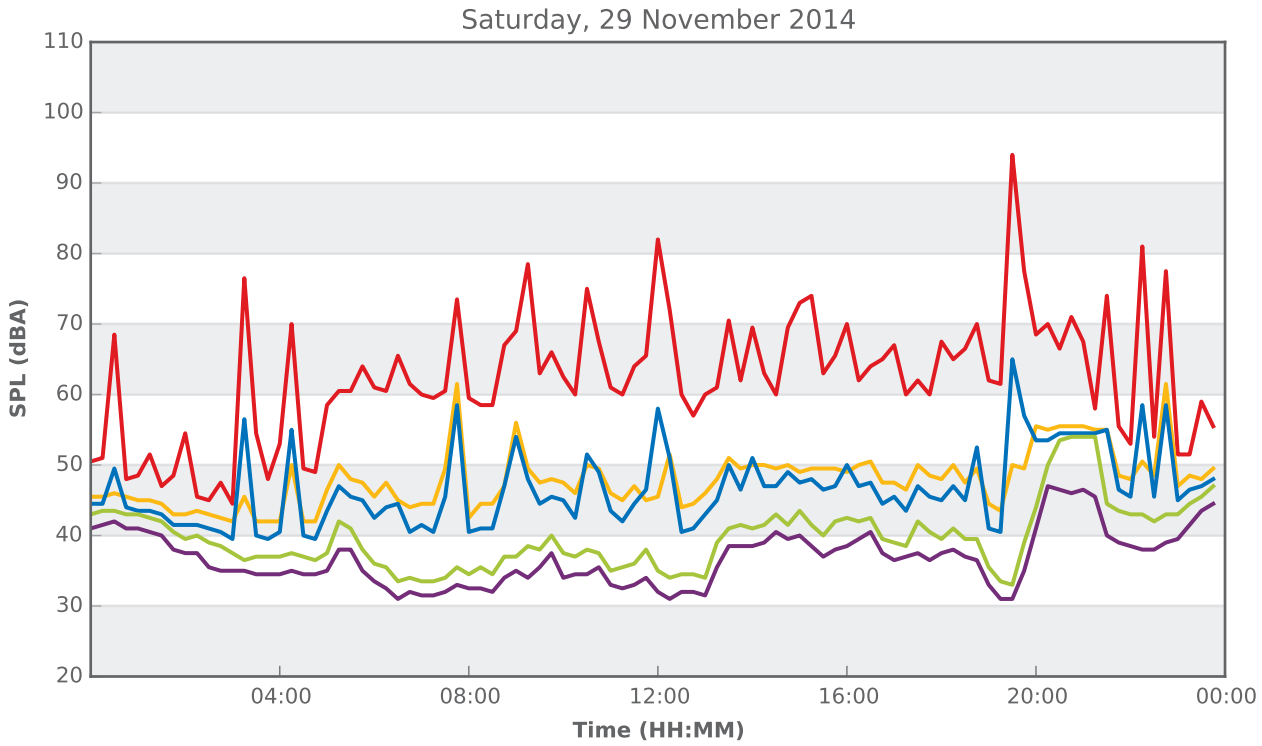
This NVIA has demonstrated that the Project is anticipated to comply with relevant NSW Government noise and vibration guidelines, and is not expected to significantly impact the acoustic amenity of nearby sensitive receivers.

APPENDIX A

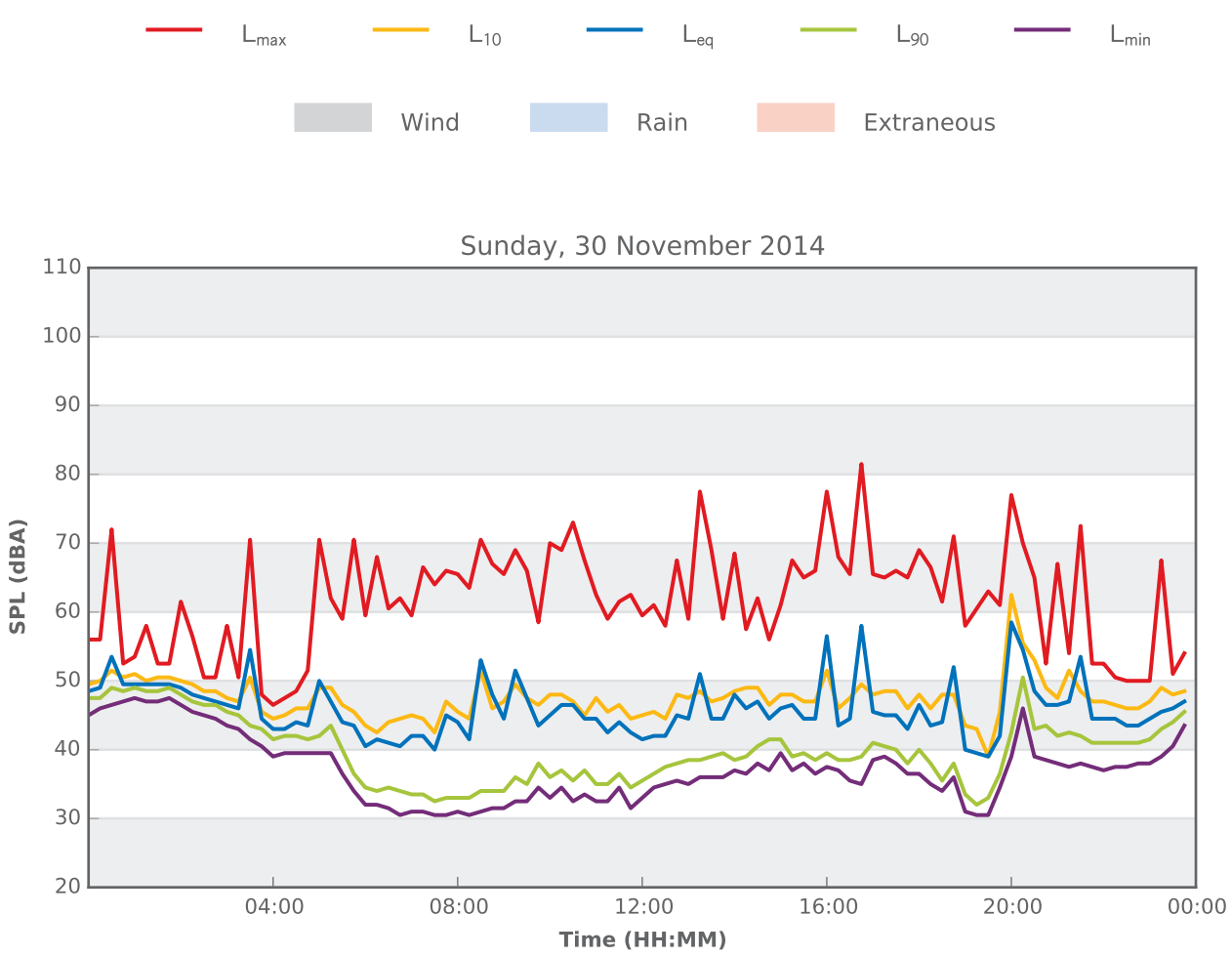
NOISE MEASUREMENT RESULTS

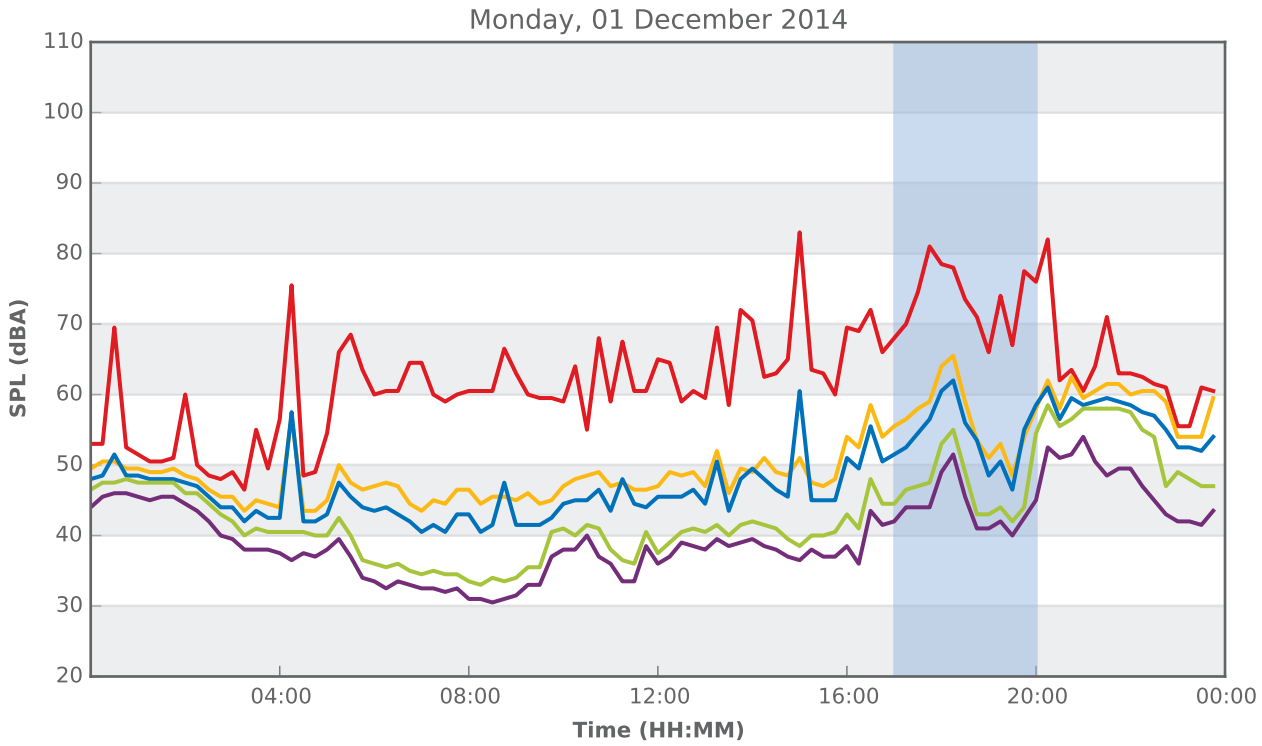
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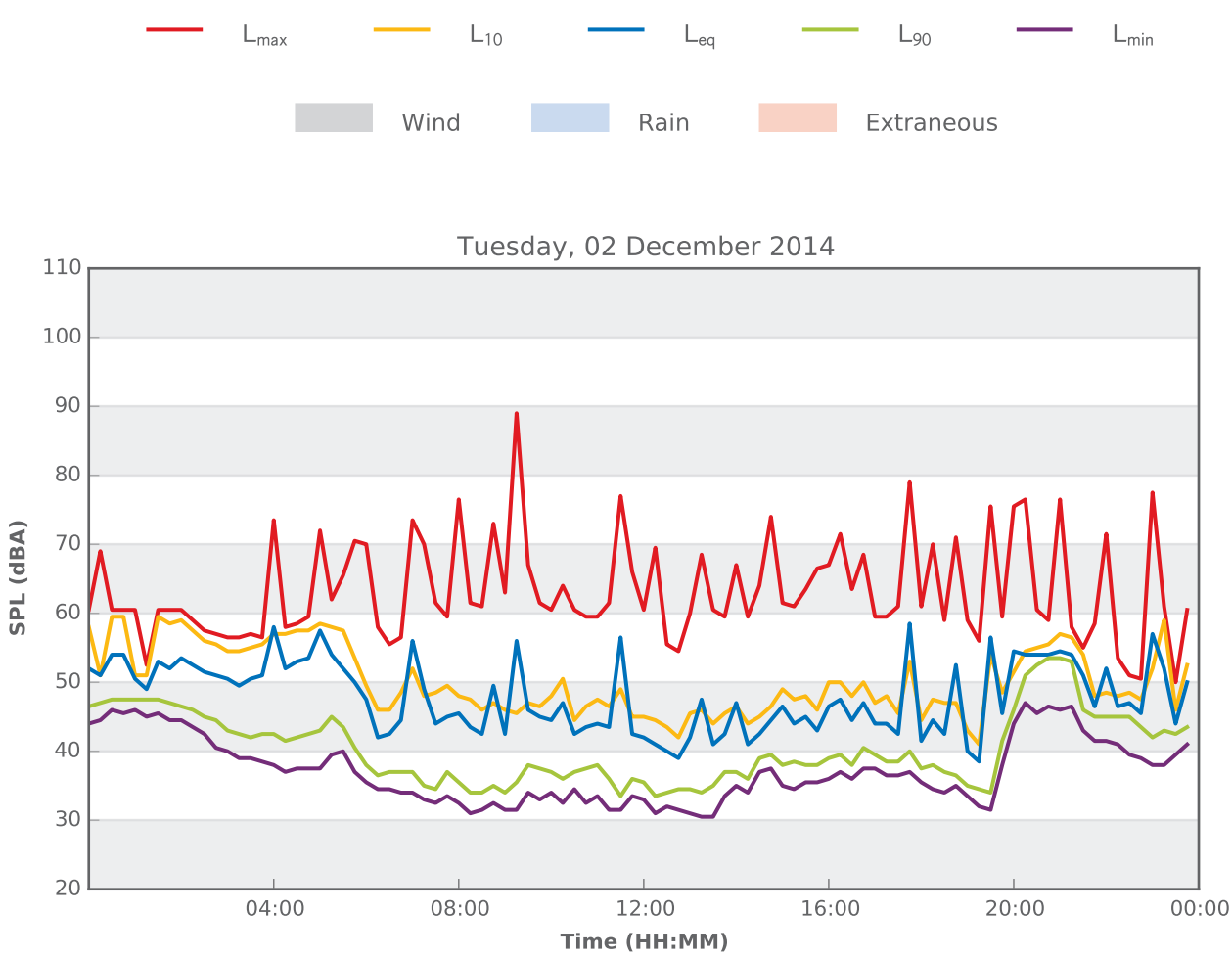

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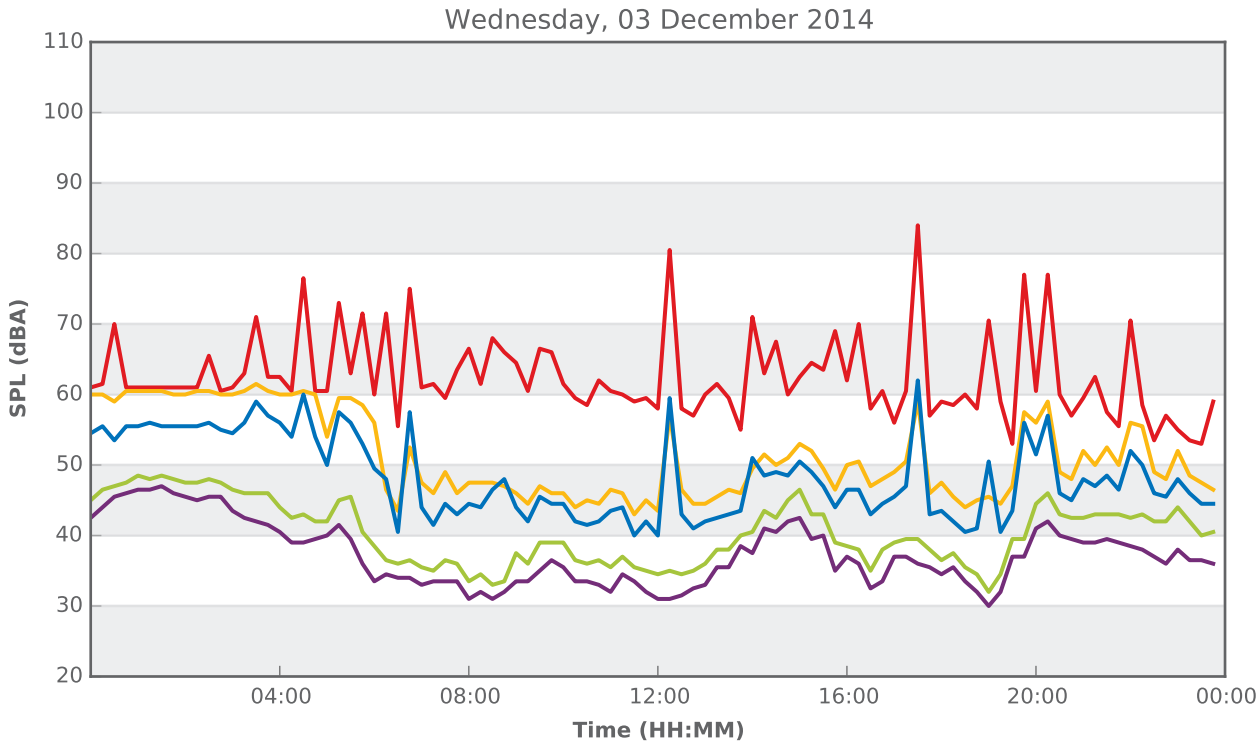
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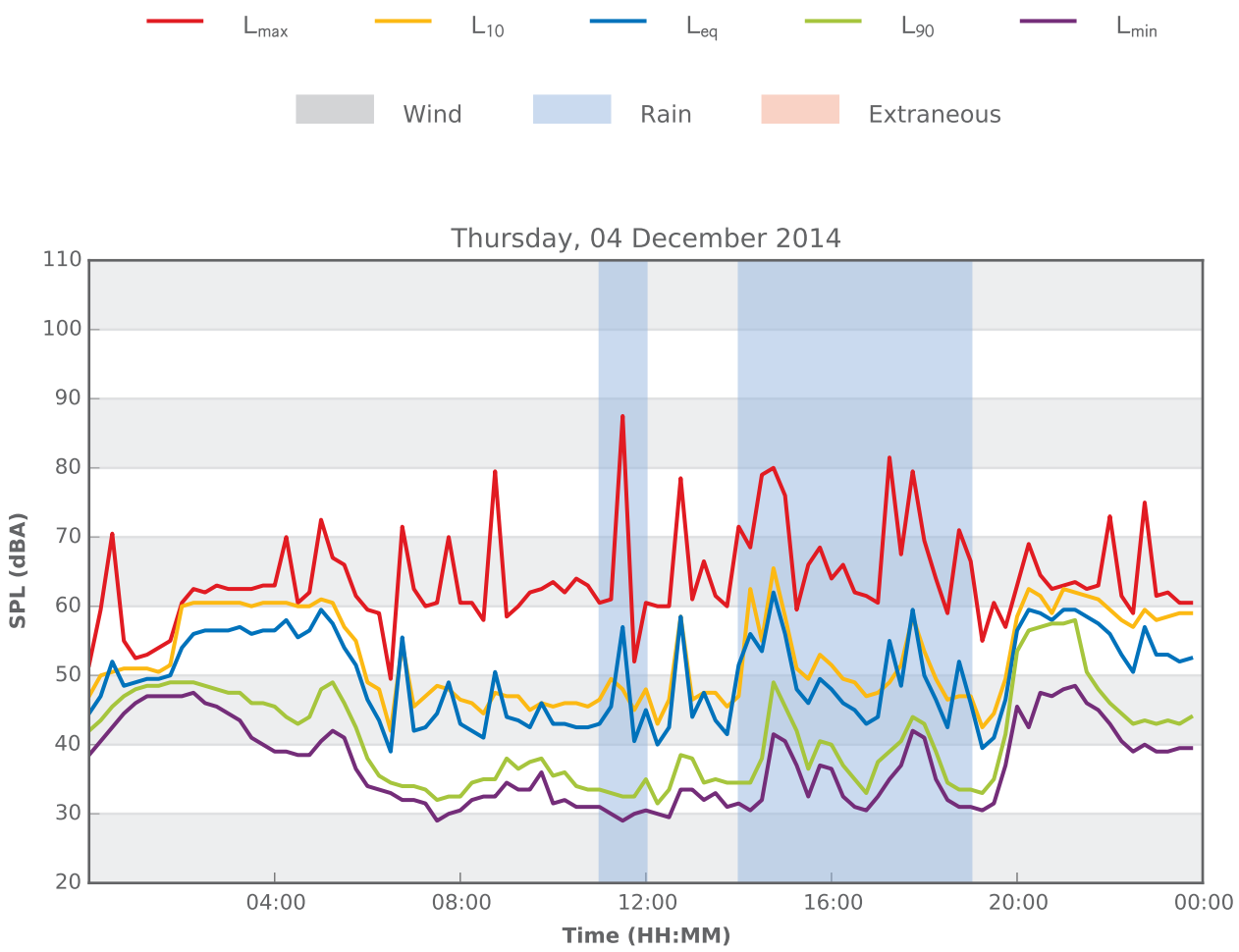

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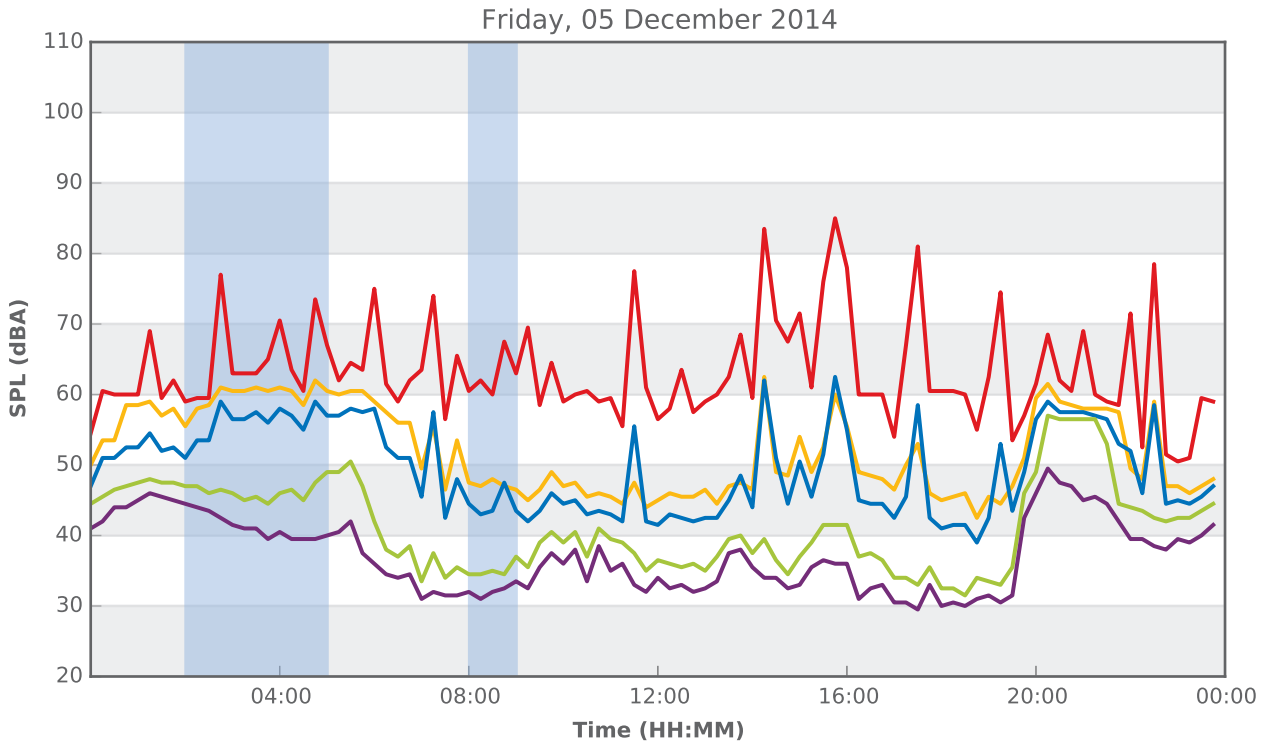
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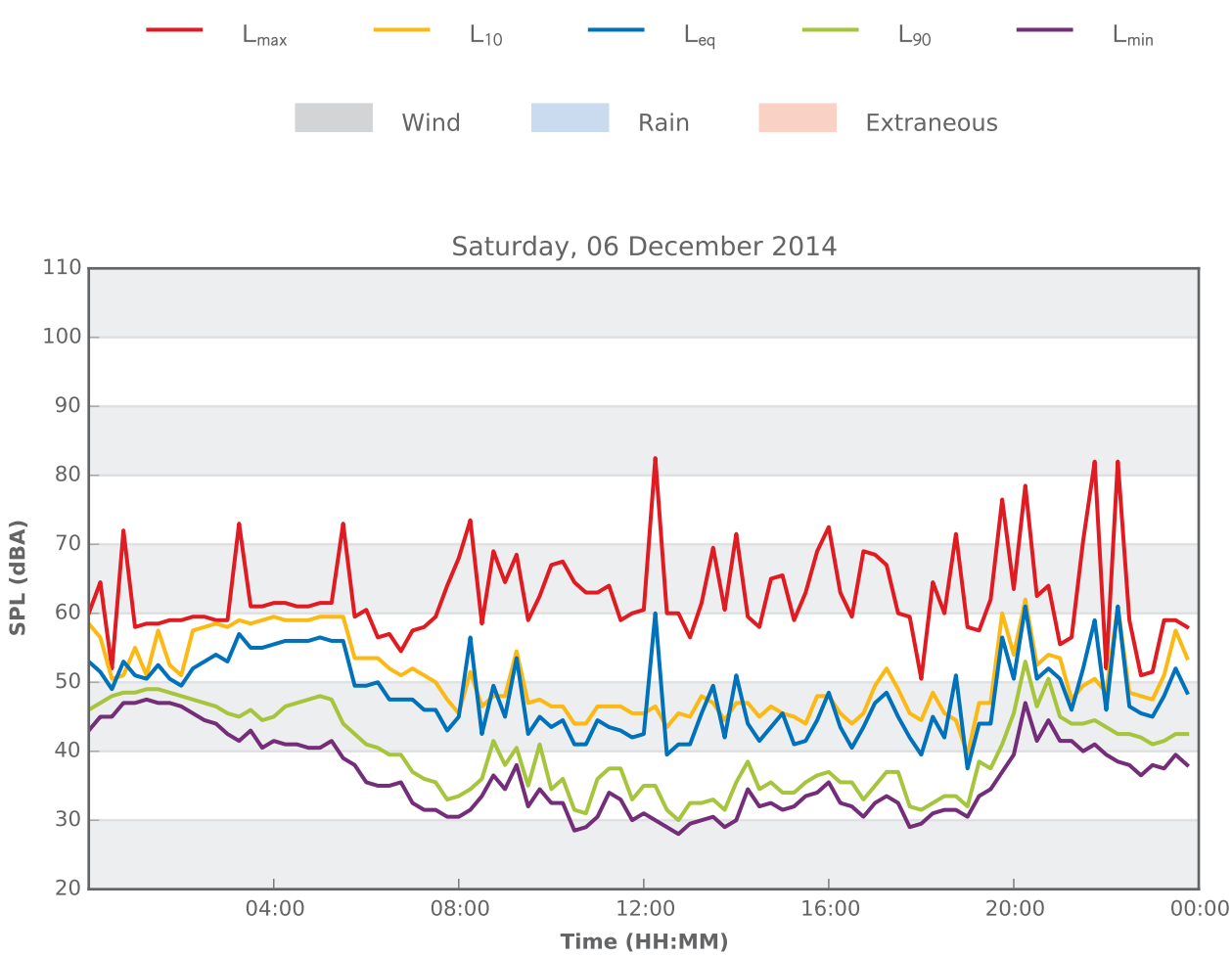

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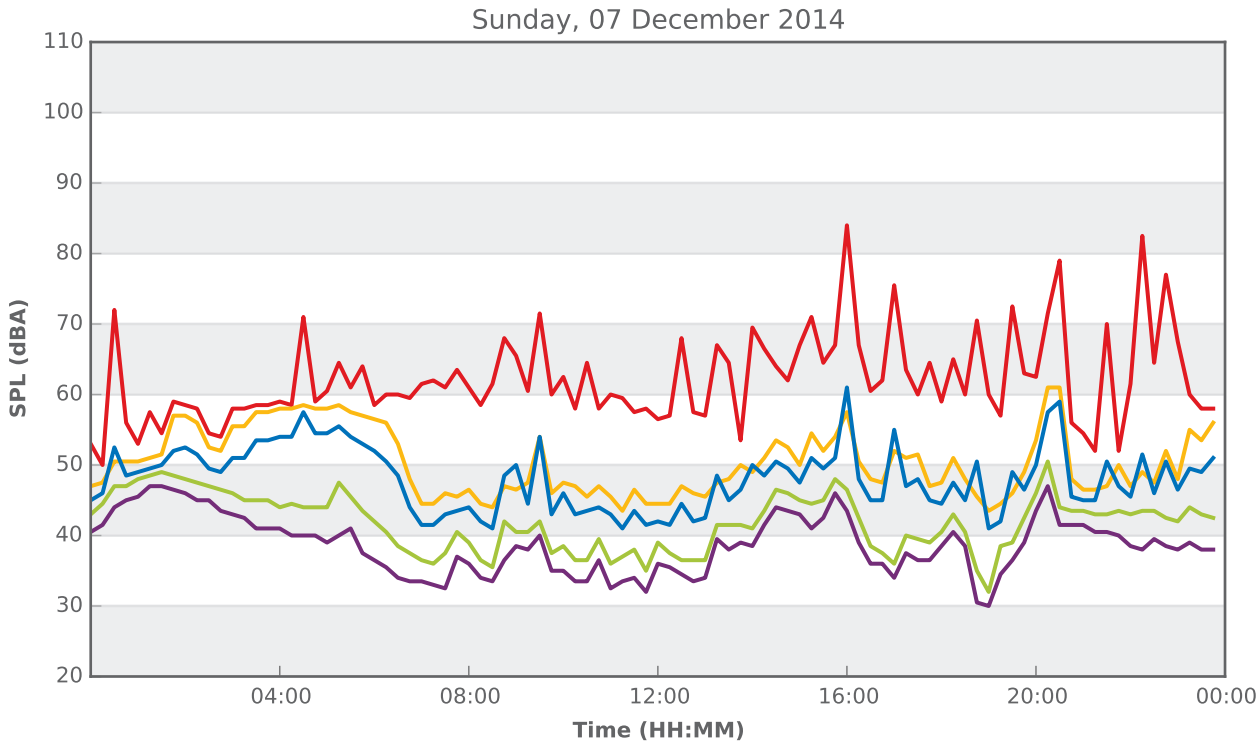
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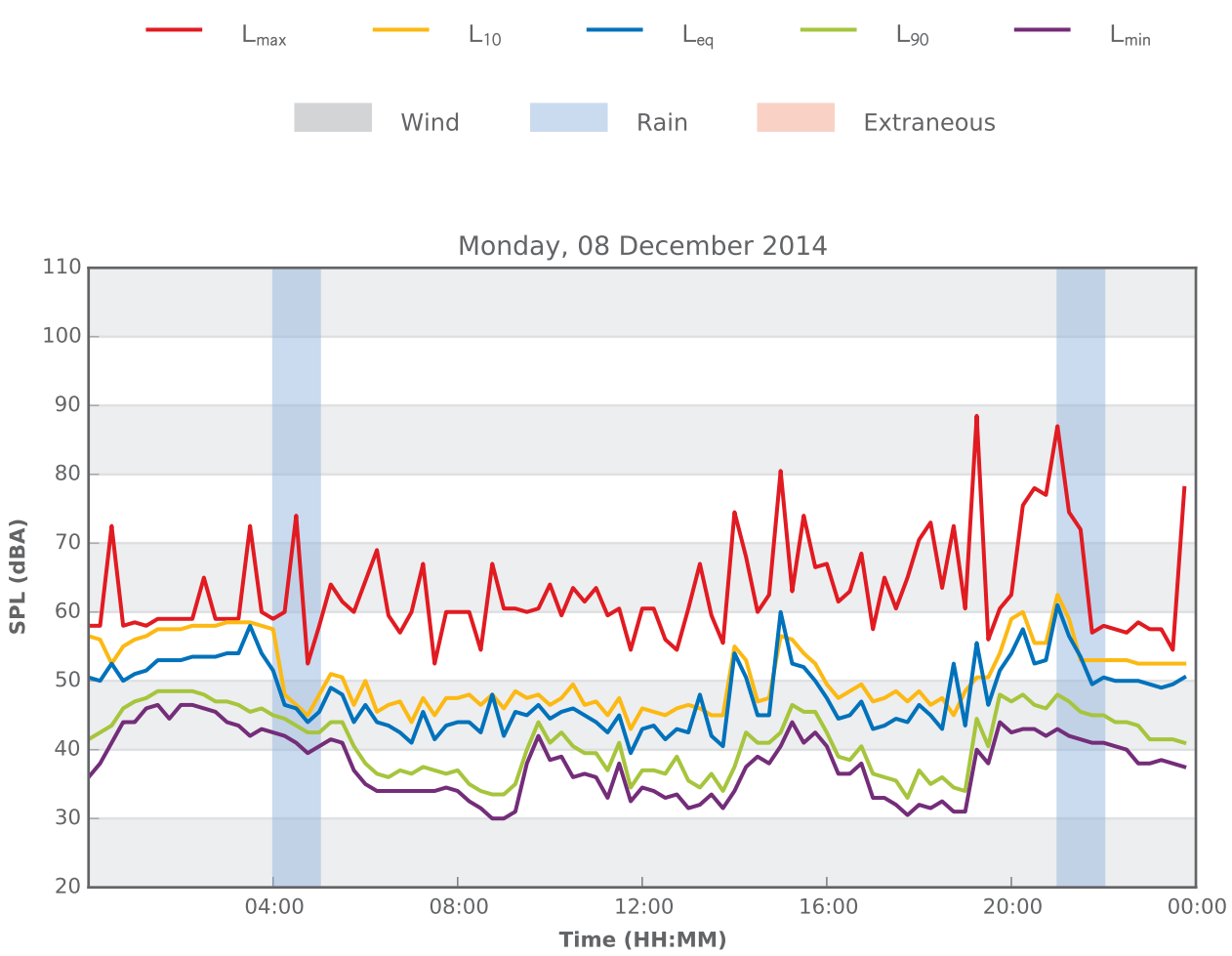

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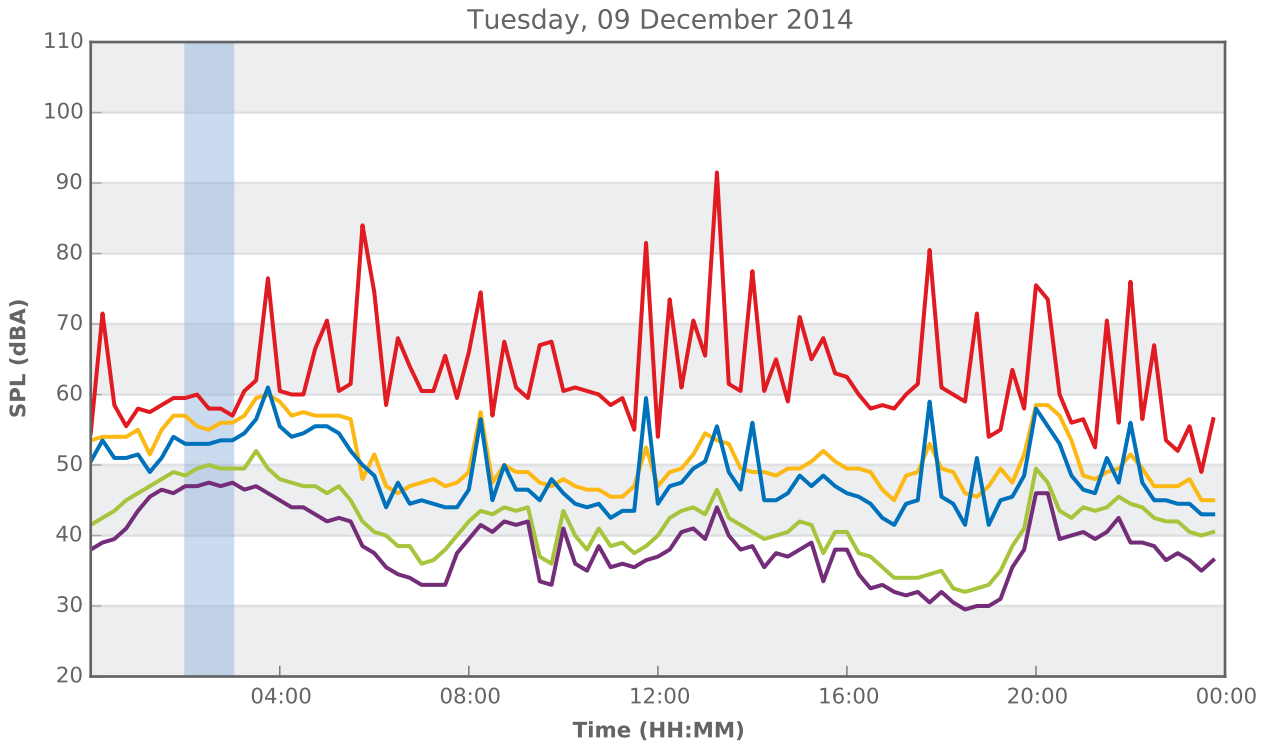
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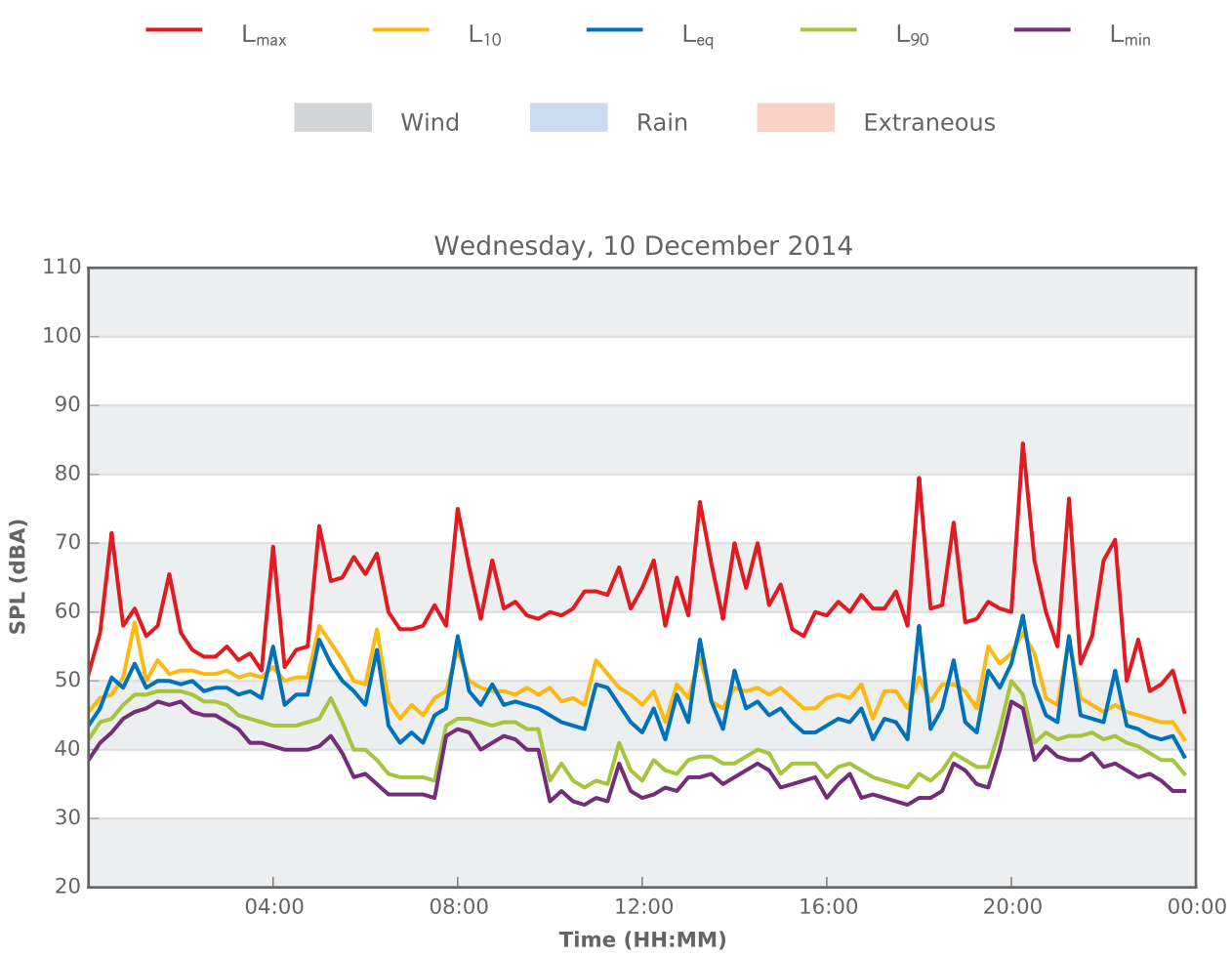

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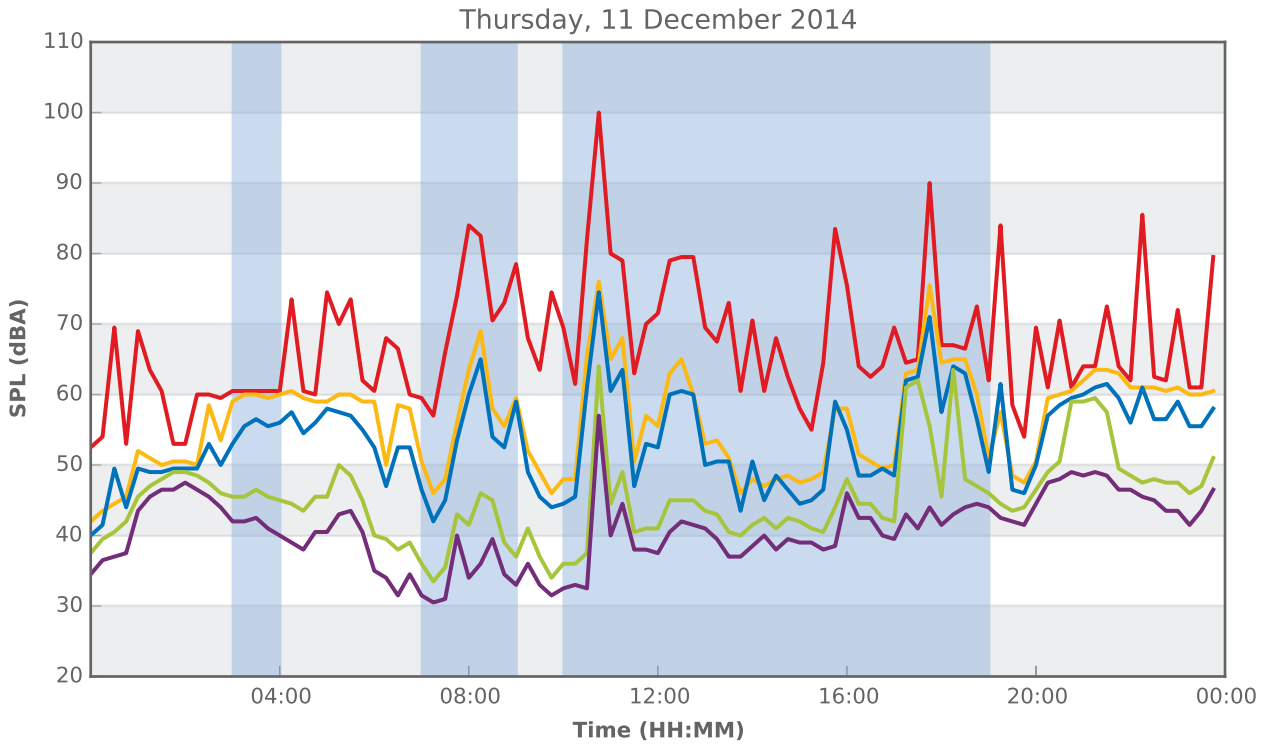
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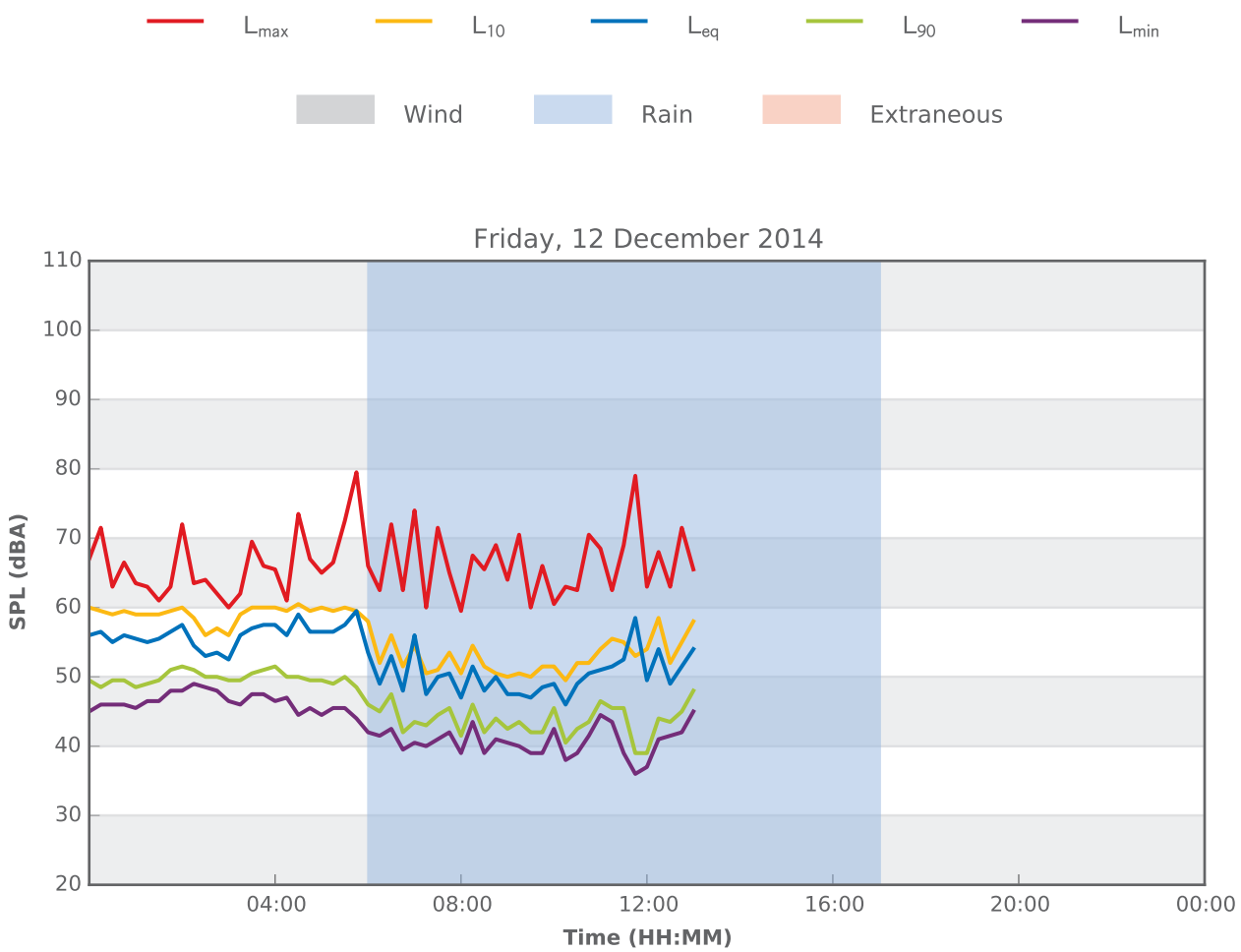

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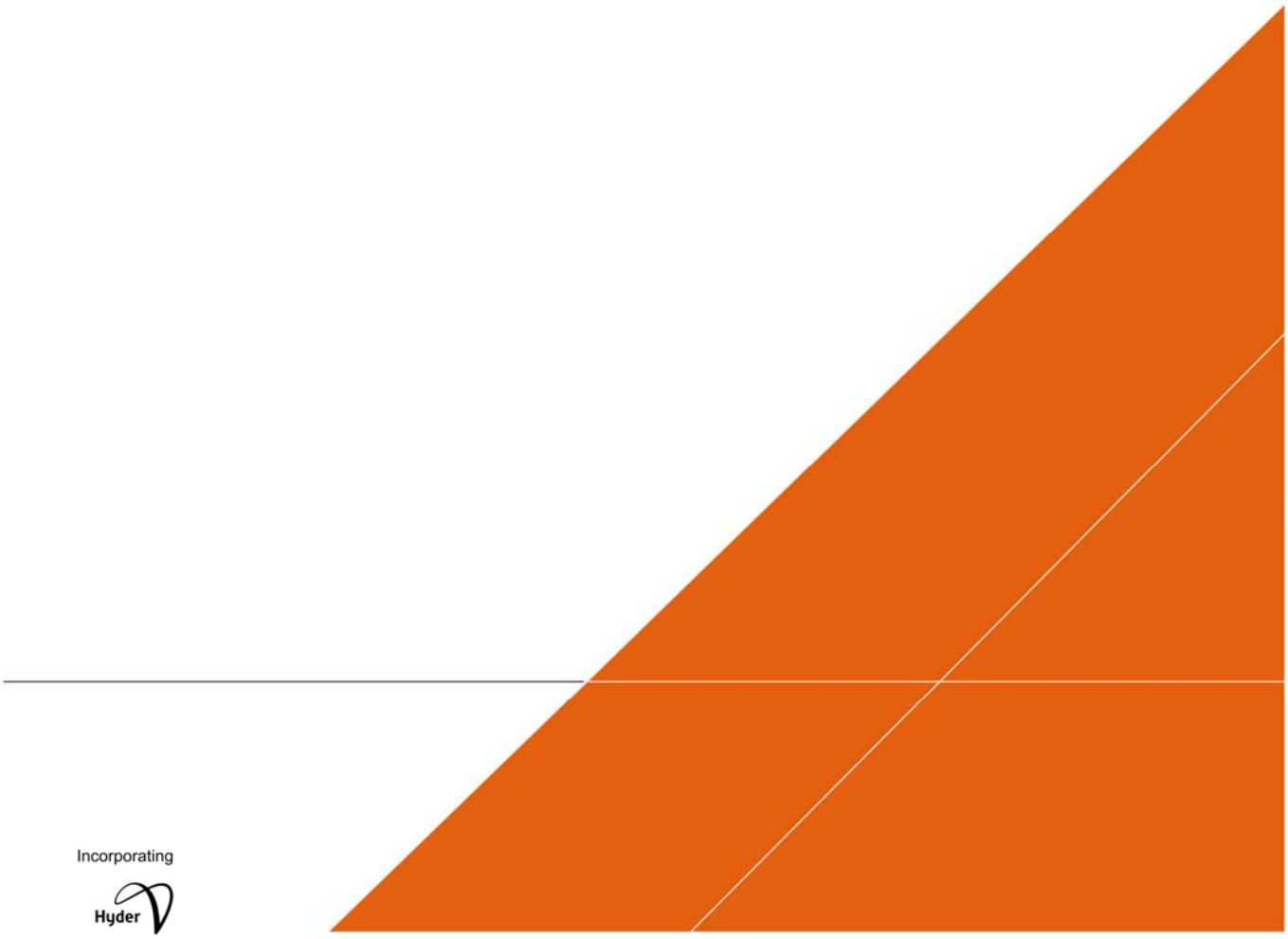
APPENDIX J TRAFFIC IMPACT ASSESSMENT

ARCADIS Design & Consultancy for natural and built assets

CAIRNCROSS WASTE MANAGEMENT FACILITY

Traffic Impact Assessment

28 APRIL 2017



Incorporating Hyder

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PORT MACQUARIE HASTINGS COUNCIL
CAIRNCROSS WASTE MANAGEMENT FACILITY ENVIRONMENTAL ASSESSMENT

Traffic Impact Assessment

Author	Sakeeb Islam, Luke Goldsworthy	
Checker	Michael Yong	
Approver	Michael Yong	
Report No	AA007398	
Date	28/04/2017	
Revision Text	C	

This report has been prepared for Port Macquarie-Hastings Council in accordance with the terms and conditions of appointment for the expansion of the Cairncross Waste Management Facility project dated 27 November 2014. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	13/03/2017	Draft Traffic Impact Assessment	SI, LG	MY
B	11/04/2017	Final Traffic Impact Assessment – PMHC Review	SI, LG	MY
C	28/04/2017	Final Traffic Impact Assessment	SI, LG	MY

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APPENDIX C SIDRA SUMMARY RESULTS

APPENDIX D SITE DISTANCE PHOTOS

APPENDIX E CRASH DATA

1 INTRODUCTION

Port Macquarie-Hastings Council (PMHC) oversees the operation of the Cairncross Waste Management Facility (Cairncross WMF), which includes the operation of a landfill, Waste Transfer Station (WTS), an Organics Resource Recovery Facility (ORRF) and a Material Recovery Facility (MRF). The Cairncross WMF was granted approval under Part 4 and Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for Stage 1 in 1999 (now referred to as the existing landfill or 'Stage E') and commenced operations in September 2001.

The Stage E landfill is expected to reach capacity in approximately 2020. PMHC is now seeking approval for three new landfill stages (the Proposal) from the Department of Planning and Environment (the Department) as State Significant Development (SSD) under Part 4, Division 4.1 of the EP&A Act. The additional stages would be in the same geographical location identified in the Environmental Impact Statement prepared in 1999 (1999 EIS) to support the original Cairncross WMF approval.

PMHC submitted a request for the Director General's Requirements (DGRs) (now Secretaries Environmental Assessment Requirements (SEARs)) for the Proposal on 24 February 2015. The SEARs were subsequently issued on 7 May 2015 (Reference SSD 13_5792). An extension to the SEARs was granted on 20 February 2017.

Arcadis has been engaged by PMHC to prepare an EIS for the Cairncross Landfill Expansion. This Traffic Impacts Assessment (TIA) has been prepared by Arcadis to supplement the EIS and support the application for approval of the landfill expansion. The TIA addresses the requirements of the SEARs as discussed below.

1.1 SEARs Requirements

This traffic report has been prepared to support the Environmental Impact Statement (EIS) for approval of the Proposal.

This traffic report has been prepared as part of a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the EP&A Act. This report has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 13-5792 and dated May 2015). Table 1-1 provides a summary of the SEARs which are relevant to this report and the section where they have been addressed in this report.

The report provides an assessment of potential traffic impacts on the road network during operation of the Proposal, and identifies mitigation measures to address any potential impacts.

Table 1-1 SEARs (SSD 13-5792) Compliance Table

SEAR	Where Addressed	
	Document	Sections
Traffic		
• details of all traffic types and volumes likely to be generated;	Traffic Impact Assessment Report	Section 4.1
• assessment of predicted impacts on road safety and the capacity of the road network to accommodate the project; and		Section 3.2.1, 3.2.2, 4.3, 4.6, 4.7
• assessment of where off site infrastructure works are required as a result of traffic impacts.		Section 4.3, 4.8, 5.0

1.2 Proposal Overview

The Proposal would involve the progressive construction, operation and rehabilitation of three landfill stages (Stages 1-3), as shown in Figure 1-1, following a staged approach with implementation over a period of approximately 36 years. Stage 1 would commence construction and operation in the year 2019 and 2020, respectively, Stage 2 would commence in the year 2040 and Stage 3 in 2047. It is envisaged that Stage 3 would reach capacity by the year 2056 with a landfill closure period to follow. The details of landfill staging are included in Table 1-2. The assessment years for this traffic assessment have been selected as the 2020 (opening year) and the 2056 (closing year). The 2056 closing year has been selected (rather than the standard 10-years after opening) to provide an indication of the worst-case traffic impacts (i.e. the final year represents the highest waste acceptance rate and therefore the highest associated traffic generation for the Proposal). The Proposal Site is shown on Figure 1-1.

Table 1-2 Details of landfill stages

Stage	Timeframe[1]	Duration (years)	Activities
Stage 1	2020 – 2040	20	Progressive landfill cell construction, operation and rehabilitation.
Stage 2	2040 – 2047	7	
Stage 3	2047 – 2056	9	
Total	**2020 – 2056**	**36**	

[1] Timeframes are approximate and subject to change (e.g. based on altered resource recovery and waste generation rates which would influence landfill life expectancy)

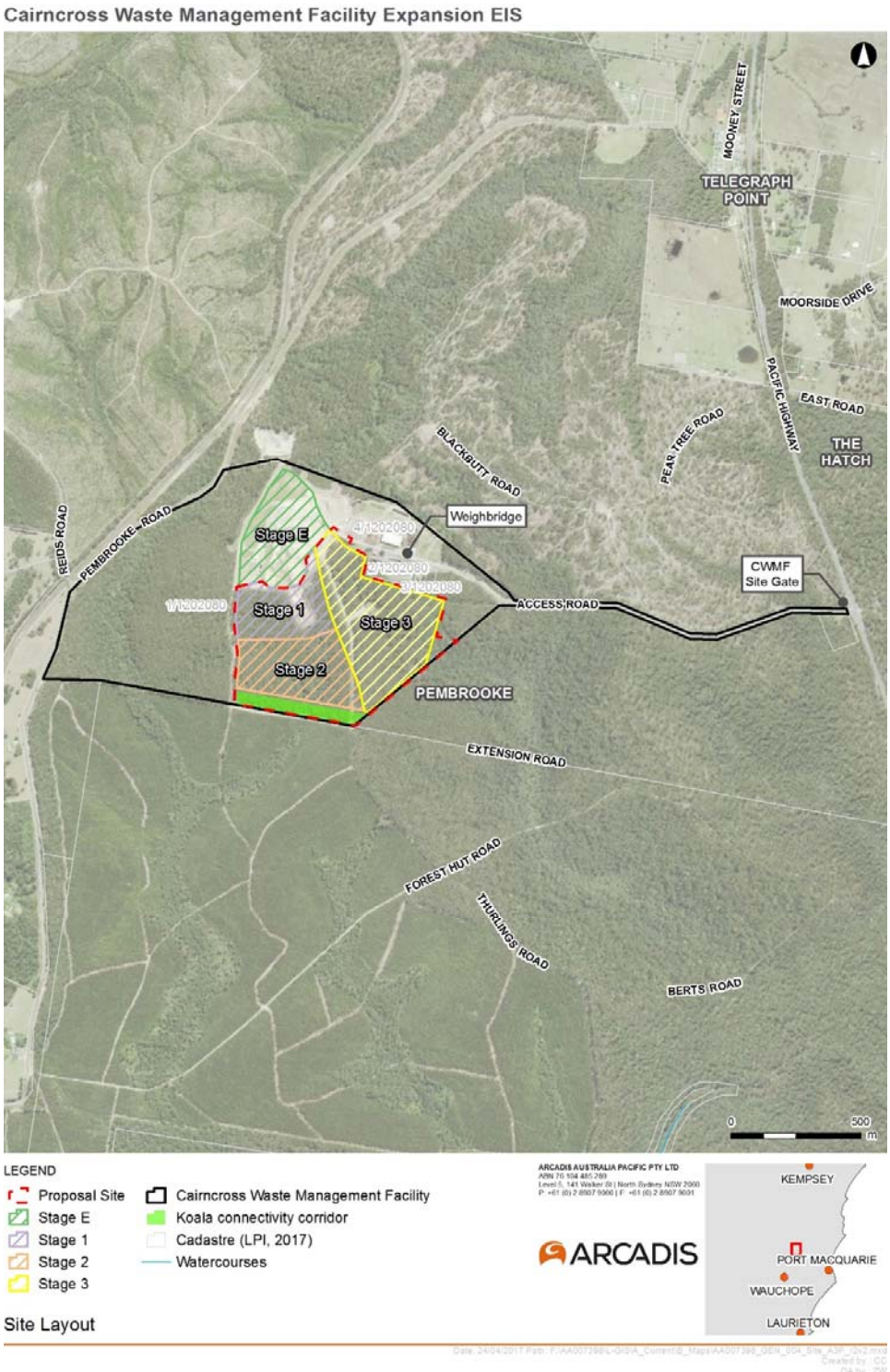


Figure 1-1 Proposed landfill staging for the Proposal

1.3 Assumptions

For the purpose of this Traffic Impact Assessment (TIA) the following assumptions were made:

- Due to count station ID 6126 only having southbound data available, a proportional calculation was undertaken using the proportion of northbound data captured in station ID 6128-PR and applied to station ID 6126 to determine the hourly northbound traffic volumes
- It was assumed that the Pacific Highway upgrade (Oxley Highway to Kempsey) has not been completed as at February 2017
- The Proposal would involve the progressive construction, operation and rehabilitation of three landfill stages (Stages 1-3), following a staged approach with implementation over approximately 36 years. Stage 1 would commence construction and operation in the year 2019 and 2020, respectively, Stage 2 would commence in the year 2040 and Stage 3 in 2047. It is envisaged that Stage 3 would reach capacity by the year 2056 with a landfill closure period to follow.
- Based on the above, the TIA was conducted for the opening year (2020) and the closing year (2056) of the Proposal
- For the opening year (2020) and closing year (2056) assessment years, it was assumed that the Oxley Highway to Kempsey section of the Pacific Highway upgrade has been completed and is operational
- Future (i.e. 2020 and 2056) traffic volumes have been based on strategic traffic volumes determined within the SMEC/Hyder Joint Venture Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013). A copy of the report is provided in Appendix A
- A background traffic growth rate of 2.8% per annum (linear) was adopted for background traffic growth based on the SMEC/Hyder Joint Venture Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013)
- A waste related traffic growth rate of 3.36% per annum (compound) has been adopted for this assessment. This rate is based on the population growth rate and waste generation growth rate adopted in the *Cairncross Landfill Expansion: Future Disposal Capacity Requirements Report* (Arcadis, 2016)
- The waste related traffic growth was applied to light vehicles to account for potential increases in staff and the sewage treatment plant traffic and would represent a worst-case scenario
- Count data collected at the Cairncross Waste Management Facility (CWMF) weighbridge was classified as light and heavy vehicles based on the Gross Vehicle Mass (GVM) of the vehicles. The following was used to determine the classification of vehicles derived from the weighbridge data and is based on the NSW license classification system where:
  - Light Vehicles were vehicles which has a GVM of less than 4.5 Tonnes; and
  - Heavy Vehicles were vehicles which has a GVM of more than 4.5 Tonnes
- Traffic distribution for the Proposal was based on calculated percentage turn movements derived from the SMEC/Hyder Joint Venture Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013)
- Background traffic volumes were capped at 2036 and not grown to 2056 due to uncertainty of future land-uses beyond 20 years
- Any vehicle recorded with no GVM was considered a Light Vehicle for the purpose of this assessment

1.4 Report Structure

This Traffic Impact Assessment contains the following four chapters providing an assessment of the traffic issues relating to the proposed operation of the Proposal:

Section 1: Introduction – Provides background information on the Proposal, the SEARs and assumptions made for the assessment.

Section 2: Methodology – Provides an account of the steps undertaken to assess the potential traffic impacts related to the Proposal

Section 3: Existing Conditions – Provides an overview of the existing road and traffic conditions within proximity of the Proposal Site[2].

Section 4: Traffic Impact Assessment – Presents the findings and likely impacts from a traffic perspective as a result of the traffic generated by the Proposal. It also identifies any mitigation measures that would need to be implemented to reduce or mitigate the likely impacts caused by the Proposal.

Section 5: Conclusion – Provides the recommendations of the traffic impact assessment and any required mitigation.

[2] The Proposal Site includes the proposed Stage 1, 2 and 3 landfill cells, as shown on Figure 1-1. The Proposal Site is located within the broader CWMF.

2 METHODOLOGY

To assess any potential impacts of the Proposal during operation, the following tasks was undertaken:

1. Identification of existing road network conditions and performance (Section 3) including:
    a. Review of existing configuration of the surround road network and its function
    b. Review of existing daily traffic data on key roads on the surrounding road network
2. Identification of Proposal traffic generation and traffic distribution onto the surrounding road network (Section 4.1 and Section 4.2)
3. Undertake traffic assessment to identify the likely impacts as a result of the Proposal on the local and regional road network(s) for the peak periods (Section 4.3). A detailed breakdown of the traffic impact assessment methodology is provided in Section 2.1.1
4. Undertake an assessment of the likely impacts the Proposal will have on parking, road safety and crashes (Sections 4.4 to 4.7)
5. Identification of mitigation measures to minimise and/or manage any potential impacts on the local and regional road network, based on the results of the assessment (Section 4.8)
6. Summarise the findings of the Traffic Impact Assessment (Section 5).

2.1.1 Traffic impact assessment methodology

To undertake the assessment the following methodology was adopted for this Traffic Impact Assessment:

1. Determine Proposal traffic by determining the volume of traffic recorded in the weighbridge data which accessed the landfill section of the Cairncross WMF
2. Determine background/existing traffic accessing the Cairncross WMF by removing landfill related traffic from the data recorded at the weighbridge
3. Determine existing background traffic on Pacific Highway through the following steps:
    a. Use Roads and Maritime AADT Station ID 6128-PR data to determine proportion of northbound traffic to southbound traffic.
    b. Apply calculated proportions to Southbound only data for Roads and Maritime AADT Station ID 6126 to determine northbound and southbound traffic on Pacific Highway for existing scenario assessment
    c. Determine hourly percentage for existing Pacific Highway traffic
4. Determine future year traffic volumes on former Pacific Highway (becomes local council road following the realignment of the existing Pacific Highway) through the following steps:
    a. For 2020 traffic volumes, extrapolate 2020 traffic volumes by using 2016 and 2020 daily traffic volumes as reported in the SMEC/Hyder Joint Venture Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013)

b. For 2056 traffic volumes, 2036 daily traffic volumes as reported in SMEC/Hyder Joint Venture Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013) are to be adopted

c. Apply peak hour percentages identified in Step 3(c) to 2020 and 2056 daily traffic volumes to determine hourly profile

5. For 2020 and 2056 turn percentage for Cairncross WMF data, in/out percentage splits were calculated based on 2016 daily turn movements as provided in the SMEC/Hyder Joint Venture Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013)
6. Based on Cairncross WMF data identified in steps 1 and 2, determine peak hour background/existing traffic volumes and Proposal traffic volumes
7. Apply turn percentages identified in step 5 to background/existing traffic volumes and Proposal traffic determined in step 6
8. Increase all Cairncross WMF traffic using the adopted growth rate of 3.36% (compounding) to 2020 and 2056 assessment years
9. Input traffic volumes determined in steps 4 and 8 into SIDRA intersection modelling software and extract results for all assessment years

3 EXISTING CONDITIONS

3.1 Surrounding Road Network

The key roads providing access to and from the Proposal Site are presented in Figure 3-1 and comprise:

- Pacific Highway (to be referred to as the local council road beyond 2017. This road will have an arterial function); and
- Cairncross WMF Access Road.

Cairncross WMF Access Road is considered a private 'local road' and is managed by Port Macquarie-Hastings Council. The Pacific Highway is a state controlled road and is managed by Roads and Maritime Services (Roads and Maritime). A more detailed description for the Pacific Highway and Cairncross WMF Access Road is provided in Section 3.1.1 and Section 3.1.2, respectively.



Figure 3-1 Location of the Cairncross WMF (Source: Google)

3.1.1 Pacific Highway

The Pacific Highway is a state road that extends between Hexham to the Queensland border and passes Gosford, Newcastle, Taree, Port Macquarie, Kempsey, Coffs Harbour, Grafton, and Ballina. The Pacific Highway has a total length of 620 kilometres and is a sealed road along the whole section. According to Roads and Maritime, currently 459 kilometres of the Pacific Highway between Hexham and the Queensland border is now a four-lane divided carriageway (70%) and approximately 161 kilometres are being upgraded (24%) with the remaining sections currently being prepared for major work. The Pacific Highway has an existing speed limit of 100km/h approaching the site from both directions.

Between 1 July 2011 and 30 June 2016, there was one recorded crash (fatality) on the Pacific Highway approximately 300 metres south of Bill Hill Road. The crash statistics showed there were no recorded crashes at or within the vicinity of the Pacific Highway / Cairncross WMF Access Road / Bill Hill Road intersection (herein referred to as the Study Intersection).

3.1.2 Cairncross WMF Access Road

Cairncross WMF Access Road is a private local road heading west from the Pacific Highway into the CWMF. The road is a sealed road, at its intersection with the Pacific Highway, for approximately two kilometres to the west. Cairncross WMF Access Road has an approximate width of seven metres. The CWMF is located approximately two kilometres to the west of the Study Intersection. Cairncross WMF Access Road has a posted speed of 60 km/h for the entirety of the road section.

Between 1 July 2011 and 30 June 2016, there were no recorded crashes on Cairncross WMF Access Road. As stated in Section 3.1.1, there were no recorded crashes at the Study Intersection.

3.2 Existing Traffic Conditions

For the purpose of understanding the existing traffic conditions in proximity of the Study Intersection, the following data sources were used:

- Roads and Maritime AADT Station ID 6126 located 730m North of Glen Ewan Road, Blackmans Point 2444 – April to December 2015
- Roads and Maritime AADT Station ID 6128-PR located 110m North of Ryans Road, Lake Innes 2446 – April to December 2015
- Port Macquarie-Hastings Council CWMF Weighbridge Data – January to December 2015

A discussion of the existing traffic volumes and roadway capacity is provided in Sections 3.2.1 and 3.2.2, respectively.

3.2.1 Existing Traffic Volumes

The traffic data was analysed to determine the average weekday and weekend traffic volumes and typical peak hour volumes by direction. Table 3-1 summarises indicative traffic volumes derived from the traffic count data.

Table 3-1 Average Daily Traffic Volumes (2015)

Location	Weekday			Weekend		
	Total EB/SB* (%HV)	**Total WB/NB* (%HV)**	**Total Bi-Directional (%HV)**	**Total EB/SB* (%HV)**	**Total WB/NB* (%HV)**	**Total Bi-Directional (%HV)**
Pacific Highway (730m North of Glen Ewan Road, Blackmans Point)	8,181 (24%)	8,483 (24%)	16,664 (24%)	6,091 (15%)	5,547 (13%)	11,637 (14%)
Cairncross WMF Access Road (at weighbridge)	111 (79%)	111 (79%)	222 (79%)	38 (54%)	38 (54%)	76 (54%)

Note: * EB = east-bound, SB = south-bound, WB = west-bound, NB = north-bound

The vehicle counts were classified according to the Austroads classification system (12 classes) whereby light vehicles (LV) consisted of class 1 and 2, and classes 3 to 12 were considered heavy vehicles (HV).

Based on the 2015 Roads and Maritime count station data, it was determined that a total of 16,664 vehicles used the Pacific Highway on an average weekday in 2015, comprising approximately 24% heavy vehicles. It was also determined that a total of 11,637 vehicles used the Pacific Highway on the weekend, comprising approximately 14% heavy vehicles.

Based on the 2015 CWMF weighbridge data, it was determined that a total of 222 vehicles used Cairncross WMF Access Road on an average weekday, comprising approximately 79% heavy vehicles. It was also determined that a total of 76 vehicles used Cairncross WMF Access Road on the weekend, comprising approximately 54% heavy vehicles.

A peak hour analysis for the Study Intersection was undertaken by combining the average daily traffic volumes for the Pacific Highway and Cairncross WMF Access Road for the weekday and weekend. The weekday AM peak was determined to be from 8:00am to 9:00am and the weekday PM peak was determined to be from 4:00pm to 5:00pm. The weekend peak was determined to be from 11:00am to 12:00pm. The hourly profile for the weekday and weekend traffic volumes is presented in Figure 3-2 and Figure 3-3, respectively. The peak hours at the Study Intersection were predominantly influenced by traffic travelling northbound and southbound on the Pacific Highway, rather than traffic accessing the Cairncross WMF.

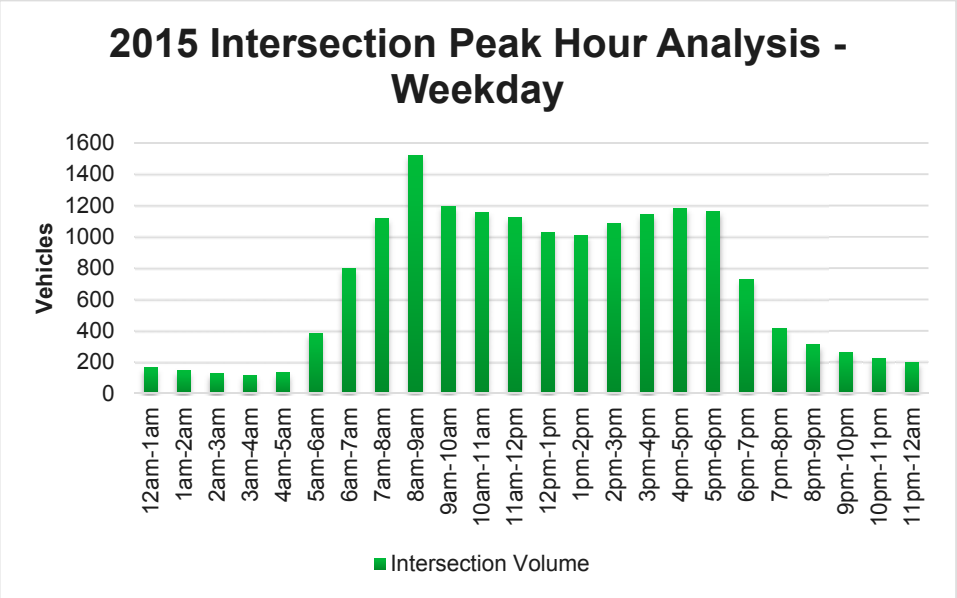


Figure 3-2 Hourly Traffic Volume Profile - Weekday

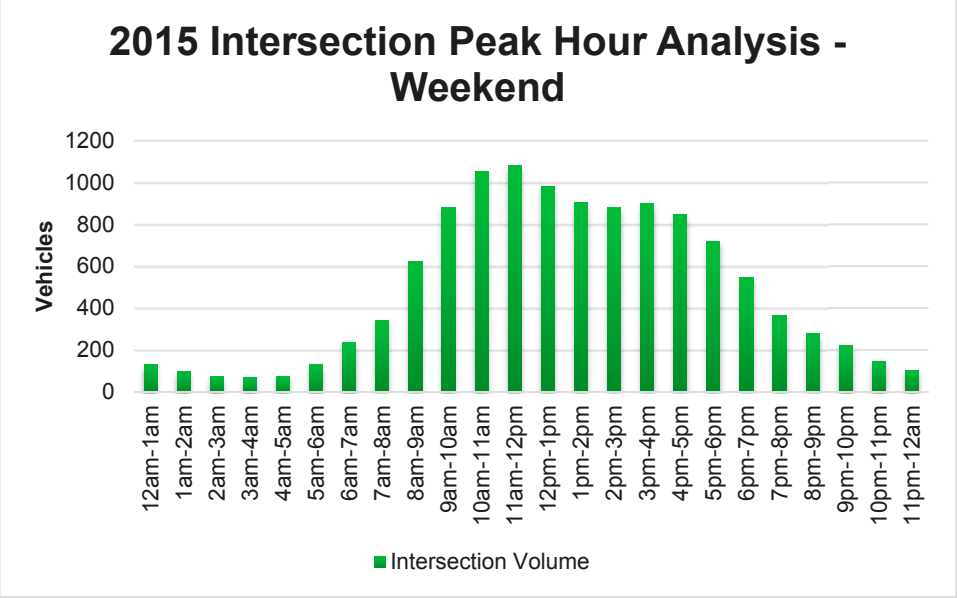


Figure 3-3 Hourly Traffic Volume Profile – Weekend

3.2.2 Roadway Capacity for Two-Lane Two-Way Highway

The Austroads Guide to Traffic Engineering Practice Part 2: Roadway capacity (Austroads Guide) defines level of service (LOS) as a qualitative measure describing operational conditions within a traffic stream.

The volume and composition of traffic on a given road determines the level of interaction between vehicles and is measured as its LOS. For a particular roadway capacity, the LOS deteriorates with increasing traffic volumes. LOS A, LOS B and LOS C in a rural context are all satisfactory. LOS D can be satisfactory in some circumstances.

The Austroads Guide provides planning guidance on maximum AADT values that two-lane, two-way rural roads can accommodate under various terrain conditions.

Table 3-2 shows the values for various LoS for a rural road in level terrain, with varying ratios of design hour volume to AADT. The underlined and bolded values are those relevant to the Proposal, as discussed further below.

Table 3-2 Maximum AADTs for Various Levels of Service on Two-Lane Two-Way Rural Roads on Level Terrain, vehicles per day

Design Hour Volume to AADT Ratio	LoS A	LoS B	LoS C	LoS D	LoS E
0.10	2,400	4,800	**7,900**	**13,500**	22,900
0.11	2,200	4,400	7,200	12,200	20,800
0.12	2,000	4,000	6,600	11,200	19,000
0.13	1,900	3,700	6,100	10,400	17,600
0.14	1,700	3,400	5,700	9,600	16,300
0.15	1,600	3,200	5,300	9,000	15,200

Source: Austroads Guide to Traffic Engineering Practice, Part 2: Roadway Capacity, Table 3.9, from TRB Highway Capacity Manual (1985) Table 8.10.

Based on the traffic count data adopted for the assessment, a design hour volume to AADT ratio of 0.10 is relevant to the Proposal. With a reported ADT of 16,664 and 11,637 vehicles per day (see Table 3-1) for the weekday and weekend, respectively, the LOS on the Pacific Highway is equivalent to LOS D and LOS C for the weekday and weekend, respectively. This indicates that the existing Pacific Highway has a mostly stable flow with some delays for the weekday and stable flow with spare capacity to accommodate additional traffic for the weekend.

As a result of the Pacific Highway upgrade (between the Oxley Highway and Kempsey), a large proportion of traffic will be diverted from the existing Pacific Highway alignment to a new alignment. The existing Pacific Highway, at the intersection with the Cairncross WMF Access Road, would become a local council road. The realignment of the Pacific Highway is anticipated to result in a reduction in traffic volumes at this location from 16,664 vehicles per day in 2015 to approximately 2,262 (86% reduction) in the year 2020 and approximately 2,560 (85% reduction) in the year 2056 during an average day.

As a result of this reduction in traffic volumes, the LOS would be equivalent to LOS A (assuming a design hour volume to AADT ratio of 0.10[3] based on the count data) for both 2020 and 2056 and indicates that the local council road would have a free, unrestricted flow.

Table 3-3 Projected Average Daily Traffic Volumes for Pacific Highway (local council road)

Year	Average Daily Traffic^		
	Total SB* (%HV)	**Total NB* (%HV)**	**Total Bi-Directional (%HV)**
2020	1,222 (13%)	1,040 (11%)	2,262 (12%)
2056	1,370 (15%)	1,190 (13%)	2,560 (14%)

Note:

* SB = south-bound, NB = north-bound

^ Volumes used for the future scenarios (2020 and 2056) were based on a single daily strategic volume reported in the SMEC/Hyder report

[3] The design volume to AADT ratio was calculated to be 0.08 based on the count data. A ratio of 0.10 was adopted for the assessment as it is the lowest value presented (in the Austroads Guide to Traffic Engineering Practice, Part 2: Roadway Capacity, Table 3.9) and it would not be expected to be higher than 0.10.

4 TRAFFIC IMPACT ASSESSMENT

The CWMF has been identified as a Traffic Generating Development under Schedule 3 of the State Environmental Planning Policy (Infrastructure) 2007[4]. This section has been prepared to assess the potential impacts on road capacity, efficiency and safety associated with the Proposal. The assessment has been undertaken for the adjacent major road and key intersections to assess potential impacts from operational traffic.

Due to existing on-site equipment and plant used to construct the additional waste cells, no construction related traffic will be generated externally and as such no construction traffic impact assessment was warranted. The assessment analysed the existing situation (2017) and the anticipated impacts in the opening (2020) and closing (2056) year of the waste facility.

4.1 Traffic Generated by the Proposal

This section provides a summary of the operational traffic generated by the Proposal for the following three scenarios:

- Existing year (Proposal not operating) – 2017: Weekday AM Peak, Weekday PM Peak and Weekend Peak
- Opening year (commencement of Stage 1) – 2020: Weekday AM Peak, Weekday PM Peak and Weekend Peak
- Closing year (conclusion of Stage 3) – 2056: Weekday AM Peak, Weekday PM Peak and Weekend Peak

4.1.1 Waste Disposal Traffic Generation

Traffic related to the Proposal would comprise of typically Austroads Class 5 (Four Axel trucks) only with no cars typically permitted to access the landfill. Peak volumes have been determined based on existing vehicle access patterns at the Cairncross Waste Management Facility which is based on weighbridge data provided by PMHC.

Table 4-1 shows the average weekday and weekend vehicle trips associated with the existing landfill for the year of 2017, as well as the year of opening (2020) and final year of operation (2056).

The current (existing year) total average weekday and weekend trips (two-way) to the Cairncross WMF is 81 and 35, respectively. The total number of two-way trips to the Proposal Site in the year of opening (2020) on an average weekday and weekend would be 91 and 39 vehicles, respectively. In the year of closing (2056) on an average weekday and weekend, there would be a total of 296 and 135 two-way trips, respectively.

Table 4-1 Waste Disposal Traffic Generation (two-way trips/day)

Vehicle Type	Existing Year (2017)		Opening Year (2020)		Closing Year (2056)	
	Average Weekday	**Average Weekend**	**Average Weekday**	**Average Weekend**	**Average Weekday**	**Average Weekend**
LV	11*	8*	13*	9*	41*	37*

[4] It is noted that a waste transfer station of any size or capacity meets the requirements to be identified as a Traffic Generating Development.

Vehicle Type	Existing Year (2017)		Opening Year (2020)		Closing Year (2056)	
HV	70	27	78	30	255	98
Total	81	35	91	39	296	135

Note: * A growth rate of 3.36% was applied to LVs to account for a potential increase in Proposal staff as a worst-case scenario.

It was observed that operational traffic typically accesses the Cairncross WMF between 6:30am and 3:45pm during a weekday and 7:45am and 4:00pm on the weekend. Due to the weekday PM peak for the Study Intersection occurring between 4:00pm and 5:00pm (refer to Section 3.2.1), no traffic related to the Proposal is anticipated to be accessing the site during this peak. A breakdown of Proposal traffic for the weekday AM peak (8:00am-9:00am), PM peak (4:00pm-5:00pm) and weekend peak (11:00am-12:00pm) is tabulated below in Table 4-2.

Table 4-2 Waste Disposal Traffic Generation (two-way trips/peak period)

Peak Period	Existing Year (2017)			Opening Year (2020)			Closing Year (2056)		
	LV	**HV**	**Total**	**LV**	**HV**	**Total**	**LV**	**HV**	**Total**
Weekday AM peak (8:00am-9:00am)	5*	10*	15	5*	10*	15	5*	24	23
Weekday PM peak (4:00pm-5:00pm)	5**	5**	10	5**	5**	10	5**	5**	10
Weekend peak (11:00am-12:00pm)	5*	5*	10	5*	5*	10	5	10*	15

Note: *Due to peak hour volumes being low, more conservative volumes were used. If the calculated trips were less than five trips, the trips were rounded up to five. Any trips greater than five and less than ten were rounded up to ten for a conservative assessment.

** For the weekday PM peak, there were zero vehicles observed accessing the site. A nominal figure of 5 vehicles per hour was adopted for the purpose of the assessment in the SIDRA modelling, as a worst-case assumption.

4.2 Site Access and Egress

The Proposal will receive waste from all areas within the Port Macquarie-Hastings local government area (LGA) including the major townships of Port Macquarie, Kempsey, Wauchope and Camden Haven. All vehicles currently access the Cairncross WMF via Cairncross WMF Access Road with direct connectivity to the existing Pacific Highway (which will become a local council road following the realignment of the Pacific Highway). In future, site access and egress for the Proposal will be via Cairncross WMF Access Road which will connect to the local council road (former Pacific Highway) and two new interchanges with the new Pacific Highway.

The Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013) estimated the distribution of traffic entering and exiting the Cairncross WMF Access Road following the realignment of the Pacific Highway. This distribution (based on 2016 vehicle distribution) has been adopted for all years and peak hours and is as follows:

- Heavy Vehicles
  - Entering the Proposal Site:
    - 25% from the north
    - 75% from the south
  - Exiting the Proposal Site:
    - 20% to the north
    - 80% to the south
- Light Vehicles
  - Entering the Proposal Site:
    - 50% from the north
    - 50% from the south
  - Exiting the Proposal Site:
    - 31% to the north
    - 69% to the south

4.3 Impacts to the Road Network

Based on the traffic generation outlined in Section 4.1, and the access/egress routes described in Section 4.2 above, it has been determined that the Proposal may have the potential to impact the Study Intersection as well as the capacity on the new Pacific Highway interchanges. An assessment of the impact of this net increase on the road capacity for these key intersections is outlined below.

Turn movement diagrams for the Study Intersection are provided in Appendix B of this report.

4.3.1 Study Intersection

An analysis of the likely impact the Proposal would have on the Study Intersection has been undertaken using traffic analysis software SIDRA (version 7 at the time of undertaking the assessment). Table 4-3 below shows standard Level of Service (LoS) criteria used for an intersection assessment as per the Roads and Maritime Guide to Traffic Generating Developments, against which the intersection performance for the existing, opening and closing years was assessed.

Table 4-3 Level of Service Criteria for Intersection Capacity Analysis

Level of Service (LoS)	Average Delay per Vehicle (sec/veh)	Give Way and Stop Signs
A	<14	Good operation
B	15 to 28	Acceptable delays and spare capacity
C	29 to 42	Satisfactory, but accident study required
D	43 to 56	Near capacity and accident study required
E	57 to 70	At capacity, requires other control mode
F	>70	Unsatisfactory with excessive queuing

Source: Roads and Maritime Services Guide to Traffic Generating Developments

For this TIA, the SIDRA assessment was undertaken for the years and peak periods identified in Section 4.1. A performance criteria of LOS D or better was adopted.

Table 4-4 shows the delay and LOS results from SIDRA at the Study Intersection for all assessment years and peak periods.

For the existing year (with operational traffic), the SIDRA model predicts a LOS F at the Study Intersection in the weekday AM and PM peak and weekend peak. For the opening year and closing year (with Proposal traffic), the SIDRA model predicts a LOS A at the Study Intersection on the weekday AM and PM peak and weekend peak, which is acceptable (i.e. LOS D or better).

The results of this assessment show that no upgrades are required at the Study Intersection due to Proposal traffic.

Table 4-4 SIDRA Summary Results for the Study Intersection

Year	Weekday AM (8:00am-9:00am)			Weekday PM (4:00pm-5:00pm)			Weekend (11:00am-12:00pm)		
	Volume (Vehs/hr)	**Delay (s)**	**LOS**	**Volume (Vehs/hr)**	**Delay (s)**	**LOS**	**Volume (Vehs/hr)**	**Delay (s)**	**LOS**
Existing Year (2017)	1,741	>200	F*	1,359	>200	F*	1,240	>200	F*
Opening Year (2020)	275	10	A	201	9	A	266	10	A
Closing Year (2056)	337	13	A	226	10	A	311	10	A

Note: * LOS F estimated for the minor east/west approaches at the intersection

The intersection impacts as a result of the increase in vehicles associated with the Proposal are offset by the significant reduction in traffic (78% to 86%) using the Service Road as a result of the Pacific Highway upgrade.

SIDRA movement summary results are provided in Appendix C of this report.

4.3.2 New Pacific Highway Interchanges

Due to the uncertainty in the layout of the proposed interchanges for the new Pacific Highway, a high-level assessment was undertaken to determine the percentage of Proposal traffic at the interchanges for the opening year and closing year only (i.e. 2020 and 2056). Background traffic volumes were based on the strategic traffic volumes reported in the SMEC/Hyder Joint Venture Pacific Highway Upgrade – Oxley Highway to Kempsey Traffic Forecasting Report (2013).

Due to no traffic related to the Proposal being generated during the weekday PM peak and the low volume of Proposal traffic being generated on the weekend, only the weekday AM peak volumes were analysed.

Table 4-5 presents the findings of the likely traffic increase at the proposed Blackmans Point Road interchange, to be located approximately 3.6 kilometres south of the Study Intersection.

Table 4-5 Interchange capacity assessment - Blackmans Point Road Interchange

Interchange	Background Traffic (trips/hr, 2-way)		Proposal Traffic (trips/hr, 2-way)		Percentage of Proposal Traffic to Background Traffic	
Year	2020	2056	2020	2056	2020	2056
Weekday AM Peak	505	479	18	43	3.6%	9.0%

It is anticipated that during the weekday AM peak, the Proposal will add a relatively small number of trips at the intersection i.e. 18 trips/hr (3.6% increase) and 43 trips/hr (9.0% increase) in the year 2020 and 2056, respectively. This is equivalent to an average arrival flow rate of one vehicle every 3.3 minutes (in 2020) and one vehicle every 1.4 minutes (in 2056), which is minimal. As such, the Proposal traffic would have a minimal impact on the operation of the Blackmans Point Road interchange.

Table 4-6 below presents the findings of the likely traffic increase at the proposed Haydons Wharf Road interchange, to be located approximately 7.4 kilometres south/north of the Study Intersection.

Table 4-6 Interchange capacity assessment – Haydons Wharf Road Interchange

Interchange	Background Traffic (trips/hr, 2-way)		Proposal Traffic (trips/hr, 2-way)		Percentage of Proposal Traffic to Background Traffic	
Year	2020	2056	2020	2056	2020	2056
Weekday AM Peak	114	122	7	16	6.1%	13.1%

It is anticipated that during the weekday AM peak, the Proposal will add a relatively small number of trips at the intersection i.e. 7 trips/hr (6.1% increase) and 16 trips/hr (13.1% increase) in the year 2020 and 2056, respectively. This is equivalent to an average arrival flow rate of one vehicle every 8.6 minutes (in 2020) and one vehicle every 3.8 minutes (in 2056), which is minimal. As such, the Proposal traffic would have a minimal impact on the proposed Haydons Wharf Road interchange.

Based on the assessment undertaken for the proposed interchanges of Blackmans Point Road and Haydons Wharf Road, no upgrades are required at the interchanges due to Proposal traffic.

4.4 Onsite Traffic Flows

As discussed in Section 4.1.1, the total average weekday and weekend two-way trips that currently access the site is 81 and 35 vehicles, respectively. The total number of two-way trips to access the site in the year of opening (2020) on an average weekday and weekend would be 91 and 39 vehicles, respectively. In the year of closing (2056) on an average weekday and weekend, there would be a total of 296 and 135 two-way trips, respectively.

All vehicles will enter the site from Cairncross WMF Access Road via a two-way access point, which will be the only point of access/egress to the site. Waste disposal vehicles would enter the site via an existing sealed/gravel road and pass through a weighbridge prior to circulating to the designated waste disposal area. The waste disposal vehicle would then exit the site via the same point of entry via the weighbridge.

4.5 Parking

Additional parking as a result of the Proposal is not required as the expansion of the landfill primarily involves heavy vehicles which travel directly to the tipping face. The Proposal does not include any changes to the current parking arrangements within the broader Cairncross WMF. Public car parking is generally not needed as vehicles would travel directly to the waste drop off area, empty their waste into the bins and then exit the site. However, sufficient temporary parking and waiting areas are available at the weighbridge should loads need to be checked. Staff parking is provided at the existing landfill work shed with capacity for 12 car park spaces for permanent staff. Currently, 9 staff parking bays are utilised at any one time which allow 3 car spaces for visitors/additional staff in future years, if required.

4.6 Road Safety

The existing posted speed limit along the Pacific Highway is currently 100 km/h. The required sight distance used in this report has been derived from the Austroads Guide to Road Design, Part 4A: Unsignalised and Signalised Intersections (Austroads, 2010) which specifies the following:

Approach Sight Distance (ASD)

This is the minimum requirement to provide the driver of a vehicle adequate distance to observe the road layout, including pavement markings, kerbs, islands, etc. in sufficient time to react and stop if necessary before entering the conflict area. Approach Sight Distance is measured from driver eye height (1.05m) to 0.0m (i.e. the road surface).

Safe Intersection Sight Distance (SISD)

It provides sufficient sight distance for a driver of a vehicle on the major road to observe a vehicle from the minor road approach moving into a collision situation (e.g. in the worst case stalling across the traffic lanes), and to decelerate to stop before reaching the collision point. Safe Intersection Sight Distance is measured from the driver eye height (1.05) on the approach with priority to eye height of a driver in the side street (1.05m).

A comparison of the required and available ASD and SISD for vehicles approaching and departing the Study Intersection is set out in Table 4-7 for a vehicle speed of 100km/h.

Table 4-7 Sight Distance Requirements

Minor Road (Entry/Exit)	ASD (minimum requirement)		SISD (desirable requirement)	
	Required distance (metres)	**Measured at intersection entrance (metres)**	**Required distance (metres)**	**Measured at intersection entrance (metres)**
Northbound (Pacific Highway)	165 m	400 m	248 m	400m
Southbound (Pacific Highway)	165 m	300 m	248 m	300 m

The Study Intersection satisfies the minimum sight distance requirement (ASD) and the desirable sight distance requirement (SISD) measured in accordance with the

definition set out in the Austroads publication. Site photos showing sight distances are provided in Appendix D of this report.

In addition to the sight distance assessment, observations were made by PMHC, during the collection of site distance photos, of occasional vehicles cutting the corner when turning right out of the Cairncross WMF Access Road. This matter was also raised by Roads and Maritime Services, during consultation about the Proposal, with a request for consideration of this matter as part of this TIA. PMHC will implement management and mitigation measures, as identified in Section 4.8, to address this site observation and potential road safety issue.

4.7 Crash Data Analysis

Crash data for the period of 1 July 2011 to 30 June 2016 was provided by Roads and Maritime. Based on the provided crash data only two crashes were recorded within proximity of the Study Intersection and are identified below.

- 1 Fatal Crash was recoded on the Pacific Highway, approximately 300 metres south of the Study Intersection, in March 2016. The crash was classified as a head-on collision between a truck and a semi-trailer as a result of one vehicle being on the incorrect side of the road
- 1 Non-Casualty Crash was recorded on the Pacific Highway, approximately 500 metres south of the Study Intersection, in October 2013. The crash was classified as a rear-end collision between a station wagon and a truck.

The crash analysis shows that there has been no recorded crashes at the Study Intersection in the last five years (2011-2016), despite heavy vehicles currently making a right-turn out of the Cairncross WMF Access Road and potentially encroaching (cutting the corner) on the northbound right-turn lane into Bill Hill Road (opposite the Cairncross WMF Access Road). Although the right-turn traffic out of the Cairncross WMF Access Road is expected to increase as result of the Proposal, there will be a reduction in through traffic because of the Oxley Highway to Kempsey Pacific Highway upgrade which is likely to assist in reducing potential vehicular conflicts.

Detailed crash data and crash location map are provided is Appendix E of this report.

4.8 Mitigation Measures

This TIA has not identified any works required as part of the Proposal. However, PMHC will implement inductions, toolbox talks and Standard Operating Procedures (SOPs) to educate waste collection contractors/heavy-vehicle drivers on appropriate exit procedures and avoidance of corner-cutting when exiting the Cairncross WMF Access Road to protect against any road safety impacts associated with the Proposal.

5 CONCLUSION

A Traffic Impact Assessment was undertaken to determine the potential traffic impacts of the Proposal on the adjacent road network. The traffic impact assessment determined the following:

- The Proposal traffic is not anticipated to impact on the operation of the Study Intersection (Cairncross WMF Access Road/old Pacific Highway intersection) in the opening year 2020 and closing year 2056 of the Proposal. No upgrades are required at the Study Intersection due to the Proposal.
- The operation of the new Pacific Highway Interchanges of Blackmans Point Road interchange and Haydons Wharf Road interchange would have minimal impact as a result of the Proposal traffic. No upgrades are required at these interchanges due to the Proposal.
- The Study Intersection satisfies the minimum sight distance requirement (ASD) and the desirable sight distance requirement (SISD) measured in accordance with the Austroads requirements. No upgrades are required at the Study Intersection to accommodate sight distance requirements.
- The crash analysis conducted identified that there have been no recorded crashes at the Study Intersection in the last five years (2011-2016), despite heavy vehicles currently making a right-turn out of Cairncross WMF Access Road and potentially encroaching (cutting the corner) on the northbound right-turn lane into Bill Hill Road (opposite the Cairncross WMF Access Road). Although the right-turn traffic is expected to increase as result of the Proposal, there will be a reduction in through traffic as a result of the Oxley Highway to Kempsey Pacific Highway upgrade which may assist in reducing potential vehicular conflicts

This TIA has not identified any works required as part of the Proposal. However, PMHC will implement inductions, toolbox talks and Standard Operating Procedures (SOPs) to educate waste collection contractors/heavy-vehicle drivers on appropriate exit procedures and avoidance of corner-cutting when exiting the Cairncross WMF Access Road to further protect against any road safety impacts associated with the Proposal.

APPENDIX A SMEC/HYDER JOINT VENTURE PACIFIC HIGHWAY UPGRADE – OXLEY HIGHWAY TO KEMPSEY TRAFFIC FORECASTING REPORT (2013)

SMEC + Hyder Joint Venture

HIGHWAY NO.10 – PACIFIC HIGHWAY UPGRADE OXLEY HIGHWAY TO KEMPSEY

TRAFFIC FORECASTING REPORT

DESIGN LOT NO.	DDTRF
REPORTNO.	FDDTRF-0001-0H2K-R-03

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HIGHWAY NO.10 - PACIFIC HIGHWAY UPGRADE - OXLEY HIGHWAY TO KEMPSEY

DDTRF - Traffic Forecasting Report

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Report No FDDTRF-0001-OH2K-R-02

Date 13 June 2013

This report has been prepared for Roads and Maritime Services in accordance with the terms and conditions of appointment for Pacific Highway Upgrade Oxley Highway to Kempsey Detailed Design and Documentation dated 30 March 2012. SMEC Hyder Joint Venture (ABN 51 914 496 016) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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1 INTRODUCTION

1.1 BACKGROUND

The proposed upgrade of the Pacific Highway between the Oxley Highway and Kempsey is part of the Pacific Highway Upgrade Program. This program is a joint commitment by the NSW and Federal Governments to provide a continuous dual carriageway on the Pacific Highway between Hexham (near Newcastle) and the Queensland border. The Oxley Highway to Kempsey (OH2K) project is approximately 37 kilometres in length, from its southern extent, approximately 700 metres north of the Oxley Highway interchange, to its northern connection to the Kempsey Bypass just south of Kempsey.

The SMEC and Hyder Joint Venture has been appointed as the Professional Services Contractor (PSC) by the Roads and Maritime Services department of the New South Wales state government to undertake concept design review and detailed design of the project. Requirements for the project are specified in the Description of Services (the Brief) issued by the RMS Pacific Highway Office.

The design was provided to SHJV at an 80% concept design completion stage. SHJV has reviewed this concept design and is now progressing the northern 14 km from Kundabung to Kempsey (K2K) to detailed design.

The K2K detailed design is to deliver an Arterial (Class A) standard highway. However, there is also a requirement to allow for a potential upgrade to Motorway standard (Class M) and subsequent widening to six lanes sometime in the future.

1.2 PROJECT OBJECTIVES

The primary objectives of the OH2K Project are to upgrade the Pacific Highway and achieve the following:

- Develop a dual carriageway road with potential to reduce crash rates over the project length;
- Develop a refined design that meets or exceeds B-double requirements, including at intersections, where required;
- Maximise the use of the existing road reserve, where feasible;
- Integrate input from local communities into development of the project through the implementation of a comprehensive program of community consultation and participation;
- Satisfy the technical and procedural requirements of the RMS with respect to the design of the project;
- Provide for transport developments that are complementary with land use;
- Allow for all connections, modifications and improvements necessary to upgrade the existing highway where it is retained as part of the project;
- Consider delay management strategies to minimise disruption to local and through traffic and maintain access to affected properties and land during construction;
- Provide flood immunity on both carriageways for a 1 in 100 year flood event (1 per cent Annual Exceedance Probability);
- Provide intersections designed to achieve at least a level of service ‘C’ 20 years after opening for the 100th highest hourly volume;

- Develop solutions that address community expectations for access to the new highway;
- Retain or replace existing rest areas within the Project Area consistent with Pacific Highway Rest Area Strategy;
- Develop a refined design meeting the design criteria detailed in this Brief and the environmental documents;
- Ensure the project outcomes achieve value for money;
- Provide a strategy for future upgrades to be easily integrated into the project from both engineering and environmental perspectives; and
- Minimise the need to modify the preferred route option and refined design during subsequent project phases.

1.3 SCOPE OF REPORT

This report documents the development of traffic forecasts for the project.

SHJV has developed an assignment model for the OH2K Upgrade corridor. The model was developed using TransCAD transport planning software. TransCAD is a Geographic Information System (GIS) based modelling software designed specifically for use by transportation professionals to store, display, manage, and analyse transportation data. It combines GIS and transportation modelling capabilities in a single integrated platform.

The assignment model embraces the main settlement and employment areas within the OH2K corridor that generate the majority of internal (local) trips.

The trip patterns within the corridor were based on a detailed Origin/Destination (OD) survey undertaken in July 2012 at 11 stations along the route. This survey captured heavy and light vehicle movements for each hour of a 24 hour period.

The major steps in developing the traffic forecasts included:

- Data Collection;
- Base Year Assignment Model Development;
- Travel Demand Forecasting (2016, 2026, 2036); and
- Pacific Highway Upgrade Assignment Model Development.

1.4 INDEPENDENT VERIFICATION

This report has been reviewed by the Independent Verifier. The record of the reviewer comments and the SHJV responses are included in Appendix J.

The report was also reviewed by RMS. There were no comments issued.

2 DATA COLLECTION

On Wednesday 18 July 2012, SHJV conducted origin-destination (OD) surveys of traffic movements along the Pacific Highway corridor, extending from just south of Oxley Highway and north through to the Kundabung area. The survey covered a full 24 hour period. Data was collated for each hour.

The field method involved the recording of vehicles and their number plates using video equipment, with subsequent reduction of video data in an office environment. This was undertaken at 11 two-direction stations, covering 22 separate traffic streams. The location of each station was as follows:

1) Pacific Highway, South of Oxley Highway

2) Oxley Highway, between the interchange and the Service Centre

3) Oxley Highway, East of the Service Centre

4) Pacific Highway, South of Sancrox Road

5) Pacific Highway, between Sancrox Road and Hastings River Drive

6) Pacific Highway, between Hastings River Drive and Blackmans Point Road

7) Pacific Highway, between Blackmans Point Road and Pembroke Road

8) Pacific Highway, between Pembroke Road and Rolland Plains Road

9) Pacific Highway, between Rolland Plains Road and Haydons Wharf Road

10) Pacific Highway, between Haydons Wharf Road and Kundabung Road

11) Pacific Highway, between Kundabung Road and Kemps Road.

Vehicle classifications were:

- Light vehicles (Class 1-2); and
- Heavy vehicles (Class 3-11).

Using the video method, the average error rate (missed number plates) for the 22 stations was less than 9%. The missed data was due to:

- The considerable geographical extent of the observation system results in some trips only being partially observed, in the first and last hour of survey; and
- Obscured or missing number plates.

Expansion factors were subsequently developed for each station to factor the data up to a 100% sample.

The data from the 22 survey sites was used to develop 12x12 OD trip matrices between 12 major land use precincts (A to L) along the corridor (refer Table 3-1).

The final light and heavy vehicle OD trip matrices are presented in Appendix A. Additional matrices were extracted for the 15-hr day and 9-hr night periods.

The classified daily vehicle profiles at each survey station are presented in Appendix B.

3 OD SURVEY PATTERNS

The directionality of outbound movements from each land use precinct (A to L) is presented in Table 3-1. The distribution of traffic movements in the corridor by time of day is presented in Table 3-2.

The overall review of the OD survey patterns within the corridor revealed the following:

- 68% of movements to the Port Macquarie Service Centre originated from the Oxley Highway, mostly from the west (Wauchope);
- 29% of movements to Sancrox originate from Hastings River Drive. A further 33% originate from the Oxley Highway. This does not support the original GHD assumption that 90% of trips to Sancrox would originate from the upgraded Oxley Highway;
- 72% of Hastings River Drive movements have a destination in the north;
- 12% of all movements in the corridor are heavy vehicles;
- 18% of all movements to Sancrox are heavy vehicles;
- 21% of Pacific Highway movements, north of Kundabung, are heavy vehicles; and
- 17% of Pacific Highway movements, south of Port Macquarie, are heavy vehicles.

Table 3-1 Directionality of Outbound Movements Between Major Land Use Precincts

Survey Zones	Land Use Precinct	North	South	East	West
A	Pacific Hwy (South)	45%	-	45%	11%
B	PMQ Service Centre	10%	22%	20%	48%
C	Oxley Highway (East)	8%	25%	-	68%
D	Oxley Highway (West)	13%	9%	77%	-
E	Sancrox	58%	42%	-	-
F	Hastings River Drive (East)	72%	28%	-	-
G	Blackmans Point	25%	75%	-	-
H	Pembroke	52%	48%	-	-
I	Telegraph Point	16%	84%	-	-
J	Cooperabung	29%	71%	-	-
K	Kundabung	32%	68%	-	-
L	Pacific Highway (North)	-	100%	-	-

Table 3-2 Distribution of Traffic Movements in Corridor by time of Day

Vehicle Class	Day (7am-10pm)	Night (10pm-7am)	Total Trips
Light Vehicles (Class 1-2)	90%	10%	36,094
Heavy Vehicles (Class 3-12)	74%	26%	4,958
All Vehicles	88%	12%	41,051

4 BASE YEAR MODEL DEVELOPMENT

The major tasks during the model development phase included:

- Coding GIS data for the existing road network into TransCAD;
- Network coding verification. Each link in the network was assigned attributes such as lane capacity, posted speed, turn restrictions and volume-delay functions;
- The network was then linked to the land use zone system and path logic checked; and
- The 2012 OD matrices (light and heavy vehicles) were expanded from the original 12x12 matrix to a 44x44 matrix to reflect a more refined zonal system. The zones were split primarily on the basis of a review of land use. The expanded matrices were then assigned to the model.

The refinement of the original 12 zones (A to L) to 44 sub-zones is presented in Appendix C.

4.1 BASE YEAR VALIDATION

The heavy and light vehicle daily matrices were validated against observed flows at 11 survey stations on the Pacific Highway and Oxley Highway listed in Section 2 of this report. Some minor matrix estimation was undertaken to improve the match between modelled and observed. Care was taken to maintain the integrity of the original matrices. Following the completion of matrix estimation the R^2 statistic for the estimated light and heavy vehicle matrices were both 0.99 indicating that minimal change had been made to the underlying pattern.

At completion of model calibration, 100% of modelled light and heavy vehicle daily flows achieved a GEH[1] value less than 5.0 against observed flows. This exceeds the RMS minimum requirement that at least 85% of sites achieve a GEH value of 5.0 or less.

A comparison of observed and modelled flows is presented in Appendix D.

4.2 DAY/NIGHT VALIDATION

In addition to daily flows, SHJV developed calibrated base case models for the Day (7am-10pm) and Night (10pm-7am) periods. These models were validated against the corresponding flows for the time of day, at the 11 survey stations on the Pacific Highway and Oxley Highway.

At completion of model calibration, 100% modelled light and heavy vehicle day/night flows achieved a GEH value less than 5.0 against observed flows. This exceeds the RMS minimum requirement that at least 85% of sites achieve a GEH value of 5.0 or less.

[1] The RMS has generally adopted the UK's DMRB standards for traffic flow calibration. These rely heavily on a measure called the GEH statistic. The GEH statistic is a self-scaling empirical statistic with similarities to a chi-squared test.

5 TRAVEL DEMAND FORECASTING

The major tasks during this phase included:

- Analysis of Pacific Highway traffic growth trends;
- Analysis of land use development trends/forecasts in the study area;
- Estimation of growth factors for the major internal land use zones and the Pacific Highway external zones; and
- Growth factors were applied to the trip end totals for the 2012 matrices to produce 2016, 2026 and 2036 forecast matrices (heavy and light vehicles). To ensure the underlying OD pattern was maintained, individual OD pairs were increased proportionally to match the trip end totals using the Iterative Proportional Fitting (IPF) method, also referred to as 'raking'.

Growth factors for the major zones along the corridor were derived from a range of transport land use forecasting sources, including:

- Historical growth rates along the Pacific Highway;
- Port Macquarie Hastings Shire population projections from the Urban Growth Management Strategy;
- Port Macquarie Hastings Council (PMHC) transport model; and
- Employment and Household trip generation calculations are based on the PMHC structure plans for new development precincts.

5.1 PACIFIC HIGHWAY

An assumed straight line growth factor for the Pacific Highway of 2.8% per annum was used. This was based on a review of historical data that was projected forward for future years (refer Table 5.1). This differs from the EA forecasts which assumed 4% annual growth.

Table 5-1 Pacific Highway Historical and Projected Traffic Volumes (Axle Pairs)

	Year	South of Hastings River Drive (Stn:09.293)	Blackmans Point at Hastings River Bridge (Stn:09.004)	Telegraph Point, North of Wauchope Road (Stn:09.137)	At Kempsey Shire Boundary (Stn:09.295)
Historic	1990	6579	8198	8746	7449
	1995	7338	10237	9984	9163
	1998	8729	11455	11605	10091
	2001	9814	12696	13508	12989
	2004	12304	14937	14409	14310
	2006	12287	15405	15260	15054
Projected	2012	14669	18192	17838	18092
	2016	16257	20049	19557	20118
	2026	20227	24693	23853	25181
	2036	24197	29336	28150	30245
	R^2	0.994	0.999	0.998	0.997
Projected Average Annual Growth		2.7%	2.6%	2.4%	2.8%

5.2 POPULATION PROJECTIONS

All the zones located north of Hastings River (19 to 44) are generally located in the area described as 'Rural North' in the Urban Growth Management Strategy (refer Table 5.2). The projected annual growth in this predominantly rural area is 0.37% per annum. Projecting these trends out to 2036, the estimated annual growth rate is 0.35% per annum. This is significantly lower than the global 4% annual growth assumed in the original EA forecasts.

Table 5-2 Population Projections by Locality, port Macquarie – Hastings, from 2006 to 2031

Area	2006	2021	2031	Annual Growth Rate
Port Macquarie	41440	52453	60175	1.81%
Wauchope	6219	8269	9531	2.13%
King Creek - Sancrox - Lake Innes	2467	3177	4182	2.78%
'Area 13'	5806	7546	9801	2.75%
Camden Haven	8968	11789	14087	2.28%
Rural North	3266	3336	3570	0.37%
Rural West -South	3119	3137	3245	0.16%
	71285	89707	104591	1.87%

Source: Urban Growth Management Strategy, 2010

5.3 PMHC MODEL FORECASTS

Port Macquarie Hastings Council (PMHC) developed a strategic transport model for the region in 2001. It later underwent a major recalibration in 2006 and was used to assess 'Area 13' and Sancrox structure plans. A further update was undertaken in 2012 for the assessment of the draft structure plan for the John Oxley Drive precinct.

The model was developed in TransCAD and covers the Hastings region including Wauchope to the West, Telegraph Point to the North and Laurieton to the South.

Growth forecasts from the PMHC transport model (refer Table 5.3) were used to determine likely growth rates for the Oxley Highway, John Oxley Drive and Hastings River Drive external zones.

Table 5-3 PMHC Transport Model PM Peak Link Flow Forecasts

PMHC Model Link	Equivalent OH2K Model Zone	2012	2016	2026	2036	Annual Growth Rate
Oxley Highway (East)	C1	1990	2130	2470	2810	1.6%
John Oxley Drive	C2	500	580	780	980	3.5%
Oxley Highway (West)	D1	1820	1920	2330	2560	1.7%
Hastings River Drive	F1	500	520	590	540	1.5%

5.4 SANCROX POPULATION & EMPLOYMENT GROWTH

At green-field sites, such as those developing in the Sancrox area, zonal trips in the model have been predicted based on forecast dwelling and GFA increases.

The Draft Sancrox Employment DCP was prepared in September 2010, and was incorporated into the Port Macquarie-Hastings DCP 2011. Part 5 of the PMHC DCP includes a chapter on specific provisions for the Sancrox Employment Lands.

The Sancrox Employments Lands include the areas surrounding the existing quarry, in the western portion of the Expressway Spares property, and the 'Fernbank Creek' area on the east of the Pacific Highway, south of Fernbank Creek Road.

The estimated growth in employment trips in the employment precinct is presented in Table 5.4.

Table 5-4 Sancrox Employment Lands Forecast trip Generation and Assumed Development Staging

Sancrox Employment Land Precincts	Gross Area (Ha)	GFA Yield (Ha)	Daily Trip rates (per 100 sqm GFA)	Total Daily Trips	Development Staging (Daily Trips)			
					2012	2016	2026	2036
Fernbank Industrial	23.3	9.3	5	4652	0	930	3722	4652
Expressway Spares	9.1	1.4	4	548	548	548	548	548
Precinct 4b	7.3	2.9	5	1458	0	292	1166	1458
Precinct 4a	2.6	1.0	5	522	0	104	418	522
Precinct 4c	6.4	2.5	5	1272	0	254	1018	1272
1	12.9	5.2	5	2580	0	516	2064	2580
2	19.2	7.7	4	3072	0	614	2458	3072
3a	9.8	3.9	5	1962	0	392	1570	1962
3b	10.4	4.2	5	2080	0	416	1664	2080
RMS Depot	3.2	0.5	5	239	239	239	239	239

Notes:

1) Precinct boundaries are based on the Sancrox Employment Lands Structure Plan. Indicative precinct Areas were measured from spatially correct GIS/cadastre maps.

2) GFA yield assume to be 40% of Gross Area.

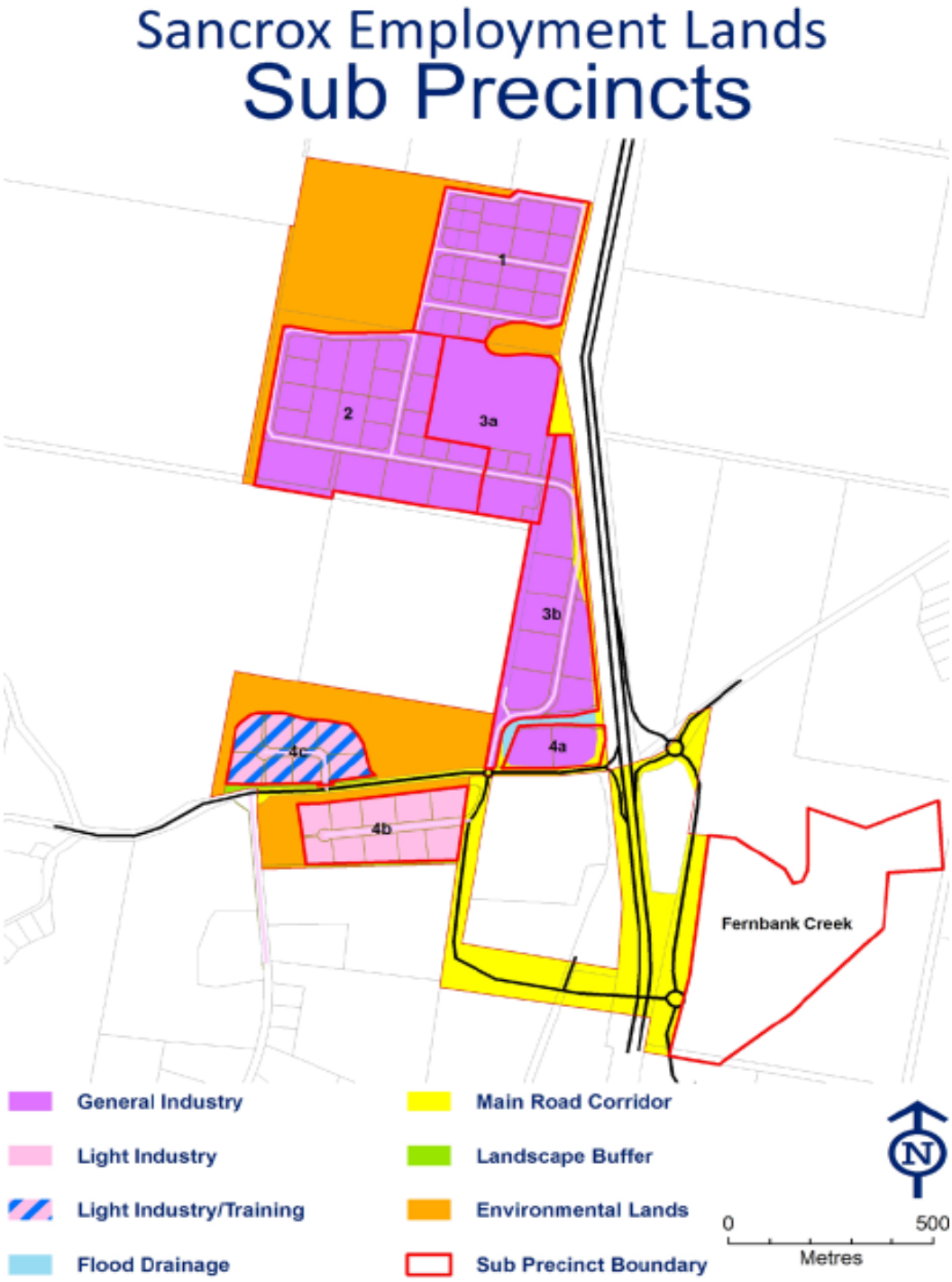


Figure 5-1 Sancrox Employment Lands Sub Precincts

The Greater Sancrox Structure Plan is currently in its very early phases of development, having been initiated in October 2011 and conducted its first public awareness meeting in February 2012. The Greater Sancrox Structure Plan covers an area between the Pacific Highway and Hastings River, and from 1 km south of the Oxley Highway to Sancrox Road.

Being in its infancy, the structure plan has yet to define the yield of dwellings and employment areas required to estimate trip generation. However, environmental constraints analysis has identified sensitive corridors and potential areas for development.

The draft structure plan considers six potential development options based on low, medium and high density development scenarios versus low and medium site constraint scenarios.

For the purposes of this assessment we have adopted the medium density scenario with low site constraints. A summary of the potential population and employment yields by precinct along with an estimate of daily trips is presented in Table 5.5.

For both the Sancrox Employment Land and Greater Sancrox precincts, GFA yield was assumed to be 40% of gross lot area. This allows for infrastructure (roads, car parks, drainage, landscaping and footpaths), environmental and topographic constraints, easements and relatively low intensity industrial development footprints. This assumption represents a 'high' growth scenario.

Table 5-5 Greater Sancrox Forecast Trip Generation and Assumed Development Staging

Zone	Precinct	Gross Area (Ha)	Yield (Ha)	Total HH	Total GFA (Ha)	Total Daily Trips	Development Staging (Daily Trips)			
							2012	2016	2026	2036
Rawdon Island Road	Sancrox Road West	48.4	41.1	51		463	407	407	407	407
	Muscio Road	77.0	65.4	82		736	361	361	361	361
	Walters Road	90.6	77.0	96		866	0	173	693	866
	Rawdon Island Rd North	47.0	40.0	50		450	0	90	360	450
	Central	24.7	21.0	26		236	0	47	189	236
	SW Corner	27.6	23.5	29		264	0	53	211	264
	South Mid	48.9	41.6	52		468	0	94	374	468
Sancrox Road	Le Clos Verdun	23.3	19.8	25		223	74	74	74	74
	River Bend Road	132.4	112.6	141		1266	63	63	63	63
	Le Clos Sancrox North	81.8	69.5	87		782	0	156	626	782
	Le Clos Sancrox South	85.0	72.2	90		813	0	163	650	813
Bushland Drive	Residential	136.5	116.1	145		1306	183	183	1,045	1,306
	Employment	39.0			15.6	6,243	0	1,247	4,987	6,234

Notes:

1) Precinct boundaries are based on the Greater Sancrox Structure Plan. Indicative precinct areas were measured from spatially correct GIS/cadastre maps.

2) The intensity of development is based on the Medium Density/Low Constraint scenario discussed in the structure plan.

3) The calculations on table 5.5 assume i) 1.25 residential lots per hectare; ii)9 trips per day per residential dwelling; iii) 85% residential lot yield after provision for infrastructure; iv) 40% GFA yield per industrial lot gross area; v) 4 employment trips per day per 100sqm GFA.

5.5 GROWTH ASSUMPTIONS

The final growth assumptions adopted in the model are presented in Table 5.6 below.

Table 5-6 Forecast Trips Productions/Attractions

Land Use Zones	ID	Light Vehicles				Heavy Vehicles			
		2012	2016	2026	2036	2012	2016	2026	2036
Pacific Hwy (South)	1	5184	5765	7216	8668	1091	1213	1518	1822
PMQ Service Centre	2	4200	4671	5847	7022	331	368	460	553
Oxley Highway (East)	3	5513	5892	6828	7775	427	456	529	602
John Oxley Drive	4	1465	1701	2315	2902	113	132	179	225
Oxley Highway (West)	5	6533	6886	8357	9185	501	528	641	705
Sancrox Road	6	57	188	583	715	12	40	123	151
Rawdon Island Road	7	317	506	1072	1260	67	107	226	266
Fernbank Ck Road	8	99	100	104	107	21	21	22	23
Fernbank Ck Industrial	9	0	192	768	961	0	40	162	202
Expressway Spares	10	226	226	226	226	48	48	48	48
Precinct 4b	11	0	60	241	301	0	13	51	63
Precinct 4a	12	0	22	86	108	0	5	18	23
Precinct 4c	13	0	53	210	263	0	11	44	55
Precincts 1-3	14	0	400	1601	2002	0	84	337	422
Bushland Drive	15	75	333	1461	1826	16	70	308	385
RMS Depot	16	99	98	98	98	21	21	21	21
Hastings River Drive	17	3573	3673	4216	3809	267	275	315	285
Glen Ewan Road	18	92	93	96	99	7	7	7	7
Blackmans Point Rd	19	429	435	450	465	98	99	102	106
Junction Road	20	129	130	135	139	29	30	31	32
Forest Hut Road	21	129	130	135	139	29	30	31	32
Bill Hill Road	22	43	43	45	46	10	10	10	11
Wharf Road	23	129	130	135	139	29	30	31	32
Pembroke Road	24	876	946	1121	1297	131	141	168	194
Rollands Plains Road	25	645	653	676	698	92	93	97	100
Cooperabung Road	26	276	280	290	299	39	40	41	43
Haydons Wharf Road	27	143	145	150	155	47	48	49	51
Yarrabee Road	28	115	116	120	124	38	38	40	41
Mingaletta	29	57	58	60	62	19	19	20	20
Upper Smith Creek	30	86	87	90	93	28	29	30	31
Wharf Road	31	29	29	30	31	9	10	10	10
Sun Valley Road	32	29	29	30	31	9	10	10	10
Mobbs Drive	33	29	29	30	31	9	10	10	10
Cooperabung Road	34	29	29	30	31	9	10	10	10
Cooperabung Close	35	57	58	60	62	19	19	20	20
Kundabung	36	221	224	232	239	51	51	53	55
Smith Creek Road	37	265	269	278	287	61	62	64	66
Ravenswood Service Rd	38	44	45	46	48	10	10	11	11
Old Coast Road	39	88	90	93	96	20	21	21	22
Kemps Road	40	133	134	139	144	30	31	32	33
Kempsey Service Road	41	44	45	46	48	10	10	11	11
Middle Gate Road	42	44	45	46	48	10	10	11	11
Knauers Service Road	43	44	45	46	48	10	10	11	11
Pacific Highway (North)	44	4412	4905	6139	7373	1148	1276	1598	1920

5.6 DAY/NIGHT FORECASTS

The Day/Night 2016 and 2026 forecast trip tables were developed based on the following:

- The observed day/night traffic profiles, for the major land use precincts (refer Table 5-7); and
- The 2016 and 2026 daily trip forecasts for each vehicle class were assigned to each period based on the observed traffic profiles and the calibrated 2012 trip patterns unique to each day/night period.

Table 5-7 Observed Day/Night Traffic Profiles for the 12 Major Land Use Precincts

Land Use Precinct	15hr Day (7am-10pm)		9hr Night (10pm-7am)	
	LV	HV	LV	HV
A	87%	74%	13%	26%
B	91%	77%	9%	23%
C	93%	77%	7%	23%
D	88%	81%	12%	19%
E	87%	80%	13%	20%
F	91%	82%	9%	18%
G	89%	71%	11%	29%
H	88%	74%	12%	26%
I	85%	70%	15%	30%
J	78%	71%	22%	29%
K	74%	43%	26%	57%
L	95%	76%	5%	24%

6 FORECASTING MODELS

6.1 OVERVIEW

The previous sections describe the development of the demand matrices for the 2016, 2026 and 2036 forecast years. These demand matrices were then assigned to two future road network scenarios developed in TransCAD, namely:

- Existing road network (Do Nothing); and
- 38 km long Class M upgrade between Sancrox Road and Kemps Road (Upgrade).

The main reasons for developing the TransCAD forecasting models were:

- To improve accuracy. The models contain 44 travel zones to ensure accurate loading of traffic. Trying to manually estimate traffic assignments for 44x44 heavy and light vehicle matrices is complex and problematic. In addition, the service road system was also particularly complex on this project;
- To improve transparency, consistency and repeatability. Once the model is complete, it can be re-run by others and will provide consistent results. Conversely, manual traffic assignments can be subjective and difficult to check, back-engineer or repeat.

6.2 NETWORK CODING

The existing road network was coded up during the Base Case calibration phase of the project.

The Class M upgrade network was based on GIS data for the current Class M design. This new alignment was coded into TransCAD. Each link was assigned lane capacity, posted speed, turn restrictions, directional attributes and volume-delay functions. In this particular case, the User Equilibrium assignment model adopted for the OH2K models uses a BPR delay function. The Class M upgrade network was then linked to the system of 44 land use zones and path logic checked.

6.3 SCENARIOS

The following model scenarios were run:

- 2016, 2026 and 2036 Daily forecast matrices on Class M network;
- 2016 and 2026 Day/Night forecast matrices on Class M network; and
- 2016 and 2026 Day/Night forecast matrices on ‘Do Nothing’ network.

6.4 DESIGN OUTPUTS

The 2016, 2026 and 2036 traffic forecasts for the OH2K upgrade are presented in Tables E1 to E3 of Appendix E. All forecasts are rounded up to the nearest 10 vehicles. The flows represent vehicles per day.

A diagrammatic representation of the forecast tables has also been developed for the Sancrox Interchange and is included in Appendix G.

Finally, 2026 and 2036 turning movement forecasts, at 26 critical intersections in the Class M network, are provided in Appendix H. All turning movement forecasts are rounded up to the nearest 10 vehicles.

6.5 NOISE OUTPUTS

The 2016 and 2026 day/night traffic forecasts for the OH2K upgrade are presented in Tables F1 to F6 of Appendix F. All forecasts are rounded up to the nearest 10 vehicles. The flows represent the total number of vehicles for a specific day (7am-10pm) or night (10pm-7am) period of a standard day.

6.6 COMPARISON AGAINST EA FORECASTS

A comparison between the original forecasts prepared for the EA and the SHJV forecasts are presented in Appendix I.

Generally, the SHJV forecasts are significantly lower than the EA forecasts. This difference can be attributed to the following:

- The EA growth assumptions for the Pacific Highway were significantly higher than those adopted by the SHJV (4% per annum versus 2.8% per annum);
- The SHJV forecasts have been based on updated 2012 light and heavy vehicle OD data patterns along the corridor; and
- There have been significant advances in land use planning for the Sancrox Employment precinct since the original EA.

7 CONCLUSION

This report has documented the development of traffic forecasts for the OH2K project.

SHJV has developed an assignment model for the OH2K Upgrade corridor. The model was developed using TransCAD transport planning software. This forecasting model embraces the main settlement and employment areas within the OH2K corridor that generate the majority of internal (local) trips.

The heavy and light vehicle models were validated against observed flows at 11 survey stations on the Pacific Highway and Oxley Highway. The validation process demonstrated that:

- The integrity of the OD patterns collected during the July 2012 traffic surveys was maintained throughout the model calibration and matrix estimation process;
- The match between modelled and observed traffic flows was good. The match exceeds minimum RMS requirements; and
- The Base Case models were fit for purpose of this analysis.

The traffic forecasts were developed based upon a review of:

- Historical growth rates along the Pacific Highway;
- Port Macquarie Hastings Shire population projections from the Urban Growth Management Strategy;
- Port Macquarie Hastings Council (PMHC) transport model; and
- Employment and Household trip generation calculations based on PMHC structure plans for new development precincts.

These forecasts are an update to those developed for the original Environmental Assessment.

APPENDIX A

OD SURVEY MATRICES

Table A1: 2012 Light Vehicle Daily Flow Pattern within the OH2K Corridor

ID	Precinct	A	B	C	D	E	F	G	H	I	J	K	L	TOTALS
A	Pacific Hwy (South)	0	617	1934	580	94	294	36	42	38	17	85	1382	5119
B	PMQ Service Centre	957	0	922	2161	57	43	21	18	26	2	19	218	4443
C	Oxley Highway (East)	1707	1456	0	3400	131	11	21	19	28	12	16	208	7008
D	Oxley Highway (West)	541	1380	3582	0	192	210	25	12	23	6	22	233	6225
E	Sancrox	89	66	166	154	0	452	27	12	9	7	11	97	1090
F	Hastings River Drive (East)	344	83	25	272	313	0	336	197	288	63	148	1630	3699
G	Blackmans Point	35	20	31	29	22	497	0	105	20	5	7	83	853
H	Pembroke	33	10	19	7	7	181	123	0	208	29	24	159	801
I	Telegraph Point	39	40	32	16	11	252	47	260	0	59	10	59	825
J	Cooperabung	66	14	16	7	7	81	14	21	317	0	139	61	745
K	Kundabung	148	27	20	18	18	158	21	39	12	132	0	330	921
L	Pacific Highway (North)	1291	244	199	198	79	1453	192	224	47	72	364	0	4364
	TOTALS	5250	3957	6948	6843	930	3630	861	950	1016	403	846	4459	36094

Table A2: 2012 Heavy Vehicle Daily Flow Pattern within the OH2K Corridor

ID	Precinct	A	B	C	D	E	F	G	H	I	J	K	L	TOTALS
A	Pacific Hwy (South)	0	59	182	86	16	27	12	9	13	8	43	663	1117
B	PMQ Service Centre	95	0	52	128	11	2	5	0	2	5	3	32	335
C	Oxley Highway (East)	148	98	0	165	22	2	11	3	8	7	3	85	551
D	Oxley Highway (West)	95	69	136	0	37	16	9	3	2	3	3	94	467
E	Sancrox	18	6	14	40	0	55	5	1	2	1	1	96	239
F	Hastings River Drive (East)	23	2	4	14	15	0	59	6	16	3	4	77	224
G	Blackmans Point	14	9	21	13	2	109	0	18	1	2	4	23	215
H	Pembroke	3	1	4	4	1	9	47	0	43	2	2	19	135
I	Telegraph Point	12	3	5	9	1	13	2	48	0	21	0	7	120
J	Cooperabung	36	10	12	5	7	10	0	2	43	0	17	63	206
K	Kundabung	101	6	11	7	9	8	0	6	0	60	0	44	252
L	Pacific Highway (North)	520	61	89	65	87	72	24	31	13	59	72	0	1094
	TOTALS	1065	326	529	535	209	324	175	127	143	171	152	1202	4958

Table A3: 2012 Light Vehicle 15-hour 'Day' Flow Pattern within the OH2K Corridor

ID	Precinct	A	B	C	D	E	F	G	H	I	J	K	L	TOTALS
A	Pacific Hwy (South)	0	547	1760	496	64	269	28	37	15	8	42	1197	4462
B	PMQ Service Centre	886	0	855	1953	41	41	21	17	21	2	13	187	4036
C	Oxley Highway (East)	1578	1322	0	3231	94	11	19	19	27	9	11	185	6508
D	Oxley Highway (West)	463	1211	3239	0	137	194	21	10	12	2	8	201	5498
E	Sancrox	84	65	157	125	0	369	25	12	9	6	9	89	951
F	Hastings River Drive (East)	329	82	24	262	278	0	310	186	268	56	100	1483	3378
G	Blackmans Point	31	16	27	25	19	457	0	79	20	5	4	73	756
H	Pembroke	28	9	16	7	5	174	105	0	174	23	18	146	704
I	Telegraph Point	22	31	27	16	8	223	41	235	0	38	8	53	702
J	Cooperabung	34	8	10	5	1	56	14	18	288	0	100	47	582
K	Kundabung	83	19	13	13	11	123	15	34	8	113	0	251	684
L	Pacific Highway (North)	1186	228	189	192	71	1419	188	216	47	66	328	0	4130
	TOTALS	4725	3538	6317	6326	731	3335	786	864	889	328	641	3910	32389

Table A4: 2012 Heavy Vehicle 15-hour 'Day' Flow Pattern within the OH2K Corridor

ID	Precinct	A	B	C	D	E	F	G	H	I	J	K	L	TOTALS
A	Pacific Hwy (South)	0	49	139	76	13	24	8	6	3	5	19	486	829
B	PMQ Service Centre	78	0	47	95	7	2	5	0	1	3	0	18	257
C	Oxley Highway (East)	105	70	0	148	12	2	11	2	5	7	2	61	425
D	Oxley Highway (West)	74	62	118	0	24	11	7	3	2	3	0	76	381
E	Sancrox	14	5	14	30	0	27	5	1	2	1	1	90	191
F	Hastings River Drive (East)	18	2	4	14	10	0	51	4	14	3	3	61	185
G	Blackmans Point	4	8	20	11	1	87	0	8	1	2	2	8	153
H	Pembroke	3	0	3	4	1	9	30	0	32	2	2	14	99
I	Telegraph Point	6	3	2	9	1	11	2	33	0	11	0	5	84
J	Cooperabung	13	6	9	4	2	6	0	2	37	0	12	56	146
K	Kundabung	30	1	3	4	4	7	0	3	0	29	0	27	109
L	Pacific Highway (North)	354	45	81	62	73	61	20	21	10	53	47	0	829
	TOTALS	699	252	440	457	149	247	138	85	108	120	89	903	3688

Table A5: 2012 Light Vehicle 9-hour 'Night' Flow Pattern within the OH2K Corridor

ID	Precinct	A	B	C	D	E	F	G	H	I	J	K	L	TOTALS
A	Pacific Hwy (South)	0	70	175	84	30	25	8	5	23	9	43	185	657
B	PMQ Service Centre	72	0	67	208	15	3	0	1	4	0	7	31	408
C	Oxley Highway (East)	129	134	0	169	36	0	1	0	1	2	4	23	500
D	Oxley Highway (West)	77	169	343	0	55	15	4	1	11	4	14	32	726
E	Sancrox	4	1	8	29	0	83	2	0	0	1	2	8	139
F	Hastings River Drive (East)	15	1	1	10	35	0	26	11	20	7	48	147	322
G	Blackmans Point	4	4	4	4	2	40	0	26	0	0	2	9	97
H	Pembroke	5	1	3	0	2	7	18	0	34	6	7	13	97
I	Telegraph Point	17	8	5	0	3	29	5	26	0	21	2	7	123
J	Cooperabung	32	6	6	2	6	25	0	3	30	0	39	14	164
K	Kundabung	64	8	6	5	6	35	5	5	4	19	0	78	237
L	Pacific Highway (North)	106	17	10	6	8	34	4	7	0	6	36	0	234
	TOTALS	525	419	631	517	200	295	75	86	127	75	204	549	3704

Table A6: 2012 Heavy Vehicle 9-hour 'Night' Flow Pattern within the OH2K Corridor

ID	Precinct	A	B	C	D	E	F	G	H	I	J	K	L	TOTALS
A	Pacific Hwy (South)	0	10	42	10	3	3	4	2	9	3	24	176	288
B	PMQ Service Centre	17	0	5	33	5	0	0	0	1	1	3	15	79
C	Oxley Highway (East)	43	27	0	17	10	0	0	1	3	0	1	24	126
D	Oxley Highway (West)	21	7	18	0	12	6	2	0	0	0	3	18	86
E	Sancrox	4	1	0	10	0	28	0	0	0	0	0	5	48
F	Hastings River Drive (East)	6	0	0	0	5	0	8	2	2	0	1	16	39
G	Blackmans Point	10	1	1	2	1	22	0	10	0	0	1	14	62
H	Pembroke	0	1	2	0	0	0	17	0	11	0	0	5	35
I	Telegraph Point	5	0	3	0	0	2	0	15	0	10	0	1	36
J	Cooperabung	23	5	4	1	5	4	0	0	6	0	5	7	60
K	Kundabung	71	5	8	3	5	1	0	2	0	31	0	17	143
L	Pacific Highway (North)	166	16	8	3	14	11	4	10	2	6	25	0	265
	TOTALS	366	74	89	79	60	77	36	43	35	51	63	299	1270

APPENDIX B

OD SURVEY DAILY VEHICLE PROFILES

Table B1: OD Survey Classified Daily Vehicle Profiles (July 2012)

Site	Road	Location	Dir	Class	Hour Commencing																								Total
					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
1	Pacific Highway	Sth of Oxley Highway	1NB	Light	57	29	33	31	37	141	238	448	595	428	368	372	320	313	377	393	365	258	177	87	64	77	75	69	5352
				Heavy	38	36	26	20	9	20	34	38	58	54	42	33	50	49	56	56	64	64	69	64	50	56	34	38	1058
				Total	95	65	59	51	46	161	272	486	653	482	410	405	370	362	433	449	429	322	246	151	114	133	109	107	6410
			1SB	Light	28	42	45	33	45	96	154	212	285	320	367	350	405	382	405	521	527	499	238	126	108	97	68	45	5398
				Heavy	44	37	32	16	22	31	47	44	63	46	42	41	33	28	37	59	49	51	42	40	48	28	26	30	936
				Total	72	79	77	49	67	127	201	256	348	366	409	391	438	410	442	580	576	550	280	166	156	125	94	75	6334
2	Oxley Highway	Between I/C and Service Centre	2 EB	Light	28	12	17	24	44	127	407	791	1108	675	509	579	549	538	600	683	558	525	291	148	144	87	76	46	8566
				Heavy	21	9	10	7	11	37	34	44	57	56	42	43	39	44	54	53	46	30	16	12	16	20	17	12	730
				Total	49	21	27	31	55	164	441	835	1165	731	551	622	588	582	654	736	604	555	307	160	160	107	93	58	9296
			2WB	Light	26	15	17	12	32	128	266	421	586	460	491	519	603	610	656	871	874	888	398	166	189	147	93	64	8532
				Heavy	16	11	6	11	13	29	63	67	67	57	61	49	37	32	43	50	32	54	25	24	23	14	12	13	809
				Total	42	26	23	23	45	157	329	488	653	517	552	568	640	642	699	921	906	942	423	190	212	161	105	77	9341
3	Oxley Highway	East of PMQ Service Centre	3EB	Light	24	8	10	20	36	118	327	666	906	551	449	452	429	438	505	595	495	407	235	112	106	65	55	36	7045
				Heavy	9	3	8	6	5	13	27	32	51	49	37	34	35	37	46	37	34	13	2	6	8	9	8	6	515
				Total	33	11	18	26	41	131	354	698	957	600	486	486	464	475	551	632	529	420	237	118	114	74	63	42	7560
			3WB	Light	15	9	12	4	30	94	225	371	532	404	407	428	459	459	524	723	769	768	281	134	162	124	78	51	7063
				Heavy	5	5	5	13	11	42	59	56	62	51	45	41	34	26	34	40	20	40	16	6	4	7	3	9	634
				Total	20	14	17	17	41	136	284	427	594	455	452	469	493	485	558	763	789	808	297	140	166	131	81	60	7697
4	Pacific Highway	South of Sancrox Road	4NB	Light	47	24	28	30	30	150	225	261	294	258	257	239	254	236	252	267	248	196	168	93	76	64	39	37	3773
				Heavy	35	40	26	16	15	17	32	62	69	59	39	46	40	62	65	64	61	42	26	26	26	43	45	51	1007
				Total	82	64	54	46	45	167	257	323	363	317	296	285	294	298	317	331	309	238	194	119	102	107	84	88	4780
			4SB	Light	36	36	34	20	30	63	117	146	204	217	239	278	305	263	260	312	334	377	185	123	104	82	53	42	3860
				Heavy	34	43	41	26	27	13	23	45	64	59	54	53	46	46	67	68	78	33	24	26	31	25	28	24	978
				Total	70	79	75	46	57	76	140	191	268	276	293	331	351	309	327	380	412	410	209	149	135	107	81	66	4838
5	Pacific Highway	Between Sancrox Road and Hastings River Drive	5NB	Light	34	26	26	22	30	107	161	239	330	258	256	248	251	232	253	277	266	185	136	58	45	49	31	18	3538
				Heavy	47	34	25	21	11	10	41	58	76	64	43	54	44	68	56	68	61	57	59	60	49	57	57	71	1191
				Total	81	60	51	43	41	117	202	297	406	322	299	302	295	300	309	345	327	242	195	118	94	106	88	89	4729
			5SB	Light	17	12	13	7	17	62	112	138	187	219	244	273	290	259	259	299	334	304	174	94	66	56	31	21	3488
				Heavy	55	70	51	42	34	27	39	38	64	62	60	58	45	53	71	76	80	59	44	57	63	57	52	44	1301
				Total	72	82	64	49	51	89	151	176	251	281	304	331	335	312	330	375	414	363	218	151	129	113	83	65	4789
6	Pacific Highway	Between Hastings River Drive and Blackmans Point Road	6NB	Light	23	13	12	11	38	142	242	361	330	353	363	346	350	357	400	433	434	398	232	129	101	76	44	26	5214
				Heavy	60	49	43	34	25	31	63	71	92	70	55	69	52	78	68	74	61	41	28	59	51	66	56	71	1367
				Total	83	62	55	45	63	173	305	432	422	423	418	415	402	435	468	507	495	439	260	188	152	142	100	97	6581
			6SB	Light	17	11	15	10	25	63	184	290	451	353	396	366	385	330	351	426	459	429	249	120	83	60	34	26	5133
				Heavy	65	68	54	40	40	31	40	53	66	74	69	63	61	69	75	87	96	74	60	61	65	58	55	47	1471
				Total	82	79	69	50	65	94	224	343	517	427	465	429	446	399	426	513	555	503	309	181	148	118	89	73	6604
7	Pacific Highway	Between Blackmans point Road and Pembroke Road	7NB	Light	38	38	23	22	36	122	226	339	336	353	343	312	317	334	405	406	407	361	187	124	94	78	61	42	5004
				Heavy	45	24	38	21	17	32	54	61	71	54	49	54	41	59	52	66	55	64	63	54	45	54	44	55	1172
				Total	83	62	61	43	53	154	280	400	407	407	392	366	358	393	457	472	462	425	250	178	139	132	105	97	6176
			7SB	Light	31	27	26	14	42	64	167	288	400	321	365	346	355	316	321	406	448	395	238	128	109	71	48	45	4971
				Heavy	52	48	36	34	22	25	36	53	53	70	53	57	50	64	66	78	89	79	57	43	41	39	36	25	1206
				Total	83	75	62	48	64	89	203	341	453	391	418	403	405	380	387	484	537	474	295	171	150	110	84	70	6177
8	Pacific Highway	Between Pembroke Road and Rolland Plains Road	8NB	Light	21	21	13	22	37	134	240	351	327	350	365	323	308	335	390	410	394	350	184	116	90	71	46	28	4926
				Heavy	68	45	48	29	16	24	48	64	83	61	52	66	45	68	59	71	59	55	59	57	48	55	59	58	1297
				Total	89	66	61	51	53	158	288	415	410	411	417	389	353	403	449	481	453	405	243	173	138	126	105	86	6223
			8SB	Light	40	29	27	15	37	70	178	272	381	320	360	359	357	315	323	413	467	424	261	128	123	75	45	37	5056
				Heavy	47	48	38	32	28	14	30	57	53	70	53	56	52	65	66	80	92	66	30	46	32	24	37	36	1152
				Total	87	77	65	47	65	84	208	329	434	390	413	415	409	380	389	493	559	490	291	174	155	99	82	73	6208
9	Pacific Highway	Between Rolland Plains Road and Haydons Wharf Road	9NB	Light	20	16	12	20	36	125	235	340	336	319	318	306	280	305	359	359	335	201	89	52	72	55	40	25	4255
				Heavy	68	50	48	30	19	31	52	59	71	66	51	65	44	65	60	67	59	36	28	29	46	58	61	70	1233
				Total	88	66	60	50	55	156	287	399	407	385	369	371	324	370	419	426	394	237	117	81	118	113	101	95	5488
			9SB	Light	17	6	10	6	21	48	147	220	303	285	330	327	323	287	292	401	429	343	157	66	70	45	26	24	4183
				Heavy	67	72	50	41	41	29	36	51	52	73	53	57	42	64	62	83	84	37	23	27	49	52	48	48	1241
				Total	84	78	60	47	62	77	183	271	355	358	383	384	365	351	354	484	513	380	180	93	119	97	74	72	5424
10	Pacific Highway	Between Haydons Wharf Road and Kundabung Road	10NB	Light	17	17	13	21	34	105	217	323	337	319	322	298	269	311	347	361	325	269	145	88	72	49	37	22	4318
				Heavy	71	47	52	29	18	35	52	60	82	64	59	64	51	68	68	68	60	58	64	63	45	61	58	72	1369
				Total	88	64	65	50	52	140	269	383	419	383	381	362	320	379	415	429	385	327	209	151	117	110	95	94	5687
			10SB	Light	8	7	12	3	15	38	134	213	311	282	315	306	332	296	291	404	433	398	197	91	72	40	20	21	4239
				Heavy	71	73	48	44	51	40	49	63	51	80	52	67	44	68	70	75	93	73	59	69	68	57	54	49	1468
				Total	79	80	60	47	66	78	183	276	362	362	367	373	376	364	361	479	526	471	256	160	140	97	74	70	5707
11	Pacific Highway	Between Kundabung and Kemps Road	11NB	Light	24	19	23	28	42	102	255	324	380	342	332	301	289	318	341	357	358	276	165	96	78	56	49	25	4580
				Heavy	68	52	43	14	11	14	41	56	83	62	66	58	57	66	71	63	63	51	50	49	46	51	47	62	1244
				Total	92	71	66	42	53	116	296	380	463	404	398	359	346	384	412	420	421	327	215	145	124	107	96	87	5824
			11SB	Light	16	12	27	32	55	76	152	210	307	297	338	295	343	302	318	383	496	413	222	100	73	37	17	23	4544
				Heavy	72	58	26	18	9	8	16	59	58	78	57	57	53	64	81	60	98	62	50	70	62	59	54	46	1275
				Total	88	70	53	50	64	84	168	269	365	375	395	352	396	366	399	443	594	475	272	170	135	96	71	69	5819

APPENDIX C

LAND USE REFINEMENT

Table C1: Refinement of Zonal System

Survey Zones	Zones	ID	2012 Base	
			Daily LV	Daily HV
A1	Pacific Hwy (South)	1	5185	1091
B1	PMQ Service Centre	2	4200	331
C1	Oxley Highway (East)	3	5512	427
C2	John Oxley Drive	4	1465	113
D1	Oxley Highway (West)	5	6534	501
D2	Sancrox Road	6	113	24
D3	Rawdon Island Road	7	634	134
E1	Fernbank Creek Road	8	99	21
E2	Fernbank Creek Industrial	9	0	0
E3	Expressway Spares	10	453	95
E4	Precinct 4b	11	0	0
E5	Precinct 4a	12	0	0
E6	Precinct 4c	13	0	0
E7	Precincts 1-3	14	0	0
E8	Bushland Drive	15	151	32
E9	RMS Depot	16	197	42
F1	Hastings River Drive	17	3573	267
F2	Glen Ewan Road	18	92	7
G1	Blackmans Point Rd	19	429	98
G2	Junction Road	20	129	29
G3	Forest Hut Road	21	129	29
G4	Bill Hill Road	22	43	10
G5	Wharf Road	23	129	29
H1	Pembroke Road	24	875	131
I1	Rollands Plains Road	25	644	92
I2	Cooperabung Road	26	276	39
J1	Haydons Wharf Road	27	143	47
J2	Yarrabee Road	28	115	38
J3	Mingaletta	29	57	19
J4	Upper Smith Creek	30	86	28
J5	Wharf Road	31	29	9
J6	Sun Valley Road	32	29	9
J7	Mobbs Drive	33	29	9
J8	Cooperabung Road	34	29	9
J9	Cooperabung Close	35	57	19
K1	Kundabung	36	221	51
K2	Smith Creek Road	37	265	61
K3	Ravenswood Service Road	38	44	10
K4	Old Coast Road	39	88	20
K5	Kemps Road	40	132	30
K6	Kempsey Service Road	41	44	10
K7	Middle Gate Road	42	44	10
K8	Knauers Service Road	43	44	10
L1	Pacific Highway (North)	44	4411	1148

Notes:

1) The assignment of trips to the refined zones was based on a review of land use, traffic counts and access arrangments

APPENDIX D

DAILY, DAY & NIGHT BASE CASE MODEL CALIBRATION

Table D1: Base Case Calibration of Modelled Daily Light Vehicle Flows versus Observed Flows

Site	Location	Dir	Observed Daily Flows	Modelled Daily Flows	GEH
1	Sth of Oxley Highway	NB	5352	5349	0.04
		SB	5398	5394	0.05
2	Between I/C and Service Centre	EB	8566	8576	0.11
		WB	8532	8535	0.03
3	East of PMQ Service Centre	EB	7045	7042	0.04
		WB	7063	7063	0.00
4	South of Sancrox Road	NB	3773	3744	0.47
		SB	3860	3743	1.90
5	Between Sancrox Road and Hastings River Drive	NB	3538	3572	0.57
		SB	3488	3607	2.00
6	Between Hastings River Drive and Blackmans Point Road	NB	5214	5212	0.03
		SB	5133	5133	0.00
7	Between Blackmans point Road and Pembroke Road	NB	5004	4967	0.52
		SB	4971	4942	0.41
8	Between Pembroke Road and Rolland Plains Road	NB	4926	4922	0.06
		SB	5056	5022	0.48
9	Between Rolland Plains Road and Haydons Wharf Road	NB	4255	4418	2.48
		SB	4183	4330	2.25
10	Between Haydons Wharf Road and Kundabung Road	NB	4318	4366	0.73
		SB	4239	4289	0.77
11	Between Kundabung and Kemps Road	EB	4580	4402	2.66
		WB	4544	4396	2.21

Table D2: Base Case Calibration of Modelled Daily Heavy Vehicle Flows versus Observed Flows

Site	Location	Dir	Observed Daily Flows	Modelled Daily Flows	GEH
1	Sth of Oxley Highway	NB	1058	1054	0.12
		SB	936	949	0.42
2	Between I/C and Service Centre	EB	730	731	0.04
		WB	809	808	0.04
3	East of PMQ Service Centre	EB	515	516	0.04
		WB	634	632	0.08
4	South of Sancrox Road	NB	1007	1046	1.22
		SB	978	1053	2.35
5	Between Sancrox Road and Hastings River Drive	NB	1191	1179	0.35
		SB	1301	1224	2.17
6	Between Hastings River Drive and Blackmans Point Road	NB	1367	1348	0.52
		SB	1471	1398	1.93
7	Between Blackmans point Road and Pembroke Road	NB	1172	1239	1.93
		SB	1206	1250	1.26
8	Between Pembroke Road and Rolland Plains Road	NB	1297	1289	0.22
		SB	1152	1269	3.36
9	Between Rolland Plains Road and Haydons Wharf Road	NB	1233	1239	0.17
		SB	1241	1244	0.09
10	Between Haydons Wharf Road and Kundabung Road	NB	1369	1304	1.78
		SB	1468	1345	3.28
11	Between Kundabung and Kemps Road	EB	1244	1237	0.20
		WB	1275	1276	0.03

Table D3: Base Case Calibration of Modelled Day (7am-10pm) Light Vehicle Flows versus Observed

Site	Location	Dir	Observed Daily Flows	Modelled Daily Flows	GEH
1	Sth of Oxley Highway	NB	4642	4641	0.01
		SB	4842	4841	0.01
2	Between I/C and Service Centre	EB	7785	7790	0.06
		WB	7879	7880	0.01
3	East of PMQ Service Centre	EB	6411	6409	0.02
		WB	6545	6545	0.00
4	South of Sancrox Road	NB	3163	3143	0.36
		SB	3429	3358	1.22
5	Between Sancrox Road and Hastings River Drive	NB	3083	3100	0.31
		SB	3196	3265	1.21
6	Between Hastings River Drive and Blackmans Point Road	NB	4663	4660	0.04
		SB	4748	4747	0.01
7	Between Blackmans point Road and Pembroke Road	NB	4396	4373	0.35
		SB	4507	4491	0.24
8	Between Pembroke Road and Rolland Plains Road	NB	4364	4347	0.26
		SB	4578	4550	0.41
9	Between Rolland Plains Road and Haydons Wharf Road	NB	3726	3873	2.38
		SB	3878	3979	1.61
10	Between Haydons Wharf Road and Kundabung Road	NB	3835	3835	0.00
		SB	3981	3967	0.22
11	Between Kundabung and Kemps Road	EB	4013	3906	1.70
		WB	4134	4092	0.65

Table D4: Base Case Calibration of Modelled Day (7am-10pm) Heavy Vehicle Flows versus Observed

Site	Location	Dir	Observed Daily Flows	Modelled Daily Flows	GEH
1	Sth of Oxley Highway	NB	803	764	1.39
		SB	651	764	4.25
2	Between I/C and Service Centre	EB	572	578	0.25
		WB	635	578	2.31
3	East of PMQ Service Centre	EB	430	433	0.14
		WB	482	433	2.29
4	South of Sancrox Road	NB	730	792	2.25
		SB	719	788	2.51
5	Between Sancrox Road and Hastings River Drive	NB	874	833	1.40
		SB	887	833	1.84
6	Between Hastings River Drive and Blackmans Point Road	NB	935	949	0.46
		SB	1031	949	2.61
7	Between Blackmans point Road and Pembroke Road	NB	842	878	1.23
		SB	892	878	0.47
8	Between Pembroke Road and Rolland Plains Road	NB	902	898	0.13
		SB	842	898	1.90
9	Between Rolland Plains Road and Haydons Wharf Road	NB	804	860	1.94
		SB	809	859	1.73
10	Between Haydons Wharf Road and Kundabung Road	NB	935	886	1.62
		SB	989	886	3.36
11	Between Kundabung and Kemps Road	EB	892	866	0.88
		WB	968	866	3.37

Table D5: Base Case Calibration of Modelled Night (10pm-7am) Light Vehicle Flows versus Observed

Site	Location	Dir	Observed Daily Flows	Modelled Daily Flows	GEH
1	Sth of Oxley Highway	NB	710	711	0.02
		SB	556	555	0.05
2	Between I/C and Service Centre	EB	781	782	0.02
		WB	653	655	0.07
3	East of PMQ Service Centre	EB	634	633	0.02
		WB	518	517	0.03
4	South of Sancrox Road	NB	610	525	3.55
		SB	431	360	3.58
5	Between Sancrox Road and Hastings River Drive	NB	455	496	1.87
		SB	292	343	2.86
6	Between Hastings River Drive and Blackmans Point Road	NB	551	597	1.93
		SB	385	430	2.25
7	Between Blackmans point Road and Pembroke Road	NB	608	599	0.38
		SB	464	438	1.22
8	Between Pembroke Road and Rolland Plains Road	NB	562	591	1.19
		SB	478	449	1.36
9	Between Rolland Plains Road and Haydons Wharf Road	NB	529	539	0.45
		SB	305	357	2.85
10	Between Haydons Wharf Road and Kundabung Road	NB	483	520	1.66
		SB	258	342	4.84
11	Between Kundabung and Kemps Road	EB	567	486	3.54
		WB	410	317	4.87

Table D6: Base Case Calibration of Modelled Night (10pm-7am) Heavy Vehicle Flows versus Observe

Site	Location	Dir	Observed Daily Flows	Modelled Daily Flows	GEH
1	Sth of Oxley Highway	NB	255	289	2.07
		SB	285	313	1.64
2	Between I/C and Service Centre	EB	158	151	0.57
		WB	174	175	0.06
3	East of PMQ Service Centre	EB	85	91	0.61
		WB	152	139	1.11
4	South of Sancrox Road	NB	277	324	2.73
		SB	259	336	4.48
5	Between Sancrox Road and Hastings River Drive	NB	317	336	1.03
		SB	414	351	3.22
6	Between Hastings River Drive and Blackmans Point Road	NB	432	386	2.27
		SB	440	390	2.45
7	Between Blackmans point Road and Pembroke Road	NB	330	380	2.64
		SB	314	372	3.13
8	Between Pembroke Road and Rolland Plains Road	NB	395	392	0.16
		SB	310	381	3.84
9	Between Rolland Plains Road and Haydons Wharf Road	NB	429	381	2.39
		SB	432	375	2.82
10	Between Haydons Wharf Road and Kundabung Road	NB	434	381	2.62
		SB	479	397	3.91
11	Between Kundabung and Kemps Road	EB	352	334	1.00
		WB	307	309	0.14

APPENDIX E

DESIGN TRAFFIC FORECAST TABLES

Table E1: Design Traffic Volumes for Main Carriageways (Vehicles Per Day)

Location	Section	Dir	2016		2026		2036	
			ADLV	ADHV	ADLV	ADHV	ADLV	ADHV
Main Carriageway	South of Sancrox Interchange	NB	4730	1140	6180	1310	7560	1610
		SB	4410	1170	6760	1400	8270	1670
	Sancrox Interchange to Blackmans Point Interchange	NB	3280	1250	5050	1730	6420	2090
		SB	3320	1350	5250	1850	6620	2210
	Blackmans Point Interchange to Haydons Wharf Road Interchange	NB	4420	1310	5580	1700	6670	2030
		SB	4210	1270	5390	1670	6480	1990
	Haydons Wharf Road Interchange to Yarrabee I/C	NB	4790	1400	6030	1780	7230	2110
		SB	4670	1410	5920	1800	7110	2130
	Yarrabee Interchange to Kundabung Interchange	NB	4770	1420	6000	1790	7200	2120
		SB	4650	1430	5890	1810	7080	2140
	North of Kundabung Interchange	NB	5030	1430	6270	1760	7500	2080
		SB	4890	1410	6120	1730	7360	2060

Notes:
1) ADLV = Average Daily Light Vehicles (Class 1-2)
2) ADHV = Average Daily Heavy Vehicles (Class 3-12)
3) All design volumes rounded up to nearest 10 vehicles

Table E2: Design Traffic Volumes for Ramps (Vehicles Per Day)

Location	Ramp	Dir	2016		2026		2036	
			ADLV	ADHV	ADLV	ADHV	ADLV	ADHV
Sancrox I/C	Exit-ramp	NB	1860	140	2840	420	3860	550
	On-ramp	NB	410	250	1710	840	2710	1030
	Exit-ramp	SB	430	310	1720	840	2330	1050
	On-ramp	SB	1510	130	3230	390	3980	510
Blackmans Point I/C	Exit-ramp	NB	480	100	800	160	940	180
	On-ramp	NB	1610	160	1330	130	1200	120
	Exit-ramp	SB	1460	100	1110	60	990	60
	On-ramp	SB	580	170	970	240	1140	270
Haydons Wharf Road I/C	On-ramp	NB	380	100	460	90	560	90
	Exit-ramp	SB	460	140	540	130	640	140
Yarrabee I/C	Exit-ramp	NB	60	20	70	20	80	30
	On-ramp	NB	40	30	40	30	40	30
	Exit-ramp	SB	70	50	70	50	70	50
	On-ramp	SB	90	30	90	40	100	40
Kundabung I/C	Exit-ramp	NB	260	90	280	110	280	120
	On-ramp	NB	520	100	540	80	580	80
	Exit-ramp	SB	670	170	710	150	750	150
	On-ramp	SB	440	190	470	220	480	230

Notes:
1) ADLV = Average Daily Light Vehicles (Class 1-2)
2) ADHV = Average Daily Heavy Vehicles (Class 3-12)
3) All design volumes rounded up to nearest 10 vehicles

Table E3: Design Traffic Volumes for Local Roads (Vehicles Per Day)

Section	Dir	2016		2026		2036	
		ADLV	ADHV	ADLV	ADHV	ADLV	ADHV
Sancrox Interchange Overpass	EB	2040	200	4930	590	5930	760
	WB	940	320	3250	950	4100	1200
Sancrox to Hastings River Drive Service Road	NB	1510	160	2720	280	2580	270
	SB	1500	100	2560	190	2410	180
Hastings River Drive to Blackmans Point Service Road	NB	2270	270	1780	230	1540	210
	SB	2150	220	1500	160	1250	140
Blackmans Point Overpass	EB	1330	250	1480	300	1550	330
	WB	2320	240	1870	210	1670	200
Blackmans Point to Haydons Wharf Road Service Road	NB	980	130	1080	170	1130	190
	SB	1150	180	1230	220	1290	240
Bill Hill Overpass	EB	50	20	50	20	50	20
	WB	50	20	50	20	50	20
Haydons Wharf Road Overpass	EB	90	30	100	30	100	30
	WB	540	150	630	150	740	160
Yarrabee Road Overpass	EB	60	20	70	20	80	30
	WB	40	30	40	30	40	30
Mingaletta Road Overpass	EB	80	40	80	40	80	40
	WB	80	40	80	40	80	40
Mobbs Drive	NB	30	20	30	20	30	20
	SB	30	20	30	20	30	20
Mingaletta Road to Upper Smith Creek Road Service Road	NB	60	30	60	30	60	30
	SB	90	50	90	50	90	50
Upper Smith Creek Road	EB	80	40	80	40	80	40
	WB	80	40	80	40	80	40
Wharf Road Overpass	EB	30	20	30	20	30	20
	WB	30	20	30	20	30	20
Smith Creek Service Road (South of Kundabung Road)	NB	90	60	100	60	100	60
	SB	130	90	130	80	140	90
Kundabung Road Overpass	EB	420	170	450	200	450	210
	WB	630	150	650	130	700	130
Pipers Creek Service Road (W)	NB	50	20	60	20	60	20
	SB	160	80	170	80	170	90
Maria River State Forest Access Bridge	NB	200	50	210	50	210	60
	SB	190	50	190	60	200	60
Scrubby Creek Access Road	NB	50	20	60	20	60	20
	SB	50	20	50	20	50	20

Notes:
1) ADLV = Average Daily Light Vehicles (Class 1-2)
2) ADHV = Average Daily Heavy Vehicles (Class 3-12)
3) All design volumes rounded up to nearest 10 vehicles

APPENDIX F

NOISE TRAFFIC FORECAST TABLES

Table F1: Design Traffic Volumes for Main Carriageways Year 2016 (Vehicles)

Location	Section	Dir	Day 15hr (7am-10pm)		Night (10pm-7am)	
			LV	HV	LV	HV
Main Carriageway	South of Sancrox Interchange	NB	4030	820	650	400
		SB	3920	830	430	400
	Sancrox Interchange to Blackmans Point Interchange	NB	2860	920	440	350
		SB	2910	940	390	410
	Blackmans Point Interchange to Haydons Wharf Road Interchange	NB	3910	930	510	400
		SB	3880	890	340	380
	Haydons Wharf Road Interchange to Yarrabee I/C	NB	4230	980	560	420
		SB	4310	970	380	420
	Yarrabee Interchange to Kundabung Interchange	NB	4210	980	550	420
		SB	4300	970	370	420
	North of Kundabung Interchange	NB	4470	990	560	390
		SB	4550	970	370	350

Notes
1) LV = Light Vehicles (Class 1-2)
2) HV = Heavy Vehicles (Class 3-12)
3) All Traffic Forecasts rounded up to nearest 10 vehicles

Table F2: Design Traffic Volumes for Ramps Year 2016 (Vehicles)

Location	Section	Dir	Day 15hr (7am-10pm)		Night (10pm-7am)	
			LV	HV	LV	HV
Sancrox I/C	Exit-ramp	NB	1550	120	250	80
	On-ramp	NB	380	220	40	30
	Exit-ramp	SB	390	240	50	90
	On-ramp	SB	1400	120	90	80
Blackmans Point I/C	Exit-ramp	NB	400	90	90	30
	On-ramp	NB	1440	100	150	70
	Exit-ramp	SB	1450	70	40	20
	On-ramp	SB	470	120	90	50
Haydons Wharf Road I/C	On-ramp	NB	330	50	50	30
	Exit-ramp	SB	430	80	40	50
Yarrabee I/C	Exit-ramp	NB	50	20	20	10
	On-ramp	NB	30	20	10	10
	Exit-ramp	SB	60	30	10	20
	On-ramp	SB	70	20	20	20
Kundabung I/C	Exit-ramp	NB	180	40	80	50
	On-ramp	NB	430	50	90	30
	Exit-ramp	SB	590	80	100	40
	On-ramp	SB	340	80	110	120

Notes
1) LV = Light Vehicles (Class 1-2)
2) HV = Heavy Vehicles (Class 3-12)
3) All Traffic Forecasts rounded up to nearest 10 vehicles

Table F3: Design Traffic Volumes for Local Roads Year 2016 (Vehicles)

Location	Section	Dir	Day 15hr (7am-10pm)		Night (10pm-7am)	
			LV	HV	LV	HV
Local Roads	Sancrox Interchange Overpass	EB	1770	150	240	90
		WB	890	250	90	60
	Sancrox to Hastings River Drive Service Road	NB	1310	110	200	70
		SB	1430	80	100	30
	Hastings River Drive to Blackmans Point Service Road	NB	2110	170	190	80
		SB	2150	150	70	30
	Blackmans Point Overpass	EB	1200	180	140	60
		WB	2120	160	200	90
	Blackmans Point to Haydons Wharf Road Service Road	NB	870	100	130	40
		SB	1010	140	130	50
	Bill Hill Overpass	EB	50	10	10	10
		WB	40	10	10	10
	Haydons Wharf Road Overpass	EB	70	20	20	10
		WB	480	100	60	50
	Yarrabee Road Overpass	EB	50	20	20	10
		WB	30	20	10	10
	Mingaletta Road Overpass	EB	70	20	20	20
		WB	60	20	20	10
	Mobbs Drive	NB	20	10	10	10
		SB	20	10	10	10
	Mingaletta Road to Upper Smith Creek Road Service Road	NB	40	20	20	10
		SB	90	30	20	20
	Upper Smith Creek Road	EB	60	20	20	10
		WB	70	20	20	20
	Wharf Road Overpass	EB	20	10	10	10
		WB	20	10	10	10
	Smith Creek Service Road (south of Kundabung Road)	NB	70	40	20	20
		SB	120	50	20	30
	Kundabung Road Overpass	EB	310	80	110	100
		WB	540	70	100	40
	Pipers Creek Service Road (W)	NB	40	10	10	10
		SB	130	30	40	50
	Maria River State Forest Access Bridge	NB	160	20	40	20
		SB	150	20	40	30
	Scrubby Creek Access Road Bridge	NB	40	10	10	10
		SB	40	10	10	10

Notes
1) LV = Light Vehicles (Class 1-2)
2) HV = Heavy Vehicles (Class 3-12)
3) All Traffic Forecasts rounded up to nearest 10 vehicles

Table F4: Design Traffic Volume for Main Carriageways Year 2026 (Vehicles)

Location	Section	Dir	Day 15hr (7am-10pm)		Night (10pm-7am)	
			LV	HV	LV	HV
Main Carriageway	South of Sancrox Interchange	NB	5390	980	1030	500
		SB	5830	970	620	470
	Sancrox Interchange to Blackmans Point Interchange	NB	4490	1290	620	450
		SB	4600	1320	610	510
	Blackmans Point Interchange to Haydons Wharf Road Interchange	NB	4960	1220	630	490
		SB	4950	1190	470	470
	Haydons Wharf Road Interchange to Yarrabee I/C	NB	5360	1260	680	510
		SB	5440	1250	510	510
	Yarrabee Interchange to Kundabung Interchange	NB	5340	1260	670	500
		SB	5430	1250	500	510
	North of Kundabung Interchange	NB	5590	1240	670	470
		SB	5670	1210	480	430

Notes
1) LV = Light Vehicles (Class 1-2)
2) HV = Heavy Vehicles (Class 3-12)
3) All Traffic Forecasts rounded up to nearest 10 vehicles

Table F5: Design Traffic Volumes for Ramps Year 2026 (Vehicles)

Location	Section	Dir	Day 15hr (7am-10pm)		Night (10pm-7am)	
			LV	HV	LV	HV
Sancrox I/C	Exit-ramp	NB	2450	340	600	150
	On-ramp	NB	1550	650	180	100
	Exit-ramp	SB	1560	670	190	190
	On-ramp	SB	2790	320	200	140
Blackmans Point I/C	Exit-ramp	NB	690	140	110	40
	On-ramp	NB	1150	60	130	70
	Exit-ramp	SB	1150	40	10	20
	On-ramp	SB	800	170	140	60
Haydons Wharf Road I/C	On-ramp	NB	410	50	50	30
	Exit-ramp	SB	500	70	40	50
Yarrabee I/C	Exit-ramp	NB	60	20	20	10
	On-ramp	NB	30	20	10	10
	Exit-ramp	SB	60	20	10	20
	On-ramp	SB	70	30	20	20
Kundabung I/C	Exit-ramp	NB	190	60	90	50
	On-ramp	NB	440	40	90	20
	Exit-ramp	SB	600	60	110	40
	On-ramp	SB	360	100	130	120

Notes
1) LV = Light Vehicles (Class 1-2)
2) HV = Heavy Vehicles (Class 3-12)
3) All Traffic Forecasts rounded up to nearest 10 vehicles

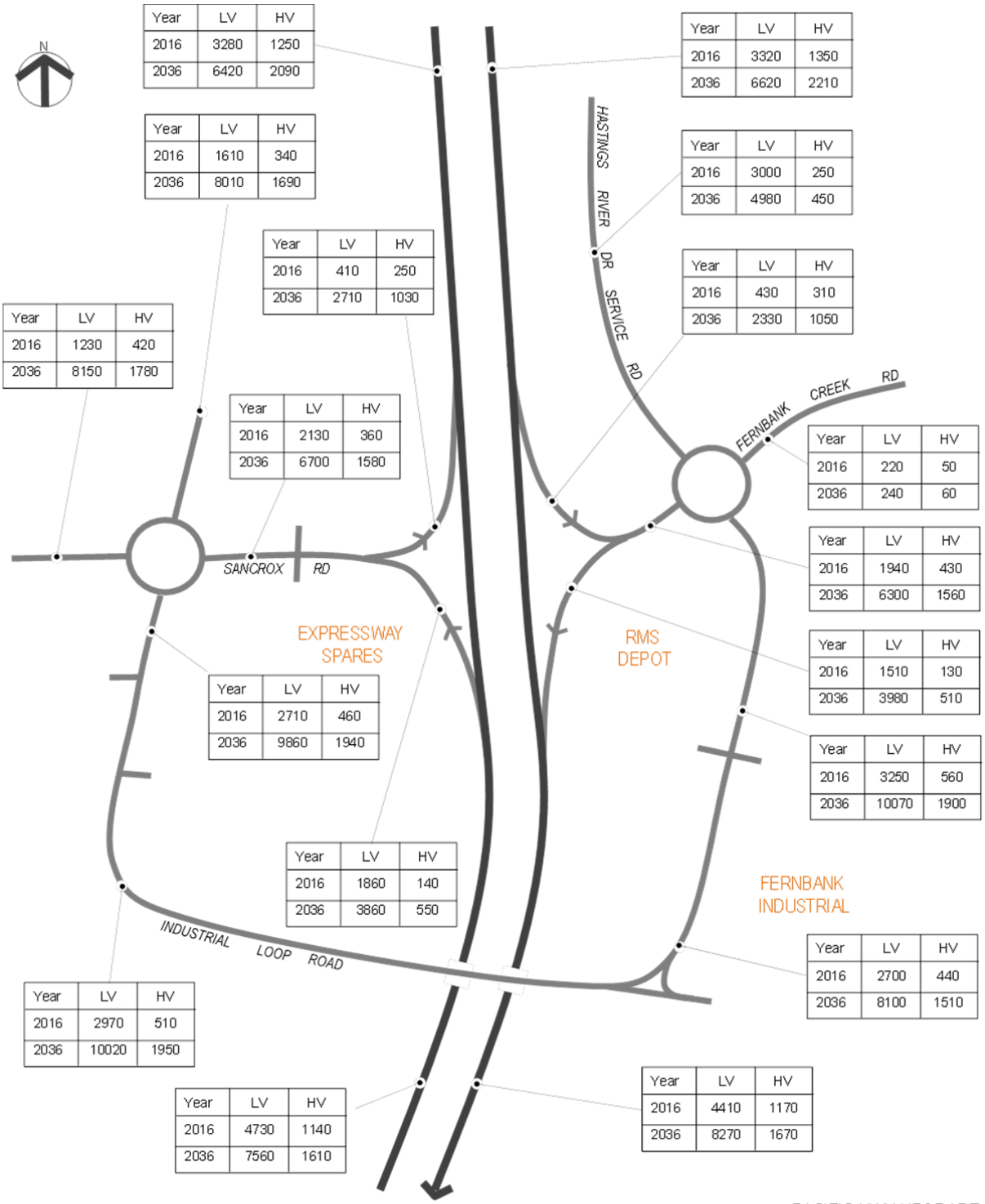
Table F6: Design Traffic Volumes for Local Roads Year 2026 (Vehicles)

Location	Section	Dir	Day 15hr (7am-10pm)		Night (10pm-7am)	
			LV	HV	LV	HV
Local Roads	Sancrox Interchange Overpass	EB	4170	440	480	180
		WB	3020	760	320	180
	Sancrox to Hastings River Drive Service Road	NB	2370	180	330	90
		SB	2430	160	190	50
	Hastings River Drive to Blackmans Point Service Road	NB	1630	130	140	80
		SB	1610	100	10	20
	Blackmans Point Overpass	EB	1320	220	170	70
		WB	1680	120	170	80
	Blackmans Point to Haydons Wharf Road Service Road	NB	950	140	140	40
		SB	1070	170	150	60
	Bill Hill Overpass	EB	50	10	10	10
		WB	50	10	10	10
	Haydons Wharf Road Overpass	EB	80	30	30	10
		WB	560	90	60	50
	Yarrabee Road Overpass	EB	60	20	20	10
		WB	30	20	10	10
	Mingaletta Road Overpass	EB	70	30	20	20
		WB	60	30	20	10
	Mobbs Drive	NB	30	10	10	10
		SB	20	10	10	10
	Mingaletta Road to Upper Smith Creek Road Service Road	NB	40	20	10	10
		SB	90	30	10	20
	Upper Smith Creek Road	EB	60	30	20	20
		WB	70	30	20	20
	Wharf Road Overpass	EB	30	10	10	10
		WB	20	10	10	10
	Smith Creek Service Road (south of Kundabung Road)	NB	70	40	30	20
		SB	120	40	20	30
	Kundabung Road Overpass	EB	330	90	130	110
		WB	550	60	100	40
	Pipers Creek Service Road (W)	NB	40	10	10	10
		SB	140	40	50	50
	Maria River State Forest Access Bridge	NB	160	30	50	20
		SB	150	30	50	30
	Scrubby Creek Access Road Bridge	NB	40	10	10	10
		SB	40	10	10	10

Notes
1) LV = Light Vehicles (Class 1-2)
2) HV = Heavy Vehicles (Class 3-12)
3) All Traffic Forecasts rounded up to nearest 10 vehicles

APPENDIX G

SANCROX TRAFFIC DIAGRAM



NOTES
1. ALL FORECASTS ARE ROUNDED UP TO NEAREST 10 VEHICLES
2. LV = LIGHT VEHICLES (CLASS 1-2)
3. HV= HEAVY VEHICLES (CLASS 3-12)

PACIFIC HWY UPGRADE
OXLEY HIGHWAY TO KEMPSEY
SANCROX INTERCHANGE
DESIGN TRAFFIC FLOW FORECASTS
PAGE 1/1

APPENDIX H

2016, 2026 & 2036 TURNING MOVEMENT FORECASTS

APPENDIX I

COMPARISON OF EA AND SHJV TRAFFIC FORECASTS

Table I1: Comparison of 2016 Design Traffic Volumes for Main Carriageways (Vehicles Per Day)

Location	Section	Dir	Original EA		SHJV		Difference	
			ADLV	ADHV	ADLV	ADHV	ADLV	ADHV
Main Carriageway	South of Sancrox Interchange	NB	7050	2050	4730	1140	-33%	-44%
		SB	7050	2050	4410	1170	-37%	-43%
	Sancrox Interchange to Blackmans Point Interchange	NB	6250	1820	3280	1250	-48%	-31%
		SB	6250	1820	3320	1350	-47%	-26%
	Blackmans Point Interchange to Haydons Wharf Road Interchange	NB	8010	2330	4420	1310	-45%	-44%
		SB	8010	2330	4210	1270	-47%	-45%
	Haydons Wharf Road Interchange to Yarrabee I/C	NB	8330	2420	4790	1400	-42%	-42%
		SB	8330	2420	4670	1410	-44%	-42%
	Yarrabee Interchange to Kundabung Interchange	NB	8300	2410	4770	1420	-43%	-41%
		SB	8300	2410	4650	1430	-44%	-41%
	North of Kundabung Interchange	NB	8450	2460	5030	1430	-40%	-42%
		SB	8450	2460	4890	1410	-42%	-43%

Notes:

1) ADLV = Average Daily Light Vehicles (Class 1-2)

2) ADHV = Average Daily Heavy Vehicles (Class 3-12)

3) All design volumes rounded up to nearest 10 vehicles

4) All EA forecasts based on Appendix B, Detailed Traffic Assessment, RTA, September 2007

Table I2: Comparison of 2026 Design Traffic Volumes for Main Carriageways (Vehicles Per Day)

Location	Section	Dir	Original EA		SHJV		Difference	
			ADLV	ADHV	ADLV	ADHV	ADLV	ADHV
Main Carriageway	South of Sancrox Interchange	NB	9670	2810	6180	1310	-36%	-53%
		SB	9670	2810	6760	1400	-30%	-50%
	Sancrox Interchange to Blackmans Point Interchange	NB	8040	2340	5050	1730	-37%	-26%
		SB	8040	2340	5250	1850	-35%	-21%
	Blackmans Point Interchange to Haydons Wharf Road Interchange	NB	10290	2990	5580	1700	-46%	-43%
		SB	10290	2990	5390	1670	-48%	-44%
	Haydons Wharf Road Interchange to Yarrabee I/C	NB	10710	3110	6030	1780	-44%	-43%
		SB	10710	3110	5920	1800	-45%	-42%
	Yarrabee Interchange to Kundabung Interchange	NB	10670	3100	6000	1790	-44%	-42%
		SB	10670	3100	5890	1810	-45%	-42%
	North of Kundabung Interchange	NB	10870	3160	6270	1760	-42%	-44%
		SB	10870	3160	6120	1730	-44%	-45%

Notes:

1) ADLV = Average Daily Light Vehicles (Class 1-2)

2) ADHV = Average Daily Heavy Vehicles (Class 3-12)

3) All design volumes rounded up to nearest 10 vehicles

4) All EA forecasts based on Appendix B, Detailed Traffic Assessment, RTA, September 2007

Table I3: Comparison of 2036 Design Traffic Volumes for Main Carriageways (Vehicles Per Day)

Location	Section	Dir	Original EA		SHJV		Difference	
			ADLV	ADHV	ADLV	ADHV	ADLV	ADHV
Main Carriageway	South of Sancrox Interchange	NB	11820	3440	7560	1610	-36%	-53%
		SB	11820	3440	8270	1670	-30%	-51%
	Sancrox Interchange to Blackmans Point Interchange	NB	9820	2850	6420	2090	-35%	-27%
		SB	9820	2850	6620	2210	-33%	-22%
	Blackmans Point Interchange to Haydons Wharf Road Interchange	NB	12580	3660	6670	2030	-47%	-45%
		SB	12580	3660	6480	1990	-48%	-46%
	Haydons Wharf Road Interchange to Yarrabee I/C	NB	13090	3800	7230	2110	-45%	-44%
		SB	13090	3800	7110	2130	-46%	-44%
	Yarrabee Interchange to Kundabung Interchange	NB	13040	3790	7200	2120	-45%	-44%
		SB	13040	3790	7080	2140	-46%	-44%
	North of Kundabung Interchange	NB	13280	3860	7500	2080	-44%	-46%
		SB	13280	3860	7360	2060	-45%	-47%

Notes:

1) ADLV = Average Daily Light Vehicles (Class 1-2)

2) ADHV = Average Daily Heavy Vehicles (Class 3-12)

3) All design volumes rounded up to nearest 10 vehicles

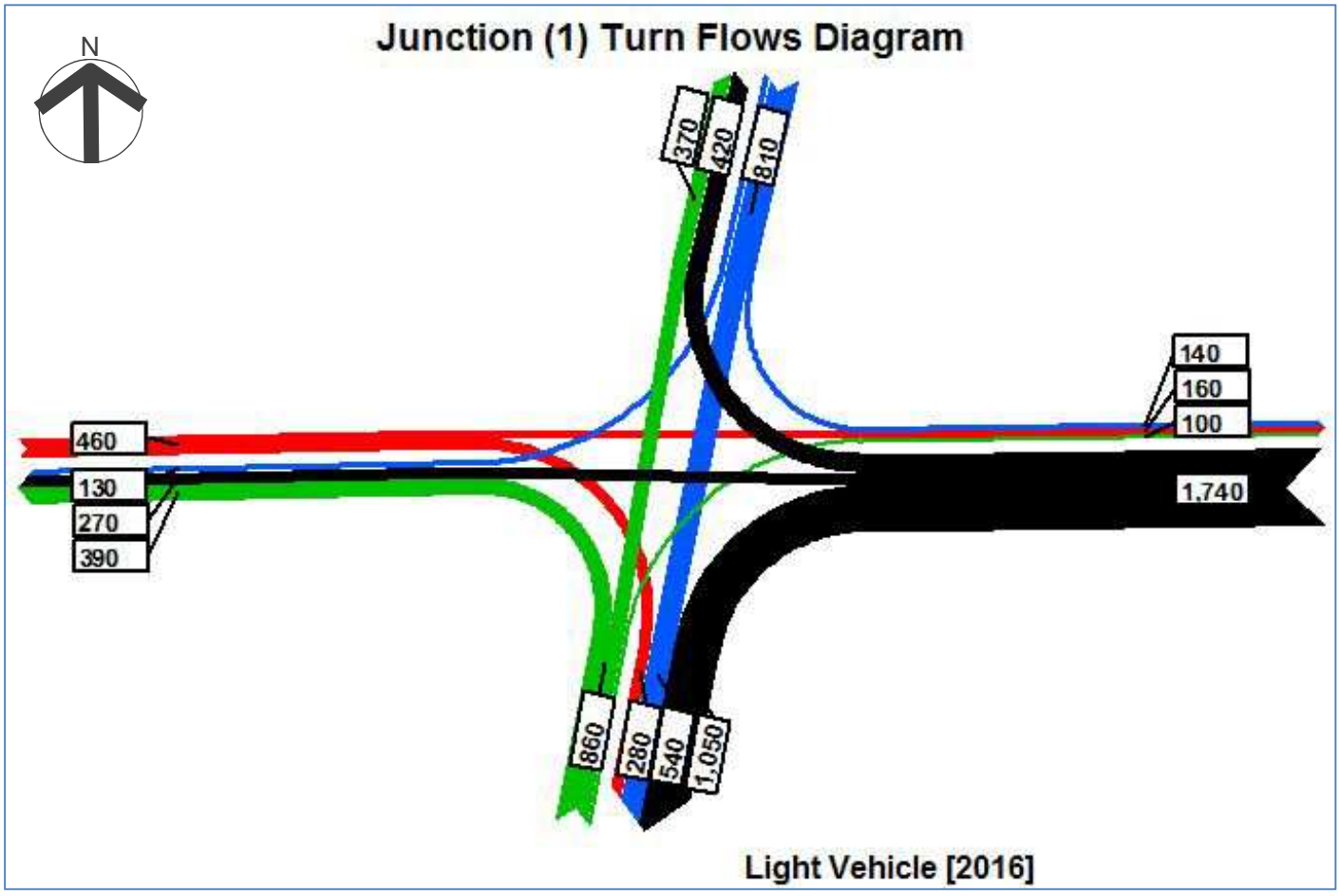
4) All EA forecasts based on Appendix B, Detailed Traffic Assessment, RTA, September 2007

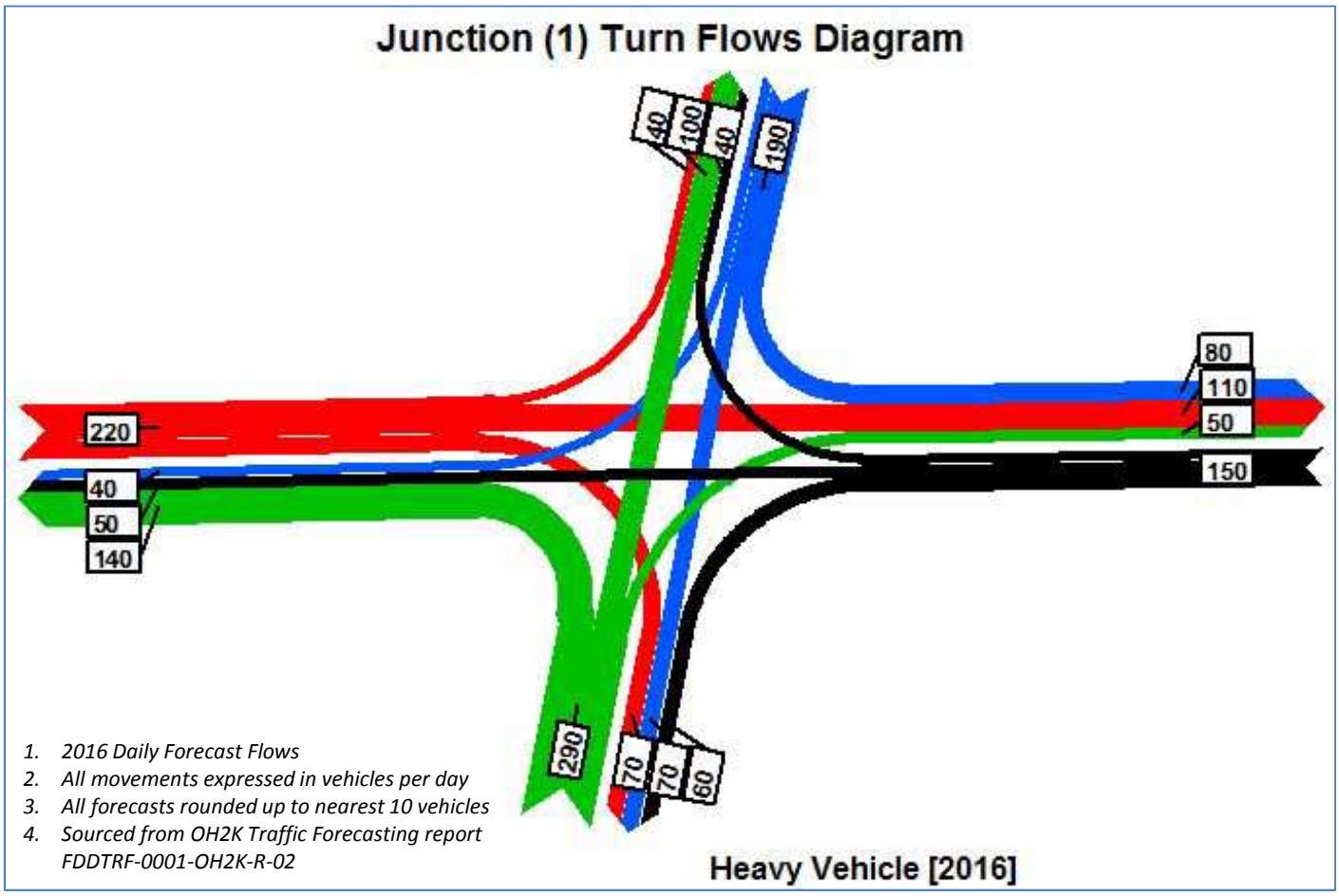
OH2K Intersection Turn Flow Diagrams

2016 Daily Forecast Flows

(Light & Heavy Vehicles)

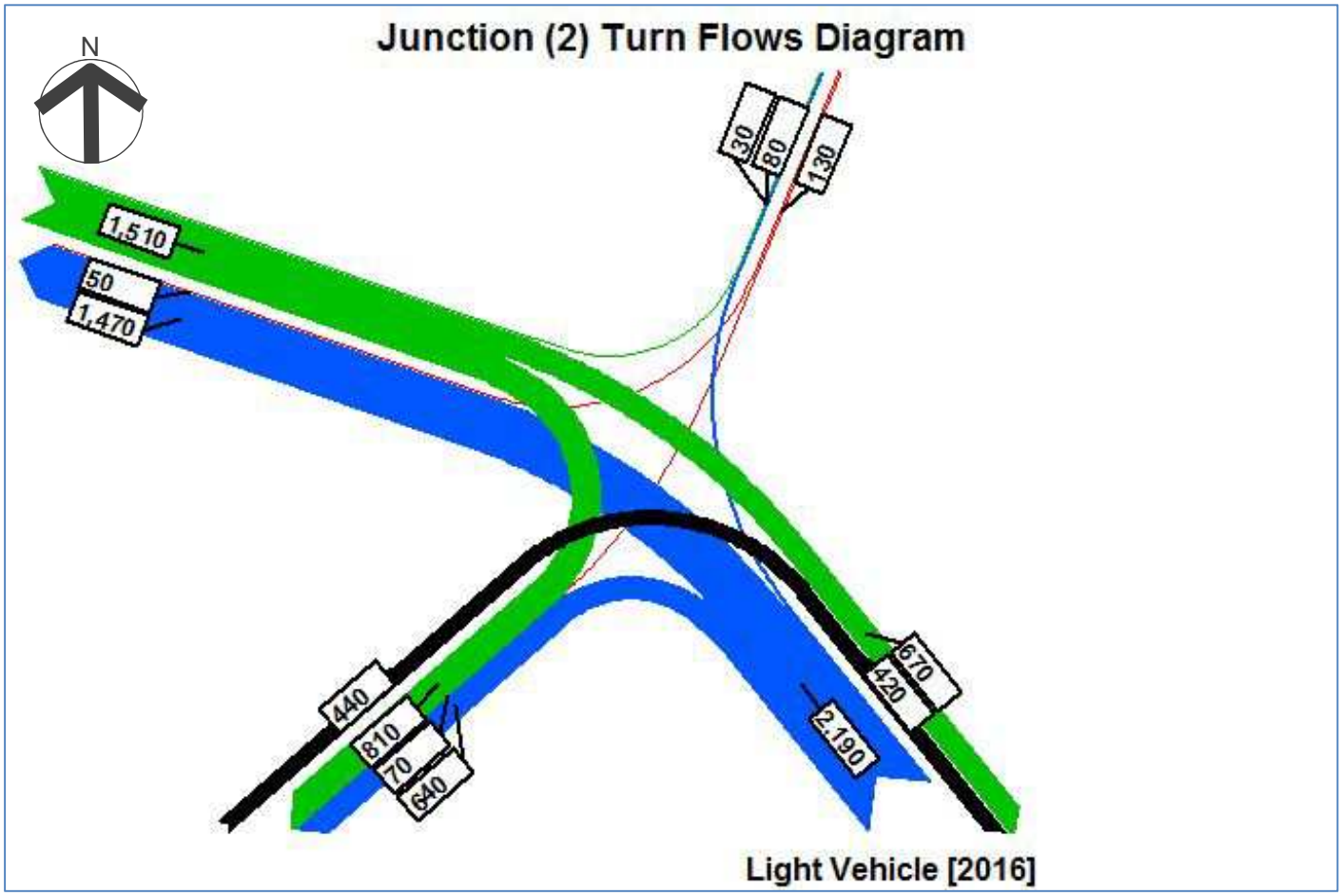
Site 1: Sancrox I/C (Western Roundabout)

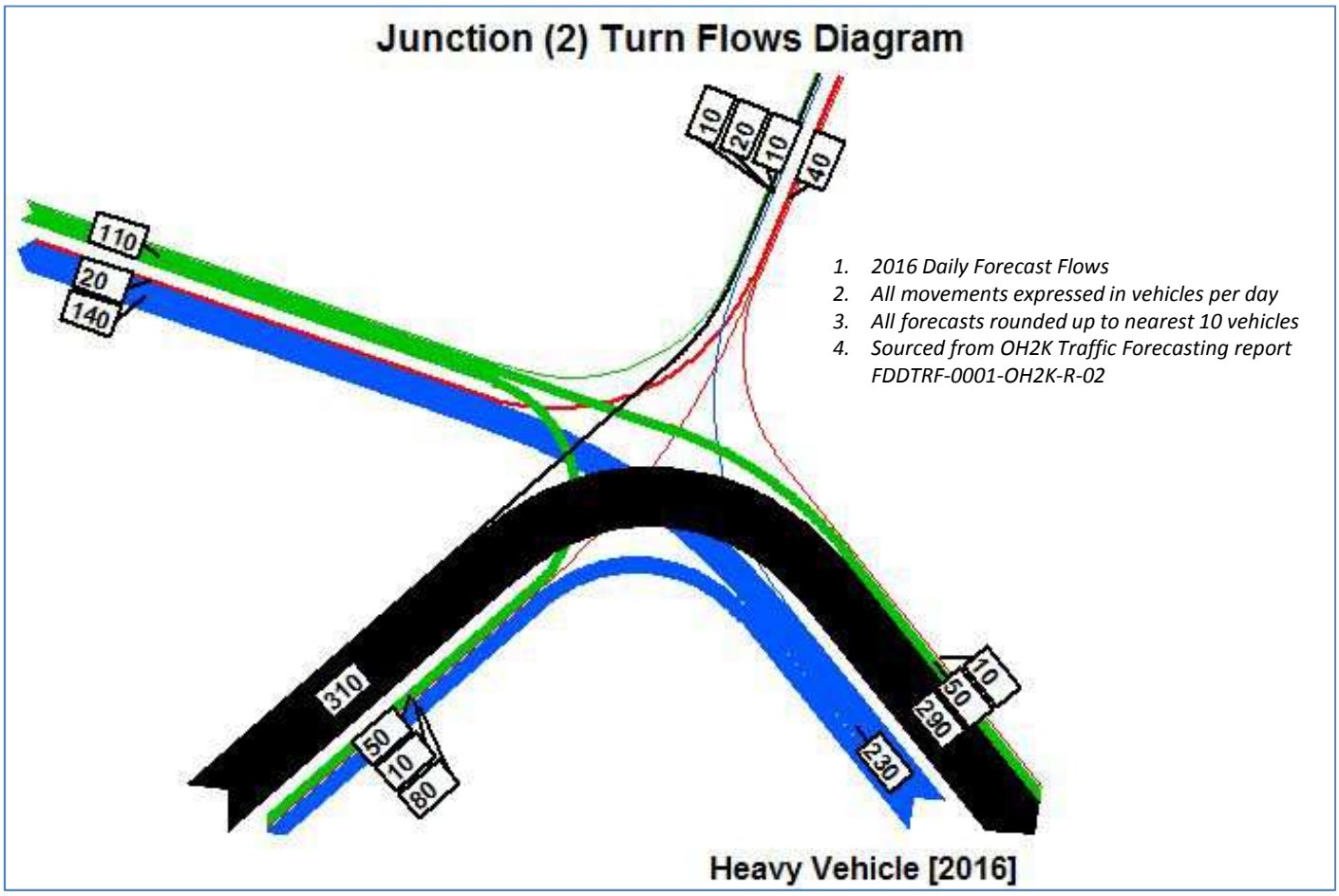




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

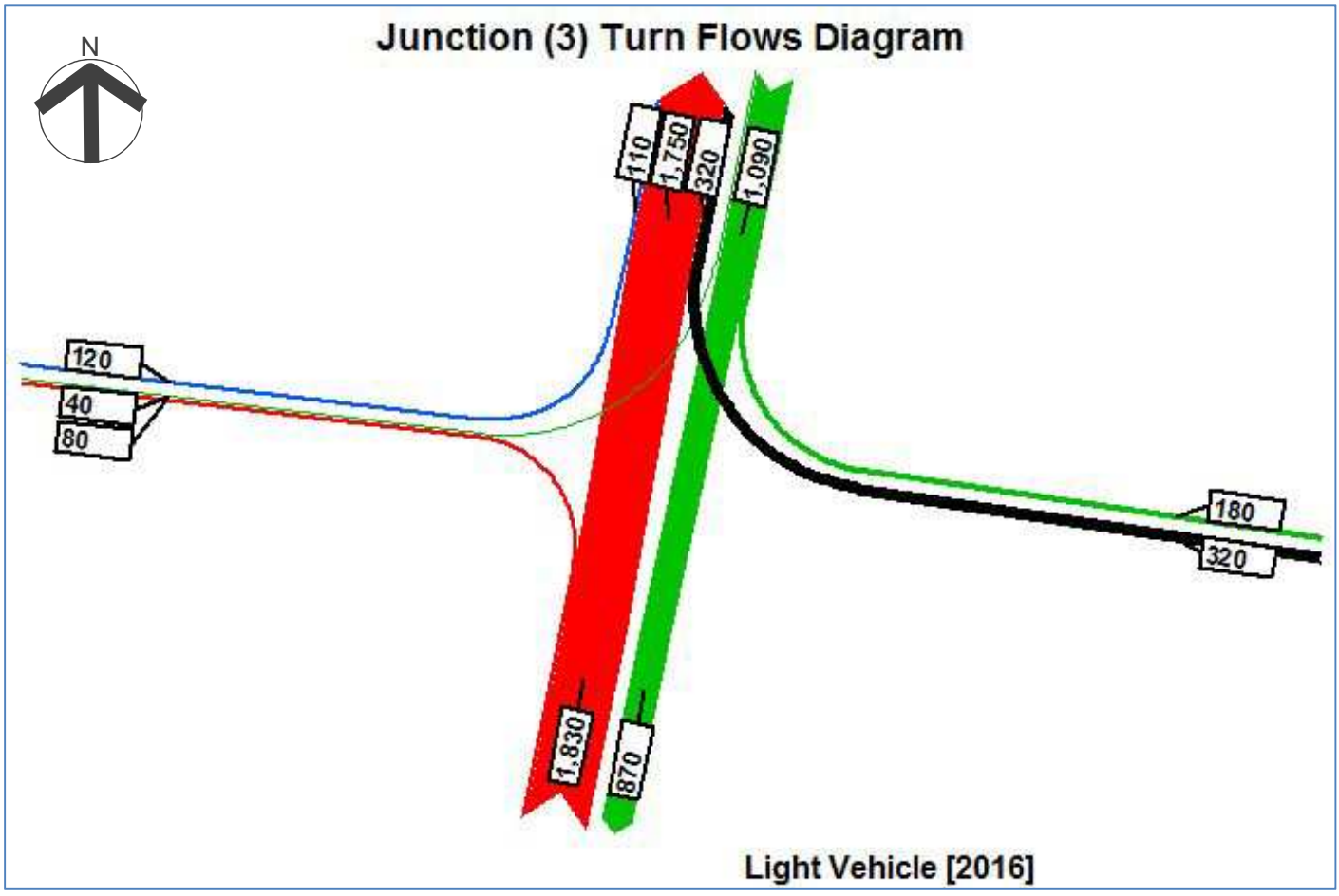
Site 2: Sancrox I/C (Eastern Roundabout)

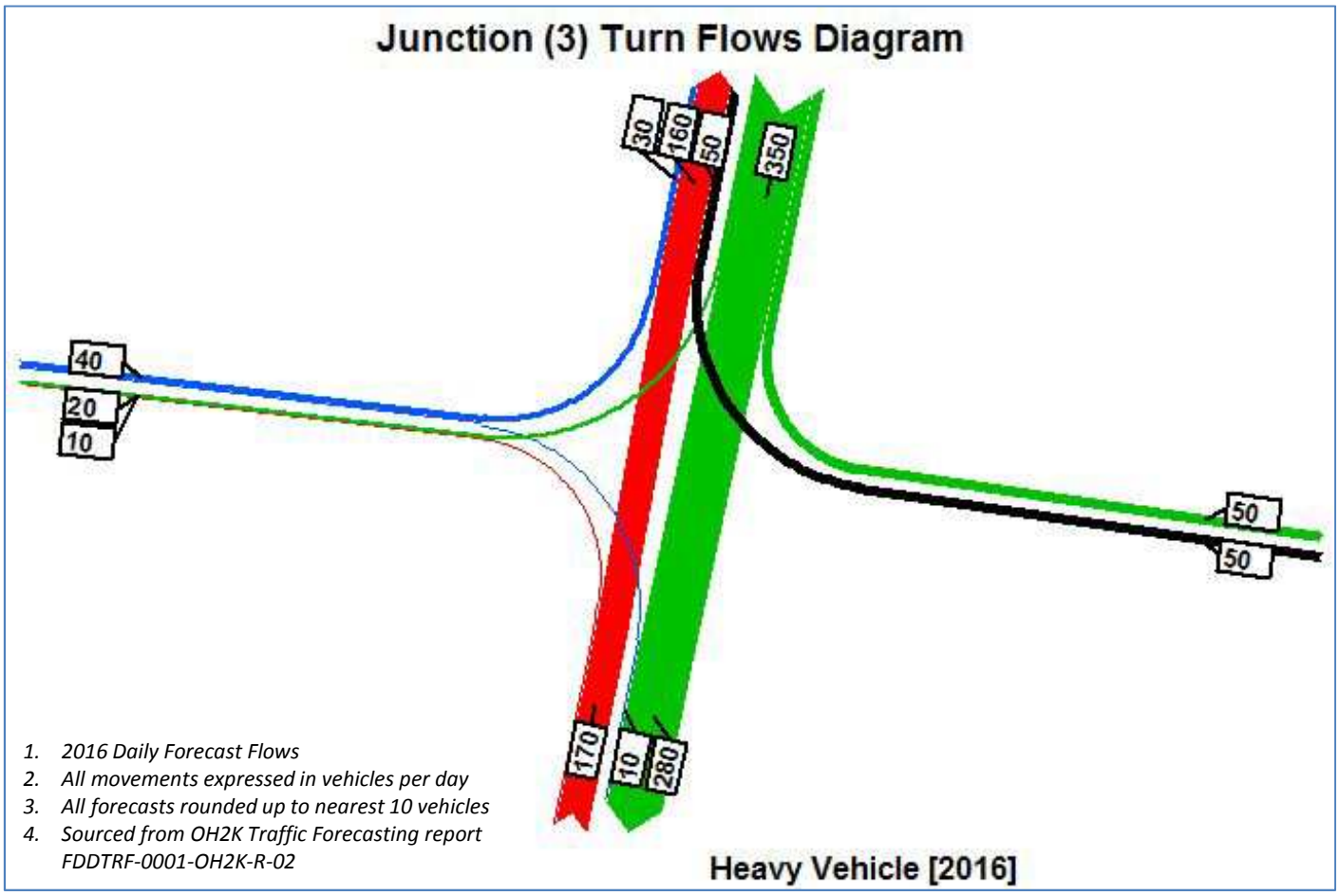




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

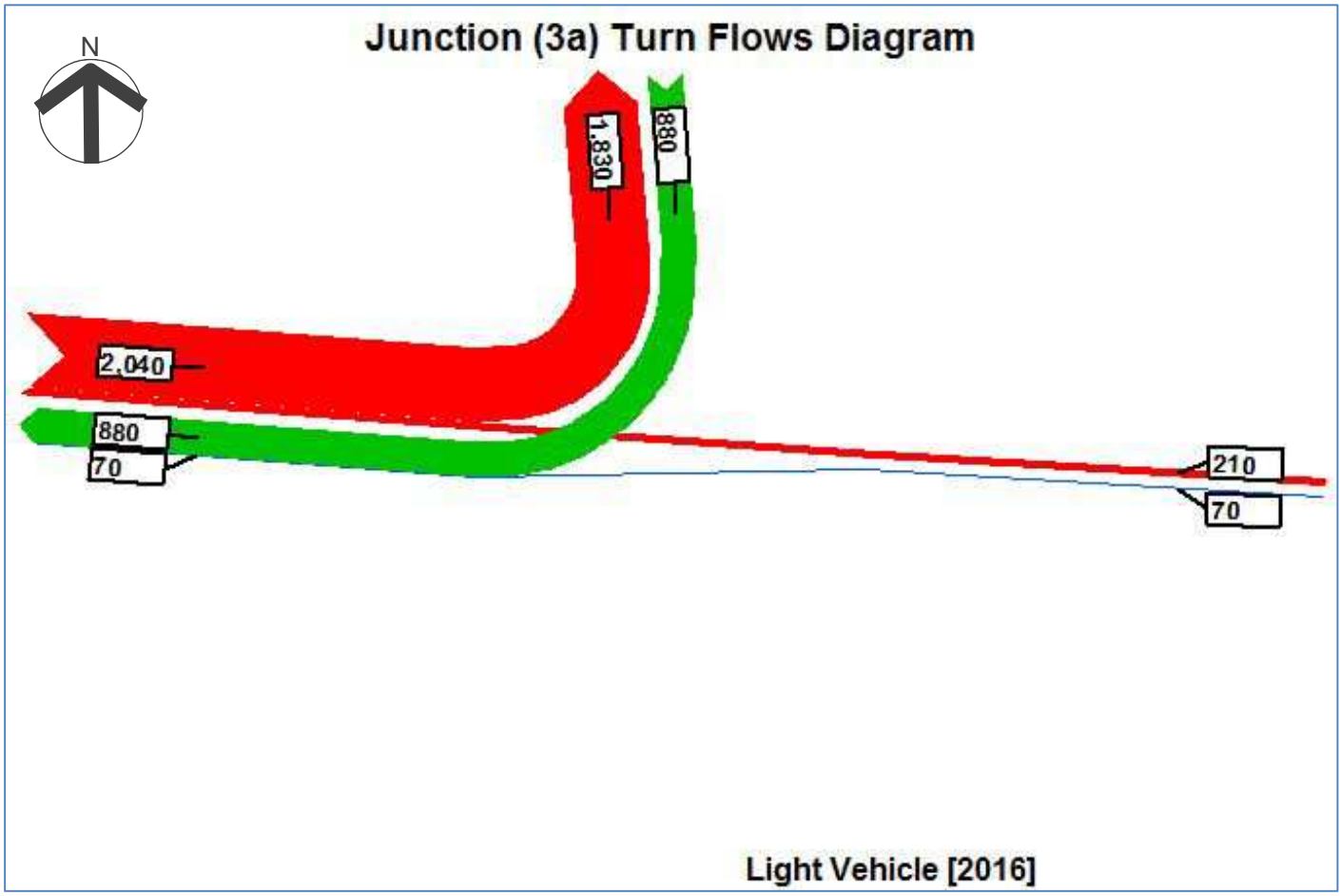
Site 3: Loop Road & RMS Depot

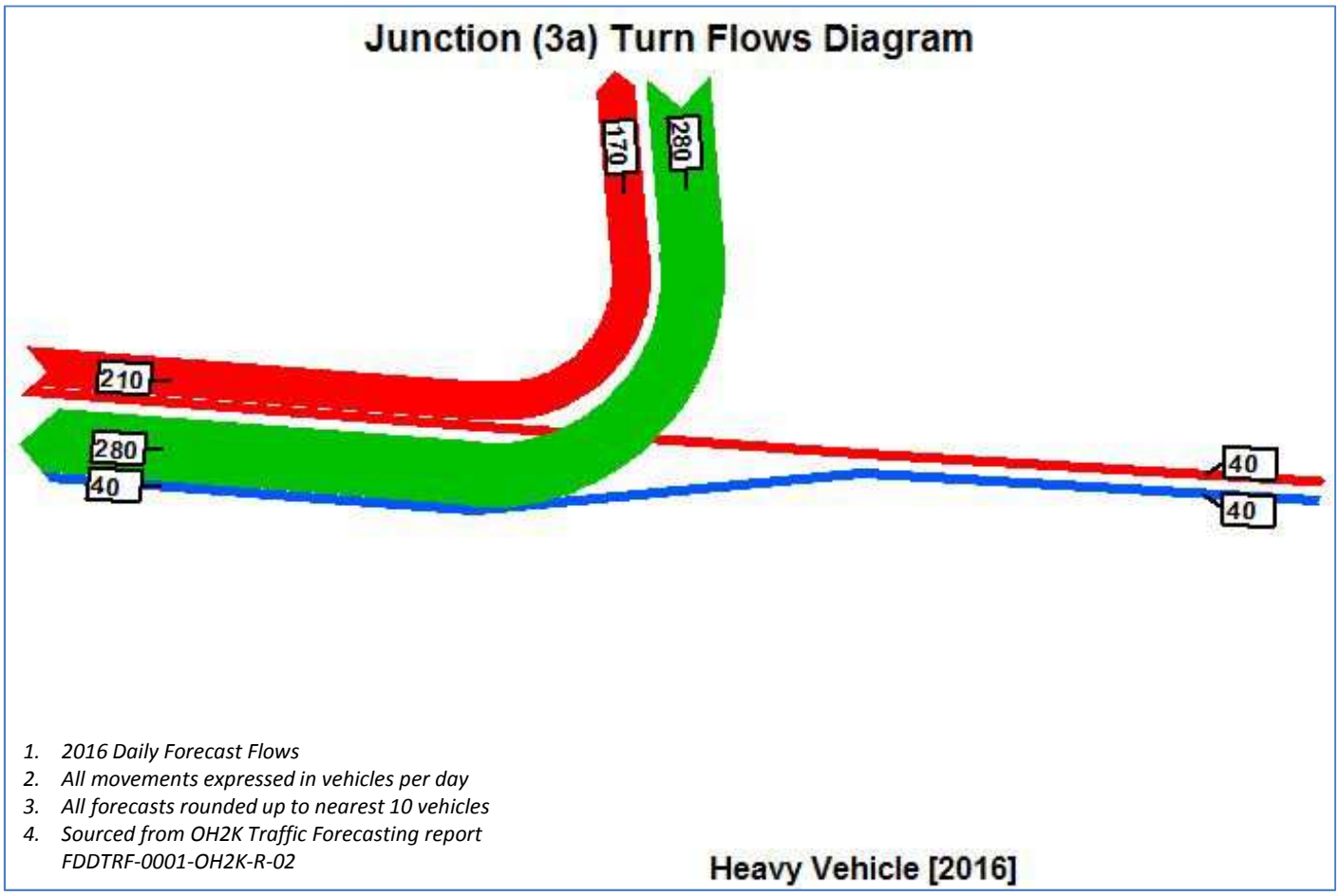




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

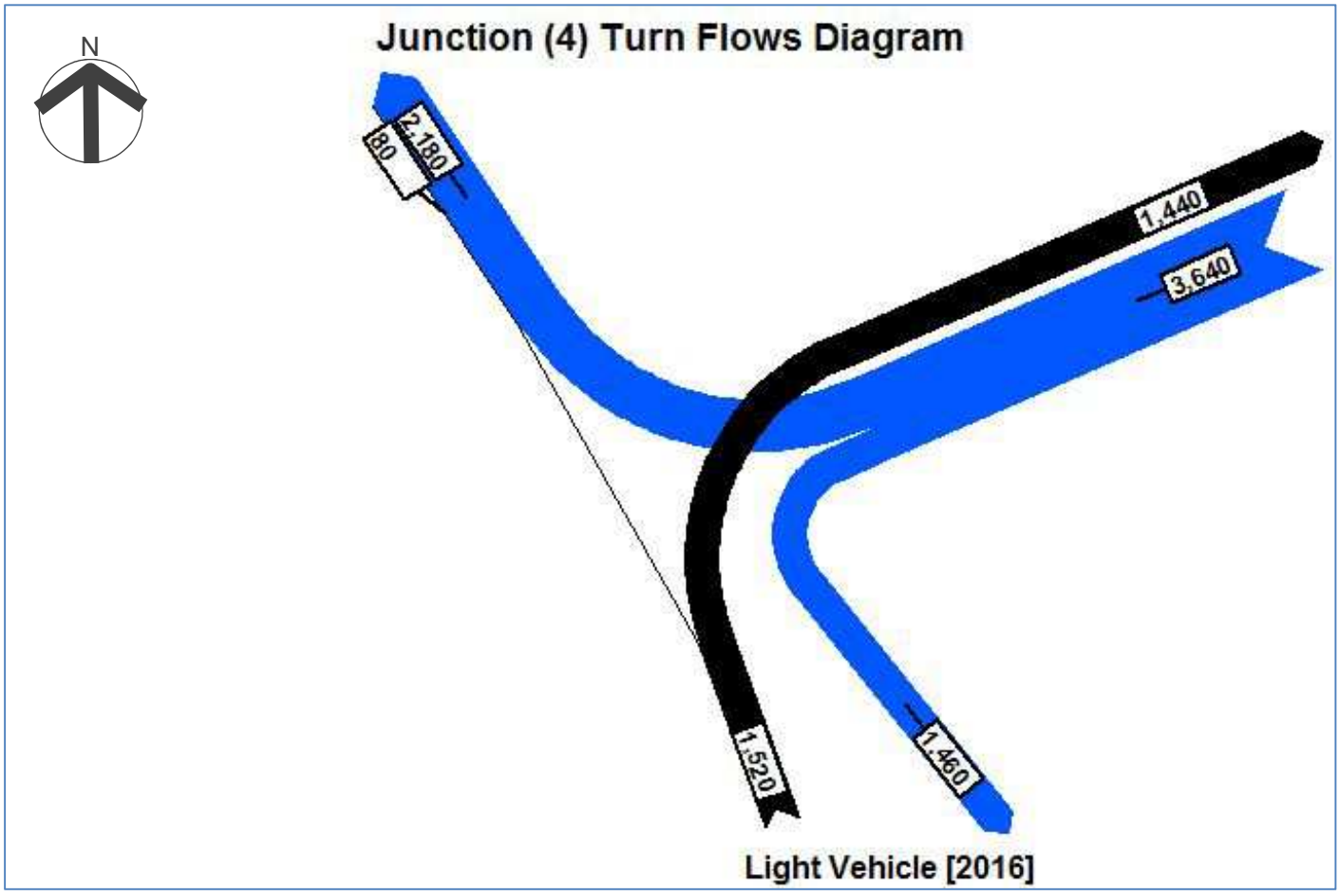
Site 3a: Loop Road & Fernbank Creek Industrial

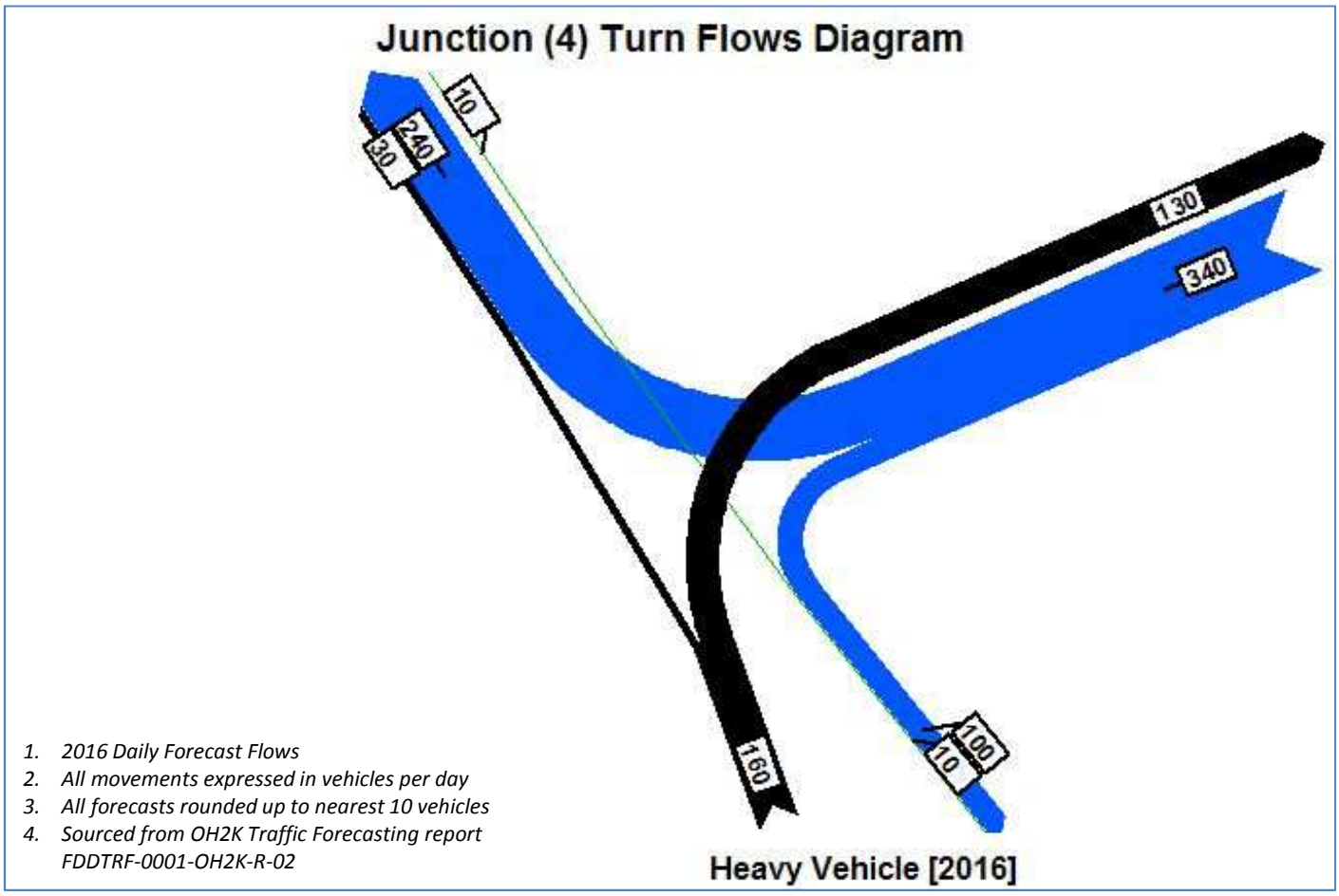




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

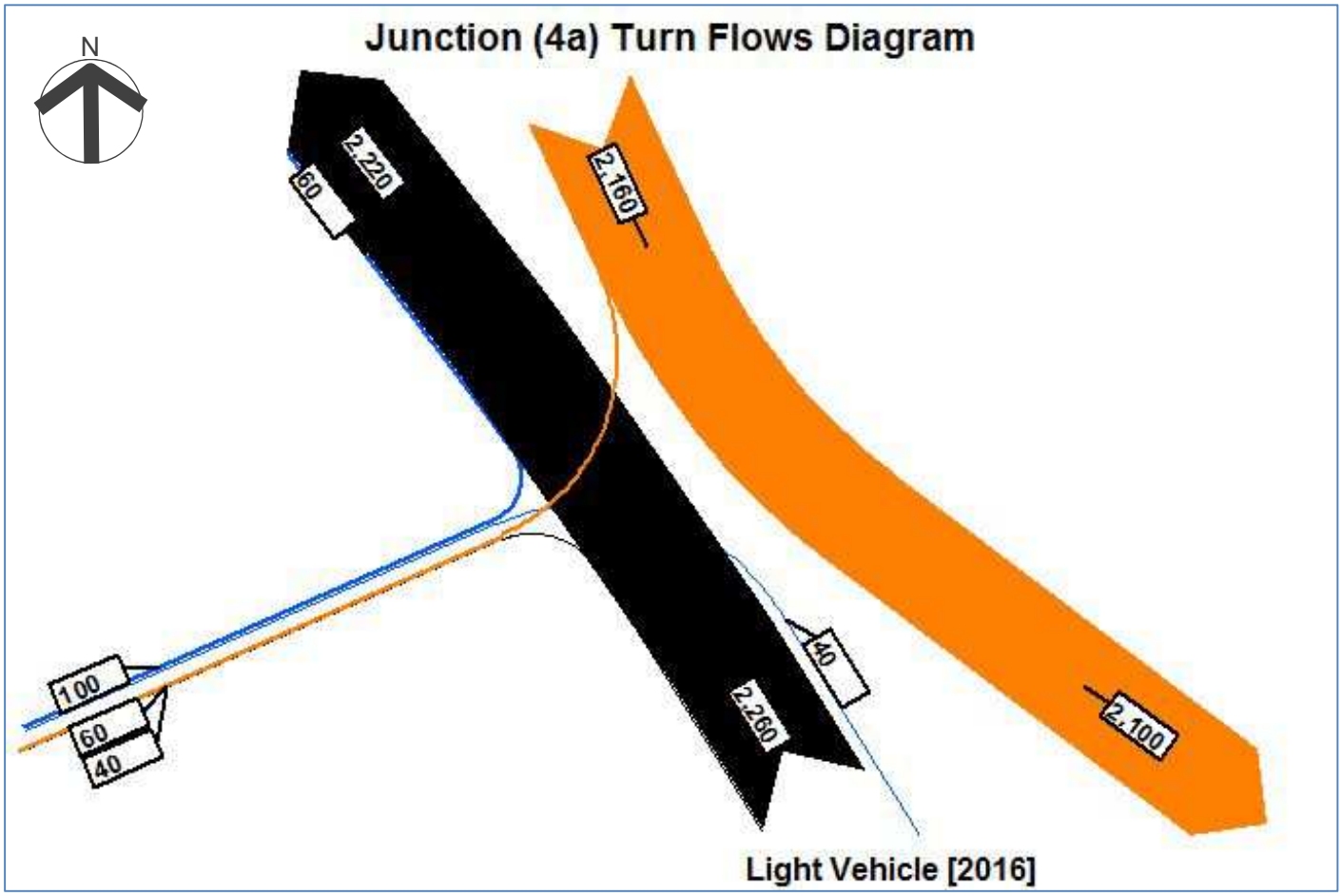
Site 4: Hasting River Drive & Service Road

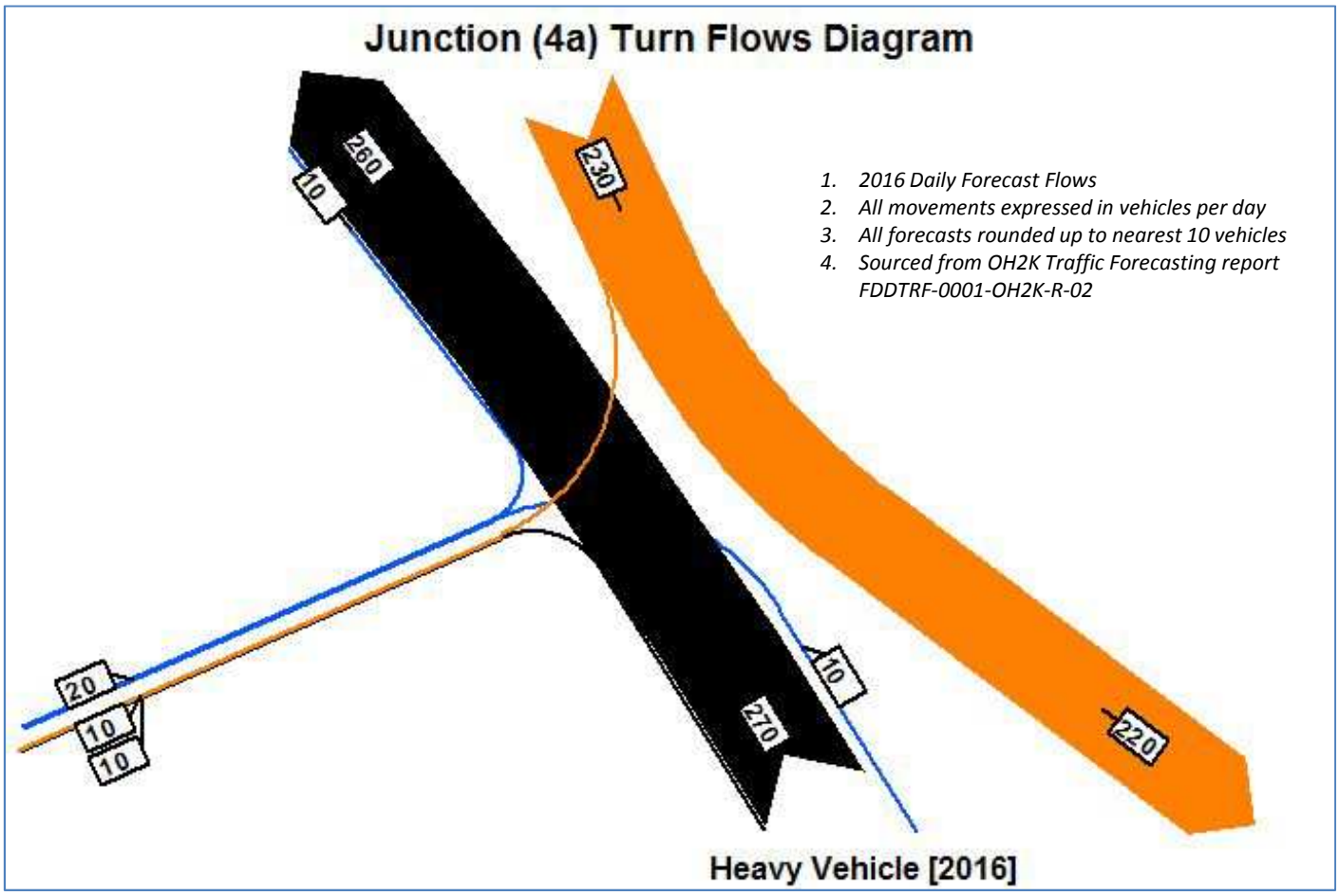




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

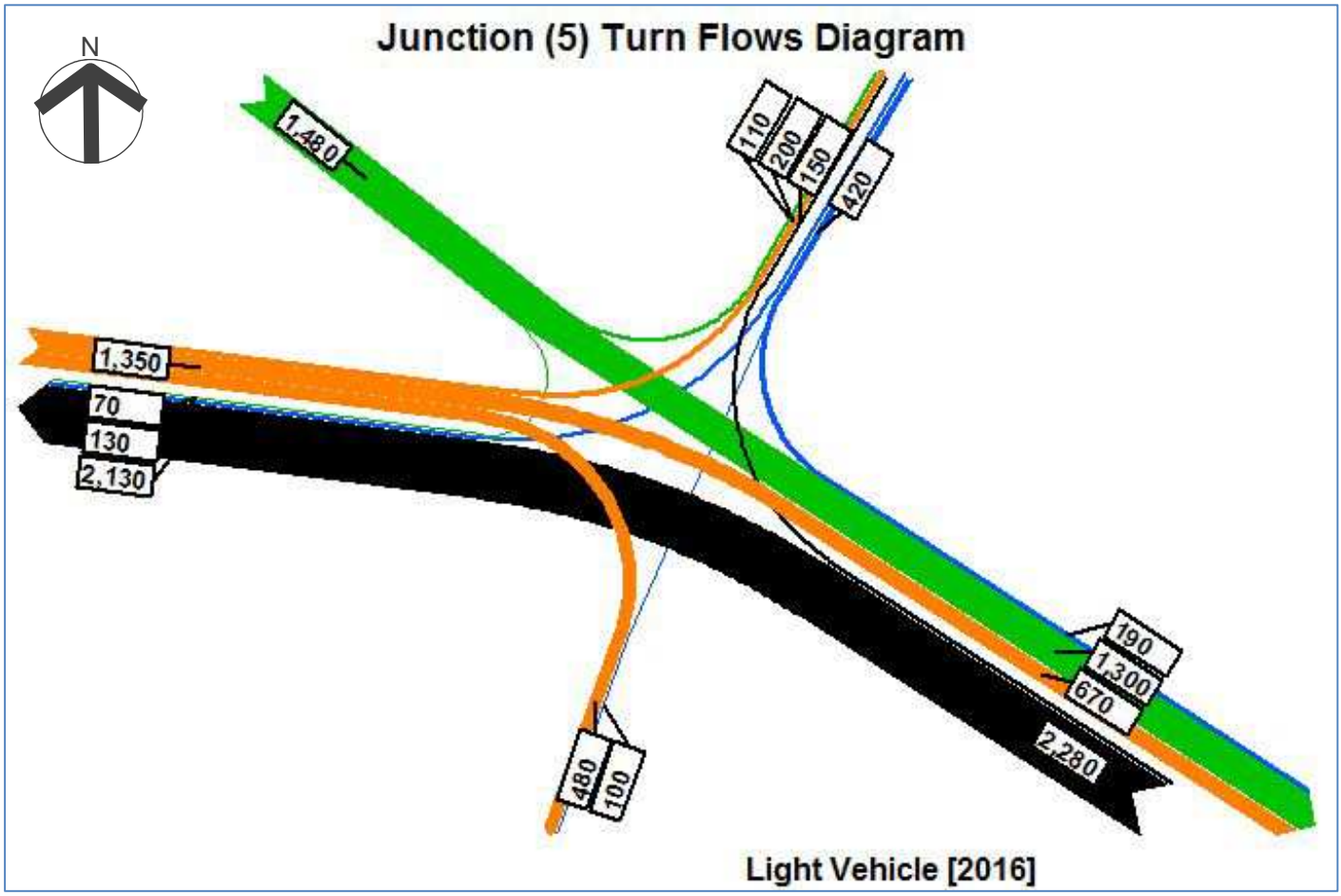
Site 4a: Glen Ewan Road & Service Road

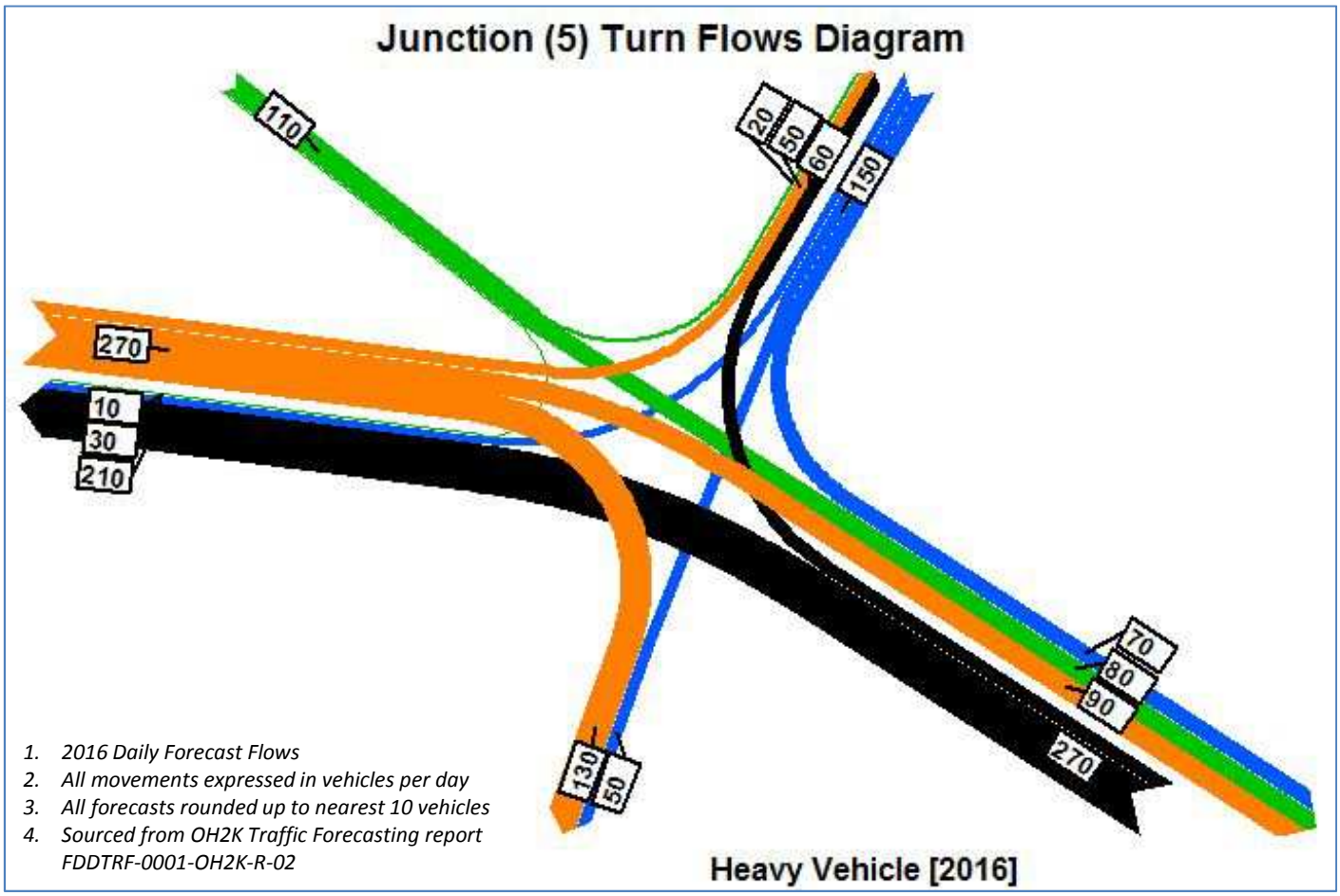




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

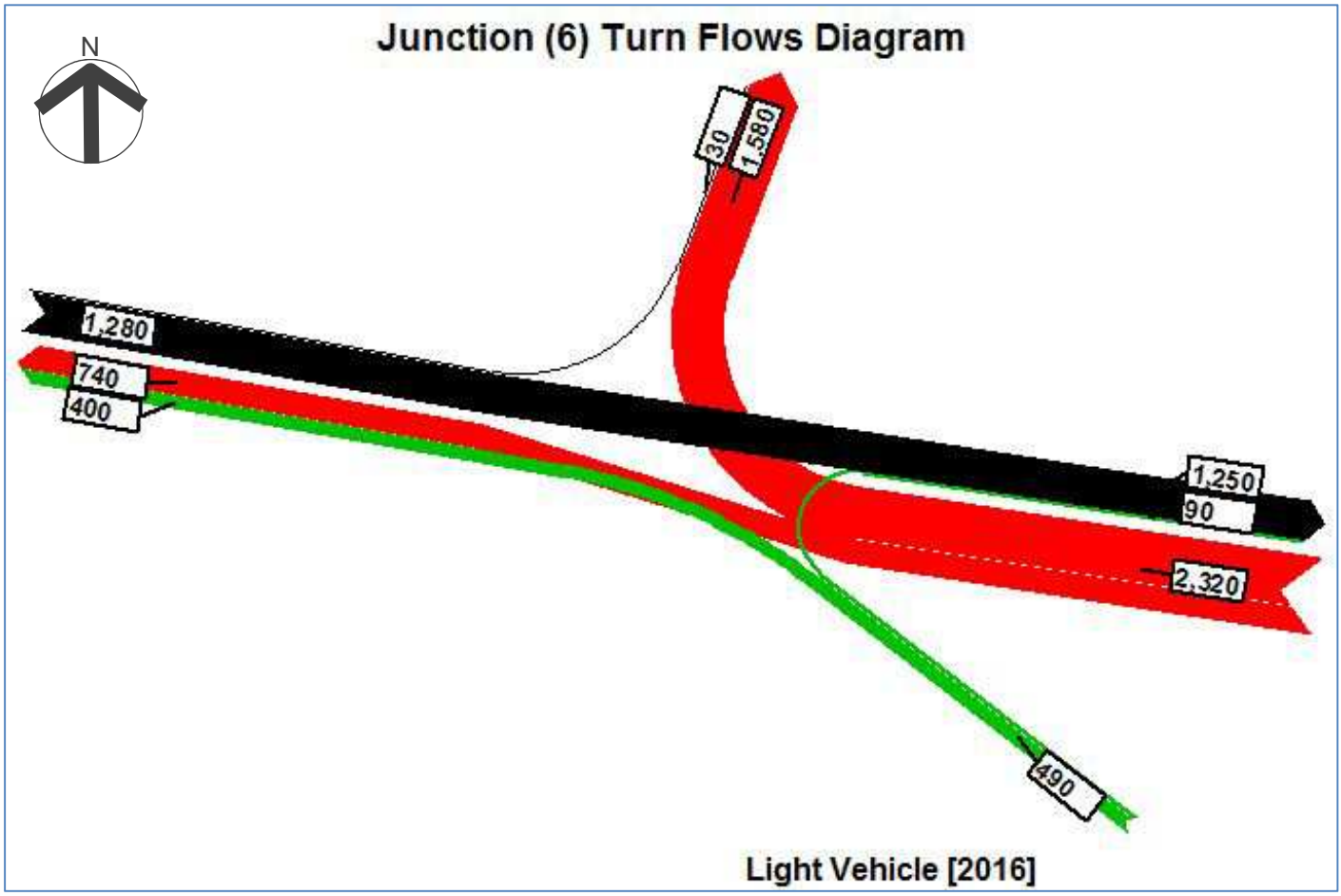
Site 5: Blackmans Point I/C (Eastern Roundabout)

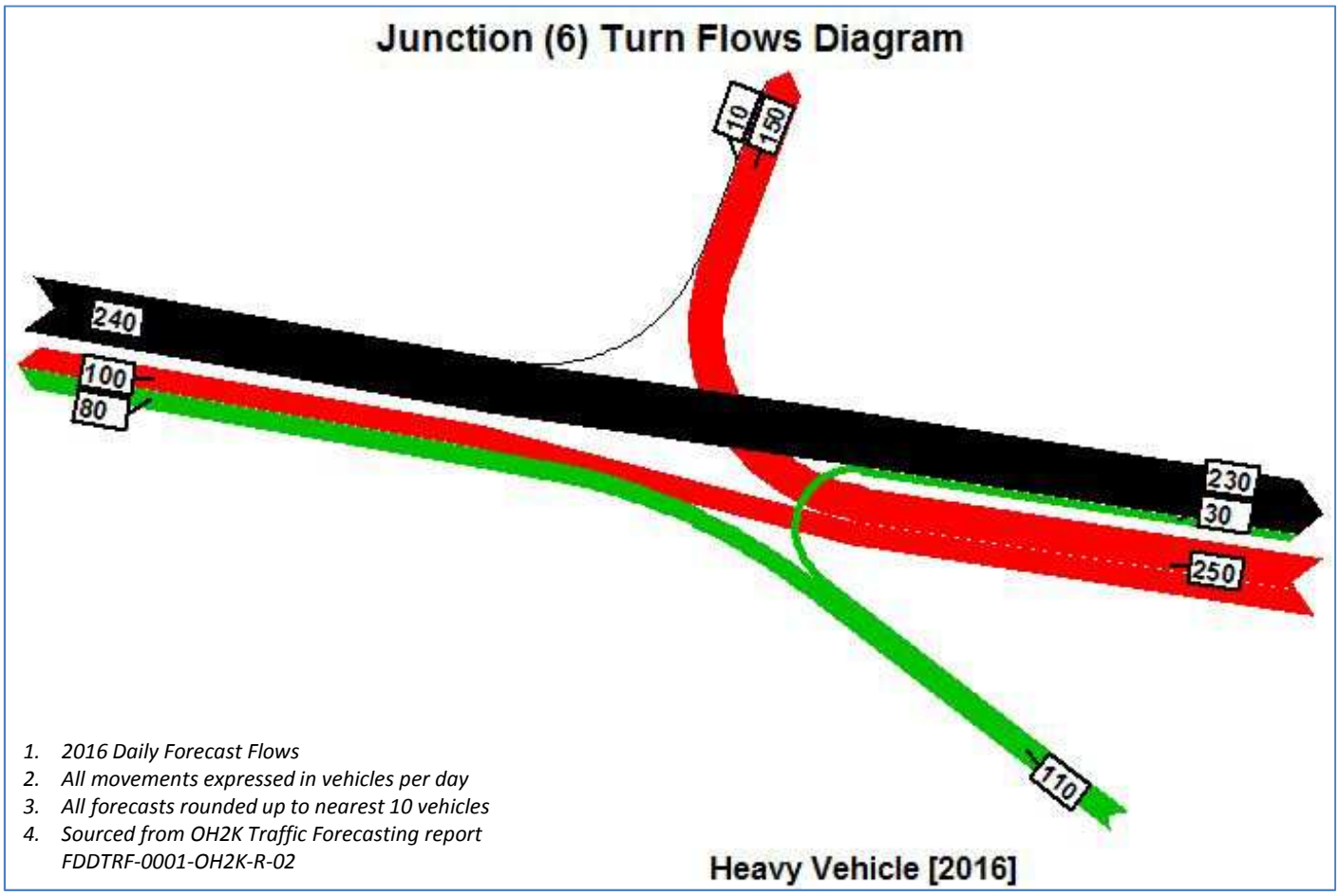




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

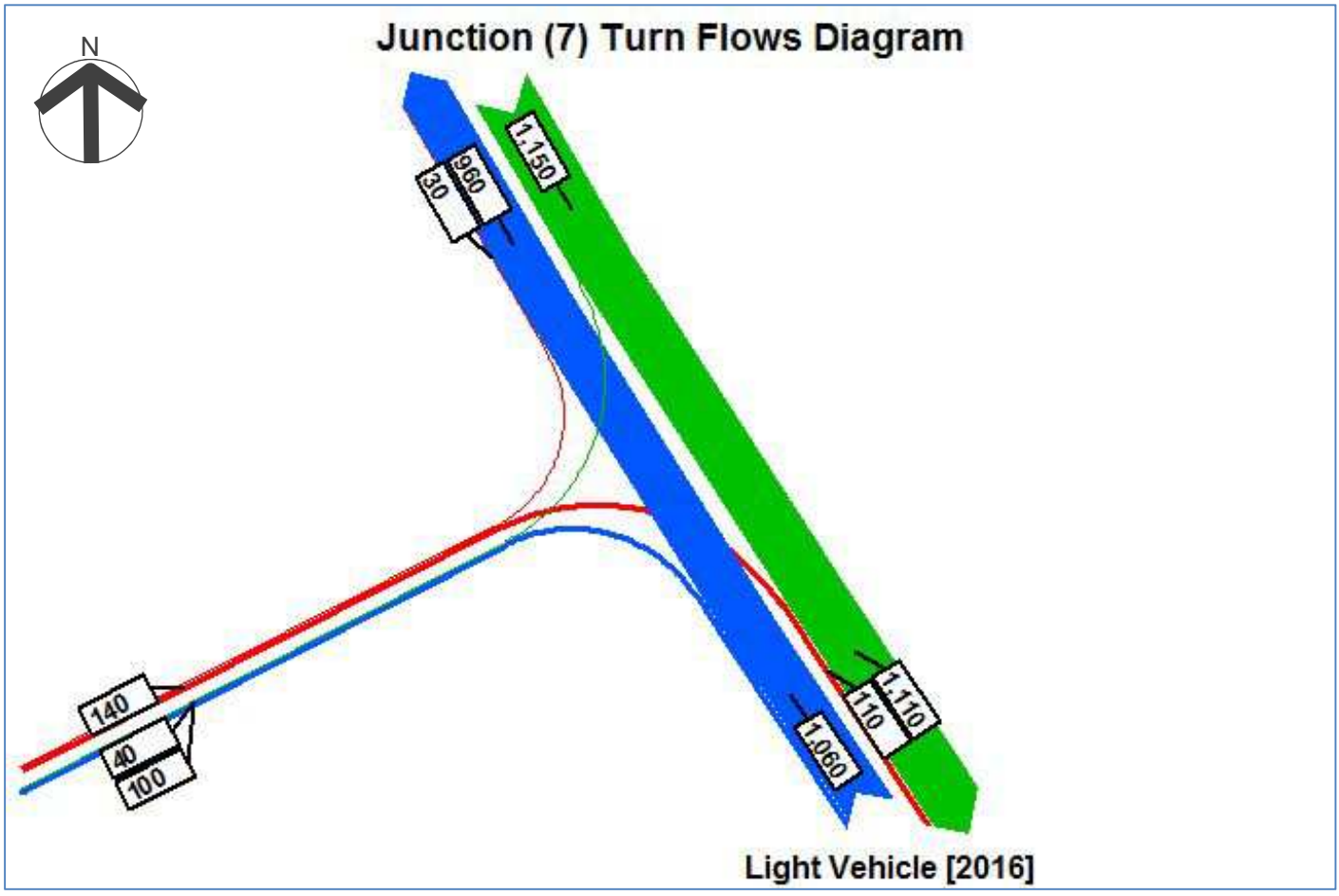
Site 6: Blackmans Point I/C (Western Roundabout)

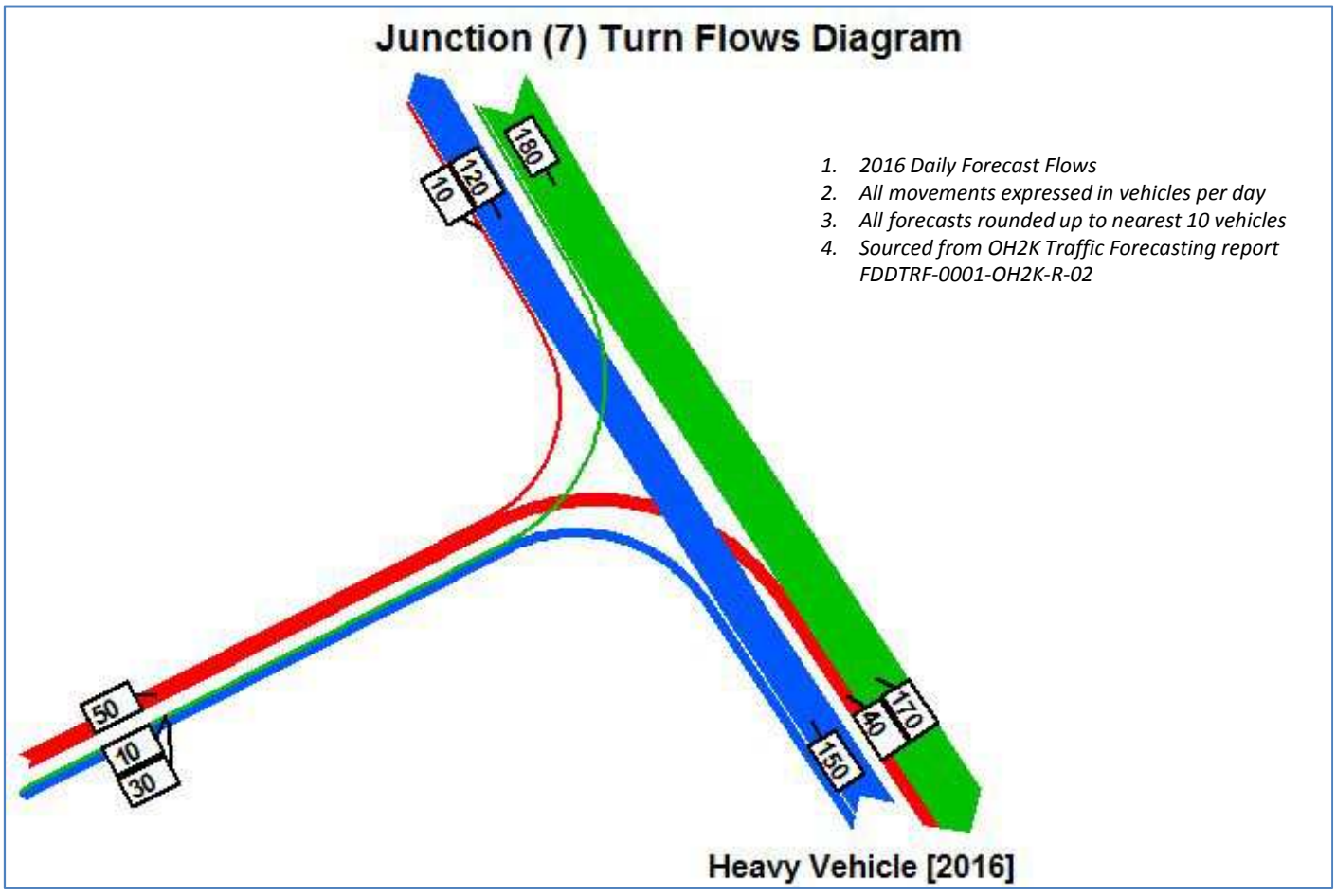




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

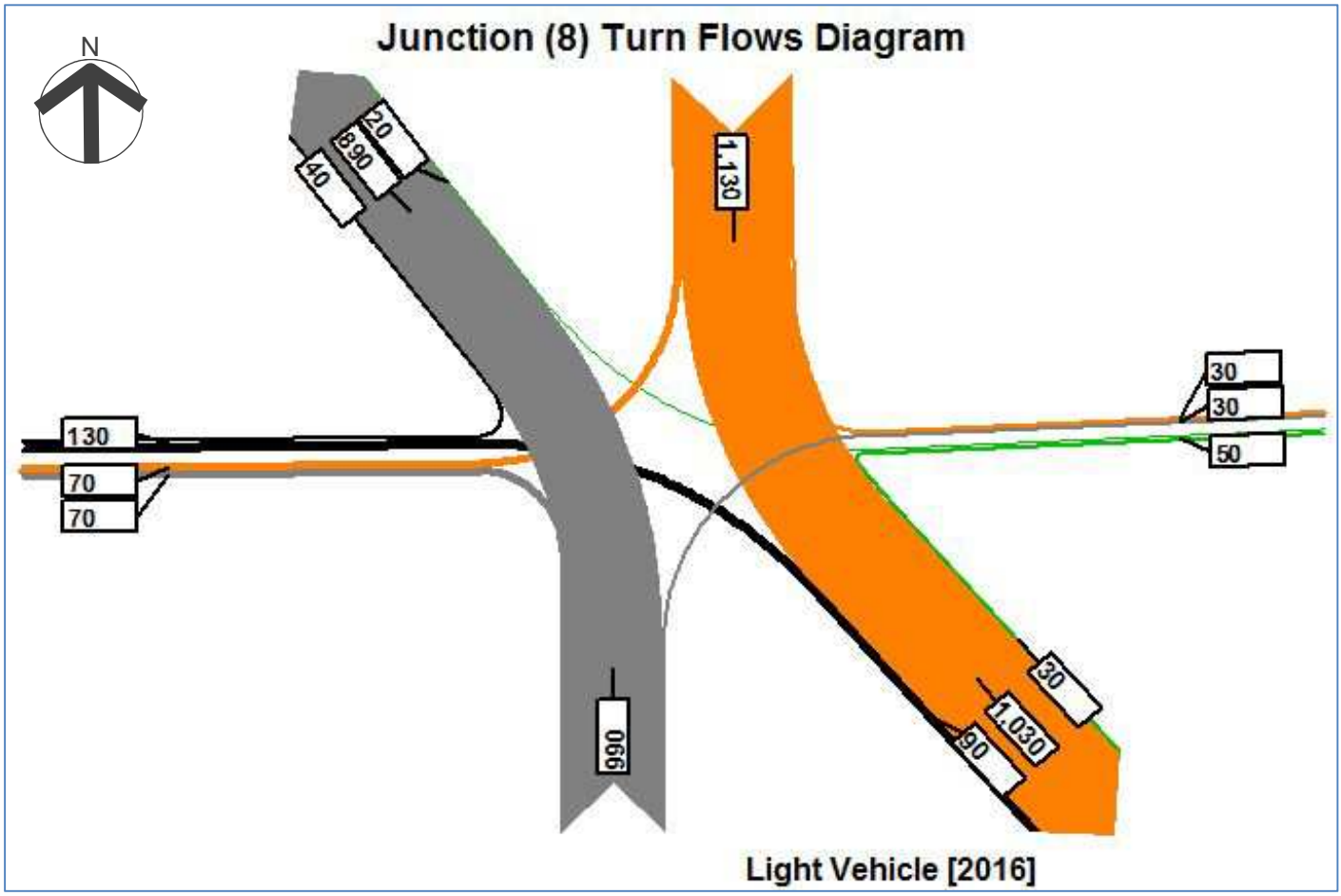
Site 7: Junction Road & Service Road

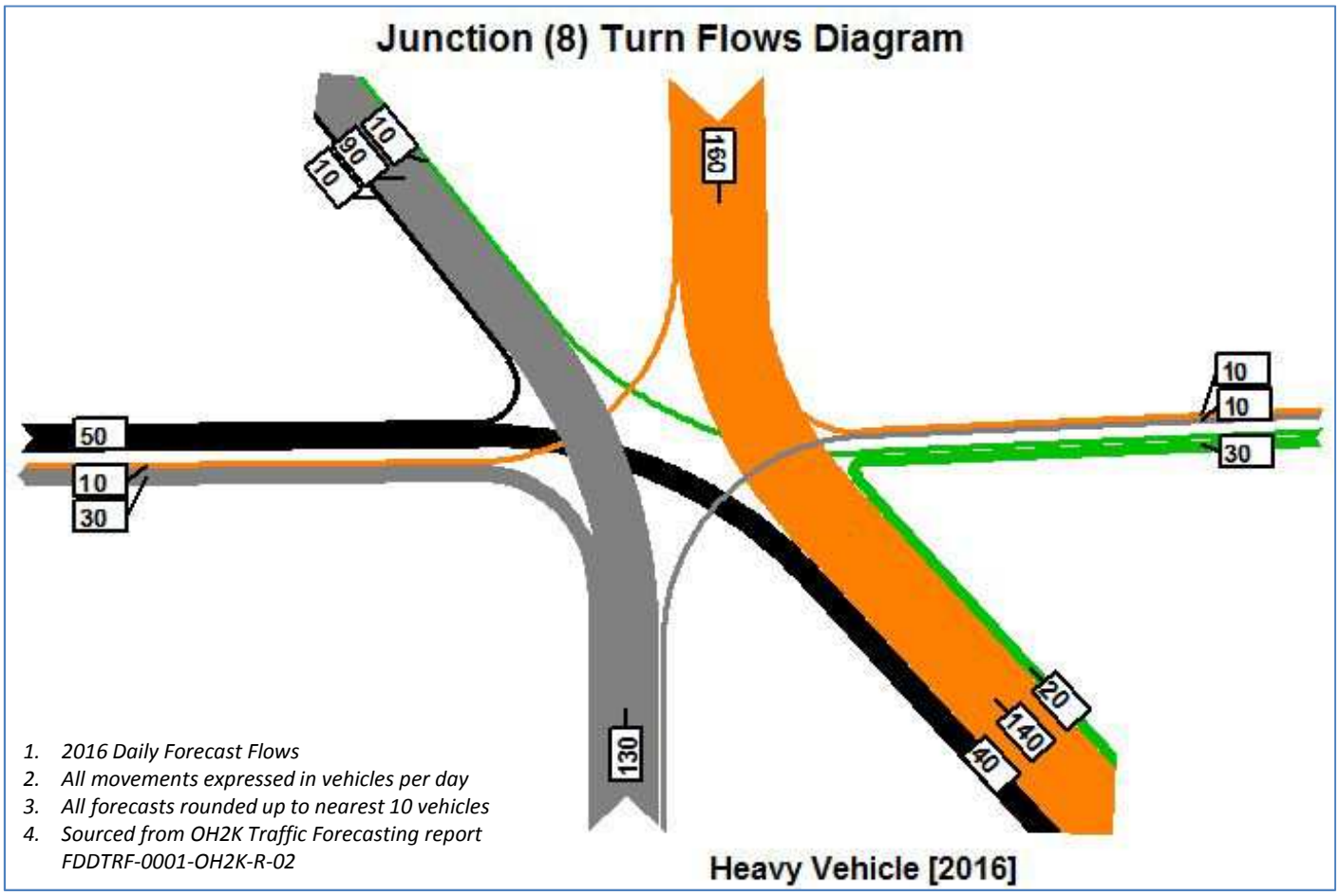




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

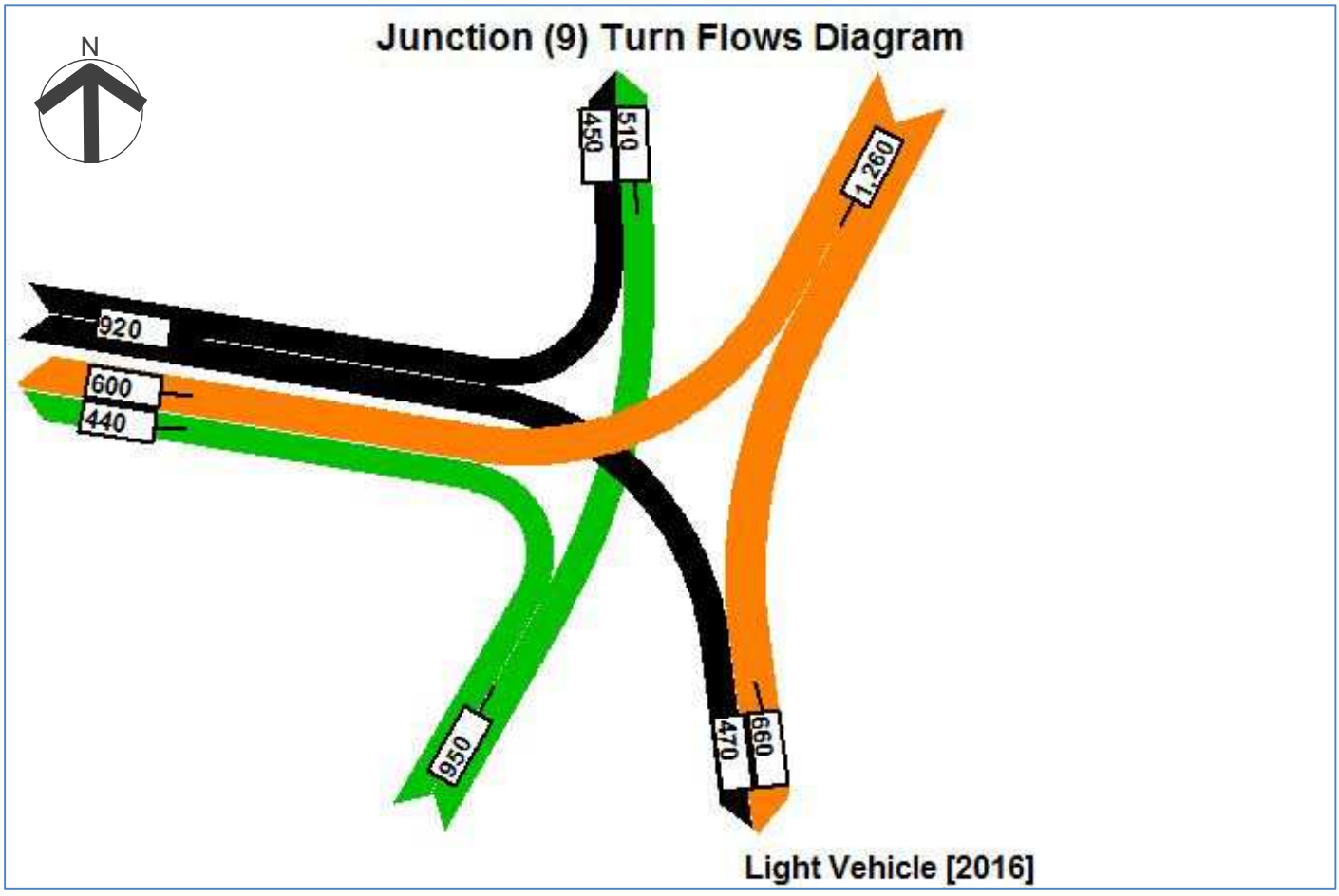
Site 8: Forest Hut Road, Bill Hill Road & Service Road

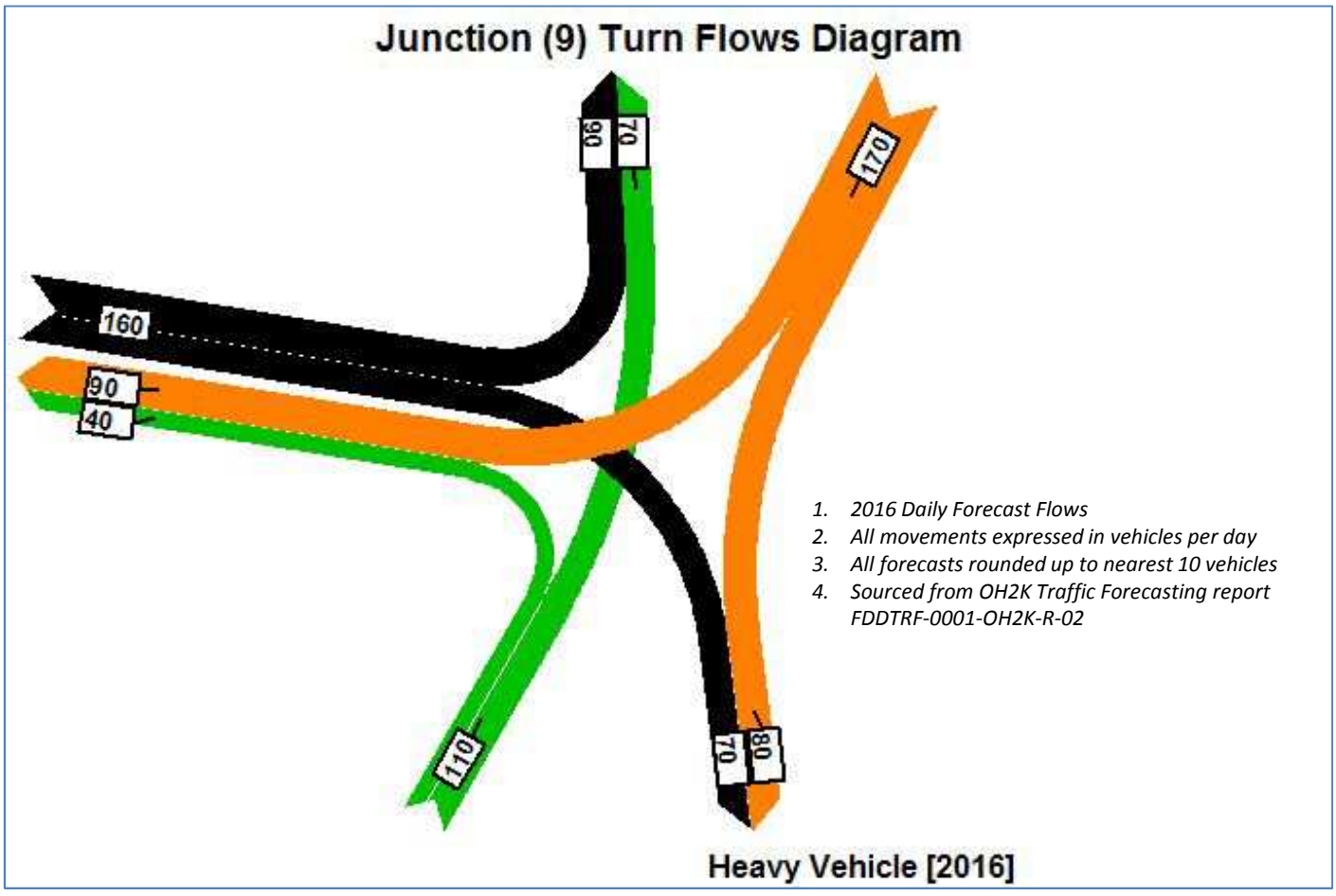




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

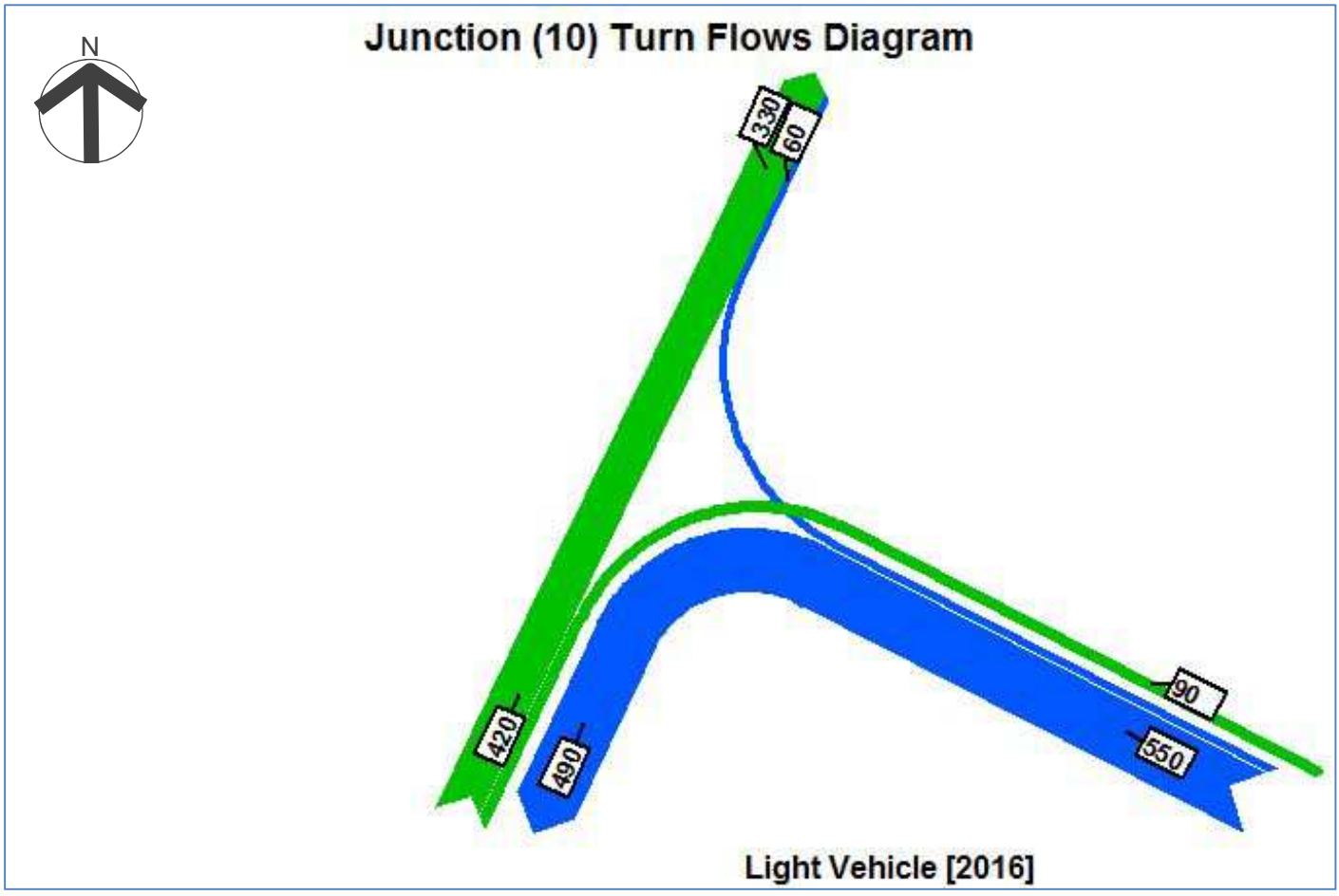
Site 9: Pembroke Road & Service Road

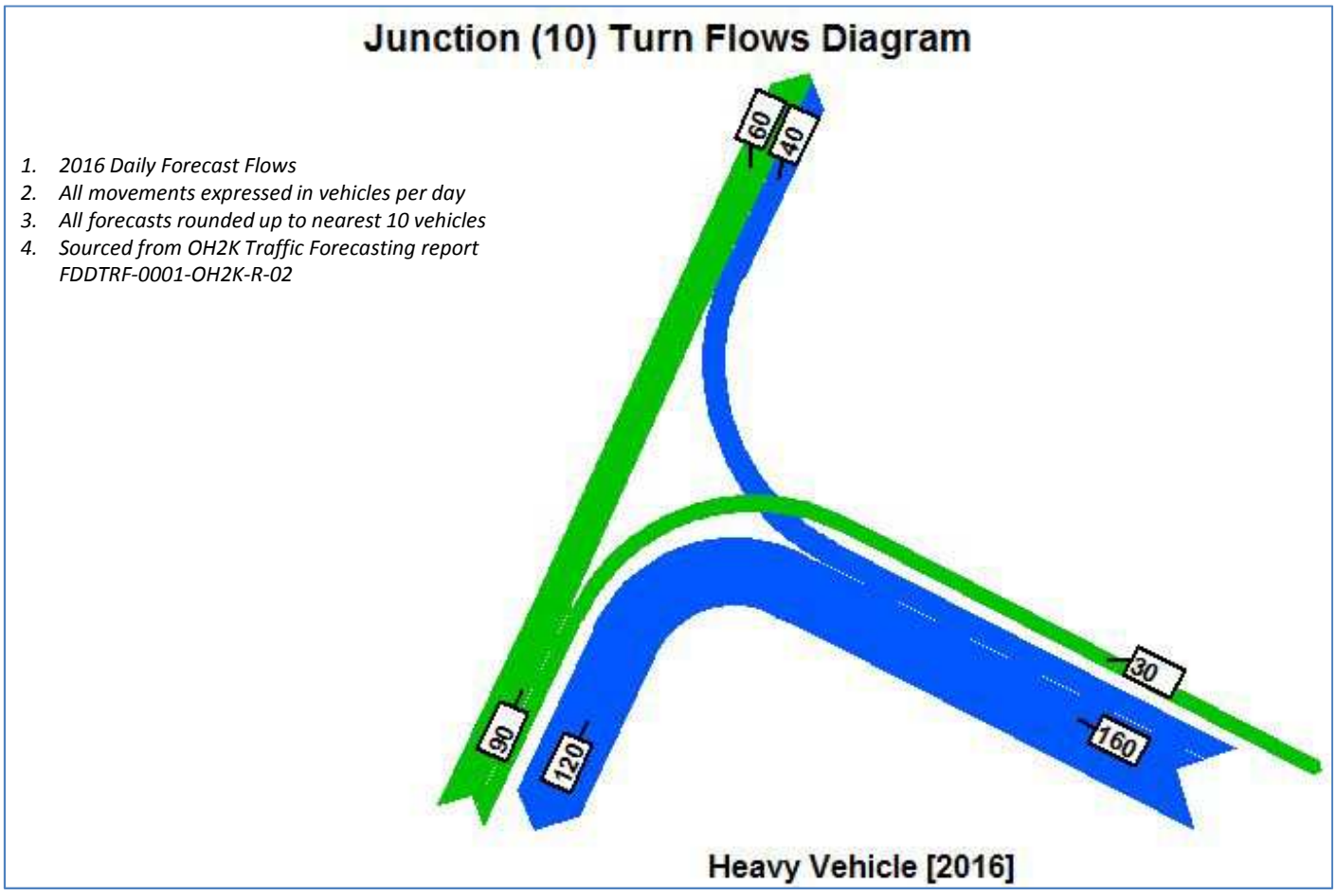




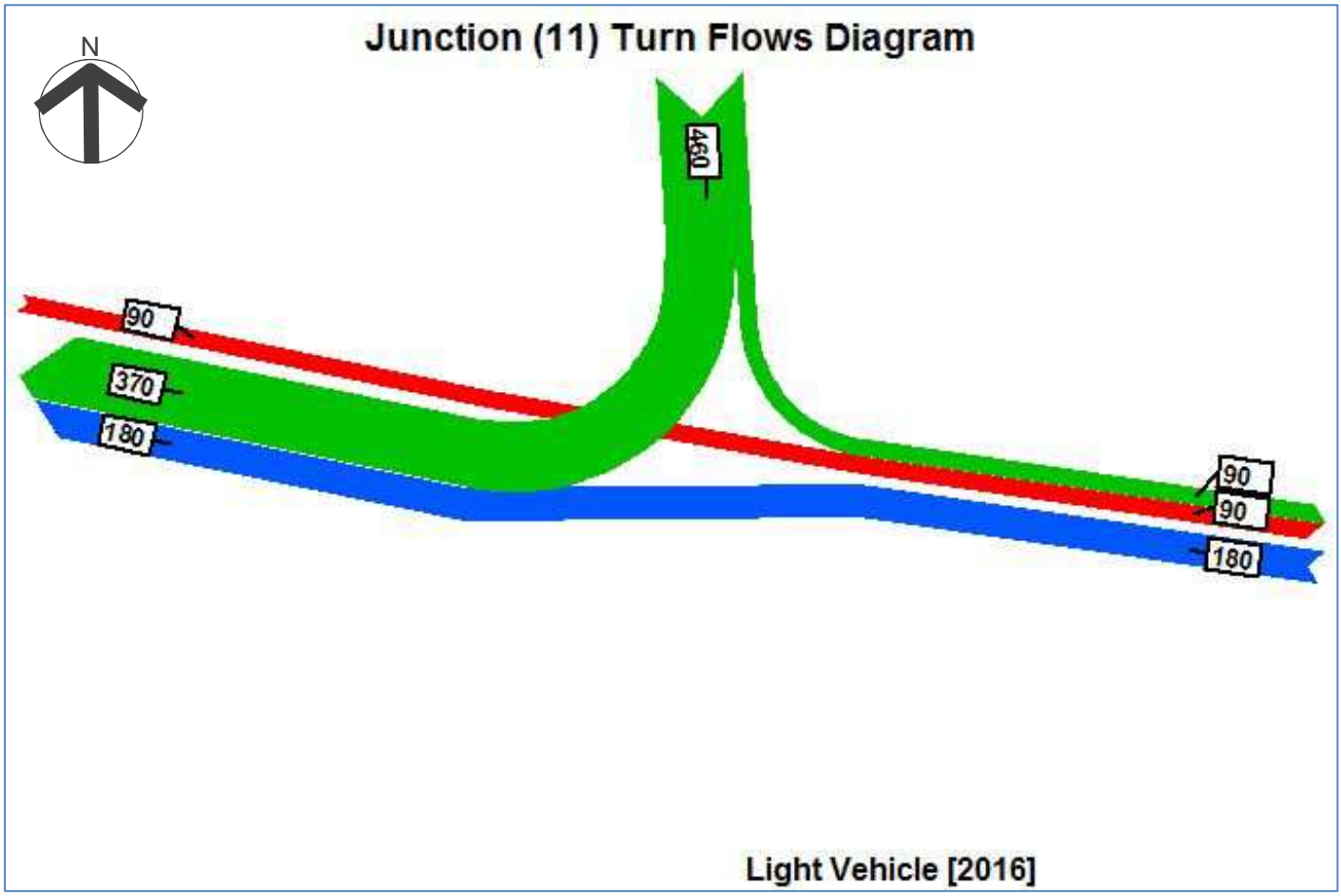
1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

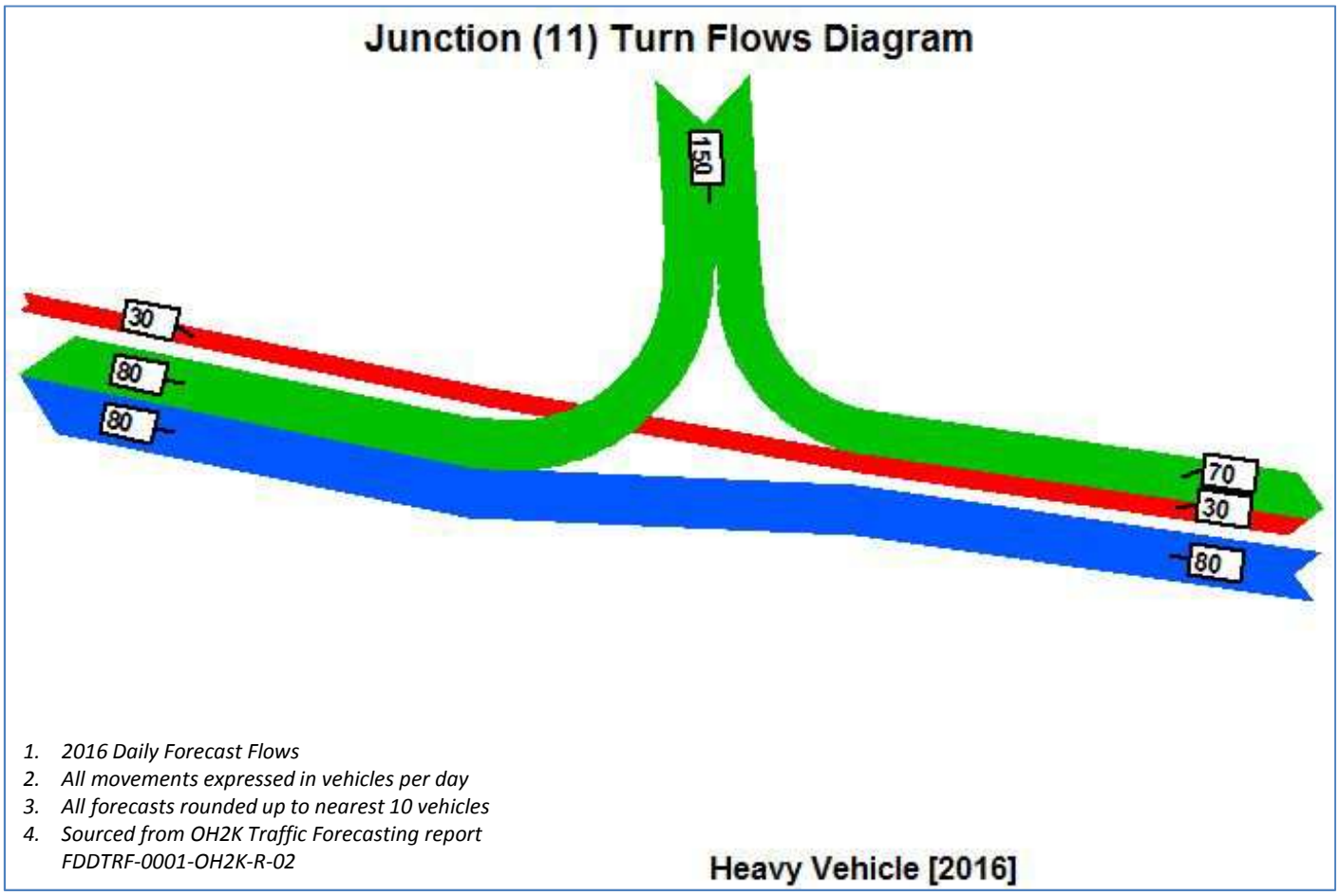
Site 10: Haydons Wharf Road & Service Road





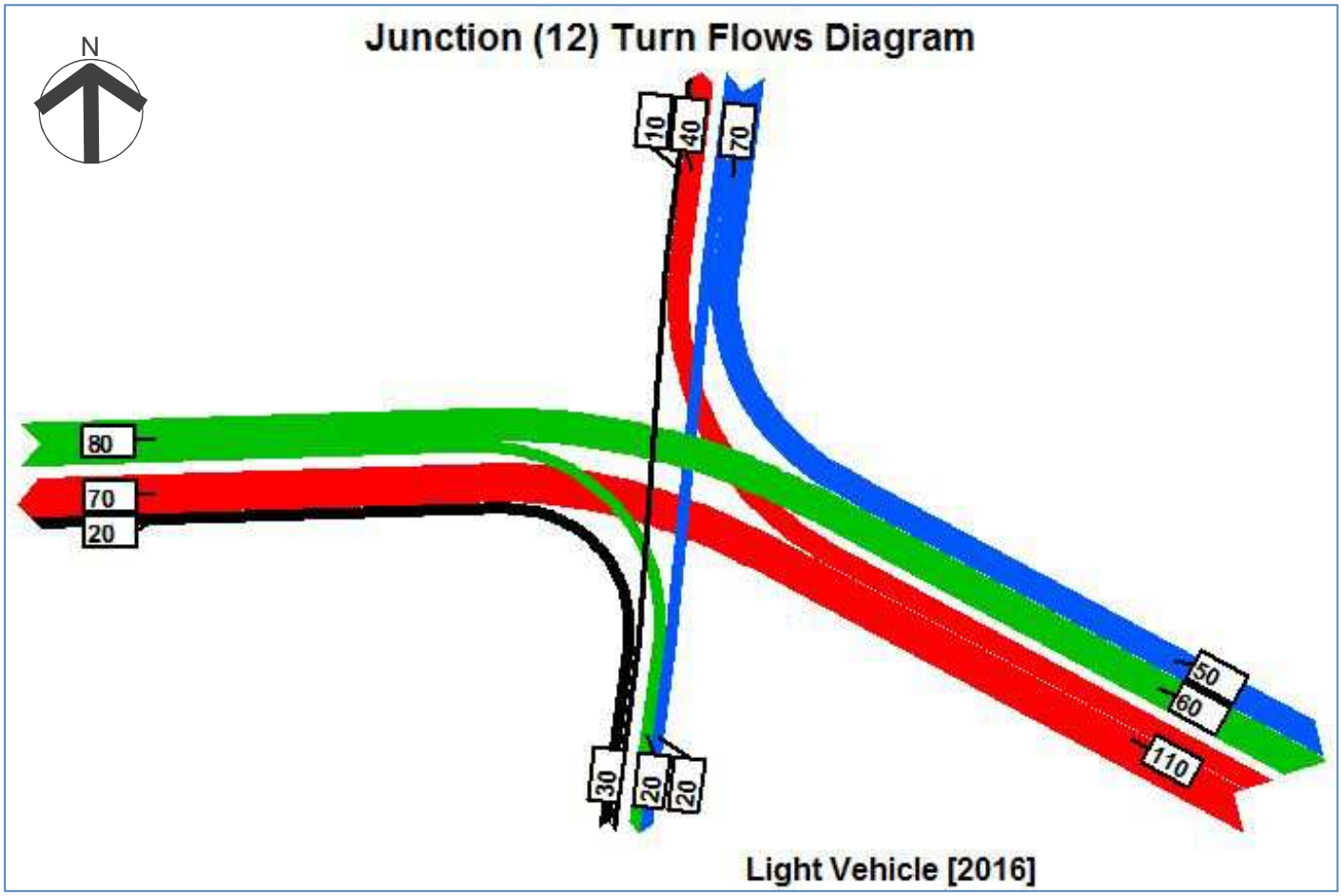
Site 11: Haydons Wharf Road & SB Off-ramp

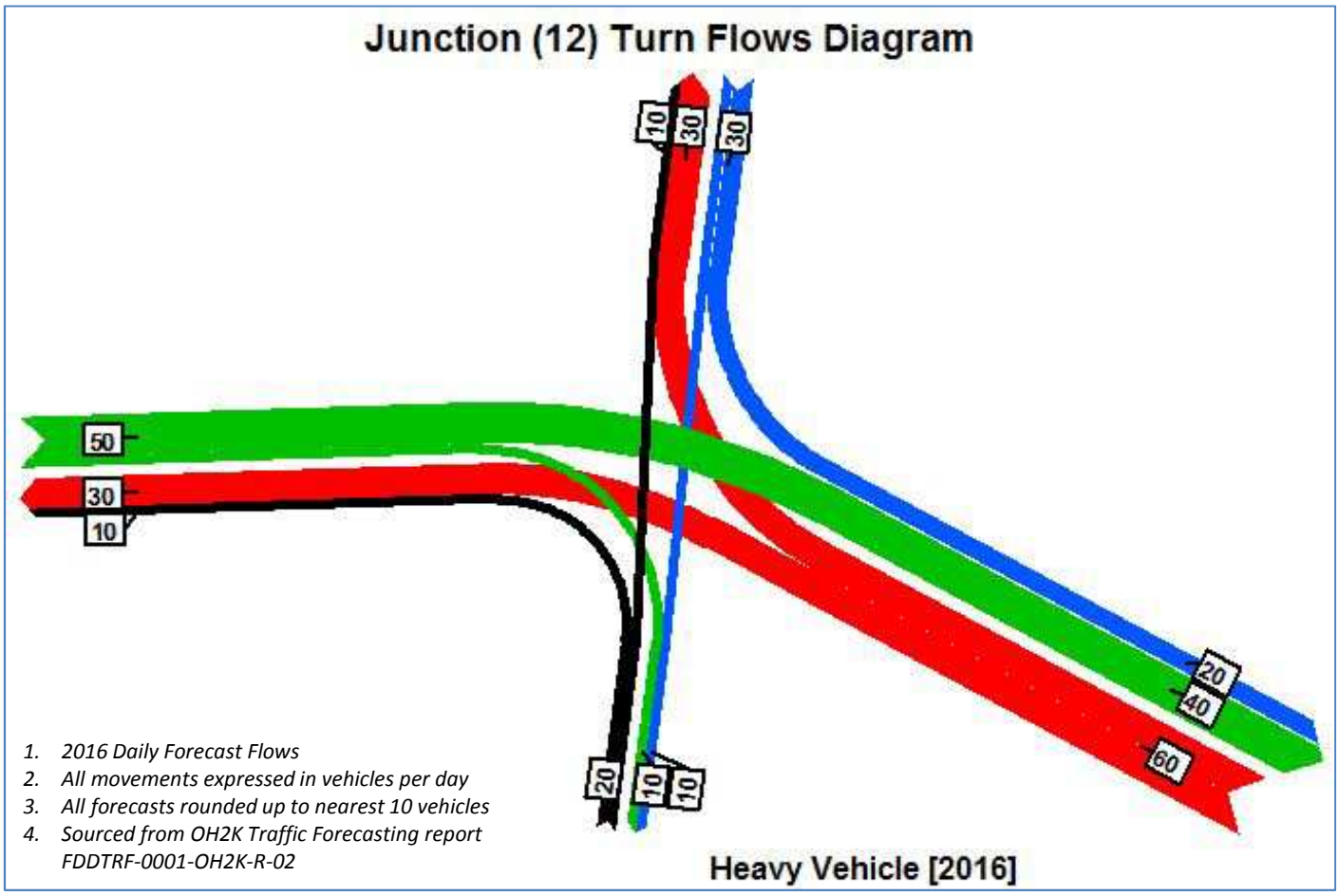




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

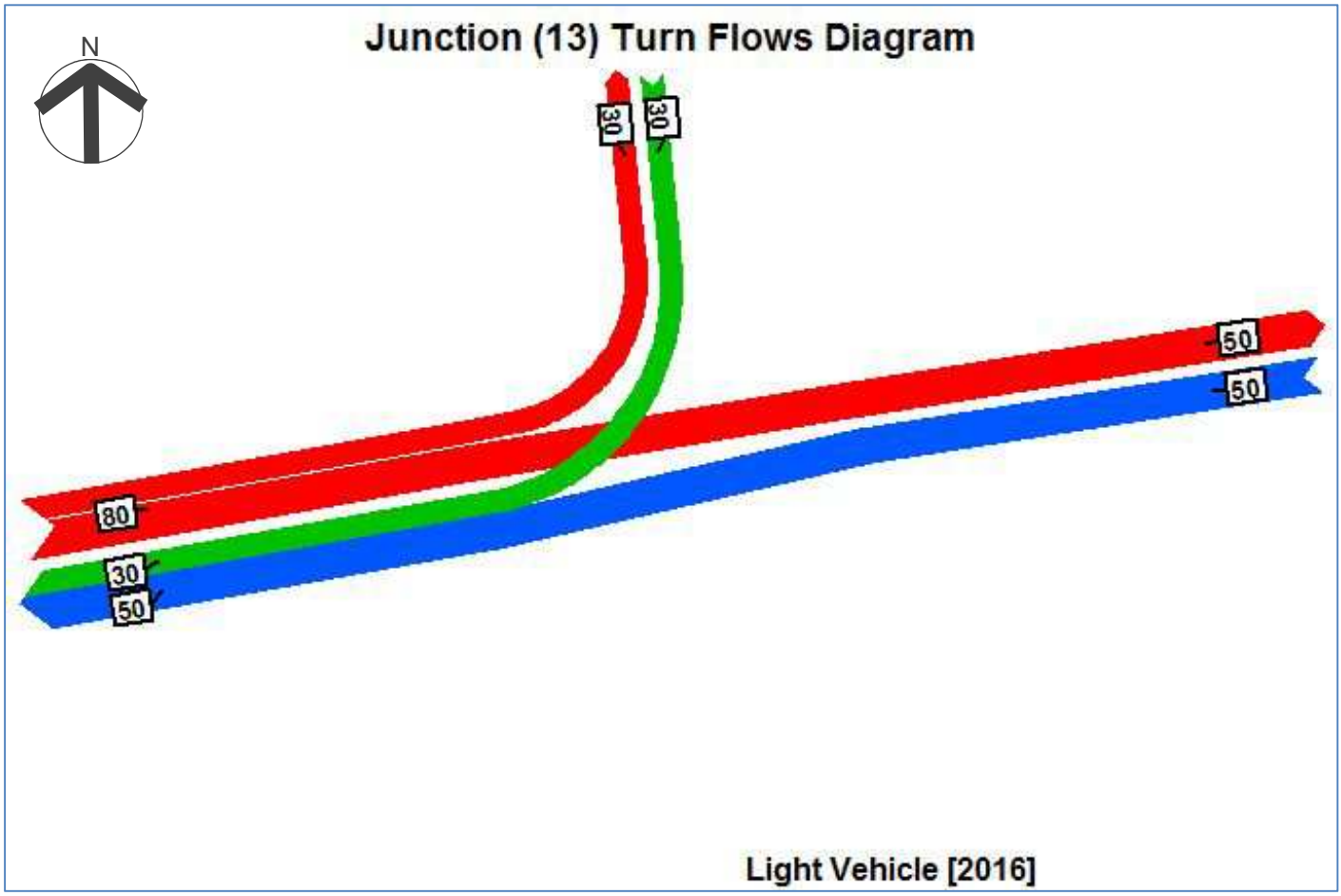
Site 12: Cooperabung Drive & Zone J2

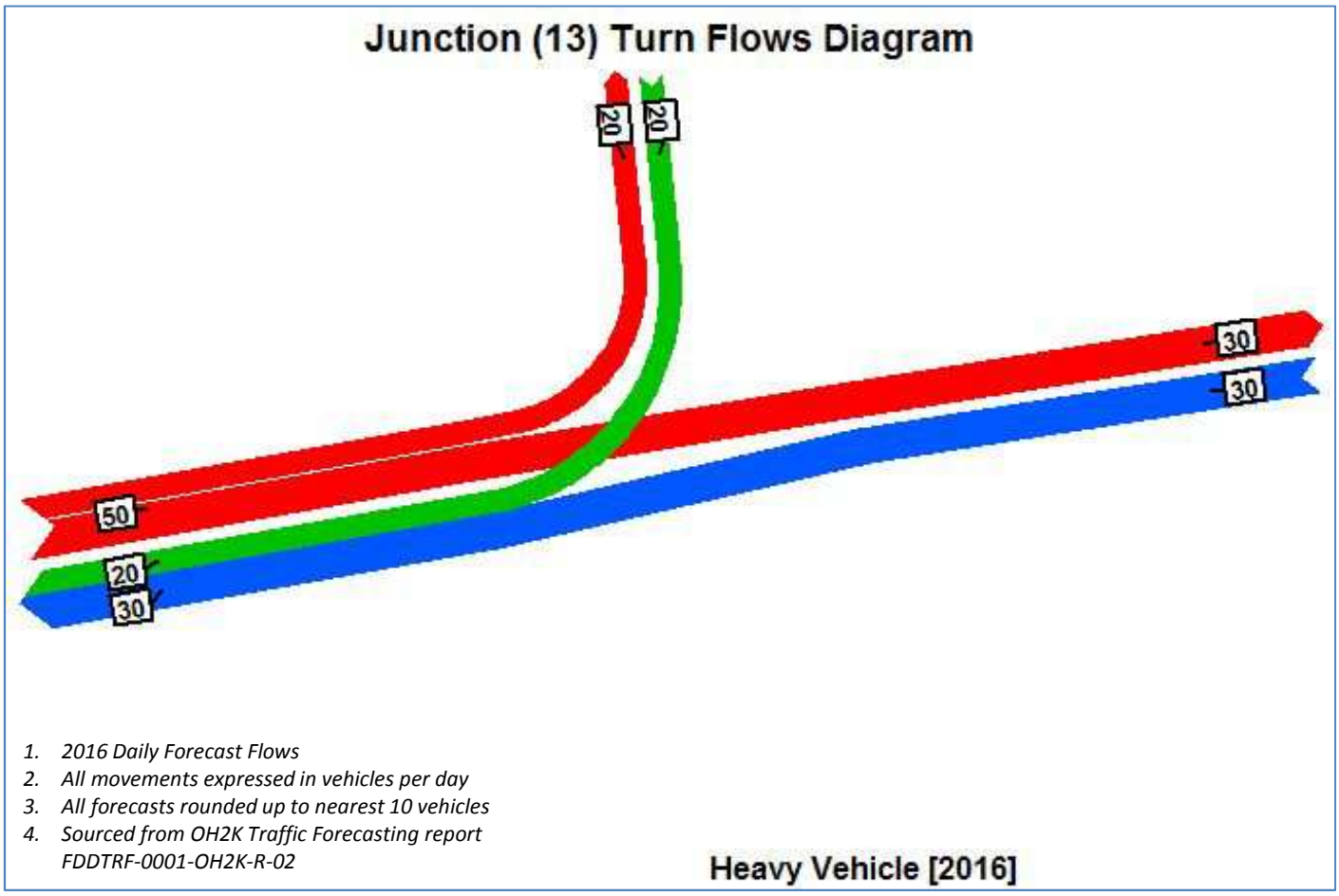




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

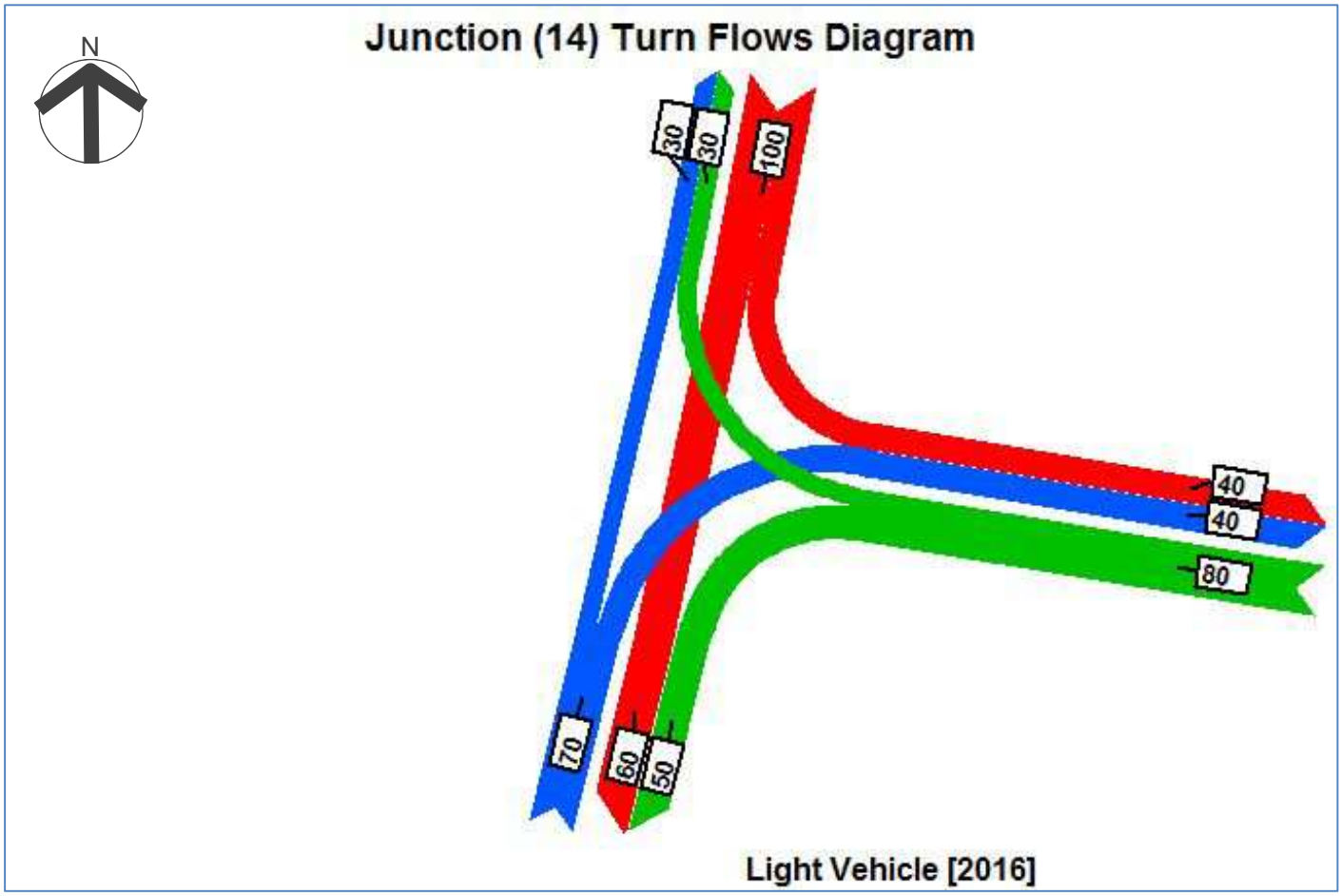
Site 13: Mingaletta Road & Mobbs Road

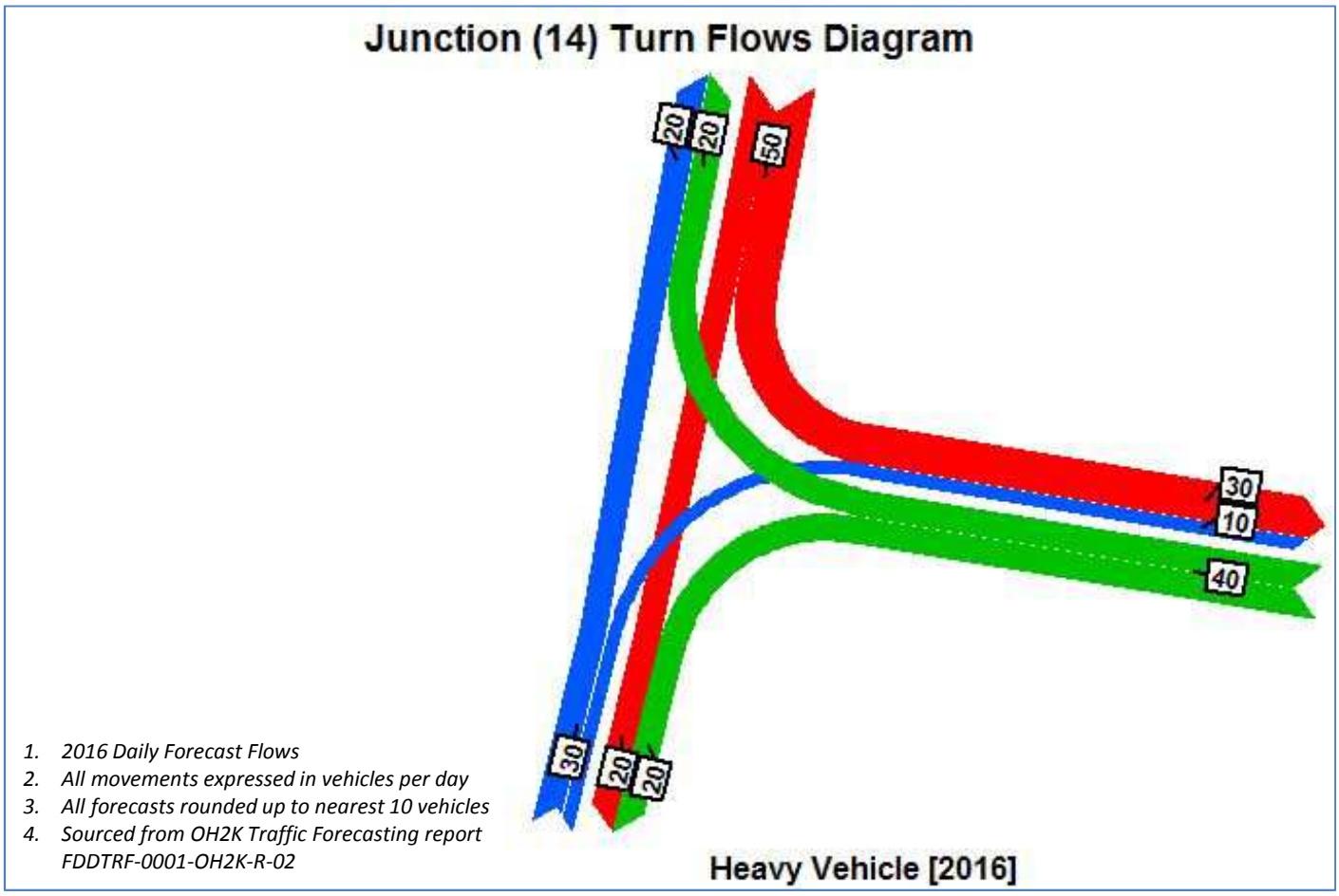




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

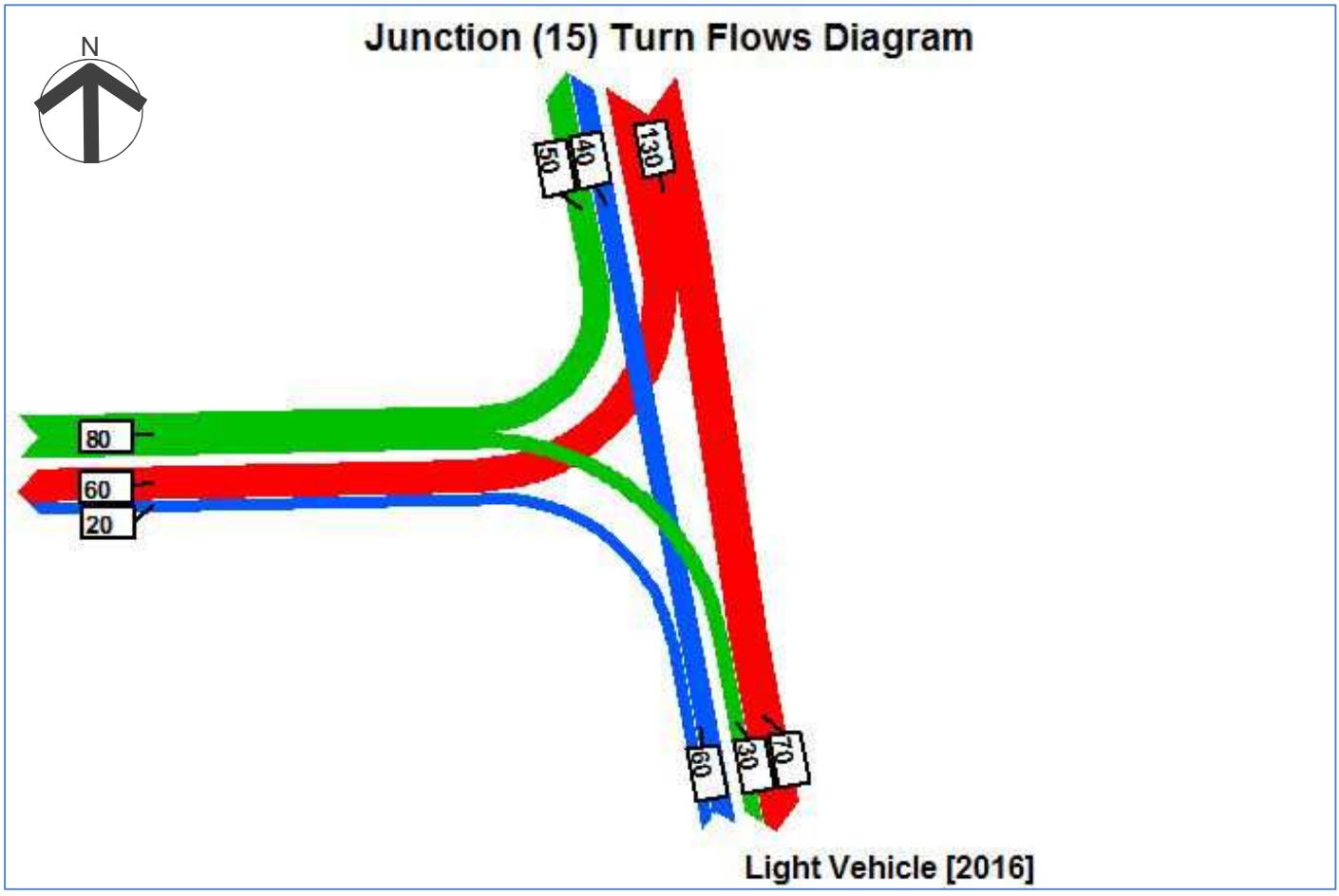
Site 14: Mingaletta Road & Service Road

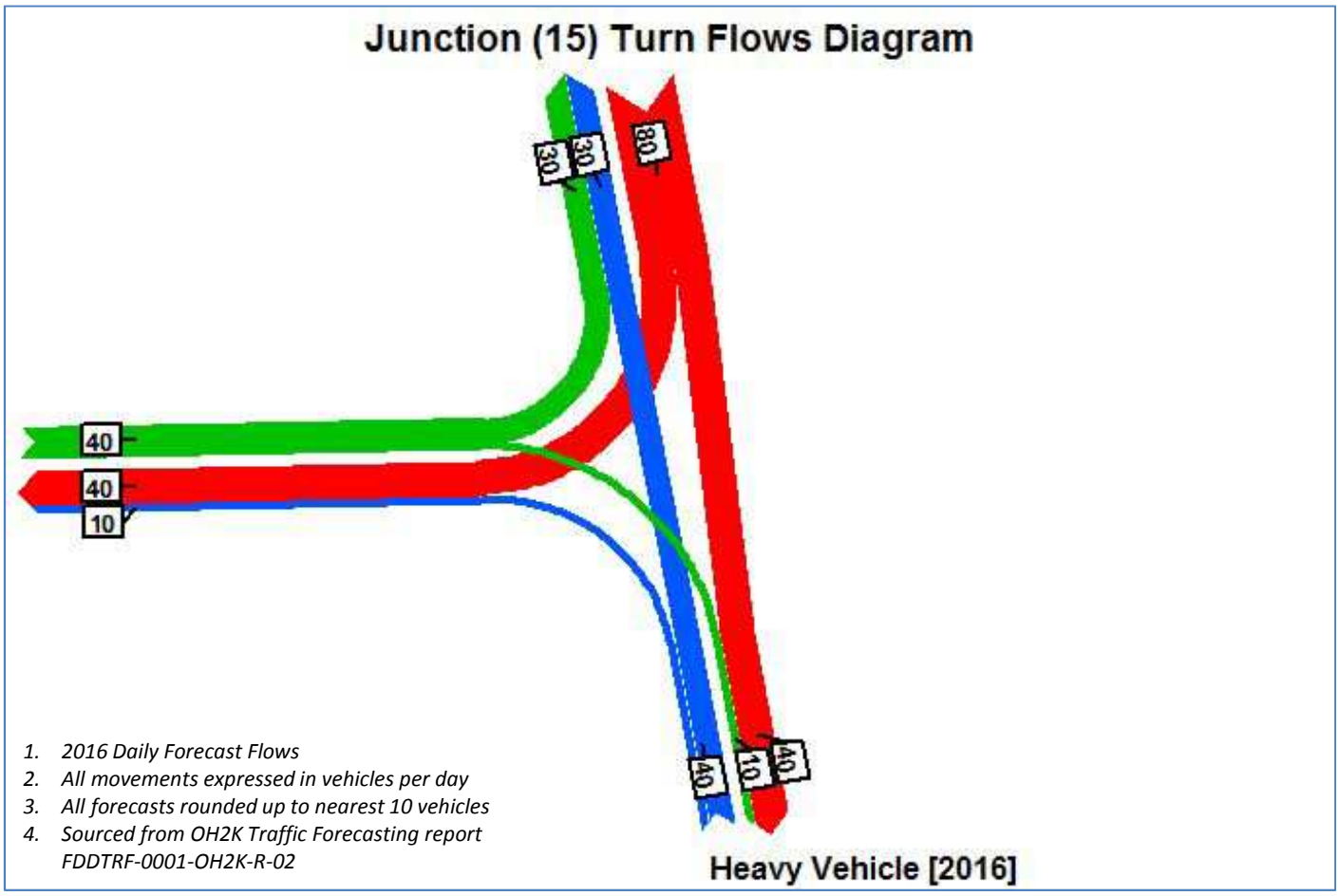




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

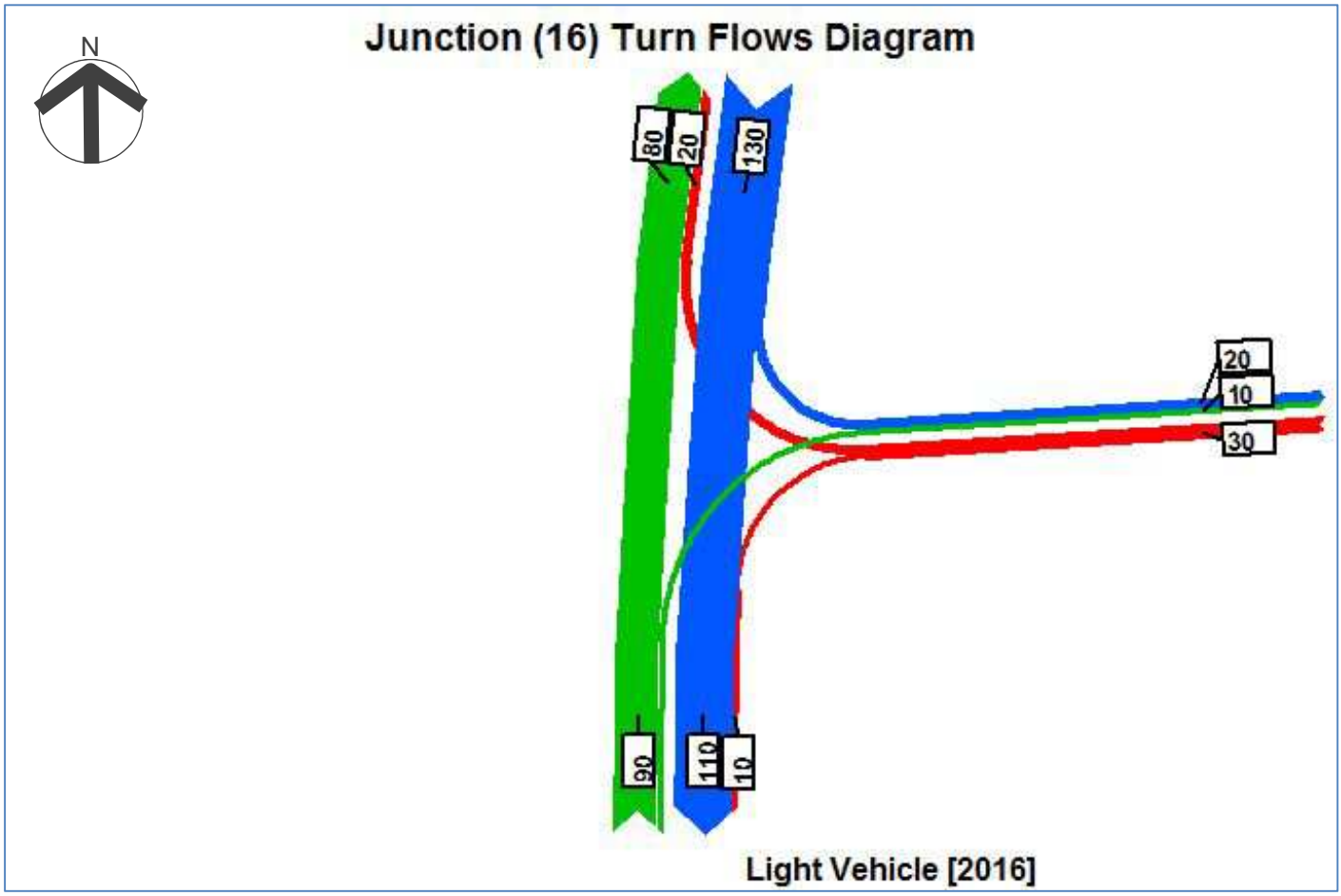
Site 15: Upper Smiths Creek Road & Service Road

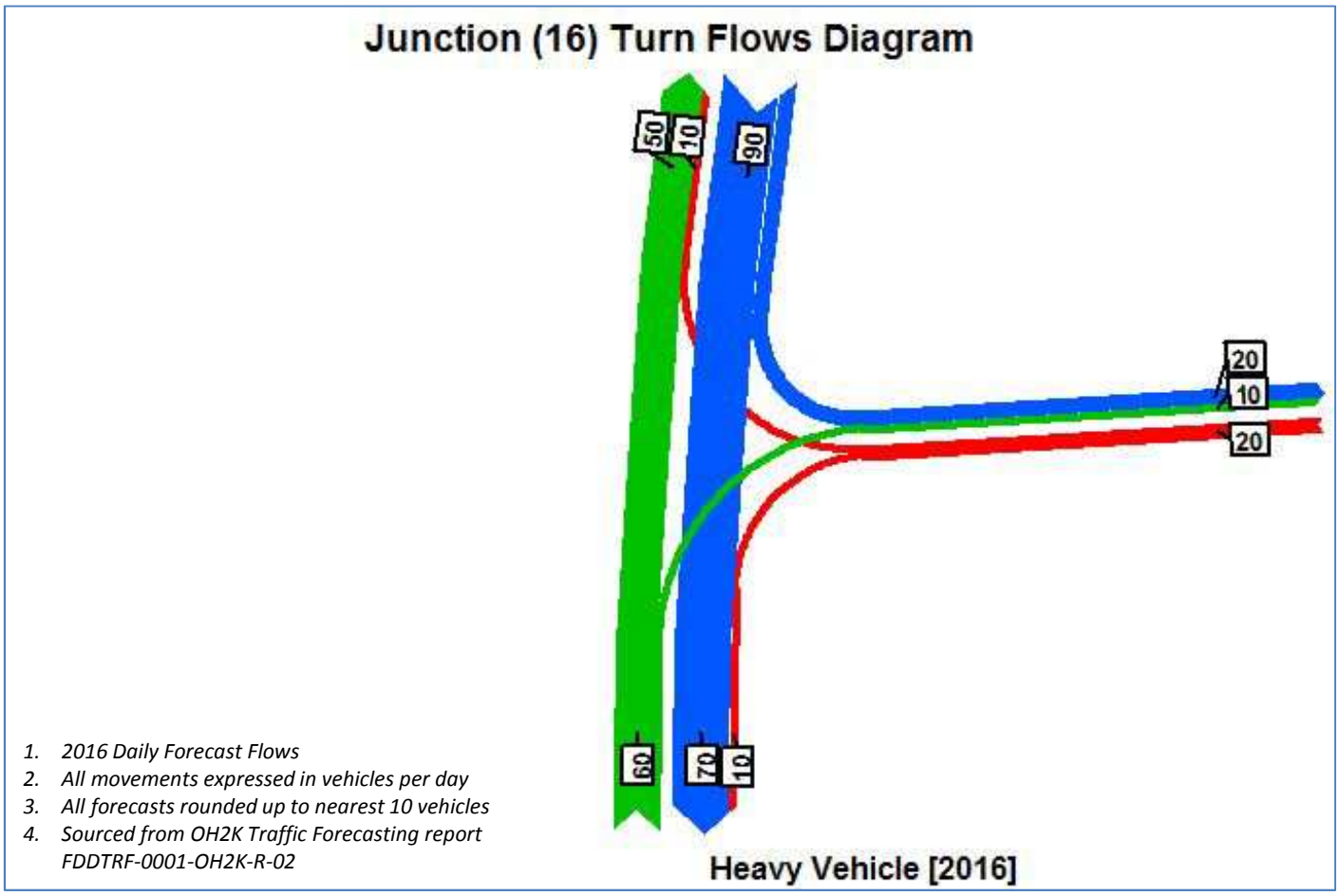




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

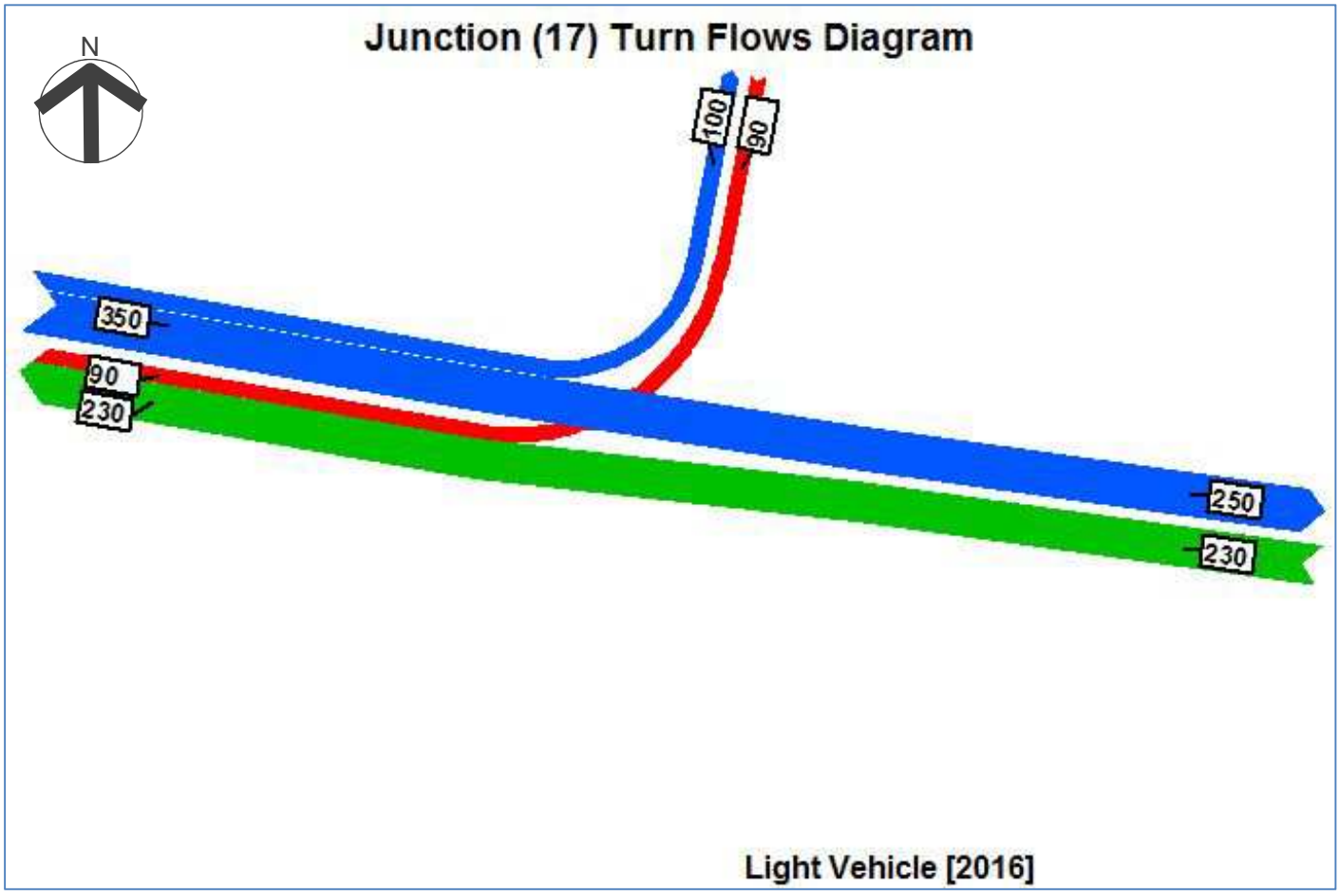
Site 16: Wharf Road & Service Road

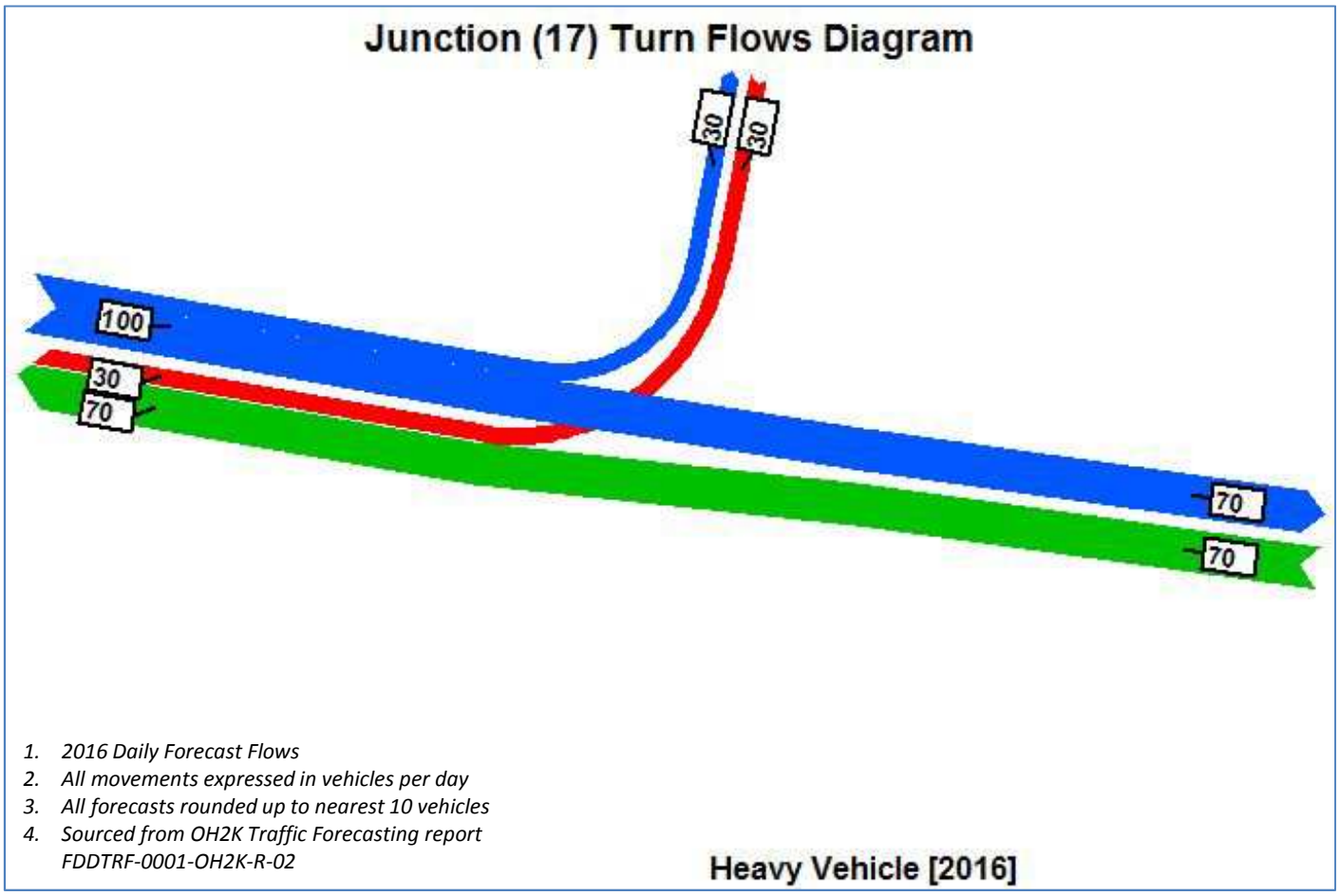




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

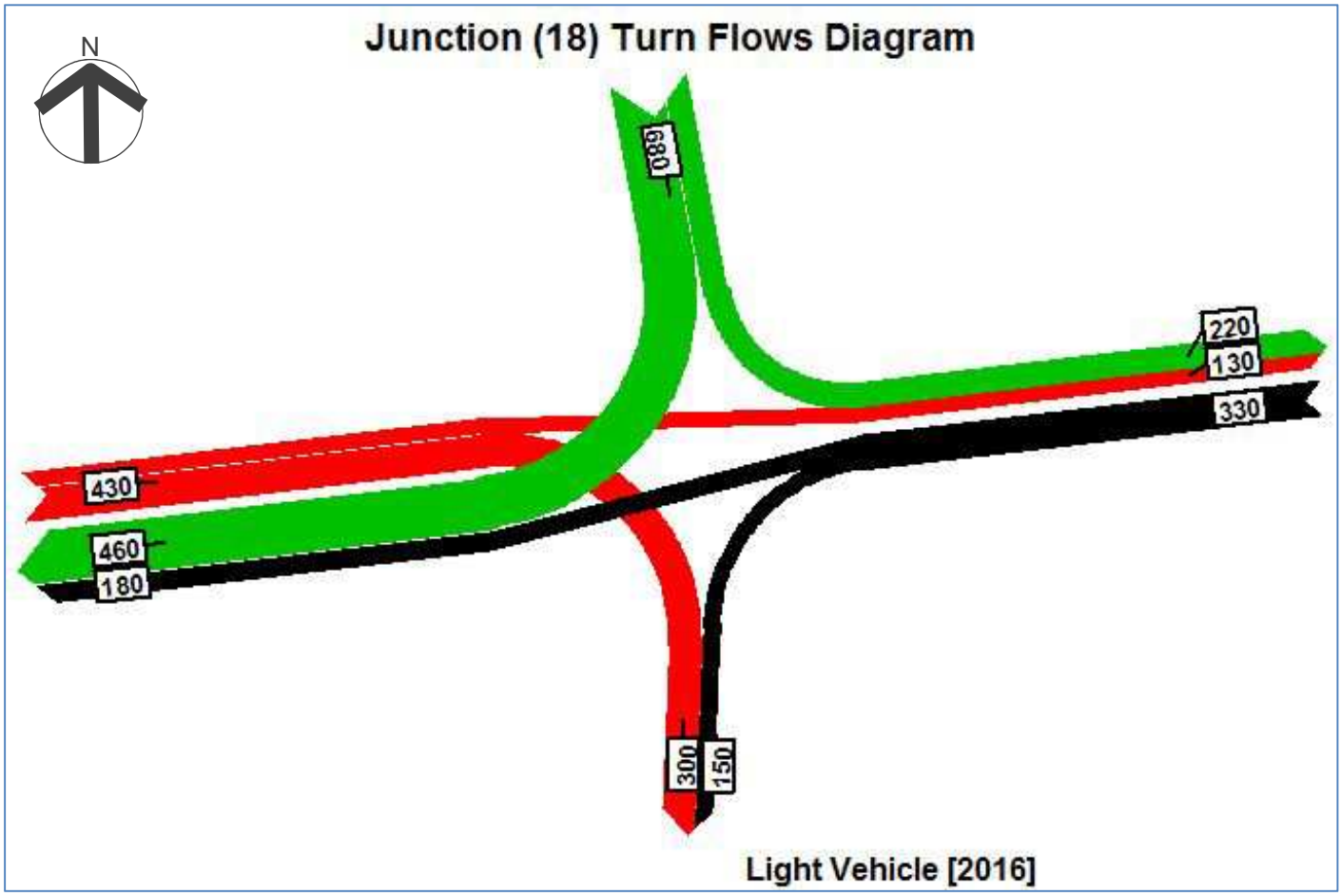
Site 17: Kundabung Road & Ravenswood Access Road

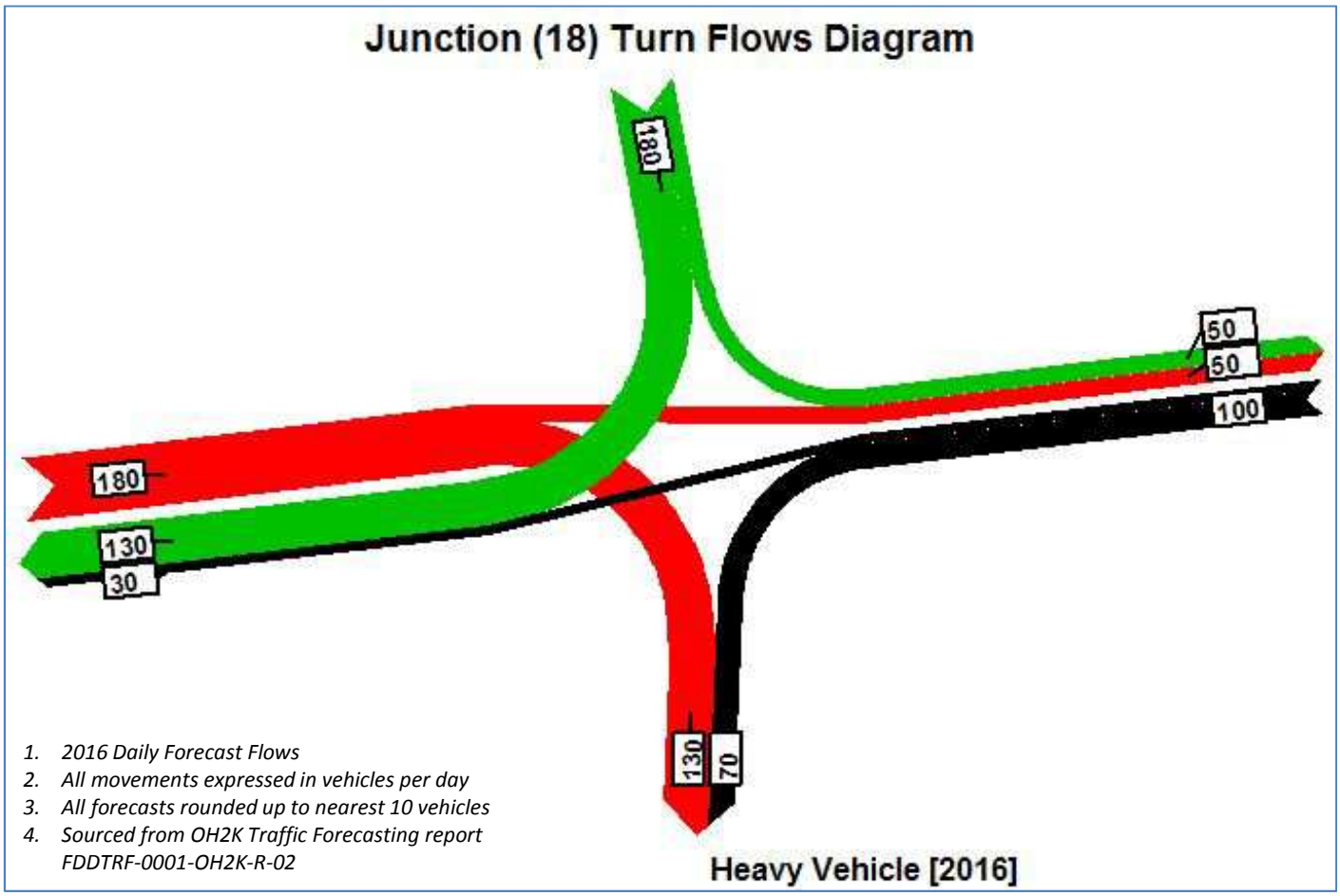




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

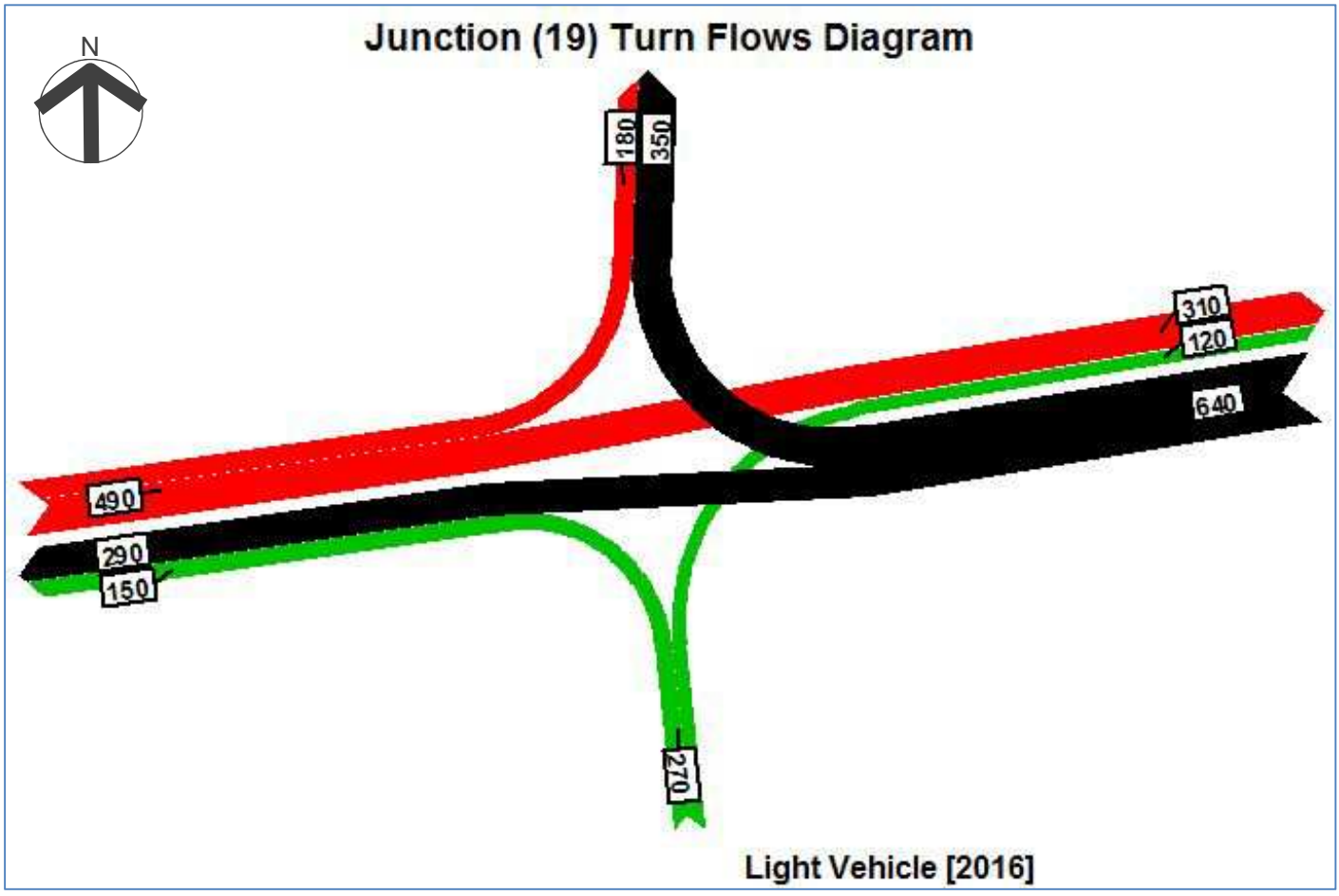
Site 18: Kundabung Road & SB On/Off ramps

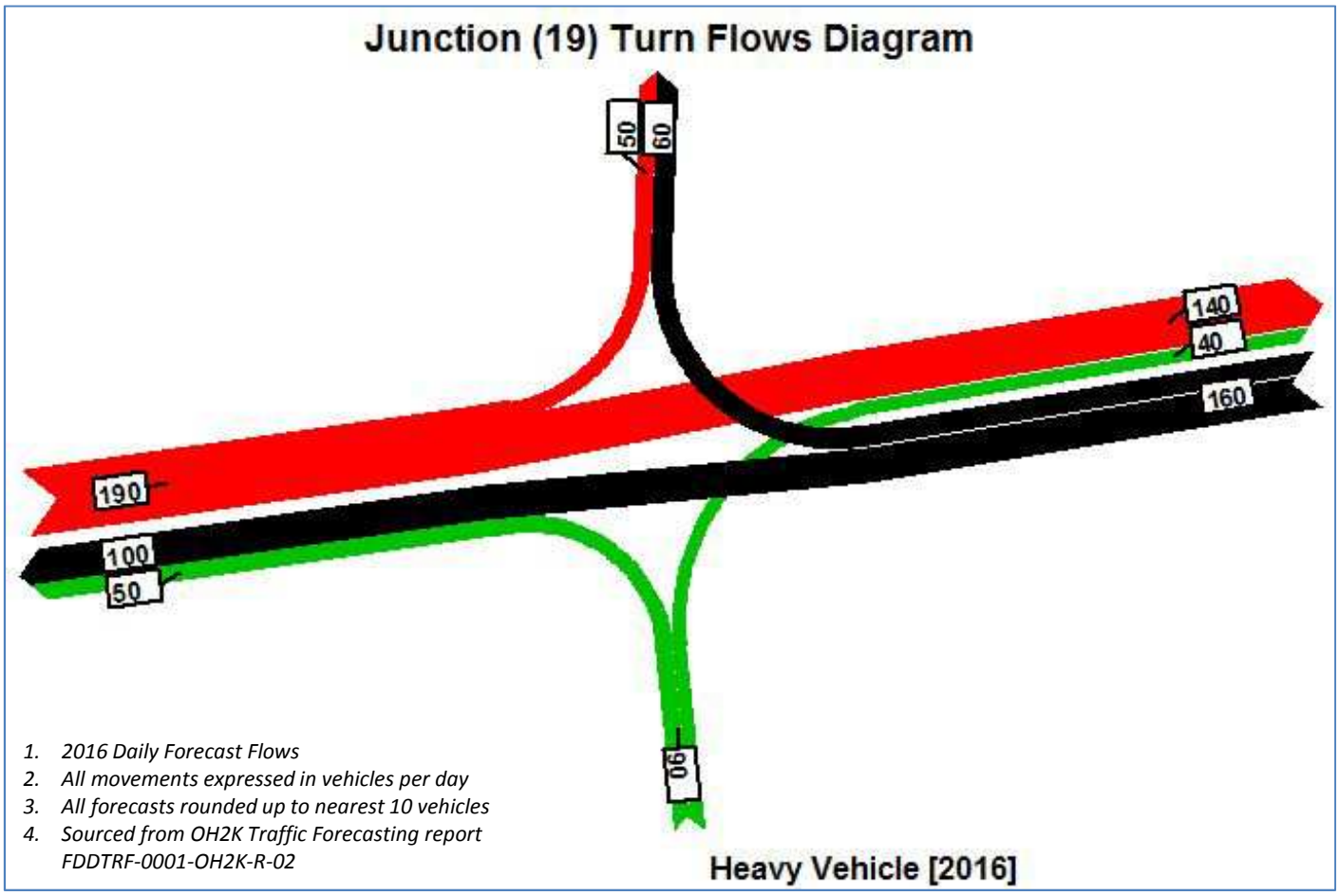




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

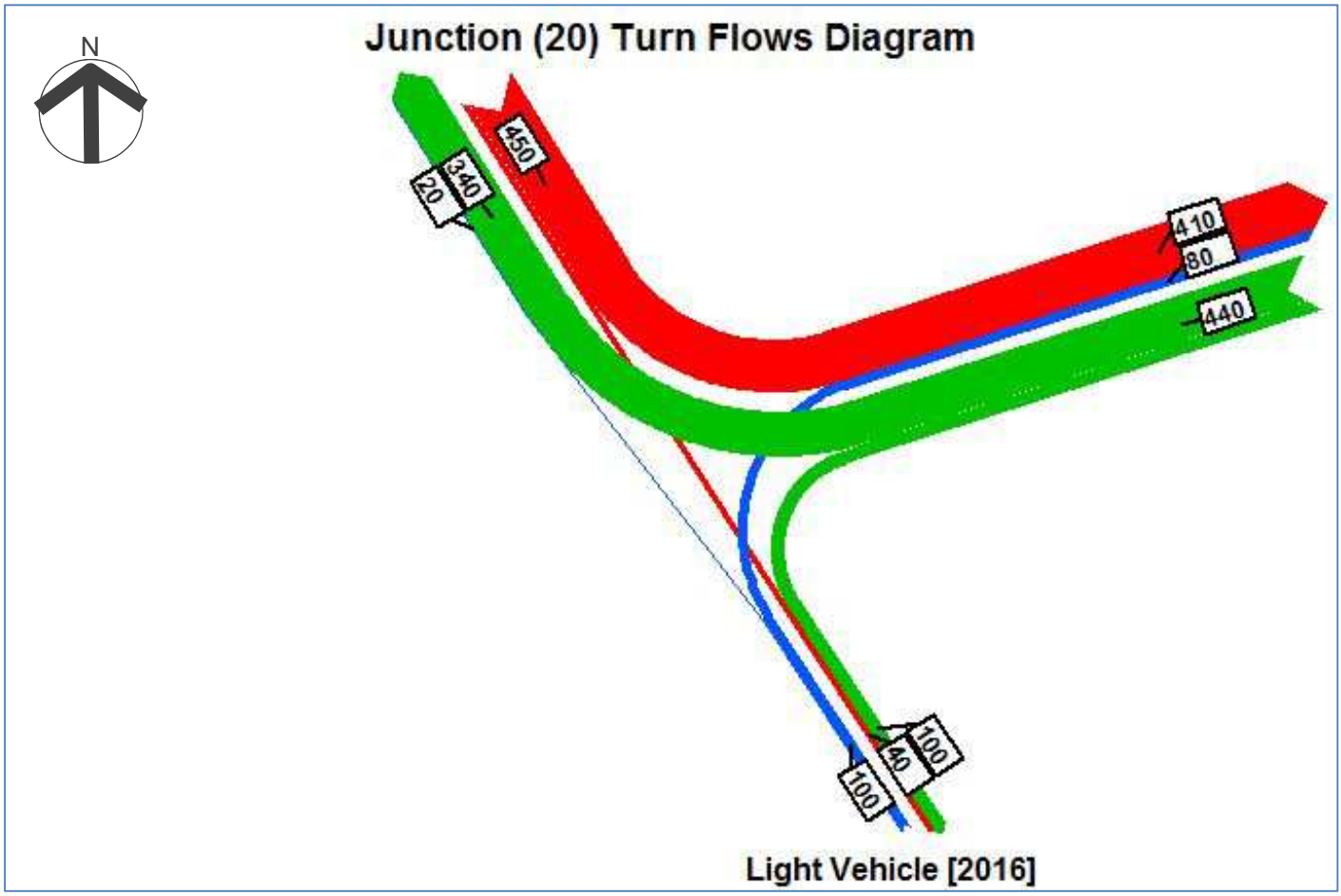
Site 19: Rodeo Drive & NB On/Off ramps

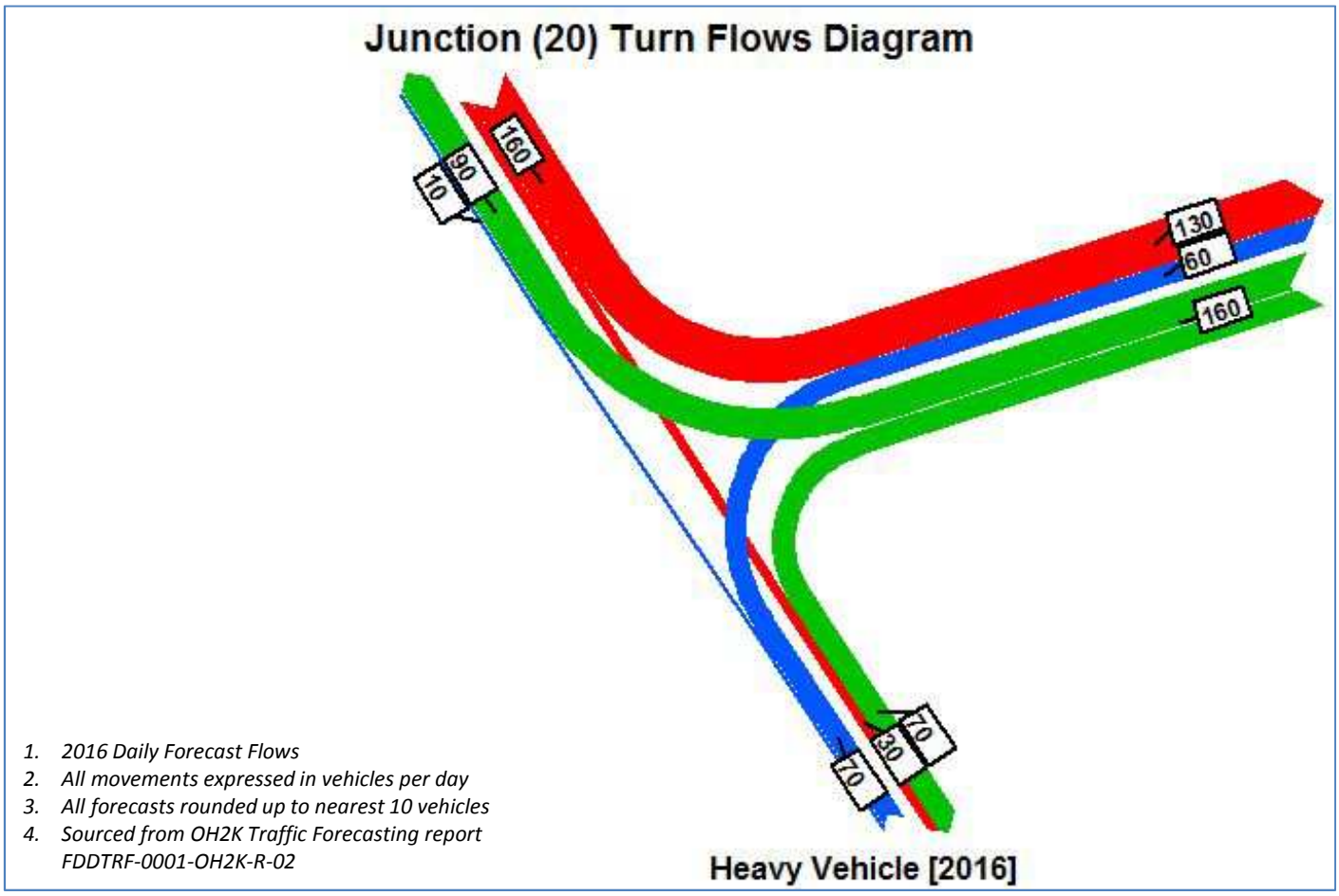




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

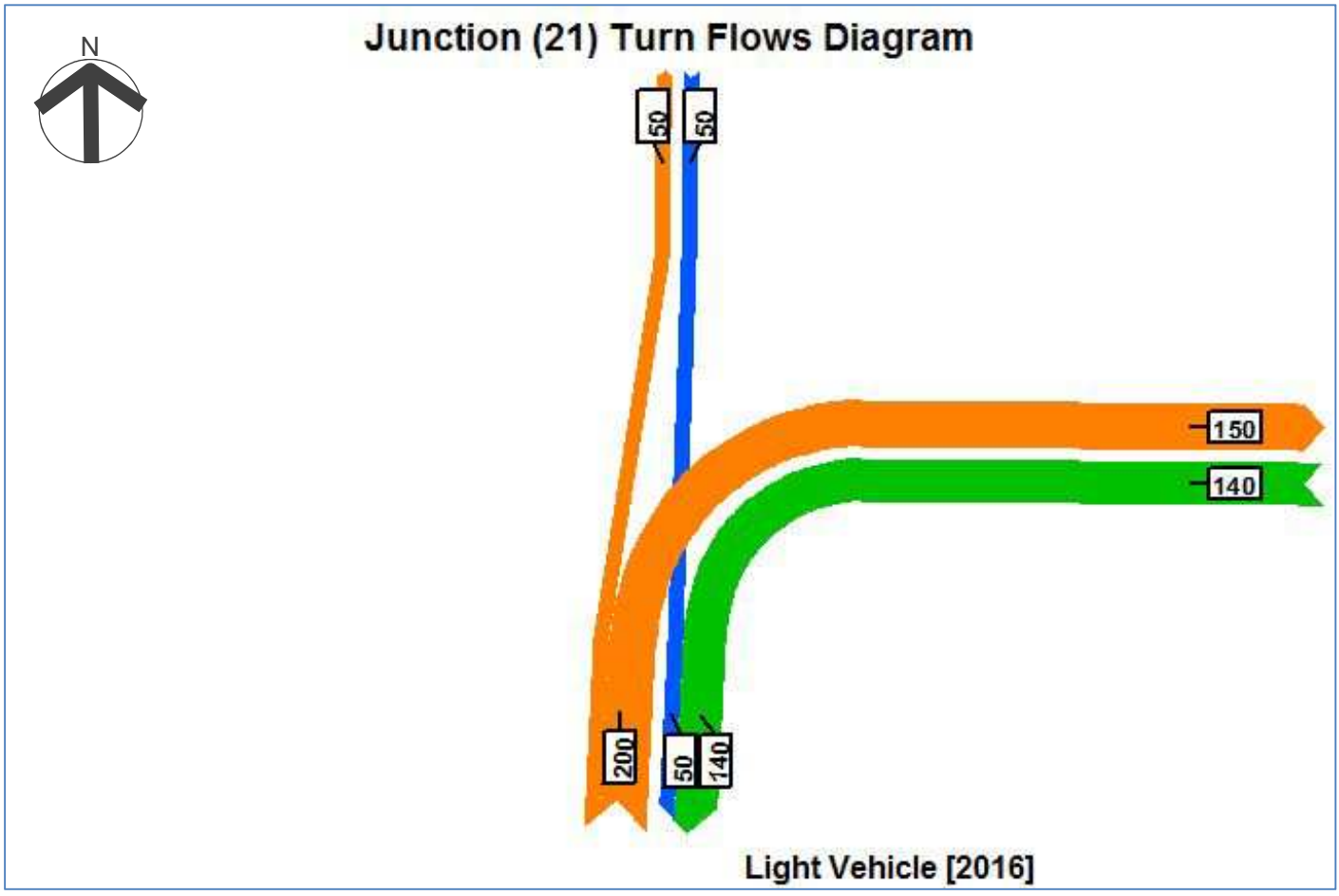
Site 20: Rodeo Drive & Service Road

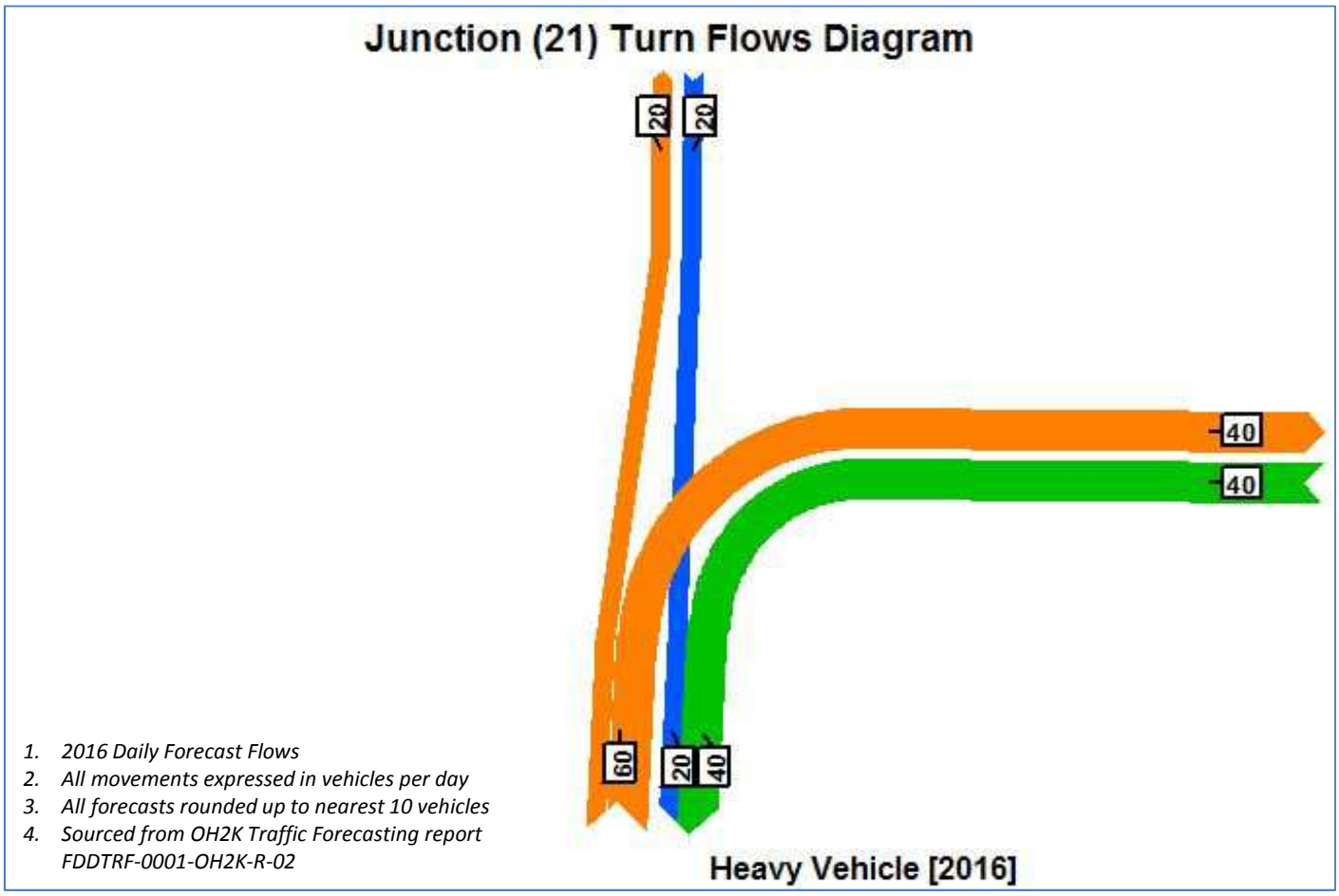




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
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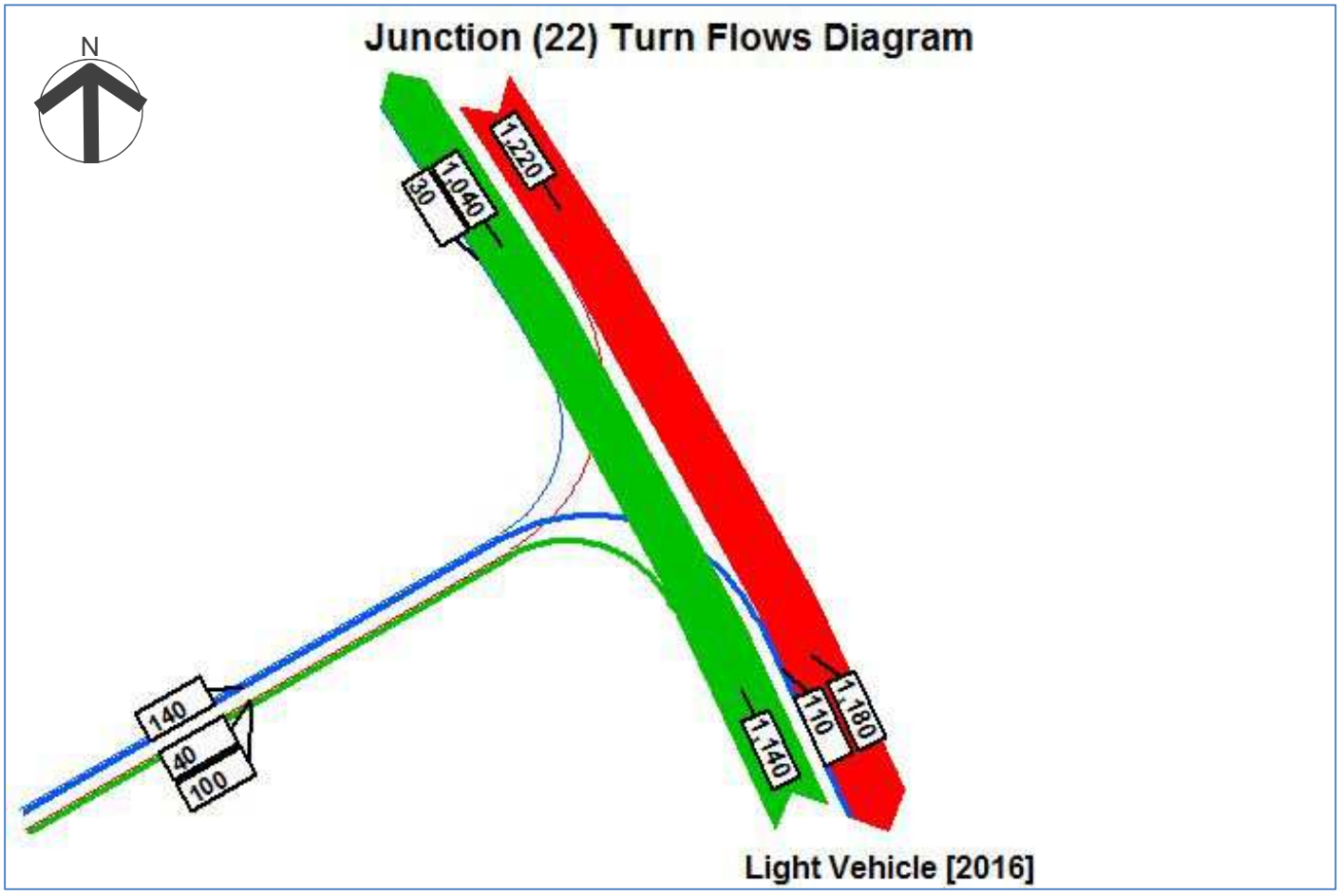
Site 21: Kemps Road & Service Road

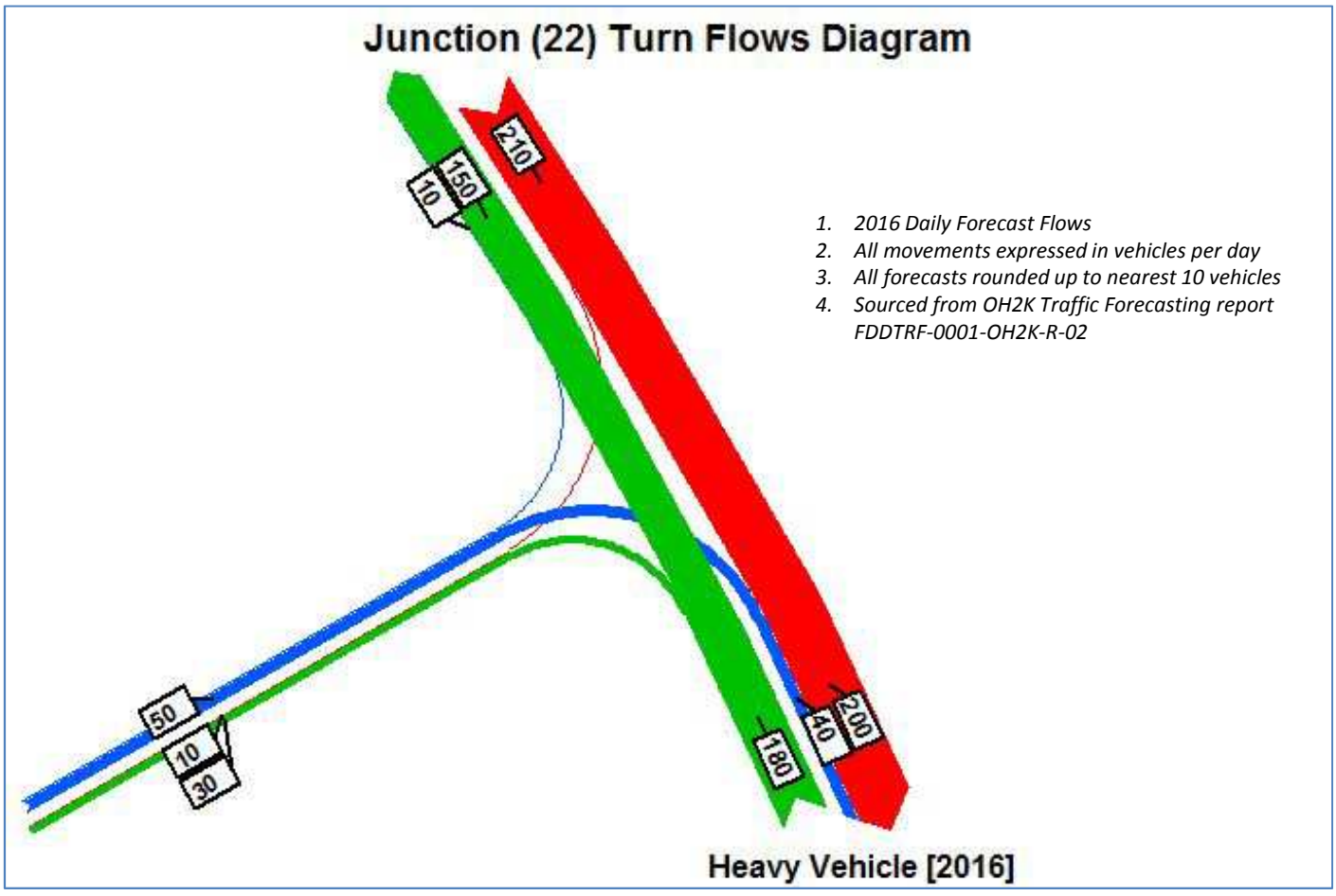




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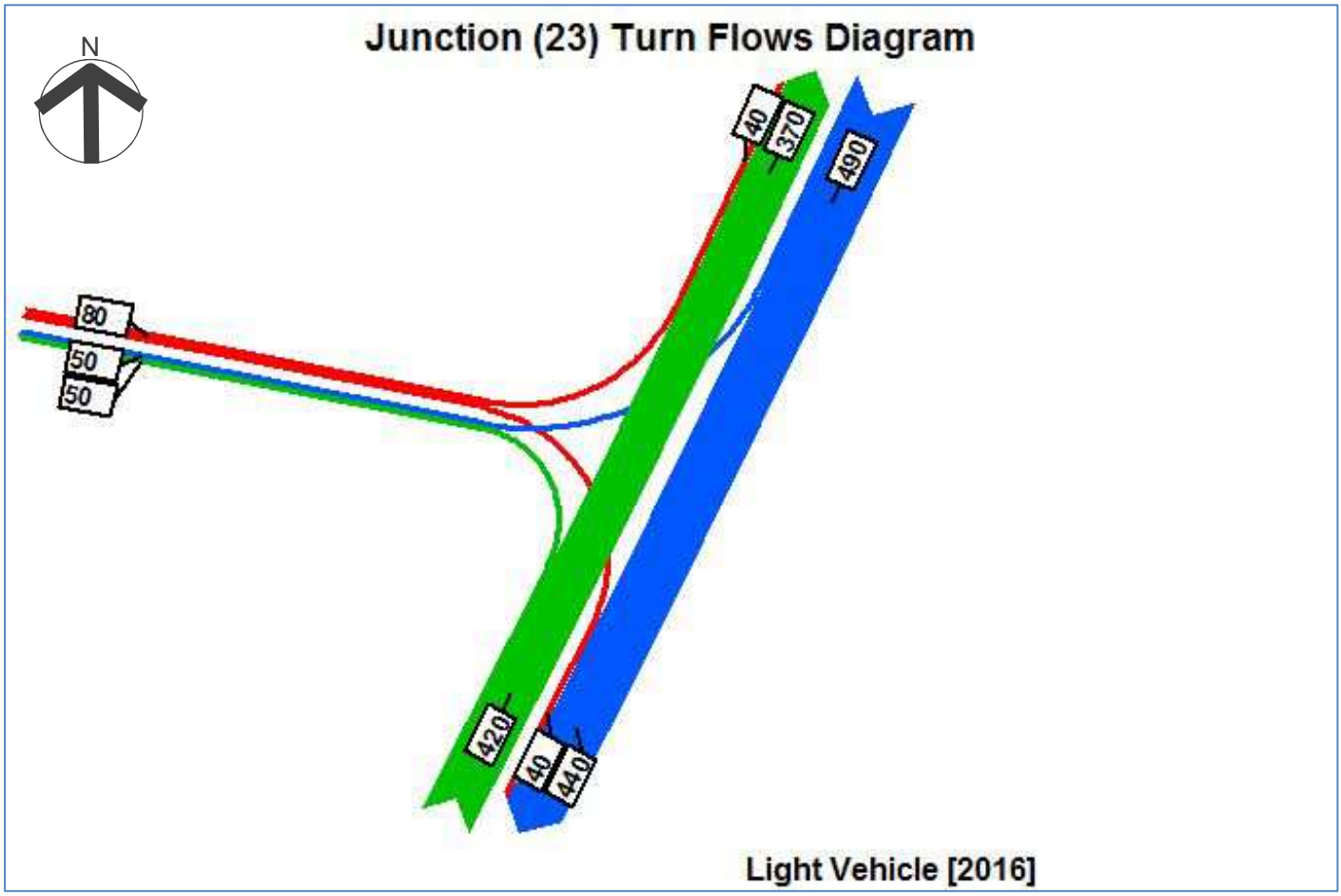
Site 22: Wharf Road & Service Road

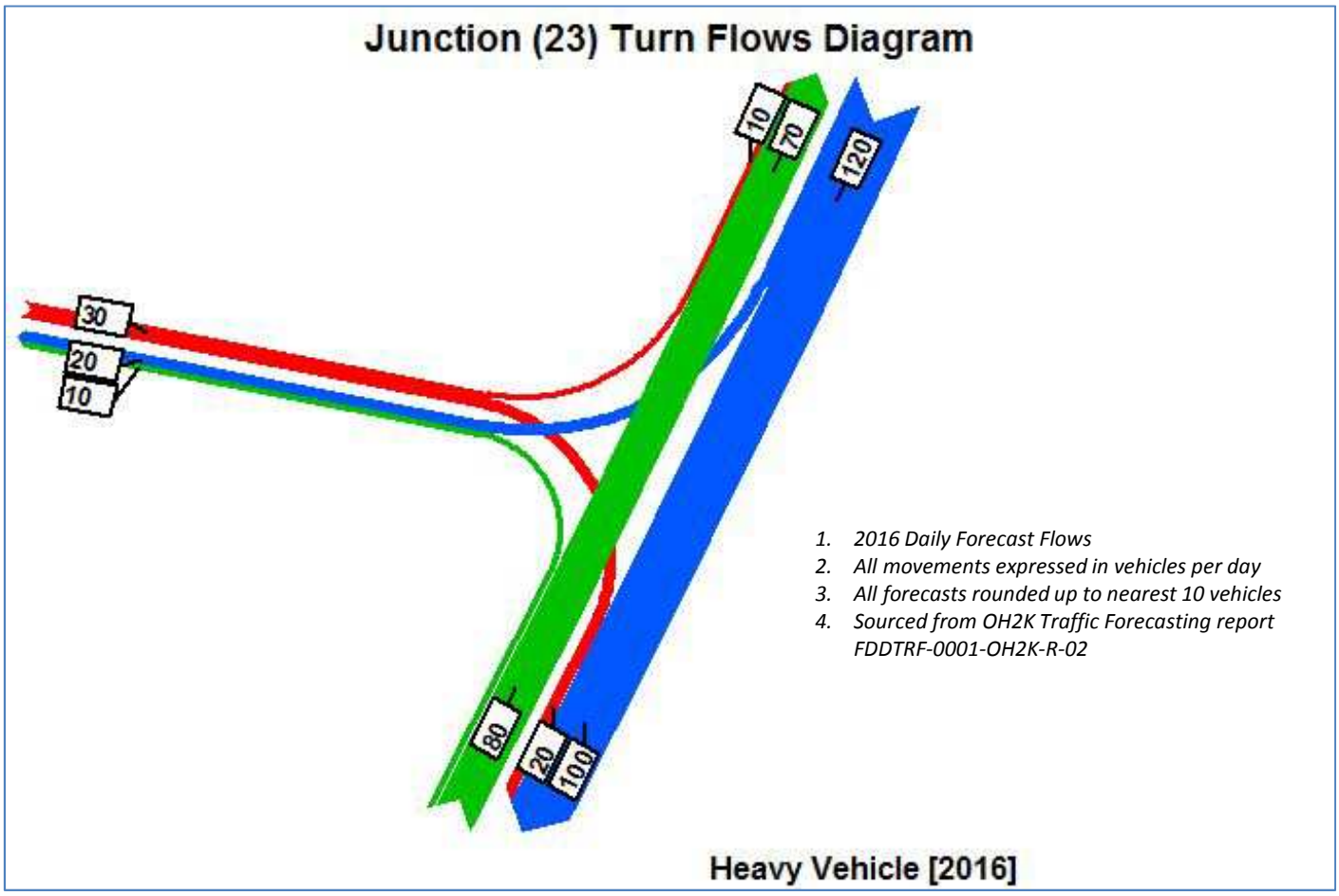




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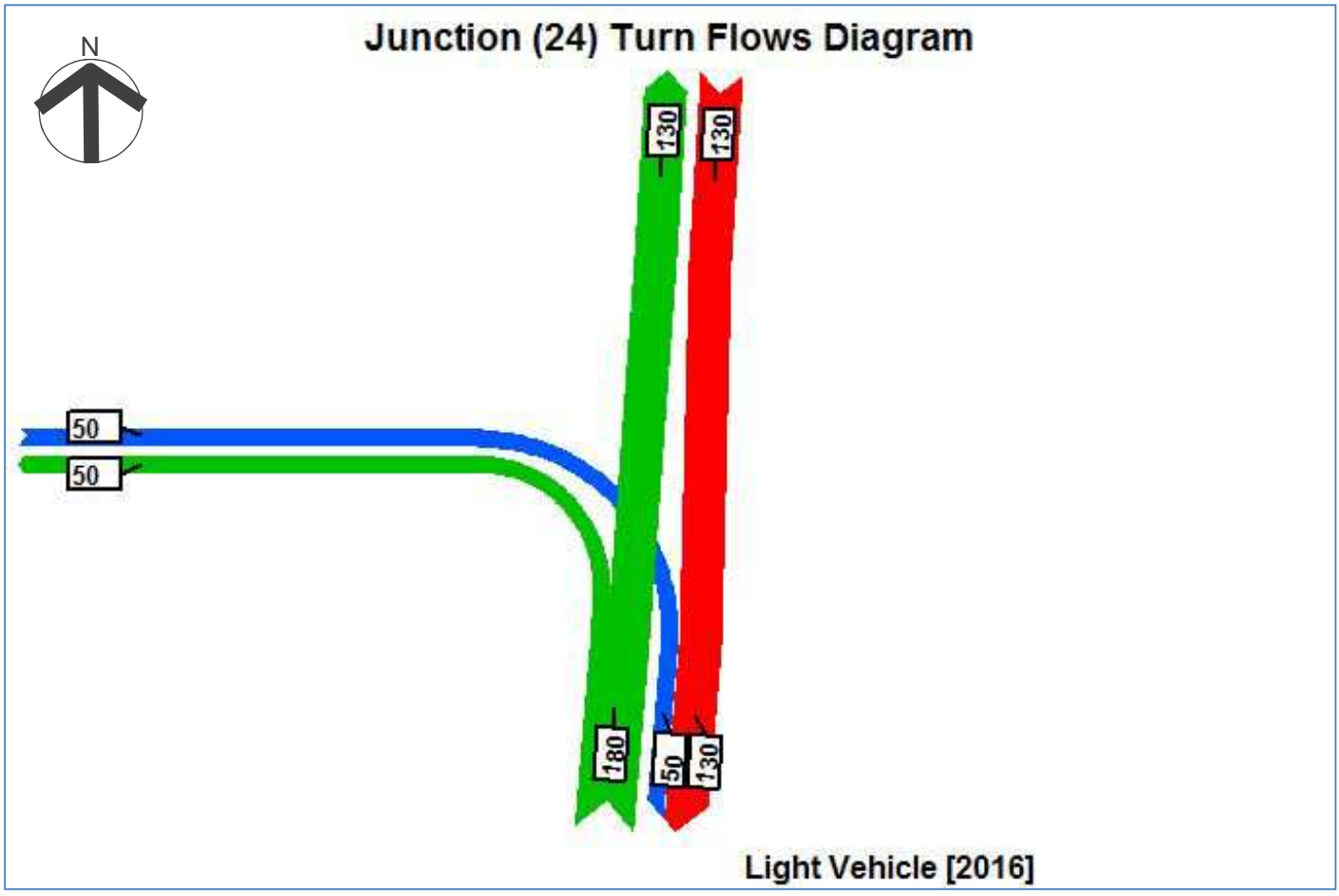
Site 23: Service Road & Haydons Wharf Road

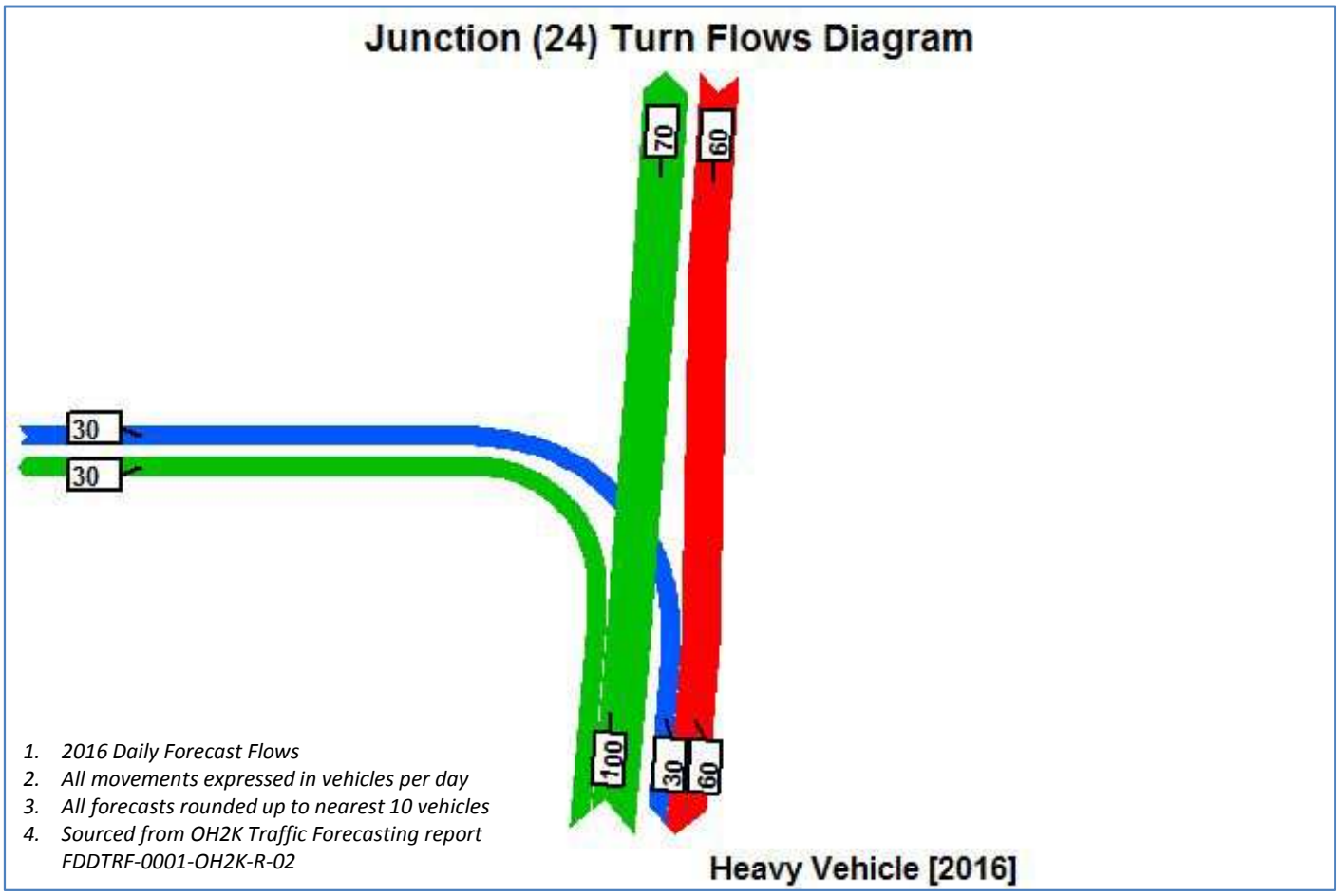




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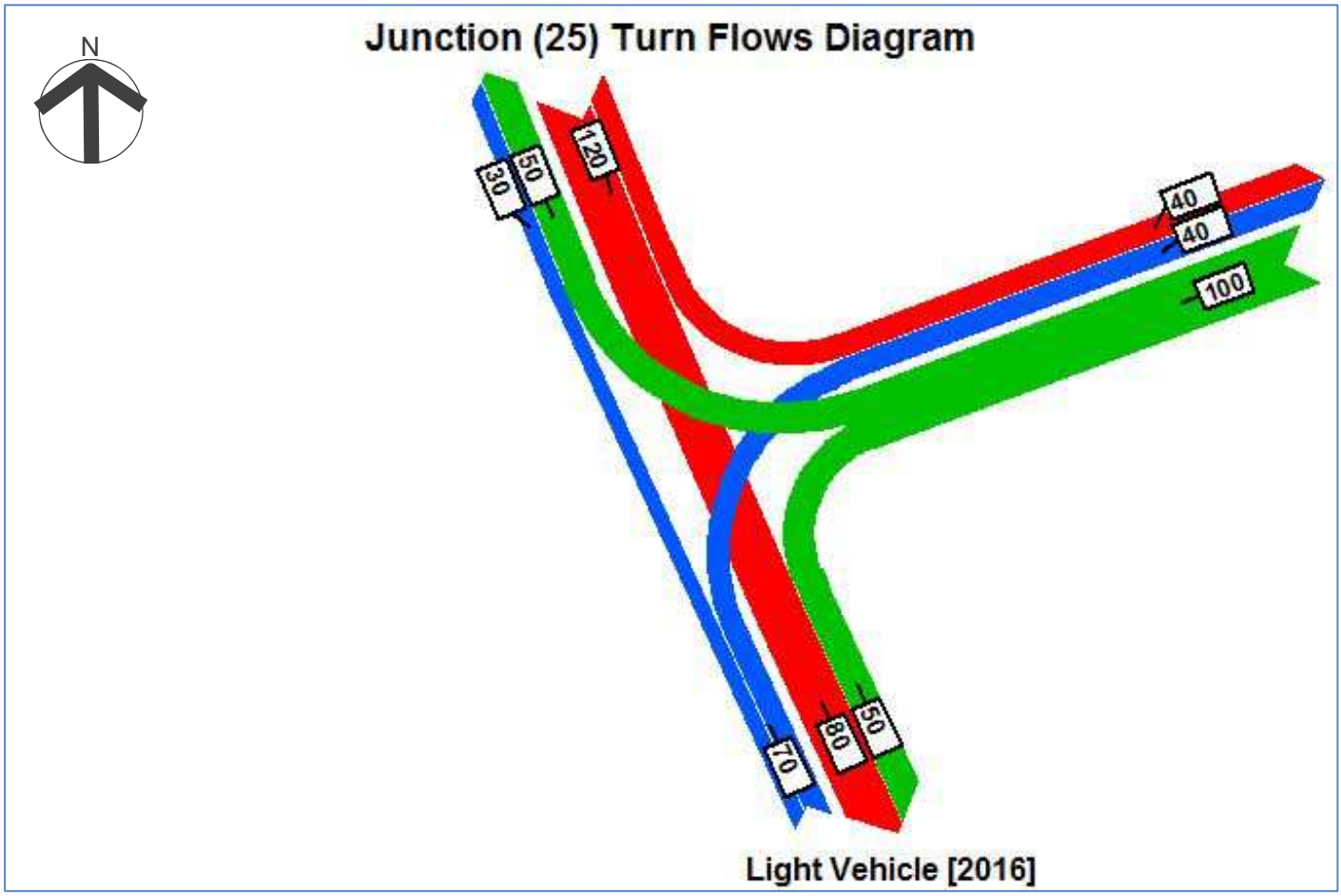
Site 24: Haydons Wharf Road & Zone J9

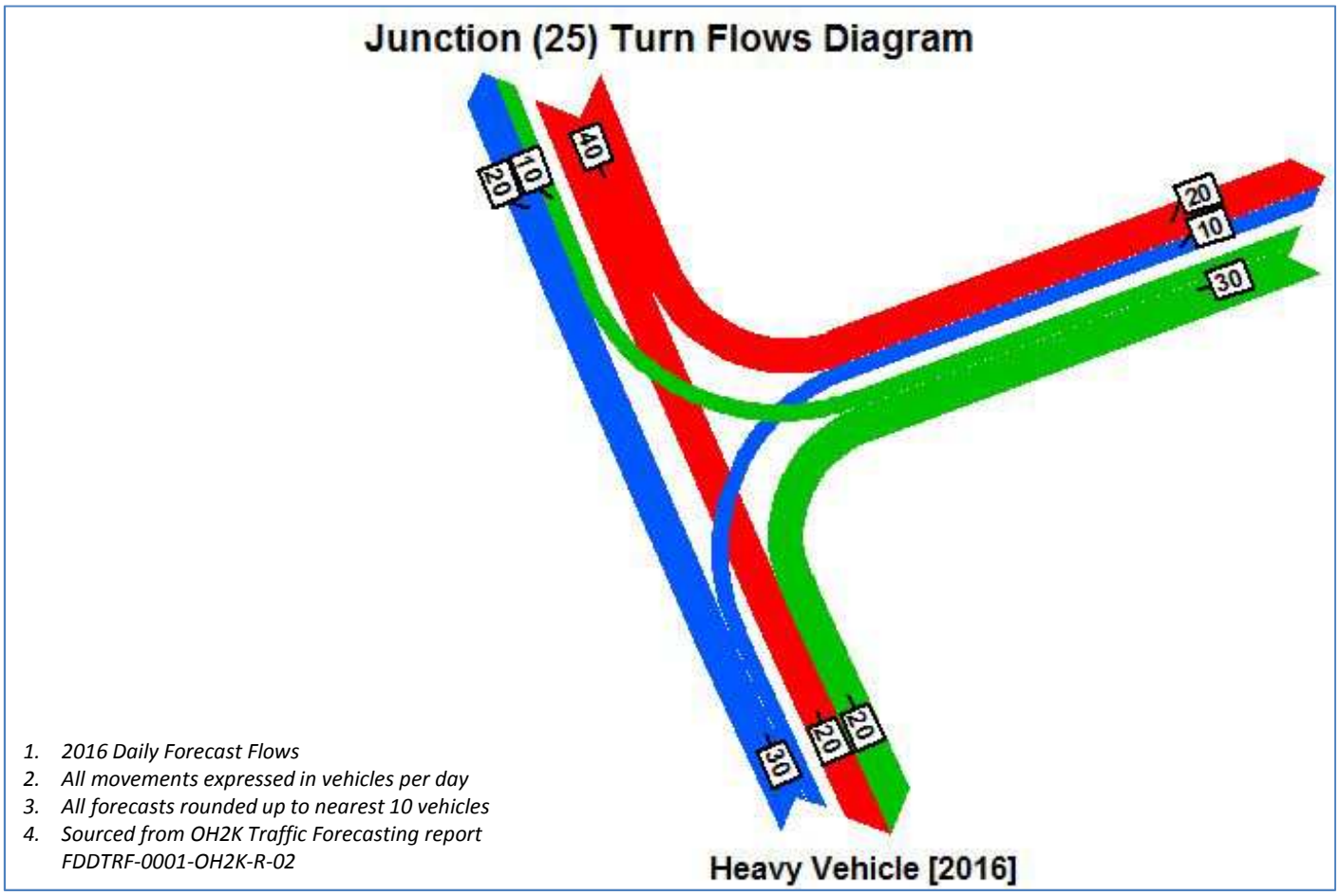




1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

Site 25: Cooperabung Road & Haydons Wharf Road



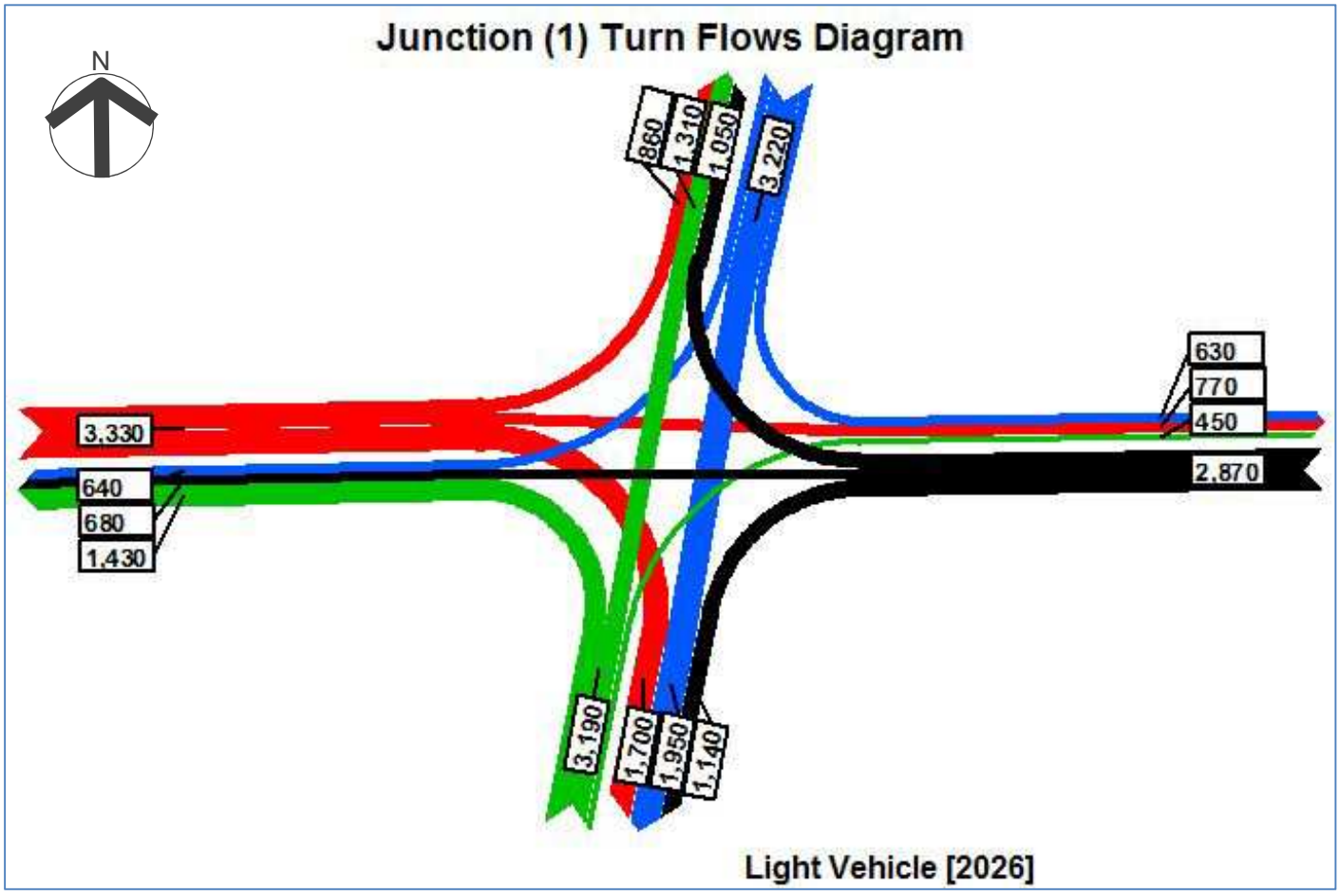


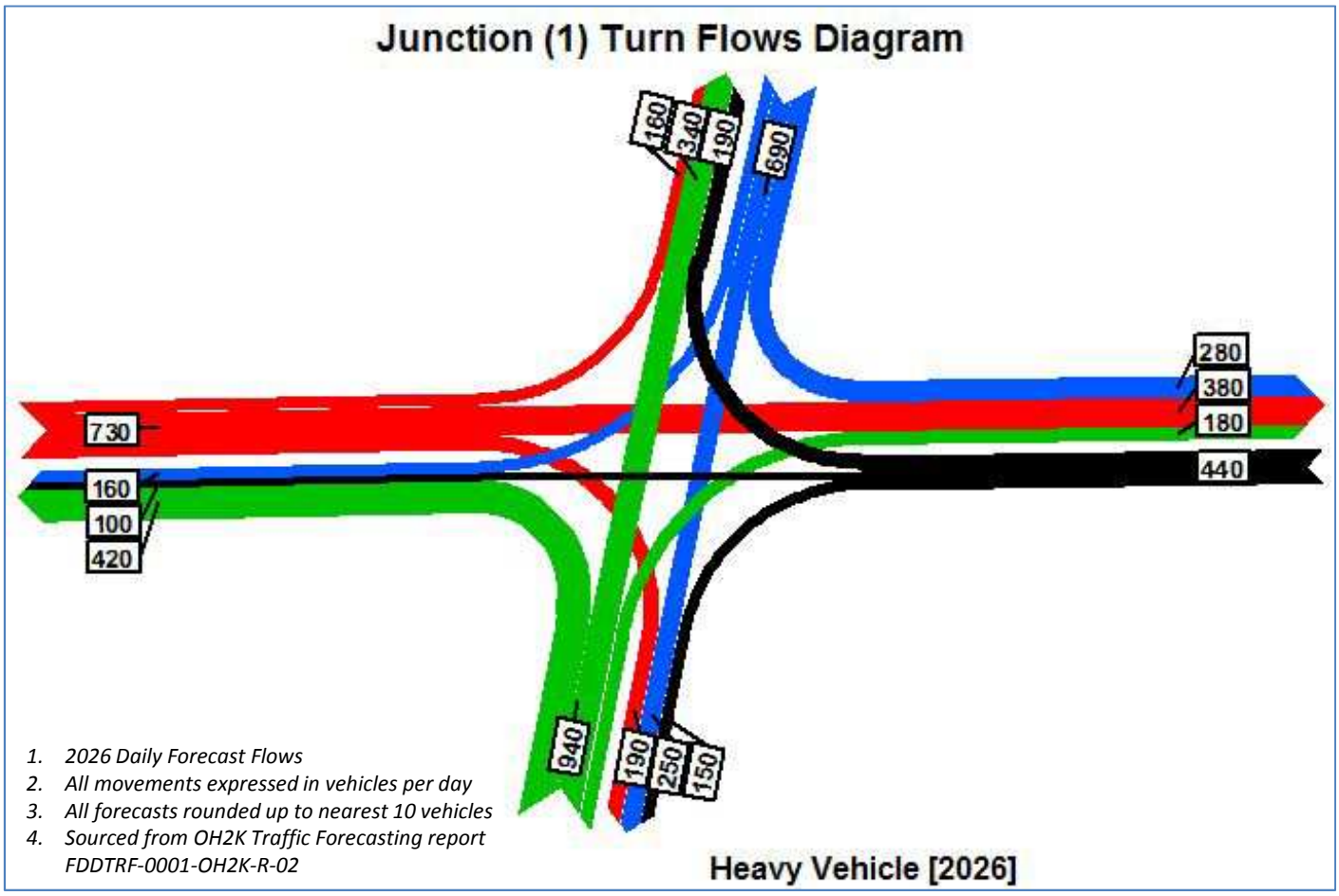
1. *2016 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

OH2K Intersection Turn Flow Diagrams

2026 Daily Forecast Flows
(Light & Heavy Vehicles)

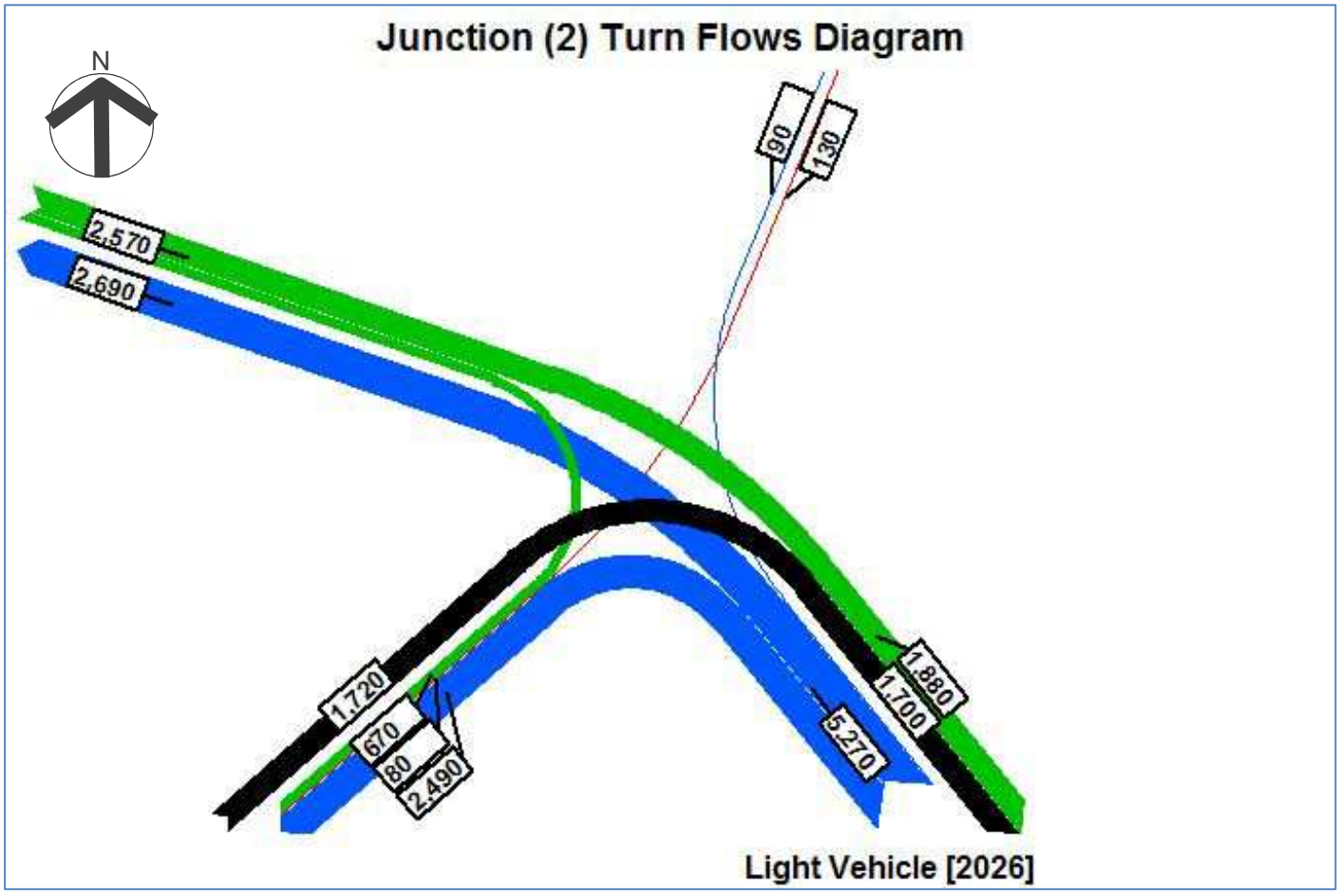
Site 1: Sancrox I/C (Western Roundabout)

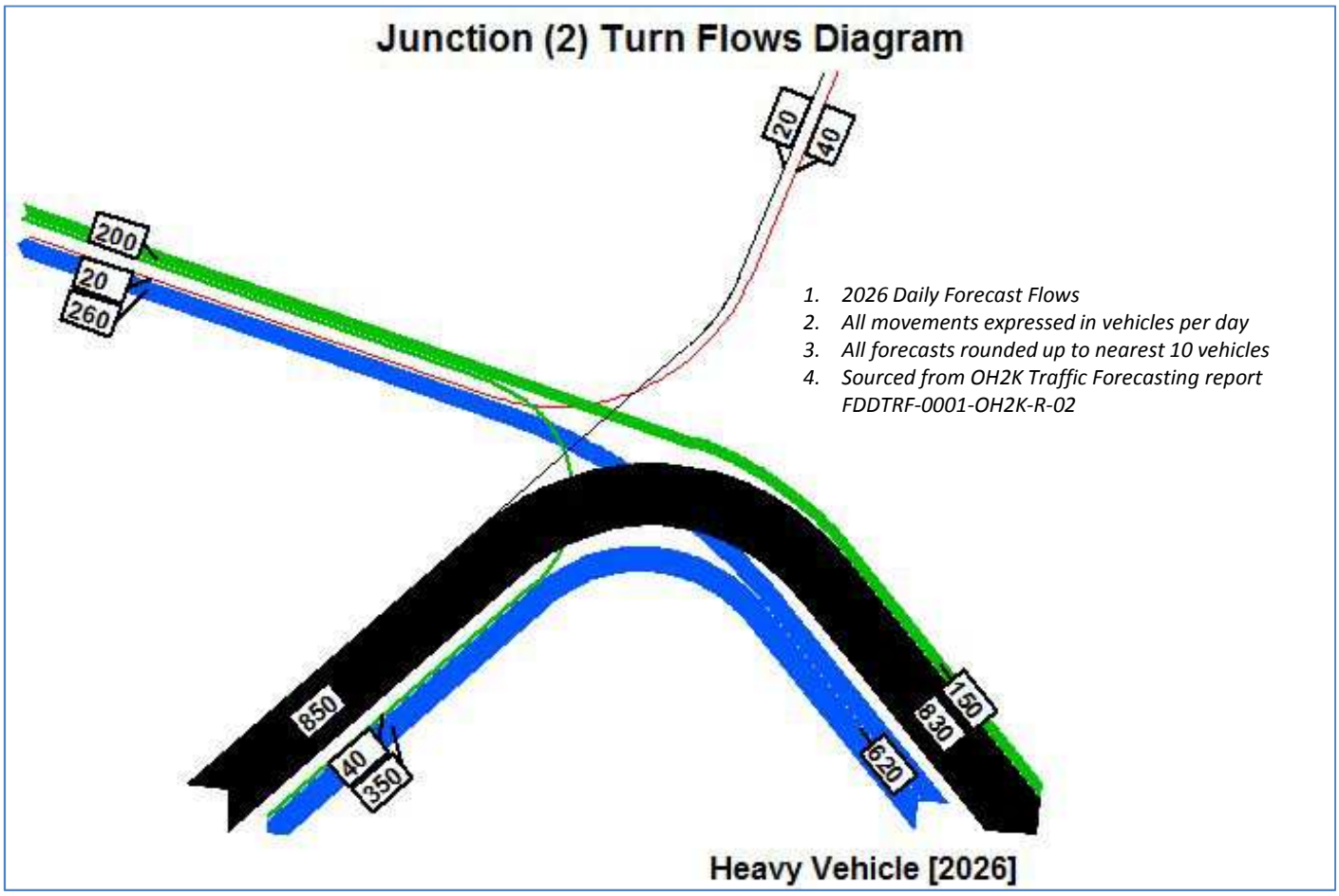




1. *2026 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

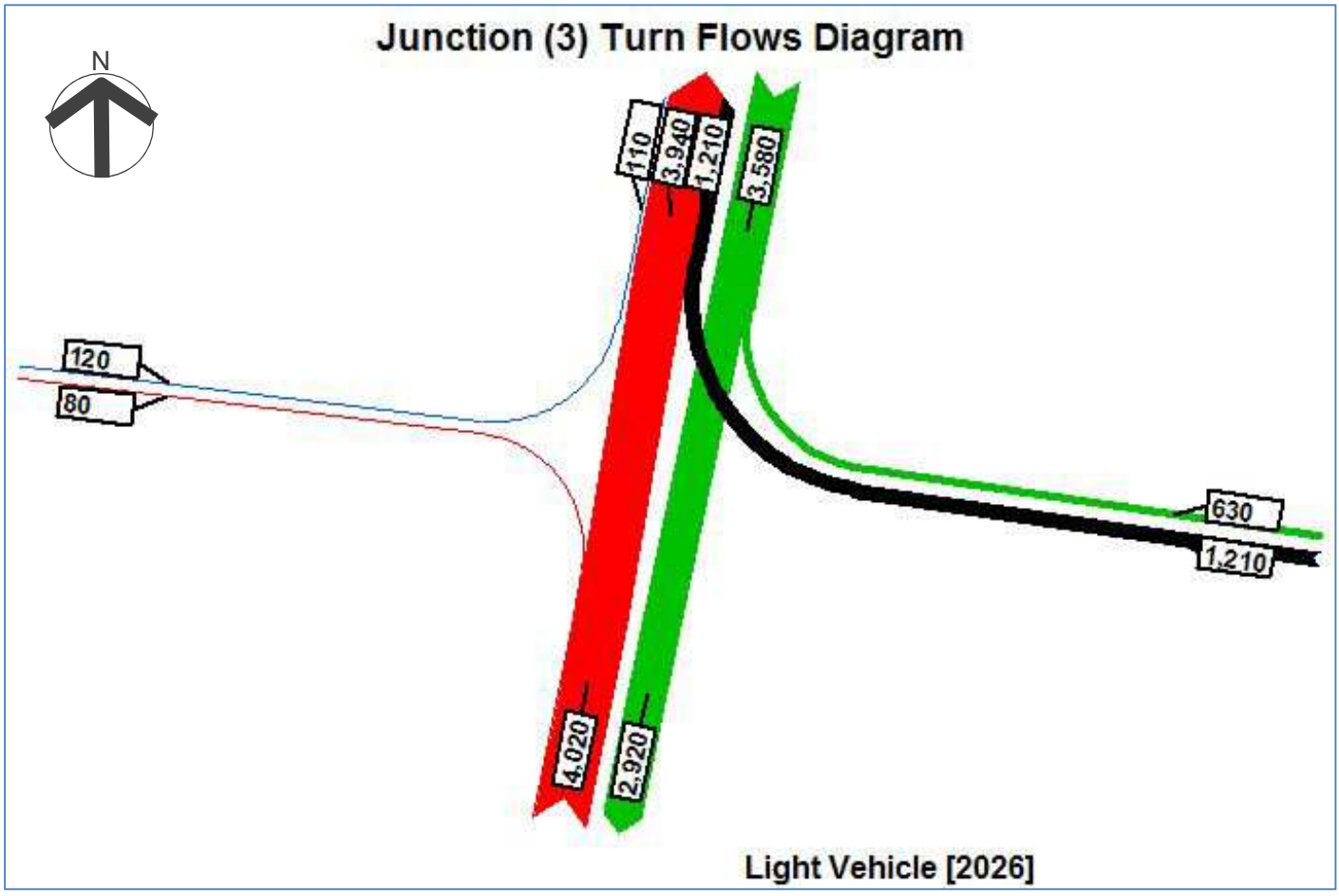
Site 2: Sancrox I/C (Eastern Roundabout)

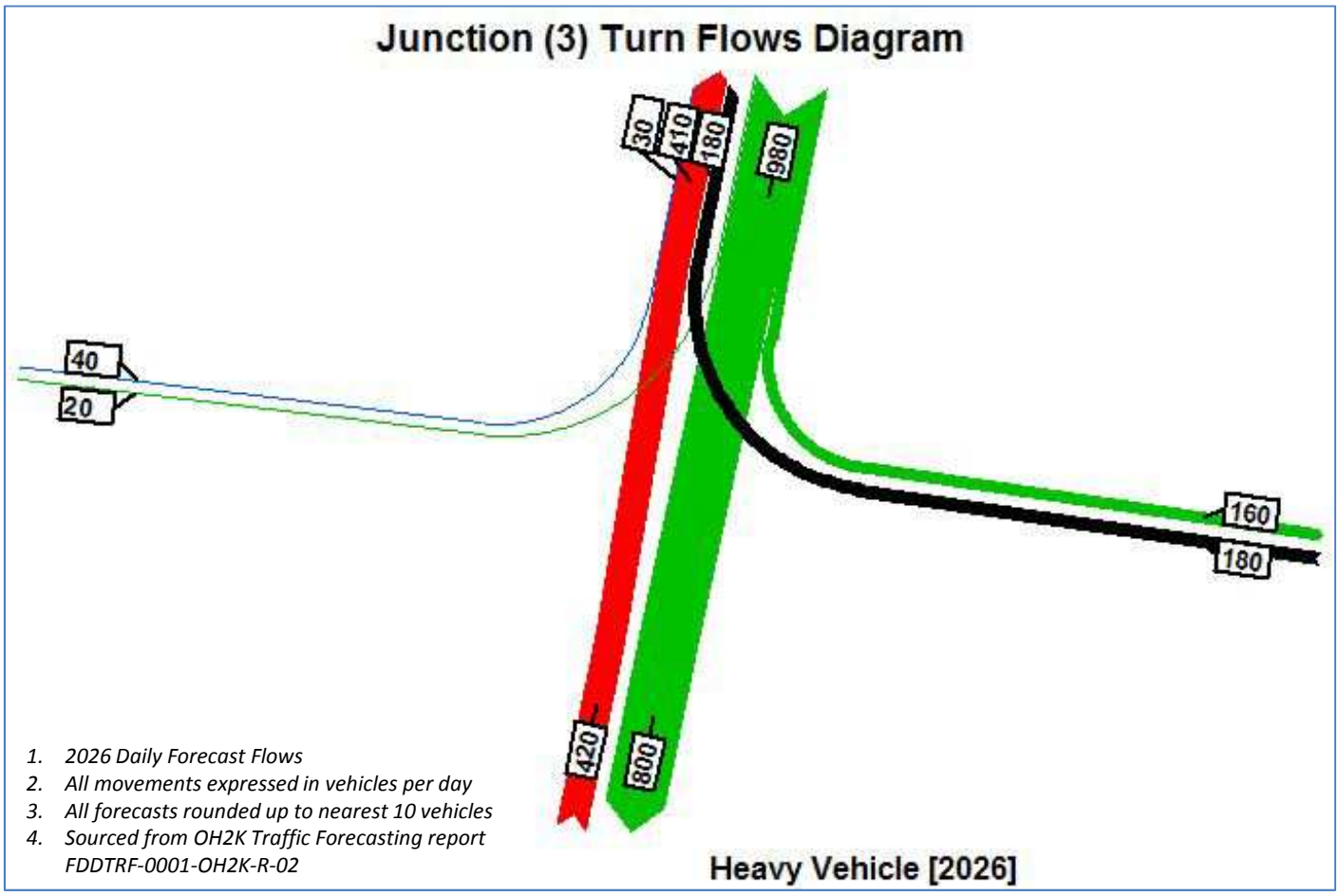




1. *2026 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

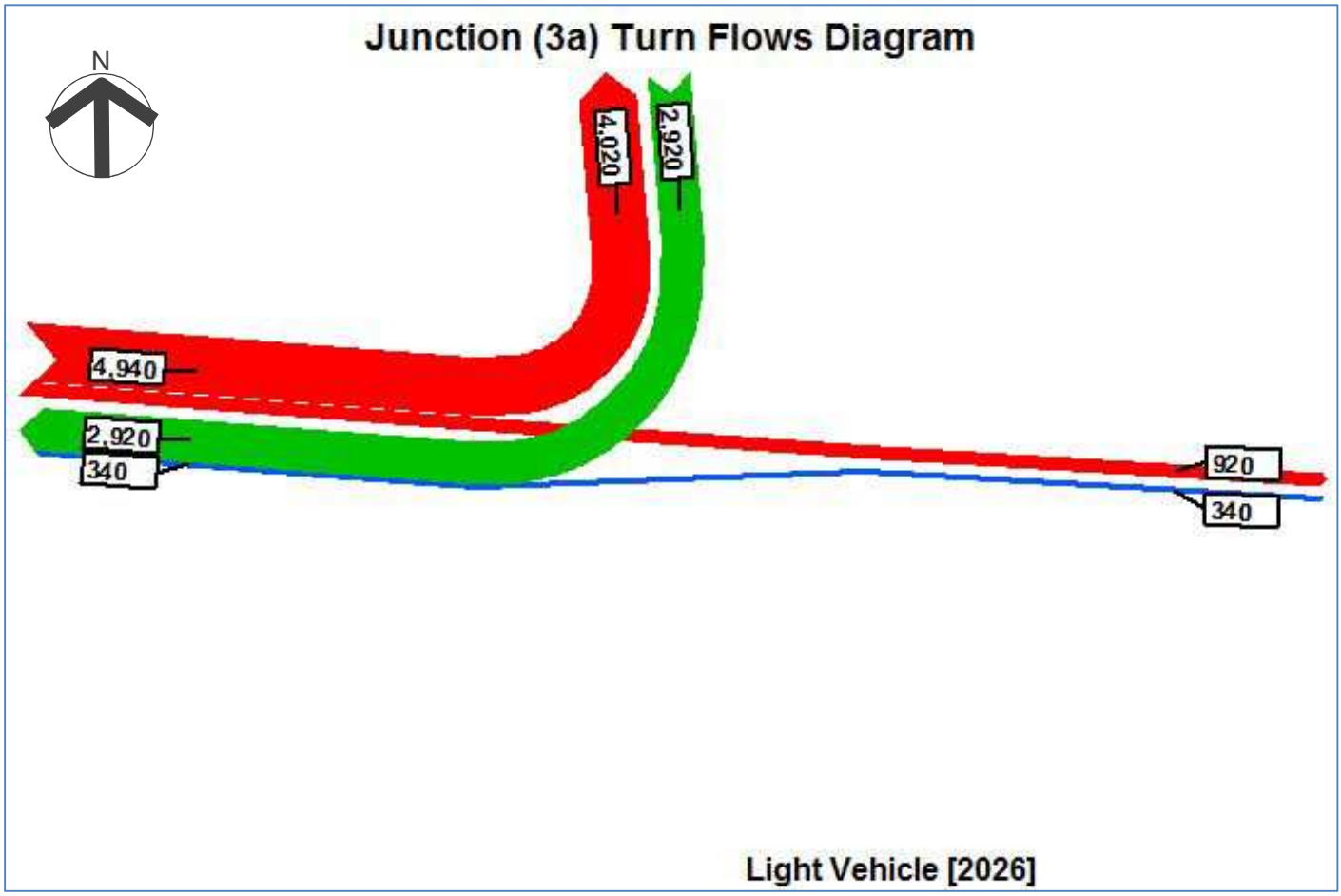
Site 3: Loop Road & RMS Depot

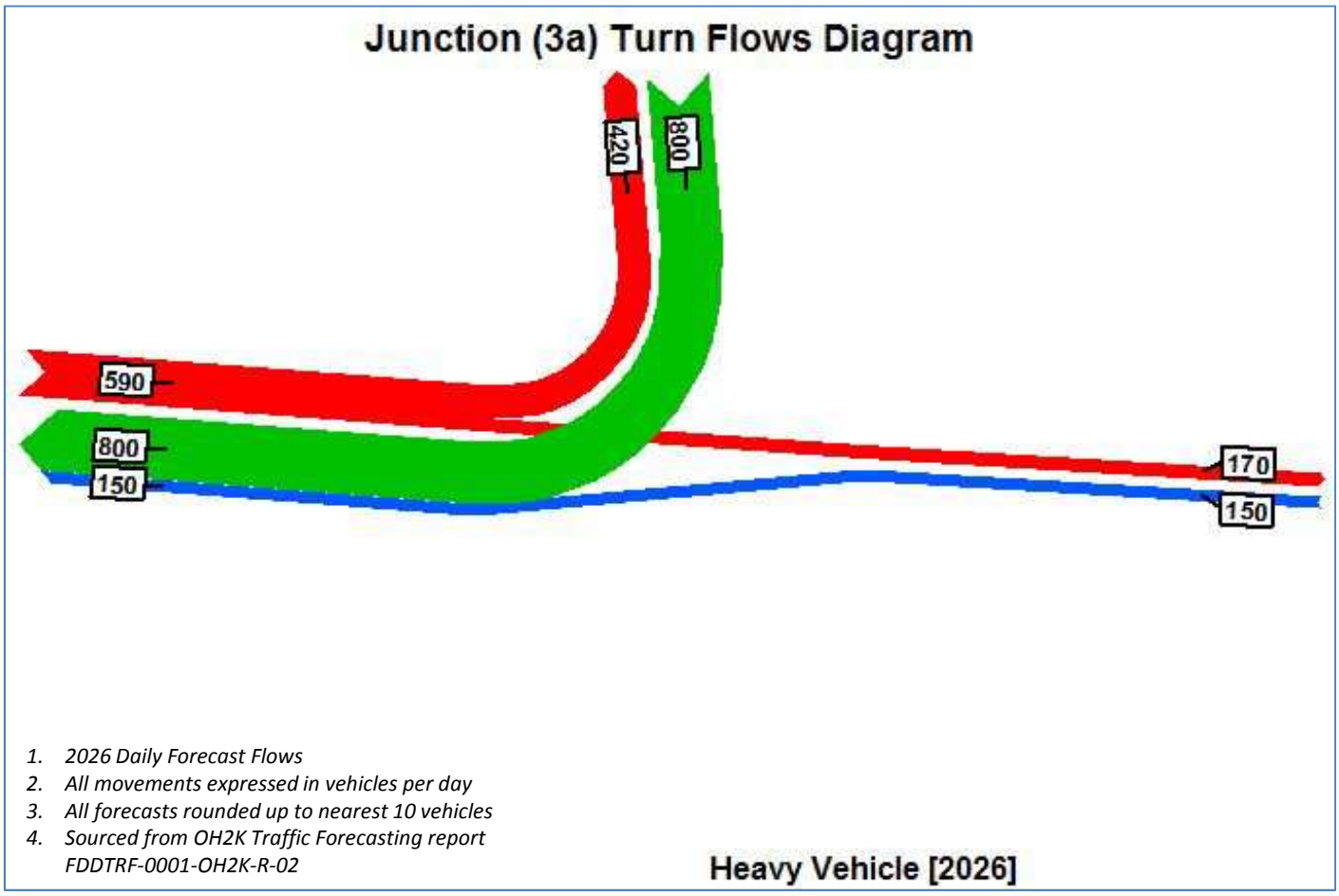




1. *2026 Daily Forecast Flows*
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3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

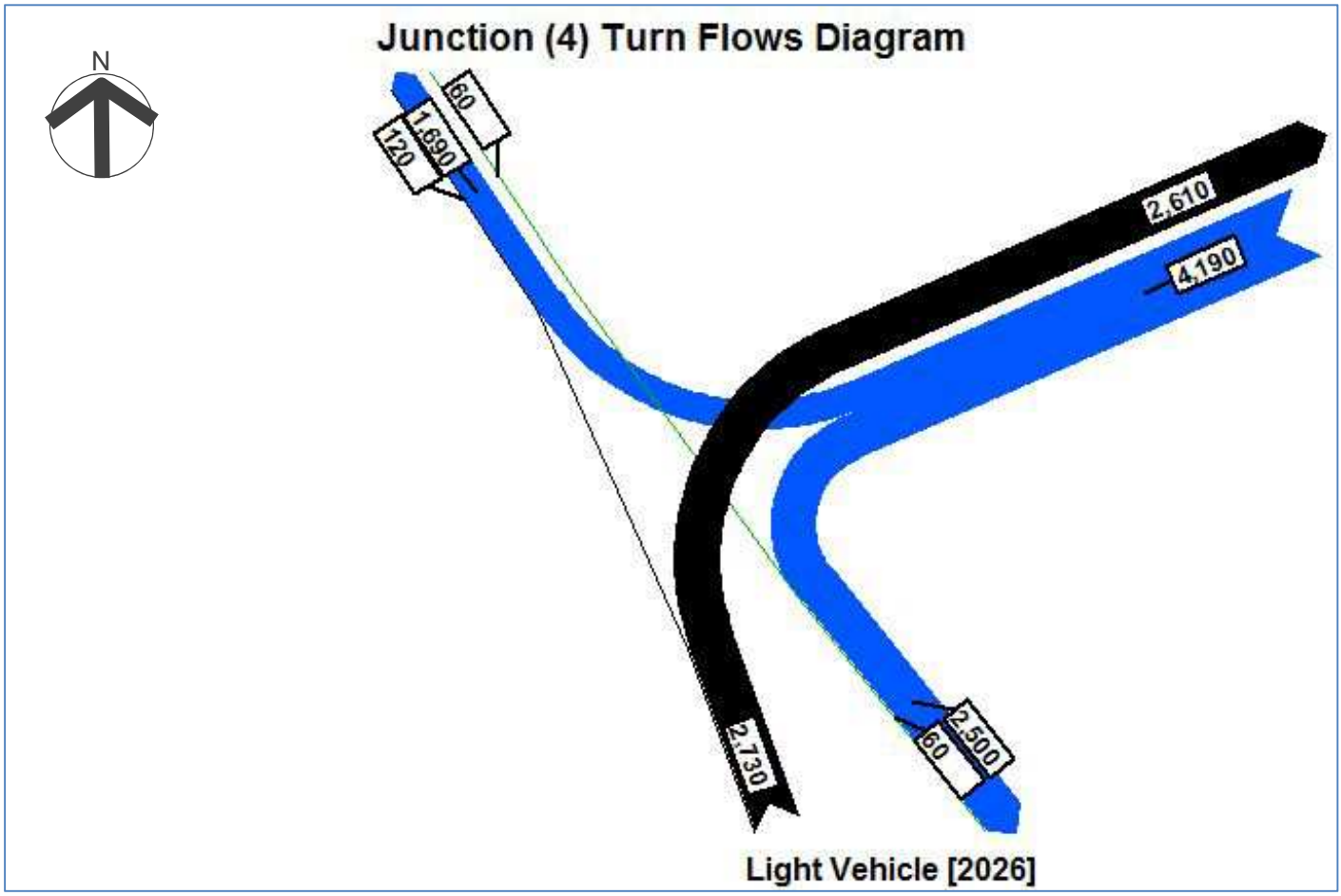
Site 3a: Loop Road & Fernbank Creek Industrial

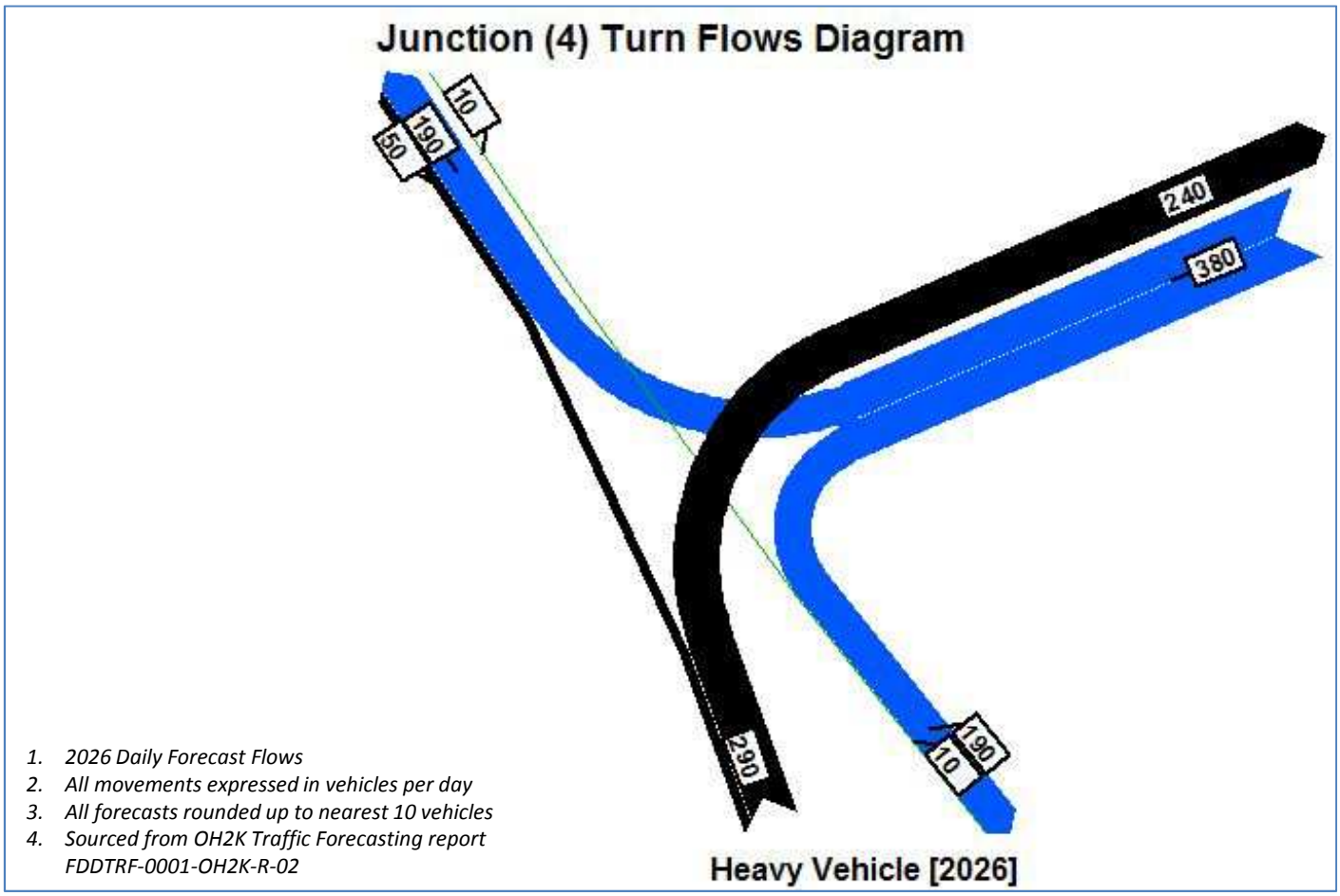




1. *2026 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

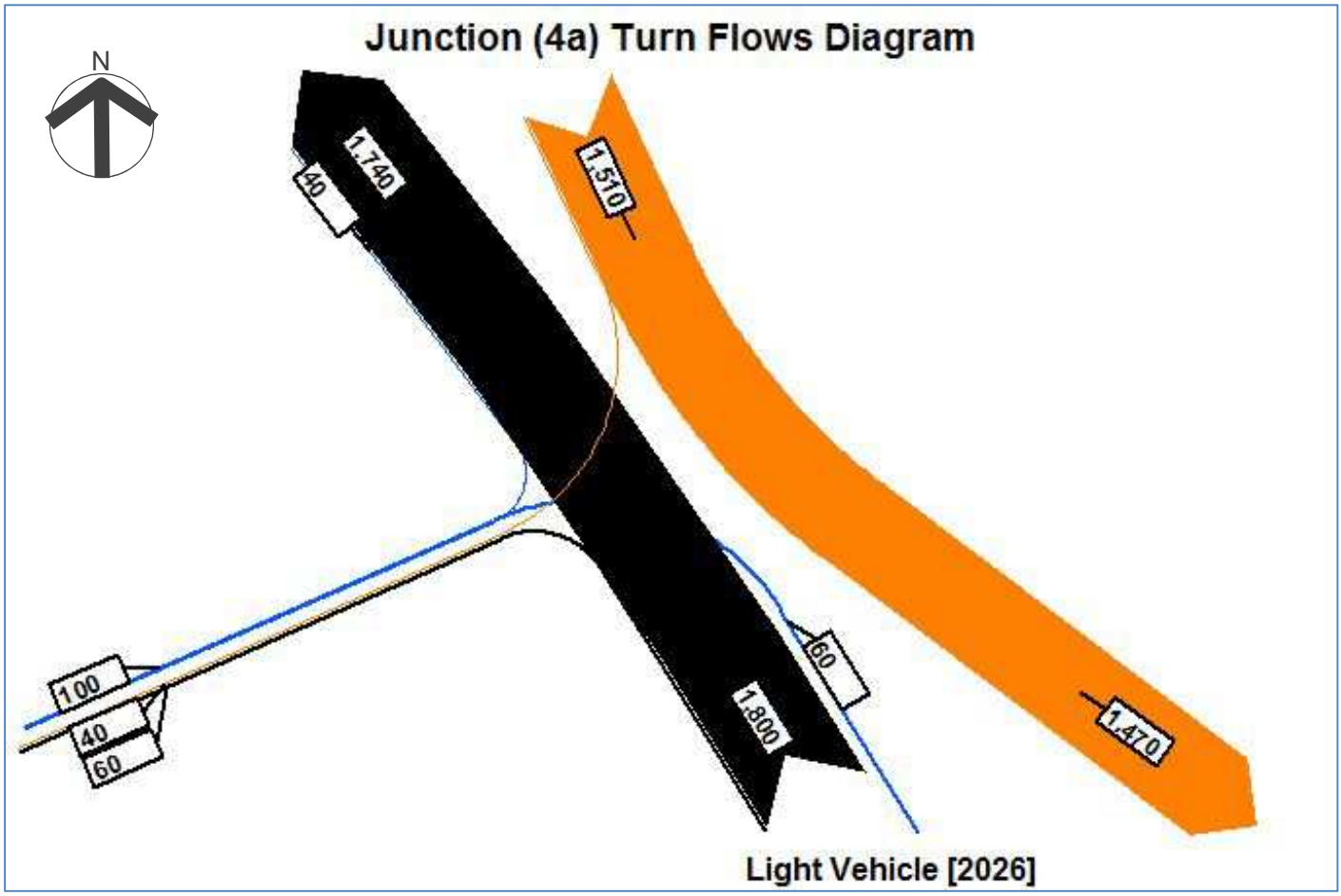
Site 4: Hasting River Drive & Service

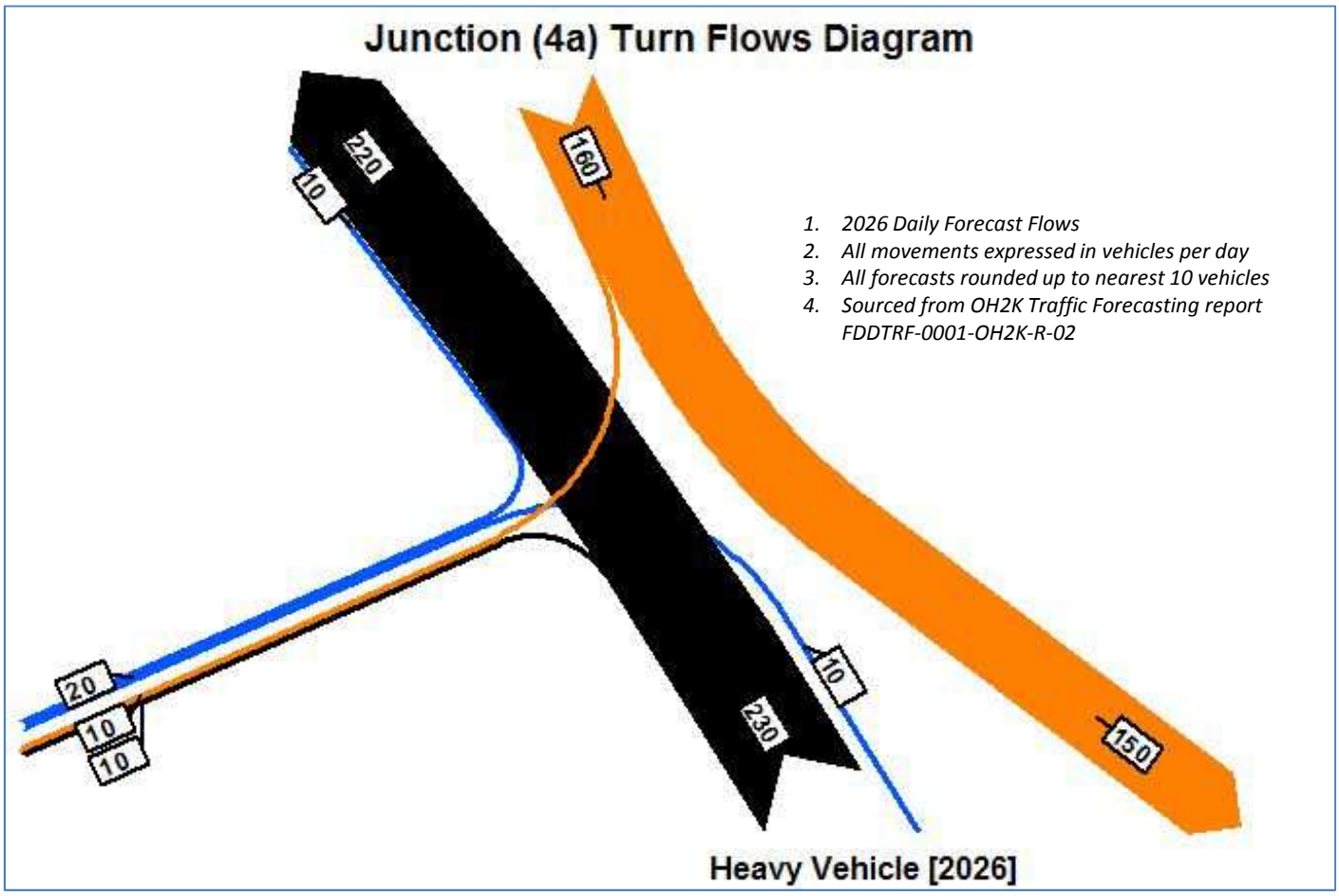




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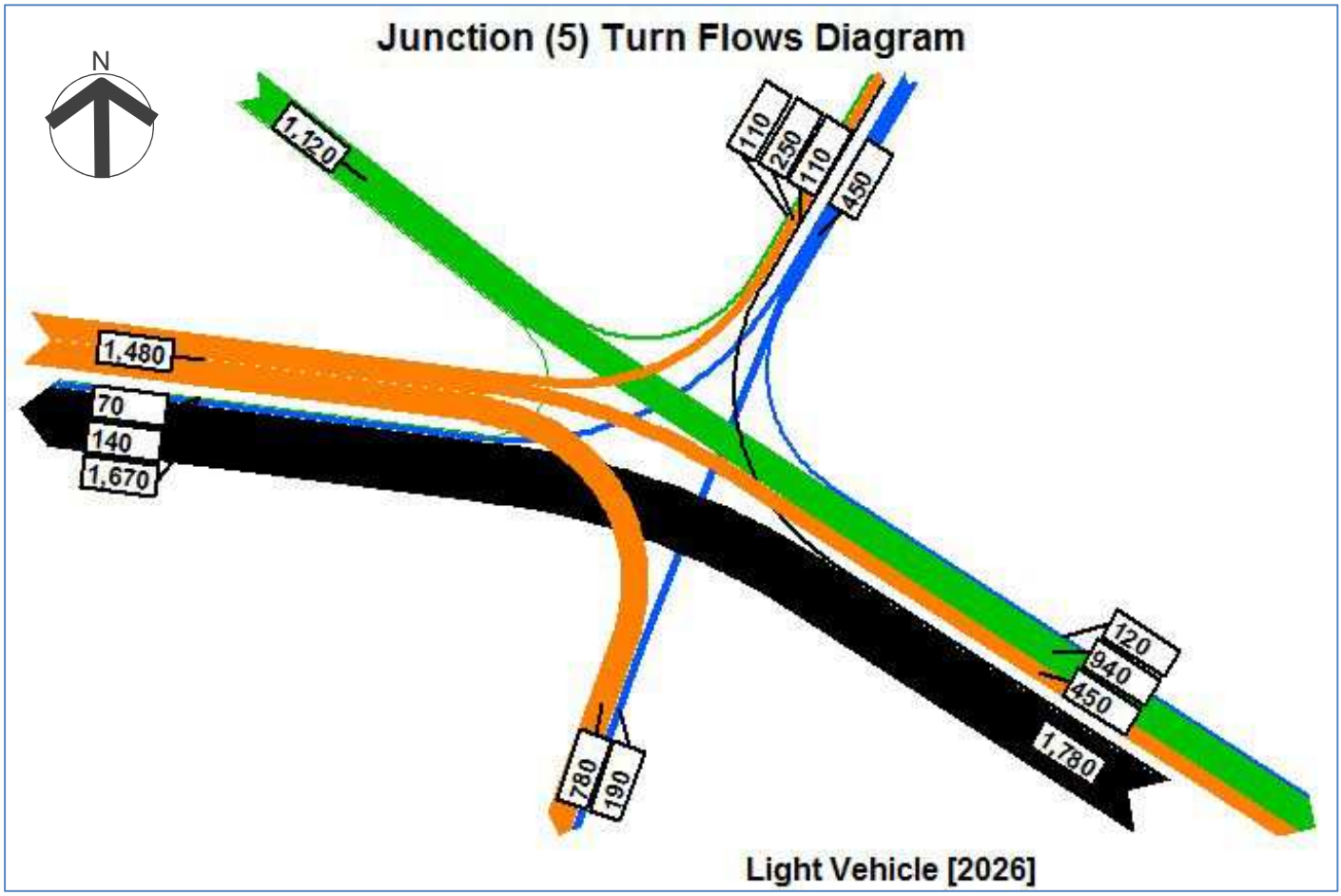
Site 4a: Glen Ewan Road & Service Road

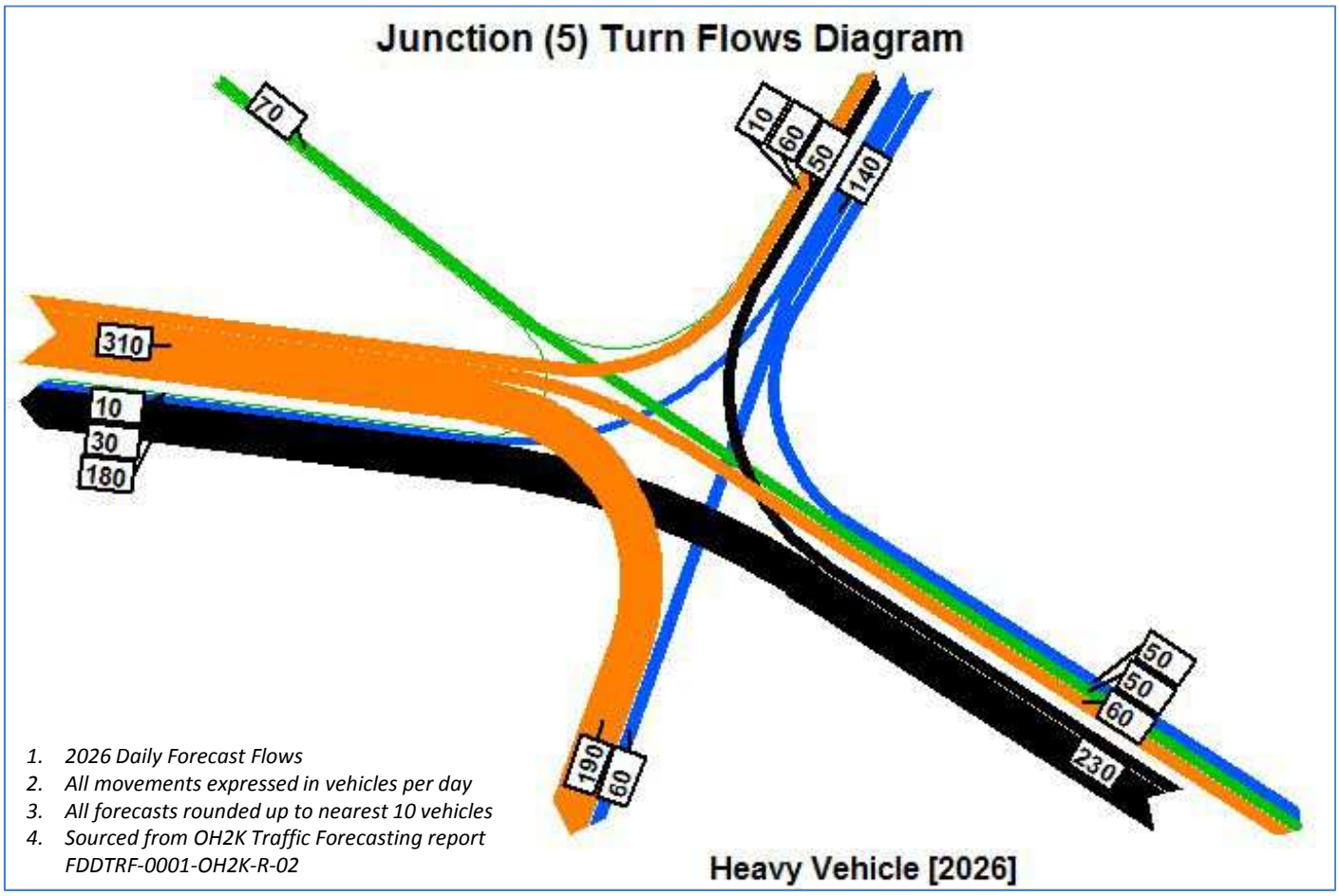




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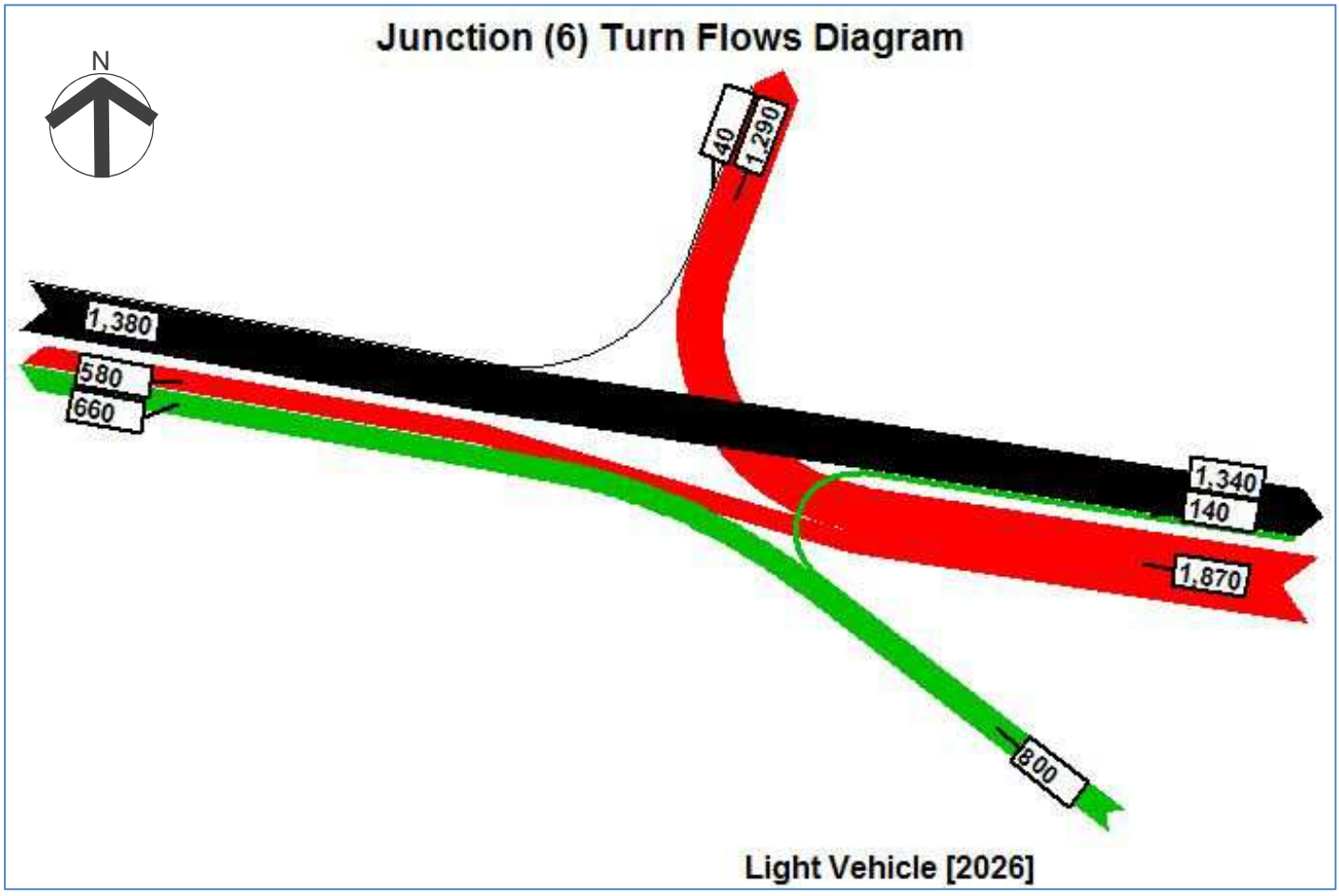
Site 5: Blackmans Point I/C (Eastern Roundabout)

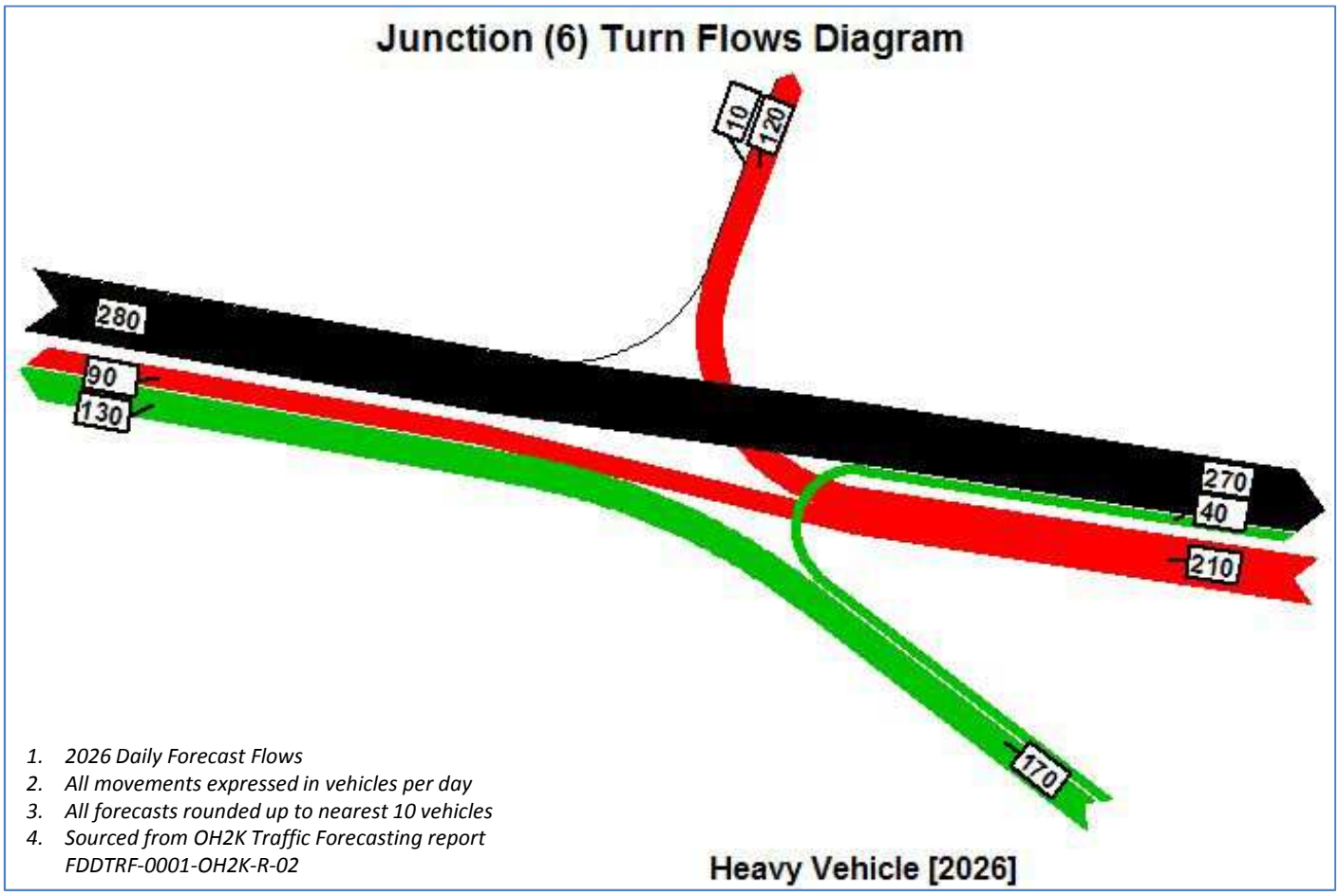




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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

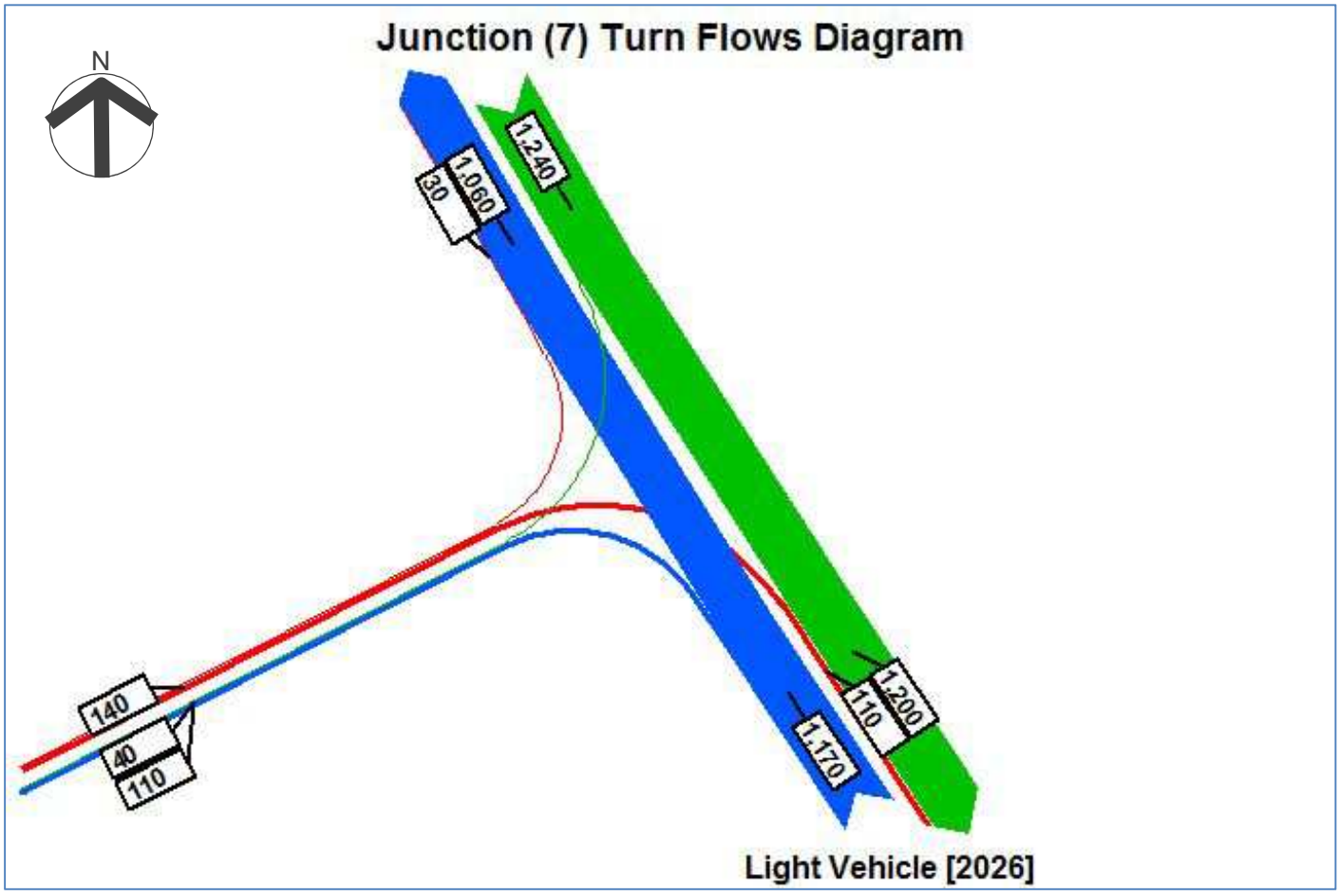
Site 6: Blackmans Point I/C (Western Roundabout)

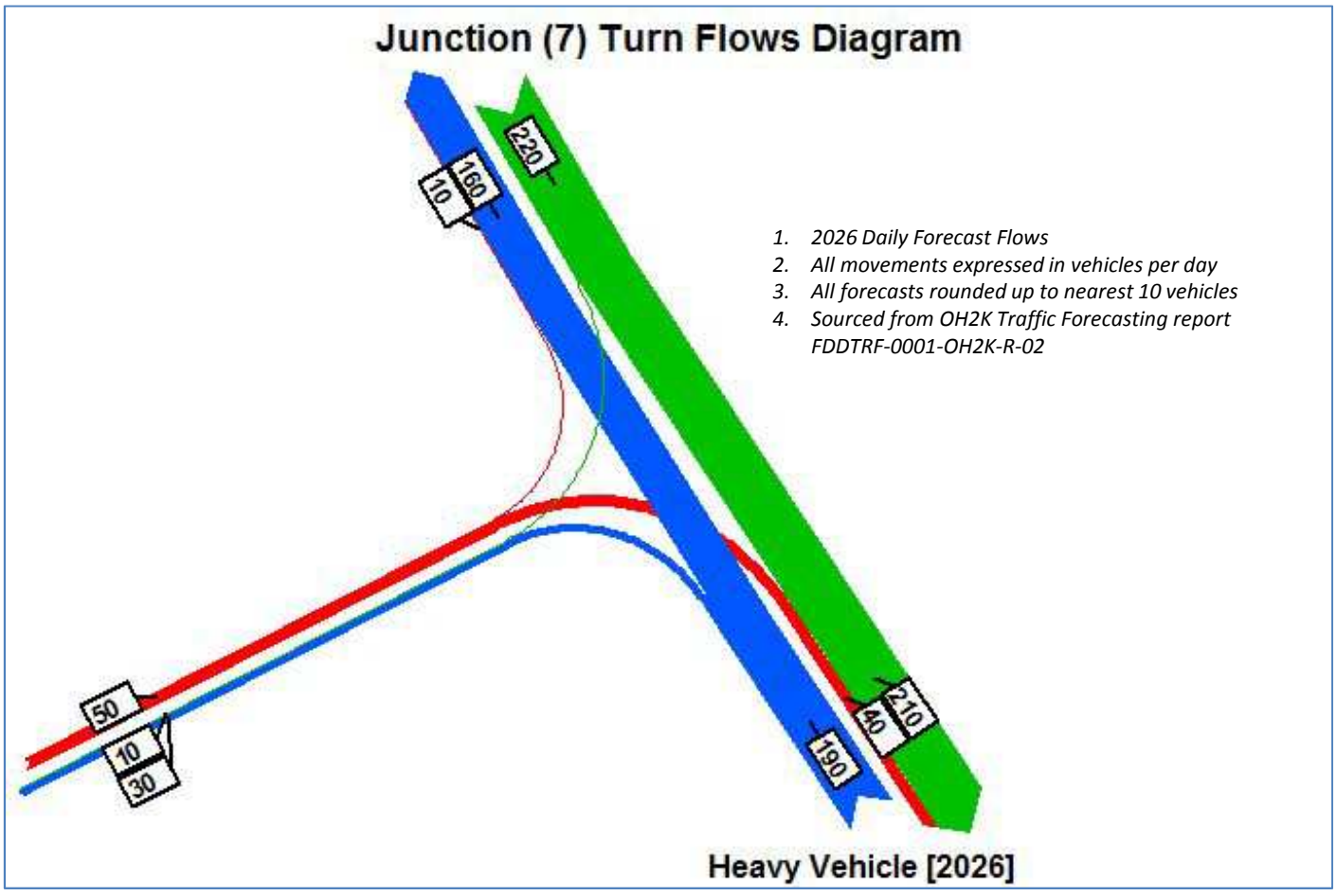




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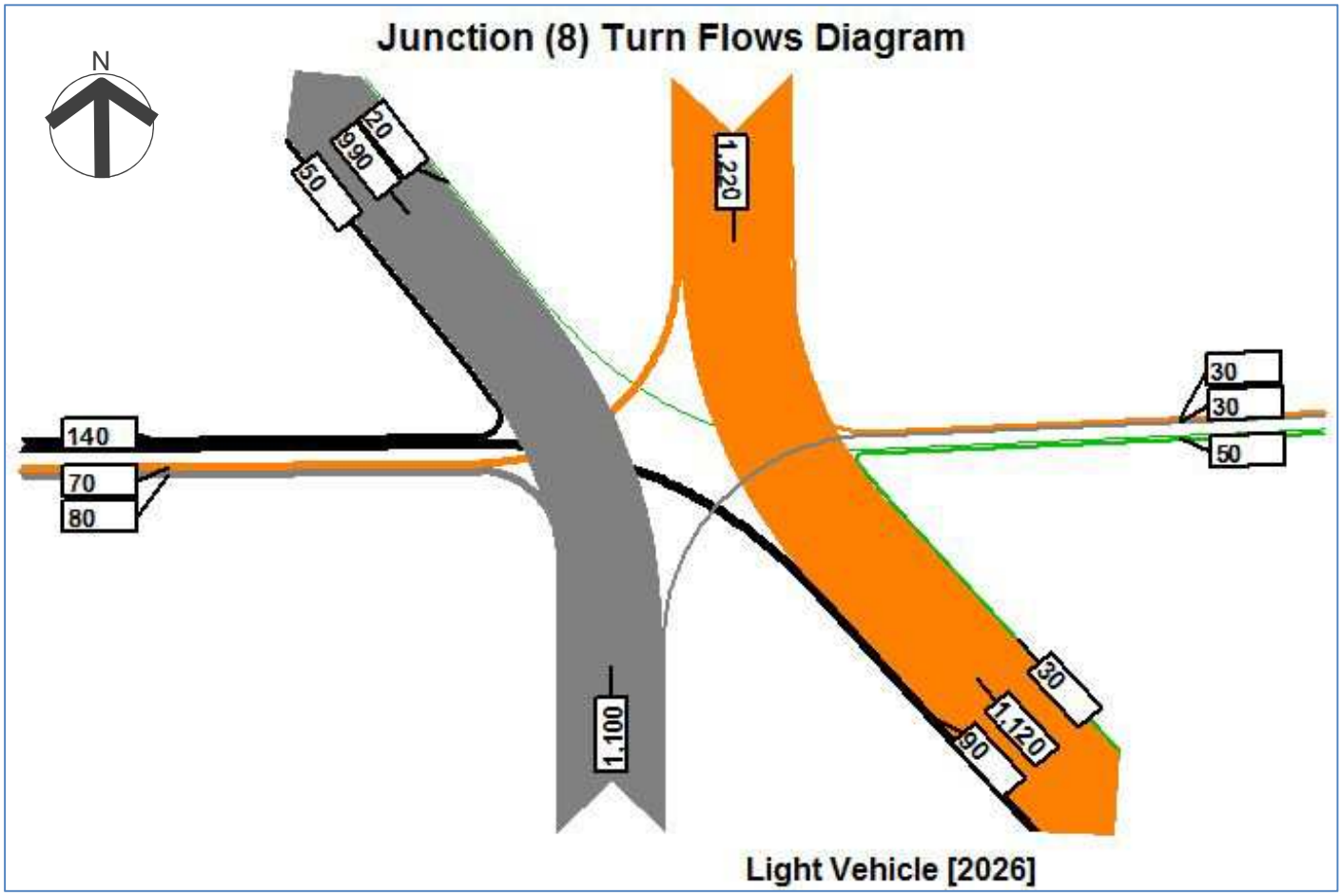
Site 7: Junction Road & Service Road

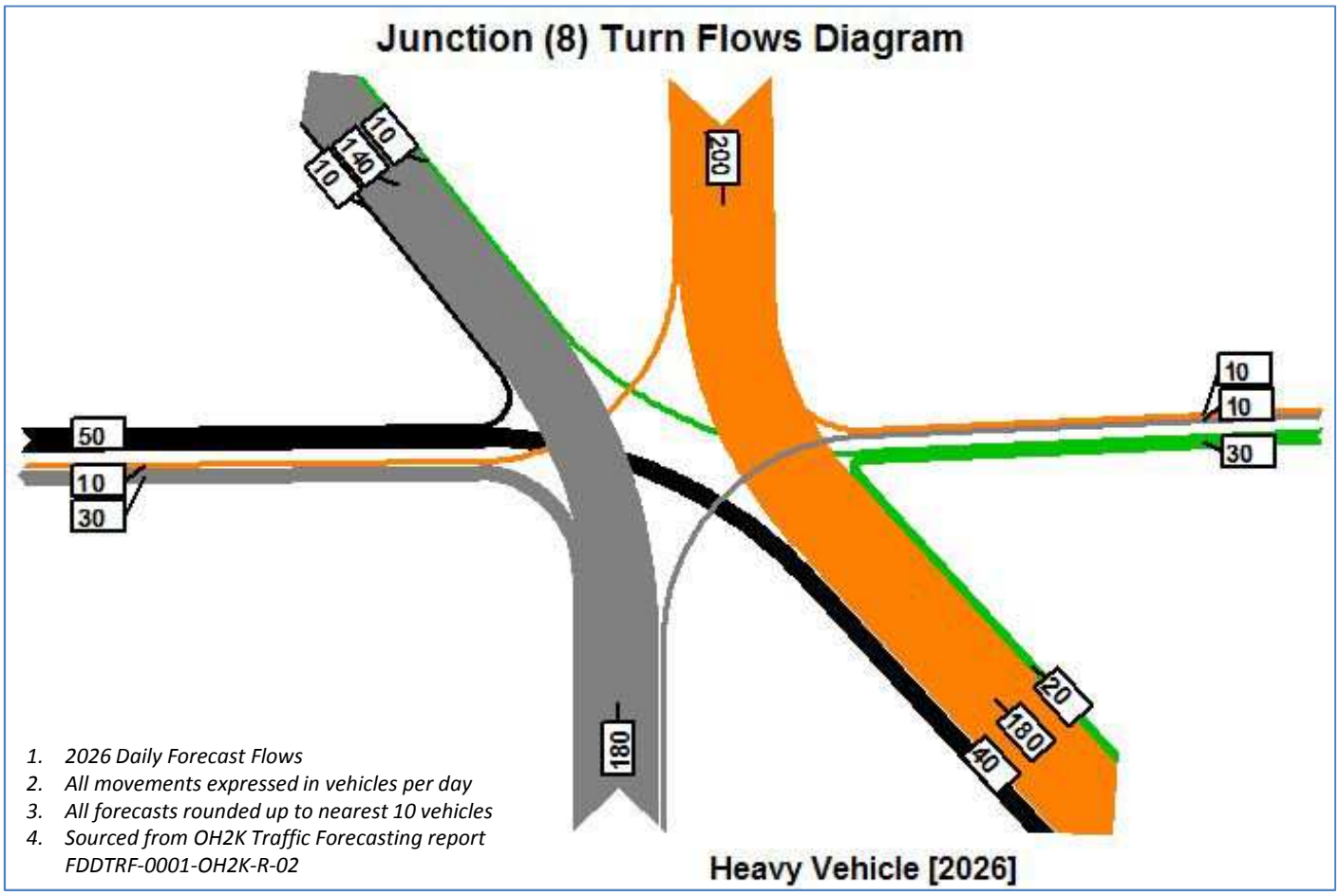




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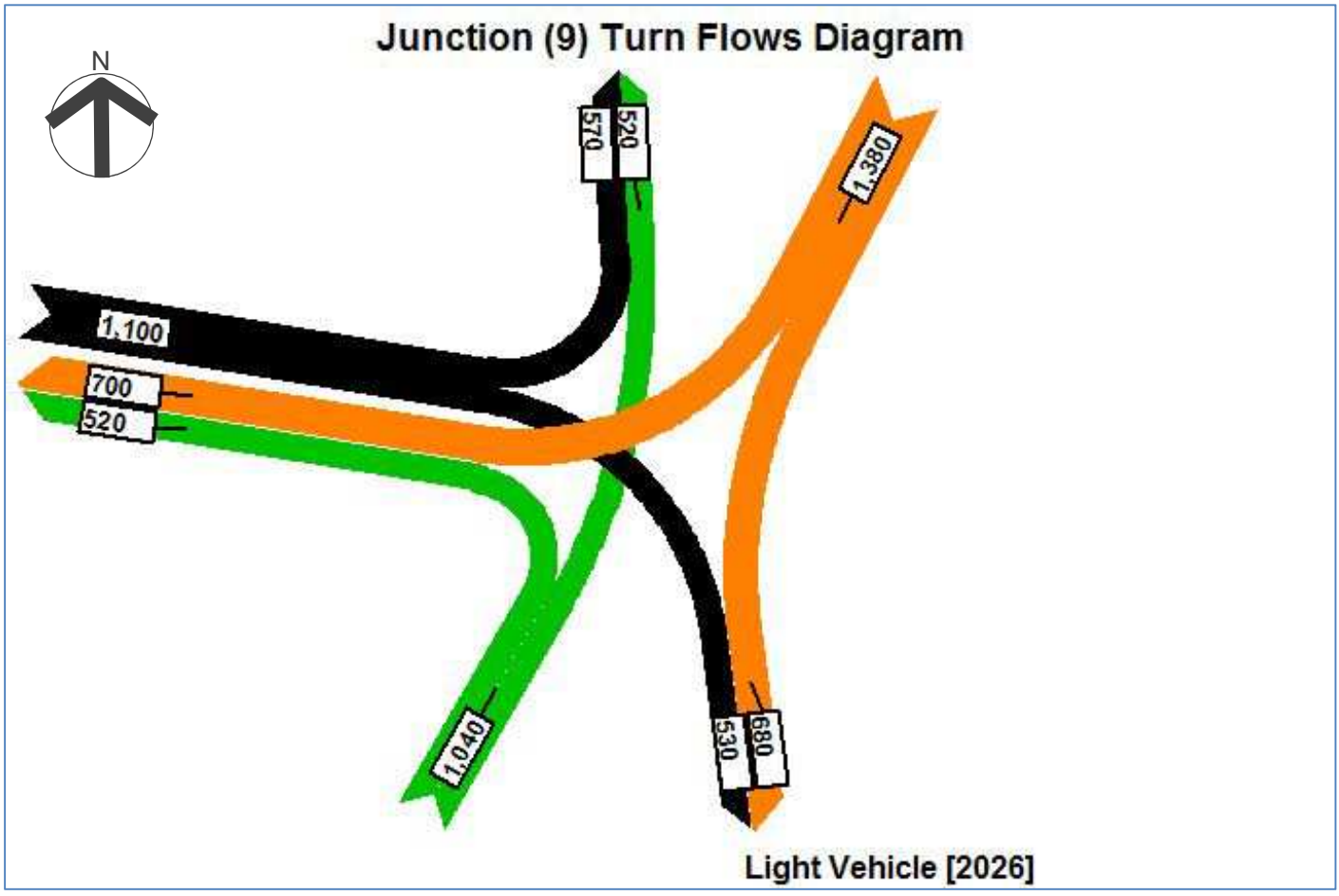
Site 8: Forest Hut Road, Bill Hill Road & Service

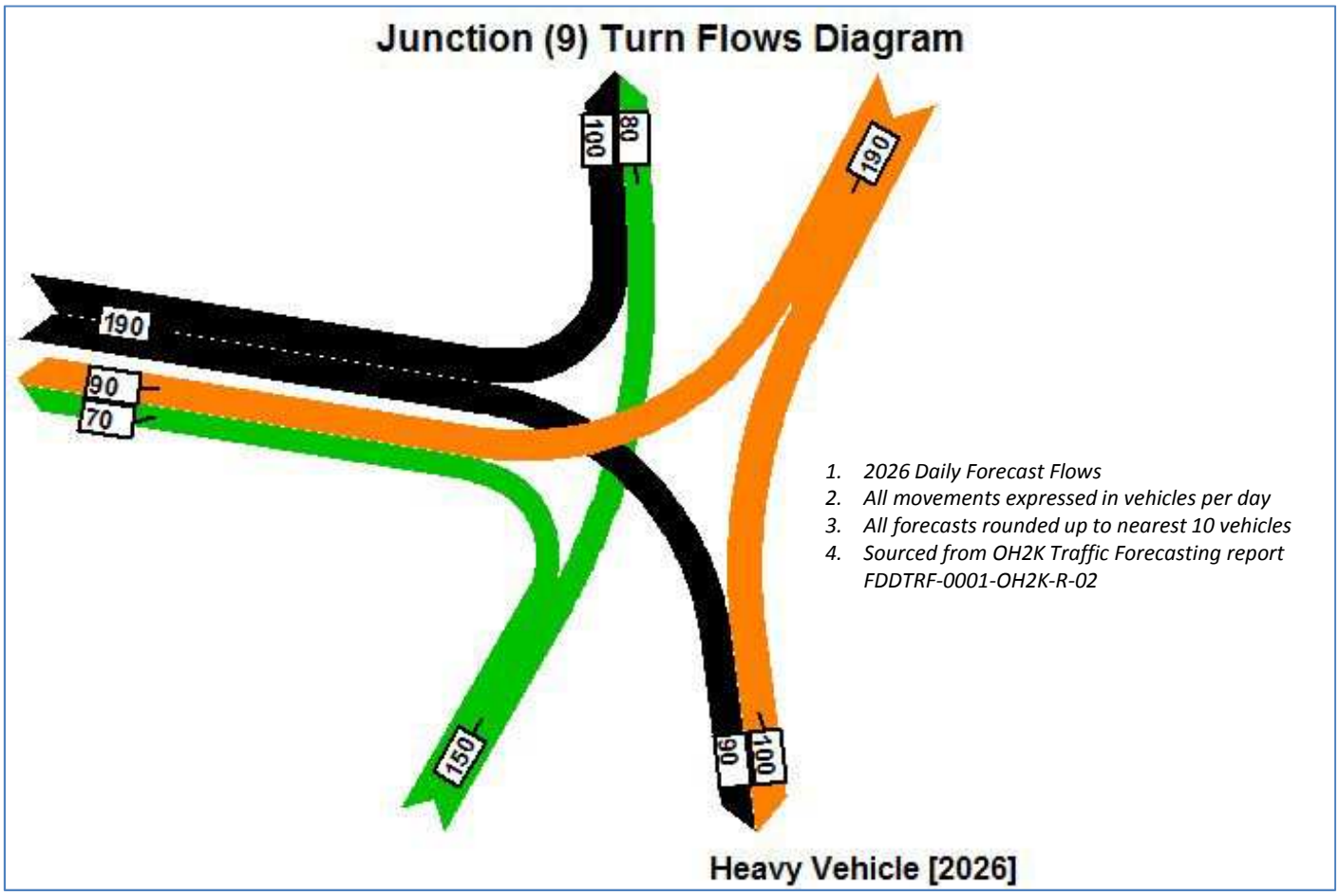




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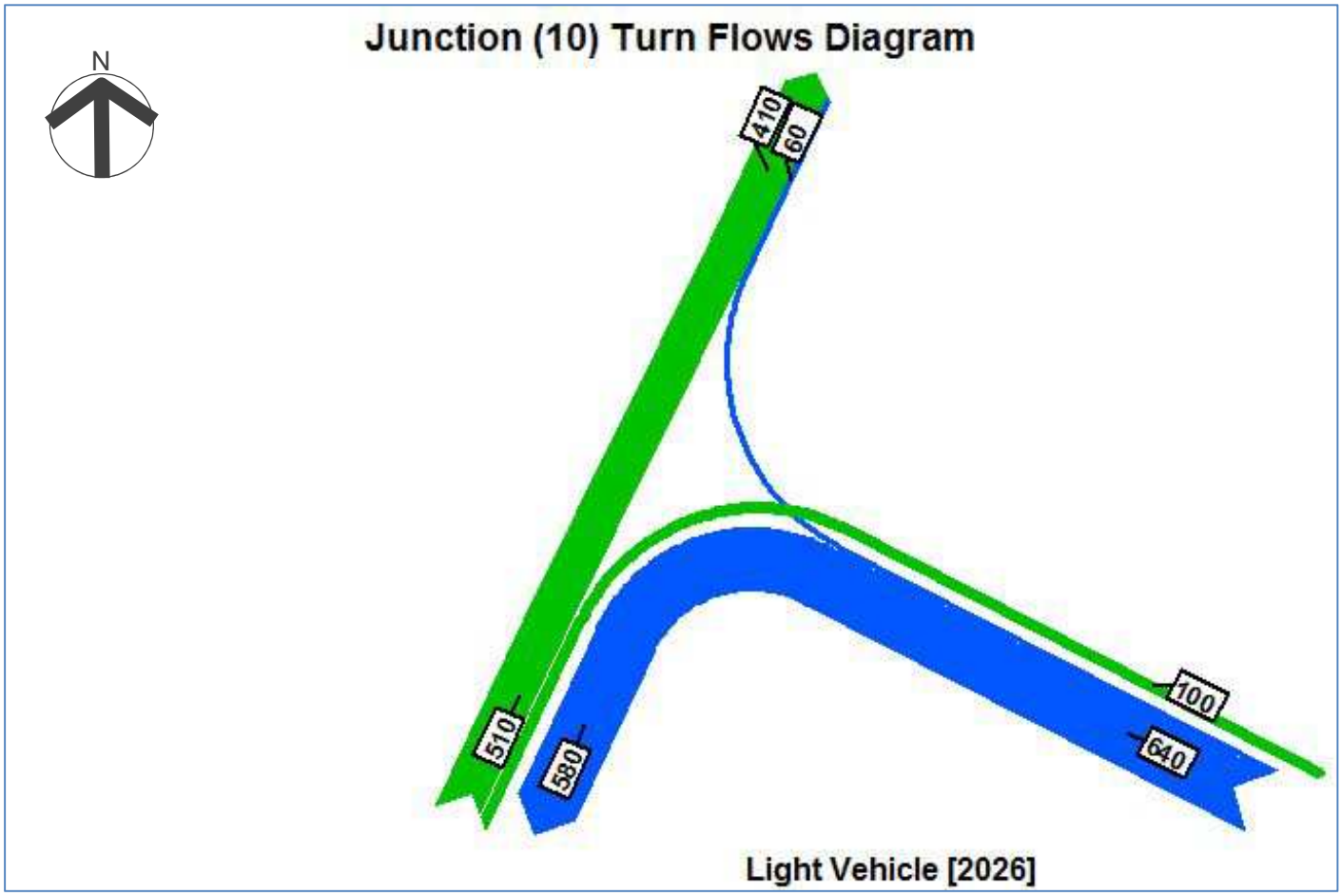
Site 9: Pembroke Road & Service Road

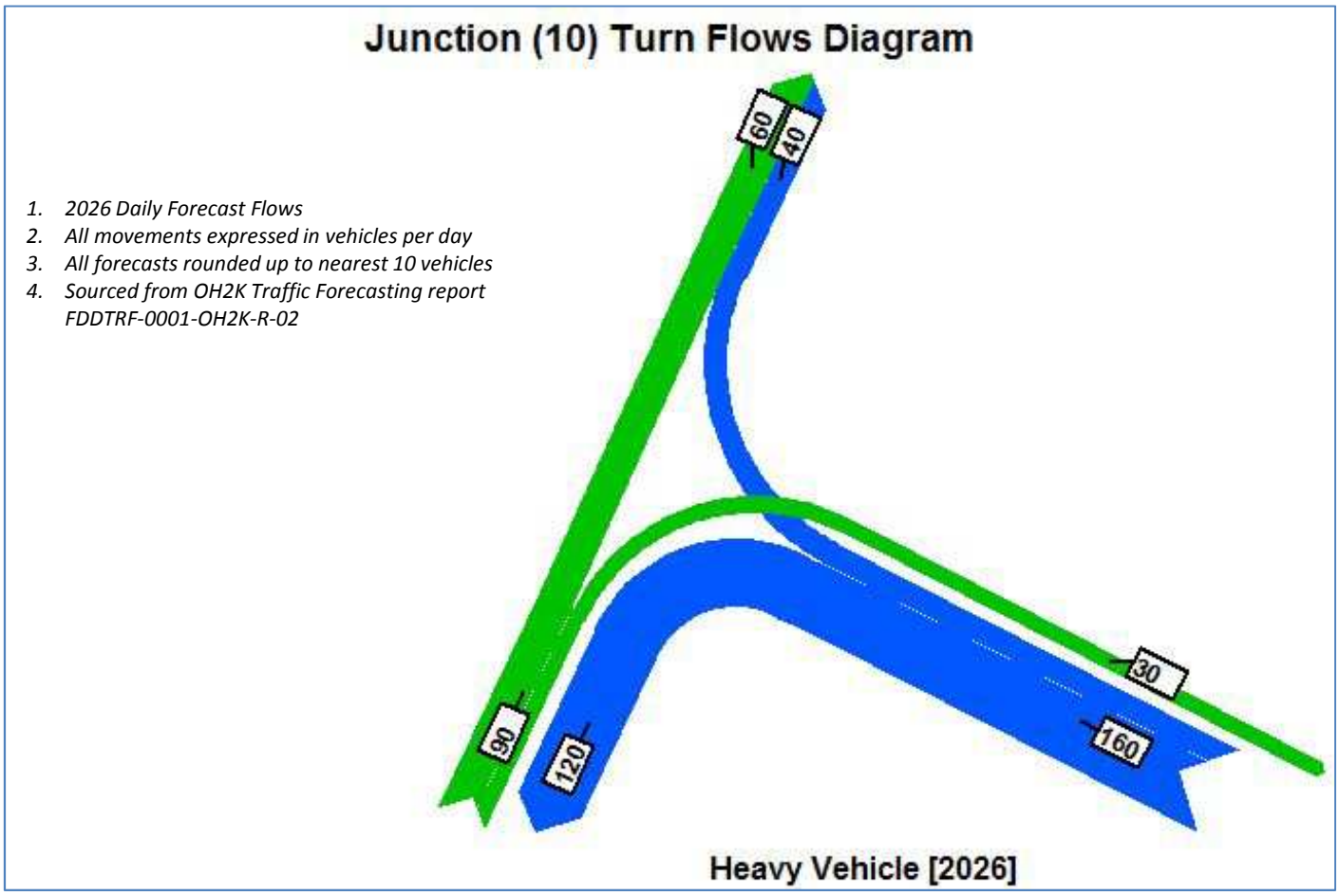




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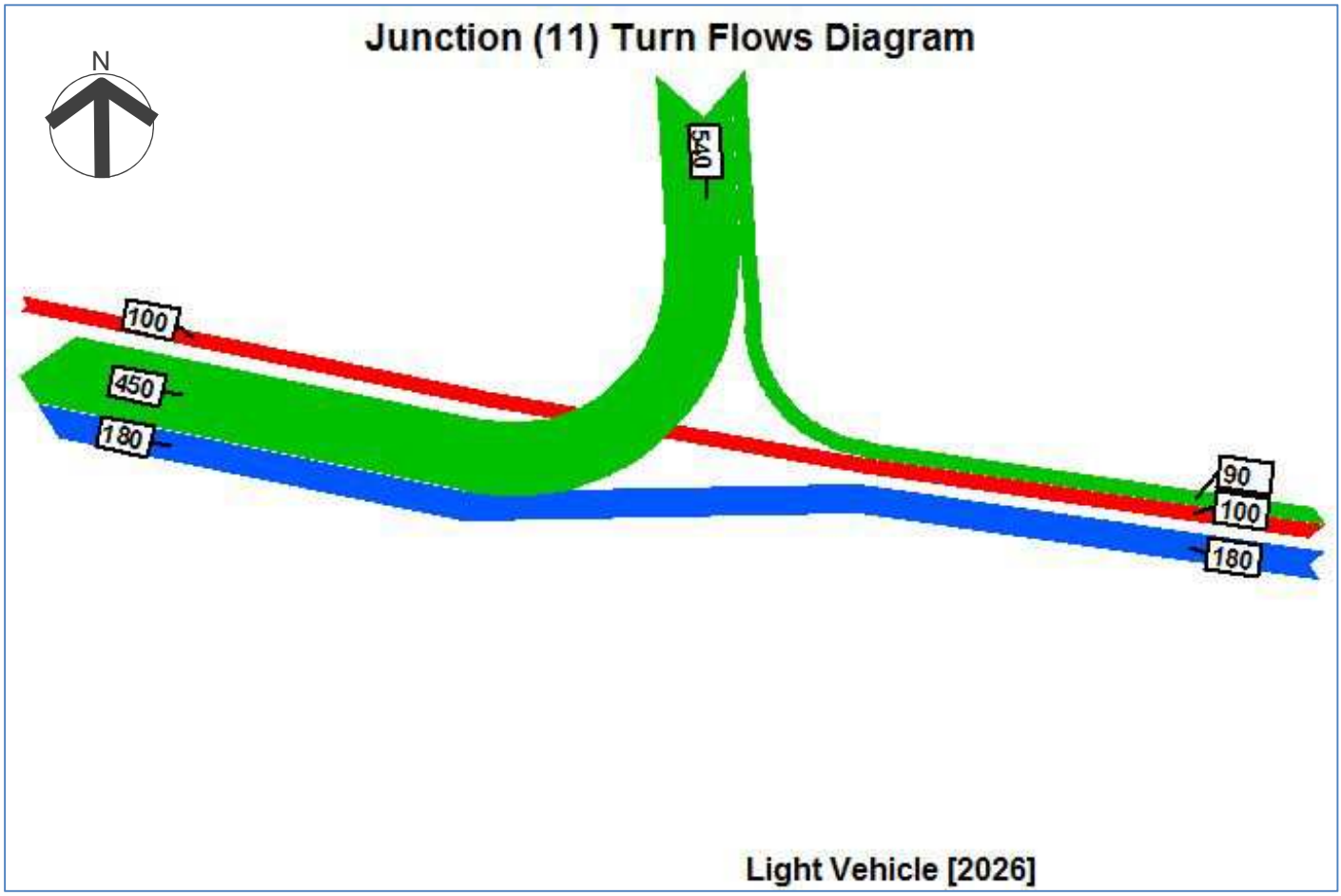
Site 10: Haydons Wharf Road & Service Road

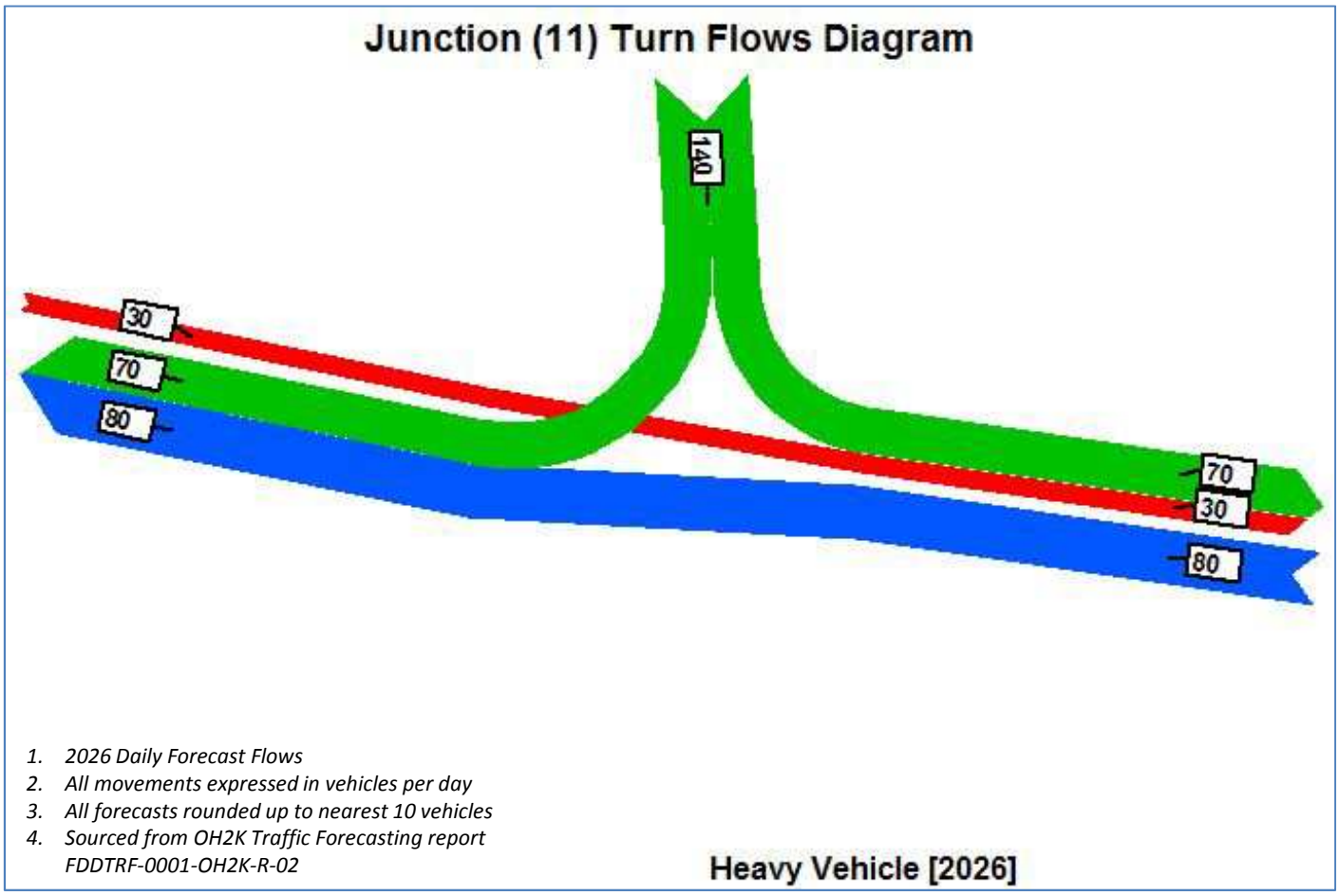




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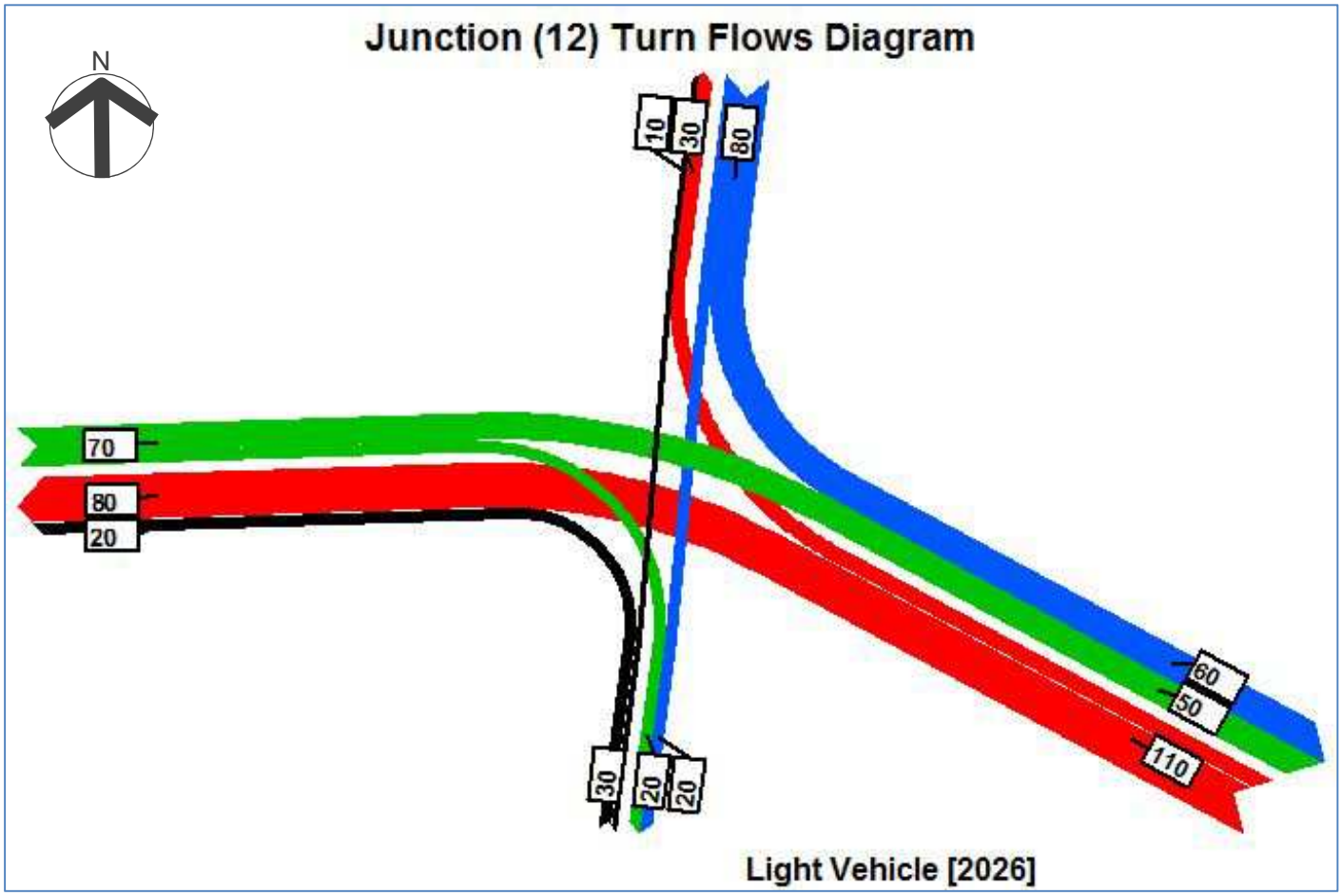
Site 11: Haydons Wharf Road & SB Off-ramp

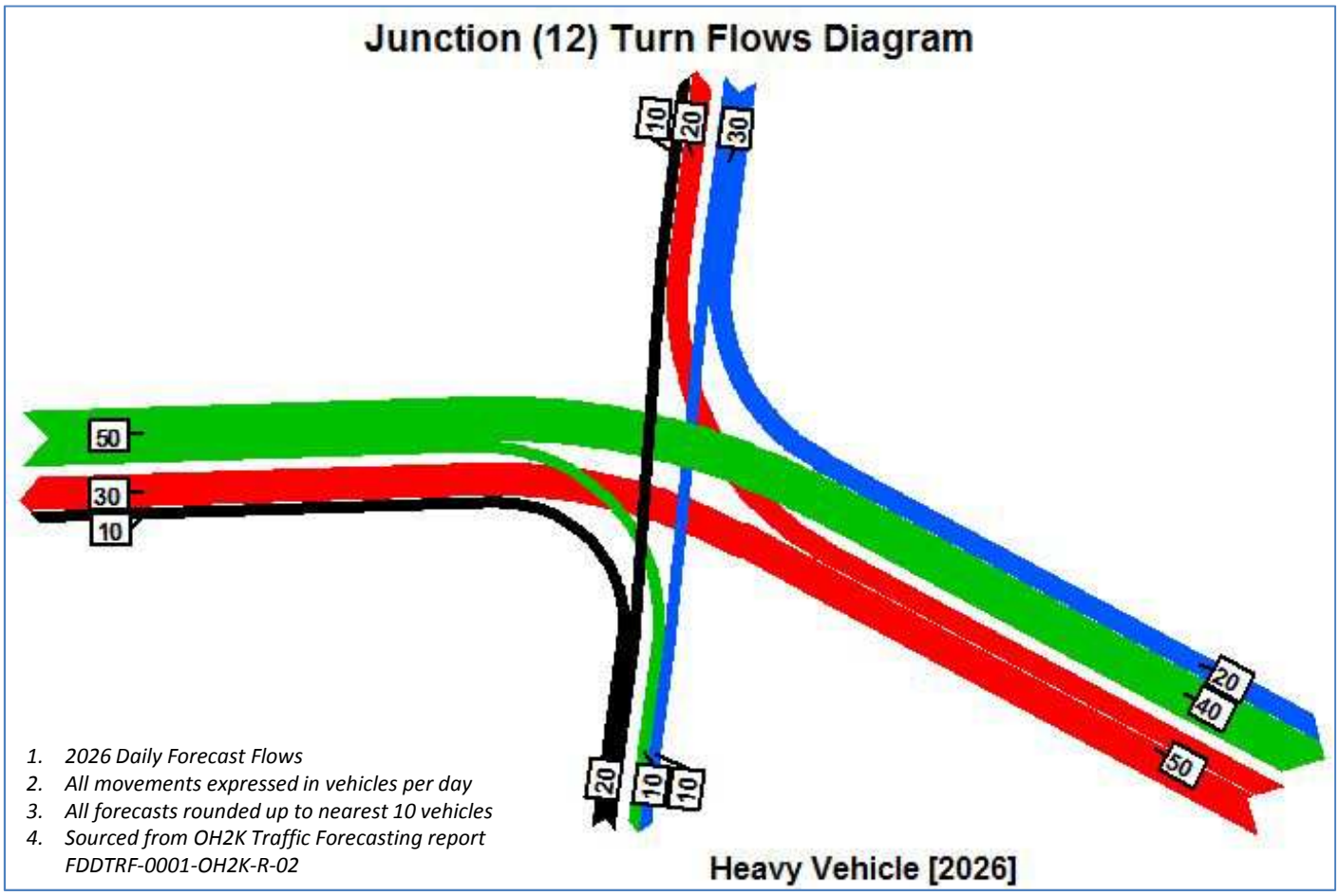




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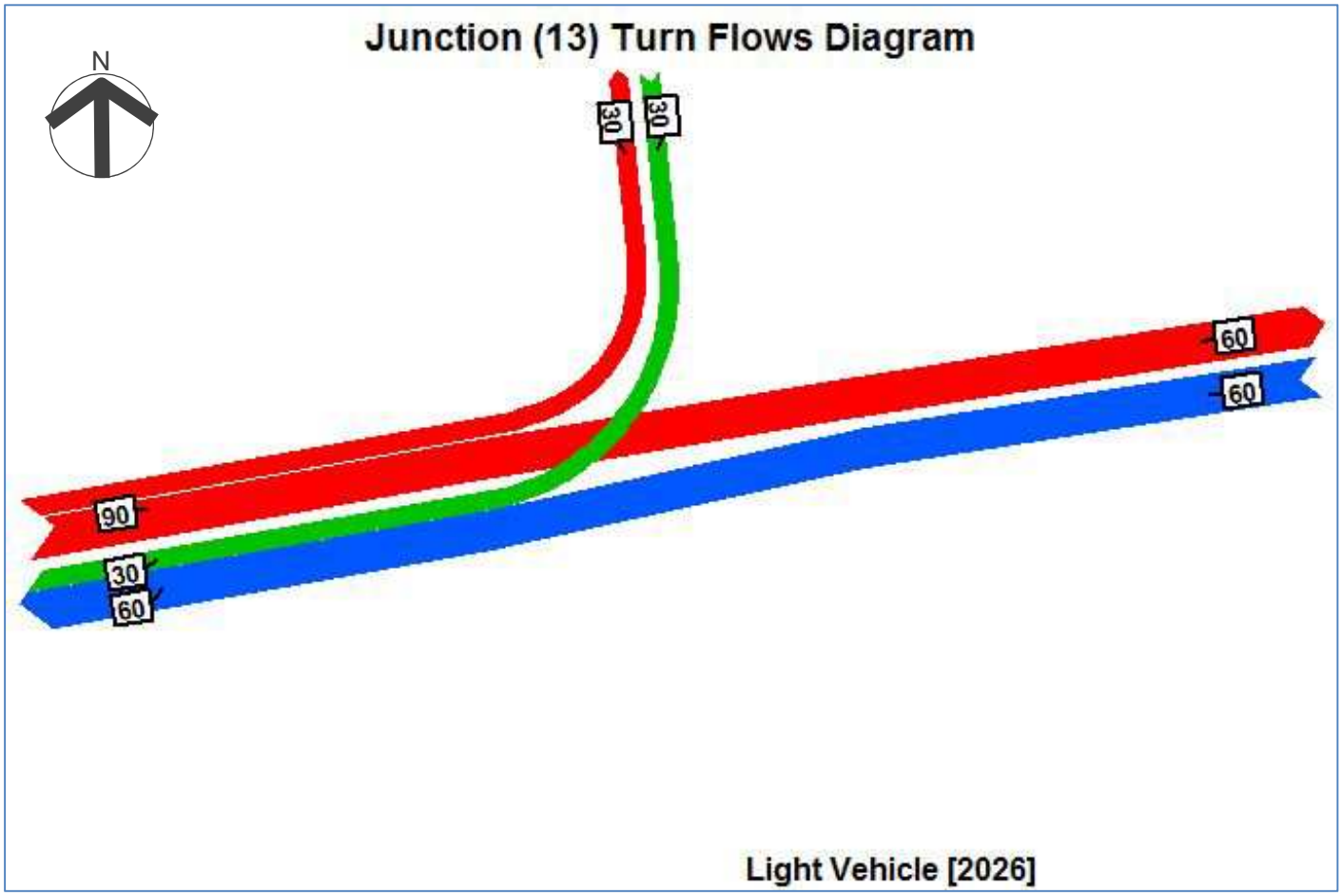
Site 12: Cooperabung Drive & Zone J2

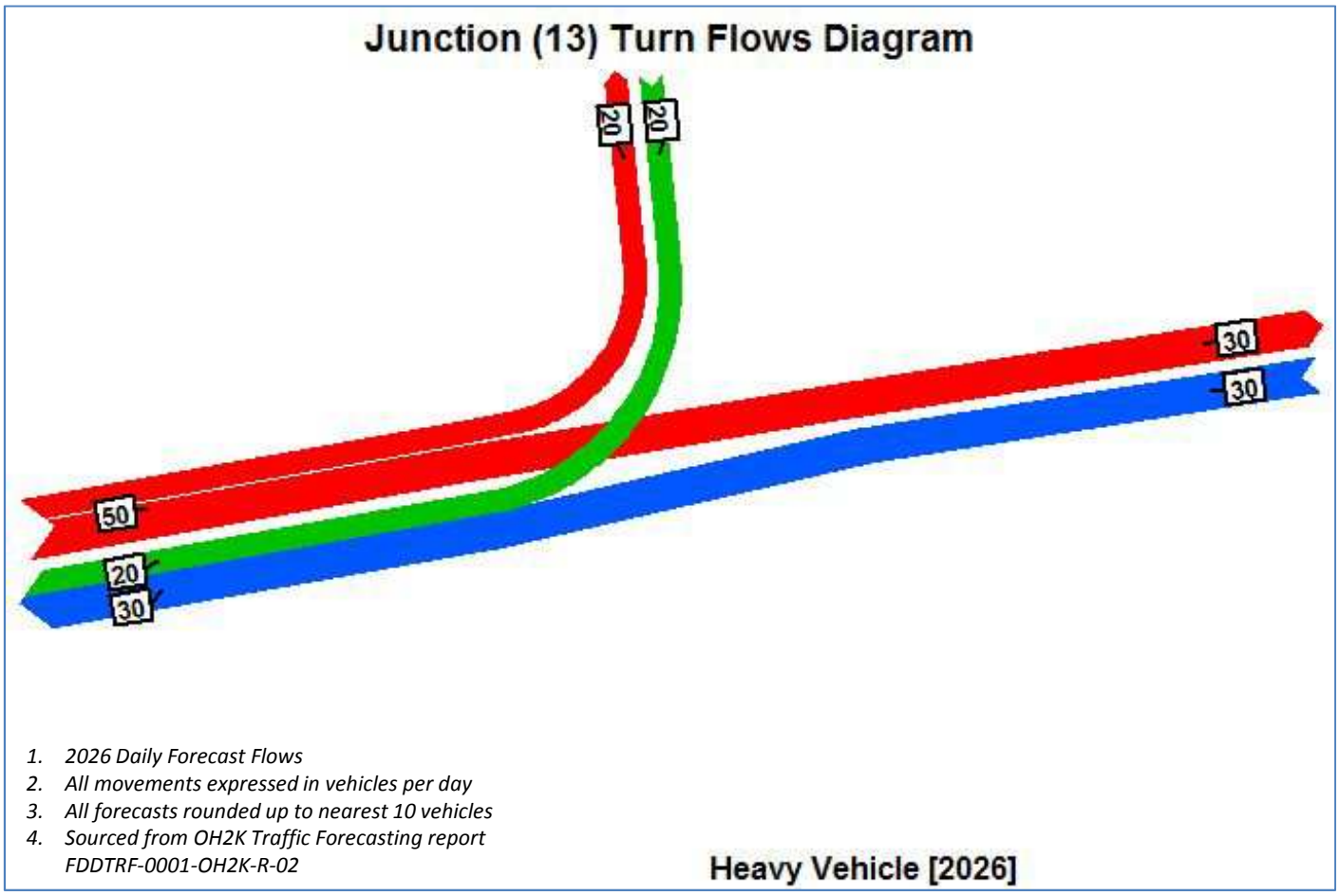




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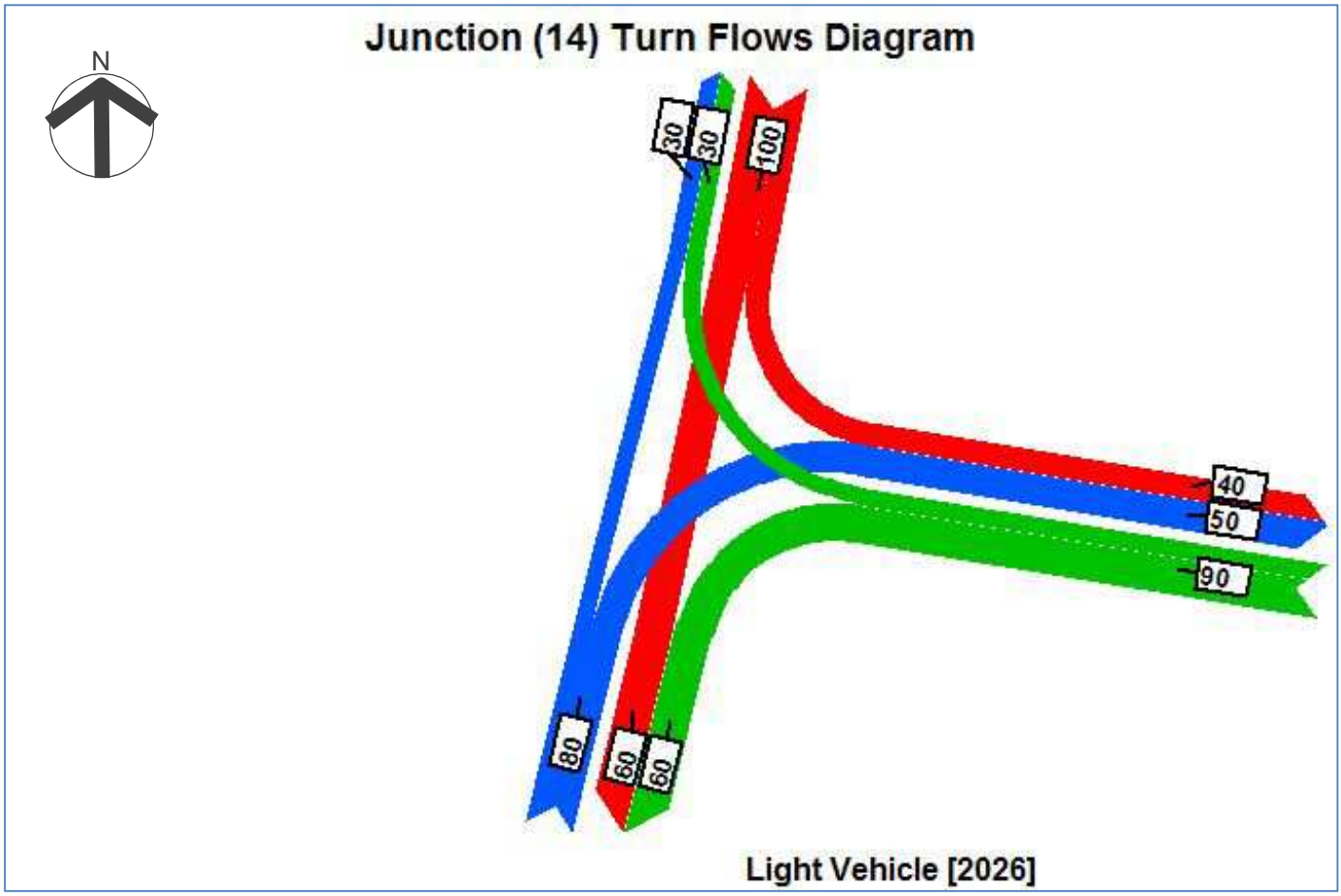
Site 13: Mingaletta Road & Mobbs Road

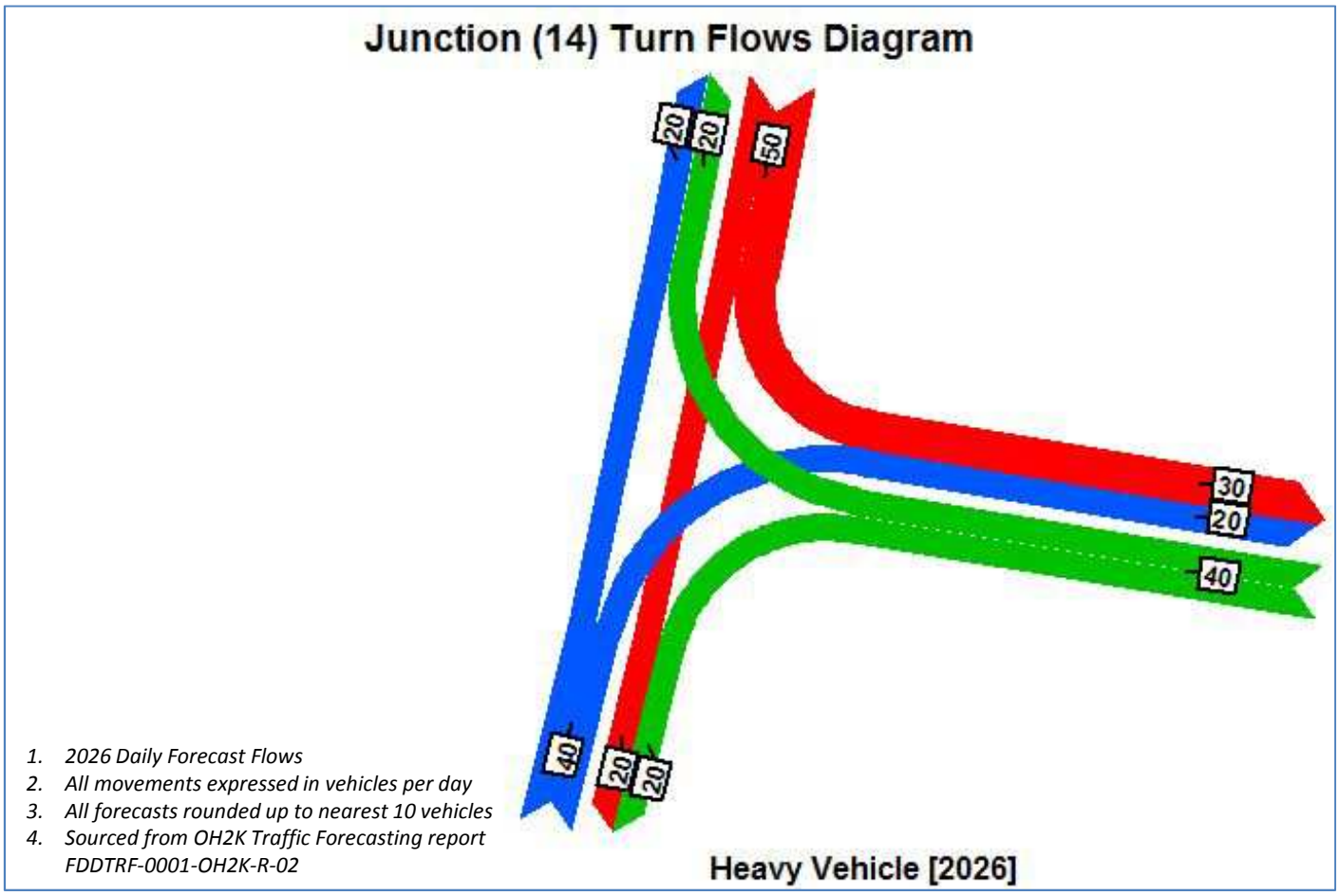




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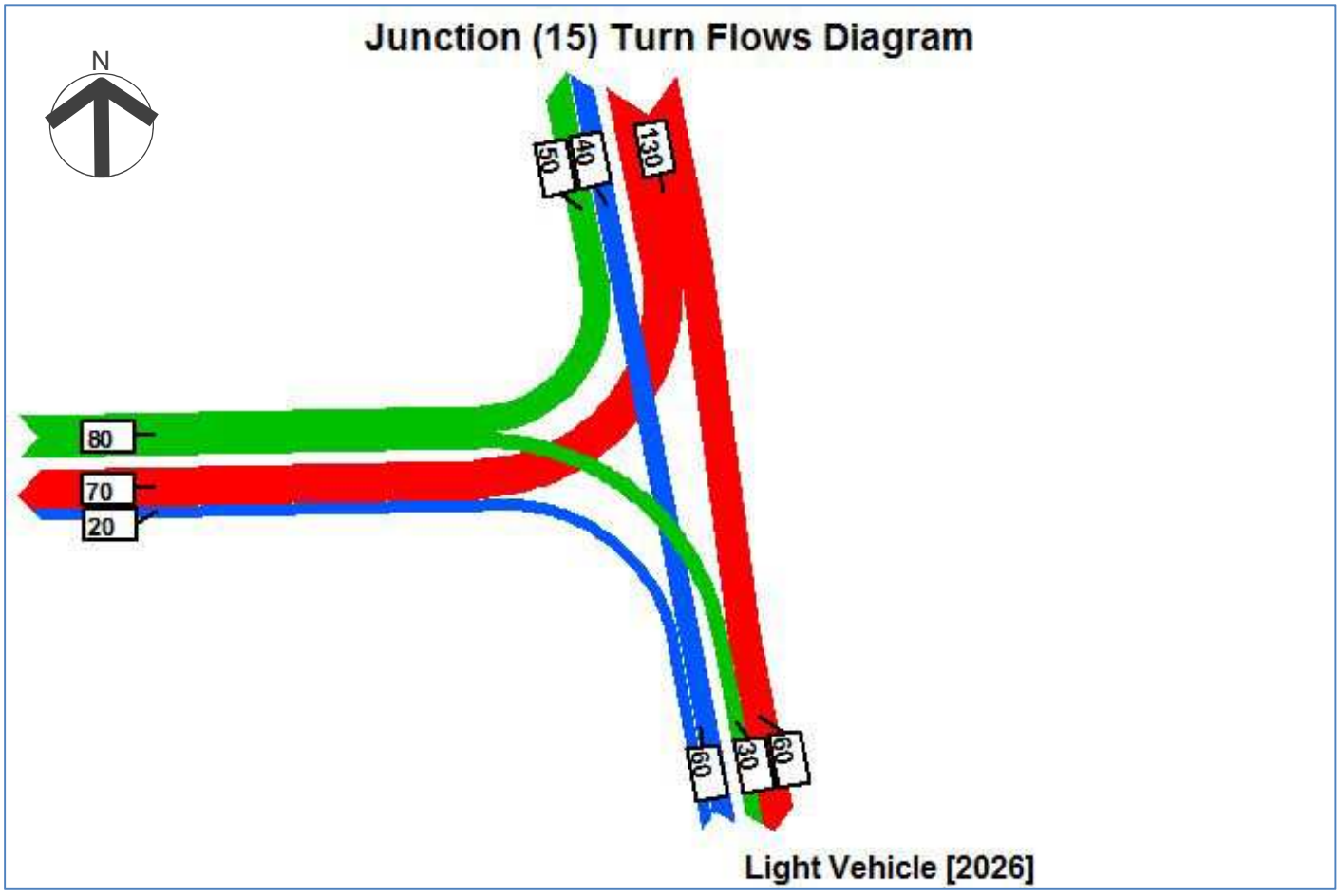
Site 14: Mingaletta Road & Service Road

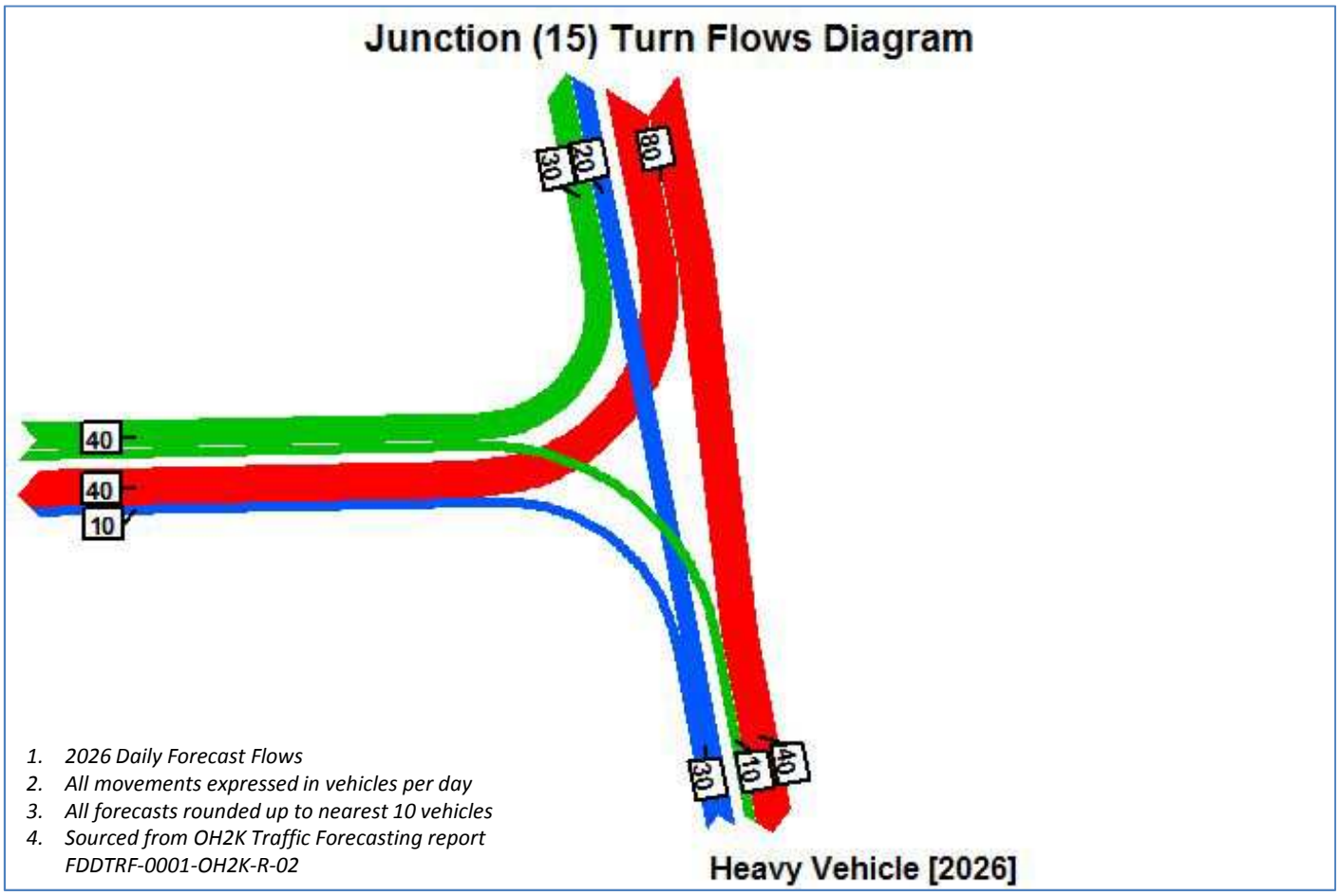




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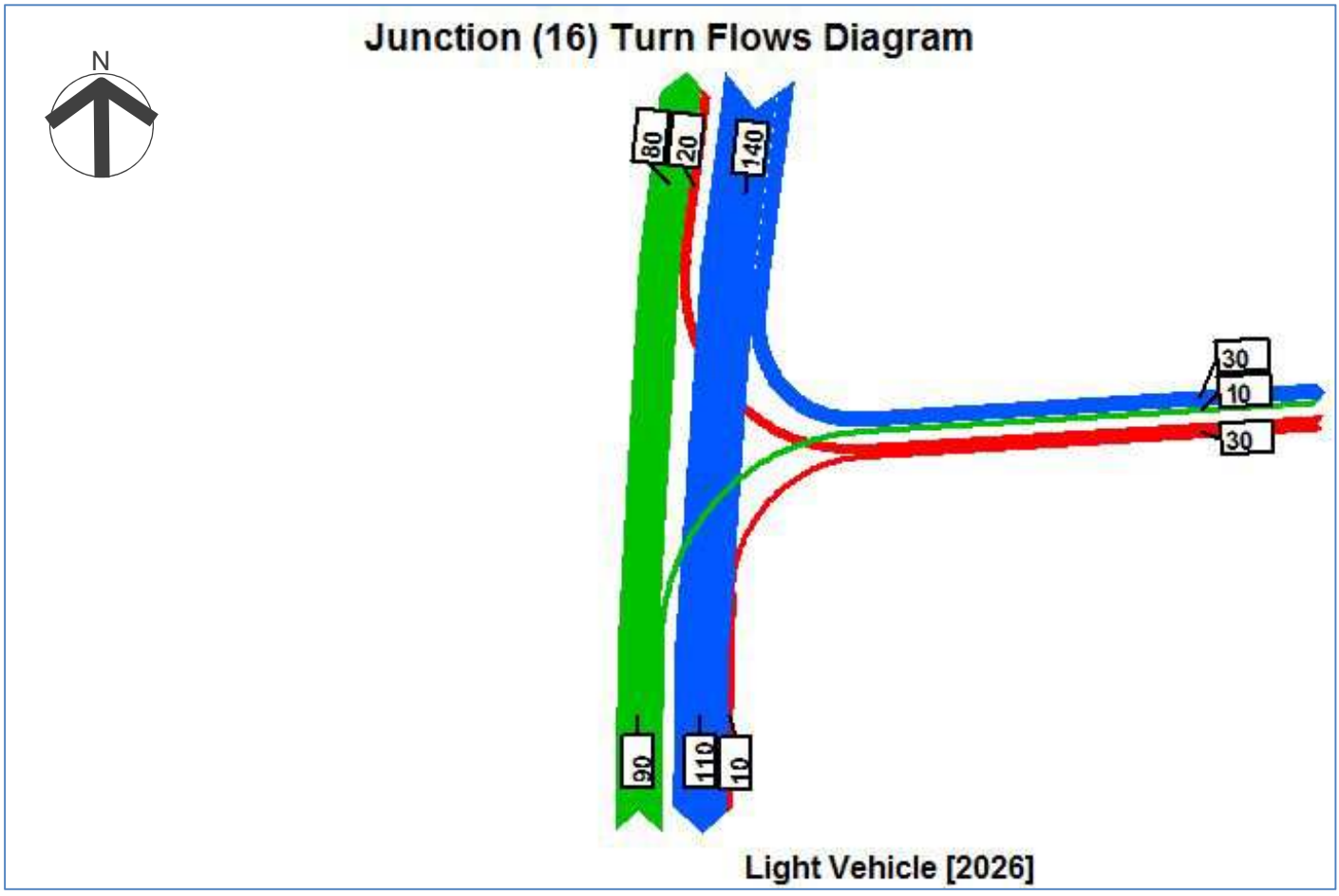
Site 15: Upper Smiths Creek Road & Service Road

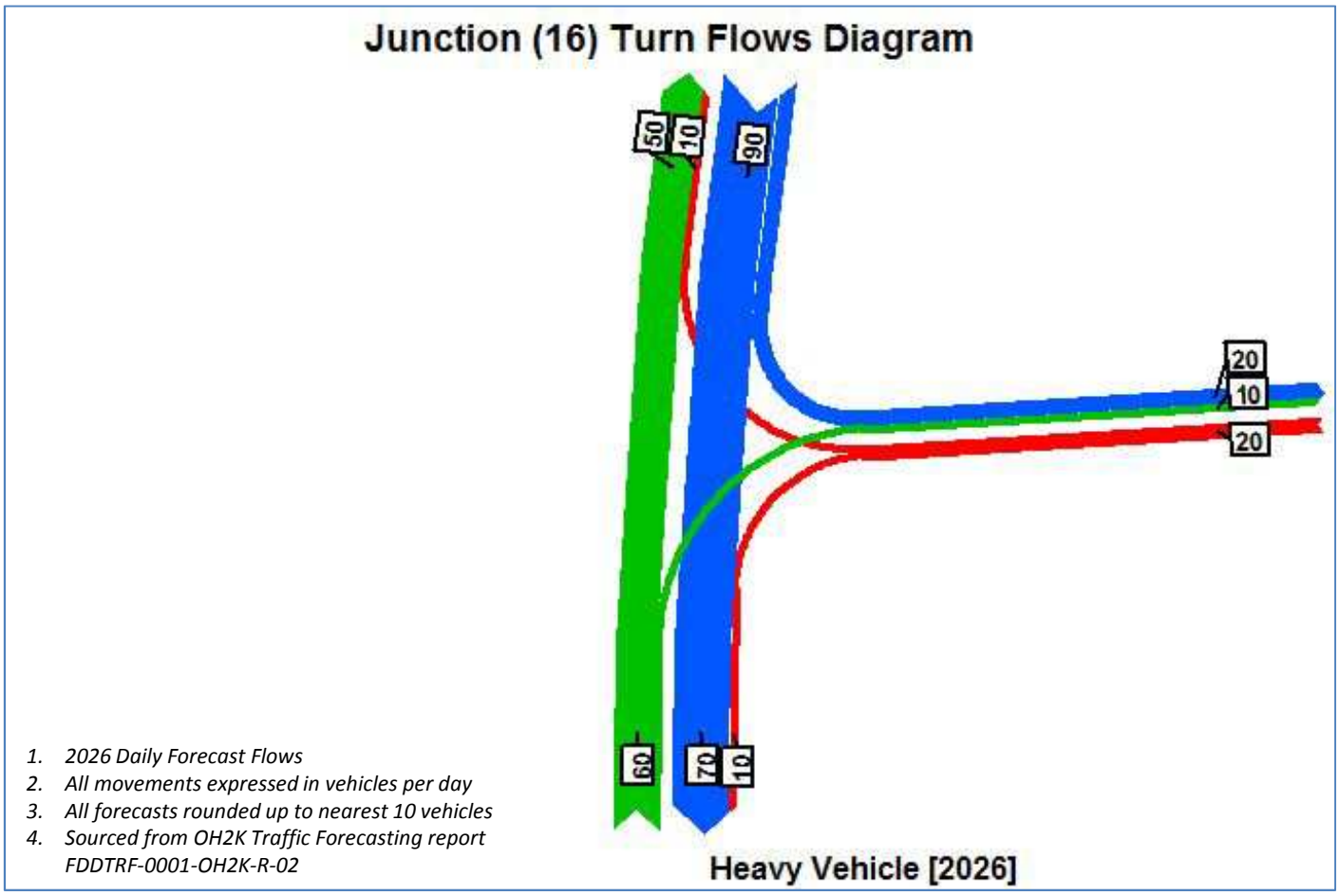




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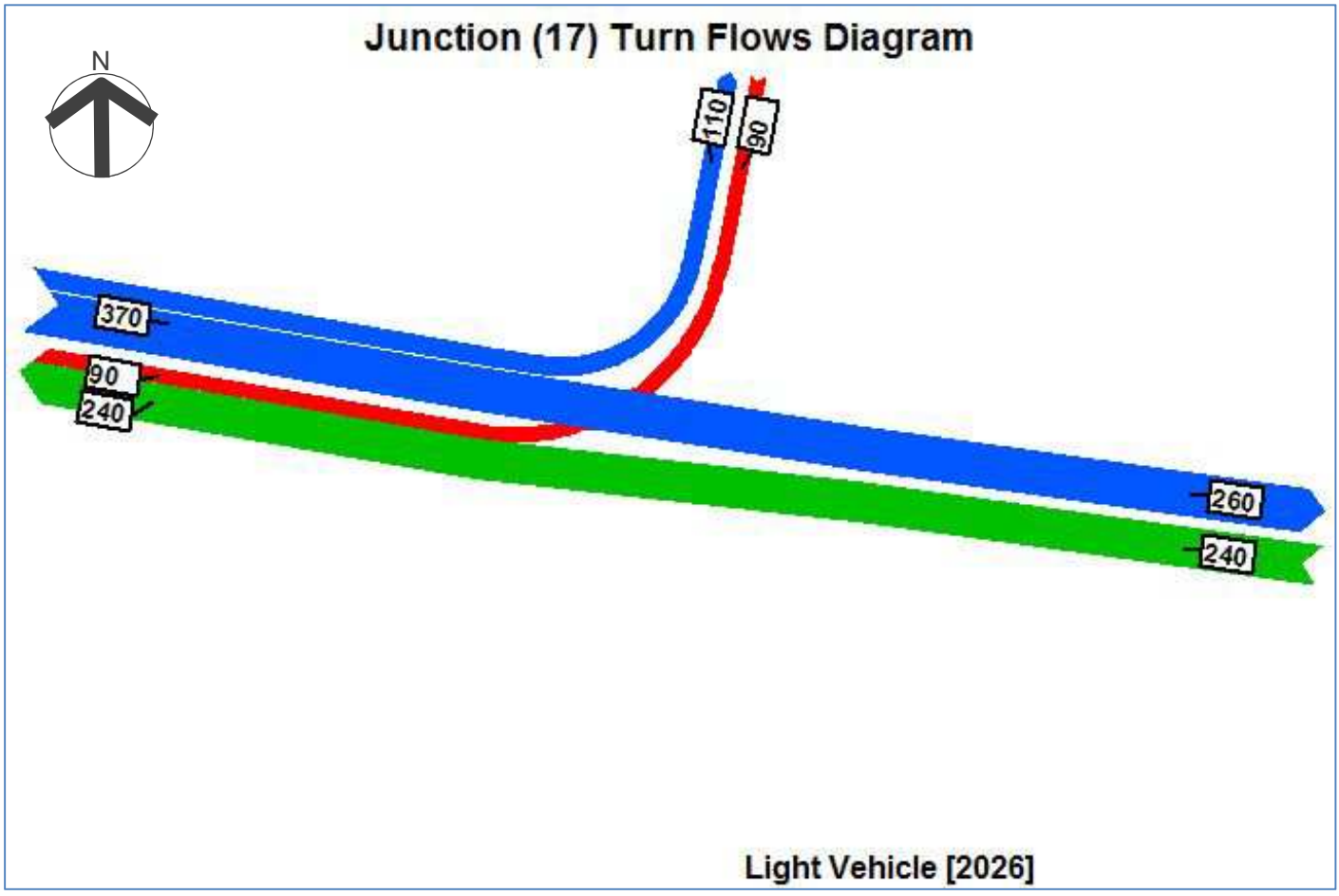
Site 16: Wharf Road & Service Road

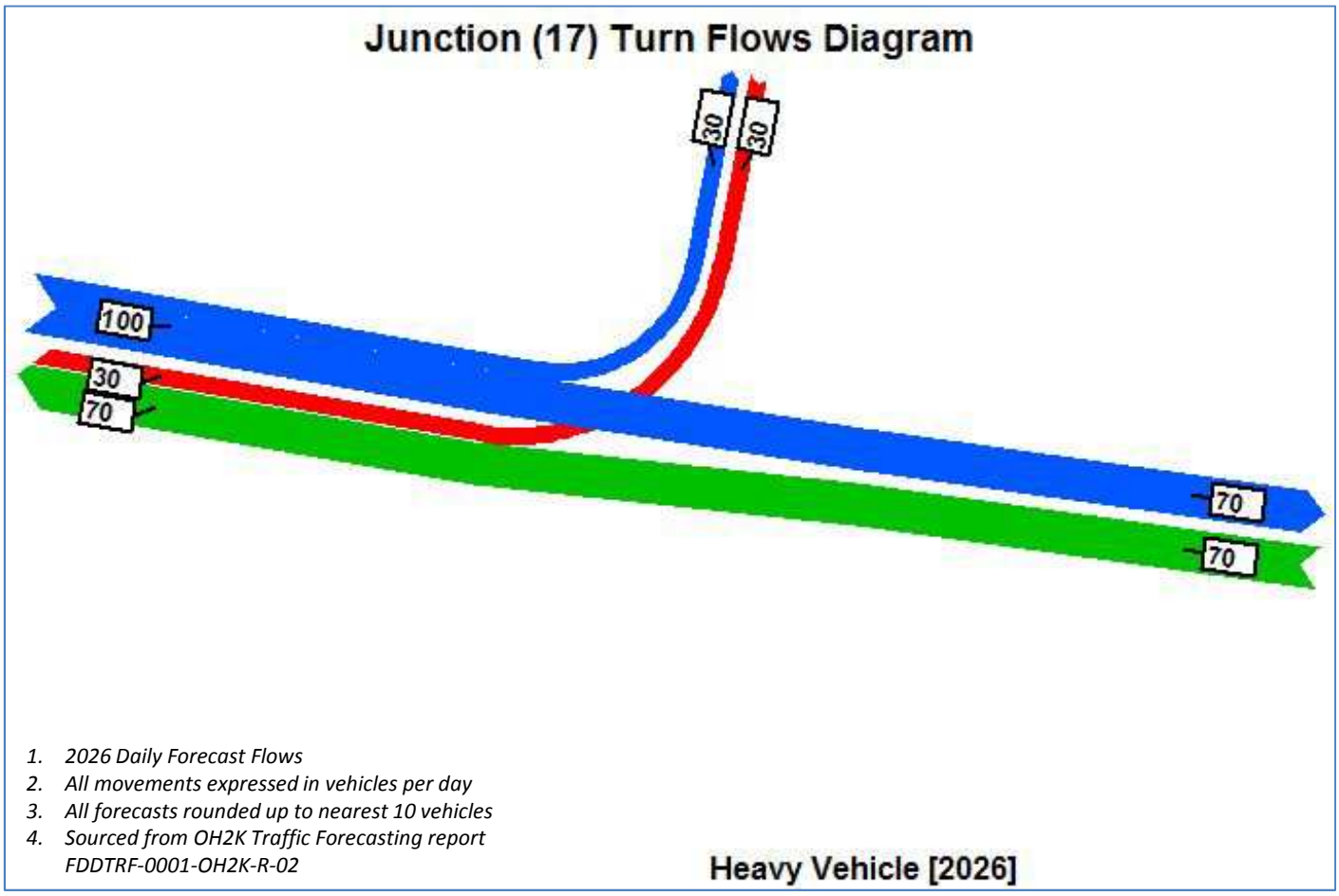




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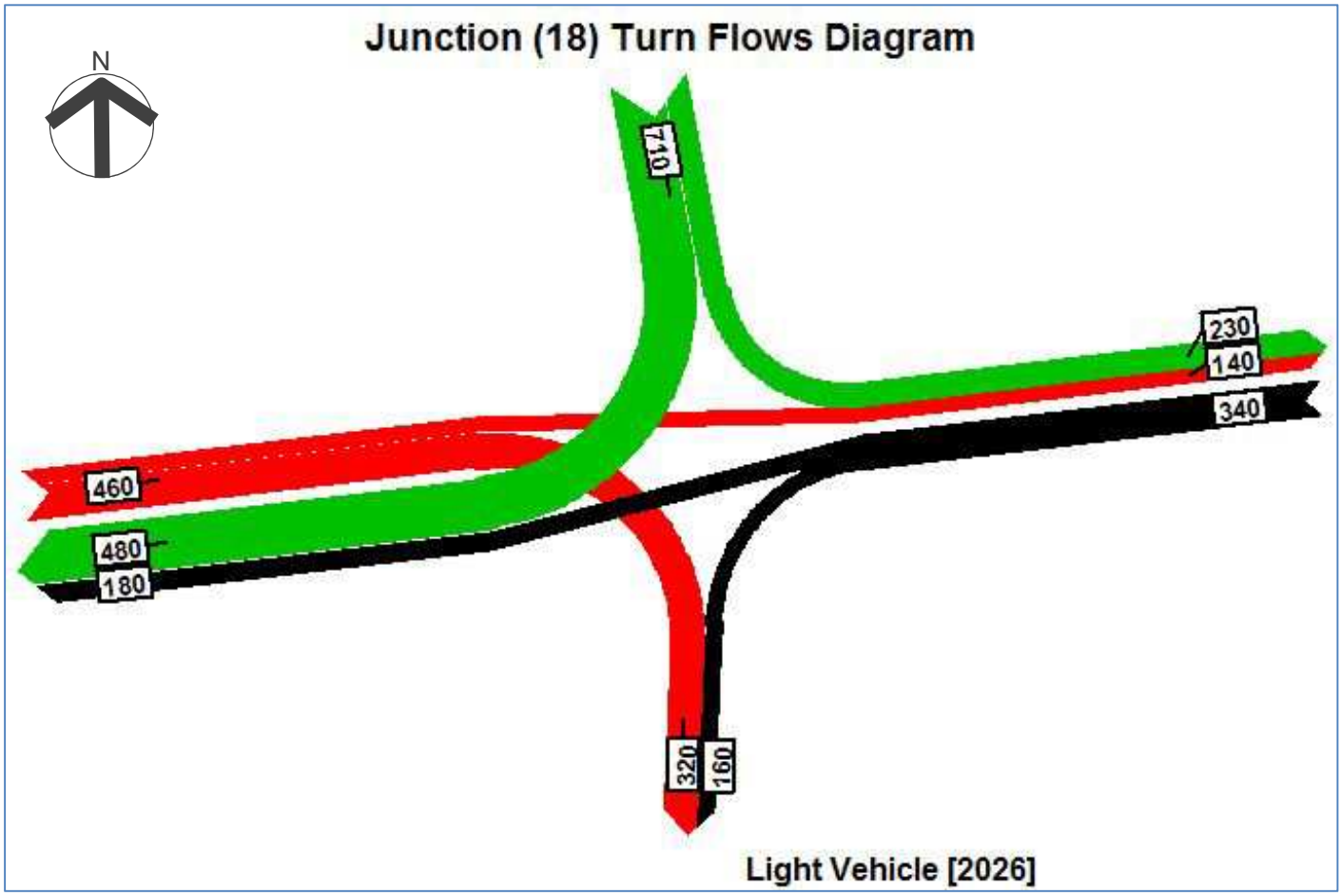
Site 17: Kundabung Road & Ravenswood Access Road

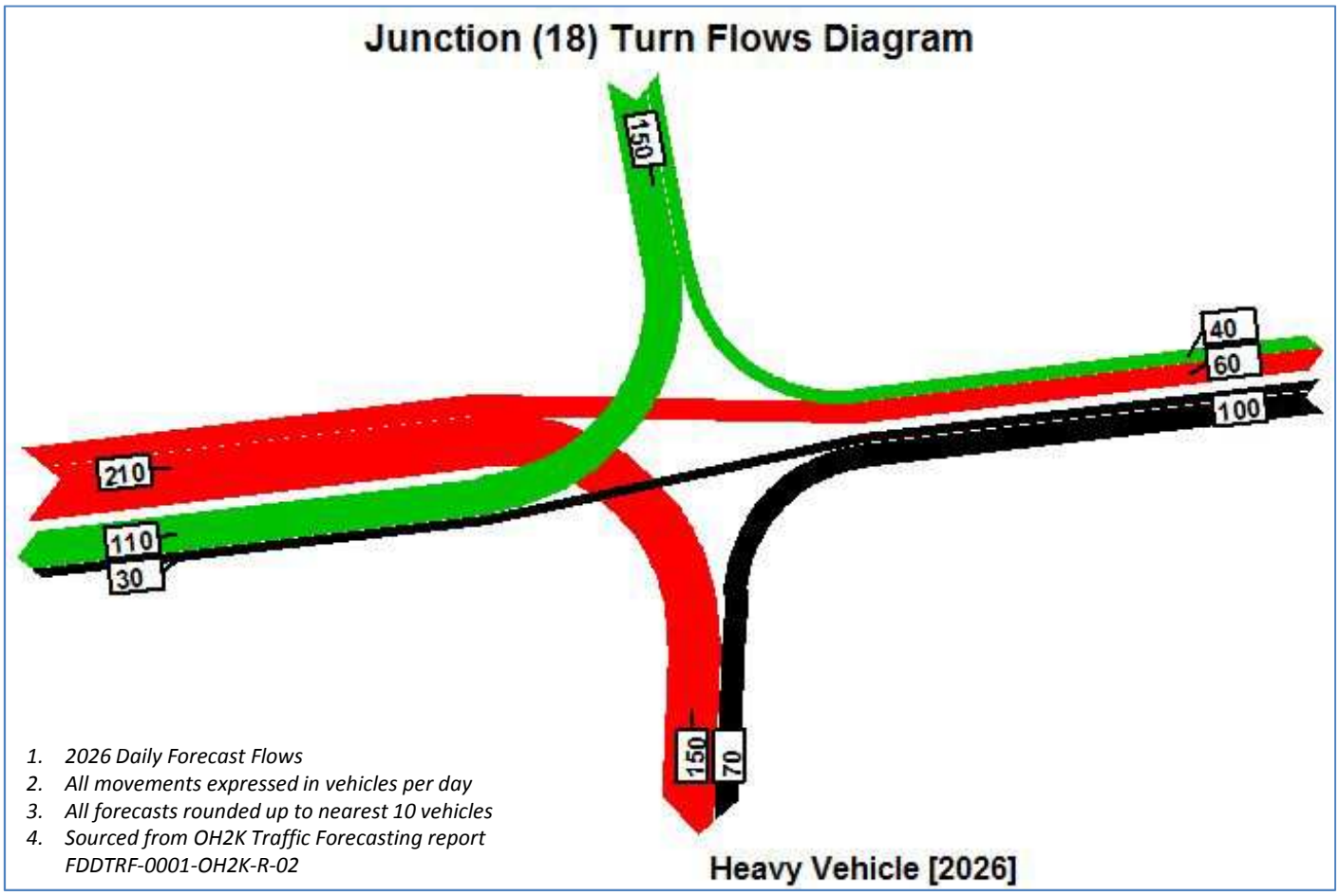




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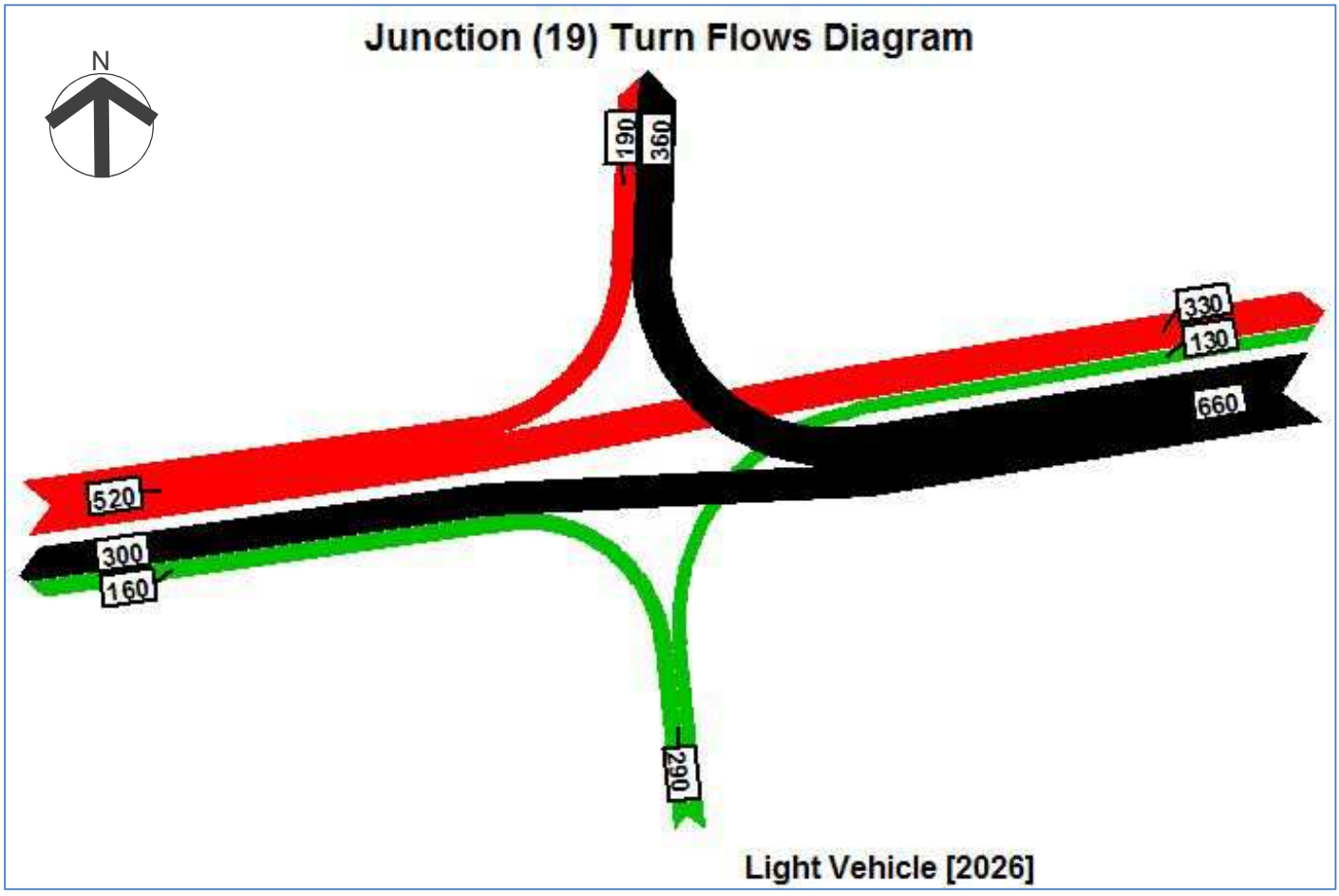
Site 18: Kundabung Road & SB On/Off ramps

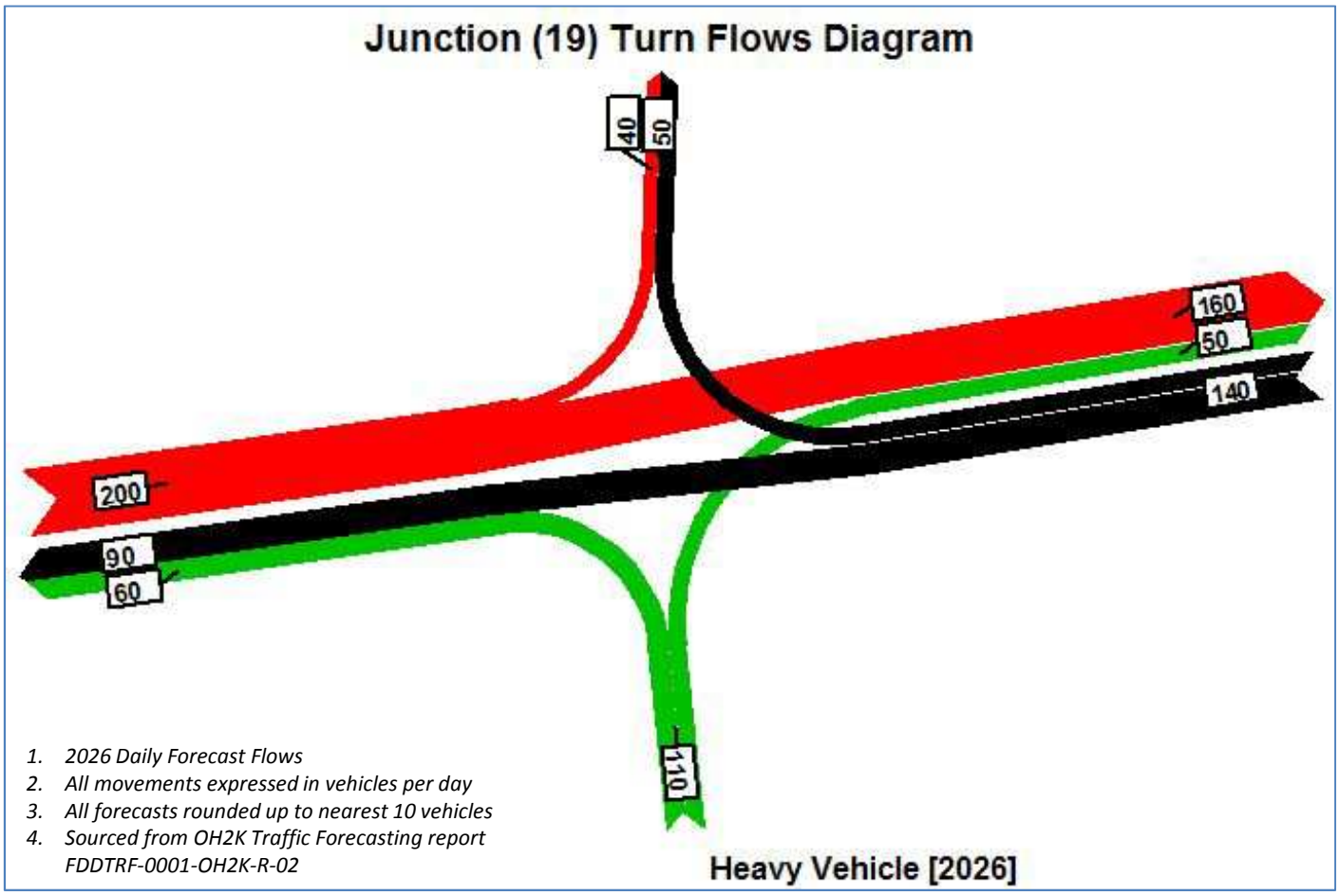




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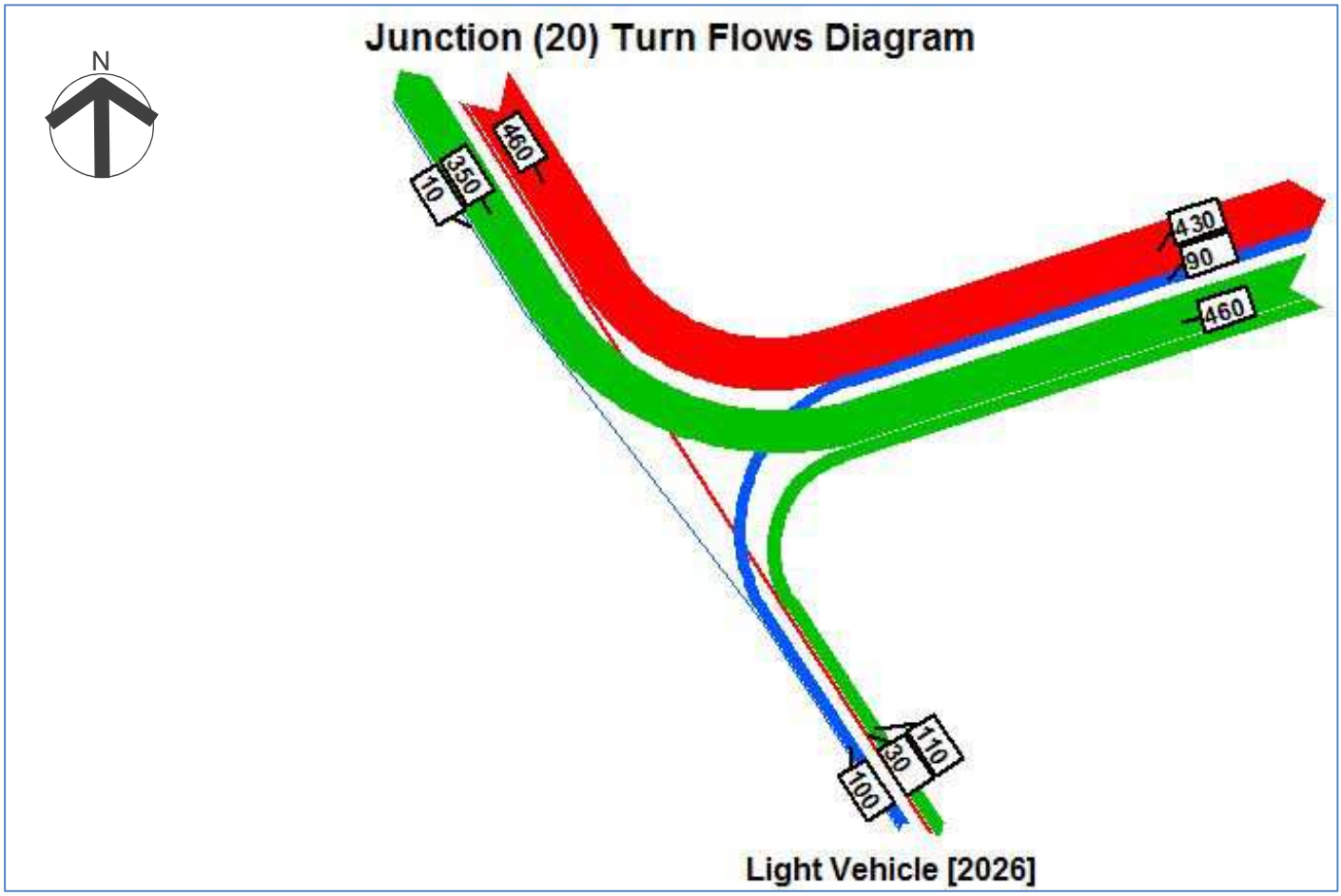
Site 19: Rodeo Drive & NB On/Off ramps

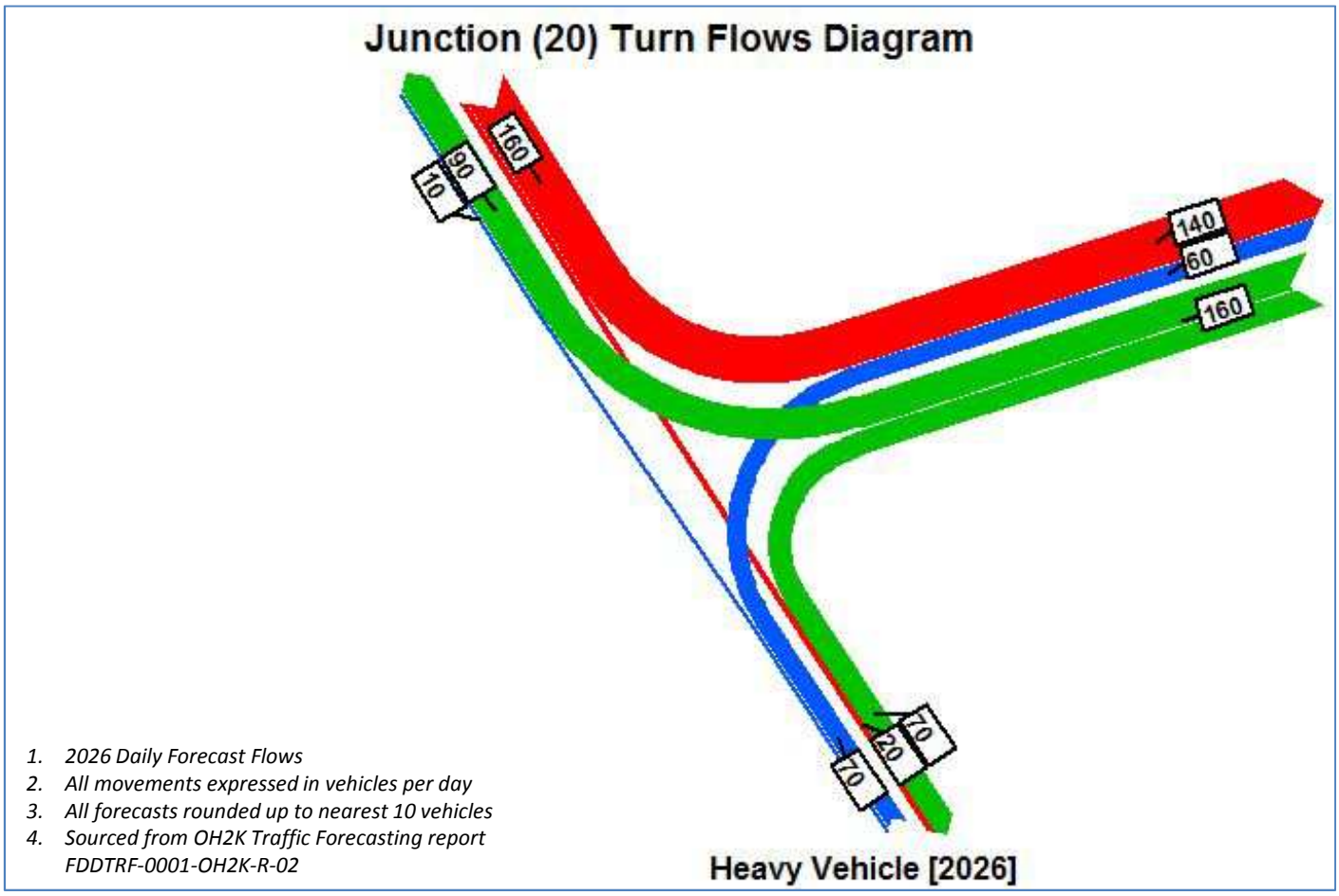




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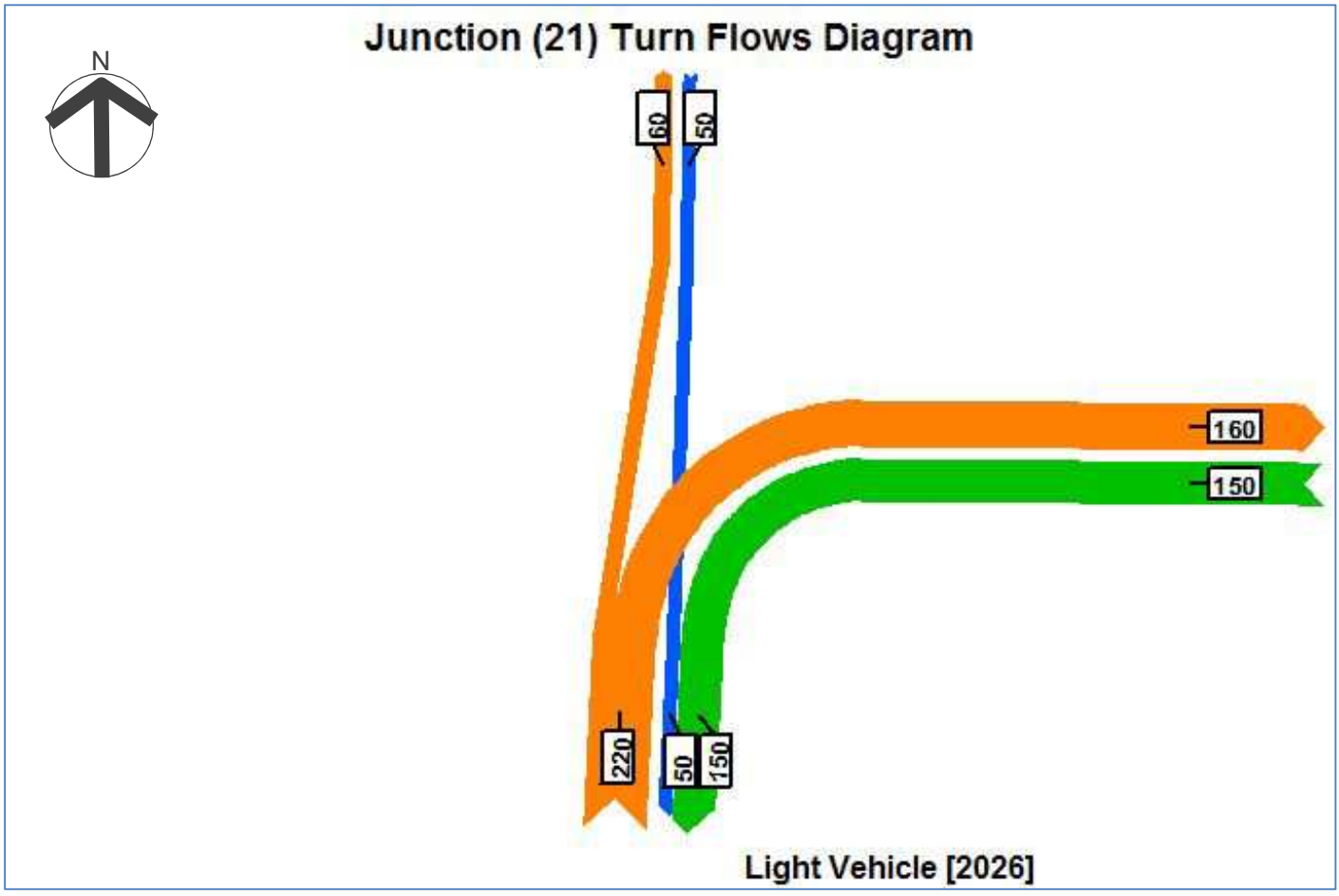
Site 20: Rodeo Drive & Service Road

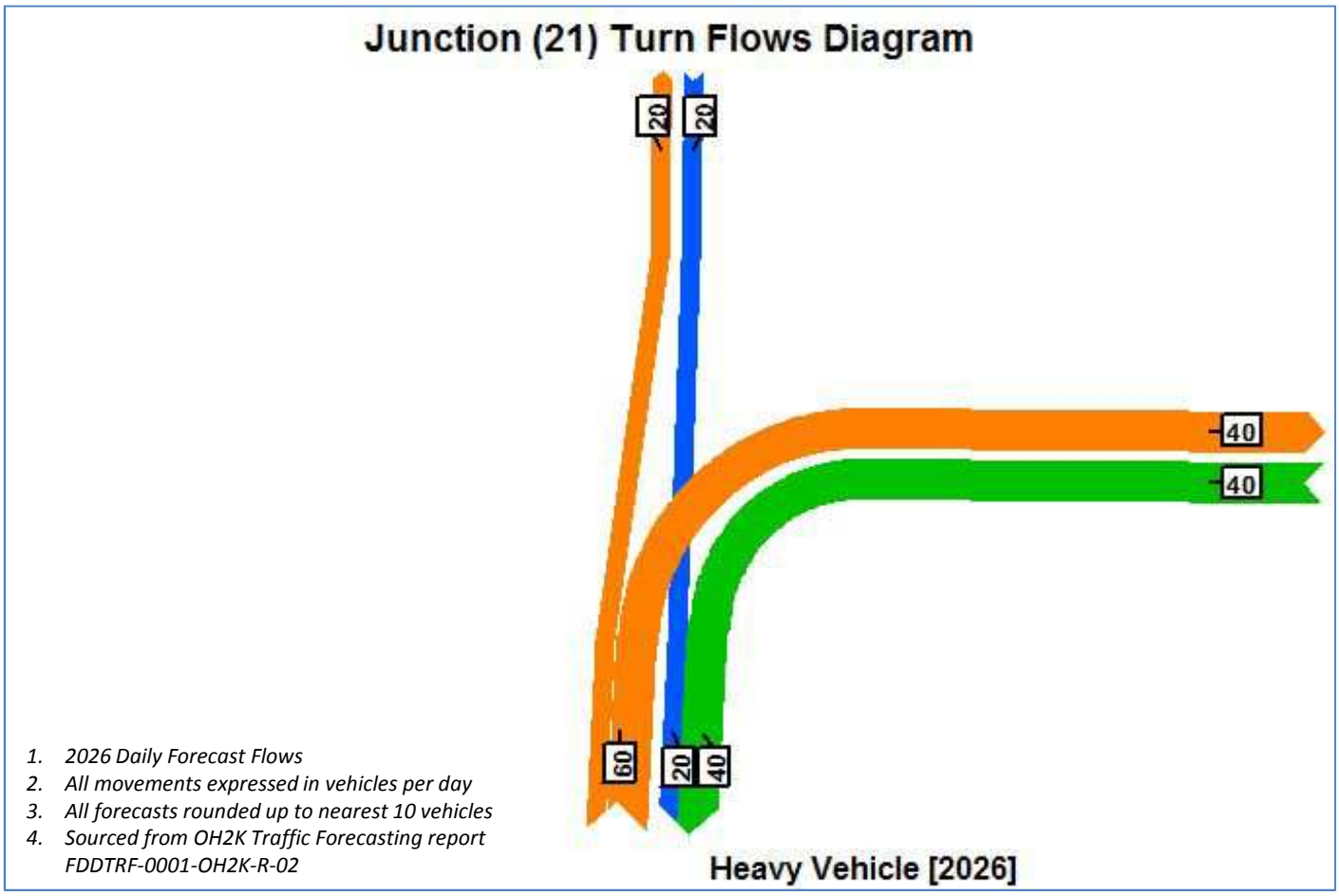




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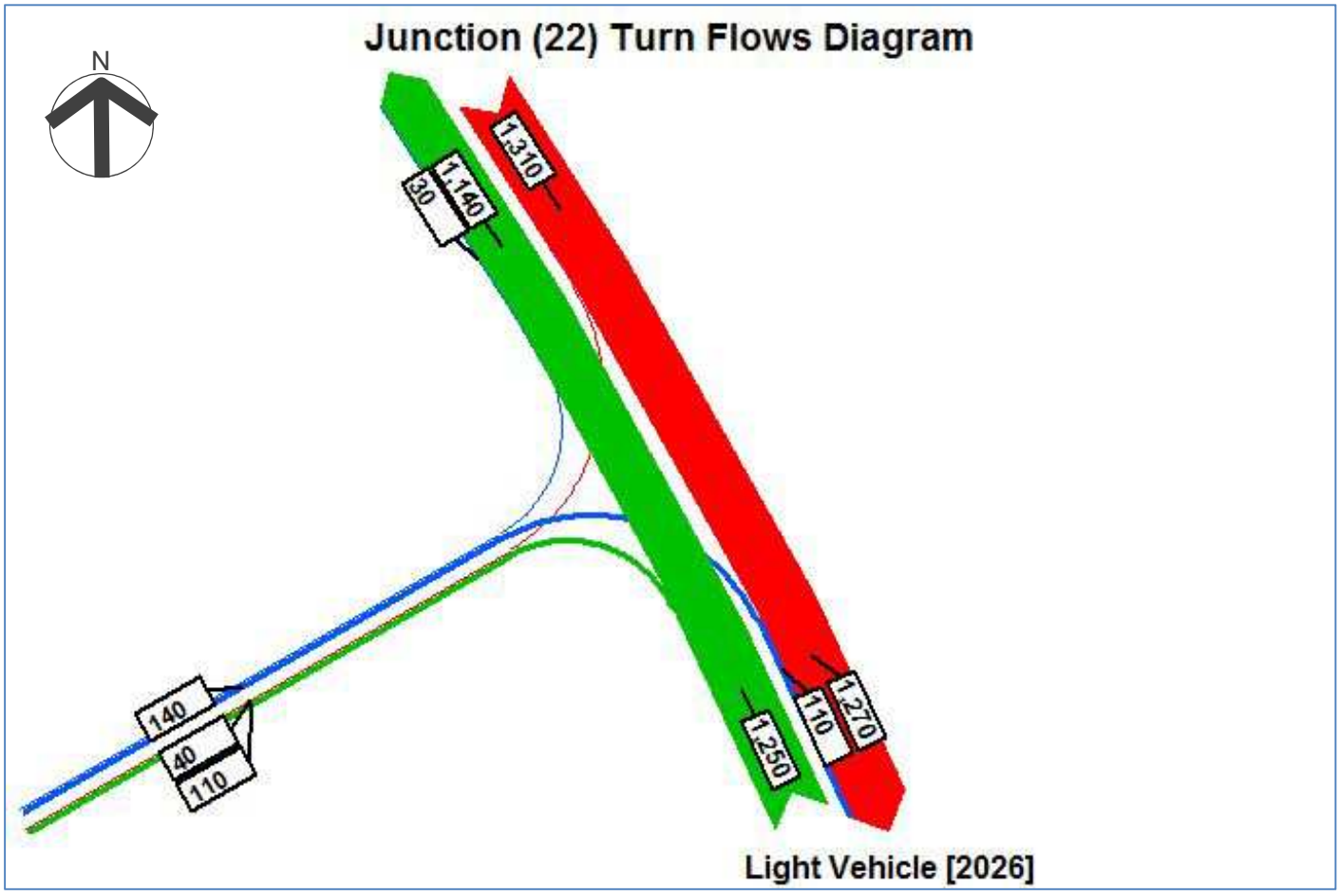
Site 21: Kemps Road & Service Road

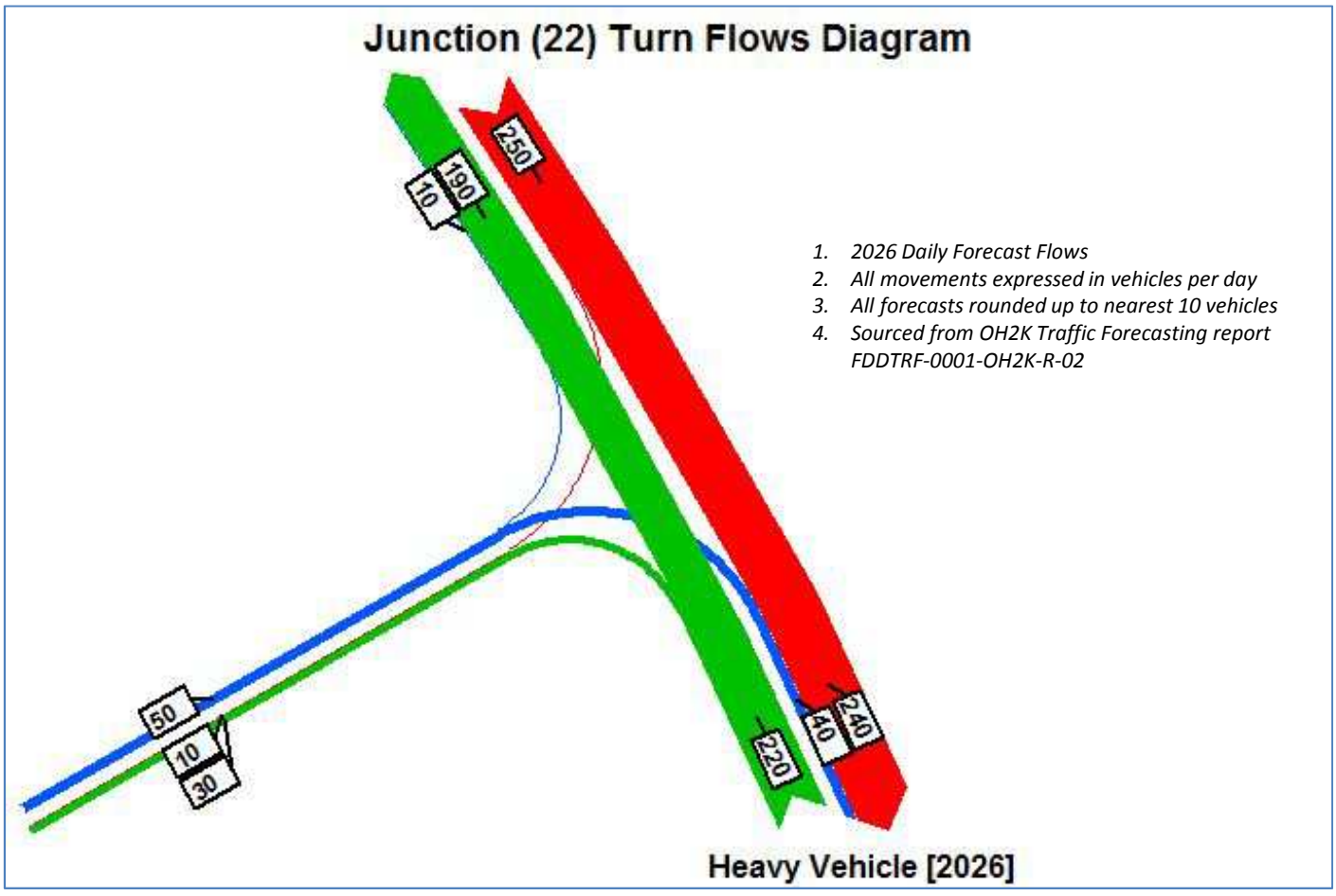




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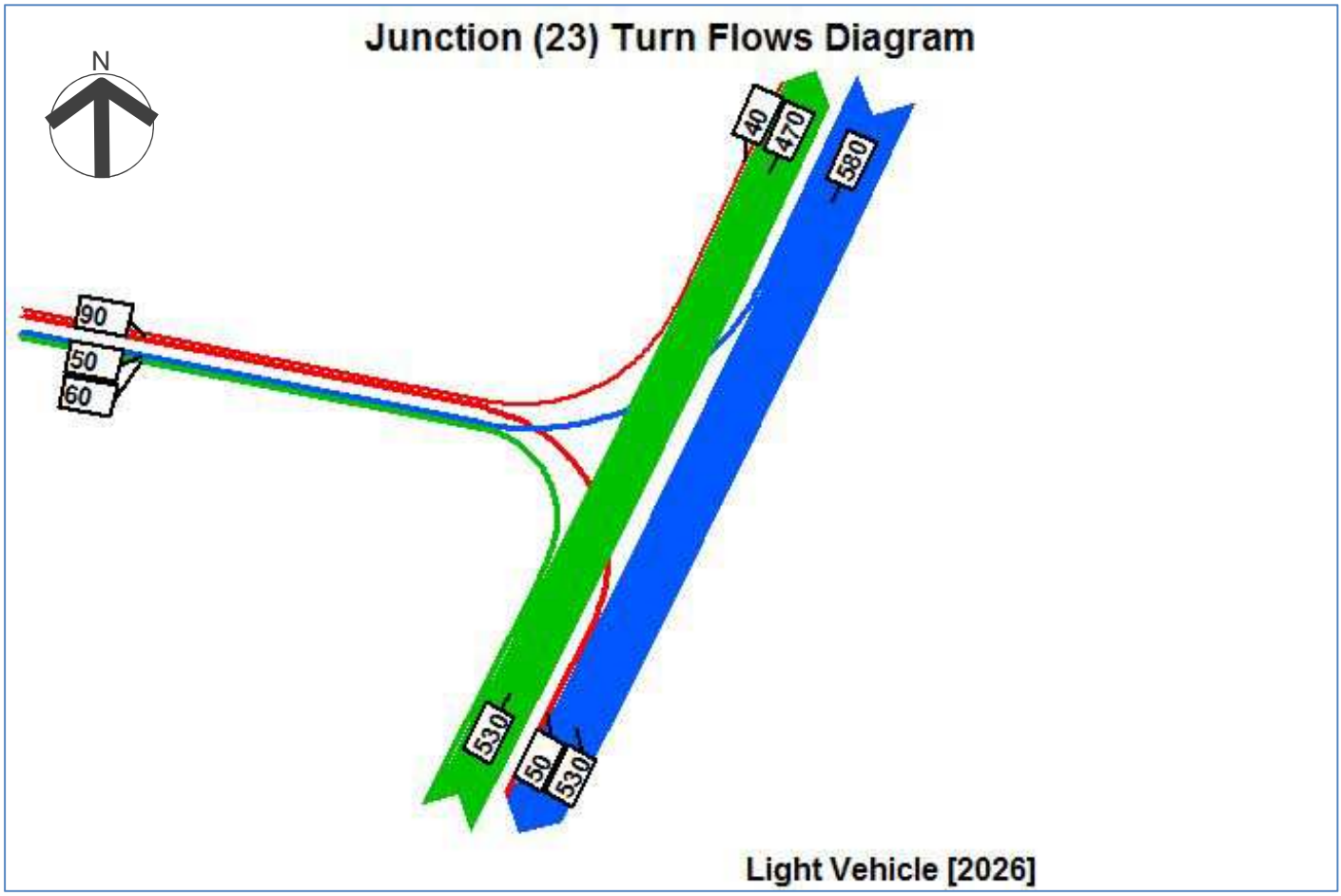
Site 22: Wharf Road & Service Road

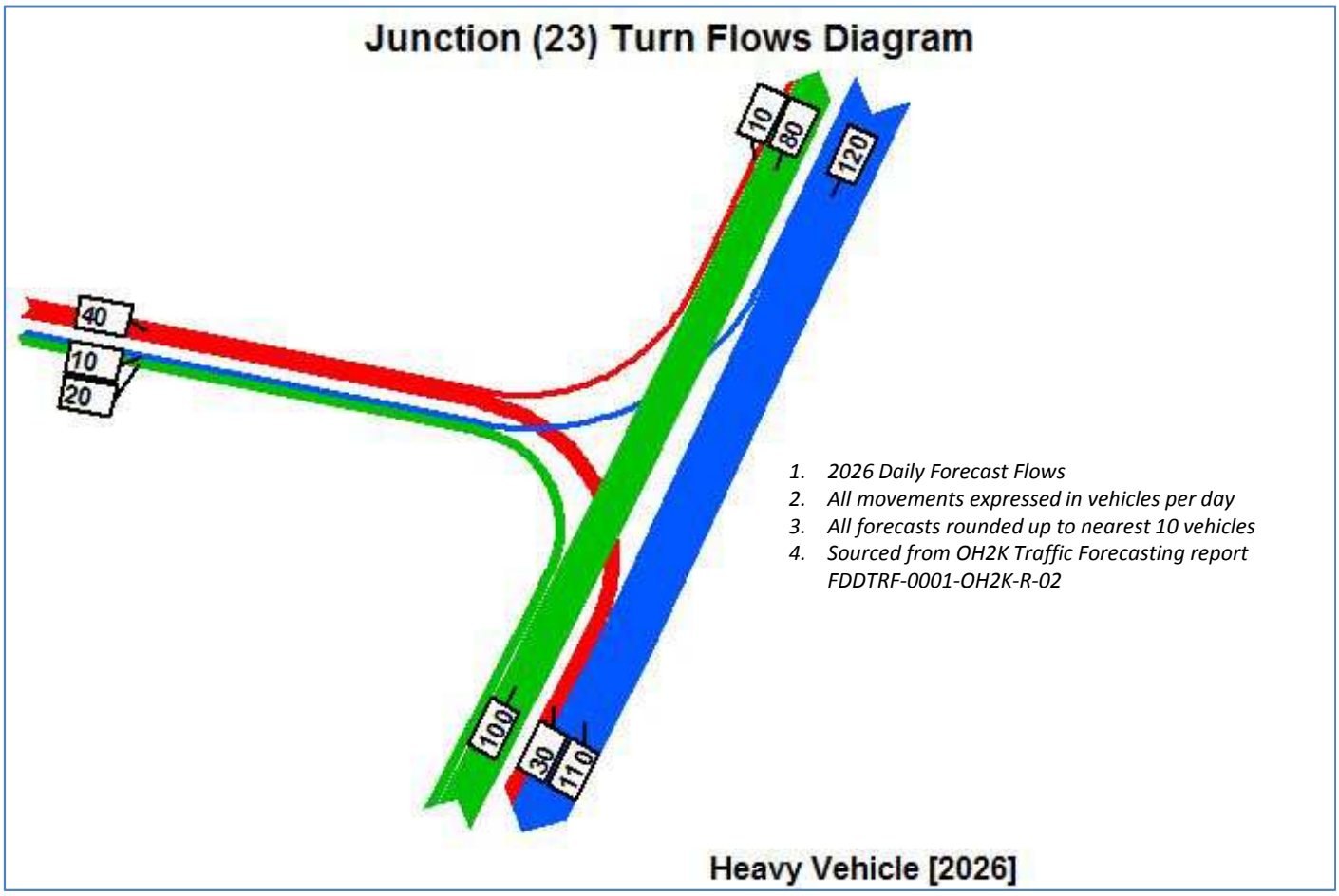




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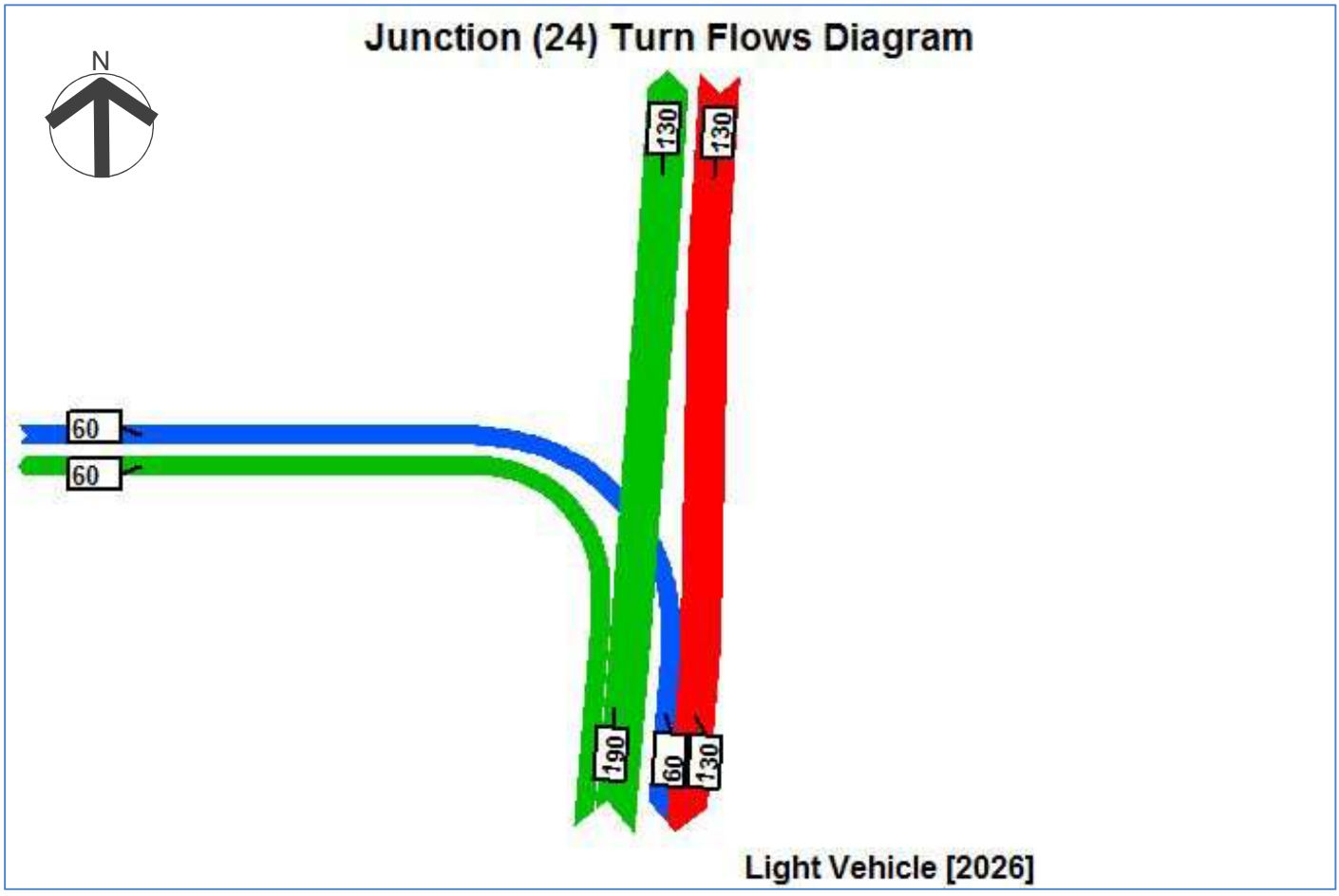
Site 23: Service Road & Haydons Wharf Road

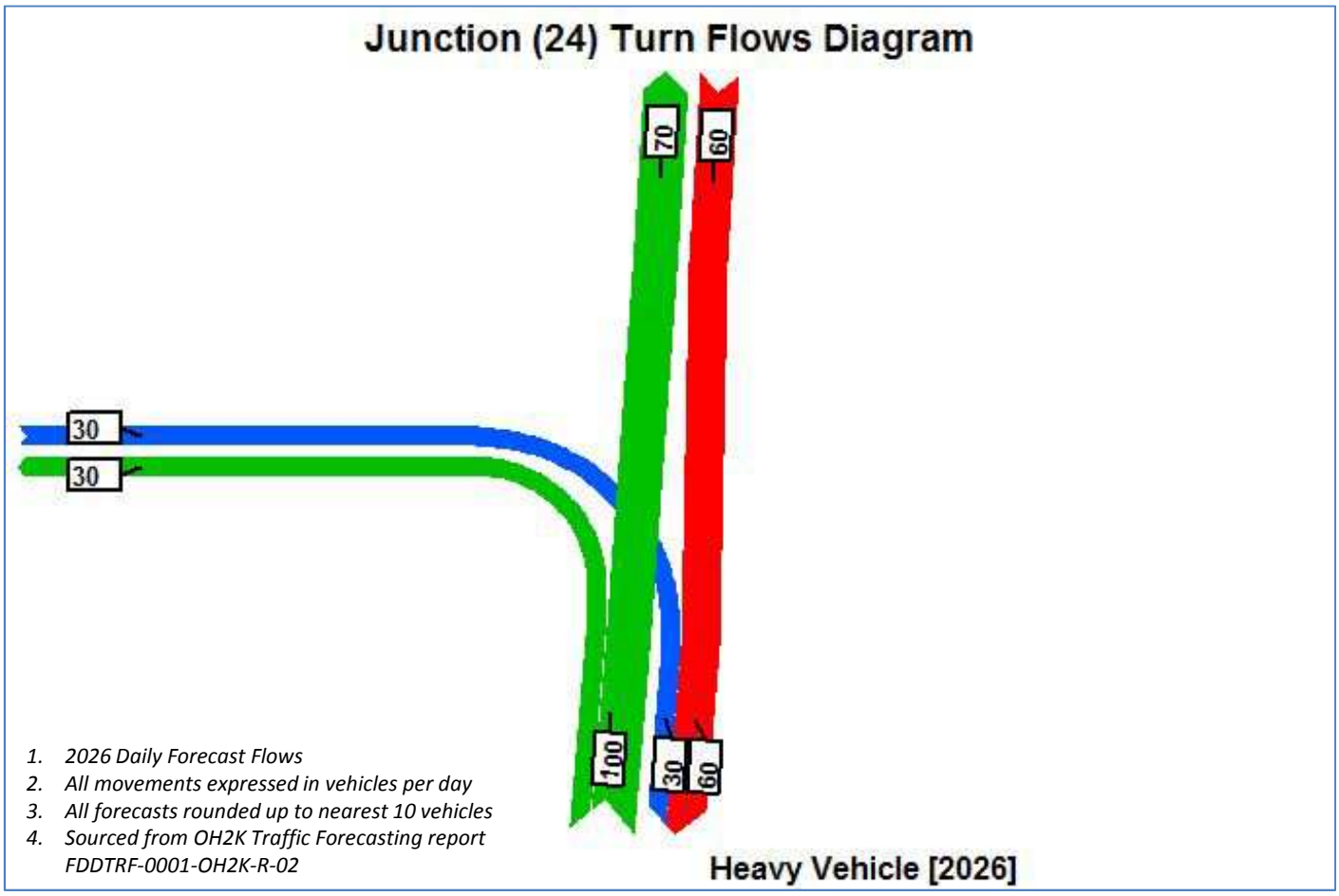




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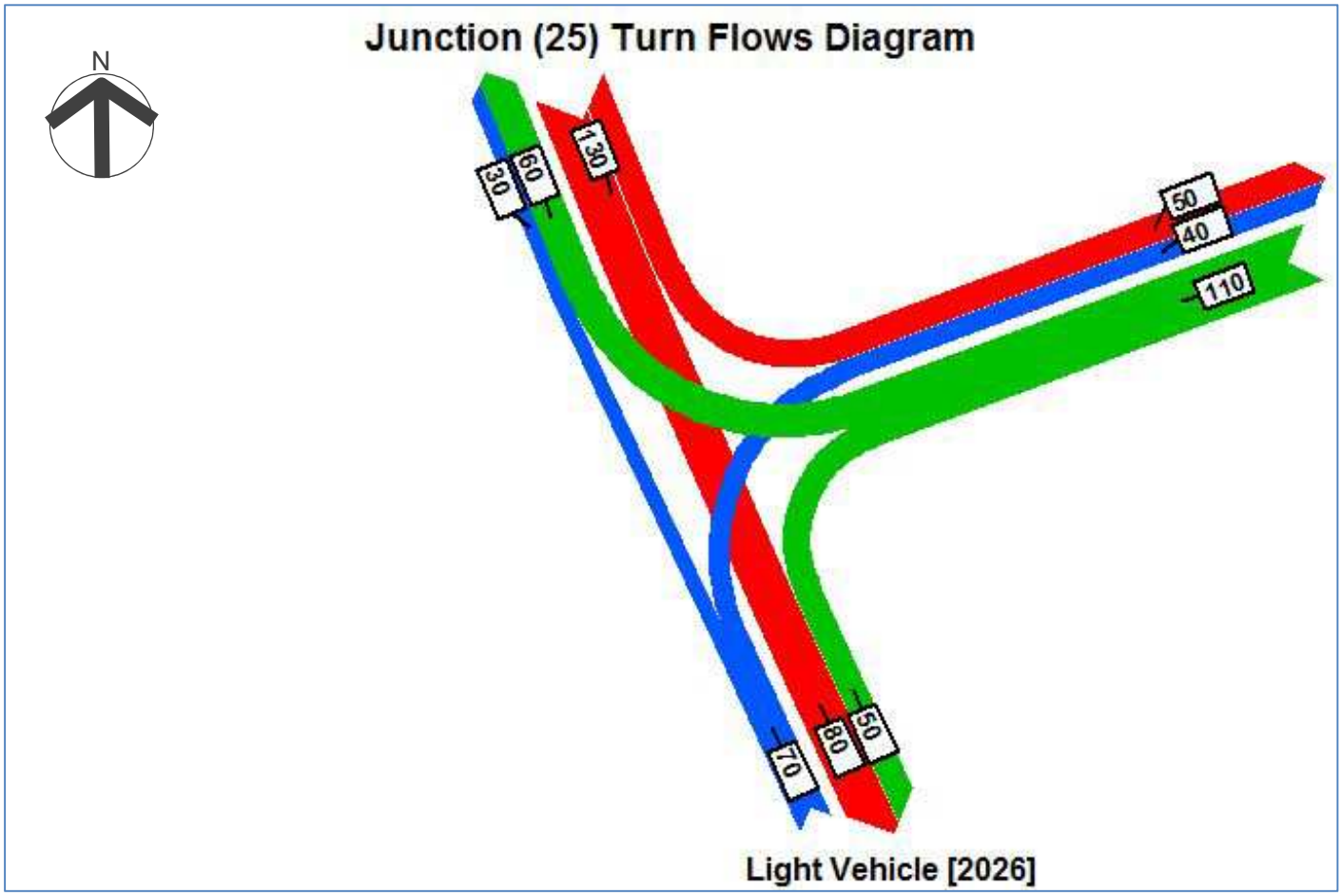
Site 24: Haydons Wharf Road & Zone J9

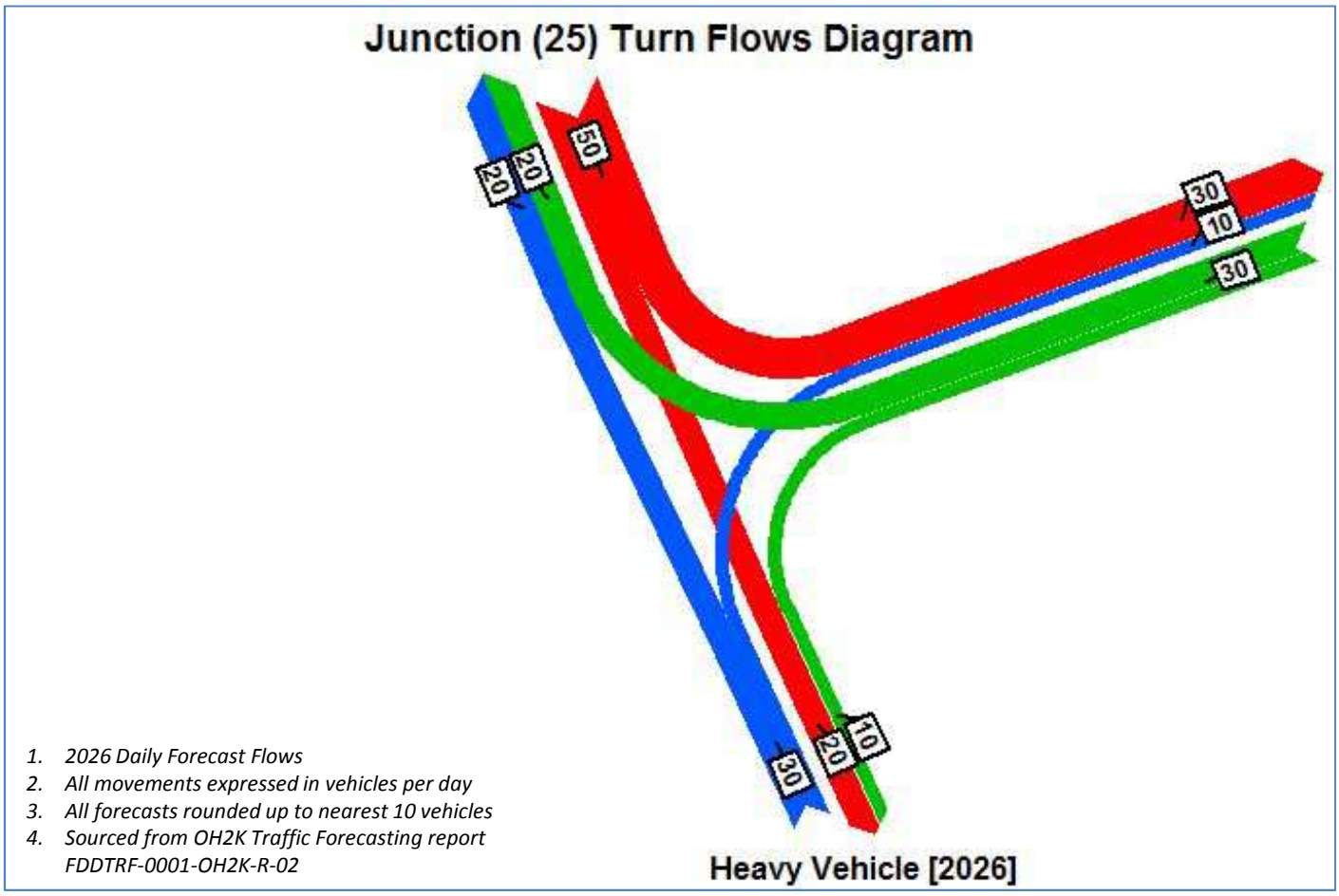




1. *2026 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

Site 25: Cooperabung Road & Haydons Wharf





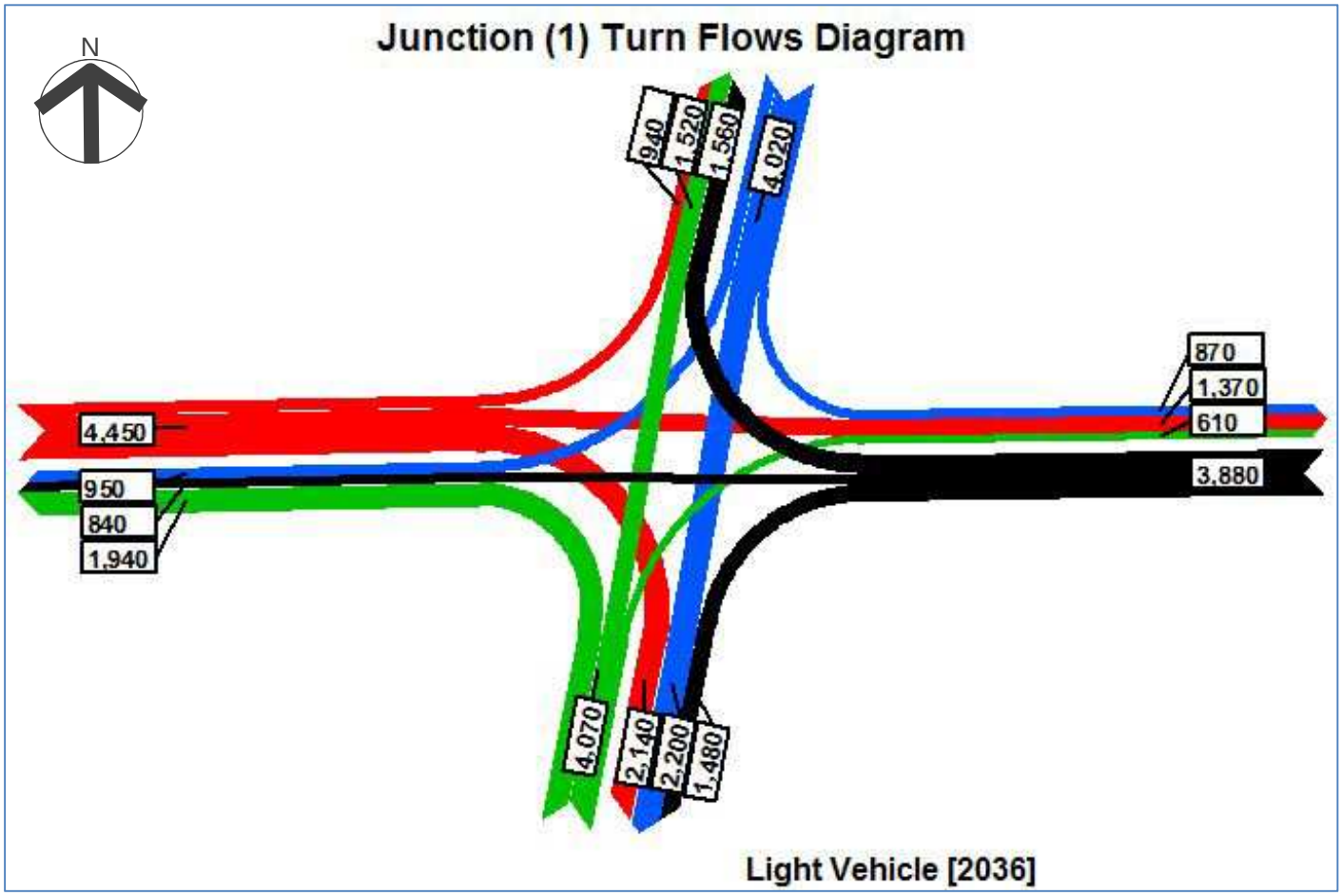
1. *2026 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

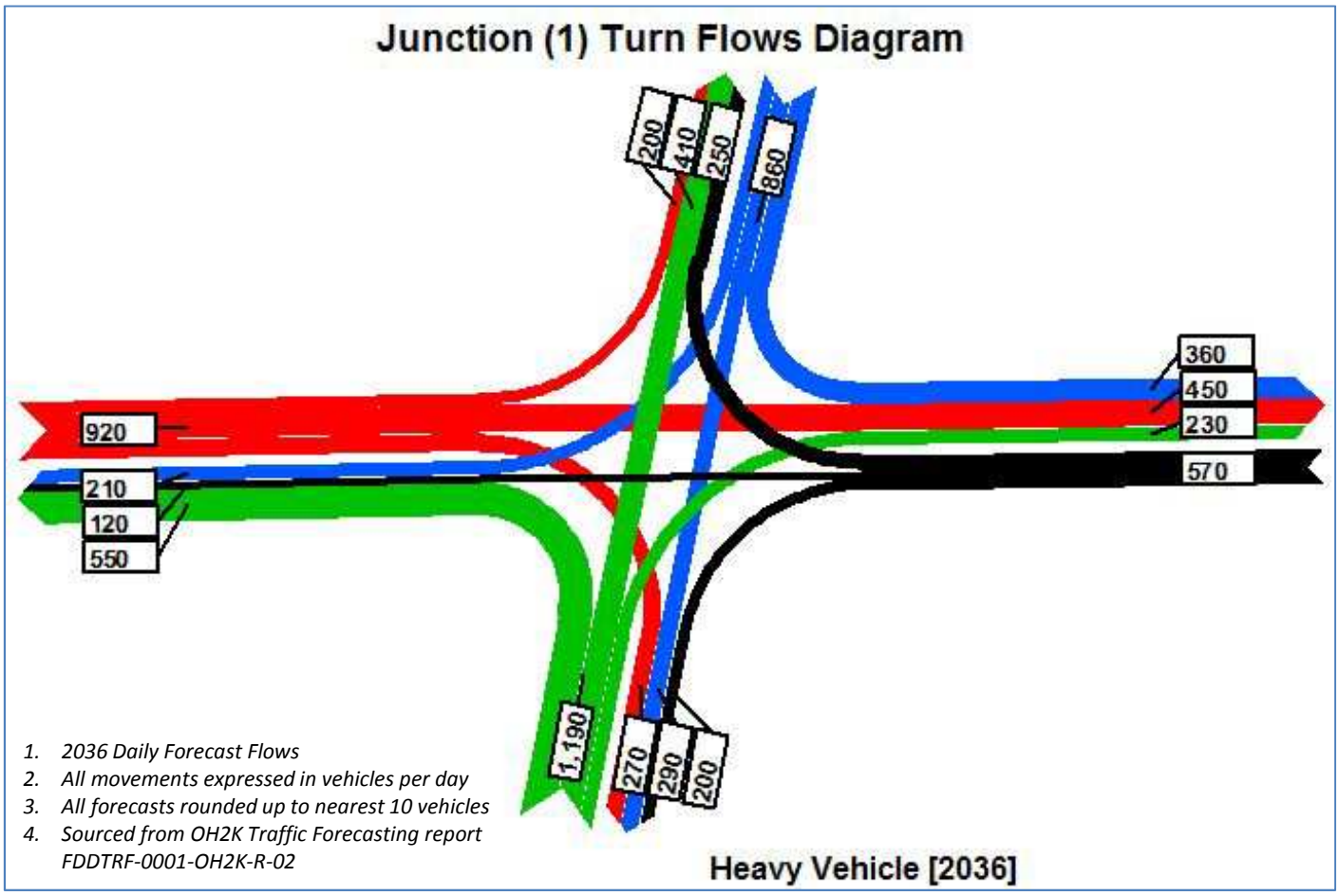
OH2K Intersection Turn Flow Diagrams

2036 Daily Forecast Flows

(Light & Heavy Vehicles)

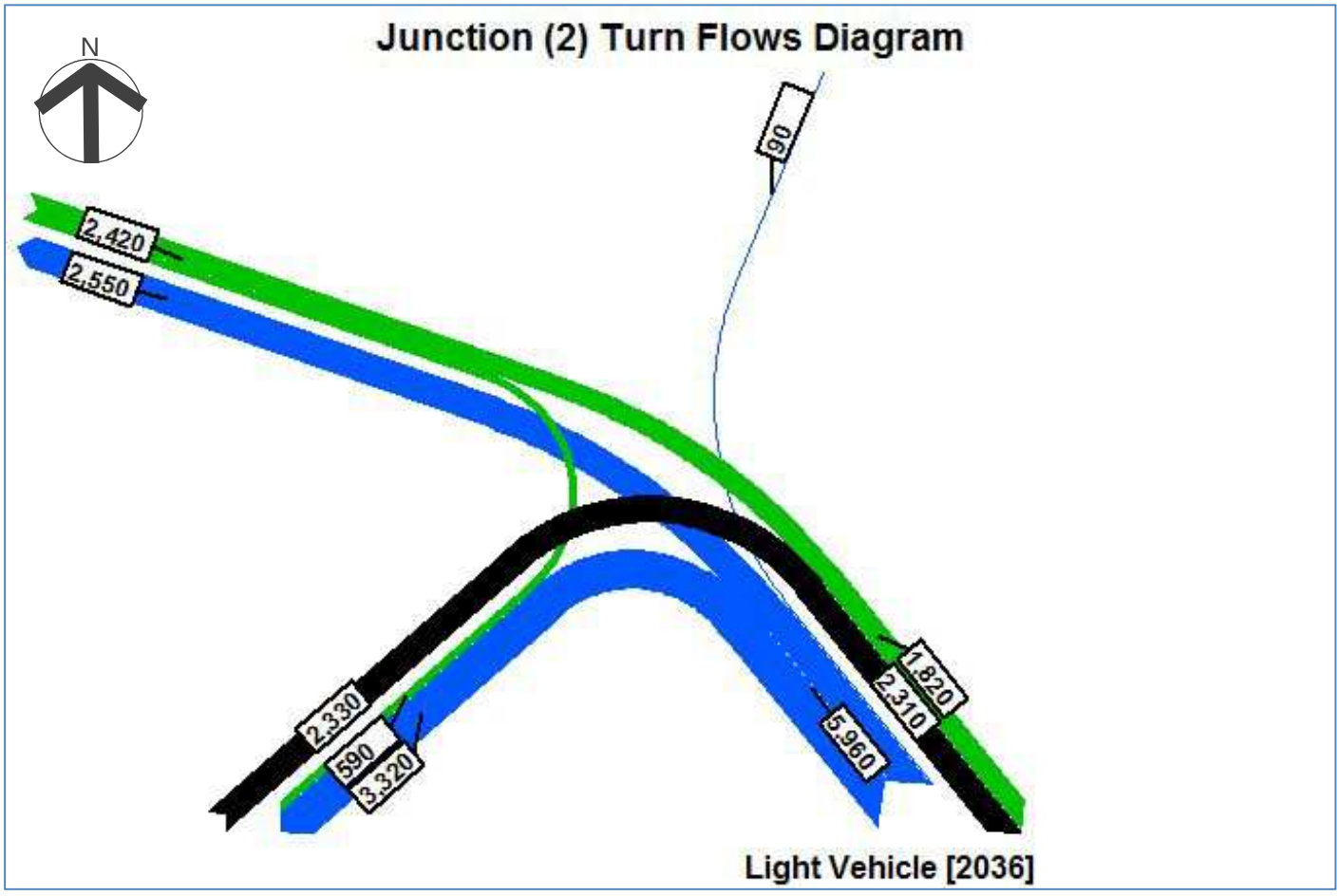
Site 1: Sancrox I/C (Western Roundabout)

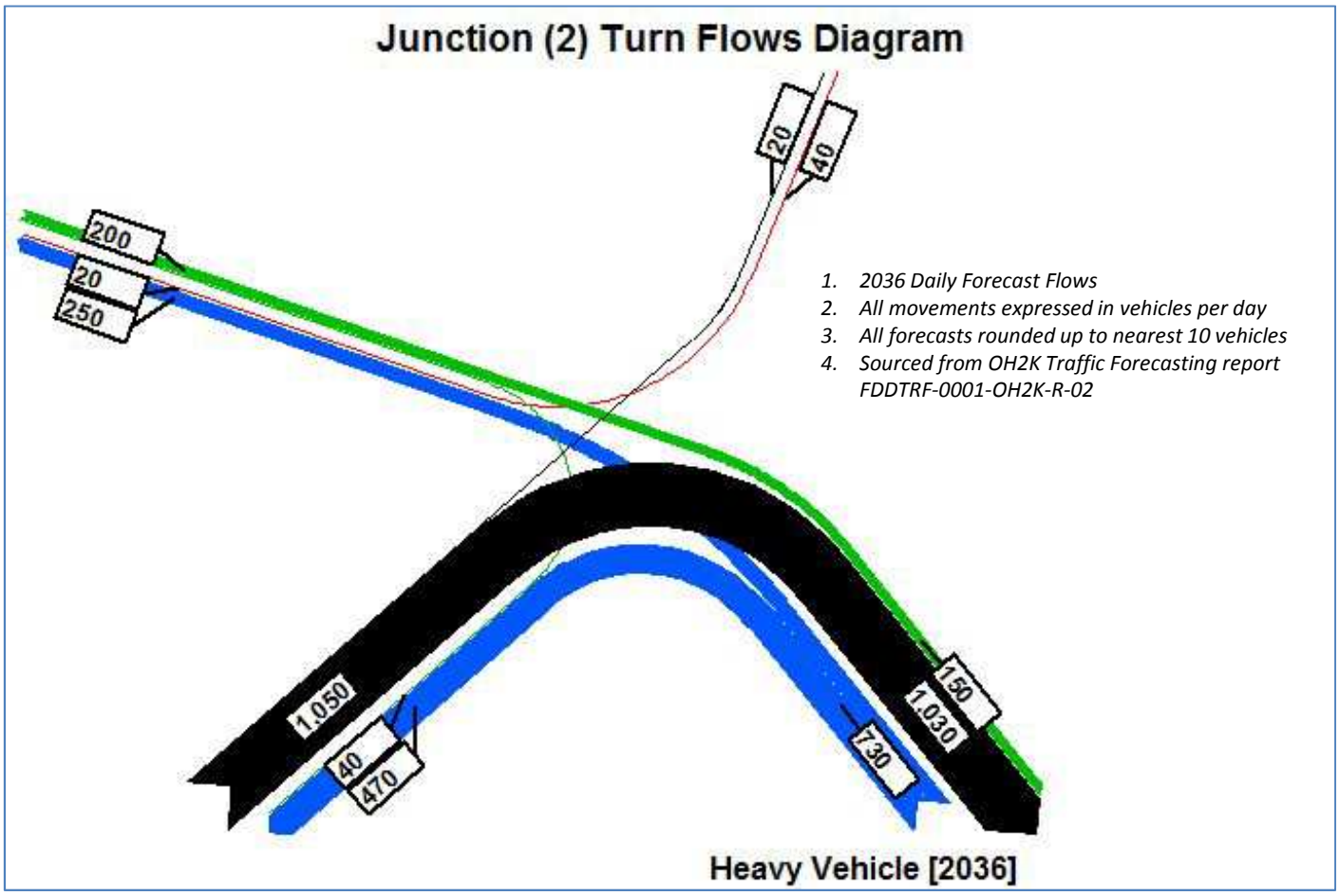




1. *2036 Daily Forecast Flows*
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3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

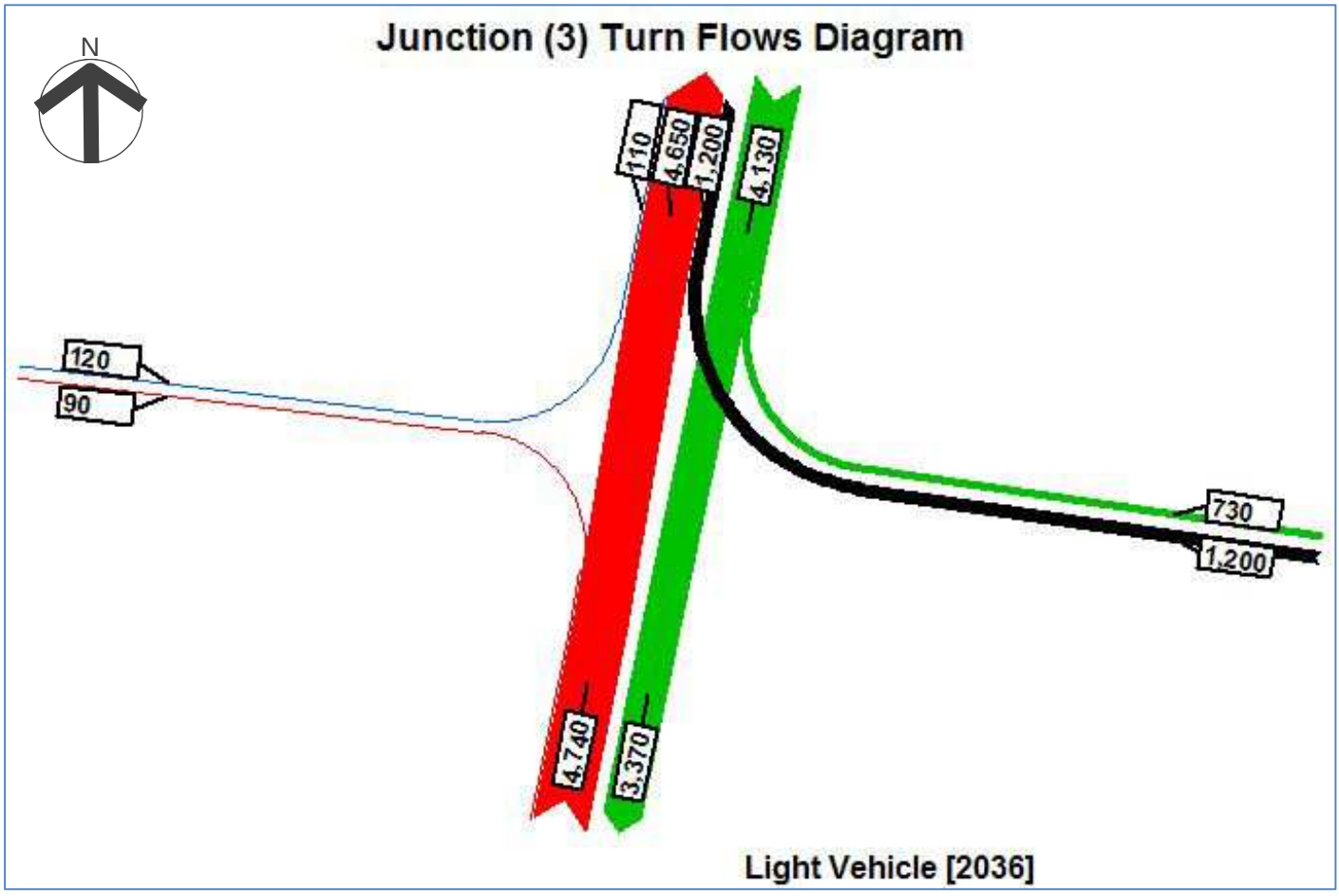
Site 2: Sancrox I/C (Eastern Roundabout)

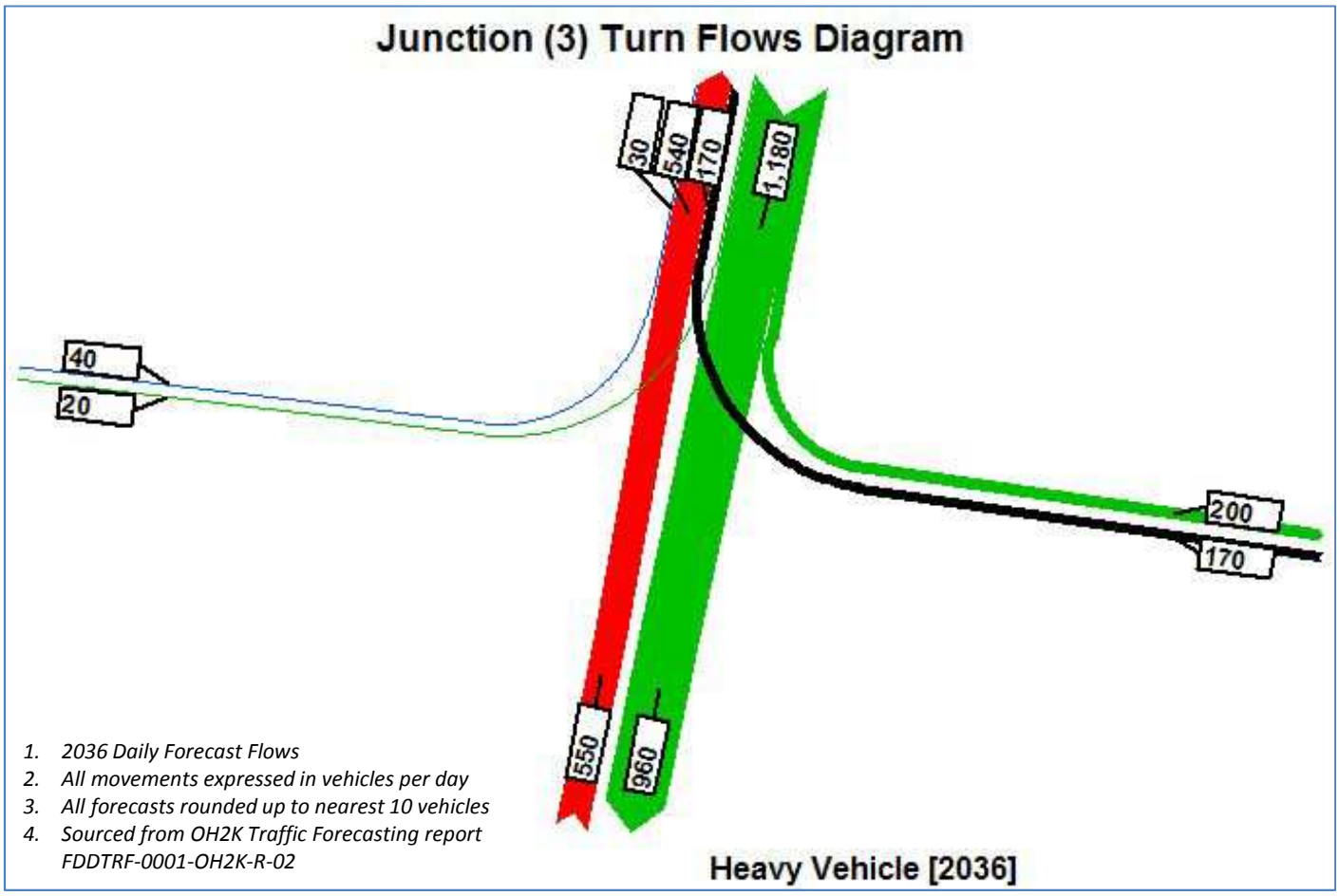




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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

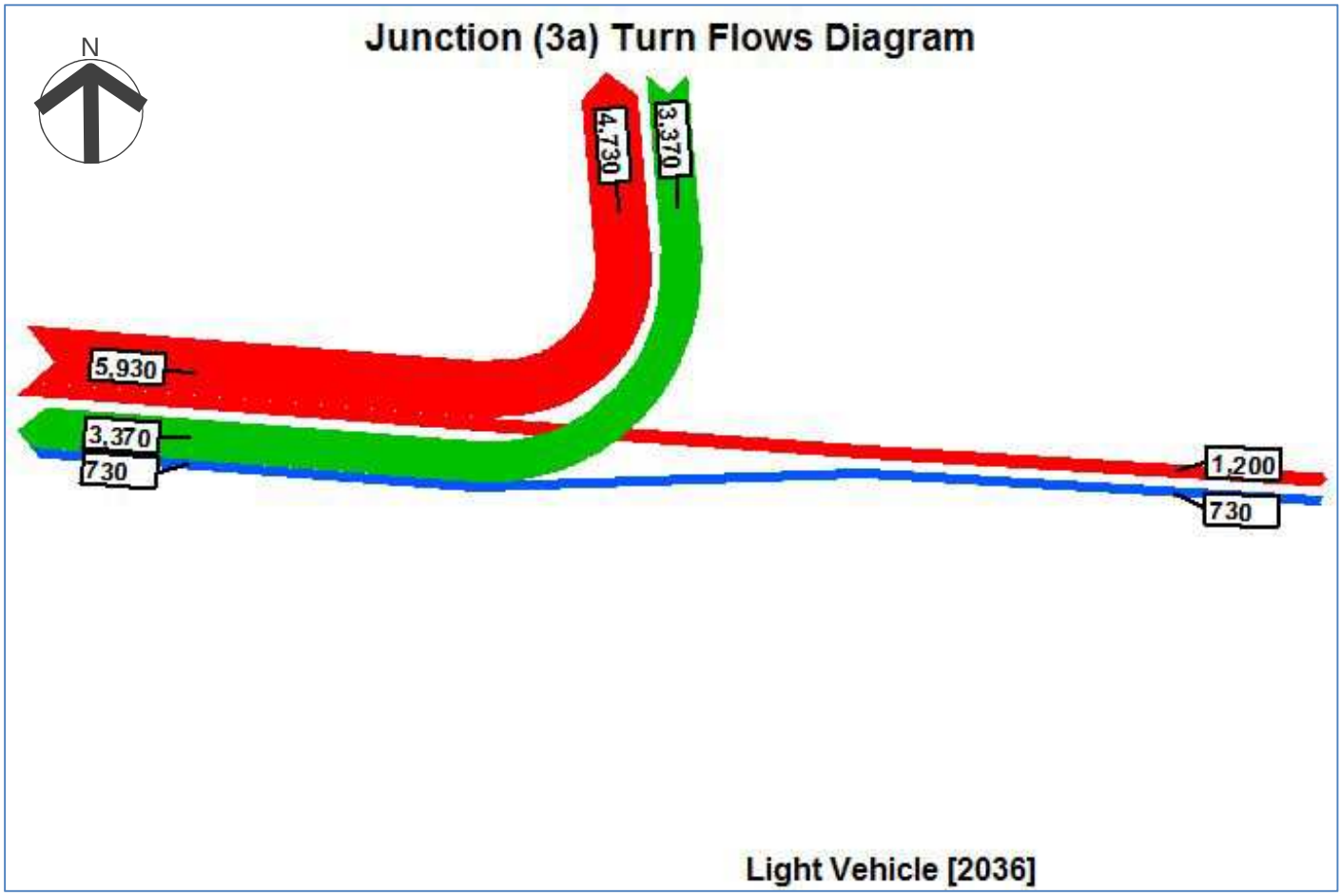
Site 3: Loop Road & RMS Depot

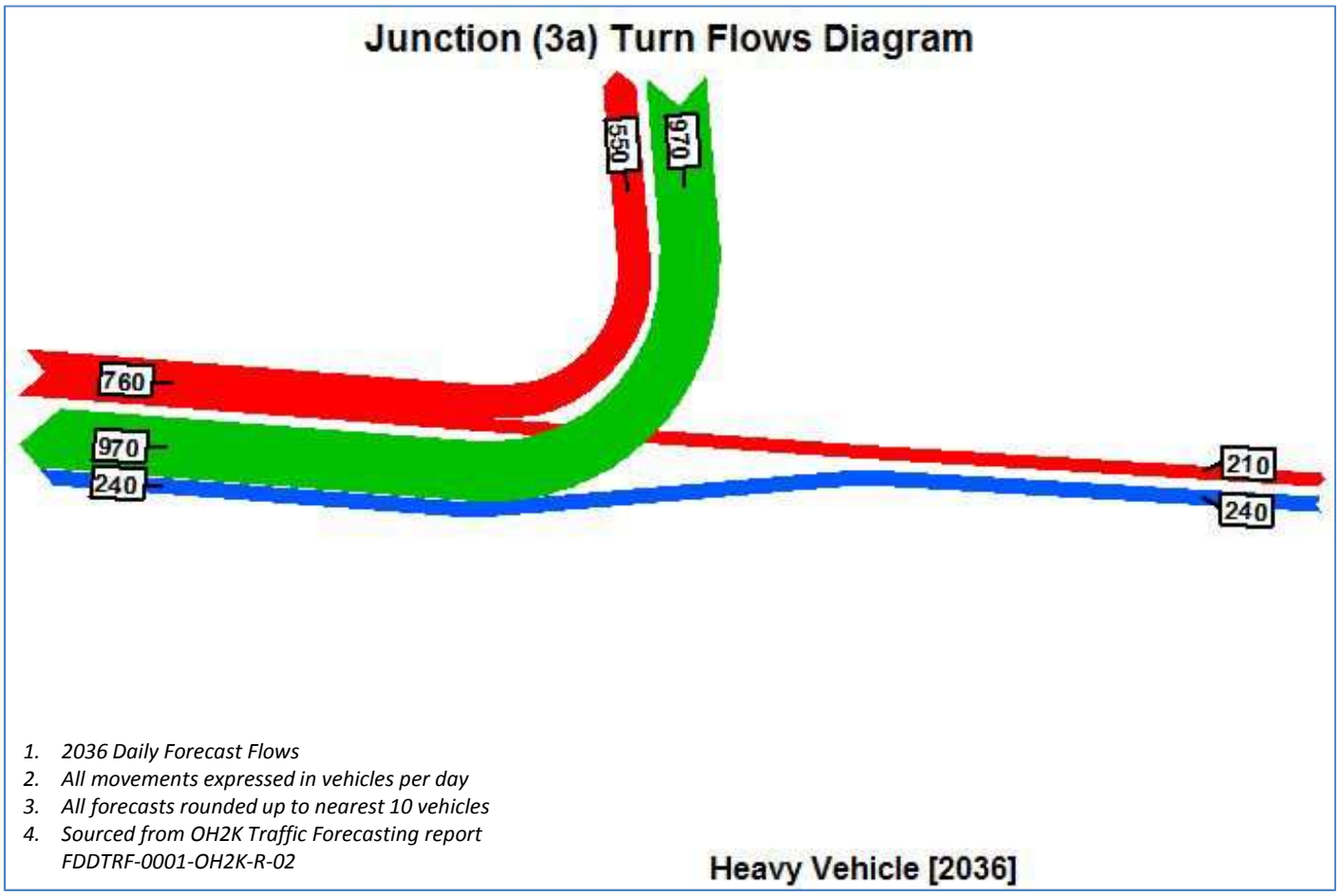




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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

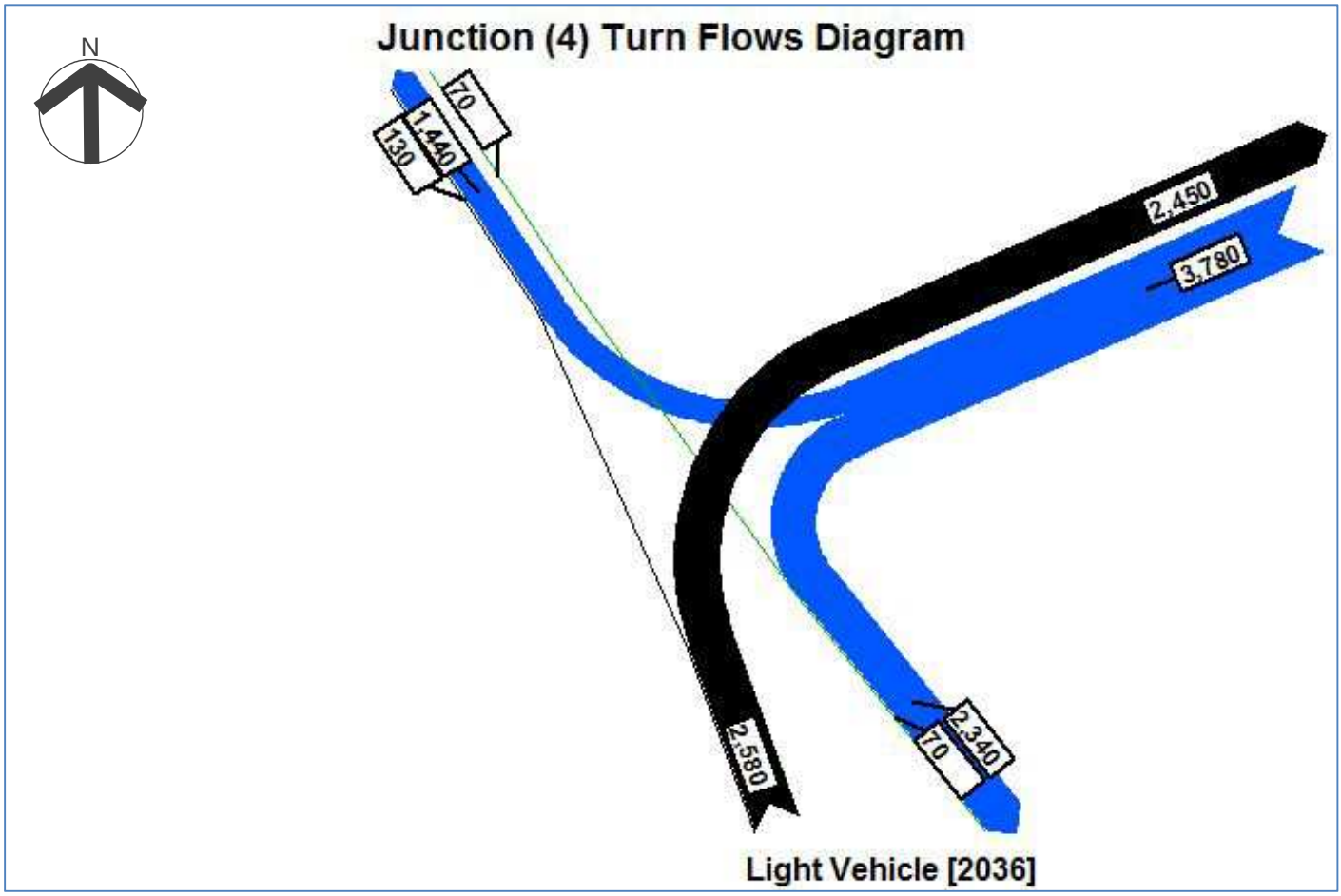
Site 3a: Loop Road & Fernbank Creek Industrial

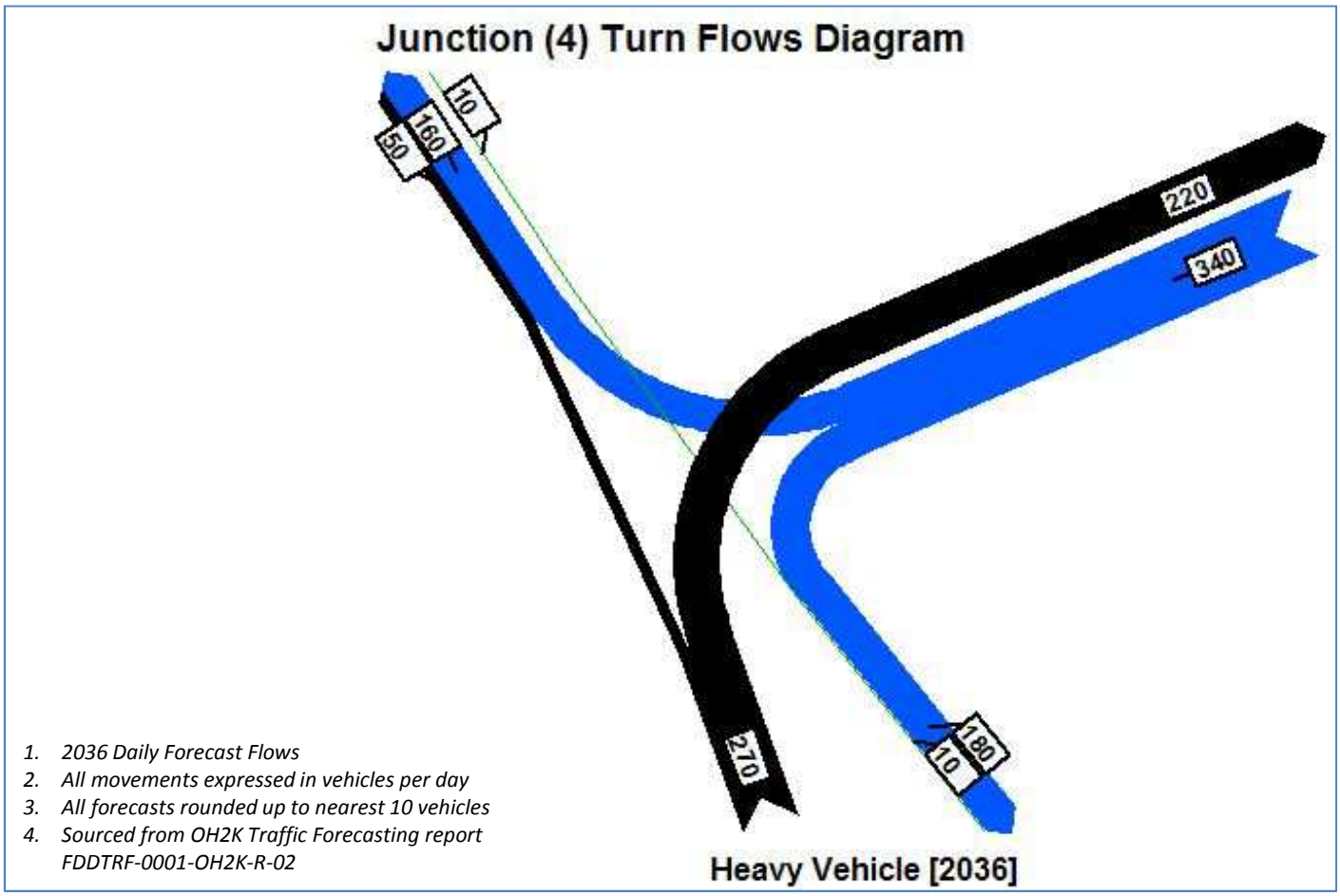




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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

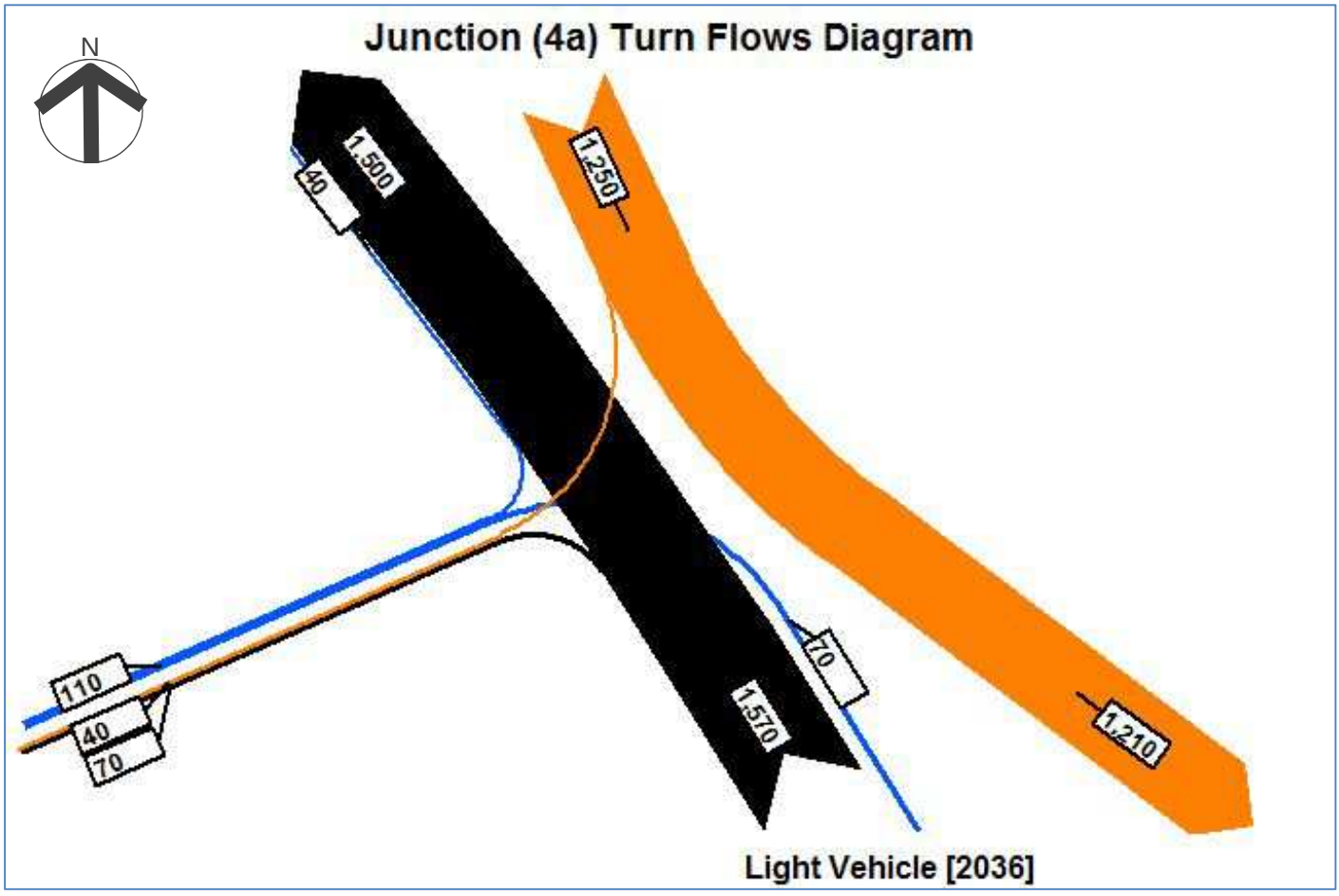
Site 4: Hasting River Drive & Service Road

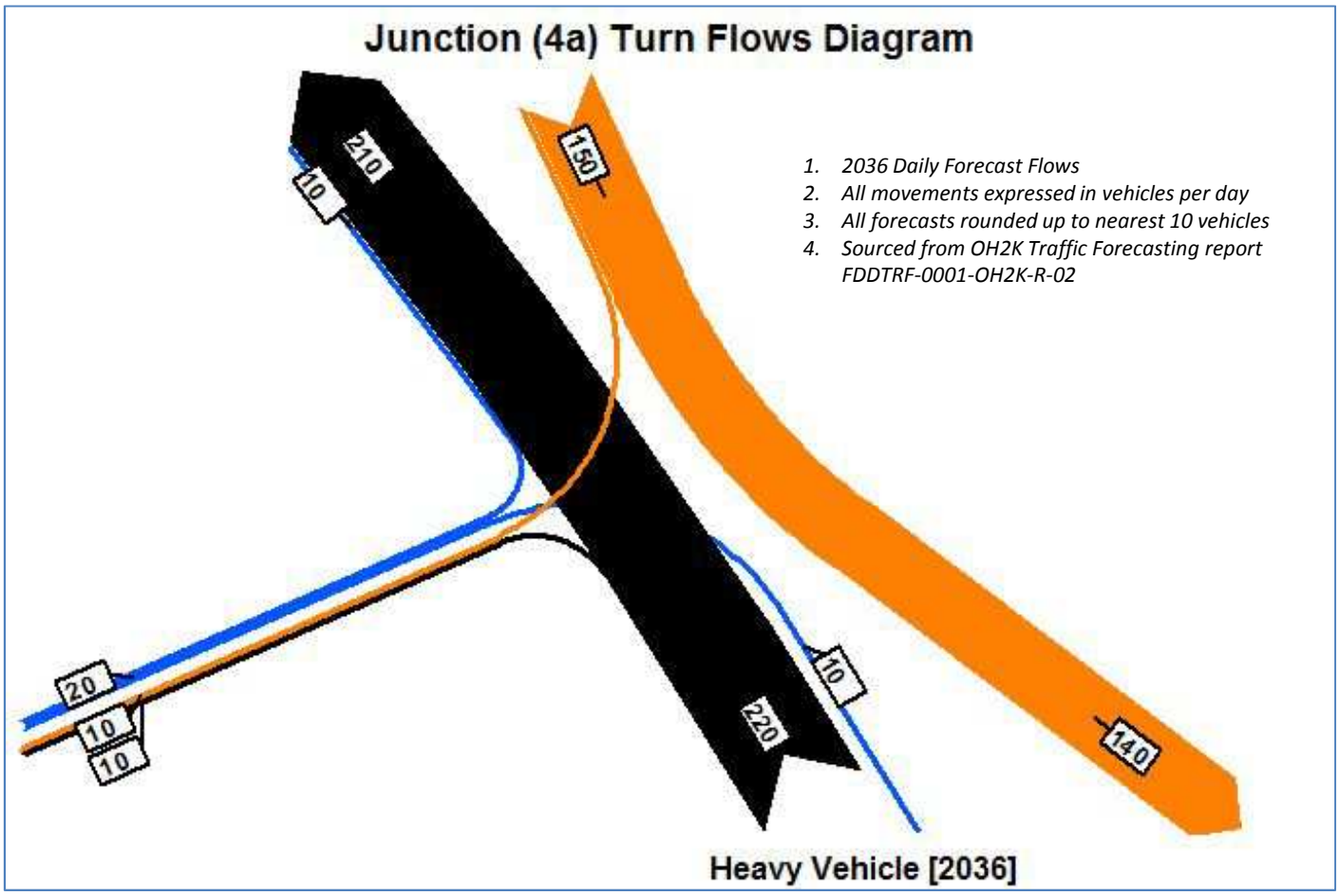




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3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

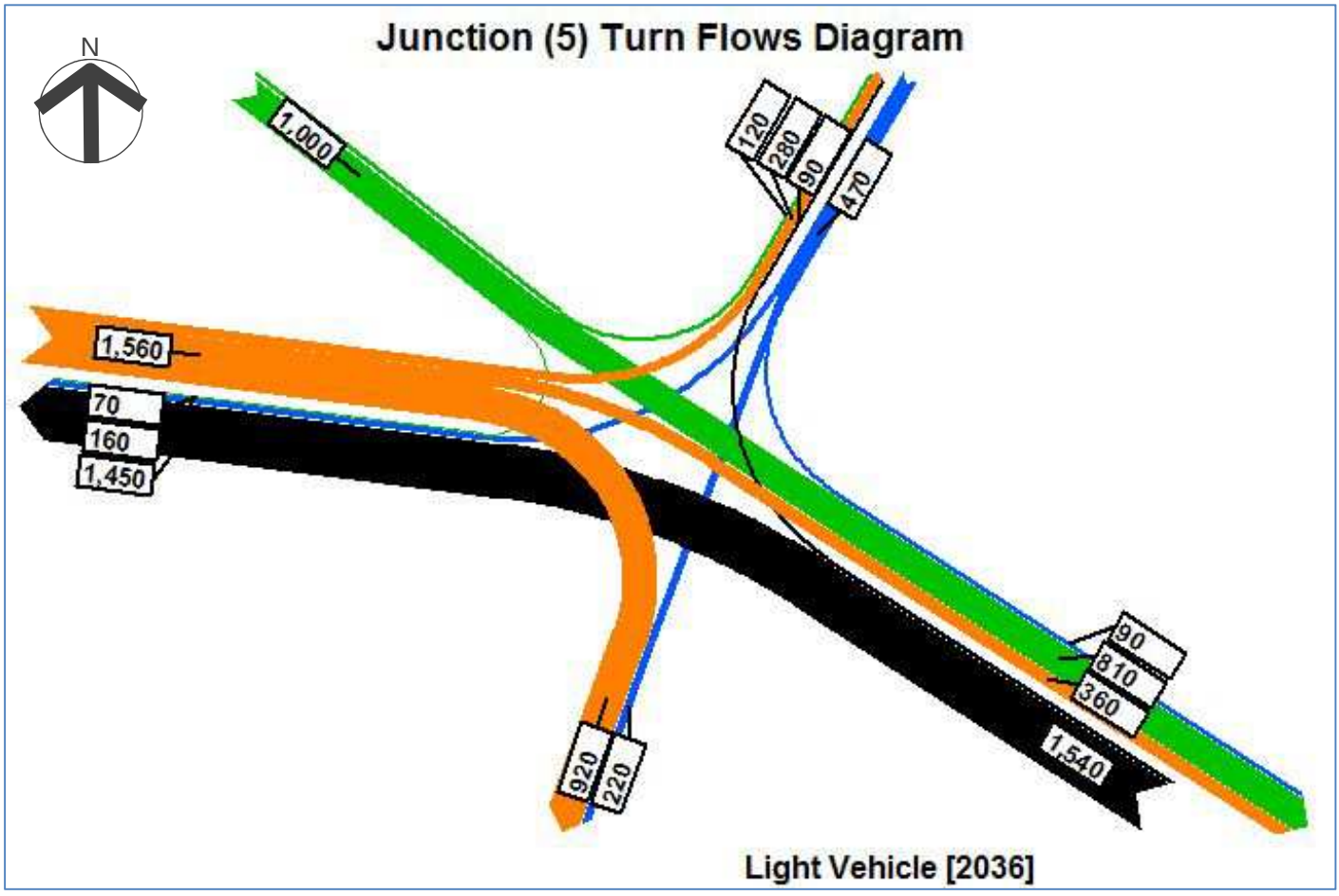
Site 4a: Glen Ewan Road & Service Road

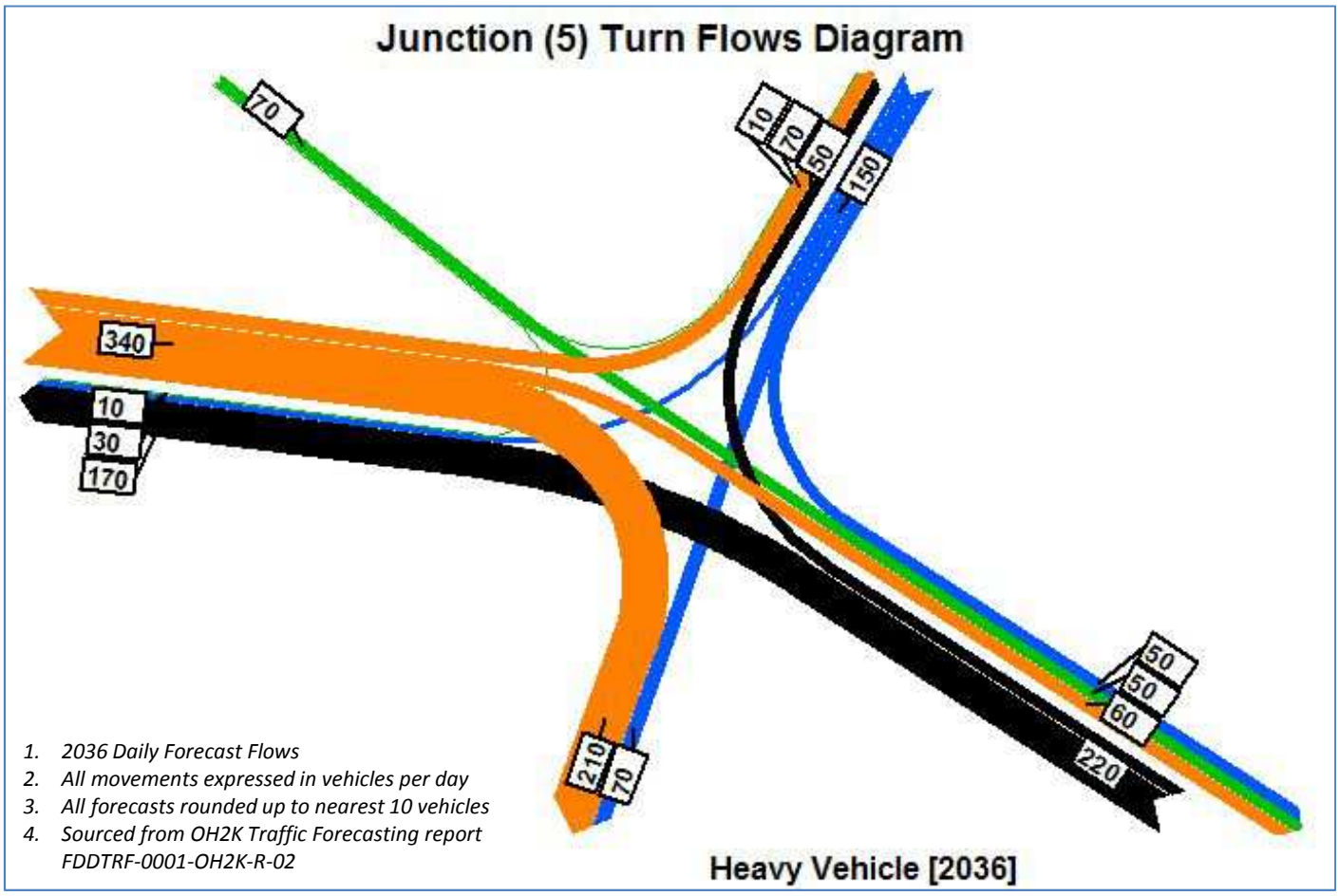




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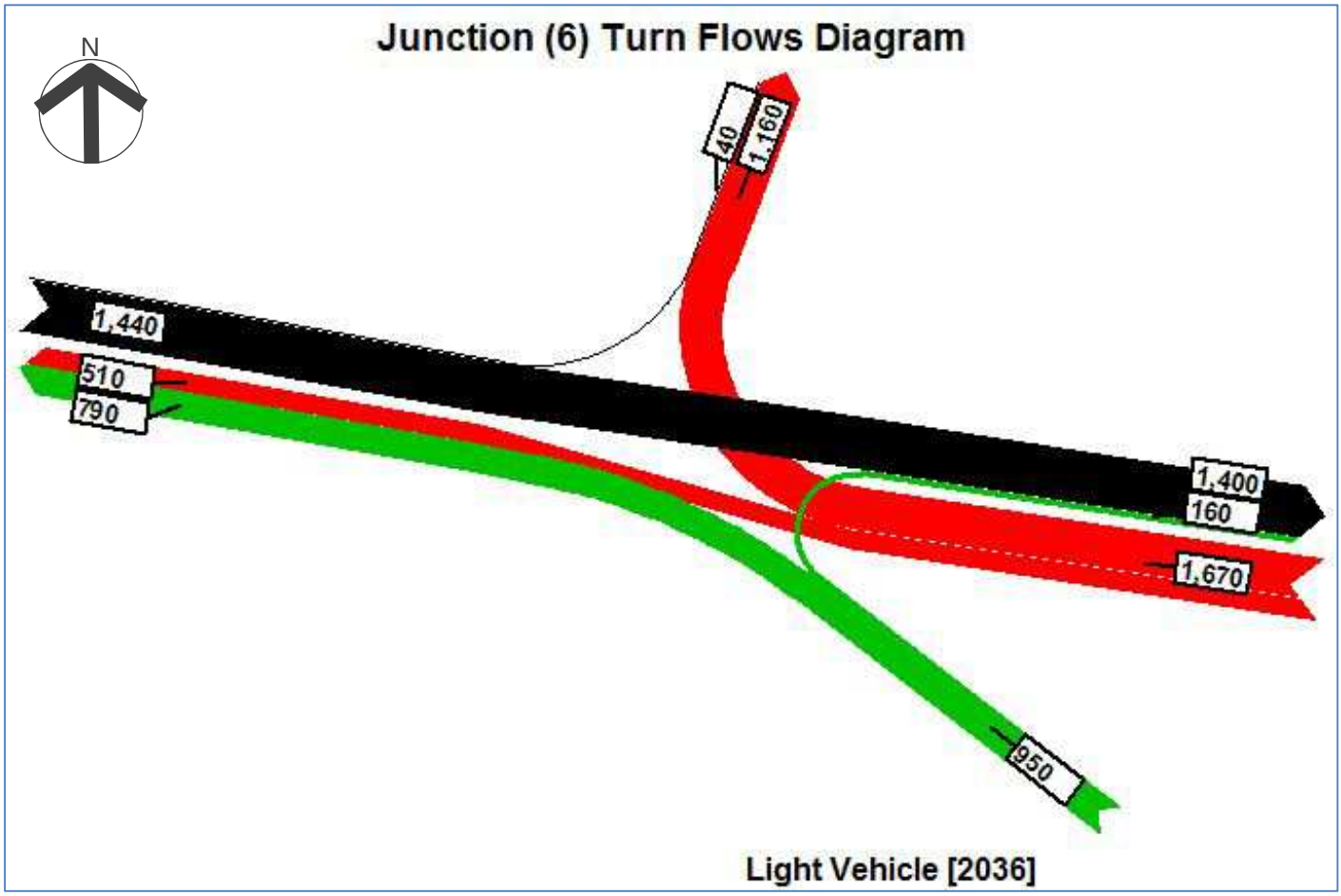
Site 5: Blackmans Point I/C (Eastern Roundabout)

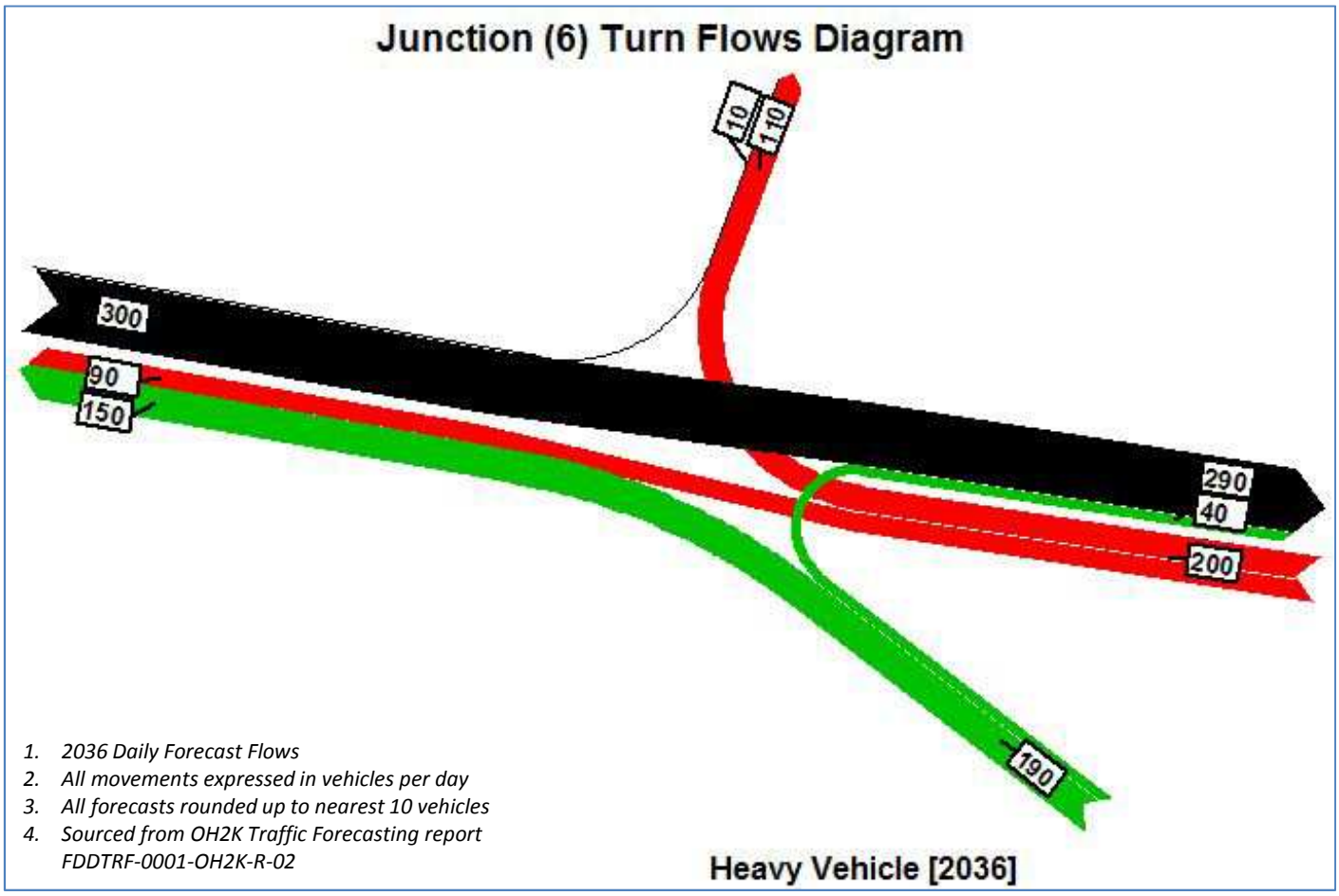




1. *2036 Daily Forecast Flows*
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3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

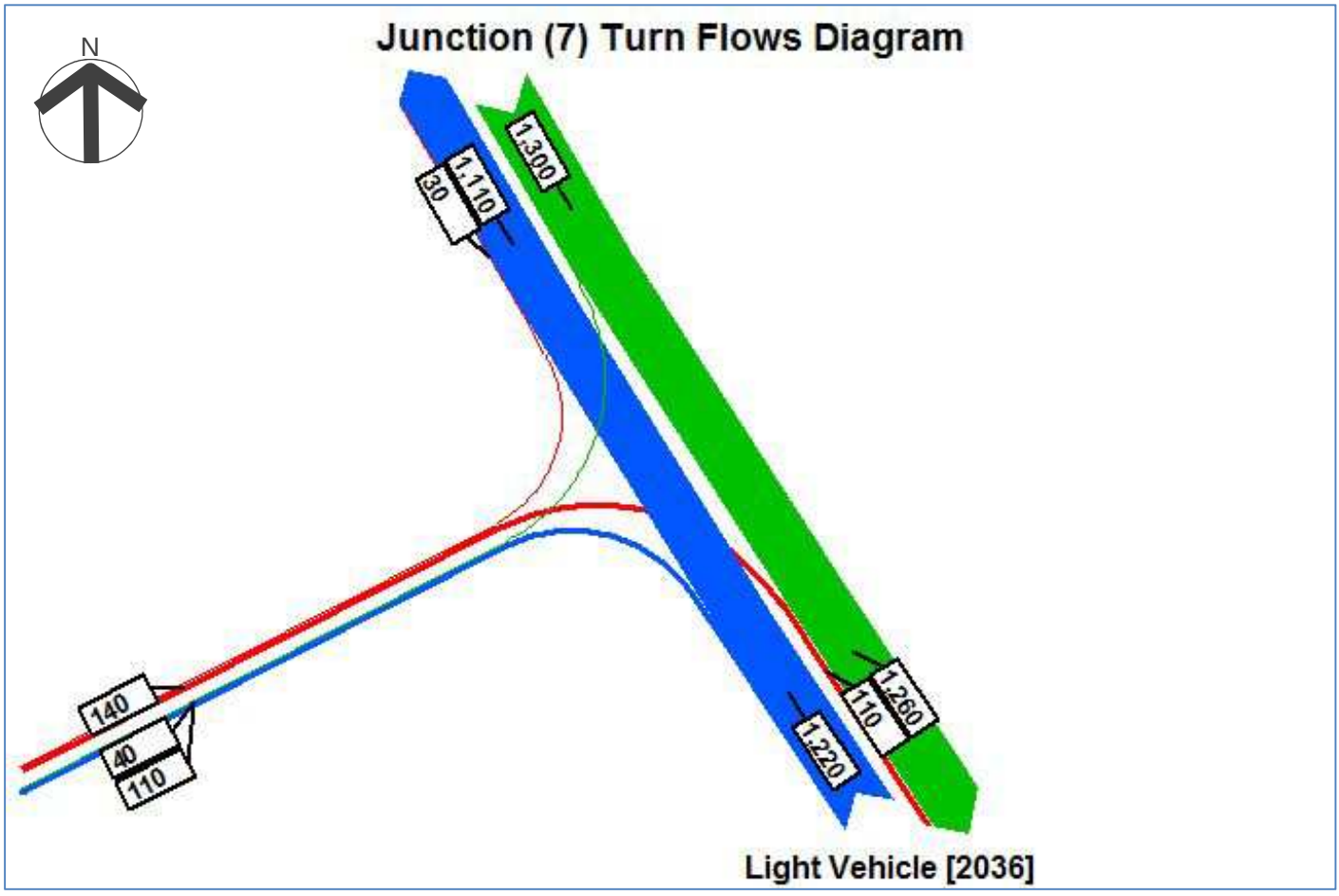
Site 6: Blackmans Point I/C (Western Roundabout)

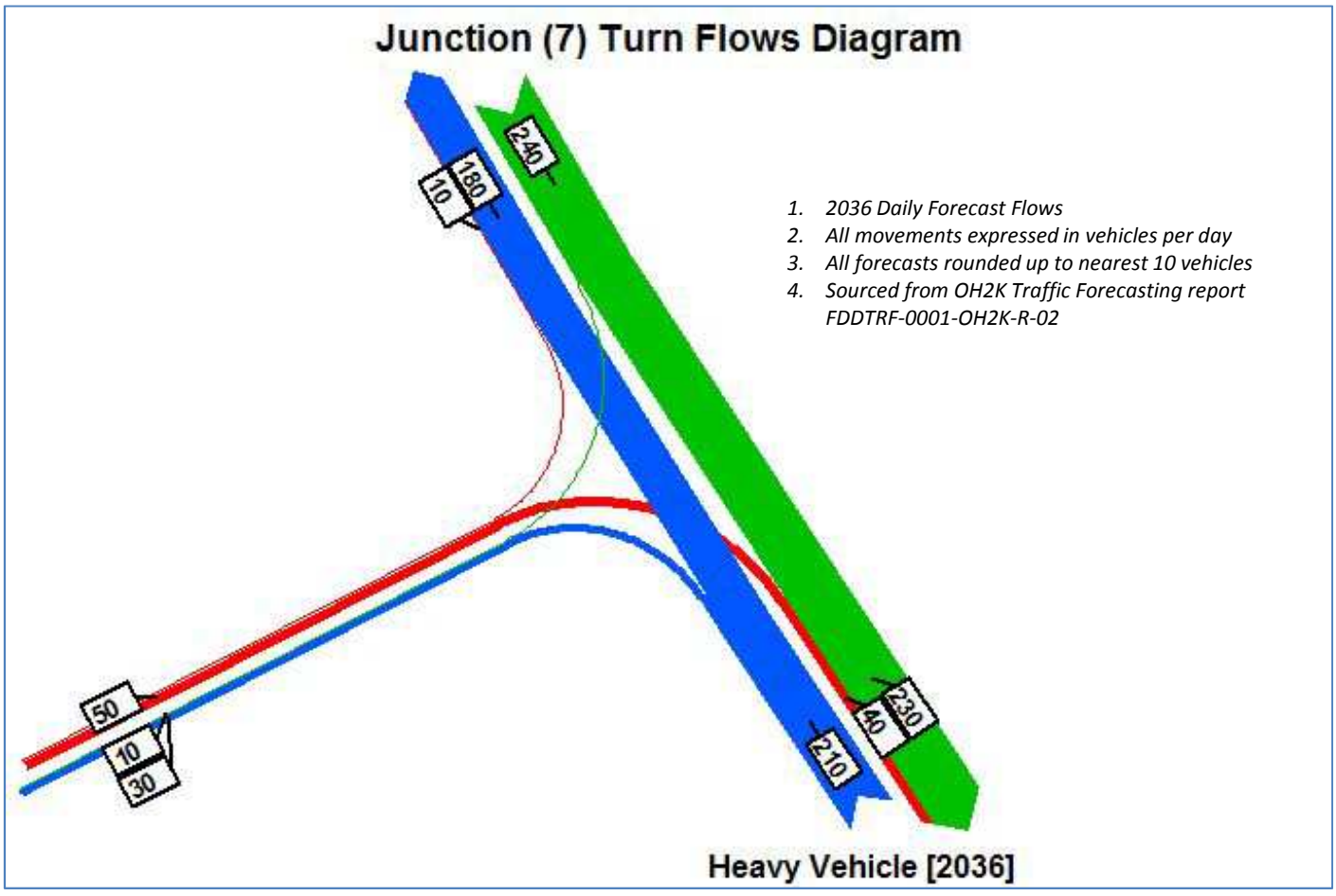




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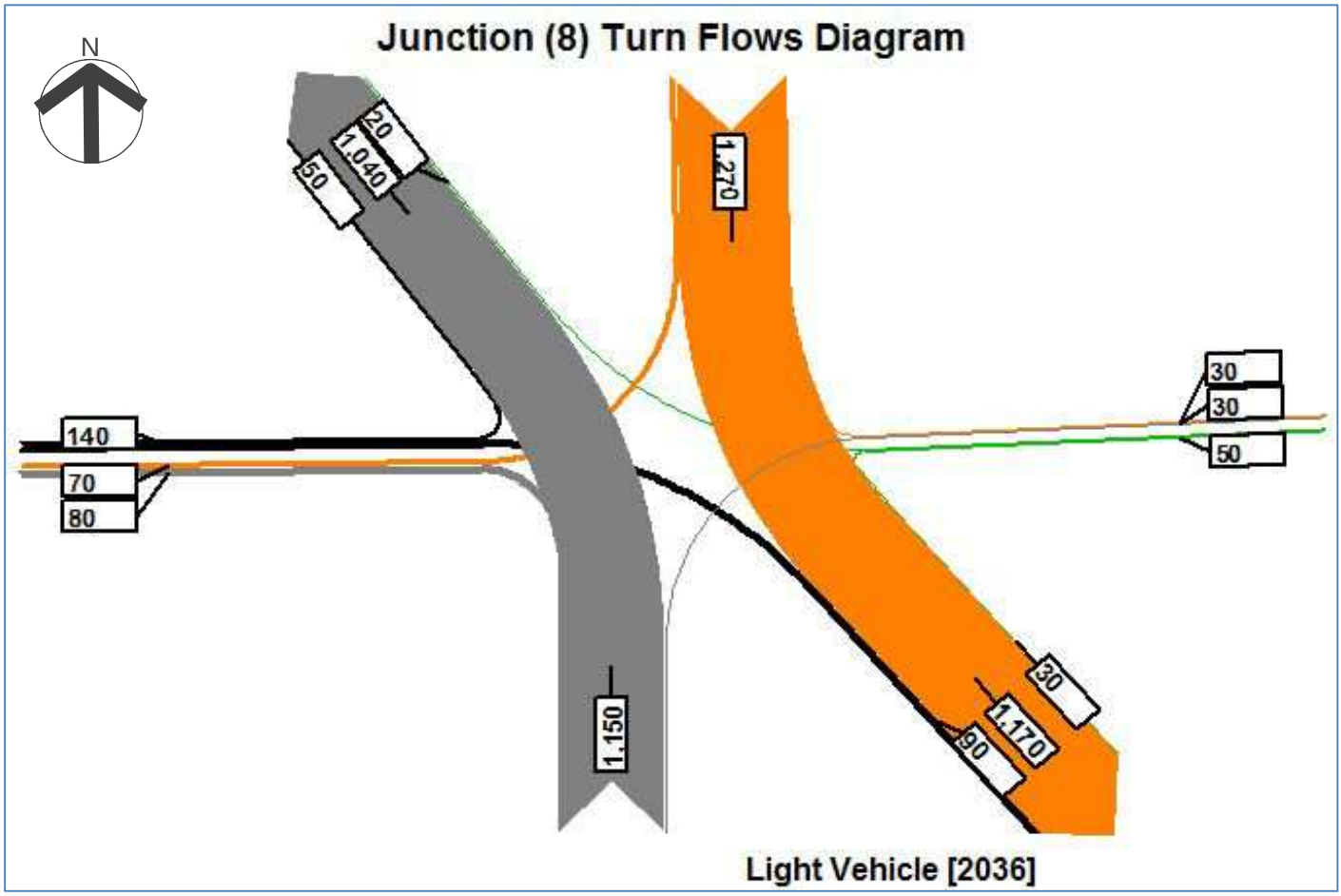
Site 7: Junction Road & Service Road

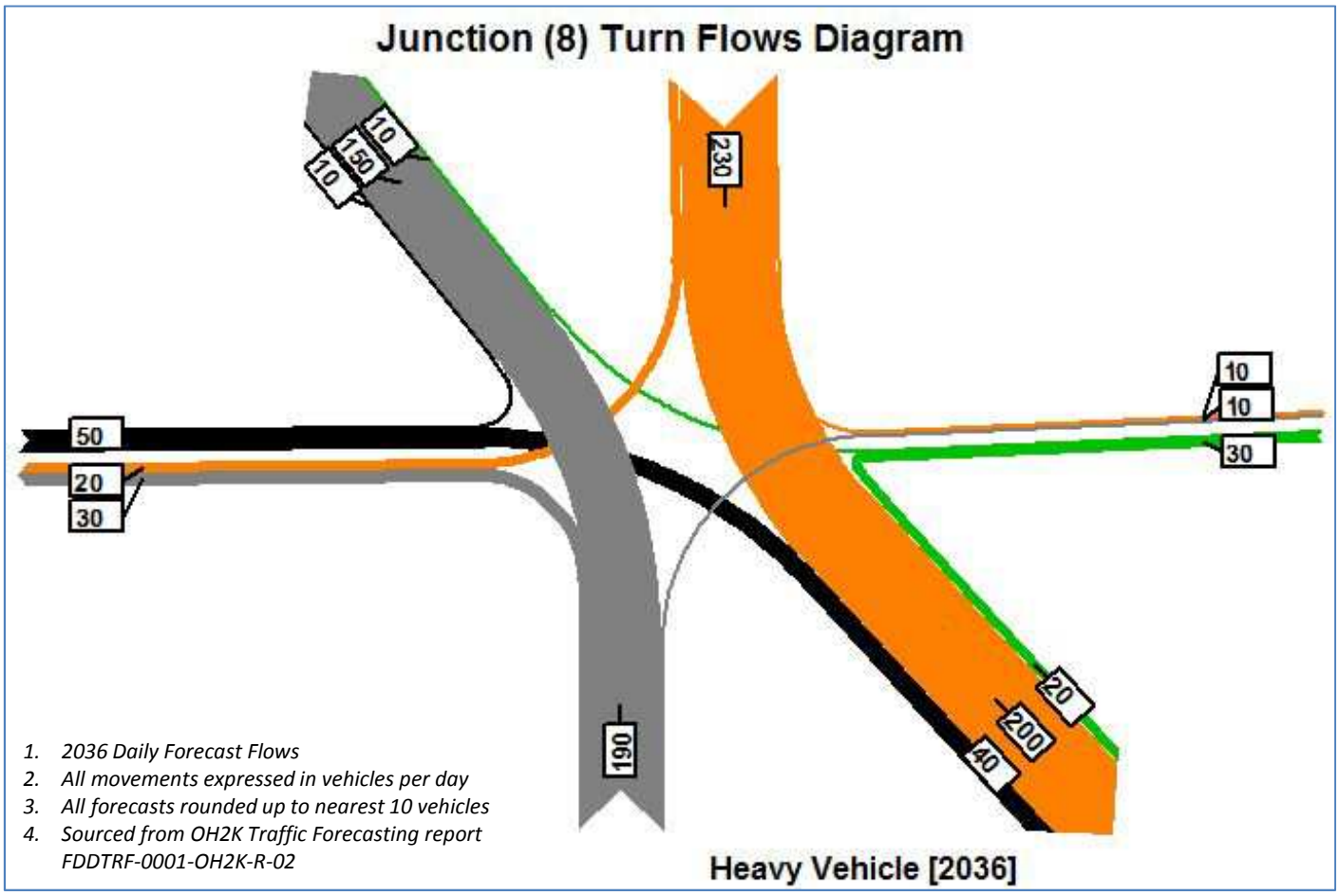




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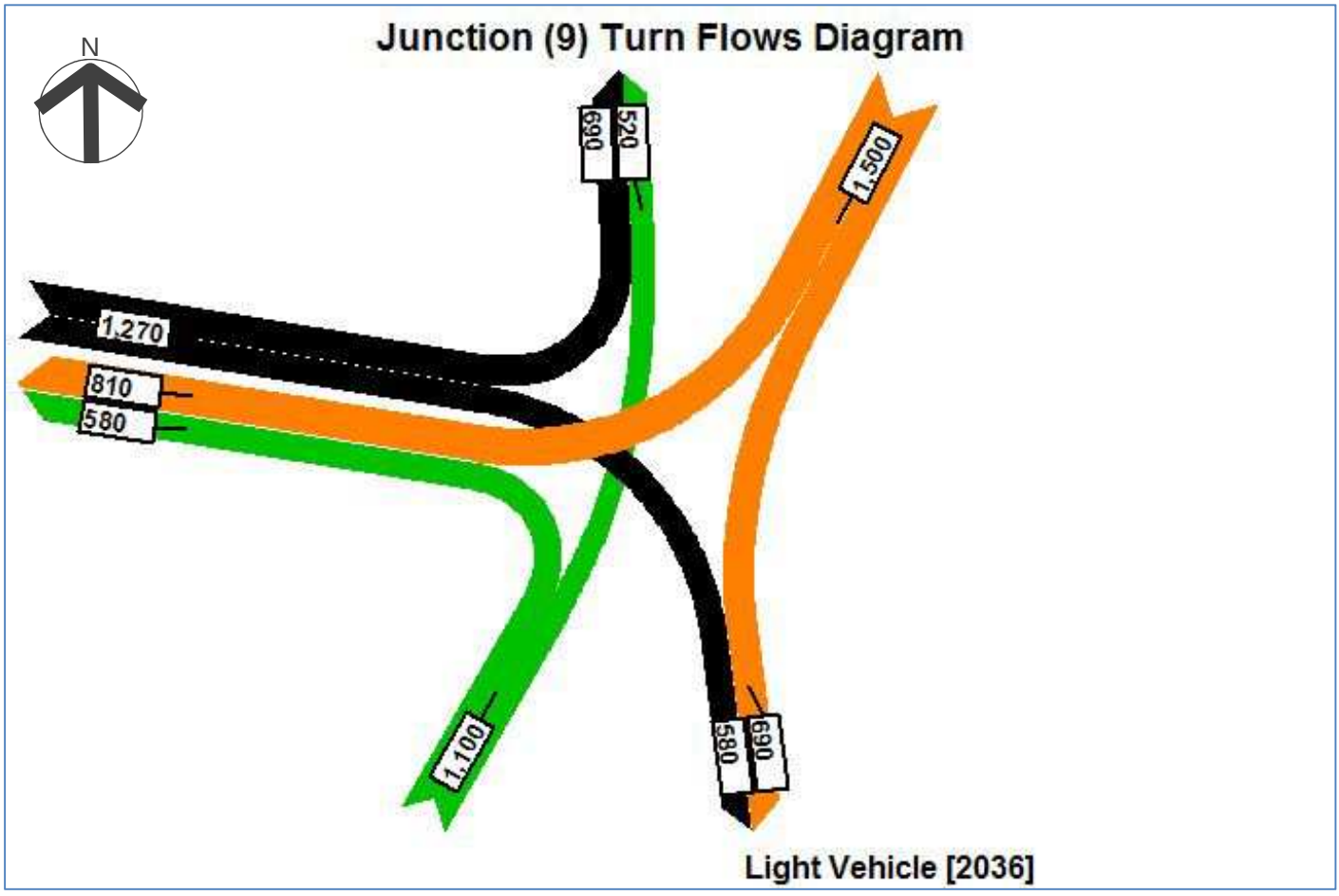
Site 8: Forest Hut Road, Bill Hill Road & Service Road

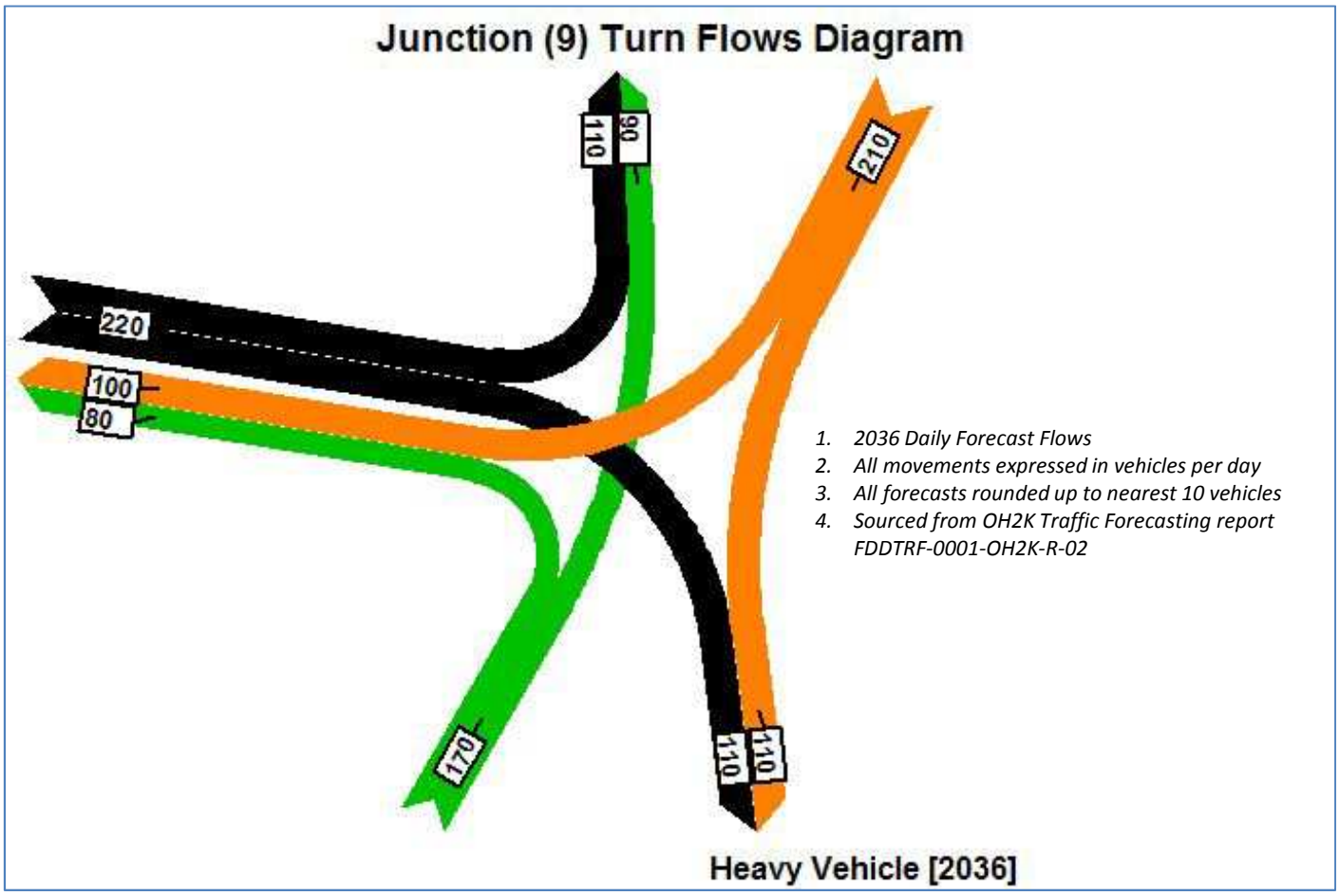




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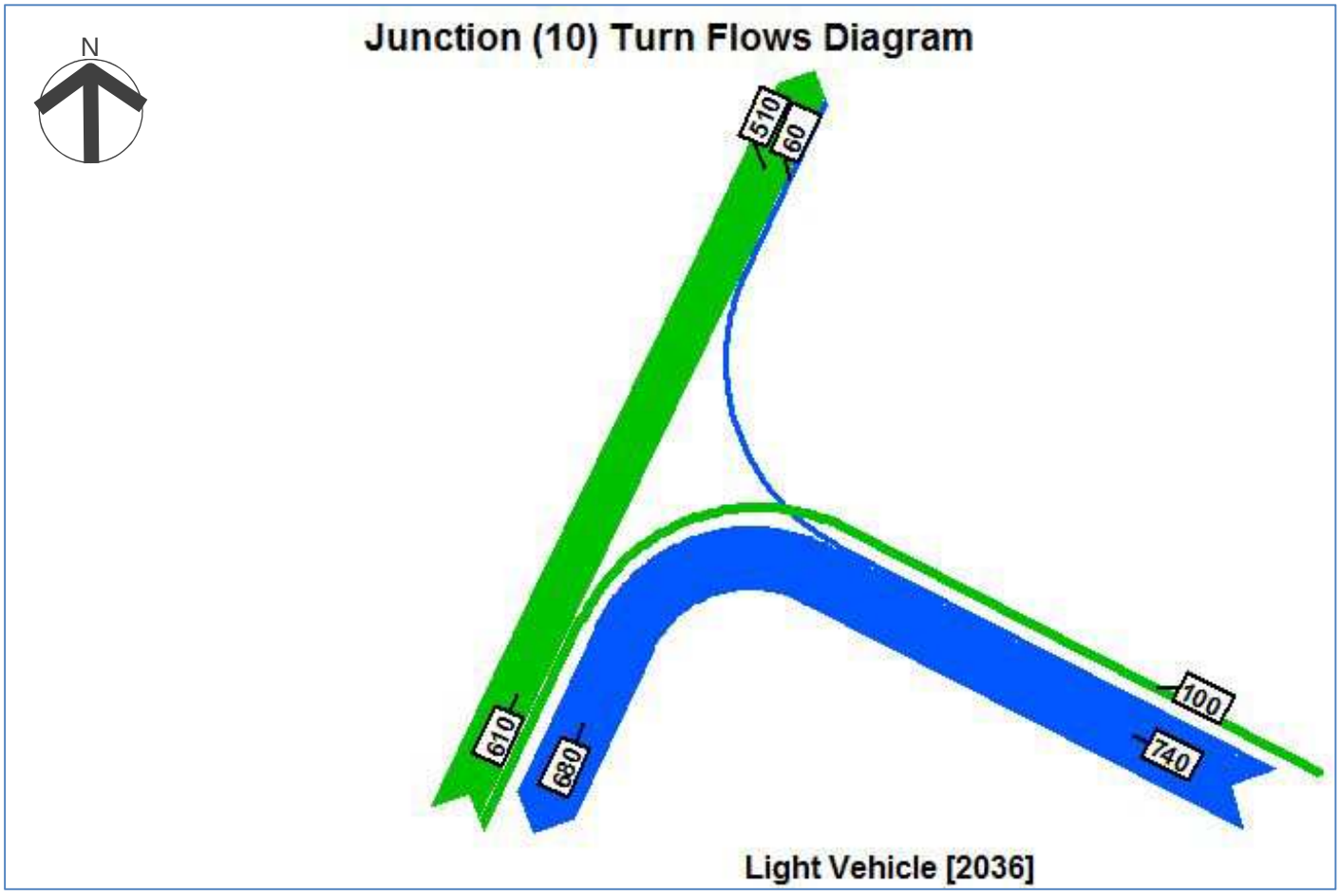
Site 9: Pembroke Road & Service Road

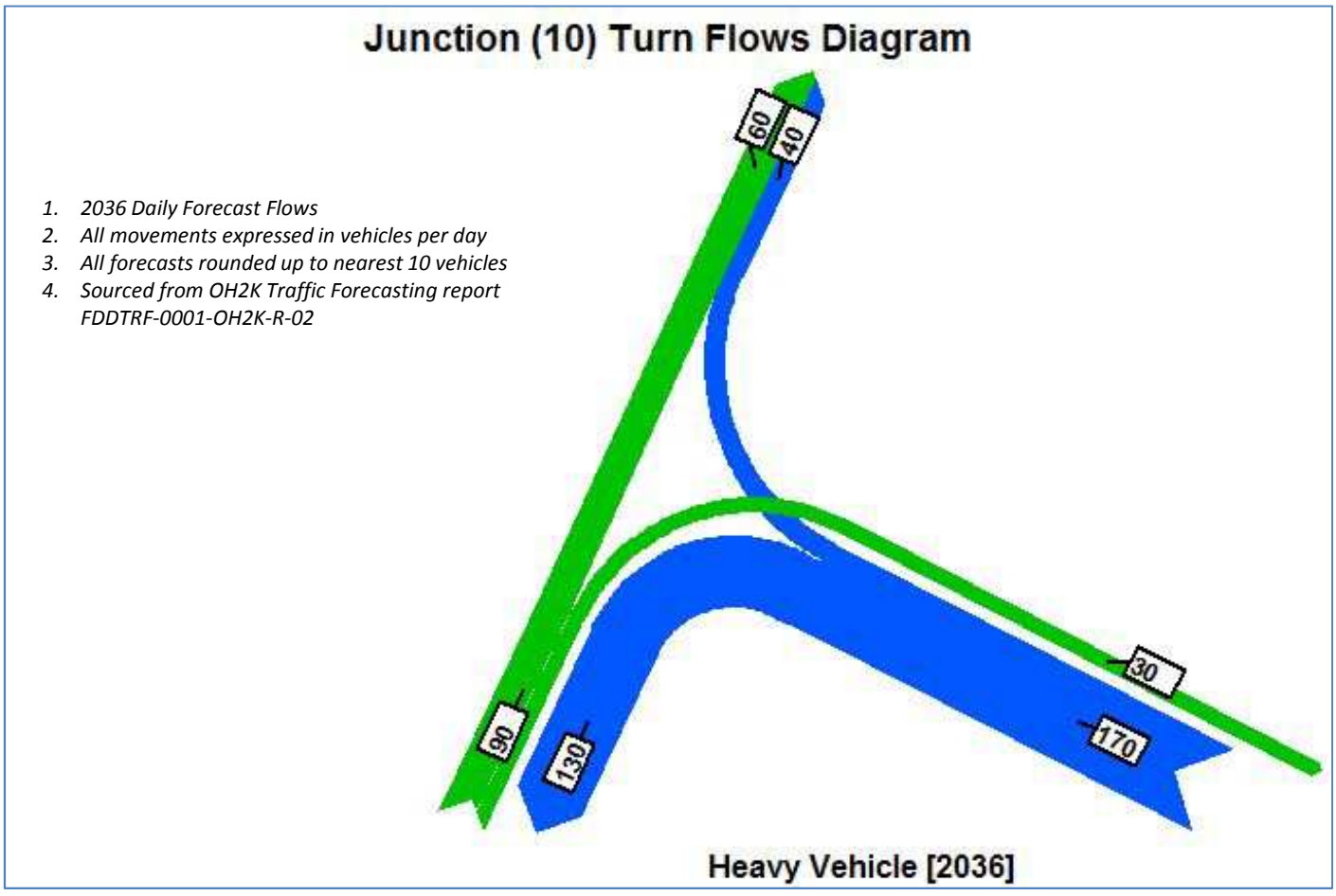




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4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

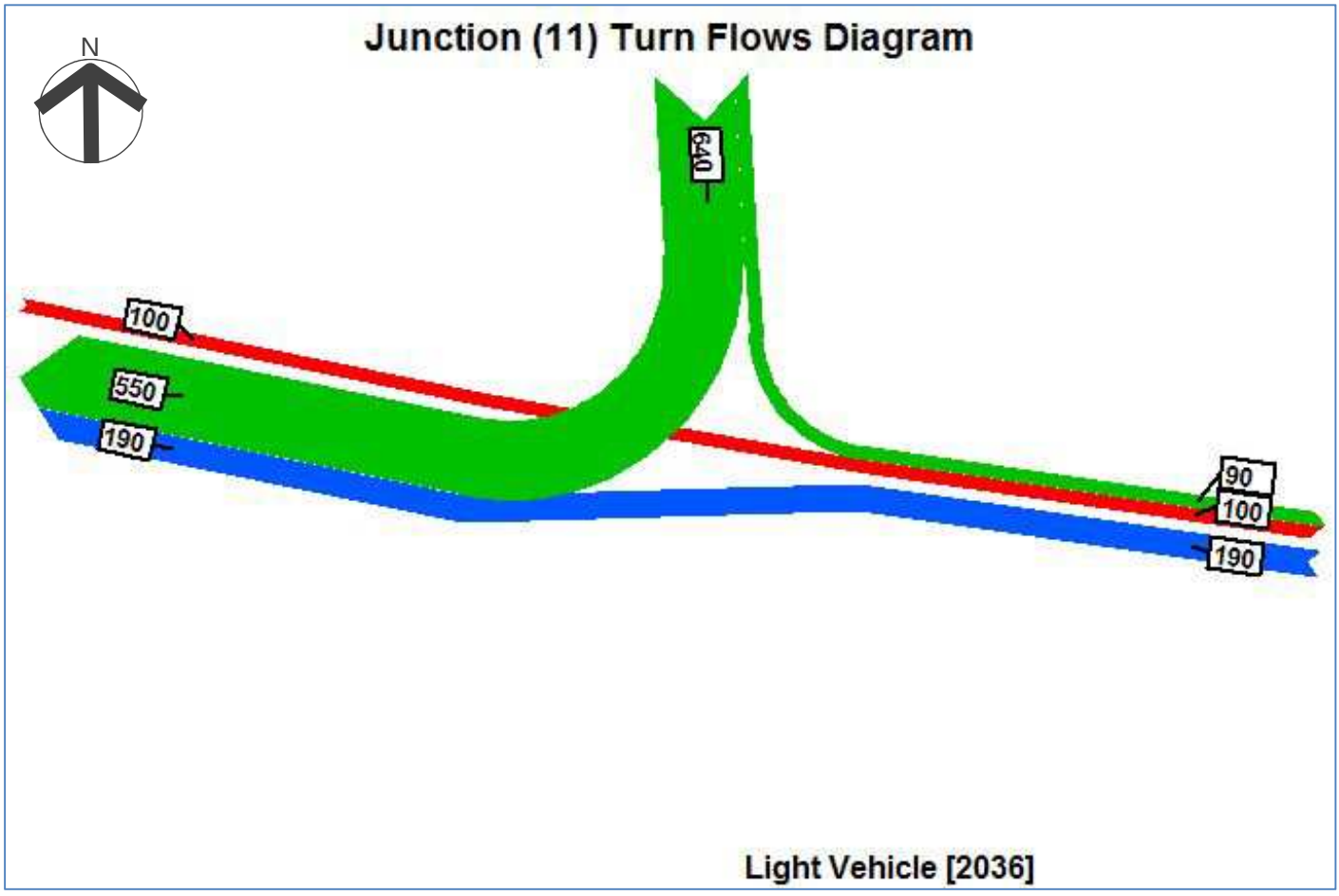
Site 10: Haydons Wharf Road & Service Road

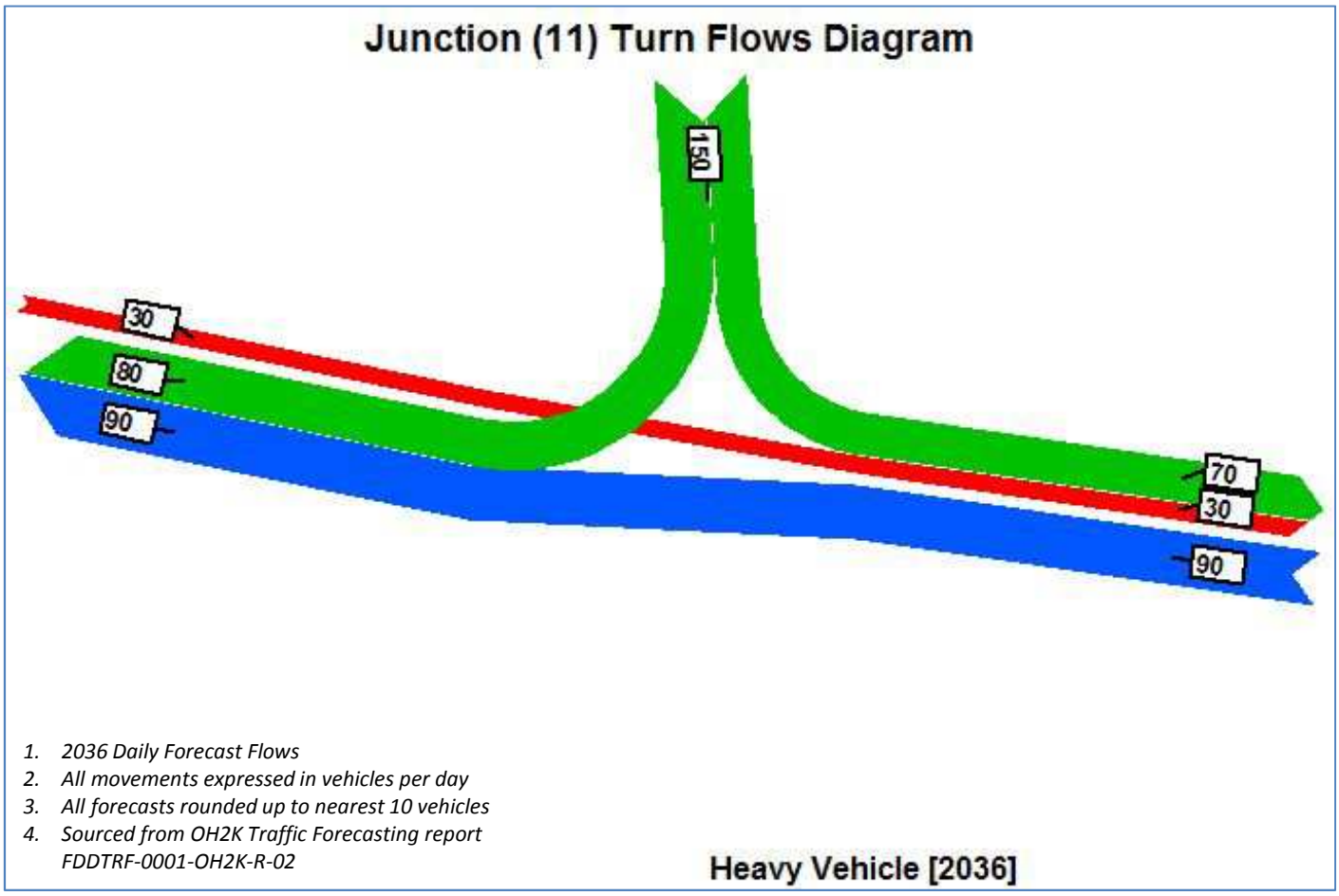




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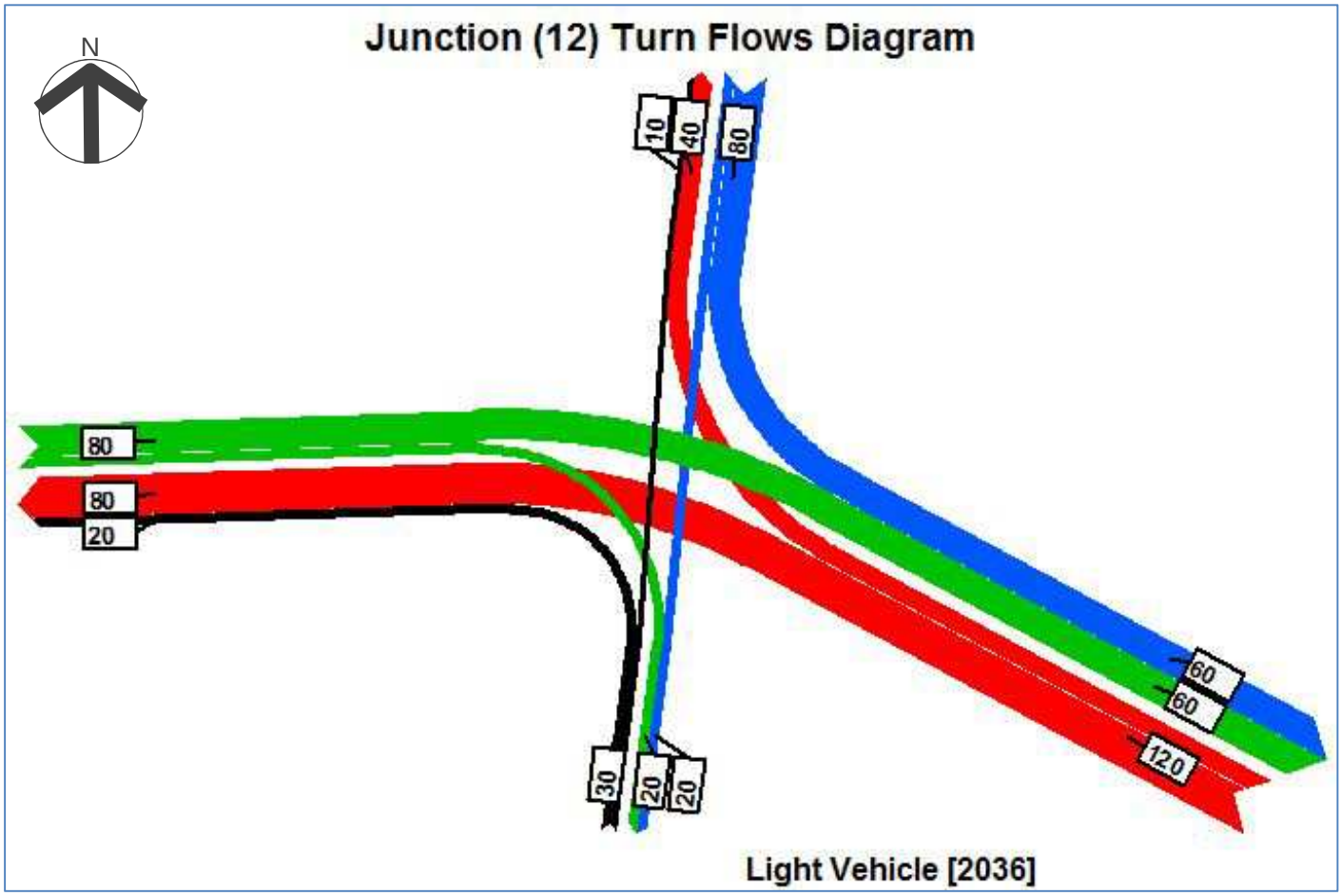
Site 11: Haydons Wharf Road & SB Off-ramp

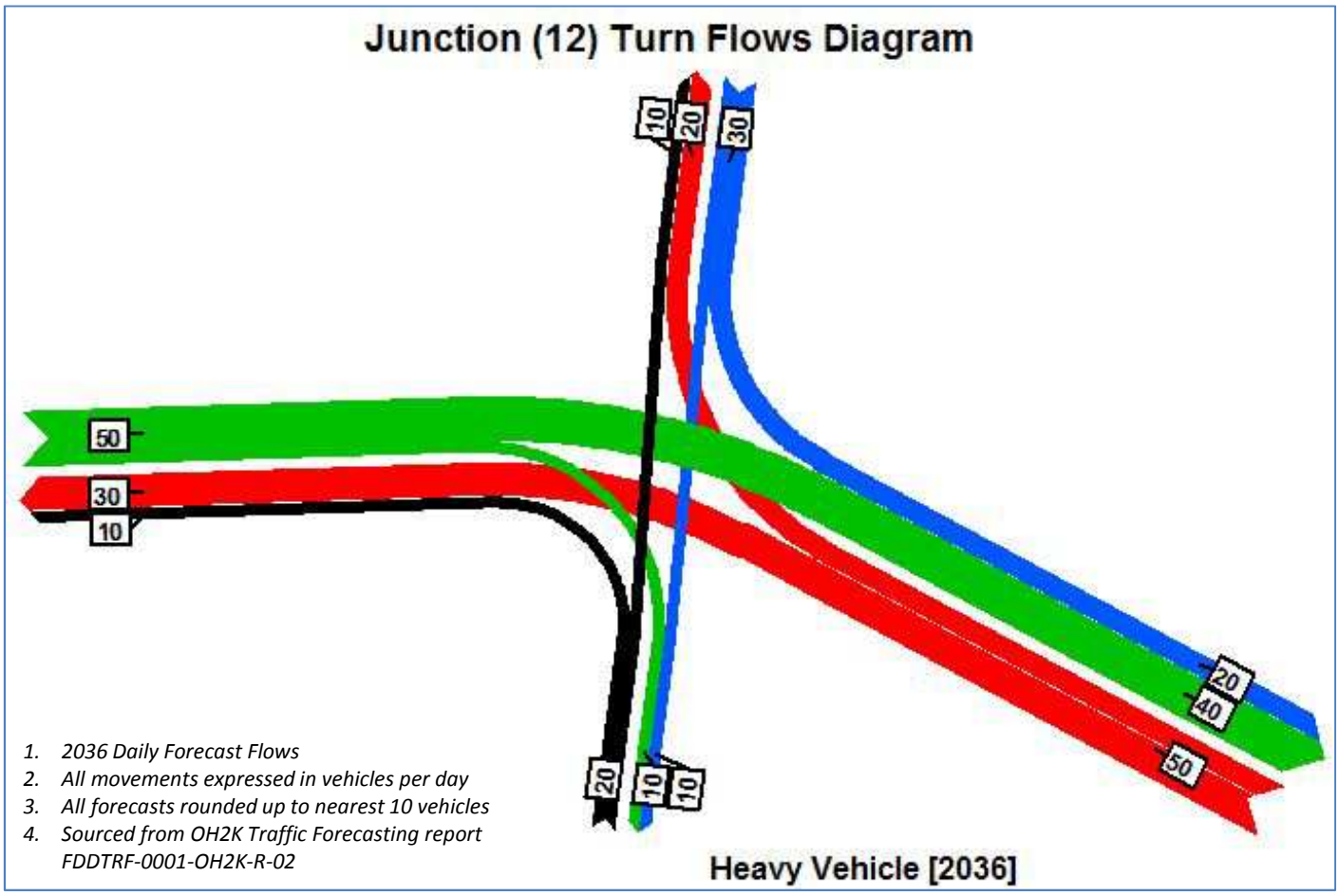




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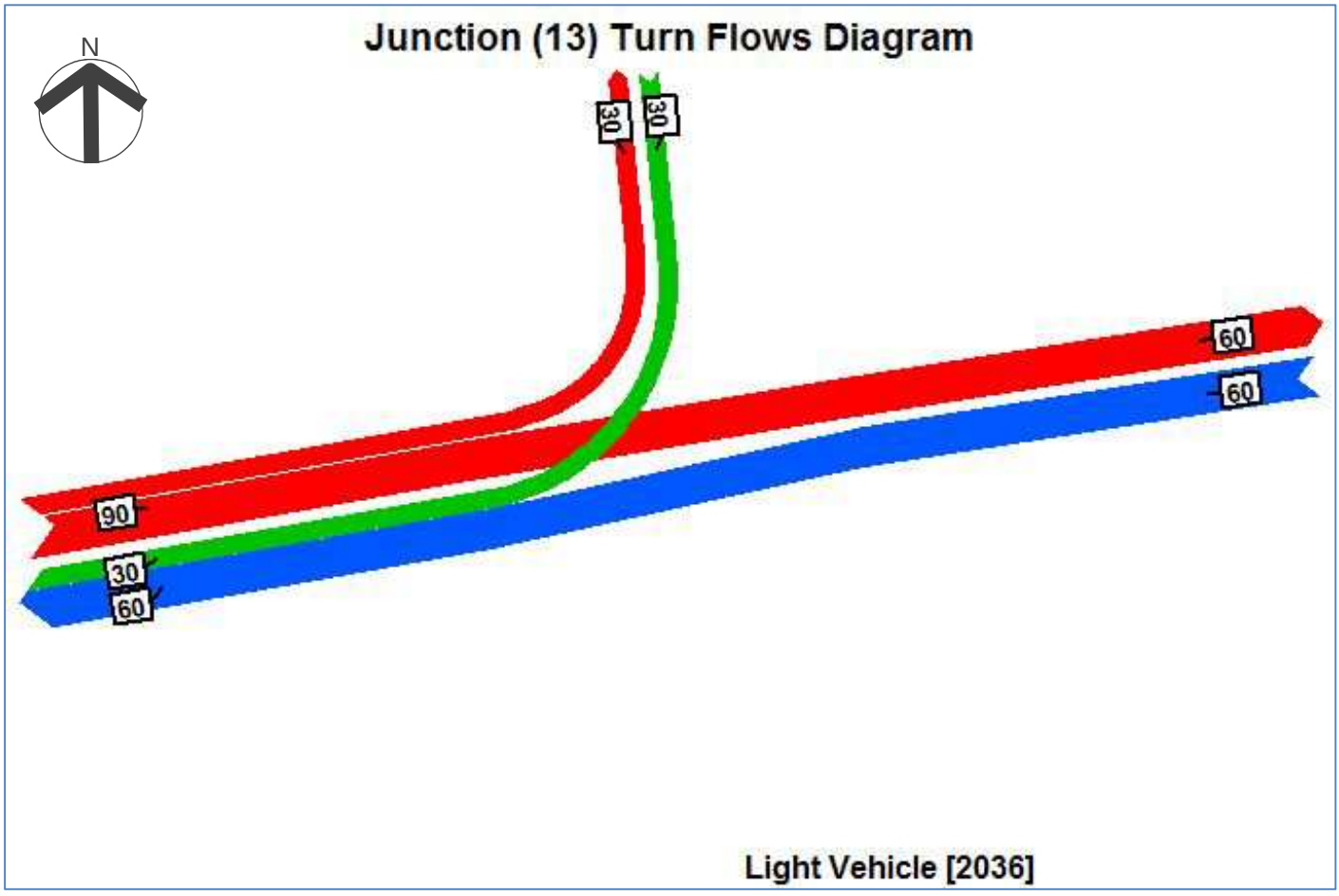
Site 12: Cooperabung Drive & Zone J2

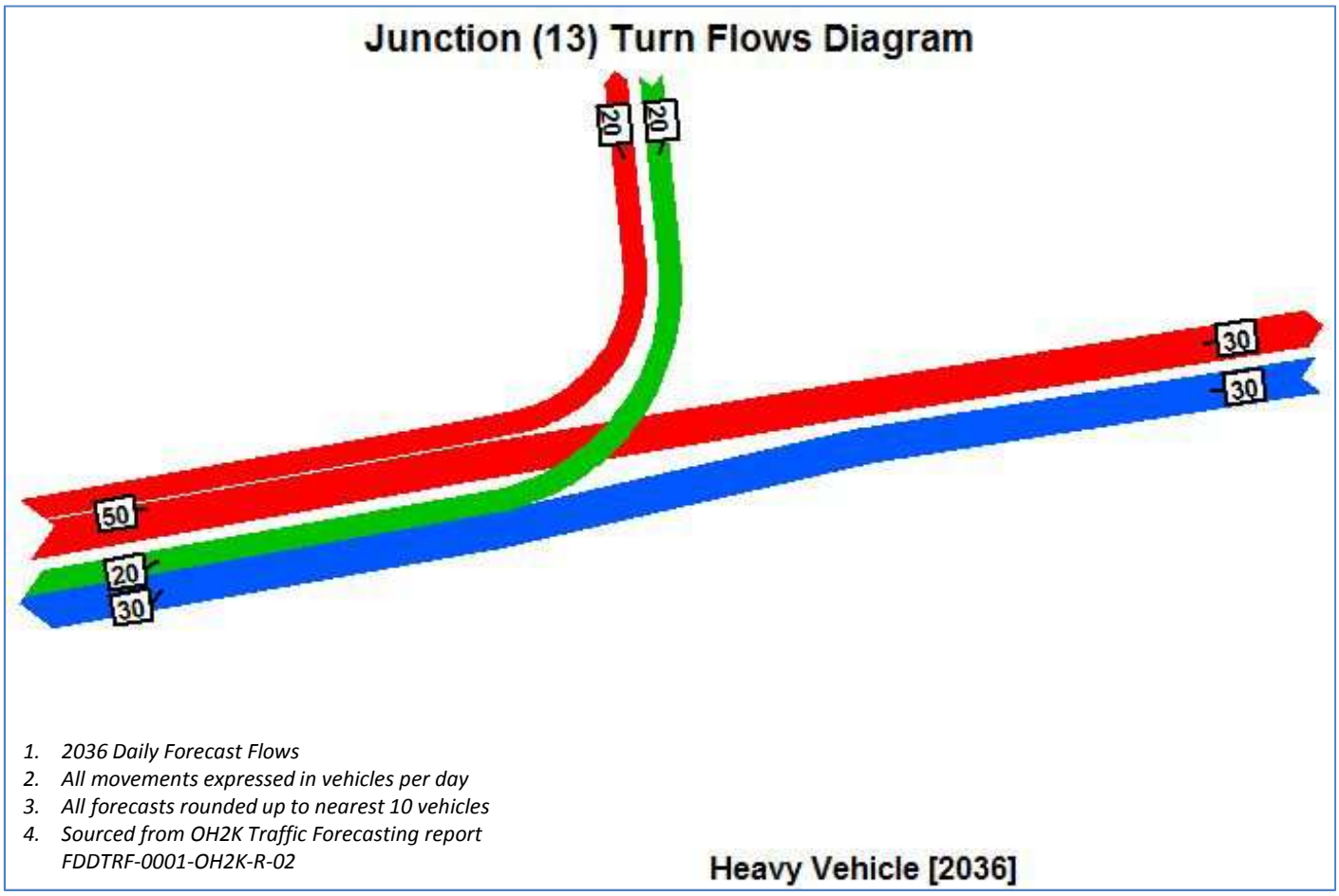




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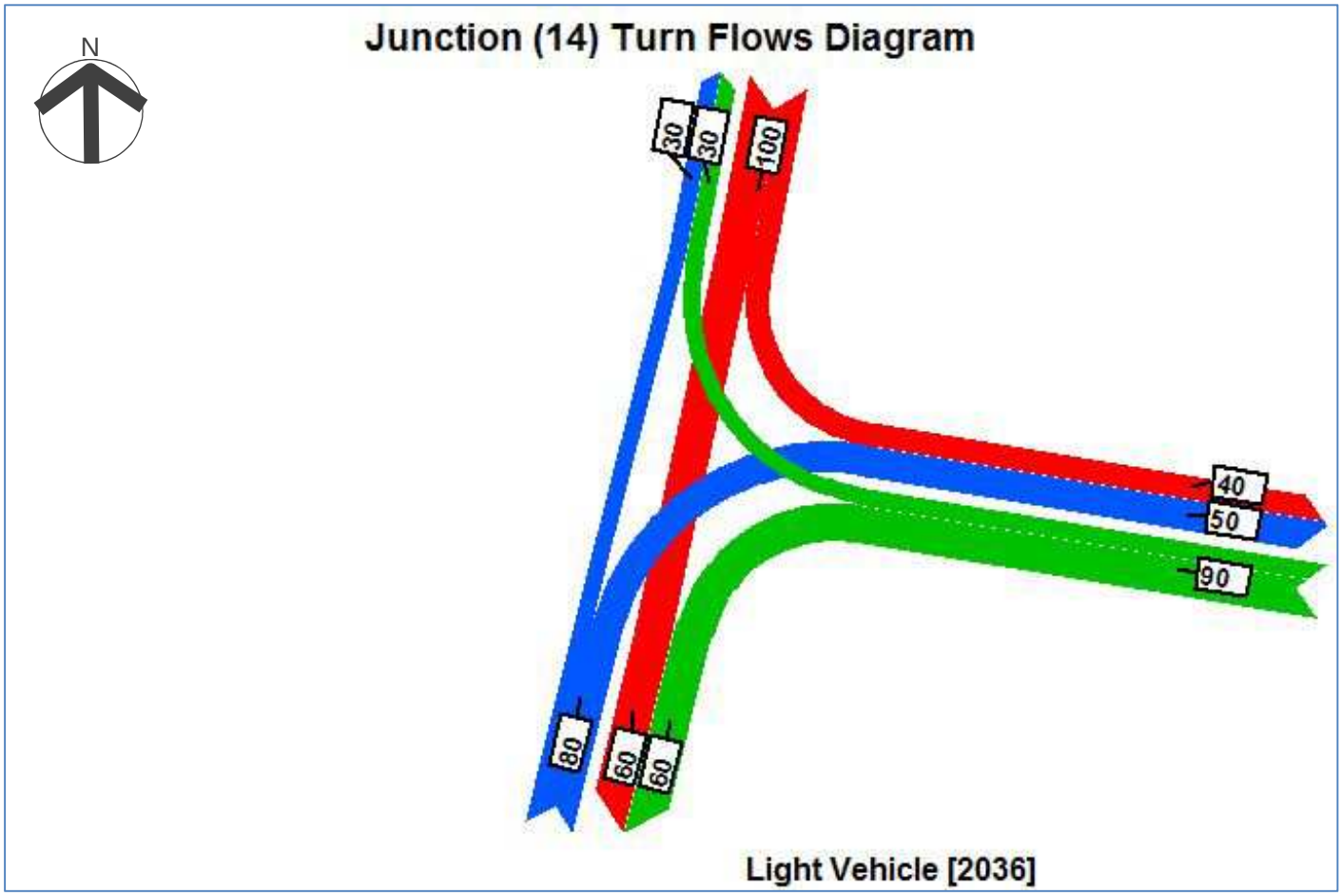
Site 13: Mingaletta Road & Mobbs Road

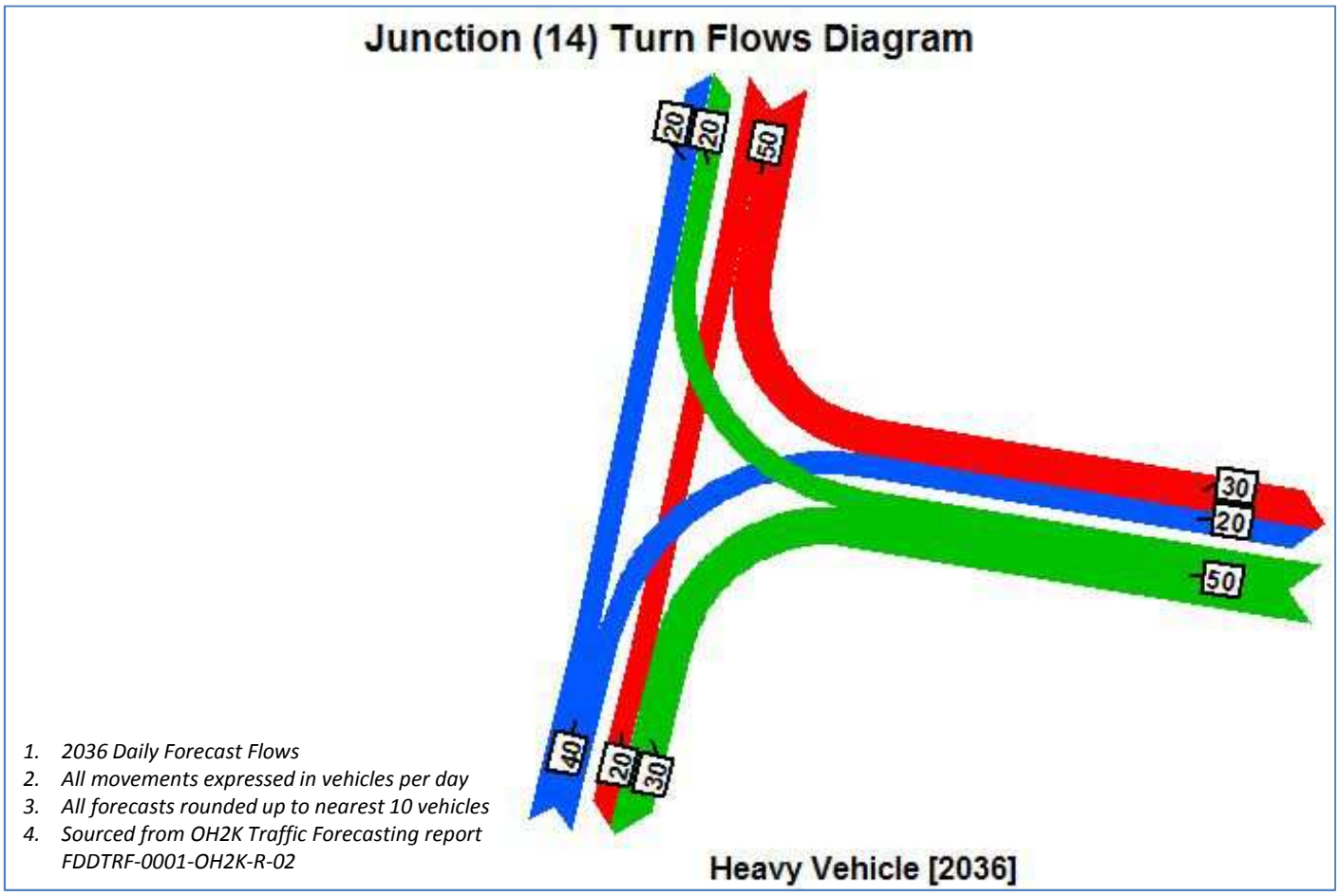




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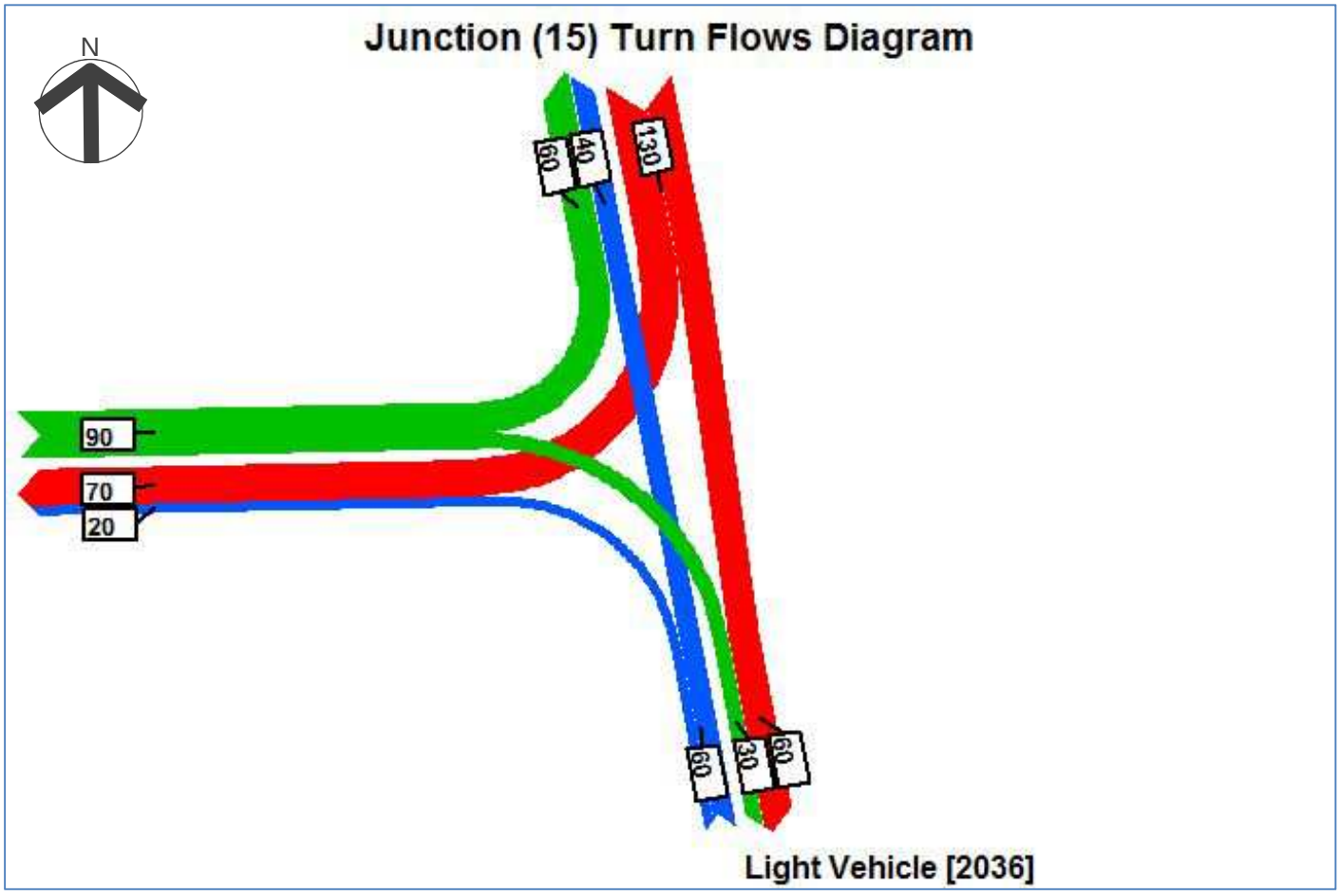
Site 14: Mingaletta Road & Service Road

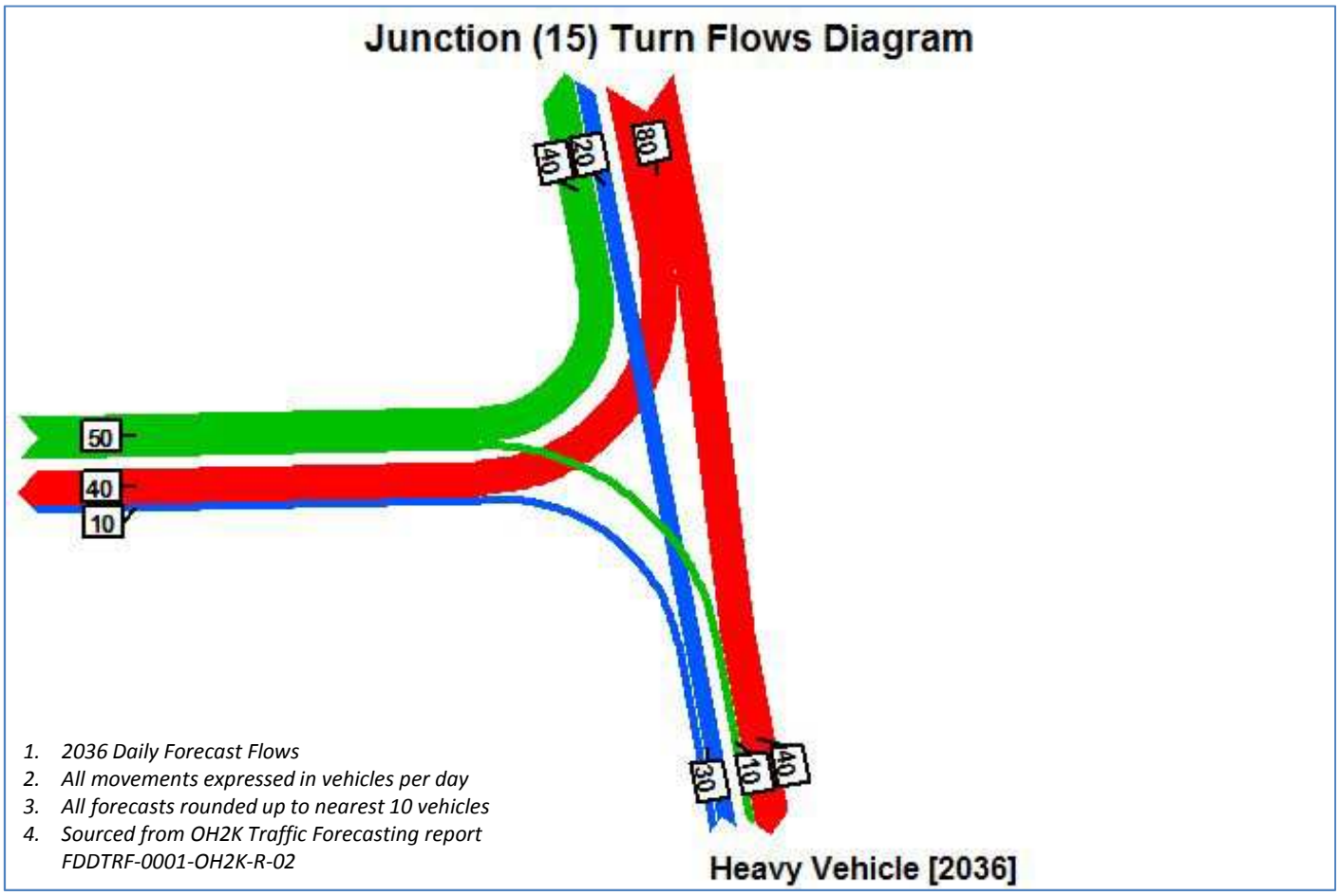




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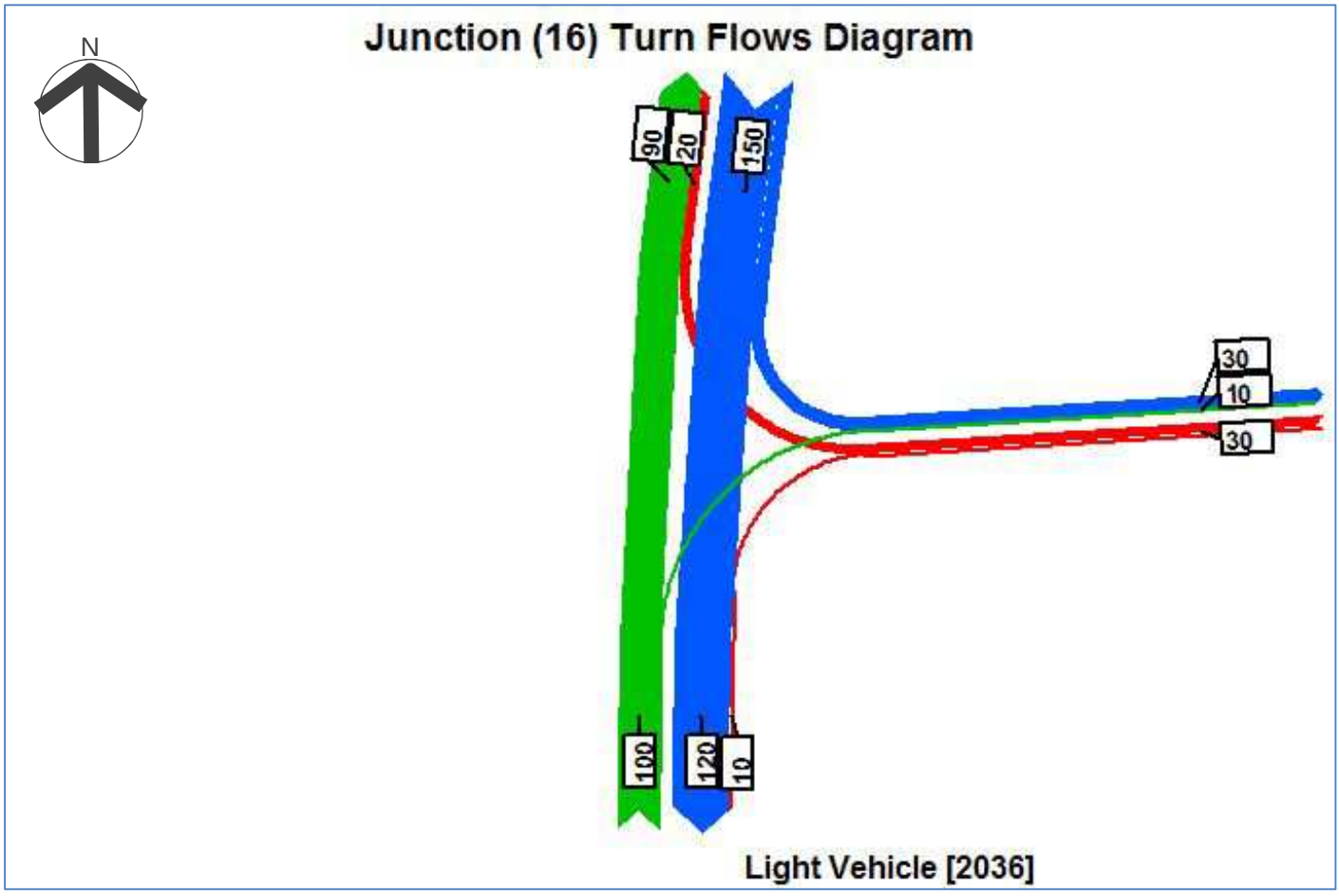
Site 15: Upper Smiths Creek Road & Service

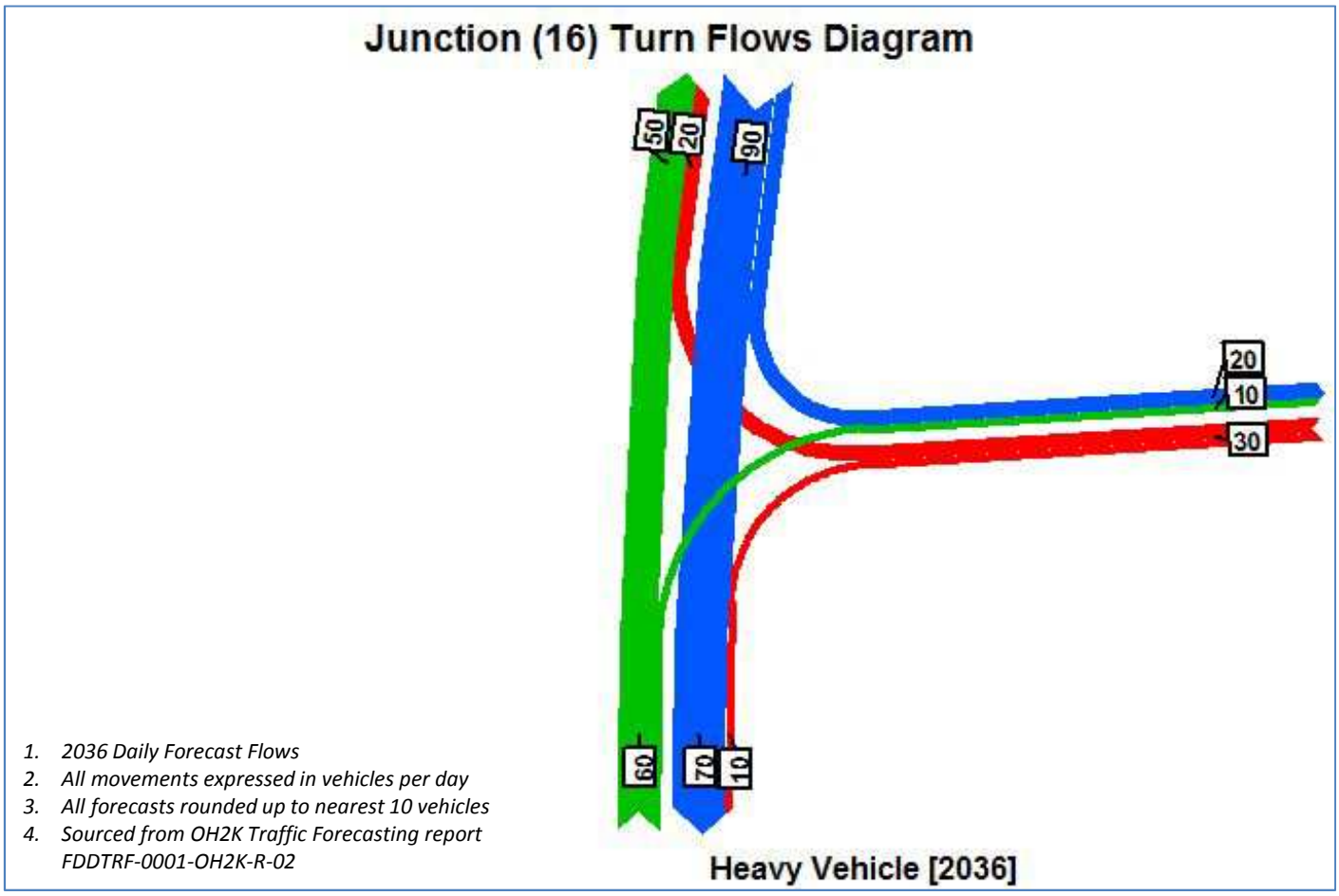




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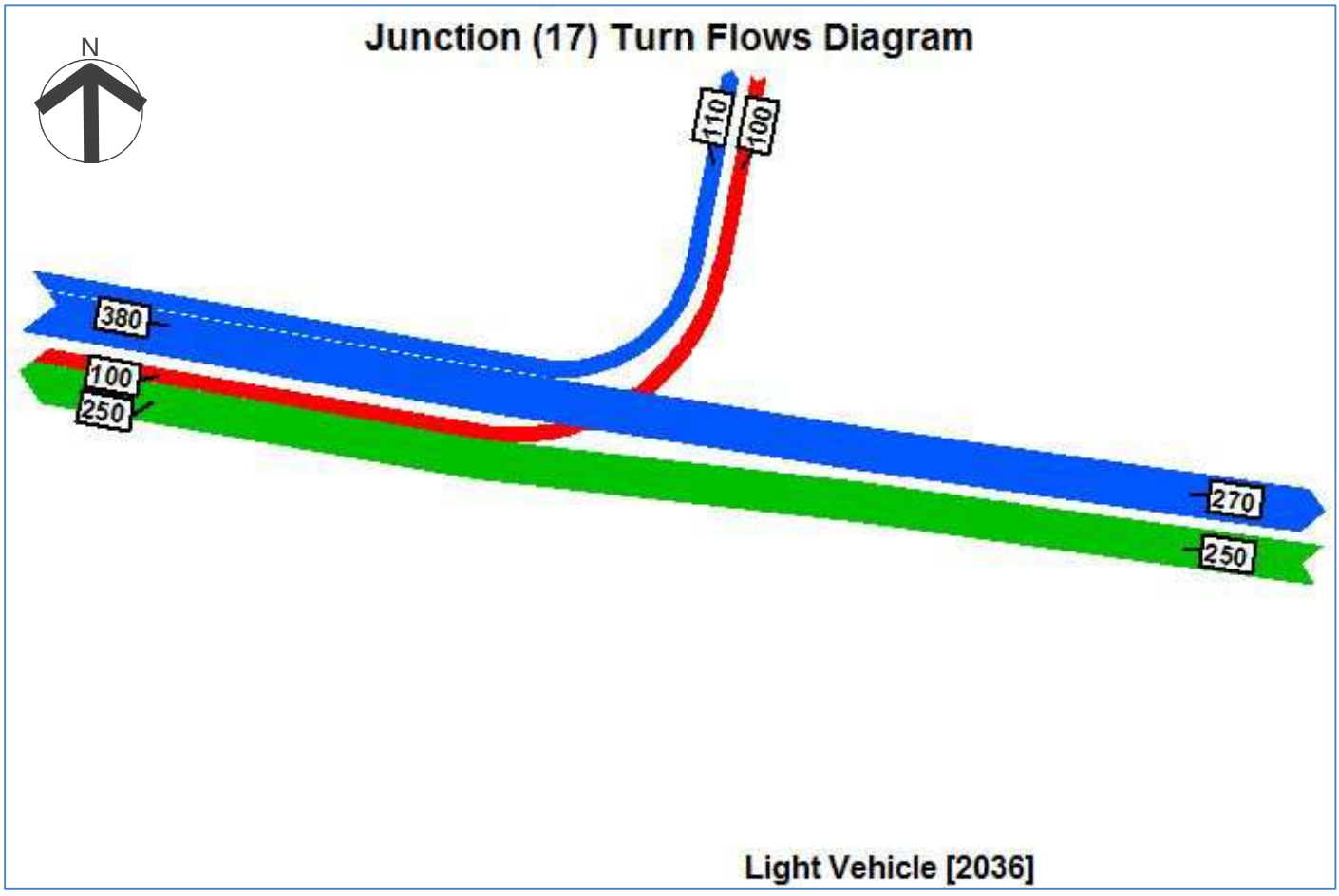
Site 16: Wharf Road & Service Road

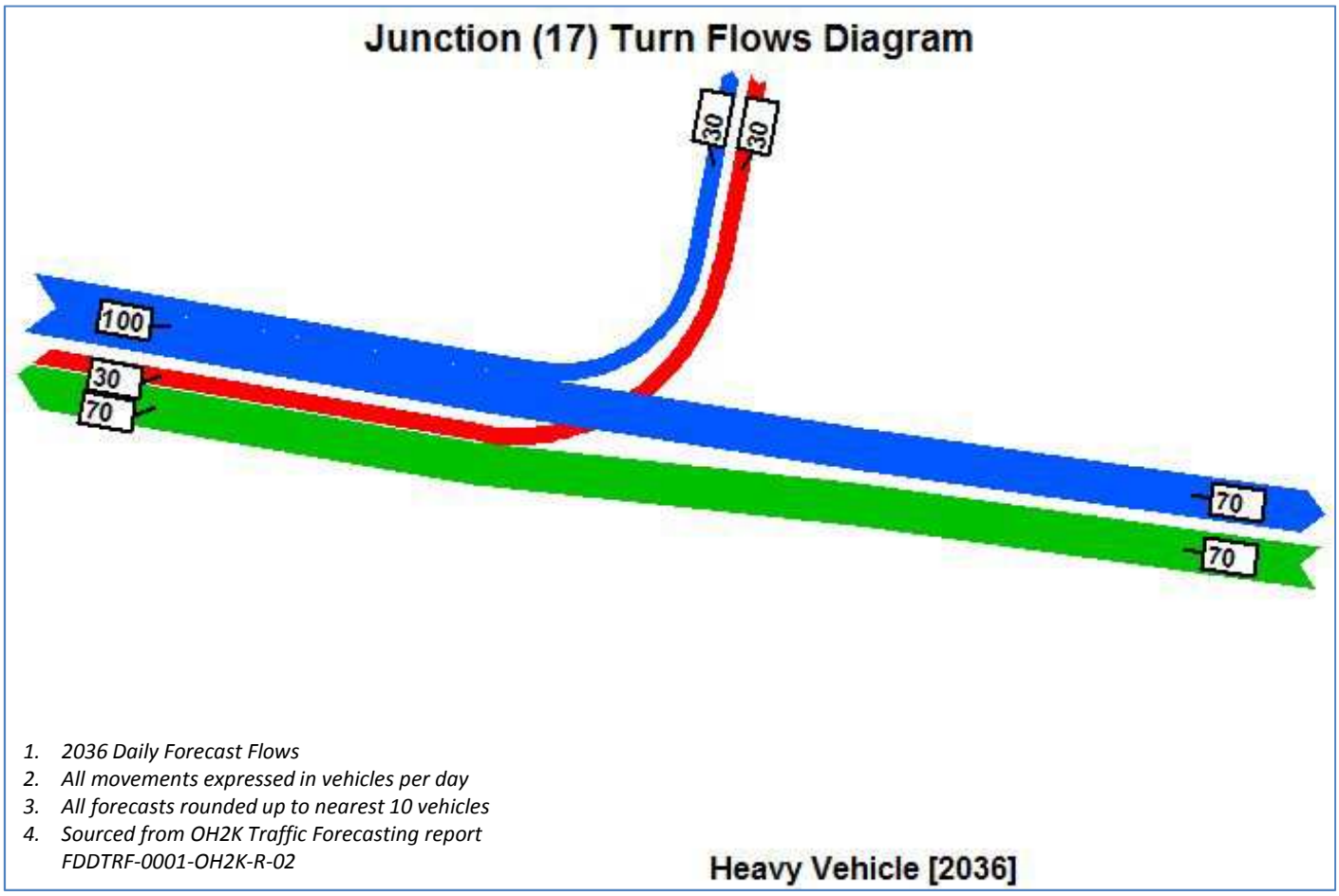




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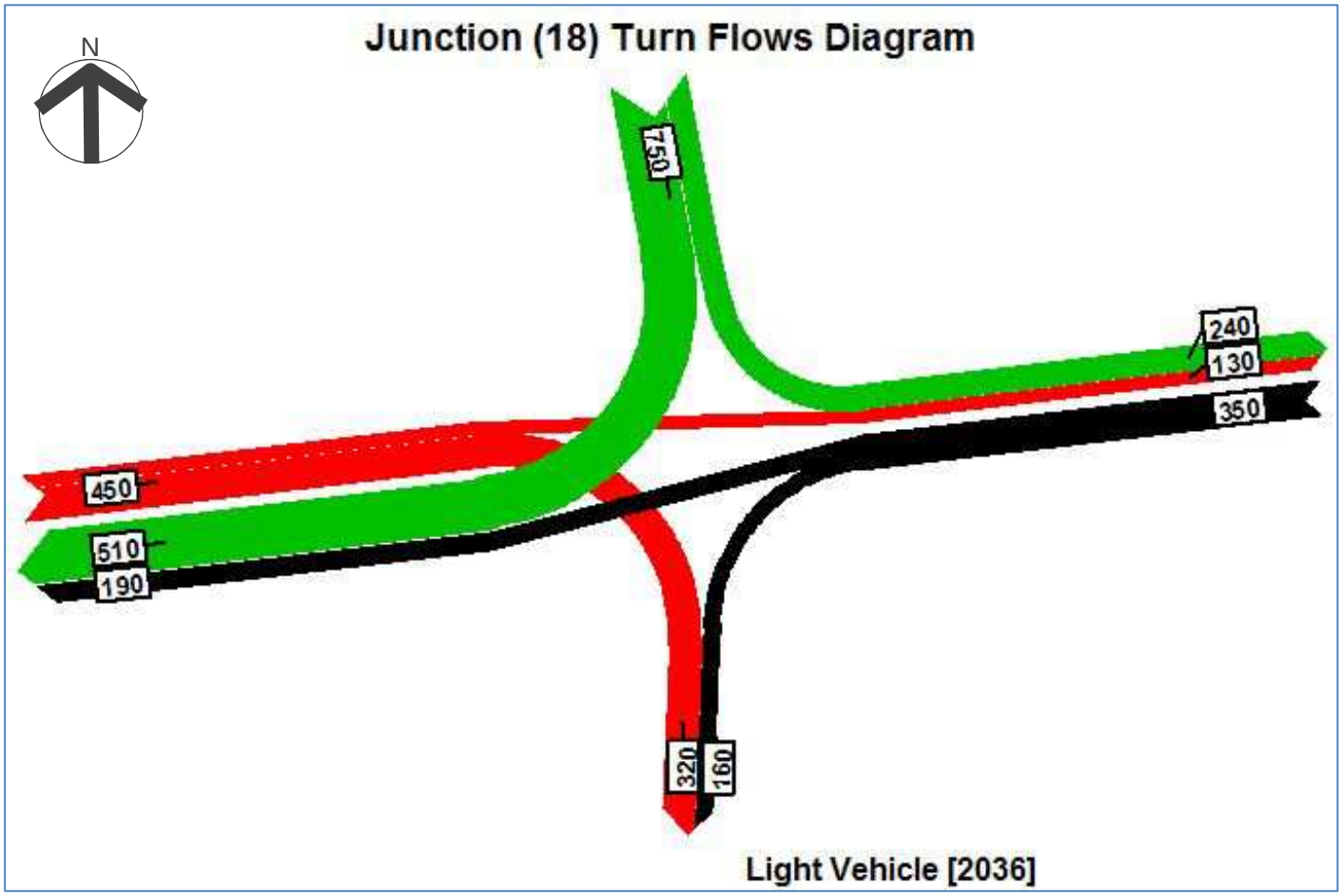
Site 17: Kundabung Road & Ravenswood Access Road

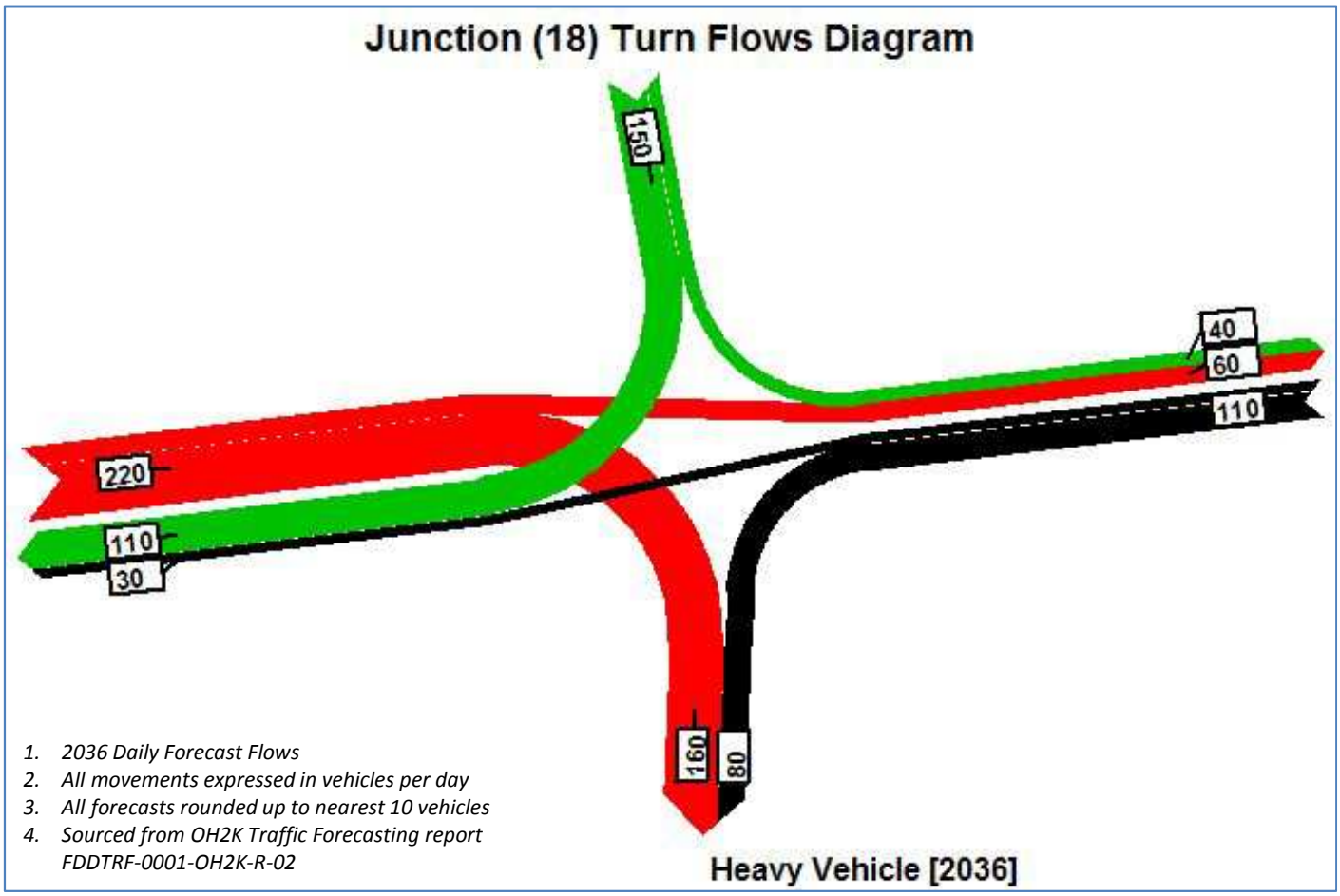




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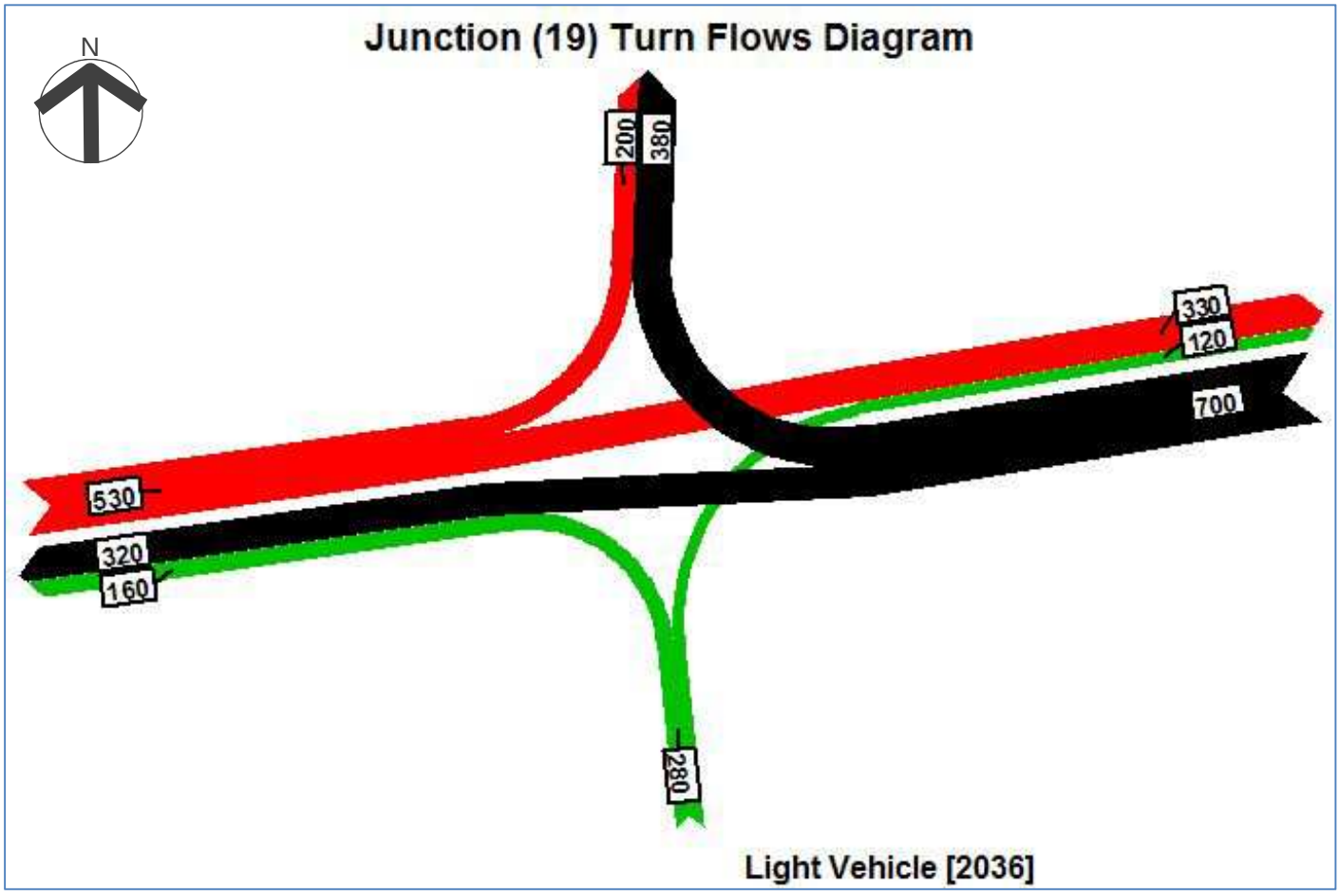
Site 18: Kundabung Road & SB On/Off ramps

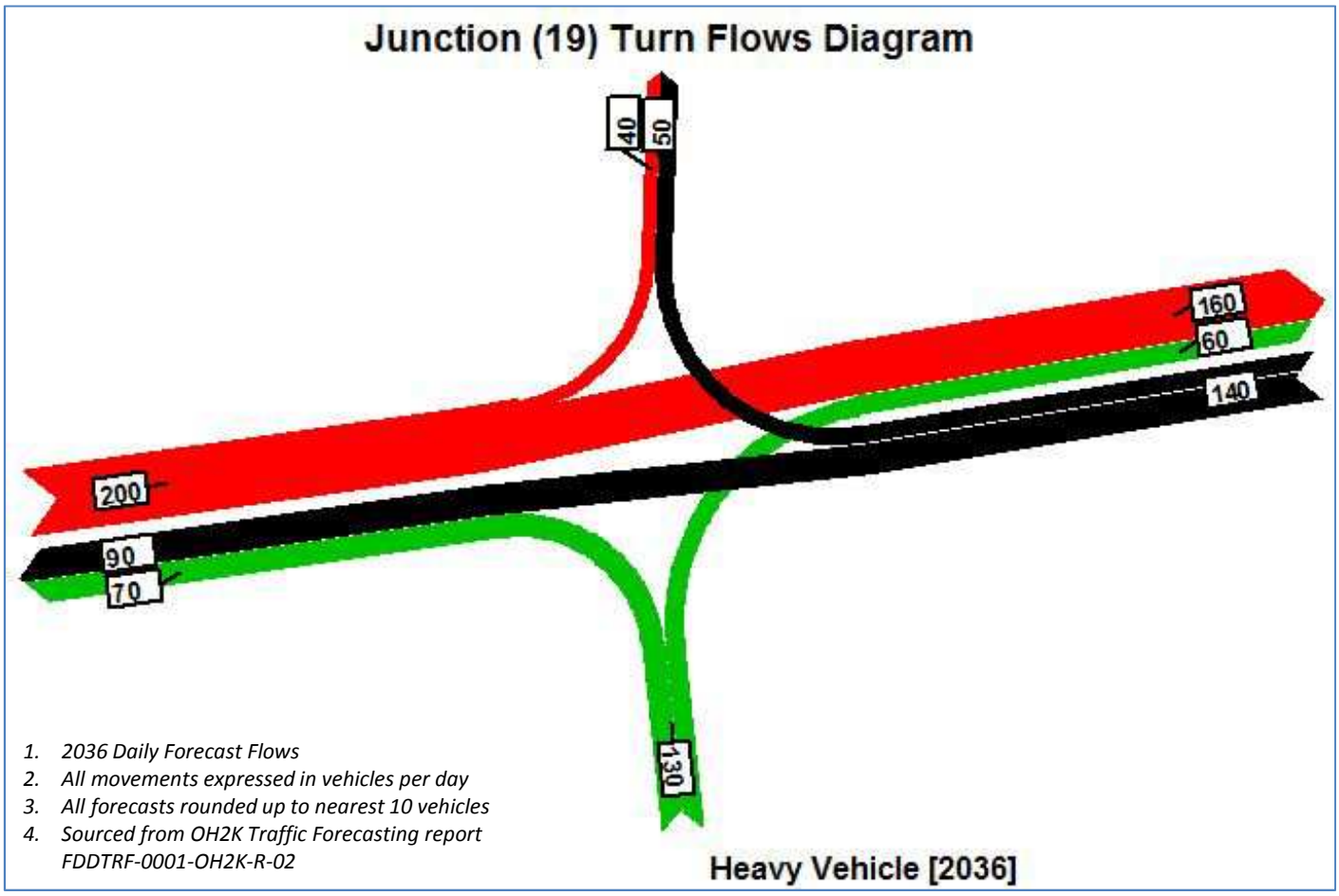




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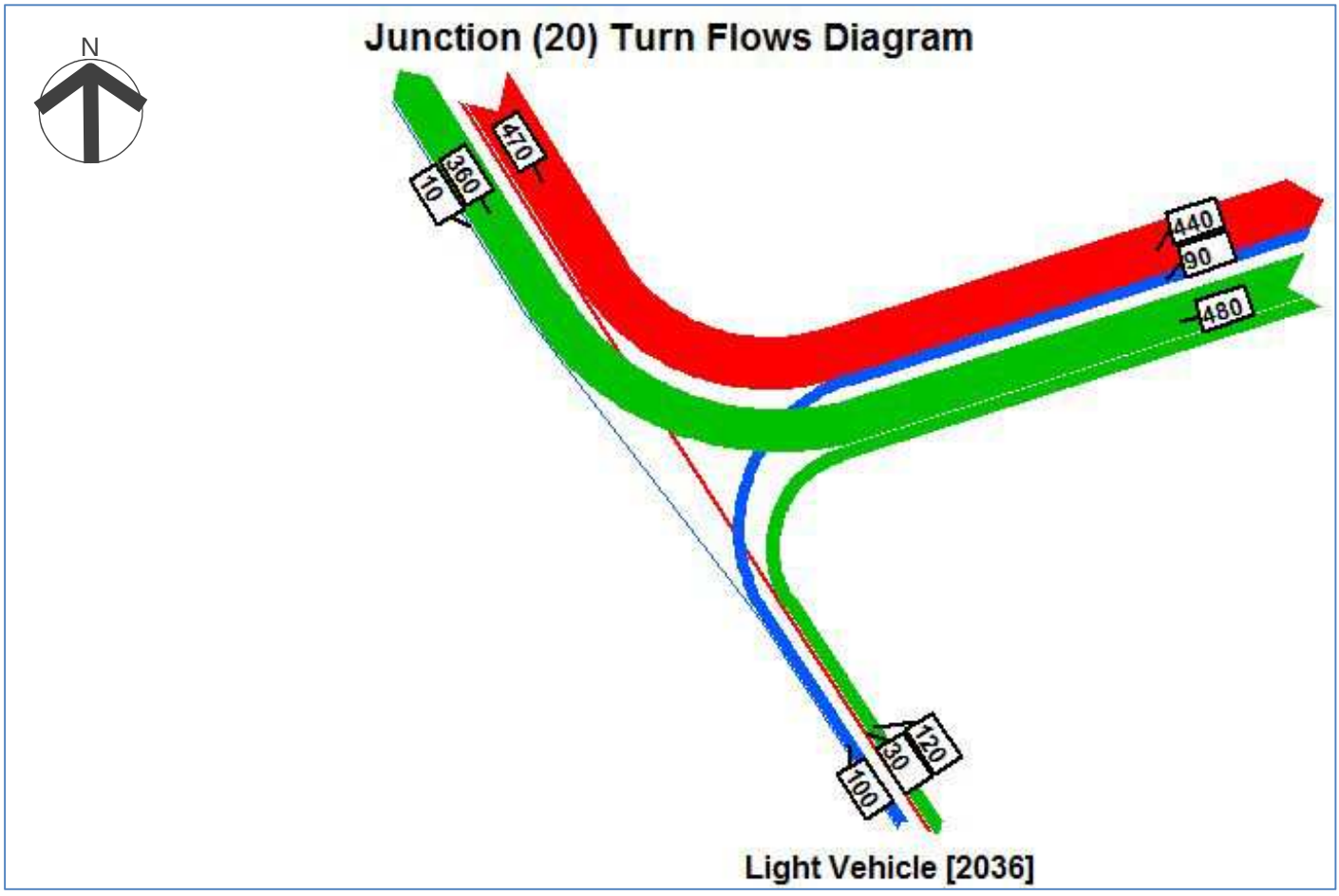
Site 19: Rodeo Drive & NB On/Off ramps

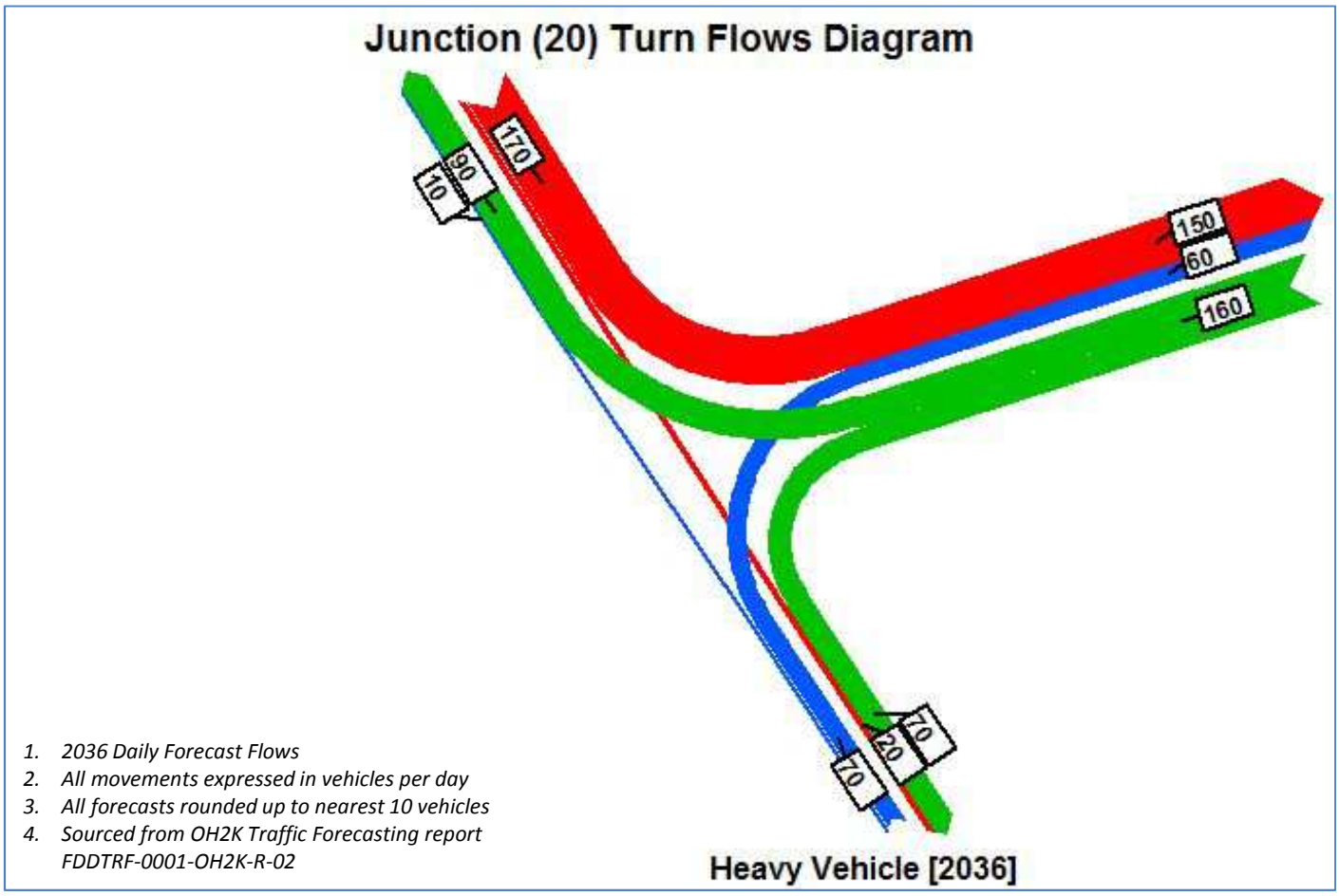




1. *2036 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

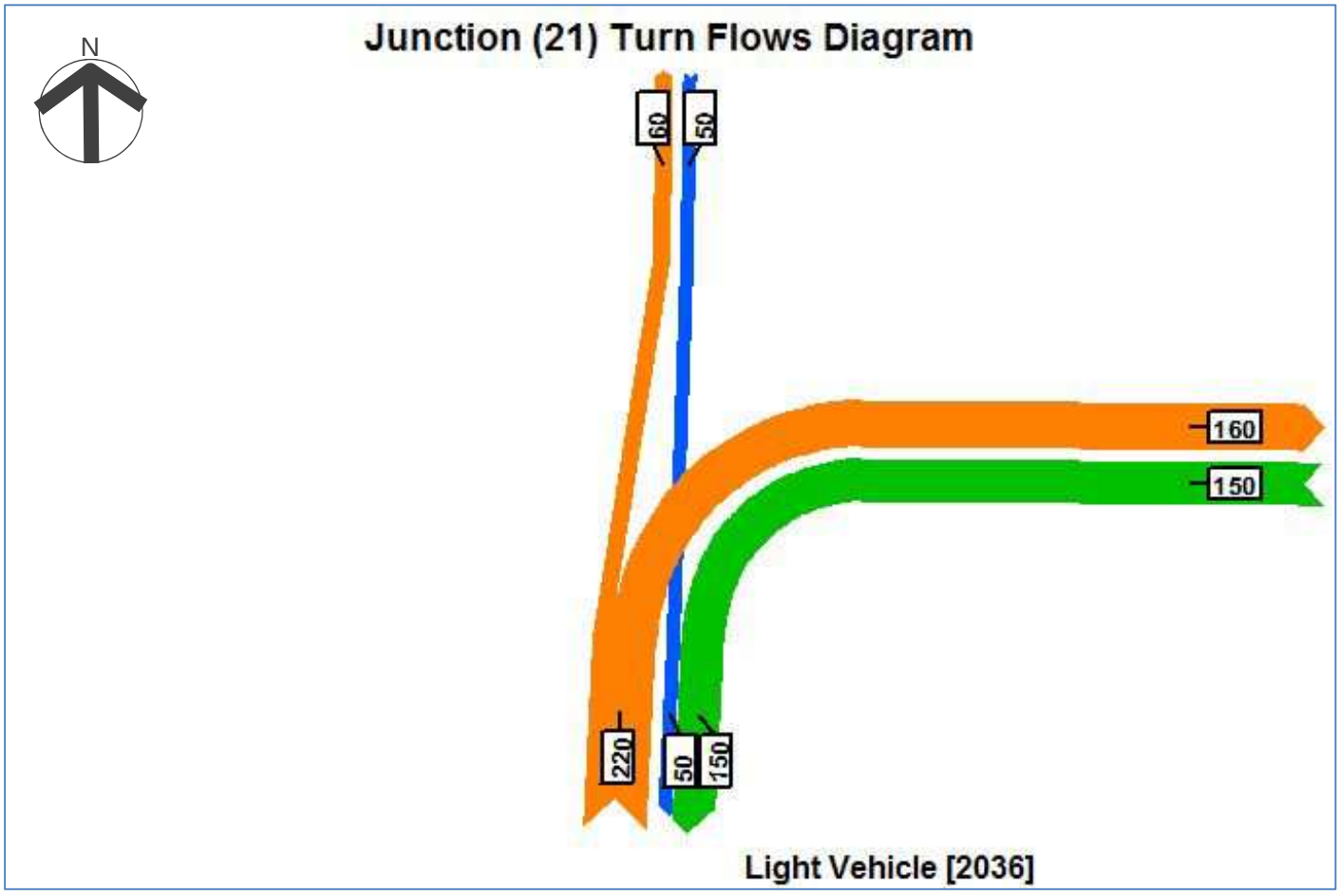
Site 20: Rodeo Drive & Service Road

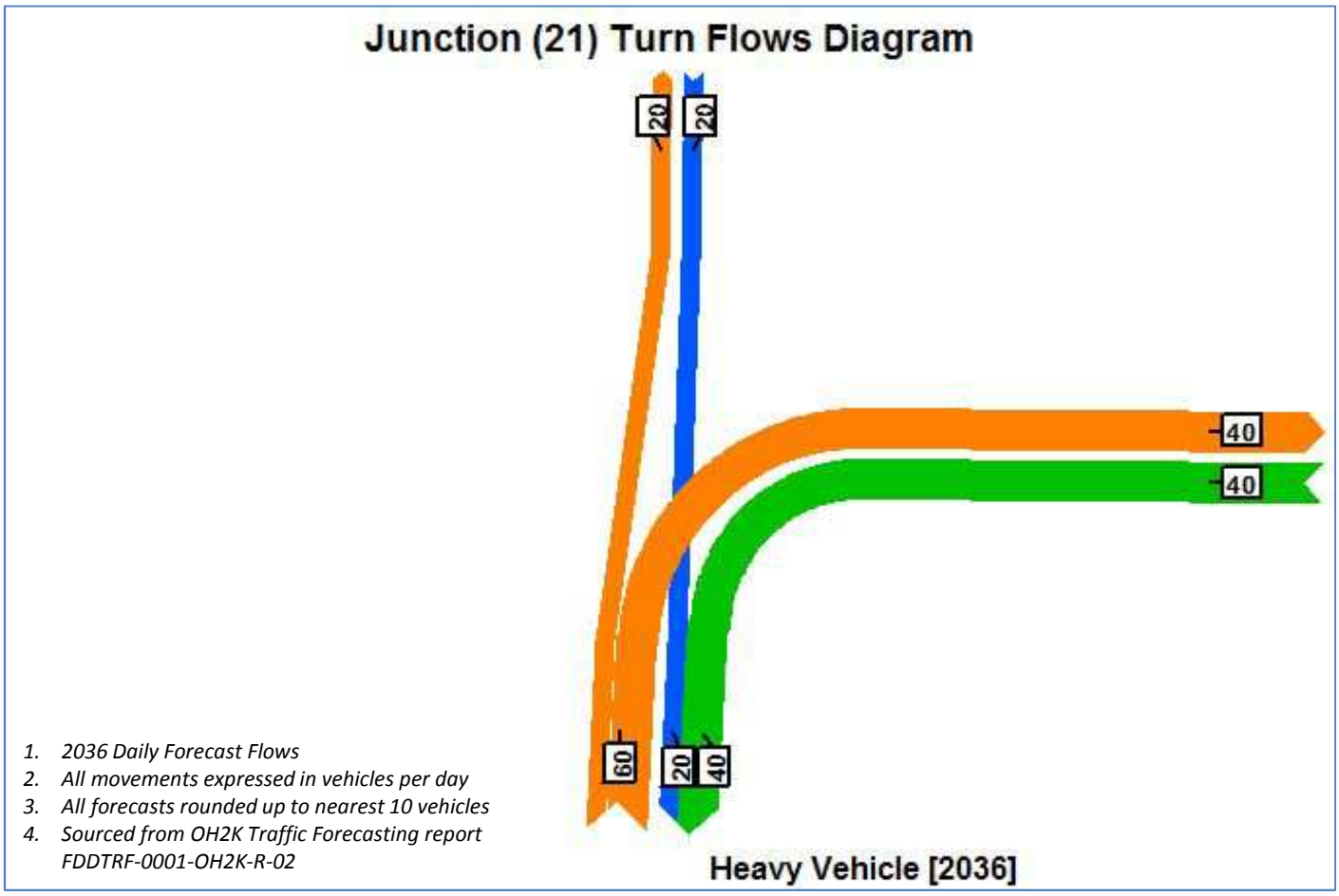




1. *2036 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

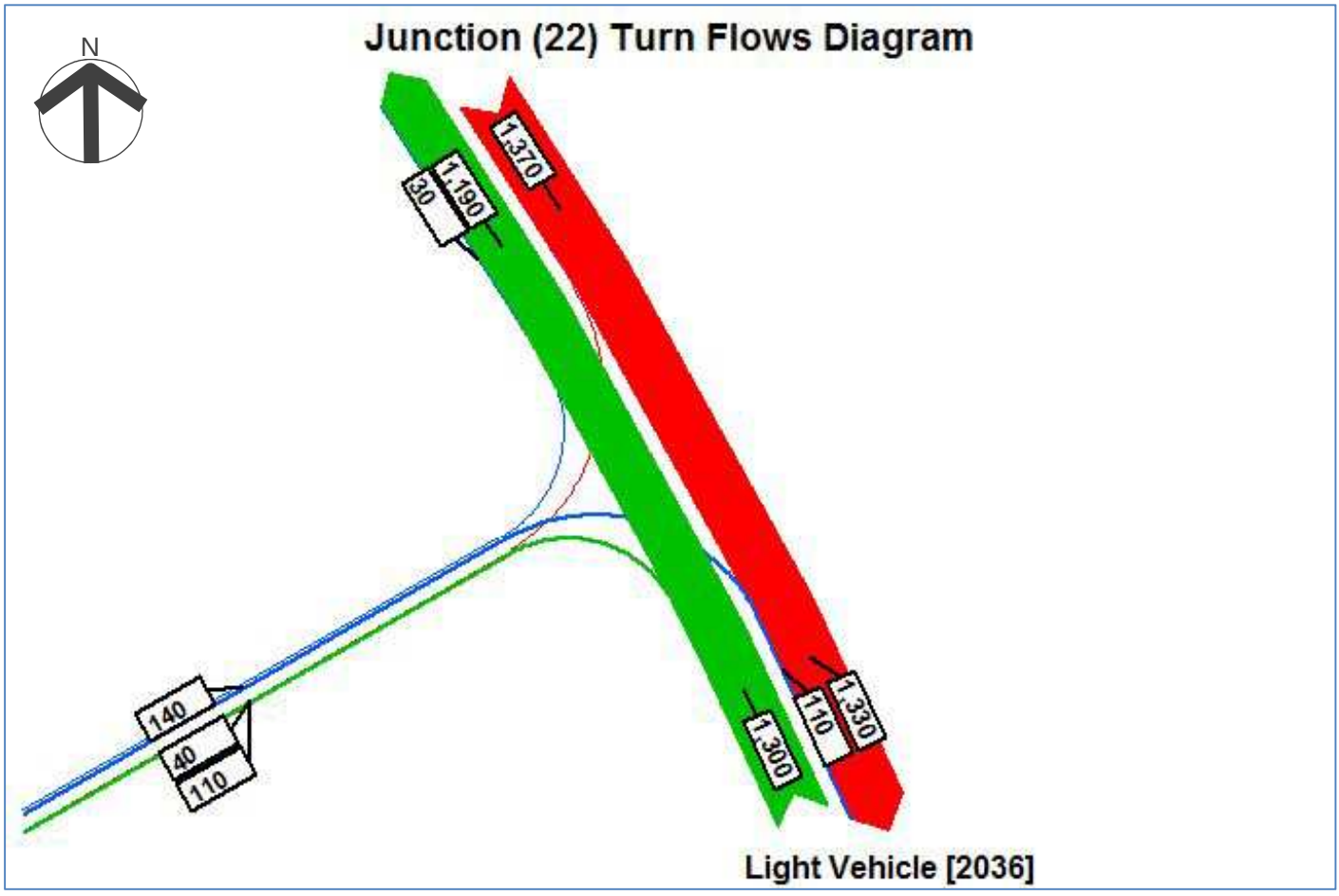
Site 21: Kemps Road & Service Road

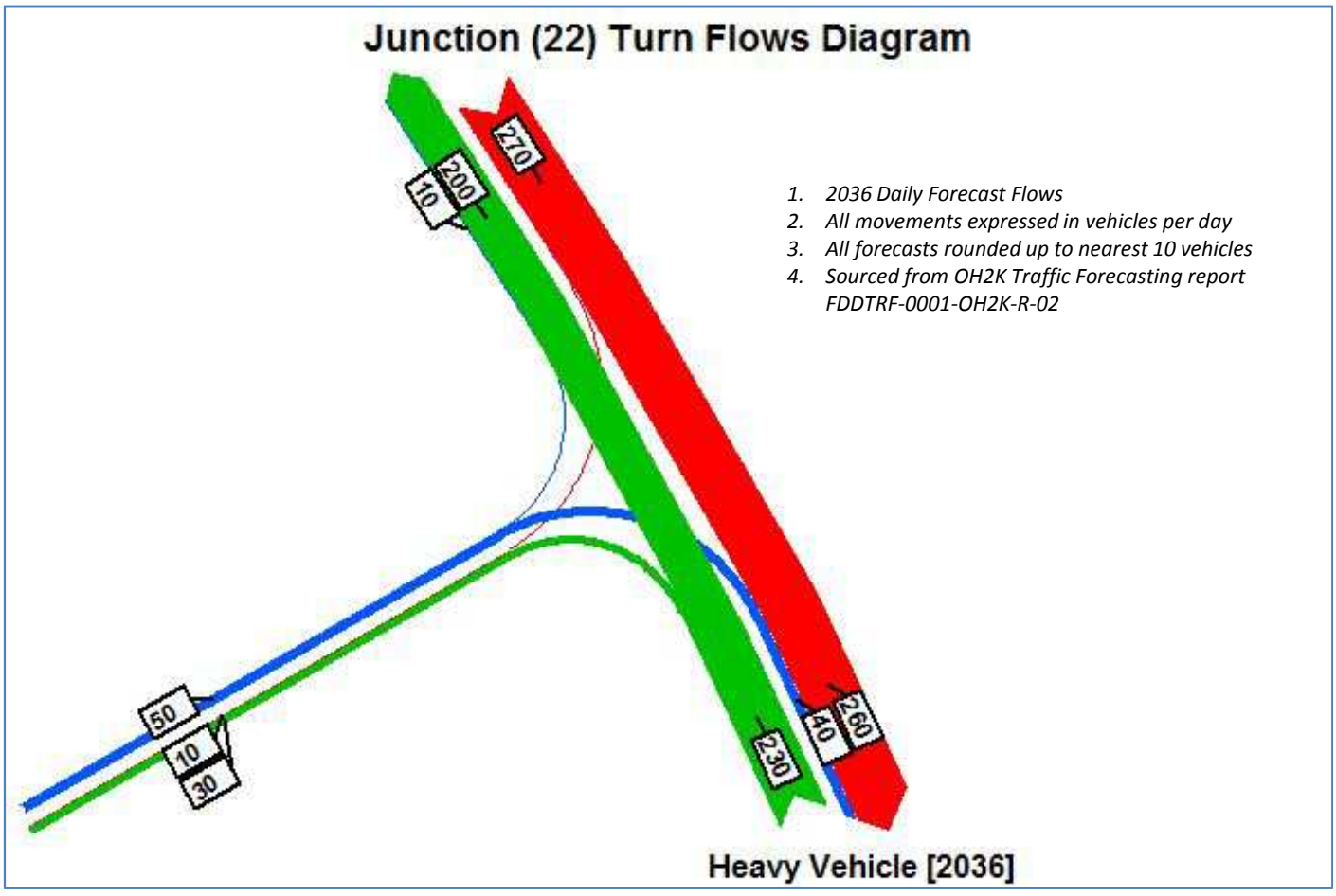




1. *2036 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

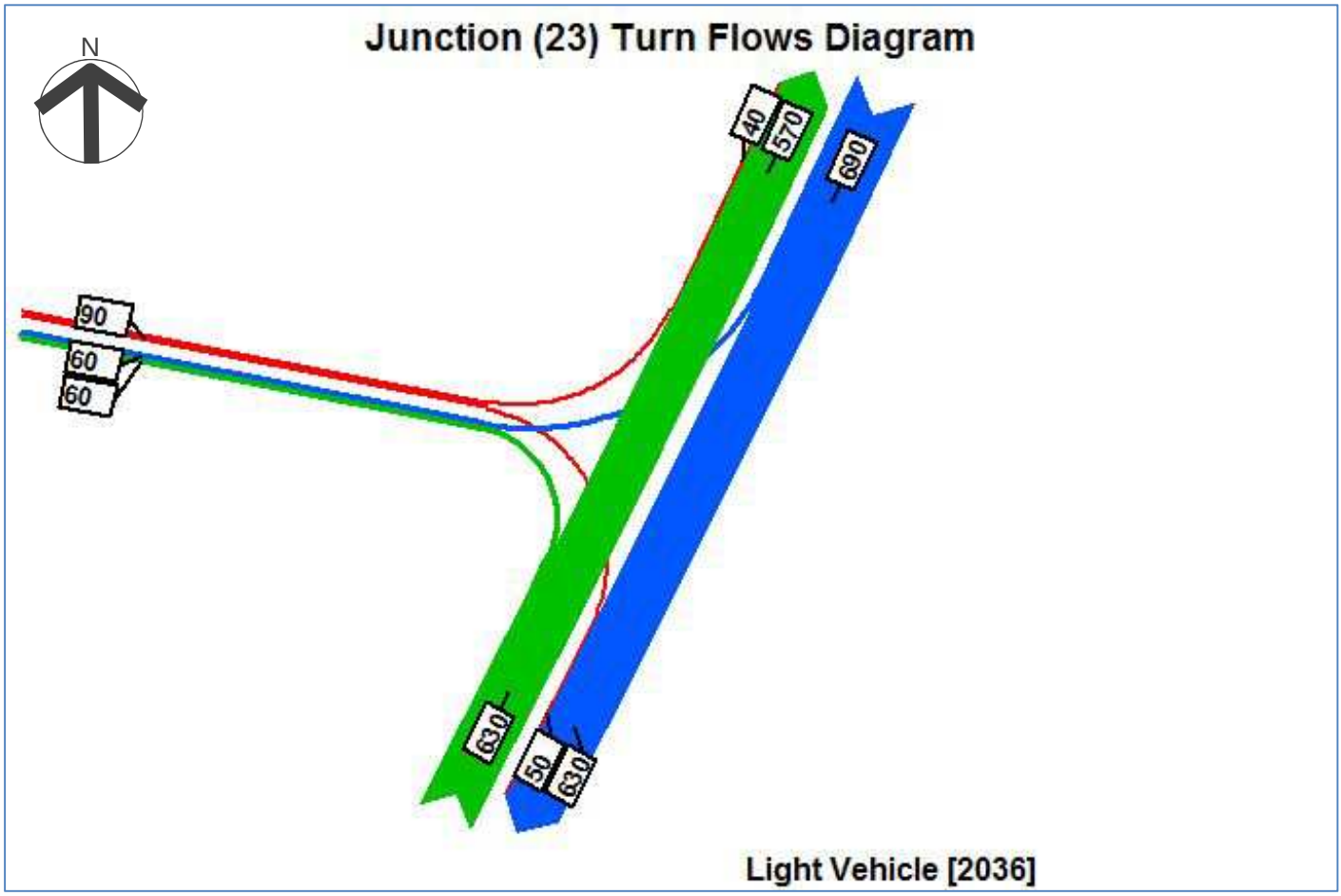
Site 22: Wharf Road & Service Road

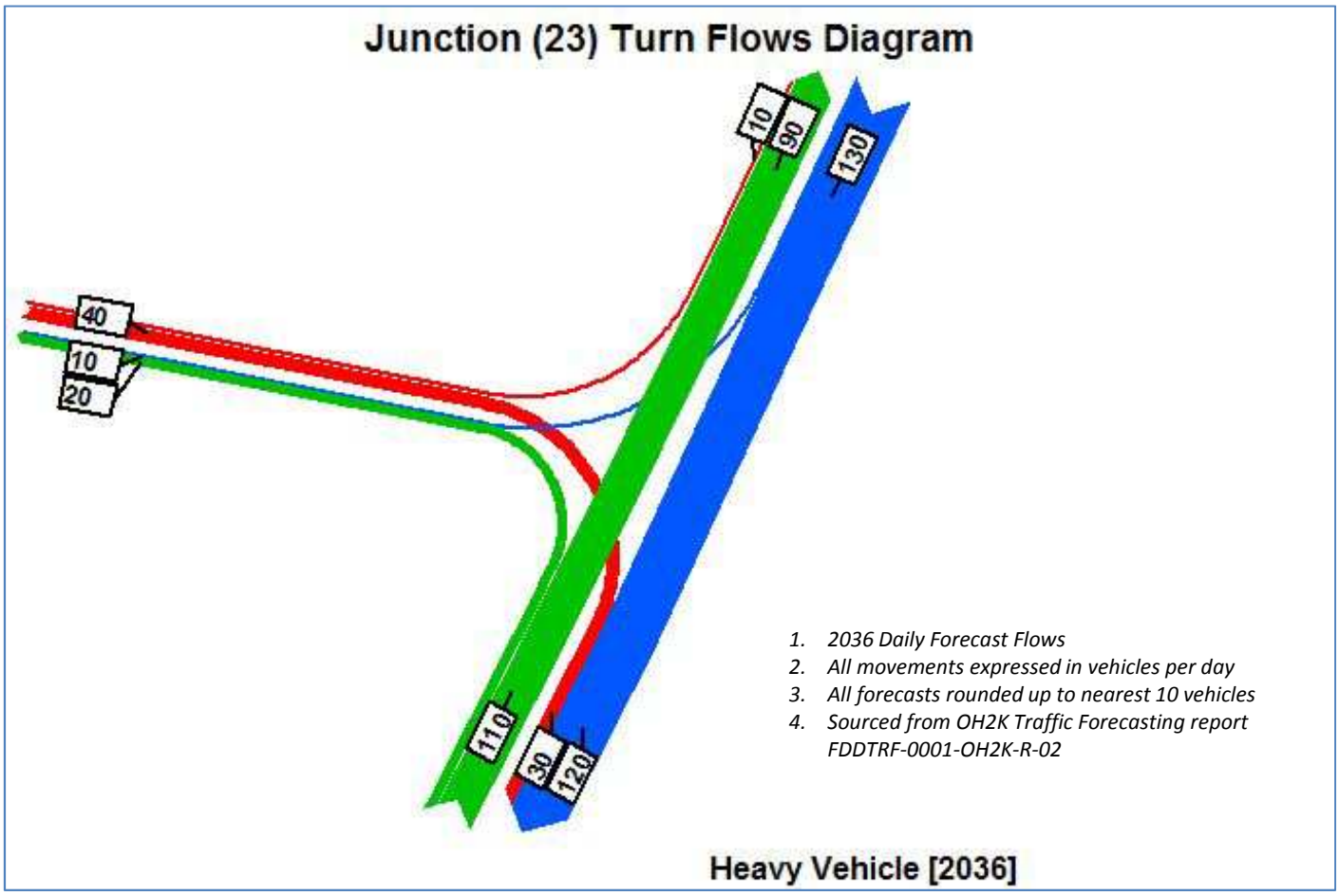




1. *2036 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

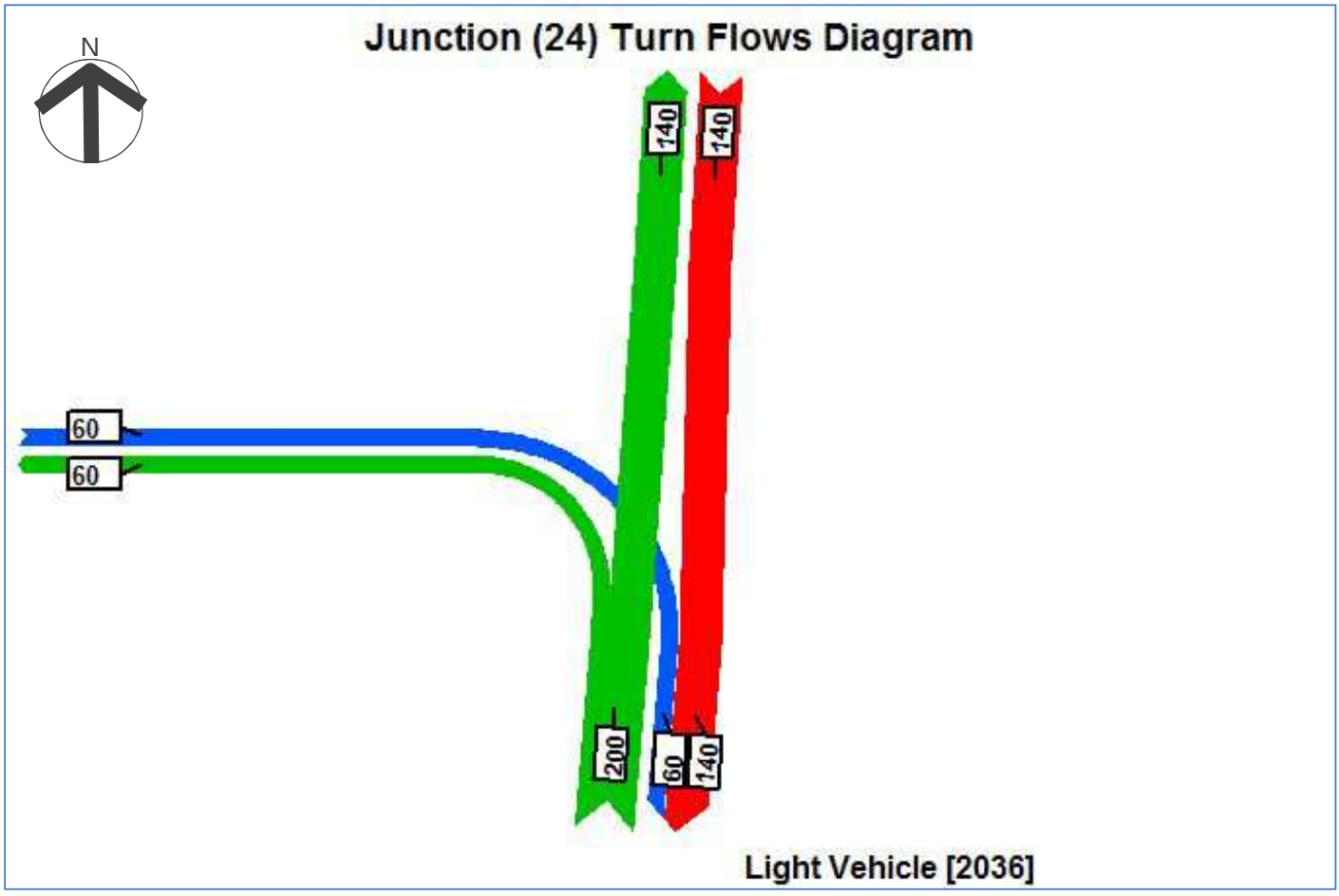
Site 23: Service Road & Haydons Wharf

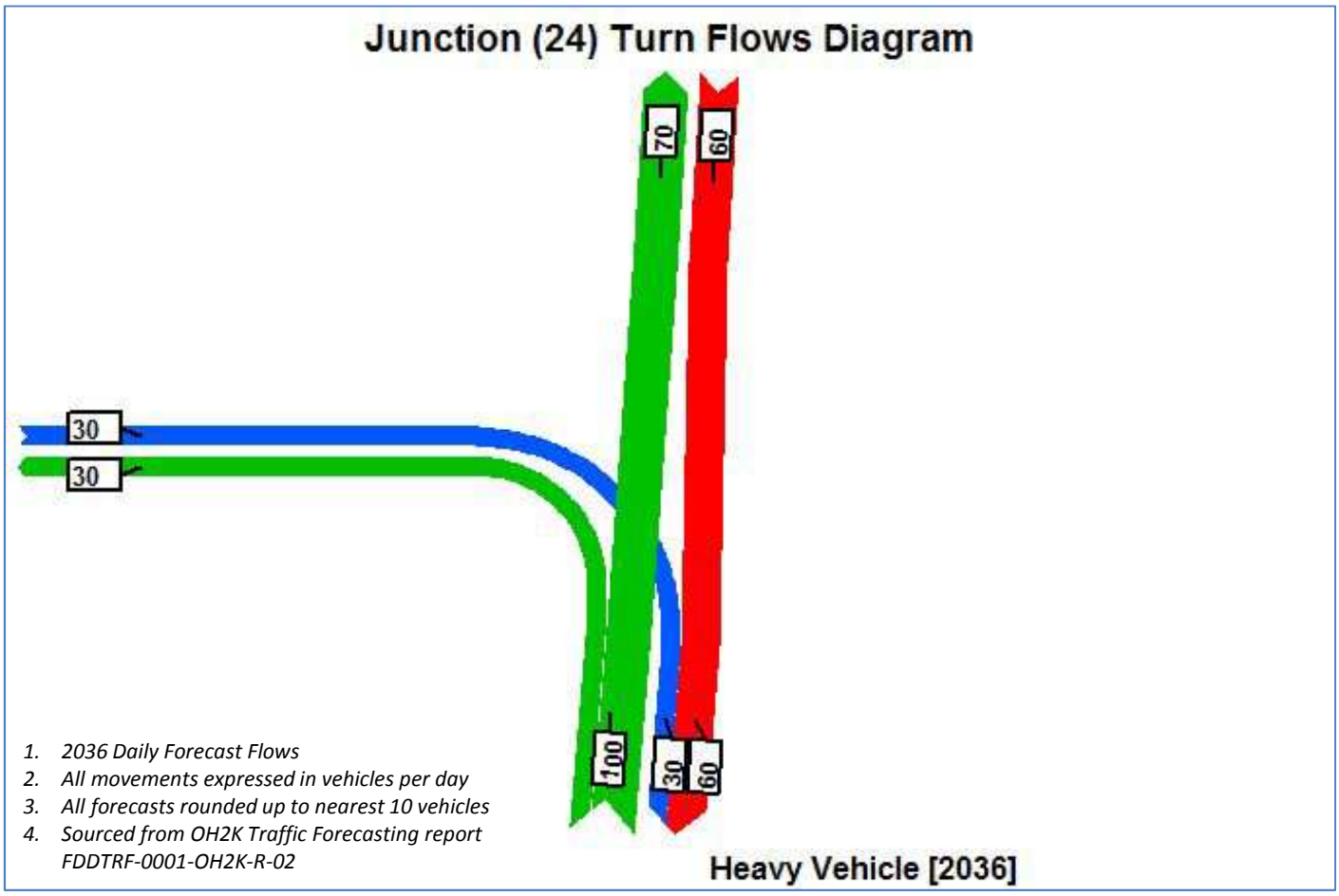




1. *2036 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

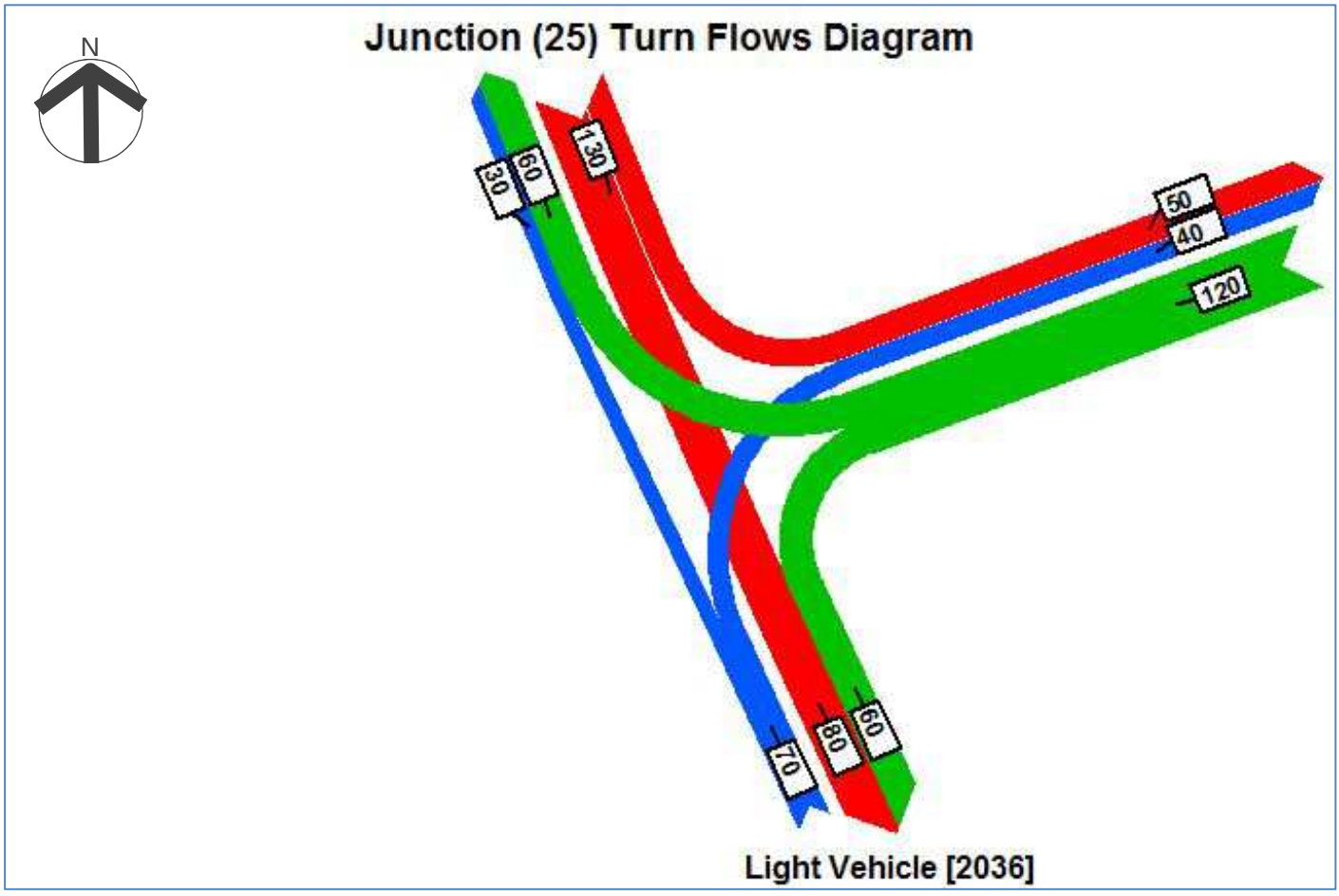
Site 24: Haydons Wharf Road & Zone J9

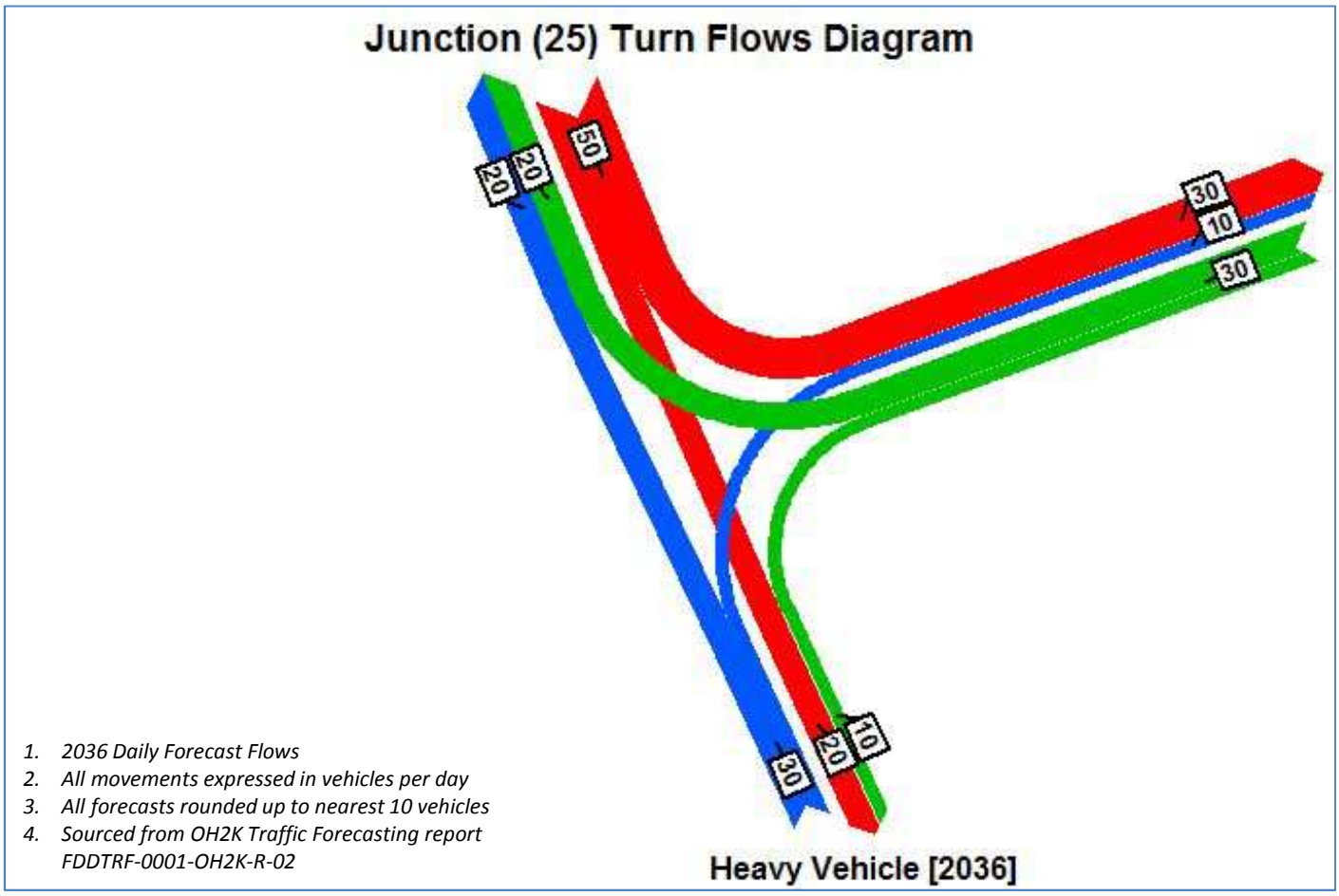




1. *2036 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

Site 25: Cooperabung Road & Haydons Wharf Road





1. *2036 Daily Forecast Flows*
2. *All movements expressed in vehicles per day*
3. *All forecasts rounded up to nearest 10 vehicles*
4. *Sourced from OH2K Traffic Forecasting report FDDTRF-0001-OH2K-R-02*

APPENDIX J

IV & RMS COMMENTS REGISTER

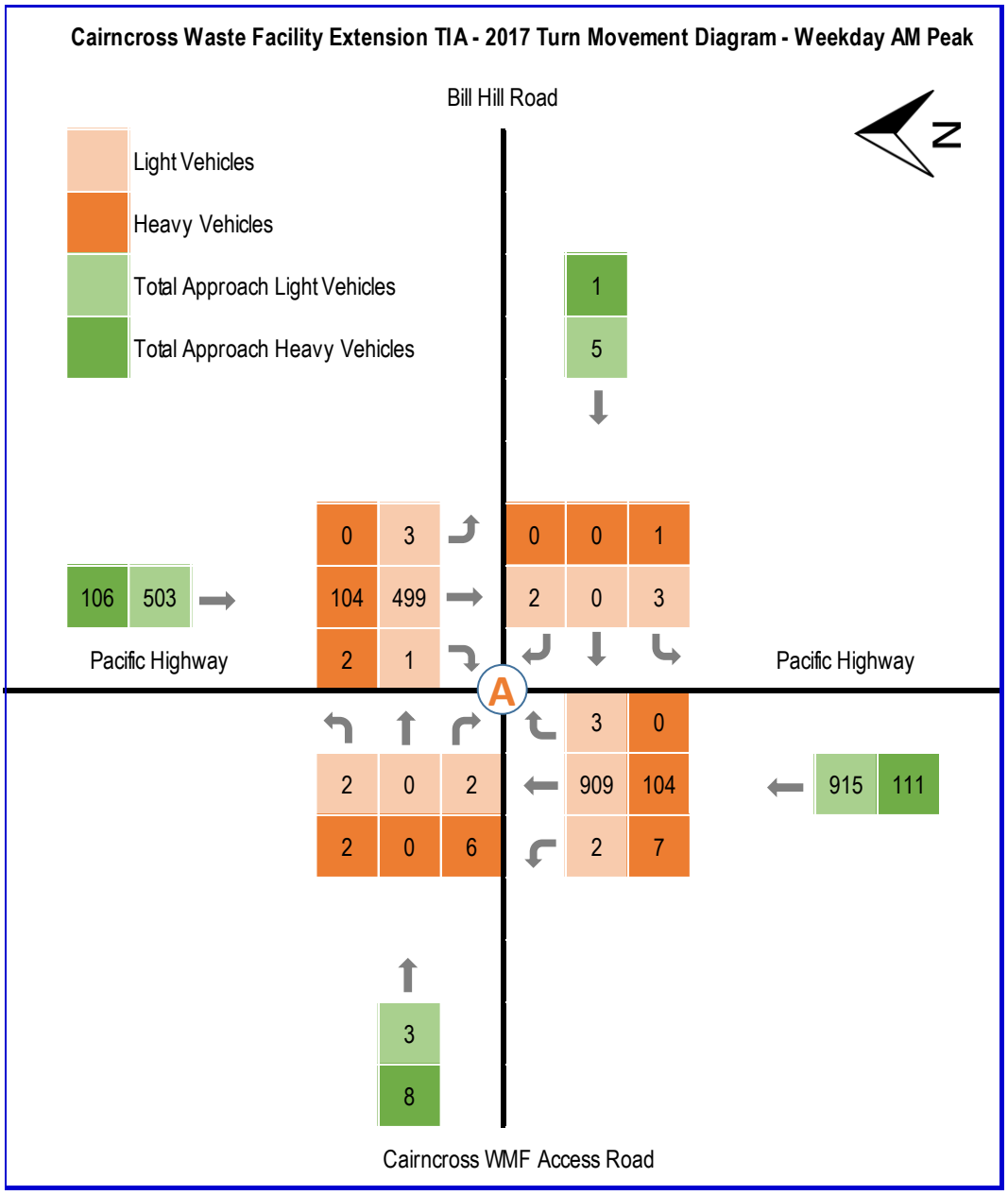
SMEC + Hyder Joint Venture	OH2K			DESIGN REVIEW RECORD	
	Zone	**Design Discipline**	**Design Lot Number(s)**	**Reviewed by discipline/name**	
	All	Traffic	DDTRF01	IV Comments Combined	
Document / Drawing Number(s):	**Document Title:**			**Design Phase:**	**Document Date**
Report: FDDTRF-0001-OH2K-R-02	Traffic Forecasting Report				19 June 2013

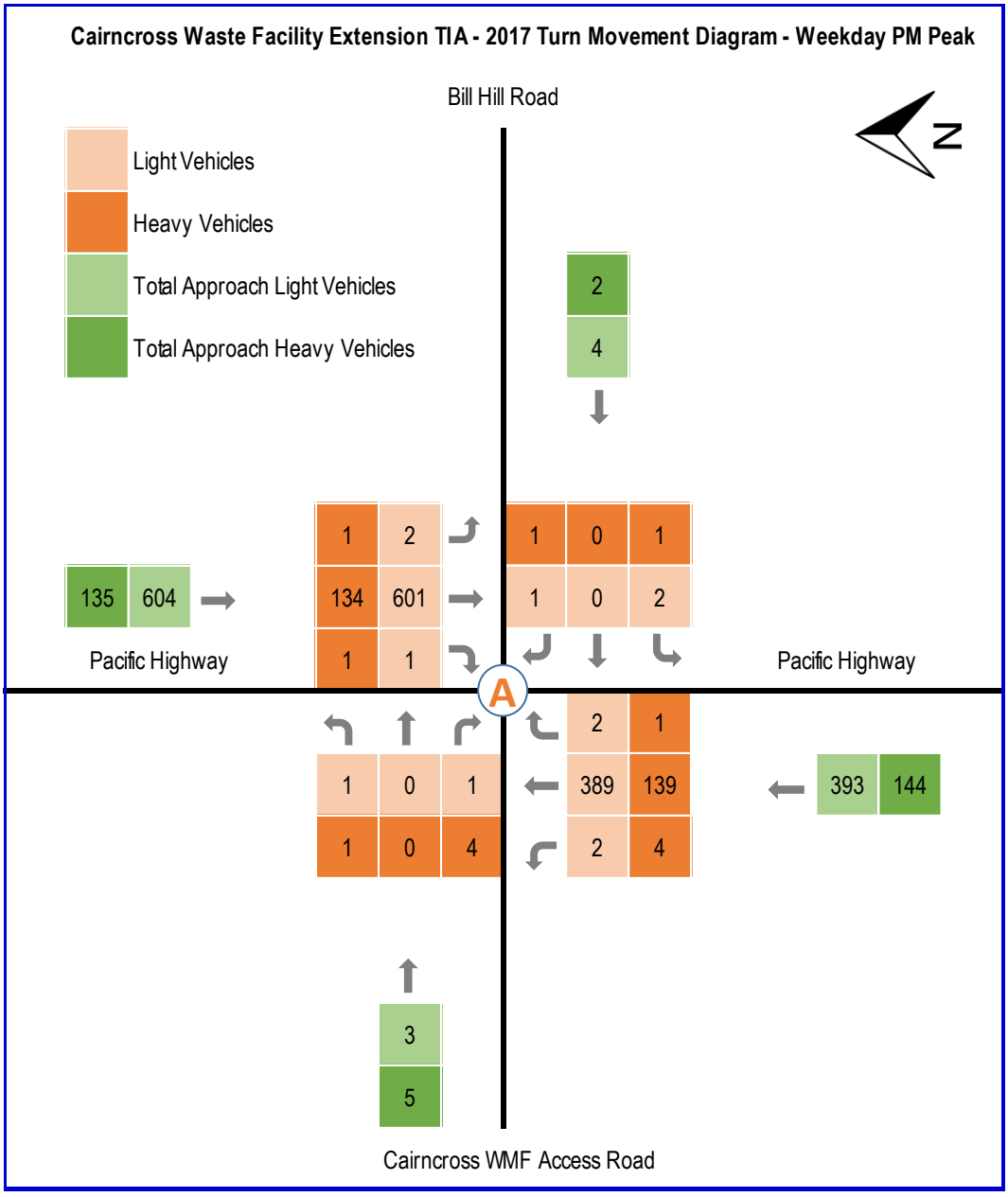
Resolved by:
ACTION "I" = Design Engineer's Information contained in Response
ACTION "R" = Comments addressed in Design Report or Document (e.g. Plan, Specification, Tech Memo, Audit)
ACTION "D" = Comment addressed by Design drawing revision and re-issue

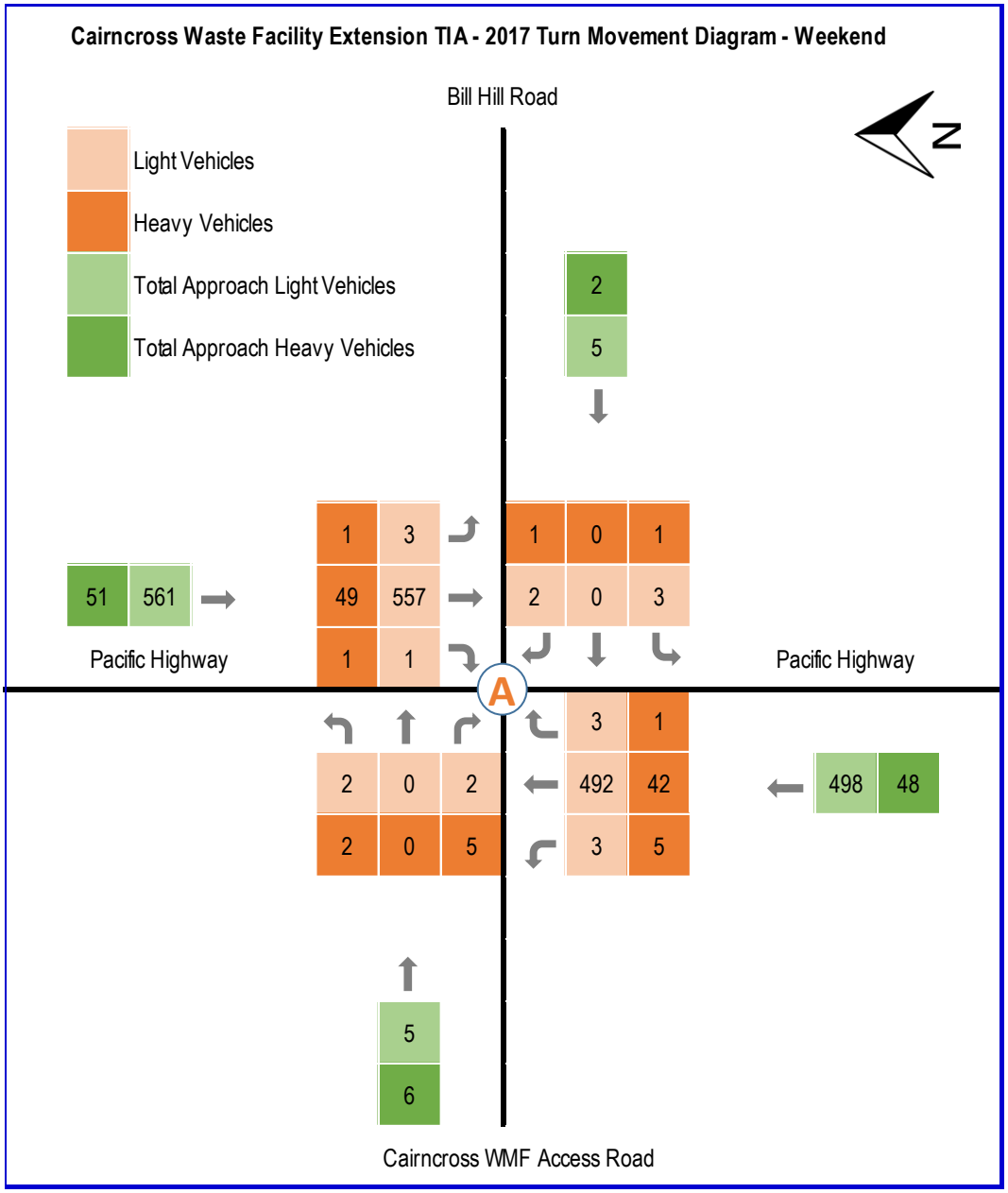
Closeout: Record date of closeout by Reviewer/Approver.
Responsible designer to seek closeout of all comments prior to submission of revised design.

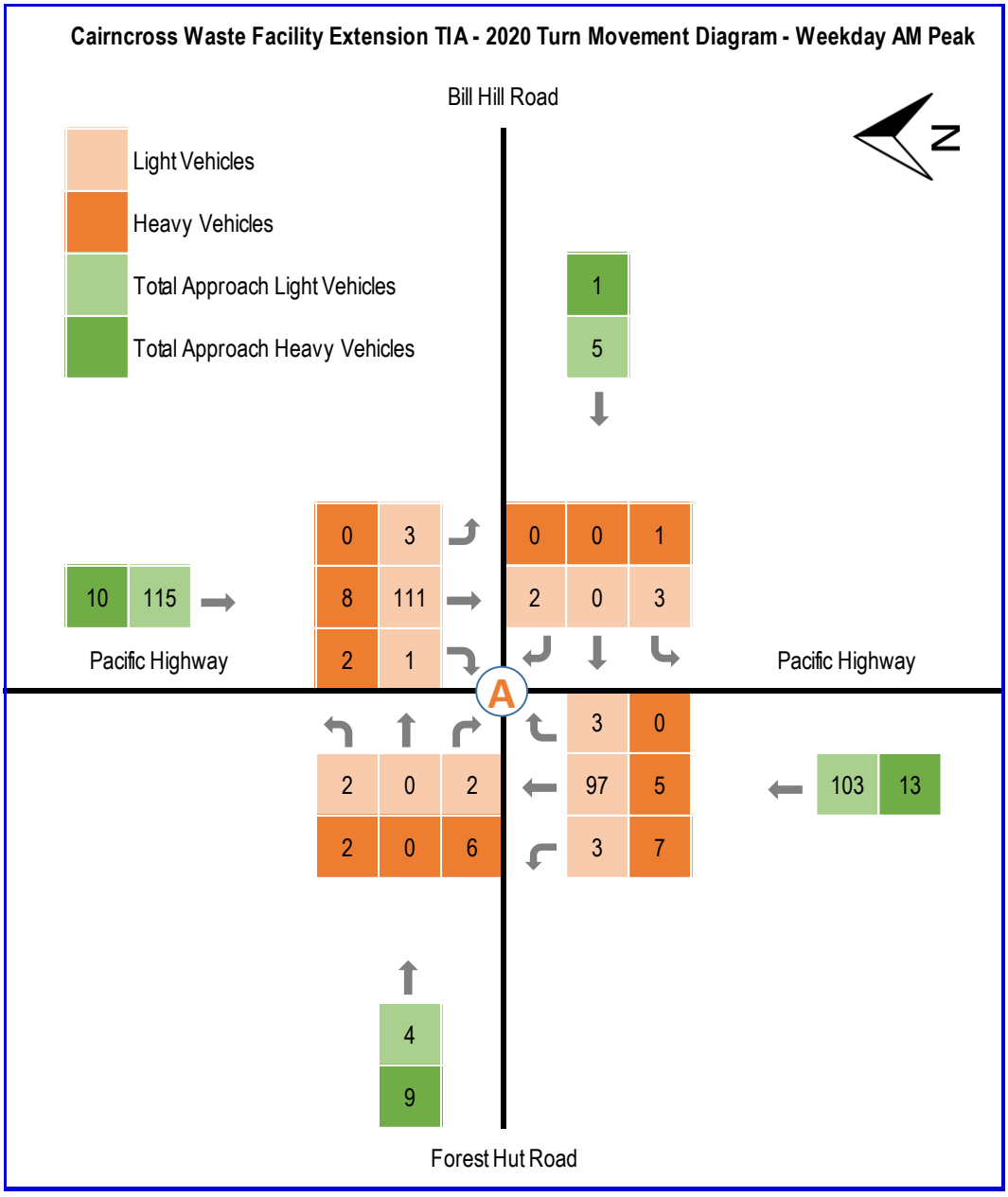
Comment No.	Item	Discipline	Date	Reviewer	Drawing No./Section	Comment	Designer Response	Action (I-R-D)	Closeout	DM - Applicability				DM - Action
										SAN	NEW	DDS	DDN	
IV_15DD-001	1	Traffic	11/1/2012	Sachin Prasad	Report FDDTRF-0001-OH2K-R-02 Section 1.1	The objectives of the project have been outlined, however this does include the traffic and transportation objectives or design criteria.	The project objectives are considered most appropriate for this strategic level review. There are no specific traffic & transportation objectives or design criteria relevant to this package.		19/06/2013 (S.Prasad)					
IV_15DD-002	2	Traffic	11/1/2012	Sachin Prasad	Report FDDTRF-0001-OH2K-R-02 Section 5.1 and 5.2	Historic traffic data was analysed to derive growth forecast for strategic traffic on Pacific Highway. Based on the analysis, a linear growth factor of 2.8% was adopted for the strategic traffic on Pacific Highway. The 2.8% growth factor is significantly lower than the growth factor assumed by the original EA forecasts (4%) by GHD. While the growth factor assumed was based on analysis of historic traffic data, it is unclear why a significantly higher factor (i.e. 4%) was adopted in the original EA forecast	It is a bit unclear why the original growth rate of 4% was adopted for the EA. Our report documented a transparent analysis of historical growth patterns to derive the new rate of 2.8%. This was subsequently accepted by RMS as a more appropriate growth rate for this section of the Highway.		19/06/2013 (S.Prasad)					

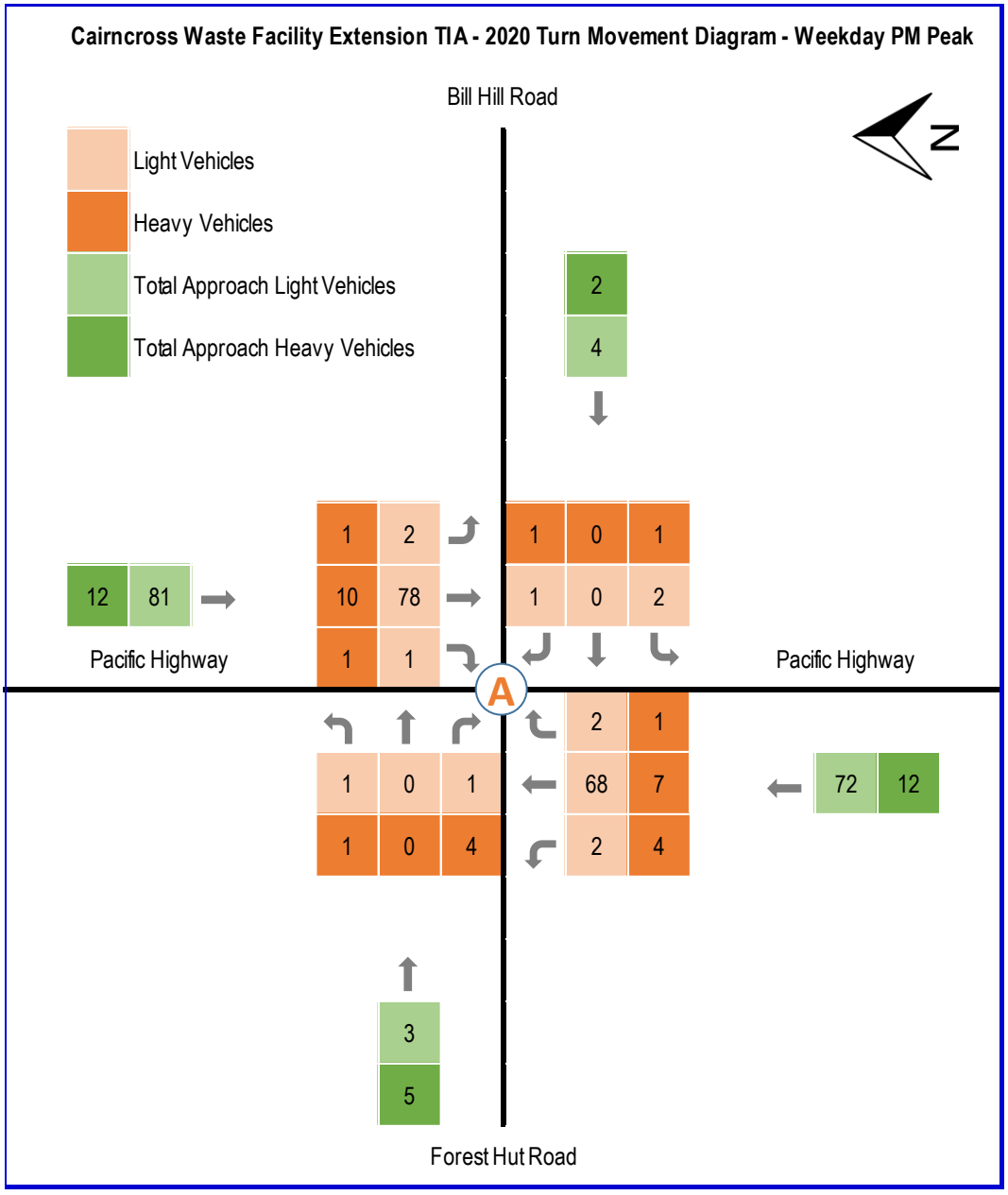
APPENDIX B TURN MOVEMENT DIAGRAMS

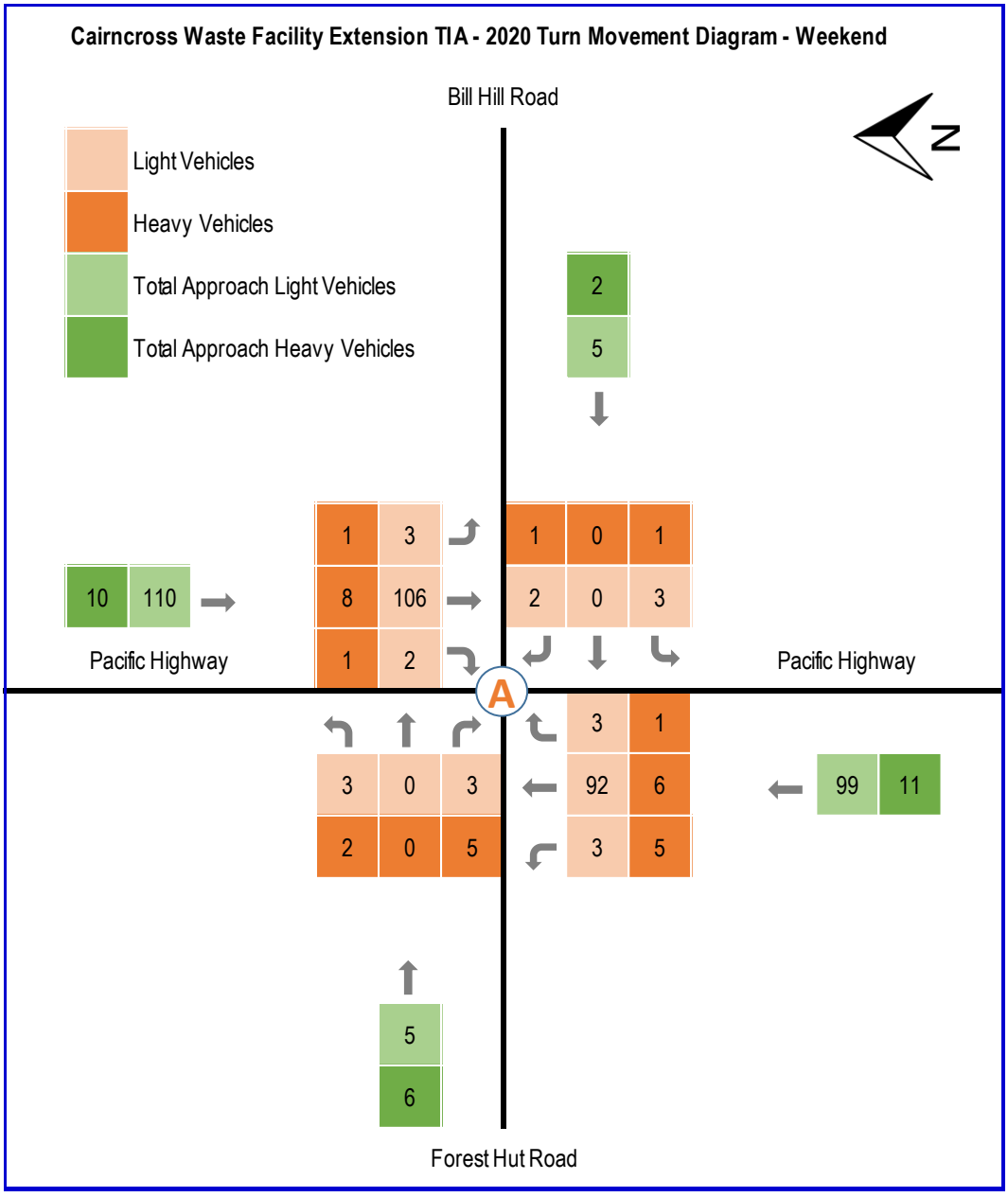


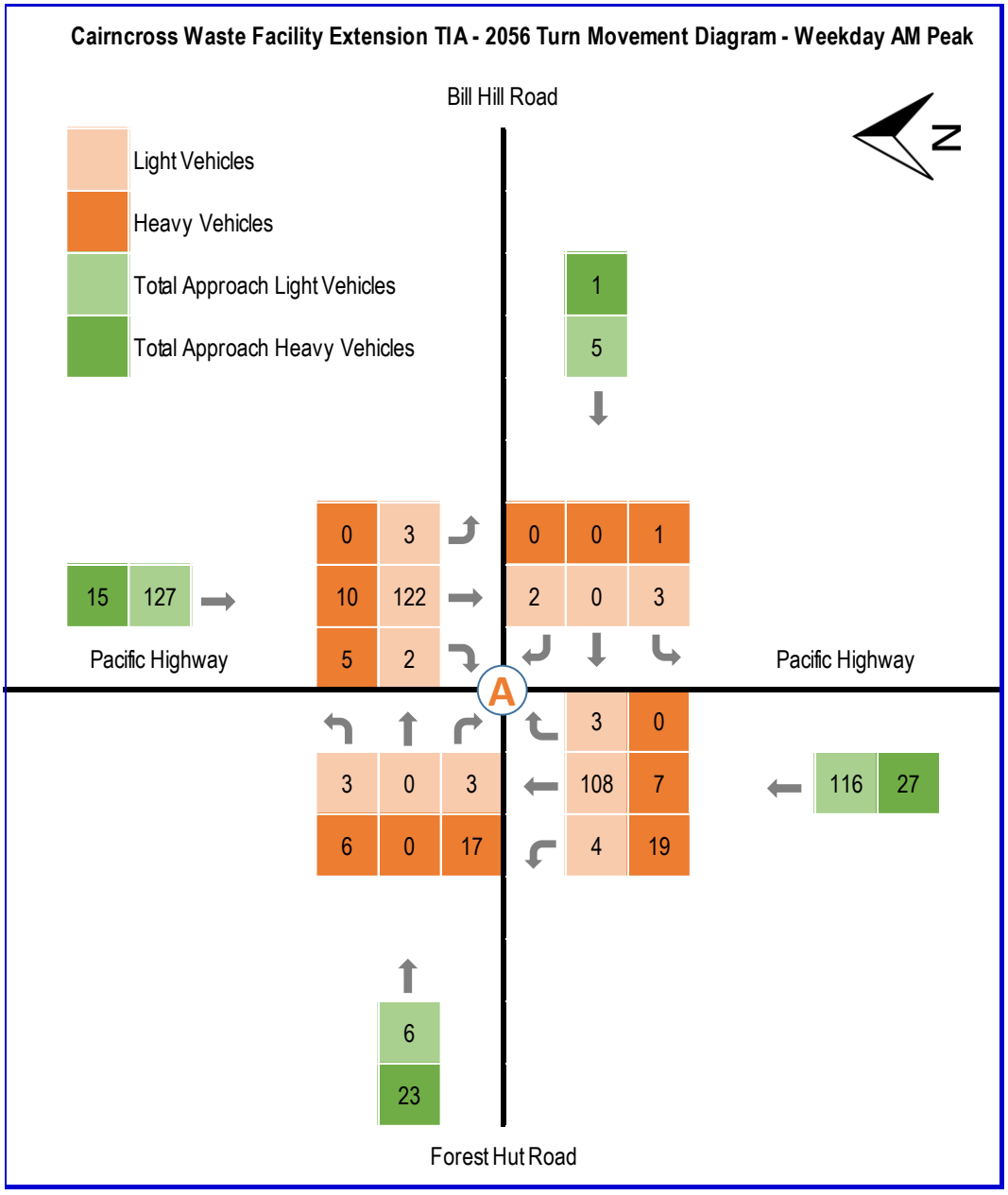

Cairncross Waste Facility Extension TIA - 2017 Turn Movement Diagram - Weekday PM Peak
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
2
4
1
2
1
0
1
135
604
134
601
1
0
2
Pacific Highway
1
1
Pacific Highway
A
2
1
1
0
1
389
139
393
144
1
0
4
2
4
3
5
Cairncross WMF Access Road

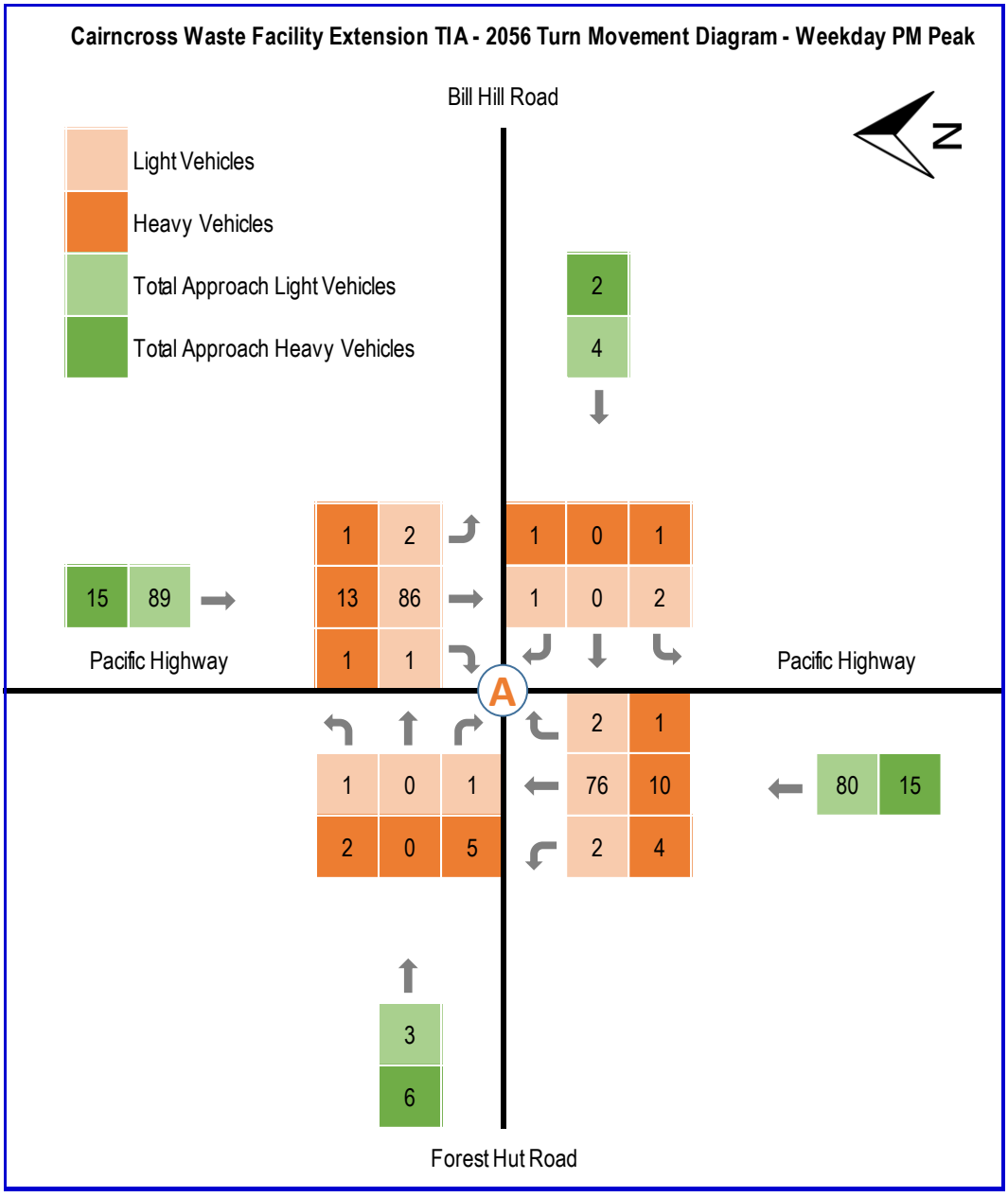

Cairncross Waste Facility Extension TIA - 2017 Turn Movement Diagram - Weekend
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
2
5
1
3
1
0
1
51
561
49
557
2
0
3
1
1
Pacific Highway
A
Pacific Highway
3
1
2
0
2
492
42
498
48
2
0
5
3
5
5
6
Cairncross WMF Access Road

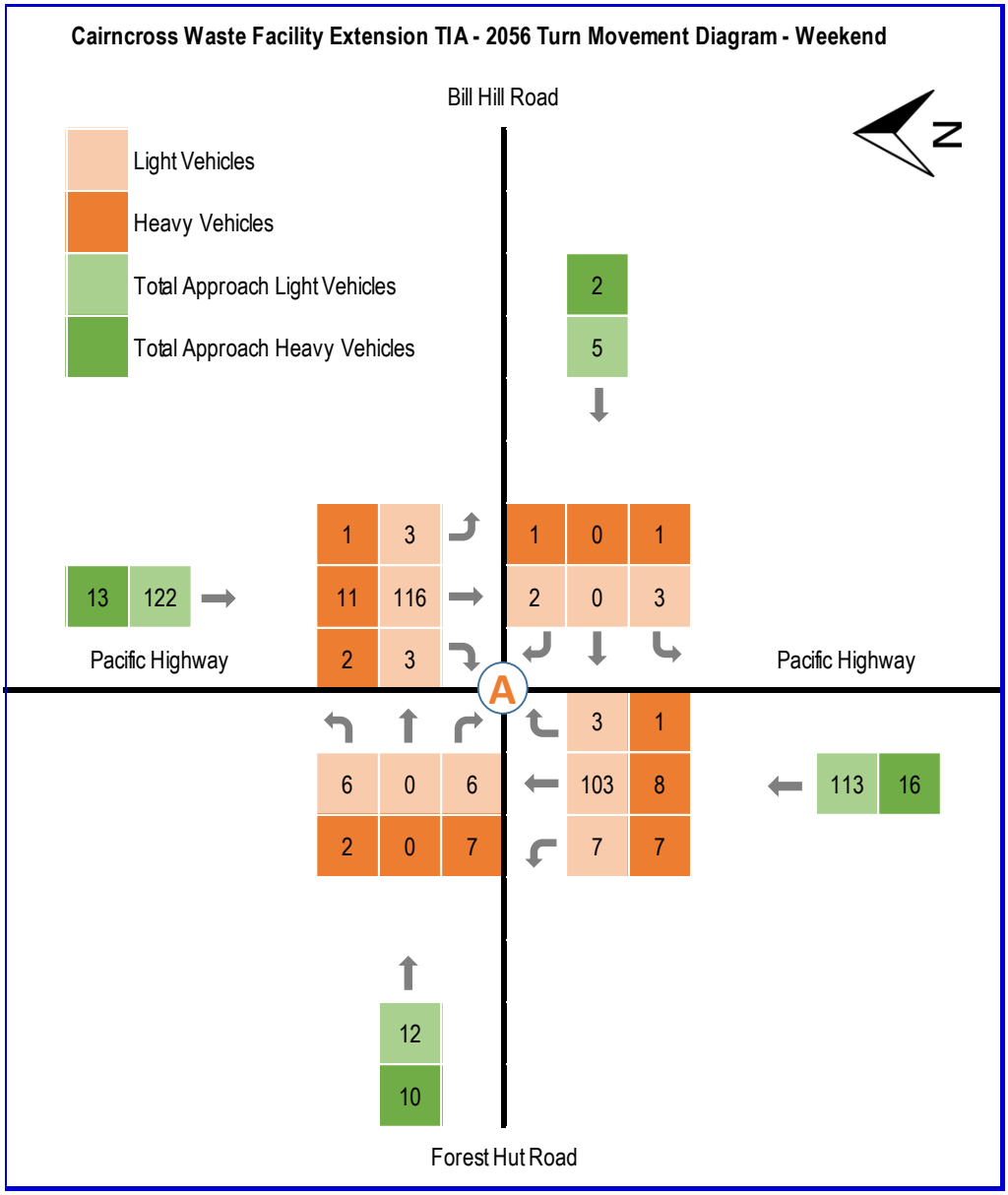

Cairncross Waste Facility Extension TIA - 2020 Turn Movement Diagram - Weekday AM Peak
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
1
5
0
3
0
0
1
10
115
8
111
2
0
3
Pacific Highway
2
1
Pacific Highway
A
3
0
2
0
2
97
5
103
13
2
0
6
3
7
4
9
Forest Hut Road


Cairncross Waste Facility Extension TIA - 2020 Turn Movement Diagram - Weekday PM Peak
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
2
4
1 2
10 78
1 1
1 0 1
1 0 2
12 81
Pacific Highway
Pacific Highway
A
2 1
1 0 1
1 0 4
68 7
2 4
72 12
3
5
Forest Hut Road


Cairncross Waste Facility Extension TIA - 2020 Turn Movement Diagram - Weekend
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
2
5
1
3
1
0
1
10
110
8
106
2
0
3
1
2
Pacific Highway
Pacific Highway
A
3
1
3
0
3
92
6
99
11
2
0
5
3
5
5
6
Forest Hut Road


Cairncross Waste Facility Extension TIA - 2056 Turn Movement Diagram - Weekday AM Peak
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
1
5
0 3
10 122
5 2
0 0 1
2 0 3
15 127
Pacific Highway
Pacific Highway
A
3 0
3 0 3
6 0 17
108 7
4 19
116 27
6
23
Forest Hut Road


Cairncross Waste Facility Extension TIA - 2056 Turn Movement Diagram - Weekday PM Peak
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
2
4
1
2
1
0
1
15
89
13
86
1
0
2
1
1
Pacific Highway
Pacific Highway
A
2
1
1
0
1
76
10
80
15
2
0
5
2
4
3
6
Forest Hut Road


Cairncross Waste Facility Extension TIA - 2056 Turn Movement Diagram - Weekend
Bill Hill Road
N
Light Vehicles
Heavy Vehicles
Total Approach Light Vehicles
Total Approach Heavy Vehicles
2
5
1
3
1
0
1
13
122
11
116
2
0
3
2
3
Pacific Highway
Pacific Highway
A
3
1
6
0
6
103
8
113
16
2
0
7
7
7
12
10
Forest Hut Road

APPENDIX C SIDRA SUMMARY RESULTS

2017 Weekday AM Peak

MOVEMENT SUMMARY

Site: 101 [2017 - AM]

2017 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	9	77.8	0.008	9.9	LOS A	0.0	0.0	0.00	0.67	53.3
2	T1	1066	10.3	0.577	0.1	LOS A	0.0	0.0	0.00	0.00	99.4
3	R2	3	0.0	0.002	7.7	LOS A	0.0	0.0	0.00	0.66	75.3
Approach		1079	10.8	0.577	0.2	NA	0.0	0.0	0.00	0.01	98.5
East: Bill Hill Road (E)											
4	L2	4	25.0	0.493	208.4	LOS F	1.3	11.8	0.01	0.56	7.8
5	T1	1	0.0	0.493	562.7	LOS F	1.3	11.8	0.01	0.56	7.7
6	R2	2	0.0	0.493	739.9	LOS F	1.3	11.8	0.01	0.56	7.9
Approach		7	14.3	0.493	410.9	LOS F	1.3	11.8	0.01	0.56	7.8
North: Pacific Motorway (N)											
7	L2	3	0.0	0.002	7.8	LOS A	0.0	0.0	0.00	0.66	75.3
8	T1	635	17.2	0.358	0.1	LOS A	0.0	0.0	0.00	0.00	99.7
9	R2	3	66.7	0.002	9.3	LOS A	0.0	0.0	0.00	0.69	54.9
Approach		641	17.4	0.358	0.1	NA	0.0	0.0	0.00	0.01	99.2
West: Forest Hut Road (W)											
10	L2	4	50.0	1.563	814.5	LOS F	6.6	103.1	1.00	1.38	3.1
11	T1	1	0.0	1.563	1175.2	LOS F	6.6	103.1	1.00	1.38	3.1
12	R2	8	75.0	1.563	1285.3	LOS F	6.6	103.1	1.00	1.38	3.0
Approach		14	61.5	1.563	1131.9	LOS F	6.6	103.1	1.00	1.38	3.1
All Vehicles		1741	13.7	1.563	10.8	NA	6.6	103.1	0.01	0.02	76.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2017 Weekday PM Peak

MOVEMENT SUMMARY

Site: 101 [2017 - PM]

2017 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	6	66.7	0.005	9.6	LOS A	0.0	0.0	0.00	0.66	55.6
2	T1	556	26.3	0.330	0.0	LOS A	0.0	0.0	0.00	0.00	99.7
3	R2	3	33.3	0.002	8.6	LOS A	0.0	0.0	0.00	0.67	63.5
Approach		565	26.8	0.330	0.2	NA	0.0	0.0	0.00	0.01	98.5
East: Bill Hill Road (E)											
4	L2	3	33.3	0.307	59.5	LOS F	0.8	9.0	0.01	0.56	13.5
5	T1	1	0.0	0.307	155.2	LOS F	0.8	9.0	0.01	0.56	13.5
6	R2	2	50.0	0.307	464.3	LOS F	0.8	9.0	0.01	0.56	13.3
Approach		6	33.3	0.307	210.4	LOS F	0.8	9.0	0.01	0.56	13.4
North: Pacific Motorway (N)											
7	L2	3	33.3	0.002	8.7	LOS A	0.0	0.0	0.00	0.66	63.7
8	T1	774	18.2	0.439	0.1	LOS A	0.0	0.0	0.00	0.00	99.6
9	R2	2	50.0	0.002	8.8	LOS A	0.0	0.0	0.00	0.69	58.8
Approach		779	18.4	0.439	0.1	NA	0.0	0.0	0.00	0.00	99.2
West: Forest Hut Road (W)											
10	L2	2	50.0	1.035	507.7	LOS F	3.2	50.9	1.00	1.18	3.6
11	T1	1	0.0	1.035	615.3	LOS F	3.2	50.9	1.00	1.18	3.6
12	R2	5	80.0	1.035	1186.7	LOS F	3.2	50.9	1.00	1.18	3.6
Approach		8	62.5	1.035	945.5	LOS F	3.2	50.9	1.00	1.18	3.6
All Vehicles		1359	22.2	1.035	7.0	NA	3.2	50.9	0.01	0.02	82.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2017 Weekend Peak

MOVEMENT SUMMARY

Site: 101 [2017 - Weekend]

2017 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	8	62.5	0.006	9.5	LOS A	0.0	0.0	0.00	0.66	56.5
2	T1	562	7.9	0.300	0.0	LOS A	0.0	0.0	0.00	0.00	99.8
3	R2	4	25.0	0.003	8.4	LOS A	0.0	0.0	0.00	0.67	66.0
Approach		575	8.8	0.300	0.2	NA	0.0	0.0	0.00	0.01	98.3
East: Bill Hill Road (E)											
4	L2	4	25.0	0.130	5.8	LOS A	0.3	3.5	0.00	0.56	31.7
5	T1	1	0.0	0.130	53.5	LOS F	0.3	3.5	0.00	0.56	31.2
6	R2	3	33.3	0.130	123.2	LOS F	0.3	3.5	0.00	0.56	31.2
Approach		8	25.0	0.130	55.8	LOS F	0.3	3.5	0.00	0.56	31.5
North: Pacific Motorway (N)											
7	L2	4	25.0	0.003	8.5	LOS A	0.0	0.0	0.00	0.66	66.1
8	T1	638	8.1	0.341	0.0	LOS A	0.0	0.0	0.00	0.00	99.8
9	R2	2	50.0	0.002	8.8	LOS A	0.0	0.0	0.00	0.69	58.8
Approach		644	8.3	0.341	0.1	NA	0.0	0.0	0.00	0.01	99.2
West: Forest Hut Road (W)											
10	L2	4	50.0	0.564	102.1	LOS F	1.6	24.3	0.98	1.07	11.8
11	T1	1	0.0	0.564	145.0	LOS F	1.6	24.3	0.98	1.07	12.0
12	R2	7	71.4	0.564	339.5	LOS F	1.6	24.3	0.98	1.07	11.6
Approach		13	58.3	0.564	244.1	LOS F	1.6	24.3	0.98	1.07	11.7
All Vehicles		1240	9.2	0.564	3.0	NA	1.6	24.3	0.01	0.02	90.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2020 Weekday AM Peak

MOVEMENT SUMMARY

Site: 101 [2020 - AM]

2020 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	11	70.0	0.008	9.7	LOS A	0.0	0.0	0.00	0.66	54.9
2	T1	107	4.9	0.056	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R2	4	25.0	0.003	8.4	LOS A	0.0	0.0	0.00	0.67	66.0
Approach		122	11.2	0.056	1.1	NA	0.0	0.0	0.00	0.08	91.8
East: Bill Hill Road (E)											
4	L2	4	25.0	0.009	5.8	LOS A	0.0	0.2	0.00	0.56	55.0
5	T1	1	0.0	0.009	7.6	LOS A	0.0	0.2	0.00	0.56	53.4
6	R2	2	0.0	0.009	8.4	LOS A	0.0	0.2	0.00	0.56	60.7
Approach		7	14.3	0.009	6.8	LOS A	0.0	0.2	0.00	0.56	56.3
North: Pacific Motorway (N)											
7	L2	3	0.0	0.002	7.8	LOS A	0.0	0.0	0.00	0.66	75.3
8	T1	125	6.7	0.066	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R2	3	66.7	0.002	9.3	LOS A	0.0	0.0	0.00	0.69	54.9
Approach		132	8.0	0.066	0.4	NA	0.0	0.0	0.00	0.03	97.3
West: Forest Hut Road (W)											
10	L2	4	50.0	0.033	6.7	LOS A	0.1	1.7	0.38	0.59	48.3
11	T1	1	0.0	0.033	7.6	LOS A	0.1	1.7	0.38	0.59	51.2
12	R2	8	75.0	0.033	12.6	LOS B	0.1	1.7	0.38	0.59	44.8
Approach		14	61.5	0.033	10.4	LOS B	0.1	1.7	0.38	0.59	46.3
All Vehicles		275	12.3	0.066	1.4	NA	0.1	1.7	0.02	0.10	88.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2020 Weekday PM Peak

MOVEMENT SUMMARY

Site: 101 [2020 - PM]

2020 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	6	66.7	0.005	9.6	LOS A	0.0	0.0	0.00	0.66	55.6
2	T1	79	9.3	0.042	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R2	3	33.3	0.002	8.6	LOS A	0.0	0.0	0.00	0.67	63.5
Approach		88	14.3	0.042	1.0	NA	0.0	0.0	0.00	0.07	92.8
East: Bill Hill Road (E)											
4	L2	3	33.3	0.009	5.9	LOS A	0.0	0.3	0.00	0.56	53.2
5	T1	1	0.0	0.009	6.8	LOS A	0.0	0.3	0.00	0.56	53.3
6	R2	2	50.0	0.009	9.4	LOS A	0.0	0.3	0.00	0.56	50.3
Approach		6	33.3	0.009	7.2	LOS A	0.0	0.3	0.00	0.56	52.2
North: Pacific Motorway (N)											
7	L2	3	33.3	0.002	8.7	LOS A	0.0	0.0	0.00	0.66	63.7
8	T1	93	11.4	0.050	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R2	2	50.0	0.002	8.8	LOS A	0.0	0.0	0.00	0.69	58.8
Approach		98	12.9	0.050	0.5	NA	0.0	0.0	0.00	0.04	96.7
West: Forest Hut Road (W)											
10	L2	2	50.0	0.018	6.6	LOS A	0.1	1.0	0.33	0.56	49.1
11	T1	1	0.0	0.018	6.8	LOS A	0.1	1.0	0.33	0.56	52.1
12	R2	5	80.0	0.018	10.8	LOS B	0.1	1.0	0.33	0.56	44.8
Approach		8	62.5	0.018	9.3	LOS A	0.1	1.0	0.33	0.56	46.6
All Vehicles		201	16.2	0.050	1.3	NA	0.1	1.0	0.01	0.09	88.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2020 Weekend Peak

MOVEMENT SUMMARY

Site: 101 [2020 - Weekend]

2020 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	8	62.5	0.006	9.5	LOS A	0.0	0.0	0.00	0.66	56.5
2	T1	103	6.1	0.054	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R2	4	25.0	0.003	8.4	LOS A	0.0	0.0	0.00	0.67	66.0
Approach		116	10.9	0.054	1.0	NA	0.0	0.0	0.00	0.07	93.0
East: Bill Hill Road (E)											
4	L2	4	25.0	0.013	5.8	LOS A	0.0	0.3	0.00	0.56	54.5
5	T1	1	0.0	0.013	7.5	LOS A	0.0	0.3	0.00	0.56	53.0
6	R2	3	33.3	0.013	9.8	LOS A	0.0	0.3	0.00	0.56	53.0
Approach		8	25.0	0.013	7.5	LOS A	0.0	0.3	0.00	0.56	53.7
North: Pacific Motorway (N)											
7	L2	4	25.0	0.003	8.5	LOS A	0.0	0.0	0.00	0.66	66.1
8	T1	120	7.0	0.064	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R2	3	33.3	0.002	8.4	LOS A	0.0	0.0	0.00	0.68	63.3
Approach		127	8.3	0.064	0.5	NA	0.0	0.0	0.00	0.04	96.9
West: Forest Hut Road (W)											
10	L2	5	40.0	0.031	6.5	LOS A	0.1	1.5	0.35	0.58	50.5
11	T1	1	0.0	0.031	7.5	LOS A	0.1	1.5	0.35	0.58	51.8
12	R2	8	62.5	0.031	11.5	LOS B	0.1	1.5	0.35	0.58	47.0
Approach		15	50.0	0.031	9.5	LOS A	0.1	1.5	0.35	0.58	48.5
All Vehicles		266	12.3	0.064	1.4	NA	0.1	1.5	0.02	0.10	88.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2056 Weekday AM Peak

MOVEMENT SUMMARY

Site: 101 [2056 - AM]

2056 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	24	82.6	0.021	10.0	LOS A	0.0	0.0	0.00	0.67	52.4
2	T1	121	6.1	0.064	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R2	3	0.0	0.002	7.7	LOS A	0.0	0.0	0.00	0.66	75.3
Approach		148	18.4	0.064	1.8	NA	0.0	0.0	0.00	0.12	86.5
East: Bill Hill Road (E)											
4	L2	4	25.0	0.010	5.8	LOS A	0.0	0.2	0.00	0.56	54.8
5	T1	1	0.0	0.010	8.2	LOS A	0.0	0.2	0.00	0.56	53.2
6	R2	2	0.0	0.010	9.0	LOS A	0.0	0.2	0.00	0.56	60.5
Approach		7	14.3	0.010	7.1	LOS A	0.0	0.2	0.00	0.56	56.0
North: Pacific Motorway (N)											
7	L2	3	0.0	0.002	7.8	LOS A	0.0	0.0	0.00	0.66	75.3
8	T1	139	7.6	0.074	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R2	7	71.4	0.006	9.4	LOS A	0.0	0.0	0.00	0.69	53.8
Approach		149	10.6	0.074	0.6	NA	0.0	0.0	0.00	0.05	95.3
West: Forest Hut Road (W)											
10	L2	9	66.7	0.091	7.2	LOS A	0.3	5.5	0.45	0.65	44.6
11	T1	1	0.0	0.091	8.3	LOS A	0.3	5.5	0.45	0.65	49.8
12	R2	21	85.0	0.091	15.3	LOS C	0.3	5.5	0.45	0.65	42.4
Approach		32	76.7	0.091	12.6	LOS B	0.3	5.5	0.45	0.65	43.3
All Vehicles		337	20.3	0.091	2.4	NA	0.3	5.5	0.04	0.15	81.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2056 Weekday PM Peak

MOVEMENT SUMMARY

Site: 101 [2056 - PM]

2056 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	6	66.7	0.005	9.6	LOS A	0.0	0.0	0.00	0.66	55.6
2	T1	91	11.6	0.049	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R2	3	33.3	0.002	8.6	LOS A	0.0	0.0	0.00	0.67	63.5
Approach		100	15.8	0.049	0.9	NA	0.0	0.0	0.00	0.06	93.5
East: Bill Hill Road (E)											
4	L2	3	33.3	0.010	5.9	LOS A	0.0	0.3	0.00	0.56	53.0
5	T1	1	0.0	0.010	7.1	LOS A	0.0	0.3	0.00	0.56	53.1
6	R2	2	50.0	0.010	10.0	LOS A	0.0	0.3	0.00	0.56	50.2
Approach		6	33.3	0.010	7.5	LOS A	0.0	0.3	0.00	0.56	52.0
North: Pacific Motorway (N)											
7	L2	3	33.3	0.002	8.7	LOS A	0.0	0.0	0.00	0.66	63.7
8	T1	104	13.1	0.057	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R2	2	50.0	0.002	8.8	LOS A	0.0	0.0	0.00	0.69	58.8
Approach		109	14.4	0.057	0.4	NA	0.0	0.0	0.00	0.03	97.1
West: Forest Hut Road (W)											
10	L2	3	66.7	0.024	6.9	LOS A	0.1	1.4	0.35	0.57	46.2
11	T1	1	0.0	0.024	7.1	LOS A	0.1	1.4	0.35	0.57	51.7
12	R2	6	83.3	0.024	11.8	LOS B	0.1	1.4	0.35	0.57	44.1
Approach		11	70.0	0.024	9.9	LOS A	0.1	1.4	0.35	0.57	45.4
All Vehicles		226	18.1	0.057	1.3	NA	0.1	1.4	0.02	0.09	88.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

2056 Weekend Peak

MOVEMENT SUMMARY

Site: 101 [2056 - Weekend]

2056 BG + Operation
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Pacific Motorway (S)											
1	L2	15	50.0	0.011	9.1	LOS A	0.0	0.0	0.00	0.66	59.4
2	T1	117	7.2	0.062	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R2	4	25.0	0.003	8.4	LOS A	0.0	0.0	0.00	0.67	66.0
Approach		136	12.4	0.062	1.3	NA	0.0	0.0	0.00	0.09	91.7
East: Bill Hill Road (E)											
4	L2	4	25.0	0.014	5.8	LOS A	0.0	0.3	0.00	0.56	54.2
5	T1	1	0.0	0.014	7.9	LOS A	0.0	0.3	0.00	0.56	52.7
6	R2	3	33.3	0.014	10.6	LOS B	0.0	0.3	0.00	0.56	52.8
Approach		8	25.0	0.014	7.9	LOS A	0.0	0.3	0.00	0.56	53.5
North: Pacific Motorway (N)											
7	L2	4	25.0	0.003	8.5	LOS A	0.0	0.0	0.00	0.66	66.1
8	T1	134	8.7	0.072	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R2	5	40.0	0.004	8.6	LOS A	0.0	0.0	0.00	0.68	61.4
Approach		143	10.3	0.072	0.6	NA	0.0	0.0	0.00	0.04	96.3
West: Forest Hut Road (W)											
10	L2	8	25.0	0.050	6.4	LOS A	0.2	2.2	0.38	0.60	52.8
11	T1	1	0.0	0.050	8.0	LOS A	0.2	2.2	0.38	0.60	51.4
12	R2	14	53.8	0.050	12.1	LOS B	0.2	2.2	0.38	0.60	48.0
Approach		23	40.9	0.050	9.9	LOS A	0.2	2.2	0.38	0.60	49.8
All Vehicles		311	13.9	0.072	1.8	NA	0.2	2.2	0.03	0.12	86.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

APPENDIX D SITE DISTANCE PHOTOS



Figure 5-1 Maximum Sight Distance looking north from Cairncross WMF Access Road



Figure 5-2 Maximum Sight Distance looking south from Cairncross WMF Access Road

APPENDIX E CRASH DATA

Detailed Crash Report

NOTES: 7135 - Pacific Hwy, Telegraph Pt crash data - 1 Jul 2011 to 30 Jun 2016

Crash No.	Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash-Detailed	Killed	Seriously Inj.	Moderately Inj.	Minor/Other Inj.	Uncateg'd Inj.	Factors	S	F
Northern Region																										
Port Macquarie-Hastings LGA																										
Pembrooke																										
Pacific Hwy																										
1095190	P	11/03/2016	Fri	14:30	300 m	S BILL HILL RD	2WY	STR	Fine	Dry	100	2	TRK	M32	N in PACIFIC HWY	Unk	Incorrect side	FC	1	0	0	0	1			F
E60705734							RUM	20	Head on				LOR	M54	S in PACIFIC HWY	Unk	Proceeding in lane									
1003064	P	31/10/2013	Thu	11:05	500 m	S WASTE DEPOT TO	2WY	STR	Fine	Dry	100	2	WAG	M61	S in PACIFIC HWY	50	Proceeding in lane	NC	0	0	0	0	0			
E52767622							RUM	30	Rear end				TRK	M55	S in PACIFIC HWY	0	Stationary									

Report Totals: Crashes: 2 Fatal Crashes(FC): 1 Serious Injury Crashes(SC): 0 Moderate Injury Crashes(MC): 0 Minor/Other Injury Crashes(OC): 0 Uncategorised Injury Crashes(UC): 0 Non-Casualty Crashes(NC): 1

Killed(K): 1 Seriously Injured(S): 0 Moderately Injured(M): 0 Minor/Other Injured(O): 0 Uncategorised Injured(U): 1

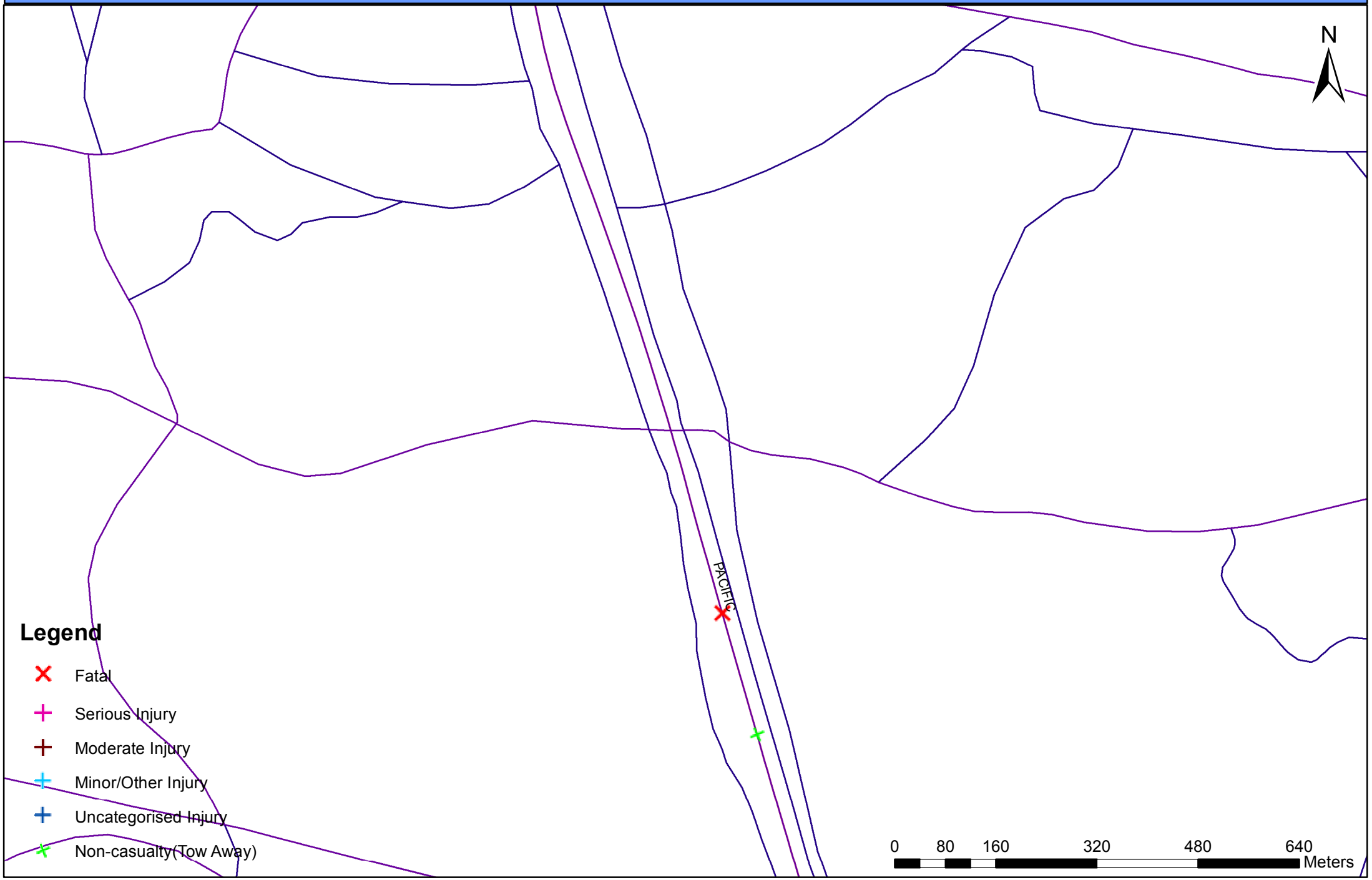
Crashid dataset 7135 - Pacific Hwy, Telegraph Pt crash data - 1 Jul 2011 to 30 Jun 2016

Note: *Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.*

Crash self reporting, including self reported injuries began Oct 2014. Trends from 2014 are expected to vary from previous yrs. More unknowns are expected in self reported data. Reporting yrs 1996-2004 and 2016 onwards contain uncategorised inj crashes.

Pacific Highway, Bill Hill Road

Crash Period: 01/04/2006 - 01/03/2016



ARCADIS Design & Consultancy for natural and built assets

APPENDIX K AIR QUALITY AND ODOUR IMPACT ASSESSMENT

ACOUSTICS AND AIR

CAIRNCROSS LANDFILL

AIR QUALITY IMPACT ASSESSMENT

REPORT NO. 14289-AQ
VERSION B

JUNE 2017

PREPARED FOR

ARCADIS
LEVEL 5, 141 WALKER STREET
NORTH SYDNEY NSW 2060

WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	2 May 2017	Nic Hall	John Wassermann
B	Final	5 June 2017	Nic Hall	John Wassermann

Note
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GLOSSARY OF AIR QUALITY TERMS

Air Pollution – The presence of contaminants or pollutant substances in the air that interfere with human health or welfare, or produce other harmful environmental effects.

Air Quality Standards – The level of pollutants prescribed by regulations that are not to be exceeded during a given time in a defined area.

Air Toxics – Any air pollutant for which a national ambient air quality standard (NAAQS) does not exist (i.e. excluding ozone, carbon monoxide, PM-10, sulphur dioxide, nitrogen oxide) that may reasonably be anticipated to cause cancer; respiratory, cardiovascular, or developmental effects; reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.

Airborne Particulates – Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Sources of airborne particulates include dust, emissions from industrial processes, combustion products from the burning of wood and coal, combustion products associated with motor vehicle or non-road engine exhausts, and reactions to gases in the atmosphere.

Area Source – Any source of air pollution that is released over a relatively small area, but which cannot be classified as a point source. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest that releases hydrocarbons, may be referred to as nonpoint source.

Concentration – The relative amount of a substance mixed with another substance. Examples are 5 ppm of carbon monoxide in air and 1 mg/l of iron in water.

Emission – Release of pollutants into the air from a source. We say sources emit pollutants.

Emission Factor – The relationship between the amount of pollution produced and the amount of raw material processed. For example, an emission factor for a blast furnace making iron would be the number of pounds of particulates per ton of raw materials.

Emission Inventory – A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Flow Rate – The rate, expressed in gallons -or litres-per-hour, at which a fluid escapes from a hole or fissure in a tank. Such measurements are also made of liquid waste, effluent, and surface water movement.

Fugitive Emissions – Emissions not caught by a capture system.

Hydrocarbons (HC) – Chemical compounds that consist entirely of carbon and hydrogen.

Hydrogen Sulphide (H_2S) – Gas emitted during organic decomposition. Also, a by-product of oil refining and burning. Smells like rotten eggs and, in heavy concentration, can kill or cause illness.

Inhalable Particles – All dust capable of entering the human respiratory tract.

Nitric Oxide (NO) – A gas formed by combustion under high temperature and high pressure in an internal combustion engine. NO is converted by sunlight and photochemical processes in ambient air to nitrogen oxide. NO is a precursor of ground-level ozone pollution, or smog.

Nitrogen Dioxide (NO_2) – The result of nitric oxide combining with oxygen in the atmosphere; major component of photochemical smog.

Nitrogen Oxides (NO_x) – A criteria air polluant. Nitrogen oxides are produced from burning fuels, including gasoline and coal. Nitrogen oxides are smog formers, which react with volatile organic compounds to form smog. Nitrogen oxides are also major components of acid rain.

Mobile Sources – Moving objects that release pollution; mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers.

Particulates; Particulate Matter (PM-10) – A criteria air pollutant. Particulate matter includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuels by trucks and buses, incineration of garbage, mixing and application of fertilizers and pesticides, road construction, industrial processes such as steel making, mining operations, agricultural burning (field and slash burning), and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems.

Parts Per Billion (ppb)/Parts Per Million (ppm) – Units commonly used to express contamination ratios, as in establishing the maximum permissible amount of a contaminant in water, land, or air.

PM10/PM2.5 – PM10 is measure of particles in the atmosphere with a diameter of less than 10 or equal to a nominal 10 micrometers. PM2.5 is a measure of smaller particles in the air.

Point Source – A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g. a pipe, ditch, ship, ore pit, factory smokestack.

Scrubber – An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Source – Any place or object from which pollutants are released.

Stack – A chimney, smokestack, or vertical pipe that discharges used air.

Stationary Source – A place or object from which pollutants are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, houses etc.

Temperature Inversion – One of the weather conditions that are often associated with serious smog episodes in some portions of the country. In a temperature inversion, air does not rise because it is trapped near the ground by a layer of warmer air above it. Pollutants, especially smog and smog-forming chemicals, including volatile organic compounds, are trapped close to the ground. As people continue driving and sources other than motor vehicles continue to release smog-forming pollutants into the air, the smog level keeps getting worse.

1 INTRODUCTION

Port Macquarie-Hastings Council (PMHC) oversees the operation of the Cairncross Waste Management Facility (Cairncross WMF), which includes the operation of a landfill, Waste Transfer Station (WTS), an Organics Resource Recovery Facility (ORRF) and a Material Recovery Facility (MRF). The Cairncross WMF was granted approval under Part 4 and Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for Stage 1 in 1999 (now referred to as the existing landfill or 'Stage E') and commenced operations in September 2001.

The Part 4 development approval (DA) for extractive industries for the current landfill operational area (Stage E), DA No. 1999/178, was limited to 20 years. In February 2013, an extension of five years was sought on the original approval and was subsequently granted by PMHC. The current Part 4 approval is now due to conclude in 2026.

A Part 5 approval (REF 1999-002) was granted in 1999 for landfilling activities on the site, which was also limited to 20 years. A Review of Environmental Factors (REF) was prepared by PMHC in 2013 (the 2013 REF), to support an application for extension of the approved operational life of the Stage E landfill to 2026. The 2013 REF was approved by PMHC in October 2013.

The existing (Stage E) landfill is expected to reach capacity in approximately 2020. PMHC is now seeking approval for three new landfill stages from the Department of Planning and Environment (the Department) as State Significant Development (SSD) under Part 4, Division 4.1 of the EP&A Act. This Proposal aims to provide the additional landfill capacity in the same geographical location identified in the 1999 EIS however proposes that future landfilling is undertaken in three stages rather than the four stages previously proposed.

Council is committed to the reduction of waste being directed to landfill. It should be noted that the proposed landfill facility is not being considered in isolation of other waste management efforts being considered by Council, including organics and materials recovery through the ORRF and MRF at the Cairncross WMF which aim to further increase resource recovery rates and thus to reduce waste to landfill volumes in the future.

Wilkinson Murray has been engaged by Arcadis, on behalf of PMHC, to prepare an Air Quality Impact Assessment (AQIA) for the Proposal. This AQIA will form part of the EIS for the Proposal.

1.1 Assessment Requirements

This AQIA has been prepared to support the Environmental Impact Statement (EIS) for approval of the Proposal, and addresses the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 13-5792 and dated May 2015) for the Proposal. Table 1-1 provides a summary of the SEARs which are relevant to this report and the section where they have been addressed in this report.

Table 1-1 SEARs (SSD 13-5792) Compliance Table (Noise and Vibration)

SEARs	Where Addressed
A quantitative assessment of potential air quality and odour impacts of the development on surrounding receivers, including impacts from construction, operation and transport.	Section 6
Details of the proposed mitigation, management and monitoring measures.	Section 7

1.2 Proposal Overview

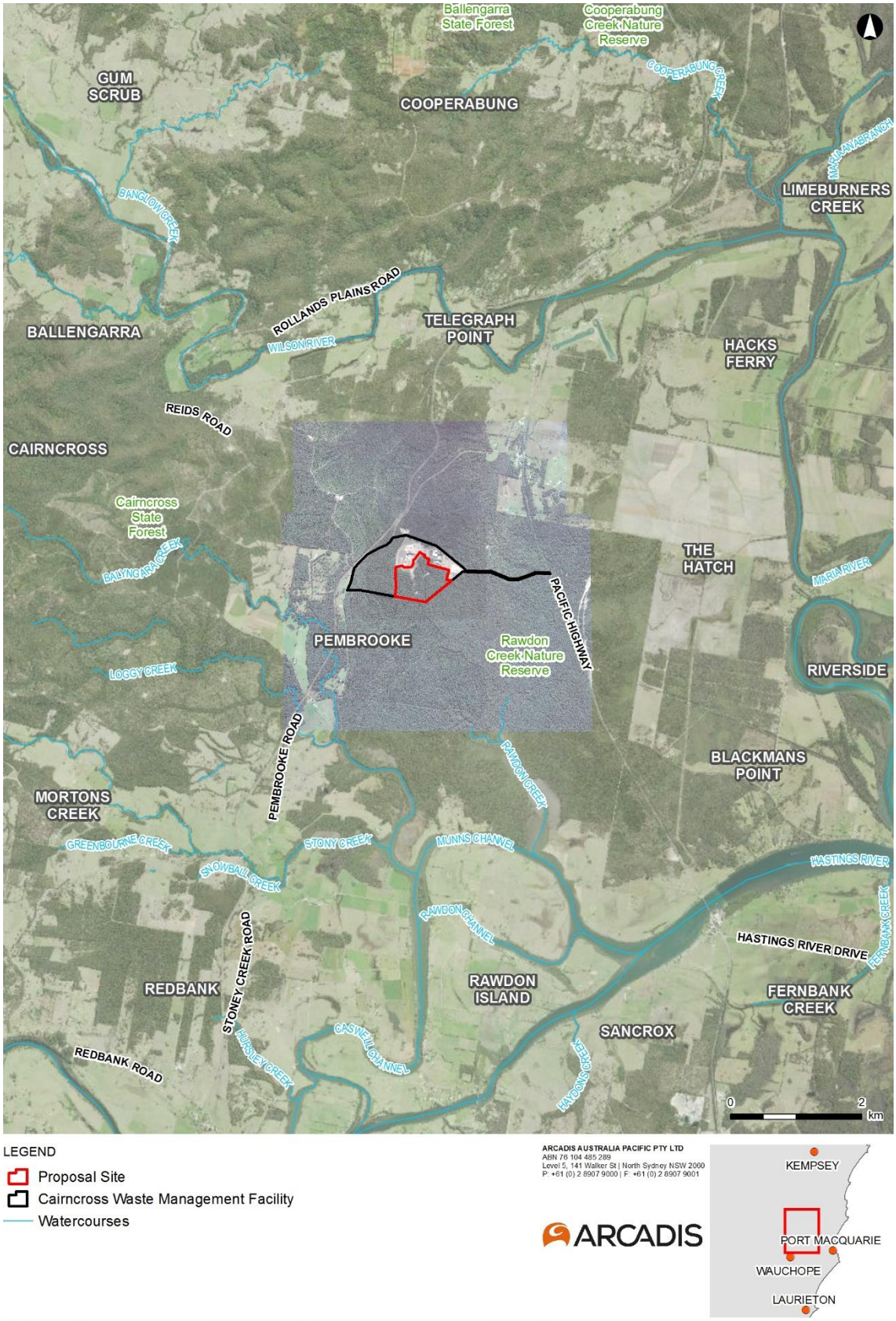
PMHC proposes to expand the existing landfill (Cairncross Landfill) at the Cairncross Waste Management Facility (WMF), located at 8395 Pacific Highway, Telegraph Point, NSW on Lot 1 / DP 1202080 (see Figure 1-1). PMHC is seeking development approval to extend Cairncross Landfill to cover the remaining area identified for landfilling in the Environmental Impact Statement (EIS) that was prepared by ERM in 1999 to support the development application for the first stage of the landfill (the 1999 EIS).

The Proposal would involve the progressive construction, operation and rehabilitation of three landfill stages (Stages 1-3), following a staged approach with implementation over approximately 36 years. Stage 1 would commence construction/operation in approximately 2019/2020 respectively and Stage 3 would reach capacity in approximately 2056 with a landfill closure period to follow. Despite recent and expected future increases in diversion of waste to landfill, the annual waste acceptance rate would progressively increase over the life of the Proposal due to predicted population and waste generation growth per capita.

The Proposal Site is defined as the area shown on Figure 1-1 and is located south-west of Telegraph Point, approximately 2 km west of the Pacific Highway. The Proposal Site covers an area of approximately 40.2 ha (including the landfill and ancillary areas such as access roads and a biodiversity corridor) and is owned by PMHC. The Proposal Site is within the broader Cairncross WMF which is bordered by the Rawdon Creek Nature Reserve to the south-east, by Cairncross State Forest to the north and south and by farmland to the west.

The Proposal will receive waste from all areas within the Port Macquarie-Hastings local government area (LGA) including the major townships of Port Macquarie, Wauchope and Camden Haven. Waste will include general solid waste (i.e. putrescible and non-putrescible materials) and asbestos from domestic and commercial and industrial (C&I) sources.

Figure 1-1 Site location



LEGEND

- Proposal Site
- Cairncross Waste Management Facility
- Watercourses

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ARCADIS

Date: 17/05/2017 Path: F:\AA007398\L-GIS\A_Current\B_Maps\AA007398_GEN_005_RegionalContext_A3P_r3v1.mxd
Created by : CC
QA by : ZW

1.2.1 Proposal Staging

The Proposal stages are shown on Figure 1-2. The anticipated timeframes for the stages are provided in Table 1-2, and are based on indicative waste generation modelling undertaken for the PMHC LGA. The start and end dates for each stage represent the likely timeframe for accepting waste, however the preparatory and completion works for each stage (e.g. landfill cell construction, construction of leachate barrier systems, and final rehabilitation) may commence/conclude up to two years before/after the timeframes provided below. The filling rates and landfill capacity would be reviewed on an ongoing basis.

Table 1-2 Details of landfill stages

Stage	Timeframe[1]	Duration (years)	Activities
Stage 1	2020 – 2040	20	Progressive landfill cell construction, operation and rehabilitation.
Stage 2	2040 – 2047	7	
Stage 3	2047 – 2056	9	
Total	**2020 – 2056**	**36**	

1.2.2 Operating Hours

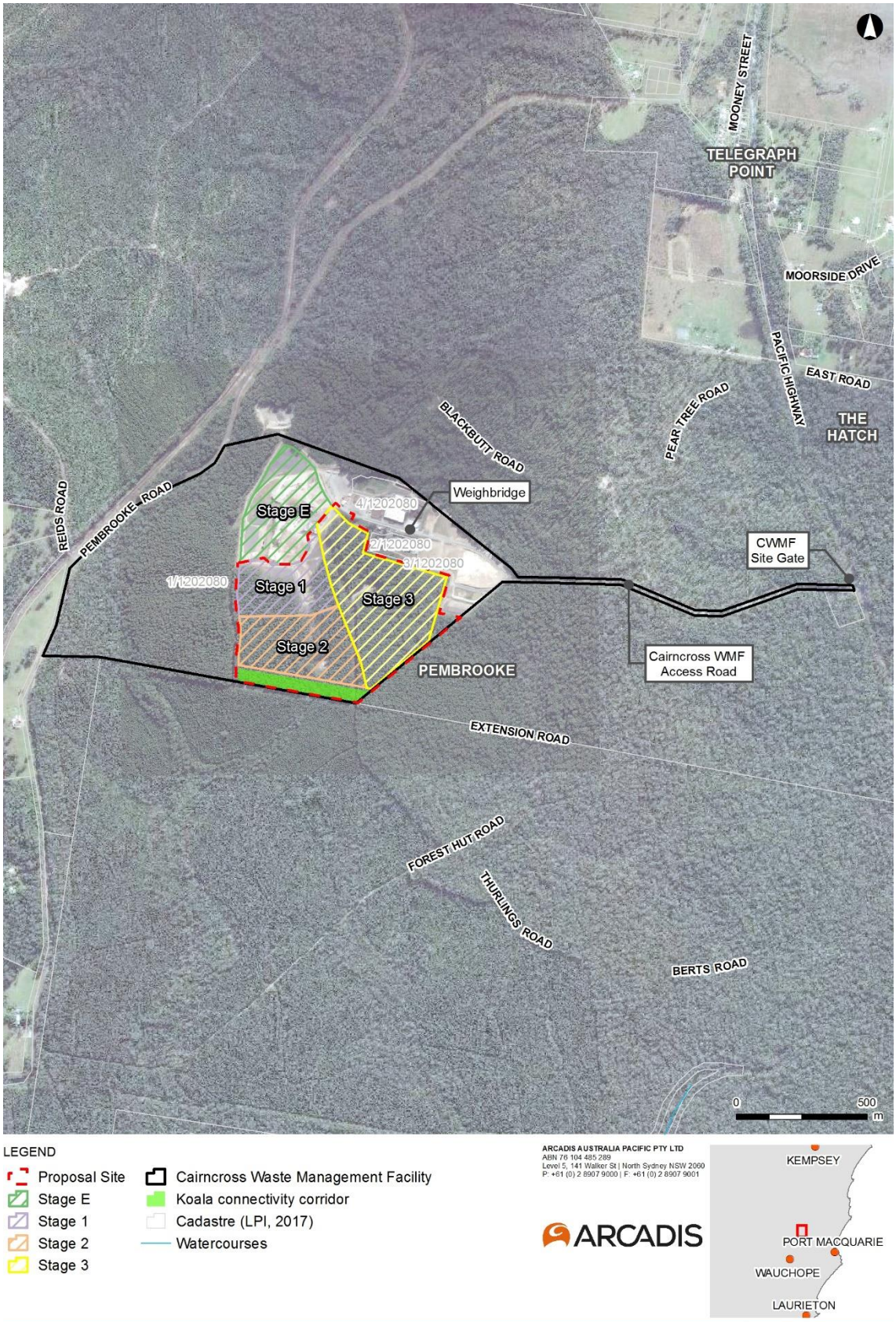
The landfill is open every day, with the exception of Good Friday and Christmas Day, and would continue to operate during the following hours:

- Monday to Friday: 7am – 5pm
- Saturday, Sunday, public holidays: 8am – 4pm.

Site management activities, such as covering operations, may continue one hour after closure.

[1] Timeframes are approximate and subject to change (e.g. based on altered resource recovery and waste generation rates which would influence landfill life expectancy)

Figure 1-2 Site layout



2 EXISTING ENVIRONMENT

2.1 Surrounding land use and sensitive receptors

The land use surrounding the Proposal is predominantly rural. The nearest, and most potentially affected, receptors are identified in Table 2-1 and shown on Figure 2-1.

Figure 2-1 Sensitive receptors

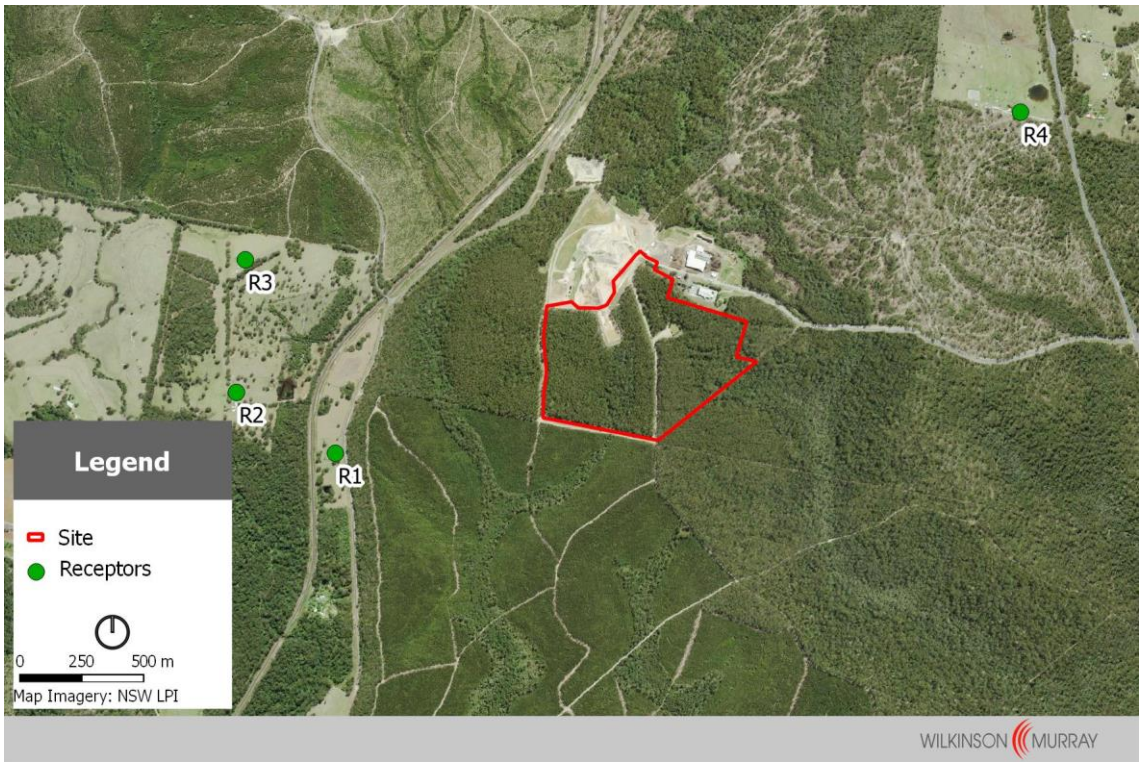


Table 2-1 Sensitive receptors

Receptor	Address	Distance to site boundary (m)
R1	1101 Pembrooke Road, Pembrooke	850
R2	21 Reids Road, Pembrooke	1,230
R3	23 Reids Road, Pembrooke	1,230
R4	8493 Pacific Highway, Telegraph Point	1,400

2.2 Local Meteorology

Meteorological conditions strongly influence air quality. Most significantly, wind speed, wind direction, temperature, relative humidity, and rainfall affect the dispersion of air pollutants, and are key inputs into dispersion models. The following sub-sections discuss the local meteorology near the Proposal site, and identify a representative set of meteorological data for use in the dispersion modelling to be undertaken for this assessment.

Long term meteorological data for the area surrounding the Site is available from the Bureau of Meteorology (BOM) operated Automatic Weather Station (AWS) at Port Macquarie Airport. The Port Macquarie Airport AWS is located approximately 12 kilometres south east of the Proposal site and records observations of a number of meteorological data including wind speed, wind direction, temperature, humidity, and rainfall.

As recommended by the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, meteorological data from the Port Macquarie AWS have been reviewed over a period of five consecutive years (2012 to 2016).

2.2.1 Wind

Figure 2-2 to Figure 2-7 present annual and seasonal windrose plots for Port Macquarie AWS for the period 2012 to 2016, inclusive. The plots show similar patterns of wind speed and wind direction over the five-year period, with northerly to north-easterly winds being prevalent in summer and autumn, and westerly winds being prevalent in winter and spring. Wind speed and wind direction during 2012 are generally representative of the five-year period, and have therefore been adopted for assessment purposes.

Figure 2-2 Port Macquarie AWS Windroses, 2012

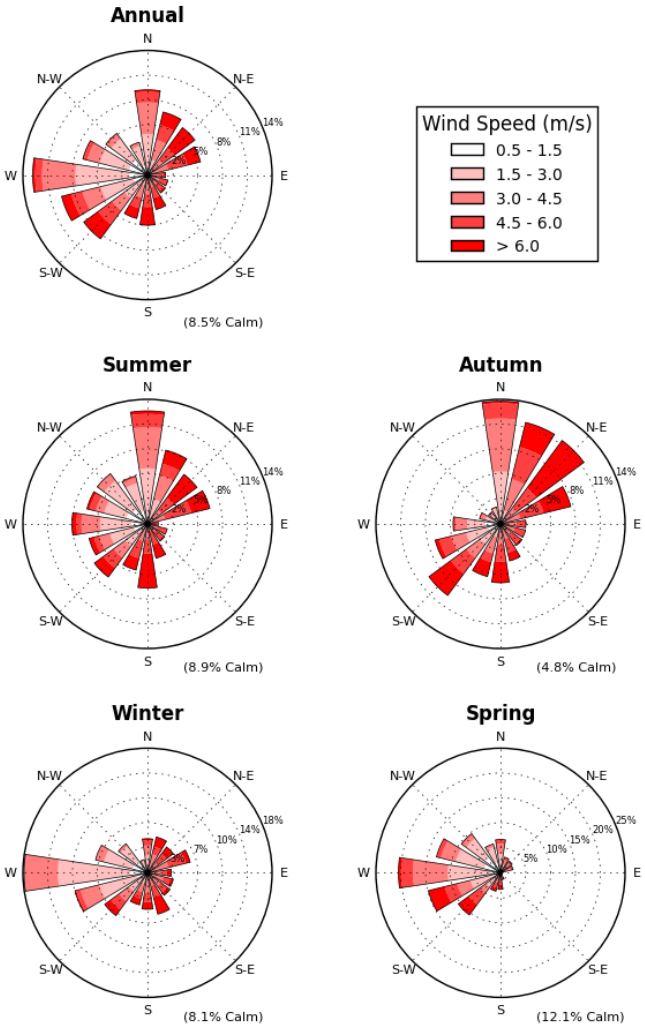


Figure 2-3 Port Macquarie AWS Windroses, 2013

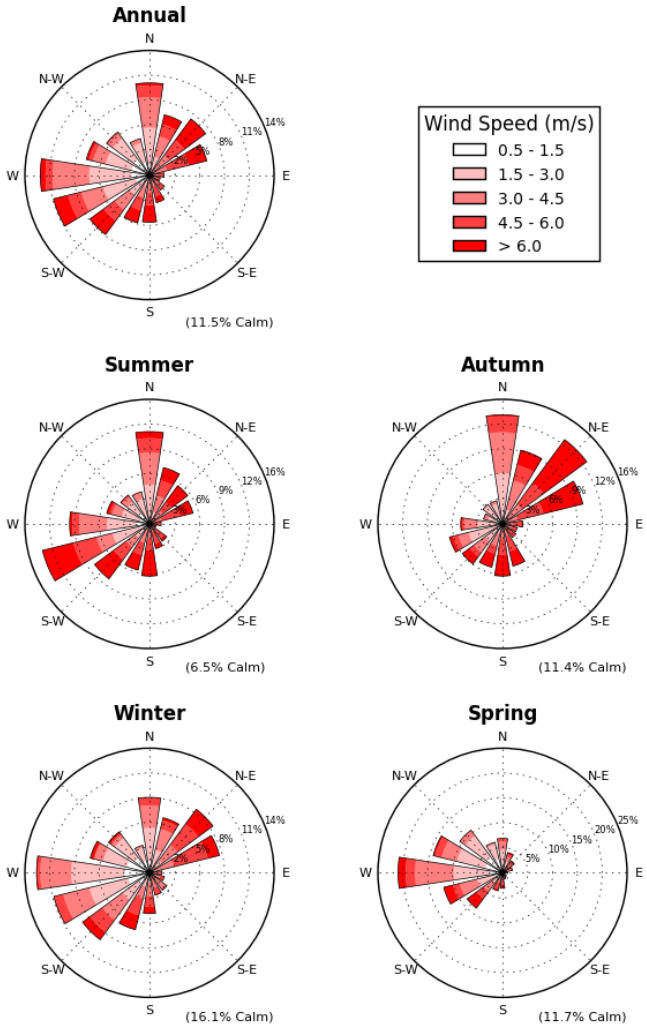


Figure 2-4 Port Macquarie AWS Windroses, 2014

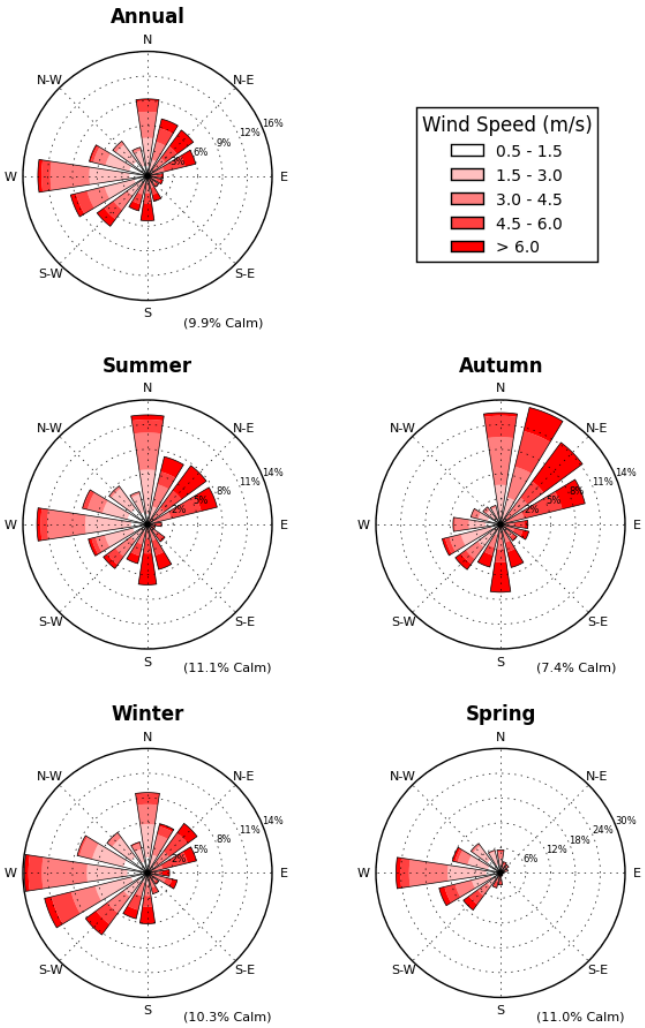


Figure 2-5 Port Macquarie AWS Windroses, 2015

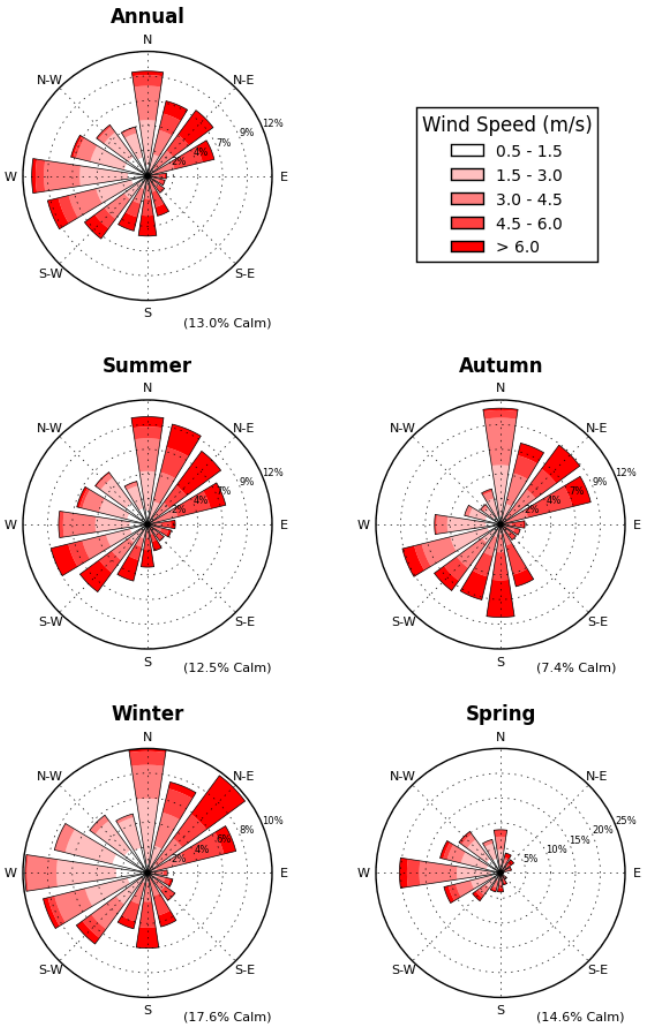


Figure 2-6 Port Macquarie AWS Windroses, 2016

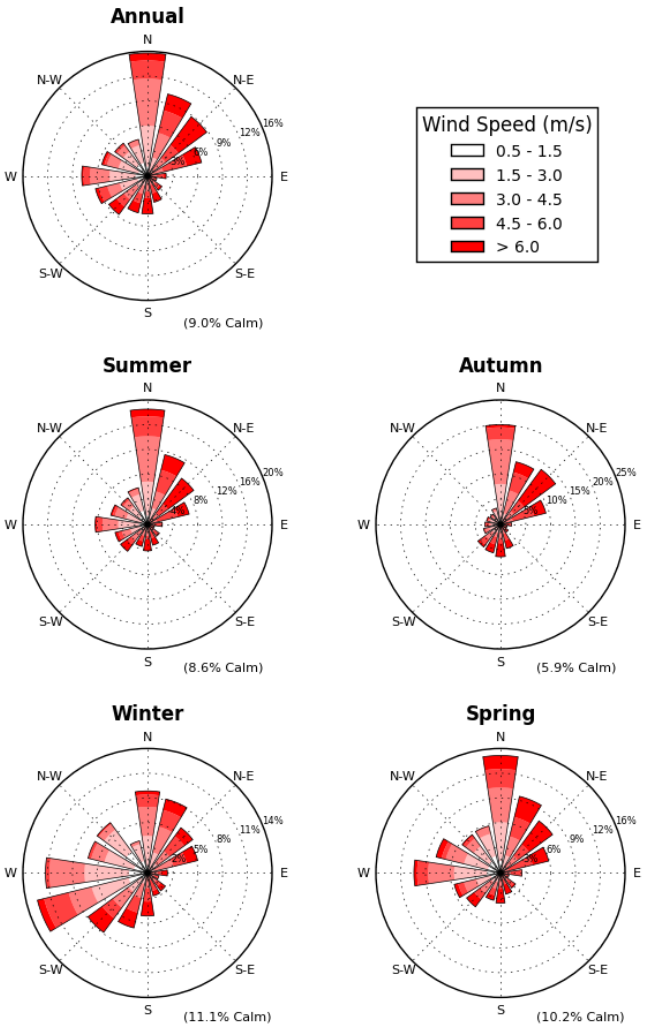
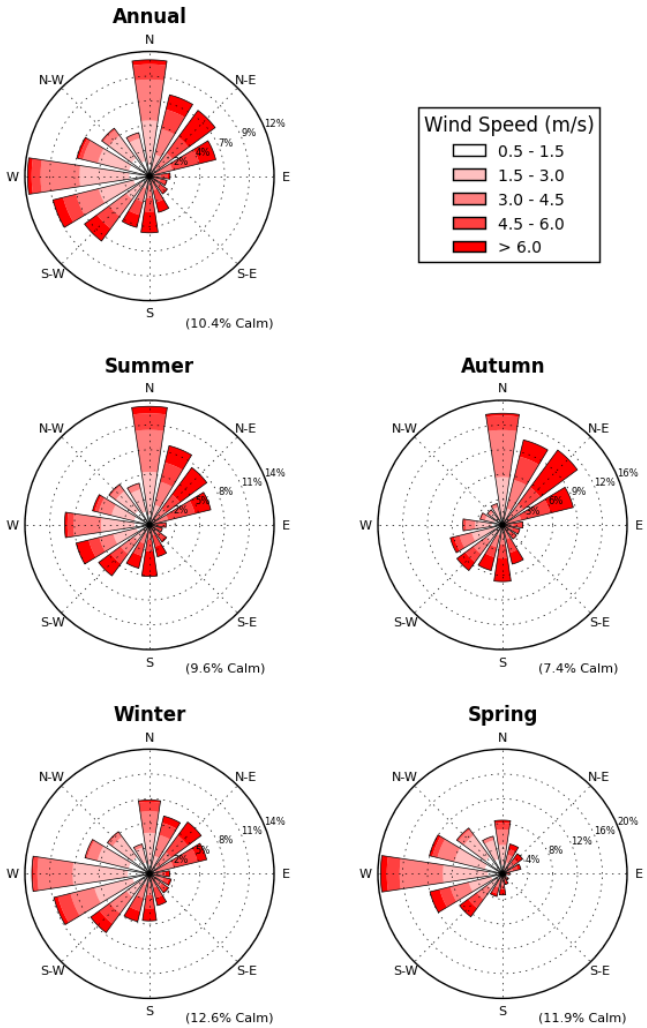


Figure 2-7 Port Macquarie AWS Windroses, 2012-2016



2.2.2 Temperature Humidity and Rainfall

Average monthly values for temperature, humidity, and rainfall over the period 2012 to 2016 are presented in Table 2-2.

Long-term climate statistics are presented in Table 2-2. Temperature data recorded at the Port Macquarie Airport AWS indicates that January is the hottest month of the year, with a mean daily maximum temperature of 27.7°C. July is the coolest month with a mean daily minimum temperature of 6.5°C. March is the wettest month with an average rainfall of 176 mm falling over 11 days. There are on average 100 rain days per year, delivering 1,417 mm of rain.

Table 2-2 Climate averages for Port Macquarie Airport AWS, 2012-2016

Obs.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Observations													
Temp (°C)	23.3	22.6	20.8	19.5	16.1	13.3	12.3	14.0	17.7	20.1	20.7	22.6	18.6
Hum (%)	76	82	83	76	76	78	75	68	64	64	73	72	74
3pm Mean Observations													
Temp (°C)	26.1	26.0	24.9	22.5	20.1	18.2	17.5	18.7	20.5	21.9	23.1	24.9	22.0
Hum (%)	65	66	65	64	61	60	55	52	56	59	65	64	61
Daily Minimum and Maximum Temperatures													
Min (°C)	18.4	18.4	17.0	13.9	10.4	8.2	6.5	6.8	9.5	11.9	15.2	16.9	12.8
Max (°C)	27.7	27.6	26.4	24.3	21.6	19.5	18.8	20.2	22.6	24.1	25.2	26.7	23.7
Rainfall													
Rain (mm)	155.3	165.5	176.0	142.5	116.2	136.6	64.0	69.2	61.8	73.1	154.8	108.0	1416.7
Rain (days)	9.0	10.4	11.0	9.7	8.0	7.2	6.5	5.7	5.7	7.4	10.5	9.2	100.3

2.3 Local Ambient Air Quality

To adequately assess the potential air quality impacts of the Proposal, consideration should be given to the existing ambient air quality in the surrounding area.

2.3.1 Odour

The most significant potential sources of odour near sensitive receptors are the existing activities at the Cairncross WMF. During site visits, no sources of offensive or nuisance odour were detected at sensitive receptors. Further, the Cairncross WMF has no history of odour complaints. Therefore, existing odour levels at sensitive receptors are understood to be negligible.

2.3.2 Dust and Particulate Matter

No site-specific data are available to determine the existing concentrations of dust and particulate matter at sensitive receptors near the Proposal. The NSW Office of Environment and Heritage (OEH) operates a network of air quality monitoring stations across NSW. The OEH monitoring station location considered to be most representative of the area surrounding the Proposal is located in Wallsend. The Wallsend monitoring station is located approximately 200 kilometres south of the Proposal site, and is in an area that is significantly more developed than the area surrounding the Proposal, and is also in a region with a number of large open-cut coal mines. Therefore, the use of data from the Wallsend monitoring station to characterise the existing ambient air quality in the area surrounding the Proposal is considered to be conservative.

A summary of the PM_{10} and $PM_{2.5}$ monitoring results from the most recent complete year of data (2016) collected at the Wallsend monitoring site is presented in Table 2-3.

Table 2-3 2016 Particulate matter monitoring results – Wallsend

Pollutant	Annual Average ($\mu g/m^3$)	24 Hour Average ($\mu g/m^3$)	
		Maximum	90th Percentile
PM_{10}	16.6	65.5 (35.2)	25.7
$PM_{2.5}$	7.8	50.7 (22.6)	12.6

When characterising typical ambient air quality, impacts from extreme events such as bushfires and dust storms are usually excluded. On 7 November 2016, the 24-hour average PM_{10} and $PM_{2.5}$ concentrations measured at Wallsend were 65.5 $\mu g/m^3$ and 50.7 $\mu g/m^3$, respectively, and were due to two large bushfires in the area. The values in brackets in Table 2-3 represent the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations measured at Wallsend, outside the bushfire event. These values will be adopted for assessment purposes.

There are no readily available site specific Total Suspended Particulates (TSP) and deposited dust monitoring data. The Wallsend monitoring site does not measure these components; however, estimates of the background levels for the area are required to assess the impacts of the Proposal on TSP and deposited dust.

Estimates of the annual average background TSP concentrations can be determined from a relationship between measured PM_{10} concentrations. This relationship assumes that 40% of the TSP is PM_{10} and was established as part of a review of ambient monitoring data collected by co-

located TSP and PM_{10} monitors operated for reasonably long periods of time in the Hunter Valley (NSW Minerals Council, 2000).

Applying this relationship with the 2016 annual average PM_{10} concentration of 16.6 µg/m3 at the Wallsend monitoring station estimates an annual average TSP concentration of 41.5 µg/m3.

To estimate annual average dust deposition levels, a similar process to the method used to estimate TSP concentrations is applied. This approach assumes that a TSP concentration of 90µg/m3 will have an equivalent dust deposition value of 4 g/m^2/month; and indicates a background annual average dust deposition of 1.84 g/m^2/month for the area surrounding the project.

Table 2-4 summarises the background air quality adopted for assessment purposes.

Table 2-4 Background Air Quality Adopted for Assessment

Pollutant	Averaging Period	Adopted Background Concentration/Level
PM_{10}	24-hour	35.2 µg/m^3
	Annual	16.6 µg/m^3
$PM_{2.5}$	24-hour	22.6 µg/m^3
	Annual	7.8 µg/m^3
TSP	Annual	41.5 µg/m^3
Deposited Dust	Annual	1.84 g/m^2/month

3 AIR QUALITY CRITERIA

3.1 Introduction

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016) sets out applicable impact assessment criteria for a number of air pollutants.

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the pollutants of interest in this study and the application air quality criteria for each pollutant.

3.2 Pollutants of Interest

Potential pollutants identified for this development with the potential to result in air quality impacts include odour and dust.

3.3 Impact Assessment Criteria

3.3.1 Odour

NSW legislation prohibits emissions that cause offensive odour to occur at any off-site receptor. Offensive odour is evaluated in the field by authorised officers, who are obliged to consider the odour in the context of its receiving environment, frequency, duration, character and so on and to determine whether the odour would unreasonably interfere with the comfort and repose of the normal person. In this context, the concept of offensive odour is applied to operational facilities and relates to actual emissions in the air.

However, in the approval and planning process for proposed new operations or modifications to existing projects, no actual odour exists and it is necessary to consider hypothetical odour. In this context, odour concentrations are used and are defined in odour units. The number of odour units represents the number of times that the odour would need to be diluted to reach a level that is just detectable to the human nose. Thus, by definition, odour less than one odour unit (1 OU), would not be detectable to most people.

The range of a person's ability to detect odour varies greatly in the population, as does their sensitivity to the type of odour. Therefore, there can be a wide range of variability in the way odour response is interpreted.

It should be noted that odour refers to complex mixtures of odours, and not "pure" odour arising from a single chemical. Odour from a single, known chemical very rarely occurs (when it does, it is best to consider that specific chemical in terms of its concentration in the air). In most situations, odour will be comprised of a cocktail of many substances that is referred to as a complex mixture of odorous pollutants, or more simply odour.

For developments with potential for odour it may be necessary to predict the likely odour impact that may arise. This is done by using air dispersion modelling which can calculate the level of dilution of odours emitted from the source at the point that it reaches surrounding receptors. This approach allows the air dispersion model to produce results in terms of odour units.

The NSW criteria for acceptable levels of odour range from 2 to 7 OU, with the more stringent 2 OU criteria applicable to densely populated urban areas and the 7 OU criteria applicable to sparsely populated rural areas, as outlined below.

Table 3-1 presents the relevant impact assessment criteria for complex mixtures of odorous pollutants.

Table 3-1 Impact assessment criteria – complex mixtures of odorous pollutants

Population of affected community	Impact assessment criteria (OU)*
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

Note: * 99th percentile nose-response time.

The sensitive receivers identified in this assessment are located in a rural setting, and therefore an impact assessment criterion of 7.0 OU/m^3 has been adopted.

3.3.2 Dust and Particulate Matter

The EPA Approved Methods specifies air quality assessment criteria for assessing impacts from dust generating activities. These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (NEPC, 1998).

Table 3-2 summarises the air quality goals for dust and particulate matter that are relevant to this study. The air quality goals relate to the total concentrations of dust and particulate matter in the air and not just that from the project. Therefore, some consideration of background levels needs to be made when using these goals to assess impacts.

Table 3-2 Impact assessment criteria – dust and particulate matter

Pollutant	Averaging period	Impact	Criteria
Total suspended particulates (TSP)	Annual	Total	90 µg/m³
Particulate matter ≤10 µm (PM_{10})	Annual	Total	25 µg/m³
	24-hour	Total	50 µg/m³
Particulate matter ≤2.5 µm ($PM_{2.5}$)	Annual	Total	8 µg/m³
	24-hour	Total	25 µg/m³
Deposited dust (DD)	Annual	Total	4 g/m²/month
	Annual	Incremental	2 g/m²/month

4 DISPERSION MODELLING

4.1 Meteorological Modelling

4.1.1 The Air Pollution Model (TAPM)

No meteorological observation data is available for the Proposal site. The Port Macquarie Airport AWS is located approximately 12 kilometres south east of the Proposal site. Therefore, site-specific meteorological data was generated through the use of a prognostic model. The prognostic model used was The Air Pollution Model (TAPM), developed and distributed by the Commonwealth Scientific and industrial Research Organisation (CSIRO).

TAPM is an incompressible, non-hydrostatic, primitive equations prognostic model with a terrain-following vertical coordinate for three-dimensional simulations. It predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of large scale meteorology provided by synoptic analyses. TAPM benefits from having access to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic scale meteorological analyses for various regions around the world.

The prognostic modelling domain was centred at 31.36° S, 152.78° E and involved four nesting grids of 30km, 10 km, 3km and 1km with 31 grids in the lateral dimensions and 25 vertical levels.

The TAPM model included assimilation of data collected at the Port Macquarie Airport AWS during the year 2012. This modelling year was chosen as being representative of typical meteorological conditions, particularly for wind speed and wind direction, based on a long term meteorological analysis, as described in Section 2.2

4.1.2 CALMET

The three dimensional prognostic wind field from the TAPM simulation was incorporated in a CALMET model as the initial guess wind field. CALMET was run using the 'No-Observations Approach' recommended by TRC (2011).

The CALMET domain was 8 x 8 km with a grid resolution of 0.15 km. Local land use and topographical data (SRTM 3) were used to produce realistic fine scale flow fields in the area surrounding the site.

4.2 Dispersion Modelling

CALPUFF is a non-steady state Gaussian puff dispersion model, developed for the US EPA and approved for use by the NSW EPA. CALPUFF is considered an advanced dispersion model and is intended for use in situations where less advanced Gaussian plume models are not appropriate. CALPUFF is most often used in areas exhibiting one or more of the following features:

- Complex terrain;
- Recirculating coastal sea breezes;
- High frequency of calm winds; and,
- Buoyant line sources.

CALPUFF is also the preferred dispersion model for odour, and for this reason has been selected for this assessment.

4.2.1 Peak to Mean Ratios

To account for the time-averaging limitations of the dispersion model, peak-to-mean ratios have been incorporated into all odour flux rates in accordance with the Approved Methods. Peak-to-mean ratios for various source types, as prescribed by the Approved Methods, are presented in Table 4-1.

Table 4-1 Peak-to-mean ratios

Source type	Pasquill-Gifford stability class	P/M60	
		Near-field	Far-field
Area	A,B,C,D	2.5	2.3
	D,E	2.3	1.9
Line	A-F	6	6
Surface wake-free point	A,B,C	12	4
	D,E,F	25	7
Tall wake-free point	A,B,C	17	3
	D,E,F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

Note: * Ratio of peak 1-second average concentrations to mean 1-hour average concentrations.

4.2.2 Building Wake Effects

All emissions associated with this development were modelled using volume sources, which are not affected by building wakes.

4.2.3 Dust Particle Size Distribution

Dust deposition is strongly influenced by particle size. Therefore, the total dust emissions from the Site are separated into three fractions, based on particle size, as presented in Table 4-2. Each fraction is modelled as a separate species in CALPUFF, and the predicted ground level concentrations of $PM_{2.5}$, PM_{10}, TSP and dust deposition levels are calculated as combinations of the relevant fractions.

Table 4-2 Dust particle size distribution

Particle Category	Size Range	Distribution (% of TSP)
Fine Particles (FP)	<2.5 µg	4.68%
Coarse Matter (CM)	2.5 – 10 µg	34.4%
Rest	10 – 30 µg	60.92

5 EMISSIONS TO AIR

5.1 Odour Emissions

While the Proposal will be developed in Stages (as described in Section 1.2.1), a single operational scenario, representing the typical worst-case odour emissions, has been modelled to assess the potential odour impacts from the Proposal. In this scenario, the active tipping face covers approximately 600 m^2 and is located in the south-western portion of the site, closest to the nearest sensitive receptor (see Figure 5-1).

The operation of the Proposal will occur in a staged manner, whereby the active area of the landfill would be limited to a total area of approximately 2,500 m^2. Within this area, on a day-to-day basis, waste would be placed within an "active tipping area" of approximately 600 m^2. At the end of each day, the active tipping area would be covered with natural site soils, to a depth of at least 150 mm, referred to as "daily cover". When an area under daily cover will not receive additional waste or will not be finally capped for some time, it will receive "intermediate cover" comprising a compacted clay layer of at least 300 mm depth.

Specific odour emission rates (SOER) for the active tipping area, daily cover, and intermediate cover have been adopted from site measurements conducted as part of an odour assessment at a landfill at Eastern Creek (PAE Holmes, 2010). A summary of the estimated odour emissions from the operation of the Proposal are presented in Table 5-1. It is assumed that, within the 2,500 m^2 active area, the active tipping area is 600 m^2 and the remaining 1,900 m^2 is split evenly between daily cover and intermediate cover. Table 5-1 also presents the "peak odour flux rate" which incorporates the appropriate peak-to-mean ratio to ensure that the modelling results represent "nose-response-time" odour levels.

Table 5-1 Odour emission estimate

Source	SOER ($OU.m^3/m^2/s$)	Area (m^2)	Odour flux rate	Peak to mean ratio	Peak odour flux rate
Active tipping area	3.65	600	2,190	2.3	5,037
Daily cover	1.74	950	1,653	2.3	3,802
Intermediate cover	0.01	950	38	2.3	87

It should be noted that the modelling assumes that the odour emissions presented in Table 5-1 would persist on a 24-hour basis; however, since the active tipping area would receive daily cover at the end of every day, the odour estimate in Table 5-1 is conservative given odours would gradually reduce after daily cover is applied.

The locations of the modelled odour sources are shown on Figure 5-1

Figure 5-1 Modelled odour sources



5.2 Dust Emissions

Dust emissions from the Proposal have been estimated based on information provided by the client, using emission factors sourced from both locally developed and US EPA developed documentation.

Since the Proposal would operate in a staged manner, whereby a new stage of the landfill is being constructed concurrently with the operation of another, the worst-case dust emissions from the Proposal would occur during day-to-day site activities, and would include contributions from "construction" and "operational" type activities.

The most significant dust generating activities on the Proposal Site would be waste vehicles driving on unsealed roads to deposit waste at the tipping face, and on-site plant and equipment (e.g. excavators) being used to excavate landfill cells and deposit daily, intermediate and final cover onto the waste. In this regard, the most significant dust generating period of the Proposal would be during Stage 3, where the greatest volume of waste is being delivered to the site, and therefore the highest number of associated vehicle movements would occur. The estimated TSP emissions from these activities are presented in Table 5-2. A detailed emission inventory and emission estimation calculations are presented in Appendix A.

Table 5-2 Estimated worst-case annual TSP emissions

Activity	TSP Emissions (kg/year)
compactor	24,492
excavators - loading tipper	48
tipper - dumping	48
haul roads - tipper	7748
haul roads - waste	120,780
wind erosion - stockpiles	701
wind erosion - exposed area	1,752
Total	**155,568**

The haul roads are modelled as a series of sources, distributed approximately along the expected main route, which is located approximately around the outer extents of the Proposal area. Since the remaining dust generating activities, as identified in Table 5-2, are located in relatively close proximity to one another, they are modelled as a single source, located in the south-western portion of the site, closest to the nearest sensitive receptors. The locations of the modelled TSP sources are shown on Figure 5-2.

Figure 5-2 Modelled dust sources



6 ASSESSMENT OF IMPACTS

The following section presents quantitative assessments of the potential odour and dust impacts on nearby sensitive receptors from the operation the Proposal.

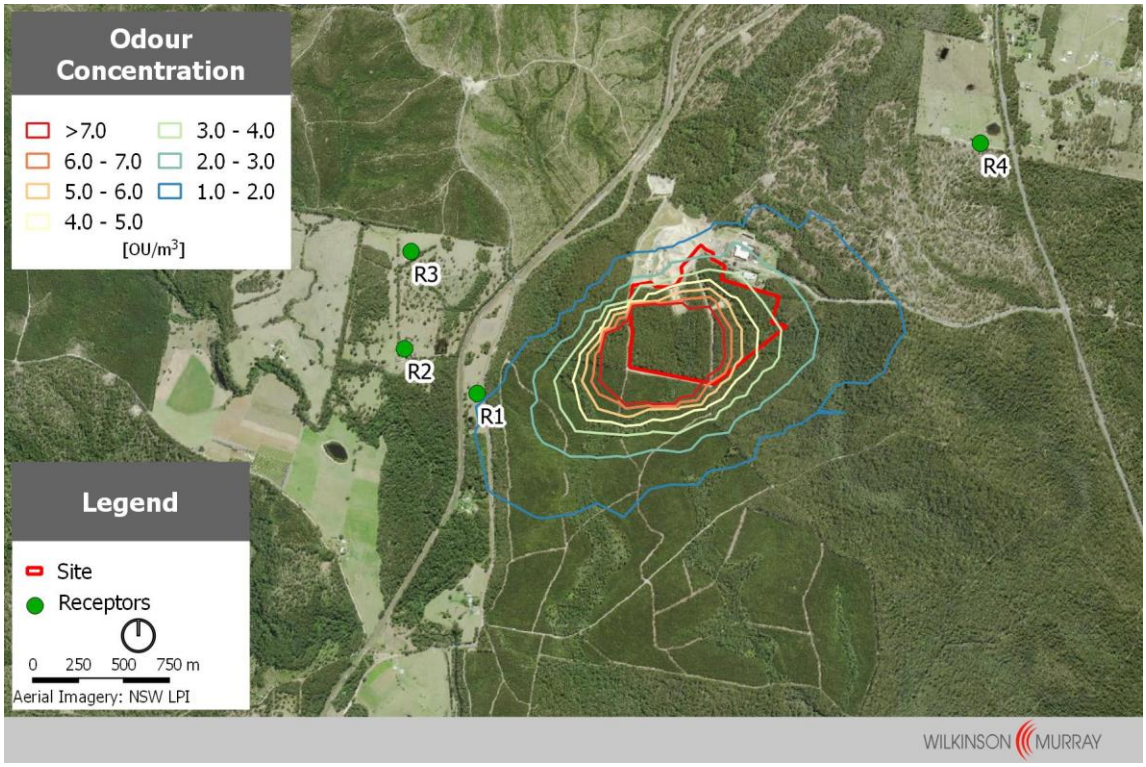
6.1 Assessment of odour impacts

Based on dispersion modelling results, the predicted operational odour impacts on nearby receptors is presented numerically in Table 6-1 and graphically via contours in Figure 6-1.

Table 6-1 Predicted 99th percentile peak odour concentrations

Receptor	Predicted peak odour concentration (OU/m³)	Impact assessment criterion (OU/m³)	Complies? (Yes/ No)
R1	0.75	7.0	Yes
R2	0.27	7.0	Yes
R3	0.08	7.0	Yes
R4	0.29	7.0	Yes

Figure 6-1 Predicted 99th percentile peak odour concentrations



Review of Table 6-1 indicates that the predicted 99th percentile odour concentrations are well below the established impact assessment criterion of 7.0 OU/m³at the most potentially affected sensitive receptors.

6.2 Assessment of dust impacts

6.2.1 TSP and Particulate matter

Table 6-2 presents the dispersion modelling results for TSP and particulate matter at sensitive receptors. A contour plot of the incremental 24-hour average PM_{10} concentrations is presented in

Review of Table 6-2 demonstrates that TSP and particulate matter concentrations, due to the Proposal, comply with the impact assessment criteria at all receptors.

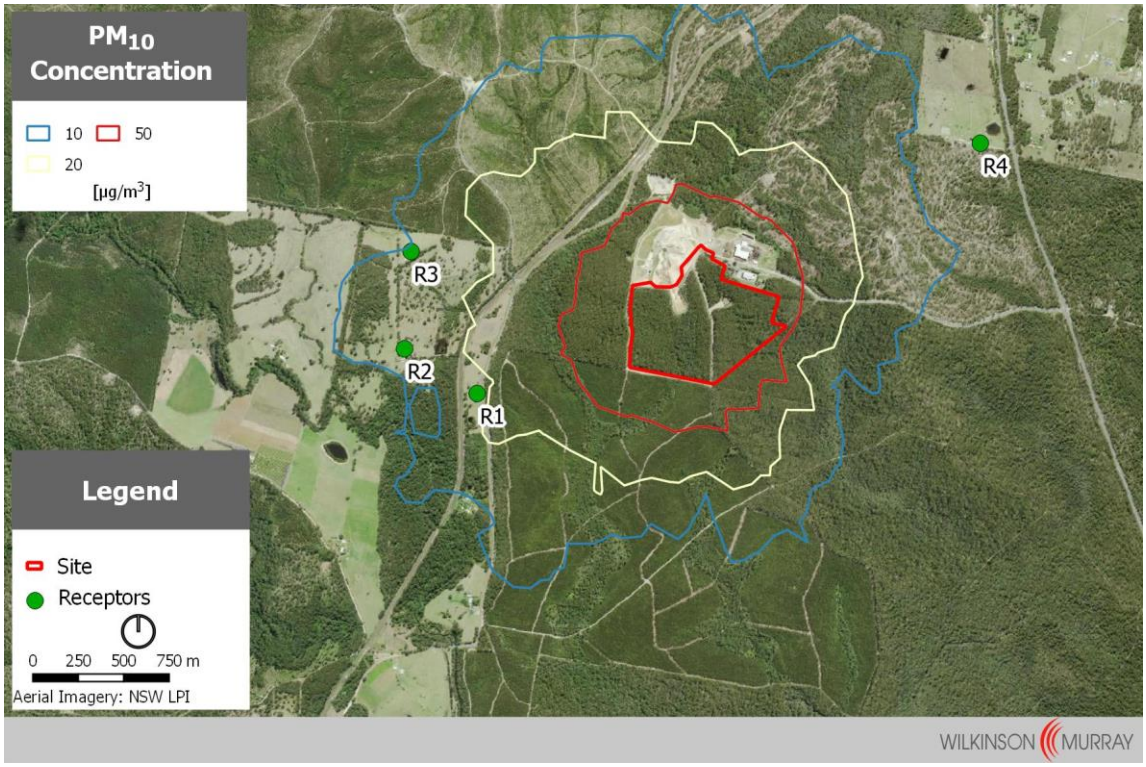
Figure 6-2.

Table 6-2 Predicted TSP and particulate matter impacts at sensitive receptors

Receptor	TSP		PM_{10}				$PM_{2.5}$			
	Annual		24-hour		Annual		24-hour		Annual	
	Increment	Total	Increment	Total	Increment	Total	Increment	Total	Increment	Total
Goal	**90 µg/m³**		**50 µg/m³**		**25 µg/m³**		**25 µg/m³**		**8 µg/m³**	
R1	2.6	44.1	13.8	49	1.8	18.4	2.0	24.6	0.2	7.8
R2	1.7	43.2	14.8	50	1.2	17.8	1.9	24.5	0.2	7.8
R3	1.2	42.7	10.6	45.8	0.9	17.5	1.5	24.1	0.1	7.7
R4	0.6	42.1	5.0	40.2	0.4	17	0.7	23.3	0.1	7.7

Review of Table 6-2 demonstrates that TSP and particulate matter concentrations, due to the Proposal, comply with the impact assessment criteria at all receptors.

Figure 6-2 Predicted incremental 24-hour average PM_{10} concentration



6.2.2 Deposited Dust

Table 6-3 Predicted deposited dust impacts at sensitive receptors

Receptor	Deposited Dust	
	Annual	
	Increment	Total
Goal	**2 g/m²/month**	**4 g/m²/month**
R1	0.11	1.95
R2	0.04	1.88
R3	0.03	1.87
R4	0.02	1.86

Review of Table 6-3 demonstrates that deposited dust levels, due to the Proposal, are well below the impact assessment criteria at all sensitive receptors.

7 MITGATION AND MANAGEMENT

The preceding air quality impact assessment has demonstrated that the Project is expected to comply with relevant air quality criteria. Notwithstanding this, responsible developments should implement reasonable and feasible measures to reduce their burden on local and regional air quality. To this end, the following section presents a number of measures to manage odour and dust emissions from the site.

7.1 Odour Management

The following odour management measures should be considered for the Proposal:

- Procedures for staff to report the presence of strong odours around the perimeter of the Proposal site;
- Apply daily and intermediate cover as soon as practicable to relevant areas; and,
- Keep the active tipping face as small as practicable.

In addition to the measures recommended above, the complaints management procedures currently in place at the existing landfill would be continued for the future landfill stages, including maintenance of the existing "Complaints Register".

7.2 Dust Management

The following dust management measures should be considered for the Proposal:

- Engines of trucks and mobile plant to be switched off when not in use;
- Maintain and service plant in accordance with manufacturer's specifications;
- Limit vehicle speeds to 20 km/h;
- Cover vehicle loads if transporting material off-site;
- Reduce drop heights during loading and unloading of material;
- Use water carts and sprays to suppress visible dust leaving the site;
- Minimise areas of exposed surfaces;
- Minimise amount of stockpiled materials;
- Where possible, apply barriers, covering or temporary rehabilitation to exposed areas;
- Apply final capping and/or rehabilitate areas as soon as practicable.

8 CONCLUSION

An Air Quality Impact Assessment (AQIA) has been conducted for the landfill expansion at the Cairncross Waste Management Facility (Cairncross WMF) (the Proposal).

Potential odour and dust impacts associated with the day-to-day construction and operational activities for the Proposal have been assessed in general accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

Quantitative assessments of potential odour and dust impacts from the operation of the Proposal have been conducted, based on TAPM meteorological simulations and the CALPUFF dispersion modelling system.

The results of the dispersion modelling indicate that odour and dust concentrations at sensitive receptors due to the operation of the Proposal comply with the established criteria at all sensitive receptors.

9 REFERENCES

NSW Environmental Protection Authority (2016)

"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW", January 2017.

PAE Holmes (2010)

"Air Quality Impact Assessment – Proposed Modification to the Northern Extension Landfill at Eastern Creek", March 2011

SPCC (1983)

"Air Pollution from Coal Mining and Related Developments", State Pollution Control Commission.

US EPA (1985 and updates)

"Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition, United States Environmental Protection Agency.

APPENDIX A

DUST EMISSIONS INVENTORY

A.1 Particulate Emission Factor Equations

Vehicles on paved roads

TSP emissions from vehicles on paved roads are a function of the mass of the vehicles and the amount of silt loading on the road. The following US EPA emission factor (US EPA, 1985 and updates) is used to calculated emissions from paved roads:

$$E[g/VKT] = k \times (sL)^{0.91} (W)^{1.02}$$

Where:

k = 3.23 for TSP

sL = road surface silt loading [g/m^2]

W = average vehicle weight [tons]

Loading / unloading / transferring material

Each tonne of material handles will generate quantities of particulate matter that will depend on the wind speed and the moisture content of the material according to the US EPA emission factor (US EPA, 1985 and updates) shown below:

$$E[kg/t] = k\ (0.0016) \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2.0}\right)^{1.4}} \right)$$

Where:

k = 0.74 for TSP

U = wind speed [m/s]

M = moisture content [%]

A wind speed of 1 m/s is assumed as the activities are taking place inside a building with no forced ventilation.

Crushing

Particulate emission factors for crushing have been taken from the US EPA (US EPA, 1985 and updates) and are summarised below:

Activity	Emission Factor [kg/t]		
	TSP	PM_{10}	$PM_{2.5}$
Tertiary crushing (uncontrolled)	0.0027	0.0012	*
Screening (uncontrolled)	0.0125	0.0043	*

* No emissions data available

A.2 Emission Estimates

Table A-1 Summary of TSP Emissions

Activity	Total Emission [kg/year]	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Control [%]
compactor	24492	3604	h/y	6.796657092	kg/h	10	silt content [%]	4	moisture content [%]			0
excavators - loading tipper	48	120000	t/y	0.000396369	kg/t	2	wind speed [m/s]	4	moisture content [%]			0
tipper - dumping	48	120000	t/y	0.000396369	kg/t	2	wind speed [m/s]	4	moisture content [%]			0
haul roads - tipper	7748	8736	VKT/y	3.547444661	kg/VKT	10	silt Loading [g/m^2]	20	ave vehicle mass [t]	0.6	km per trip	75
haul roads - waste	120780	136188	VKT/y	3.547444661	kg/VKT	10	silt Loading [g/m^2]	20	ave vehicle mass [t]	1.8	km per trip	75
wind erosion - stockpiles	701	0.4	ha	0.4	kg/ha/h	8760	h/y					50
wind erosion - exposed area	1752	1.0	ha	0.4	kg/ha/h	8760	h/y					50
Total	155568											

APPENDIX L NSW EPA CONTAMINATED LAND PUBLIC RECORD

Healthy Environment, Healthy Community, Healthy Business

Home Contaminated land Record of notices

Search results

Your search for: LGA: Port Macquarie-Hastings Council

Search Again
Refine Search

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the planning process.

Search TIP

To search for a specific site, search by LGA (local government area) and carefully review all sites listed.

... more search tips

More information about particular sites may be available from:

- The POEO public register
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.
This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register

17 March 2017

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APPENDIX M NSW EPA POEO ACT PUBLIC REGISTER

Healthy Environment, Healthy Community, Healthy Business

Search results

Your search for: **General Search** with the following criteria

Suburb - TELEGRAPH POINT

returned 10 results

Export to excel 1 of 1 Pages Search Again

Number	Name	Location	Type	Status	Issued date
11189	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Highway, TELEGRAPH POINT, NSW 2441	POEO licence	Issued	23 Oct 2000
1010666	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Highway, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	11 Sep 2001
1033914	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Highway, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	13 May 2004
1055483	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Highway, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	03 Feb 2009
1102147	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Highway, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	23 Jul 2009
13120	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Hwy, TELEGRAPH POINT, NSW 2441	POEO licence	Issued	24 Jul 2009
1109054	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Hwy, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	27 Jan 2011
1125722	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Hwy, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	18 Mar 2011
1523521	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Hwy, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	31 Oct 2014
1527550	PORT MACQUARIE HASTINGS COUNCIL	8395 Pacific Highway, TELEGRAPH POINT, NSW 2441	s.58 Licence Variation	Issued	09 Mar 2015

17 March 2017

APPENDIX N LIST OF NSW CONTAMINATED SITES

List of NSW Contaminated Sites Notified to EPA as of 6 March 2017

Background

A strategy to systematically assess, prioritise and respond to notifications under Section 60 of the *Contaminated Land Management Act 1997* (CLM Act) has been developed by the EPA. This strategy acknowledges the EPA's obligations to make information available to the public under *Government Information (Public Access) Act 2009*.

When a site is notified to the EPA, it may be accompanied by detailed site reports where the owner has been proactive in addressing the contamination and its source. However, often there is minimal information on the nature or extent of the contamination.

For some notifications, the information indicates the contamination is securely immobilised within the site, such as under a building or carpark, and is not currently causing any offsite consequences to the community or environment. Such sites would still need to be cleaned up, but this could be done in conjunction with any subsequent building or redevelopment of the land. These sites may not require intervention under the CLM Act, but could be dealt with through the planning and development consent process.

Where indications are that the nominated site is causing actual harm to the environment or an unacceptable offsite impact (i.e. it is a "significantly contaminated site"), the EPA would apply the regulatory provisions of the CLM Act to have the responsible polluter and/or landowner investigate and remediate the site.

As such, the sites notified to the EPA and presented in the following table are at various stages of the assessment and/or remediation process. Understanding the nature of the underlying contamination, its implications and implementing a remediation program where required, can take a considerable period of time. The tables provide an indication, in relation to each nominated site, as to the management status of that particular site. Further detailed information may be available from the EPA or the responsible landowner.

The following questions and answers may assist those interested in this issue:

Frequently asked questions

What is the difference between the "List of NSW Contaminated Sites Notified to the EPA" and the "Contaminated Land: Record of Notices"?

A site will be on the Contaminated Land: Record of Notices only if the EPA has issued a regulatory notice in relation to the site under the *Contaminated Land Management Act 1997*.

The sites appearing on this "List of NSW contaminated sites notified to the EPA" indicate that the notifiers consider that the sites are contaminated and warrant reporting to the EPA. However, the contamination may or may not be significant enough to warrant regulation by the EPA. The EPA needs to review and, if necessary, obtain more information before it can make a determination as to whether the site warrants regulation.

Why my site appears on the list?

Your site appears on the list because of one or more of the following reasons:

- The site owner and/or the person partly or fully responsible for causing the contamination notified to the EPA about the contamination under Section 60 of the *Contaminated Land Management Act 1997*. In other words, the site owner or the "polluter" believes the site is contaminated.
- The EPA has been notified via other means and is satisfied that the site is or was contaminated.

Does the list contain all contaminated sites in NSW?

No. The list only contains contaminated sites that the EPA is aware of, with regard to its regulatory role under the CLM Act. An absence of a site from the list does not necessarily imply the site is not contaminated.

The EPA relies upon responsible parties to notify contaminated sites.

How are these notified contaminated sites managed by the EPA?

There are different ways that the EPA manages these notified contaminated sites. First, an initial assessment is carried out by the EPA. At the completion of the initial assessment, the EPA may take one or more than one of the following management approaches:

- The contamination warrants the EPA's direct regulatory intervention either under the *Contaminated Land Management Act 1997* or the *Protection of the Environment Operations Act 1997* (POEO Act), or both. Information about current or past regulatory action on this site can be found on EPA website.
- The contamination with respect to the current use or approved use of the site, as defined under the *Contaminated Land Management Act 1997,* is not significant enough that it warrants EPA regulation.
- The contamination does not require EPA regulation and can be managed by a planning approval process.
- The contamination is related to an operational Underground Petroleum Storage System, such as a service station or fuel depot. The contamination may be managed under the POEO Act and the Protection of the Environment Operation (Underground Petroleum Storage Systems) Regulation 2008.
- The contamination is being managed under a specifically tailored program operated by another agency (for example the Department of Industry and Investment's *Derelict Mines Program*).

I am the owner of a site that appears on the list. What should I do?

First of all, you should ensure the current use of the site is compatible with the site contamination. Secondly, if the site is the subject of EPA regulation, make sure you comply with the regulatory requirements, and you have considered your obligations to notify other parties who may be affected.

If you have any concerns, contact us and we may be able to offer you general advice, or direct you to accredited professionals who can assist with specific issues.

I am a prospective buyer of a site that appears on the list. What should I do?

You should seek advice from the vendor to put the contamination issue into perspective. You may need to seek independent expert advice.

The information provided in the list is meant to be indicative only, and a starting point for your own assessment. Site contamination as a legacy of past site uses is not uncommon,

particularly in an urbanised environment. If the contamination on a site is properly remediated or managed, it may not materially impact upon the intended future use of the site. However, each site needs to be considered in context.

List of NSW Contaminated Sites Notified to the EPA

Disclaimer

The EPA has taken all reasonable care to ensure that the information in the list of contaminated sites notified to the EPA (the list) is complete and correct. The EPA does not, however, warrant or represent that the list is free from errors or omissions or that it is exhaustive.

The EPA may, without notice, change any or all of the information in the list at any time.

You should obtain independent advice before you make any decision based on the information in the list.

The list is made available on the understanding that the EPA, its servants and agents, to the extent permitted by law, accept no responsibility for any damage, cost, loss or expense incurred by you as a result of:

1. any information in the list; or
2. any error, omission or misrepresentation in the list; or
3. any malfunction or failure to function of the list;
4. without limiting (2) or (3) above, any delay, failure or error in recording, displaying or updating information.

Site Status	Explanation
Under assessment	The contamination is being assessed by the EPA to determine whether regulation is required. The EPA may require further information to complete the assessment. For example, the completion of management actions regulated under the planning process or *Protection of the Environment Operations Act 1997*. Alternatively, the EPA may require information via a notice issued under s77 of the *Contaminated Land Management Act 1997* or issue a Preliminary Investigation Order.
Regulation under CLM Act not required	The EPA has completed an assessment of the contamination and decided that regulation under the *Contaminated Land Management Act 1997* is not required.
Regulation being finalised	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the *Contaminated Land Management Act 1997*. A regulatory approach is being finalised.

Contamination currently regulated under CLM Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the *Contaminated Land Management Act 1997* (CLM Act). Management of the contamination is regulated by the EPA under the CLM Act. Regulatory notices are available on the EPA's Contaminated Land Public Record.
Contamination currently regulated under POEO Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. Management of the contamination is regulated under the *Protection of the Environment Operations Act 1997* (POEO Act). The EPA's regulatory actions under the POEO Act are available on the POEO public register.
Contamination being managed via the planning process (EP&A Act)	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. The contamination of this site is managed by the consent authority under the *Environmental Planning and Assessment Act 1979* (EP&A Act) planning approval process, with EPA involvement as necessary to ensure significant contamination is adequately addressed. The consent authority is typically a local council or the Department of Planning and Environment.
Contamination formerly regulated under the CLM Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation under the *Contaminated Land Management Act 1997* (CLM Act). The contamination was addressed under the CLM Act.
Contamination formerly regulated under the POEO Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed under the *Protection of the Environment Operations Act 1997* (POEO Act).
Contamination was addressed via the planning process (EP&A Act)	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed by the appropriate consent authority via the planning process under the *Environmental Planning and Assessment Act 1979* (EP&A Act).
Ongoing maintenance required to manage residual contamination (CLM Act)	The EPA has determined that ongoing maintenance, under the *Contaminated Land Management Act 1997* (CLM Act), is required to manage the residual contamination. Regulatory notices under the CLM Act are available on the EPA's Contaminated Land Public Record.

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
ABBOTSFORD	Former Gasworks	43 St Albans STREET	Gasworks	Contamination formerly regulated under the CLM Act	-33.85270604	151.126976
ABBOTSFORD	Former Gasworks	80-81 Wymston Pde and 35 and 41 St Albans STREET	Gasworks	Regulation under CLM Act not required	-33.85306653	151.1268142
ABBOTSFORD	Former Gasworks	82, 83, 84 Wymston Pde, & 37, 39, 43, 45 St Albans STREET	Gasworks	Contamination formerly regulated under the CLM Act	-33.85288316	151.1267729
ABBOTSFORD	Former Gasworks	83 Wymston PARADE	Gasworks	Contamination formerly regulated under the CLM Act	-33.85288351	151.1265979
ABBOTSFORD	Former Gasworks	85 Wymston PARADE	Gasworks	Regulation under CLM Act not required	-33.85265214	151.1266277
ABERDEEN	Former Transport Depot	87-89 St Andrew STREET	Other Industry	Regulation under CLM Act not required	-32.17160931	150.8972859
ALBION PARK	Caltex Albion Park Service Station	1 Calderwood ROAD	Service Station	Regulation under CLM Act not required	-34.57131362	150.7647971
ALBION PARK RAIL	Caltex Service Station	172-174 Princes HIGHWAY	Service Station	Under assessment	-34.56134097	150.7953663
ALBION PARK RAIL	Caltex Service Station	31 Princes HIGHWAY	Service Station	Under assessment	-34.55162786	150.7880626
ALBION PARK RAIL	Former Timber Storage Area	36 Rivulet CRESCENT	Other Industry	Regulation under CLM Act not required	-34.54872597	150.7899351
ALBURY	Mobil Depot, Railway Place Albury	1 Railway PLACE	Other Petroleum	Regulation under CLM Act not required	-36.08526805	146.9236999
ALBURY	Former Thales Australia site, Albury	161 Fallon STREET	Other Industry	Contamination currently regulated under CLM Act	-36.064966	146.9434831
ALBURY	Former Gasworks and surrounding commercial land.	441 Kiewa STREET	Gasworks	Contamination currently regulated under CLM Act	-36.08357983	146.9137004
ALBURY	SRA Land	448 and 452 Young STREET	Unclassified	Regulation under CLM Act not required	-36.08438605	146.9235454
ALBURY	Coles Express Albury	465 Guinea STREET	Service Station	Under assessment	-36.07513665	146.9213077
ALBURY	SRA Land, 514 to 526 Young Street	514 to 526 Young STREET	Other Petroleum	Under assessment	-36.08084123	146.9241682
ALBURY	Woolworths Petrol	515 Young STREET	Service Station	Under assessment	-36.08073723	146.92351
ALBURY	Former Caltex Service Station	624 Young STREET	Service Station	Contamination formerly regulated under the CLM Act	-36.07555262	146.9256466
ALBURY	Caltex Service Station	79 Union ROAD	Service Station	Under assessment	-36.05496713	146.9487635
ALBURY	Former Caltex Service Station	842 David STREET	Service Station	Regulation under CLM Act not required	-36.06398743	146.9252143
ALBURY	Albury Plaza	Cnr Smollett Street and Townsend STREET	Other Industry	Regulation under CLM Act not required	-36.08112933	146.9135719
ALBURY	Caltex Service Station	Dean St Cnr Creek STREET	Service Station	Under assessment	-36.07978937	146.9110825
ALBURY	Mobil Albury Aviation Fuel Depot	Hangar 8 (Albury Airport), Ogden PLACE	Other Petroleum	Regulation under CLM Act not required	-36.07178139	146.9530165
ALEXANDRIA	Formerly Gas N Go Alexandria (fully redeveloped into residential apartment as of September 2016)	10-20 Botany ROAD	Service Station	Contamination currently regulated under CLM Act	-33.895363	151.198779
ALEXANDRIA	Australia Post	10-24 Ralph STREET	Other Industry	Contamination being managed via the planning process (EP&A Act)	-33.91583041	151.197997
ALEXANDRIA	Caltex Alexandria Service Station	133 Wyndham St, cnr McEvoy STREET	Service Station	Regulation under CLM Act not required	-33.90220927	151.2000425
ALEXANDRIA	Alexandria Gardens	146-156 Wyndham St & 146-156 Botany Rd	Unclassified	Under assessment	-33.89956961	151.1997377

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
ALEXANDRIA	Former Industrial Site	16 O'Riordan STREET	Other Industry	Under assessment	-33.9069796	151.201902
ALEXANDRIA	Former Mobil Service Station	20 O'Riordan STREET	Service Station	Regulation under CLM Act not required	-33.9075539	151.2014811
ALEXANDRIA	Australian Refined Alloys	202-212 Euston ROAD	Metal Industry	Regulation under CLM Act not required	-33.91505136	151.185872
ALEXANDRIA	Mascot Developments	494-504 Gardeners ROAD	Other Industry	Regulation under CLM Act not required	-33.9198218	151.191282
ALEXANDRIA	Former Cadbury Schweppes	49-59 O'Riordan STREET	Other Industry	Contamination formerly regulated under the CLM Act	-33.91406619	151.195067
ALEXANDRIA	Alexandria GoGas	562 Botany ROAD	Service Station	Regulation under CLM Act not required	-33.91577222	151.2000753
ALEXANDRIA	Alexandra Canal Sediments	Off Huntley STREET	Unclassified	Contamination currently regulated under CLM Act	-33.92204213	151.1770009
ALEXANDRIA	Sydney Park	Sydney Park, Alexandria ROAD	Landfill	Under assessment	-33.91163421	151.1840827
ALSTONVILLE	Caltex Service Station	73 Main STREET	Service Station	Under assessment	-28.84115994	153.4388699
AMBARVALE	Caltex Service Station	37 Woodhouse DRIVE	Service Station	Regulation under CLM Act not required	-34.08438034	150.8019168
ANNANDALE	Shell Coles Express Service Station	124-126 Johnston STREET	Service Station	Regulation under CLM Act not required	-33.88085651	151.1704805
ANNANDALE	7-Eleven (former Mobil) Annandale Service Station	198 Parramatta ROAD	Service Station	Under assessment	-33.88706434	151.1741135
APPIN	Elladale Creek Aqueduct Upper Canal	Macquariedale ROAD	Unclassified	Regulation under CLM Act not required	-34.18867067	150.7539597
APPIN	West Cliff Colliery	Wedderburn ROAD	Other Petroleum	Regulation under CLM Act not required	-34.21970612	150.8217522
ARDLETHAN	Landmark Fertiliser storage	24-26 Ariah STREET	Chemical Industry	Under assessment	-34.35696645	146.9007084
ARMIDALE	Mobil Armidale Service Station and Former Depot	10-12 McLennan STREET	Service Station	Regulation under CLM Act not required	-30.51107573	151.648242
ARMIDALE	Former Mobil Depot	132 Niagara STREET	Other Petroleum	Contamination formerly regulated under the CLM Act	-30.51115918	151.6490343
ARMIDALE	Former Shell Depot	134 Niagara STREET	Other Petroleum	Regulation under CLM Act not required	-30.51180178	151.6488634
ARMIDALE	Caltex Service Station	144 Marsh STREET	Service Station	Under assessment	-30.51709925	151.6675802
ARMIDALE	Caltex Service Station	146 Miller STREET	Service Station	Under assessment	-30.51362759	151.6481123
ARMIDALE	Armidale Dumaresq Council Grafton Road Depot	15-25 Grafton ROAD	Other Petroleum	Under assessment	-30.52058076	151.6815261
ARMIDALE	Caltex North Hill Service Station	2-4 Marsh STREET	Service Station	Under assessment	-30.50320439	151.6727051
ARMIDALE	Shell Service Station	93 Marsh STREET	Service Station	Regulation under CLM Act not required	-30.51299824	151.6697557
ARMIDALE	RTA land adjoining Martin Street estate	adjoining Martin STREET	Other Industry	Contamination formerly regulated under the CLM Act	-30.5045	151.6433
ARMIDALE	Parklands near the former gasworks	Beardy Street and Allingham STREET	Gasworks	Regulation under CLM Act not required	-30.51013465	151.6652722
ARMIDALE	Gasworks and portion of Harris Park	Corner of Beardy Street and Allingham STREET	Gasworks	Contamination currently regulated under CLM Act	-30.51157406	151.6623073
ARMIDALE	Martin Street Estate, Lot 3	Lot 3 Martin STREET	Other Industry	Regulation under CLM Act not required	-30.5066659	151.6453692
ARMIDALE	Martin Street , Crown Land	Martin STREET	Other Industry	Contamination formerly regulated under the CLM Act	-30.50414076	151.6429516
ARMIDALE	Martin Street Estate	Martin STREET	Other Industry	Regulation under CLM Act not required	-30.50559024	151.6431854

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ARMIDALE	Caltex Service Station	New England HIGHWAY	Service Station	Under assessment	-30.53210764	151.6160492
ARMIDALE	Caltex Service Station	Queen Elizabeth DRIVE	Service Station	Under assessment	-30.50348872	151.6510748
ARNCLIFFE	7-Eleven Arncliffe	28 Princes HIGHWAY	Service Station	Under assessment	-33.93428397	151.1525438
ARTARMON	BP Artarmon	432 Pacific HIGHWAY	Service Station	Under assessment	-33.81132193	151.1755358
ARTARMON	7-Eleven (former Mobil) Artarmon Service Station	477 Pacific HIGHWAY	Service Station	Under assessment	-33.81053826	151.1774248
ASHBY	Ashby Dry Dock	via Clarence STREET	Other Industry	Contamination formerly regulated under the CLM Act	-29.44158377	153.1972304
ASHFIELD	Vehicle Workshop	445-449 Liverpool ROAD	Service Station	Regulation under CLM Act not required	-33.88826829	151.1167477
ASQUITH	BP Service Station	462 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.68982678	151.106156
ATTUNGA	Attunga Limestone Mine (Waste Oil Site)	Garthowen ROAD	Other Industry	Regulation under CLM Act not required	-30.92920627	150.8579435
AUBURN	RailCorp Auburn	1 Manchester ROAD	Other Industry	Under assessment	-33.84410947	151.0242502
AUBURN	DIC Australia	323 Chisholm ROAD	Other Industry	Regulation under CLM Act not required	-33.87228962	151.0157032
AUBURN	Former Ajax chemical factory	9 Short STREET	Other Industry	Contamination currently regulated under CLM Act	-33.83671601	151.0292071
AUBURN	Department of Corrective Services land adjacent to the former Auburn Landfill	Jamieson STREET	Landfill	Contamination formerly regulated under the CLM Act	-33.82928257	151.0590653
AUBURN	Janyon	Manchester ROAD	Other Industry	Regulation under CLM Act not required	-33.84467826	151.020745
AWABA	Awaba Colliery	Wilton ROAD	Other Industry	Under assessment	-33.02098186	151.5383612
BALGOWLAH	Part of Manly Council Maintenance Depot	8-10 Roseberry STREET	Other Petroleum	Regulation under CLM Act not required	-33.78928907	151.2679557
BALGOWLAH	BP Service Station	Cnr Sydney Road and Maretimo STREET	Service Station	Under assessment	-33.79546175	151.2559309
BALLINA	Ballina Shell	273 River STREET	Service Station	Under assessment	-28.86809272	153.5552789
BALLINA	Former Mobil Service Station	37-41 Cherry STREET	Service Station	Regulation under CLM Act not required	-28.87022308	153.5620713
BALLINA	Woolworths Petrol	Kerr STREET	Service Station	Regulation under CLM Act not required	-28.85824461	153.5605439
BALLINA	Ballina Mays Motors	River STREET	Other Petroleum	Regulation under CLM Act not required	-28.86935402	153.5585931
BALRANALD	Caltex Service Station	Sturt HIGHWAY	Service Station	Under assessment	-34.57451679	142.7431207
BANKSMEADOW	Caltex Terminal	1-3 Penrhyn ROAD	Other Petroleum	Contamination currently regulated under POEO Act	-33.96335328	151.2171062
BANKSMEADOW	Orica Botany Groundwater Project	16-20 Beauchamp ROAD	Chemical Industry	Contamination currently regulated under CLM Act	-33.9552673	151.2151954
BANKSMEADOW	Discovery Cove, Former Ampol Rail Terminal	1801 Botany ROAD	Other Petroleum	Regulation being finalised	-33.96162178	151.2184122
BANKSMEADOW	Pacific National Rail Siding	Beauchamp ROAD	Unclassified	Contamination currently regulated under CLM Act	-33.95757712	151.2204974
BANKSMEADOW	Orica Former Chlor Alkali Plant	Botany Industrial PARK	Chemical Industry	Contamination currently regulated under CLM Act	-33.95664283	151.221685
BANKSMEADOW	Mobil Terminal	Coal Pier ROAD	Other Petroleum	Under assessment	-33.94477081	151.1965027
BANKSMEADOW	Orica Car Park Waste Encapsulation	Corish CIRCLE	Landfill	Contamination currently regulated under POEO Act	-33.94703665	151.22083
BANKSMEADOW	Former Pipeline	Corish CIRCLE	Other Petroleum	Regulation being finalised	-33.94705787	151.2209919

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
BANKSMEADOW	Mobil Banksmeadow Terminal	Port Feeder ROAD	Other Petroleum	Contamination currently regulated under POEO Act	-33.953944	151.214305
BANKSMEADOW	Orica Botany (Pre-2003 Regulation)	Port Feeder ROAD	Chemical Industry	Contamination currently regulated under CLM Act	-33.9516159	151.2195804
BANKSTOWN	7-Eleven Service Station	689 Henry Lawson DRIVE	Service Station	Regulation under CLM Act not required	-33.92749953	150.9804784
BANORA POINT	Caltex Service Station	Corner Leisure Drive and Darlington DRIVE	Service Station	Regulation under CLM Act not required	-28.21390712	153.5417434
BARMEDMAN	Caltex - Barmedman	Corner Watson Street and Star STREET	Other Petroleum	Regulation under CLM Act not required	-34.14351302	147.3824934
BARRACK HEIGHTS	Caltex Service Station	332-336 Shellharbour ROAD	Service Station	Under assessment	-34.56489171	150.8597814
BATEAU BAY	Former landfill	The Entrance ROAD	Landfill	Contamination currently regulated under CLM Act	-33.3938305	151.4699046
BATEHAVEN	Caltex Service Station	264 Beach ROAD	Service Station	Under assessment	-35.73255166	150.1997536
BATEMANS BAY	Caltex Service Station	87-89 Princes HIGHWAY	Service Station	Under assessment	-35.71940701	150.1762788
BATHURST	Shell Coles Express Service Station	(Cnr Stewart and Rocket Street) 298 Stewart STREET	Service Station	Regulation under CLM Act not required	-33.41910999	149.5677773
BATHURST	Former Mobil Depot	1 Lambert STREET	Other Petroleum	Regulation under CLM Act not required	-33.42875534	149.5806344
BATHURST	Bathurst - Former Caltex Depot	114 Howick STREET	Other Petroleum	Regulation under CLM Act not required	-33.42296963	149.5862574
BATHURST	Bathurst Rail Fabrication Centre	34 Alpha STREET	Other Industry	Regulation under CLM Act not required	-33.43037796	149.5821533
BATHURST	Devro Cattle Hide Processing Plant	46 Vale ROAD	Other Industry	Regulation under CLM Act not required	-33.43926137	149.5803563
BATHURST	Caltex Bathurst Service Station	53 Durham STREET	Service Station	Under assessment	-33.41689545	149.5848527
BATHURST	Former Shell Depot Bathurst	56 Bant STREET	Other Petroleum	Regulation under CLM Act not required	-33.43471575	149.5774595
BATHURST	Shell Coles Express Bathurst Service Station	59 Durham STREET	Service Station	Under assessment	-33.41639415	149.5843243
BATHURST	Former Gasworks	71 Russell STREET	Gasworks	Contamination formerly regulated under the CLM Act	-33.42420302	149.5864517
BATHURST	Former Police Station	Corner of William Street and Durham STREET	Other Petroleum	Contamination formerly regulated under the CLM Act	-33.41592424	149.5842233
BATHURST	Former Mobil Depot	Lower Russell STREET	Other Petroleum	Regulation under CLM Act not required	-33.42497876	149.585128
BATHURST	Crago Mill site	Piper STREET	Other Industry	Regulation under CLM Act not required	-33.42777602	149.5809428
BAULKHAM HILLS	Caltex Service Station	117 Seven Hills ROAD	Service Station	Under assessment	-33.76139872	150.9750767
BAULKHAM HILLS	Caltex Service Station	130-132 Seven Hills ROAD	Service Station	Under assessment	-33.76180431	150.9746297
BAULKHAM HILLS	Shell Coles Express Service Station	363 Windsor ROAD	Service Station	Regulation under CLM Act not required	-33.7601819	150.9916224
BEACON HILL	Caltex Service Station	176 Warringah ROAD	Service Station	Contamination currently regulated under CLM Act	-33.75381485	151.2602617
BEACONSFIELD	Redevelopment Site	63-85 Victoria STREET	Other Industry	Under assessment	-33.9102929	151.2016275
BEGA	Former BP Service Station	100 - 102 Gipps STREET	Service Station	Regulation under CLM Act not required	-36.67563094	149.8433291
BEGA	Bega Gasworks	27 Upper STREET	Gasworks	Under assessment	-36.67710613	149.8480253
BEGA	Coles Express (former Caltex) Service Station	280 Carp (2-6 Swan) STREET	Service Station	Under assessment	-36.67388263	149.838163
BEGA	Caltex Service Station	36-40 Lagoon STREET	Service Station	Under assessment	-36.66832965	149.8289048

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
BELMONT	Belmont Bus Depot	2 Floraville ROAD	Other Petroleum	Under assessment	-33.02476269	151.6606657
BELMONT	Former Ampol Service Station	467-469 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.0299728	151.6613301
BELMONT	Shell Coles Express Belmont Service Station	502 Pacific HIGHWAY	Service Station	Under assessment	-33.03317155	151.6605194
BELMONT NORTH	Woolworths Service Station Belmont North	399 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.02454211	151.6634893
BELMONT NORTH	Caltex Service Station	406 Pacific HIGHWAY	Service Station	Under assessment	-33.02476876	151.6623655
BELMORE	SRA Land	348 Burwood ROAD	Unclassified	Regulation under CLM Act not required	-33.91753611	151.0859487
BELMORE	7-Eleven Service Station	792-794 Canterbury ROAD	Service Station	Regulation under CLM Act not required	-33.92567992	151.0873469
BELROSE	Caltex Service Station	157 Forest WAY	Service Station	Under assessment	-33.7347675	151.2212004
BELROSE	Glenrose Shopping Centre	56-58 Glen STREET	Unclassified	Contamination currently regulated under CLM Act	-33.73917996	151.2101029
BELROSE	Woolworths Petrol	60 Glen STREET	Service Station	Regulation under CLM Act not required	-33.74009002	151.2091045
BERESFIELD	Former Koppers Timber Treatment Site	53 Weakleys DRIVE	Other Industry	Under assessment	-32.79902937	151.6358846
BERESFIELD	BP Beresfield Truckstop	Cnr Kinta Drive and John Renshaw DRIVE	Service Station	Under assessment	-32.81122768	151.6393427
BERKELEY VALE	Former Berkeley Vale Service Station	121-123 Lakedge AVENUE	Service Station	Regulation under CLM Act not required	-33.34899186	151.4423109
BERKSHIRE PARK	Shell Coles Express Berkshire Park	746 - 752 Richmond ROAD	Service Station	Regulation under CLM Act not required	-33.66508654	150.7990243
BEROWRA	Caltex Berowra Service Station	12-14 Berowra Waters ROAD	Service Station	Regulation under CLM Act not required	-33.6233827	151.1505554
BEROWRA	42 Berowra Waters Road	42 Berowra Waters ROAD	Unclassified	Regulation under CLM Act not required	-33.6203211	151.1482454
BEROWRA	Shell Coles Express Berowra	955 Pacific (Cnr Yallambee Rd) HIGHWAY	Service Station	Regulation under CLM Act not required	-33.62818015	151.1475736
BEROWRA	7-Eleven Service Station	965-969 Pacific HIGHWAY	Service Station	Under assessment	-33.62673163	151.1479171
BERRIGAN	Caltex Service Station	155-165 Chanter STREET	Service Station	Under assessment	-35.6557616	145.8015557
BERRY	Shell Berry - Now BP branded	79 Queen STREET	Service Station	Under assessment	-34.77500516	150.695167
BERRY	Berry Service Centre - Shell Branded	88 Queen STREET	Service Station	Regulation under CLM Act not required	-34.77571634	150.6961713
BEXLEY	7-Eleven Bexley	474 Forest ROAD	Service Station	Under assessment	-33.95160096	151.1252355
BEXLEY	7-Eleven (former Mobil) Service Station	613 Forest ROAD	Service Station	Under assessment	-33.95539246	151.118447
BILLINUDGEL	CSR Readymix	Mogo PLACE	Other Industry	Regulation under CLM Act not required	-28.50210255	153.5278161
BLACKMANS FLAT	Mount Piper Extension Development Site	2847 Boulder ROAD	Other Industry	Regulation under CLM Act not required	-33.35619968	150.0279881
BLACKMANS FLAT	Lamberts Gully Mine	Castlereagh HIGHWAY	Other Industry	Under assessment	-33.36713827	150.0483236
BLACKTOWN	Former Caltex Service Station	131 Richmond ROAD	Service Station	Regulation under CLM Act not required	-33.75866104	150.8962614
BLACKTOWN	Valspar Blacktown	4 Steel STREET	Chemical Industry	Regulation under CLM Act not required	-33.75425018	150.9127714
BLACKTOWN	7-Eleven Service Station	62 Walters ROAD	Service Station	Under assessment	-33.77599783	150.8948926
BLACKTOWN	Land at Reservoir Road	Reservoir ROAD	Unclassified	Regulation under CLM Act not required	-33.79119448	150.8967838

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BLAKEHURST	Woolworths Service Station Blakehurst	390 Princes HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-33.990197	151.11361
BLAKEHURST	The Bay Nursing Home	392-394 Princes HIGHWAY	Service Station	Under assessment	-33.99030465	151.1140293
BLAXLAND	7-Eleven (former Mobil) Service Station	137 Great Western HIGHWAY	Service Station	Under assessment	-33.74627	150.6137669
BOAMBEE	Lindsay Bros transport depot site	542 Pacific HIGHWAY	Other Petroleum	Regulation under CLM Act not required	-30.33106848	153.0802985
BOAMBEE	Mobil Service Station	601 Pacific HIGHWAY	Service Station	Under assessment	-30.33530175	153.0806342
BOBS FARM	Bob's Farm	15 Fenningham Island ROAD	Other Industry	Regulation under CLM Act not required	-32.74867207	152.0316217
BOGGABILLA	Caltex Service Station	Cnr Simpson St & Newell HIGHWAY	Service Station	Under assessment	-28.60654029	150.3571056
BOGGABILLA	Lowes (Former Mobil) Depot	Newell HIGHWAY	Other Petroleum	Under assessment	-28.61023985	150.3529156
BOMADERRY	Bomaderry Works Depot	10 McIntyre WAY	Other Petroleum	Under assessment	-34.84576748	150.6131411
BOMADERRY	Caltex Service Station	246 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-34.83833824	150.5958799
BOMADERRY	Commercial Land	320 Princes Highway HIGHWAY	Other Industry	Under assessment	-34.84424073	150.5958149
BOMADERRY	Caltex Service Station	341 Princes HIGHWAY	Service Station	Under assessment	-34.84561952	150.5946978
BOMADERRY	Former Shell Depot	44 Railway STREET	Other Petroleum	Regulation under CLM Act not required	-34.85193621	150.6117038
BOMADERRY	Former Mobil Emoleum Depot	7 Victa WAY	Other Petroleum	Under assessment	-34.84454618	150.6139462
BOMADERRY	SRA Land	Lot 2 Meroo STREET	Unclassified	Regulation under CLM Act not required	-34.85314813	150.6099573
BOMBALA	Caltex Service Station	161 Maybe STREET	Service Station	Under assessment	-36.91234945	149.2374622
BOMBALA	Former Bright Street Timber Mill	Bright STREET	Other Industry	Regulation under CLM Act not required	-36.91547645	149.2302454
BOMBALA	Caltex Bombala Service Station	High Street corner Stephen STREET	Service Station	Under assessment	-36.90447935	149.241292
BOMBALA	Prime Pine site	Sandy LANE	Other Industry	Regulation under CLM Act not required	-36.9315425	149.2110959
BOMEN	Caltex Terminal	18 Lewington STREET	Other Petroleum	Under assessment	-35.0695246	147.4084379
BONDI	BP-branded Service Station	185 Bondi ROAD	Service Station	Regulation under CLM Act not required	-33.89432208	151.2647671
BONDI	Caltex Service Station	51 Bondi ROAD	Service Station	Under assessment	-33.8936307	151.260001
BONDI JUNCTION	Waverley Bus Depot	1-15 Oxford STREET	Other Industry	Regulation under CLM Act not required	-33.89165341	151.2421246
BONNY HILLS	Bonny View Store	923 Ocean DRIVE	Service Station	Regulation under CLM Act not required	-31.59075636	152.8392935
BONNYRIGG	United Bonnyrigg (Formerly AP SAVER)	709 Cabramatta ROAD	Service Station	Contamination currently regulated under POEO Act	-33.893058	150.892476
BONNYRIGG	BP-branded Service Station	Corner Cowpasture Road and North Liverpool ROAD	Service Station	Under assessment	-33.89416327	150.8578378
BONNYRIGG	Caltex Service Station	Smithfield Rd Cnr Elizabeth DRIVE	Service Station	Under assessment	-33.88840816	150.8822609
BOOLAROO	Incitec Pivot	13 Main STREET	Other Industry	Contamination formerly regulated under the CLM Act	-32.94803538	151.6302187
BOOLAROO	Bunnings Site - Pasminco Cockle Creek	13a Main ROAD	Metal Industry	Contamination formerly regulated under the CLM Act	-32.94364503	151.6252316
BOOLAROO	Cardiff West Estate - Pasminco Cockle Creek	Adjacent to PCC Smelter at 13A Main ROAD	Metal Industry	Regulation under CLM Act not required	-32.93950137	151.6349183

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
BOOLAROO	Pasminco Cockle Creek Smelter	Lake ROAD	Metal Industry	Contamination currently regulated under CLM Act	-32.94434593	151.6307345
BOOLAROO	Cockle Creek and Cockle Bay Sediments	Off Creek Reserve ROAD	Metal Industry	Contamination currently regulated under CLM Act	-32.96079541	151.6141327
BOOROWA	Former Mobil Depot	14-16 Brial STREET	Other Petroleum	Under assessment	-34.43673234	148.7300821
BOOROWA	Mobil Service Station	63-69 Marsden STREET	Service Station	Contamination formerly regulated under the CLM Act	-34.44157331	148.7162391
BOTANY	Botany, Underwood	14a Underwood AVENUE	Unclassified	Contamination being managed via the planning process (EP&A Act)	-33.94508532	151.1947626
BOTANY	Former Aerosols of Australia	1617 Botany ROAD	Chemical Industry	Under assessment	-33.9529386	151.2037468
BOTANY	Former Tannery	2 Daniel STREET	Other Industry	Regulation under CLM Act not required	-33.94126194	151.1991087
BOTANY	Former Industrial Site	28 Folkestone PARADE	Unclassified	Contamination being managed via the planning process (EP&A Act)	-33.95187539	151.1960537
BOTANY	Nuplex Resins	49-61 Stephen ROAD	Chemical Industry	Contamination currently regulated under CLM Act	-33.952588	151.21101
BOTANY	Roads and Maritime Service	5 - 9 Lord STREET	Other Industry	Regulation under CLM Act not required	-33.94100279	151.1968763
BOTANY	Caltex Terminal	Penrhyn ROAD	Other Petroleum	Under assessment	-33.96633917	151.2149156
BOURKE	Caltex Service Station	82-86 Anson STREET	Service Station	Regulation under CLM Act not required	-30.09500388	145.9414388
BOURKE	Former Shell Bourke Depot	94-106 Anson STREET	Service Station	Regulation under CLM Act not required	-30.09548497	145.9436745
BOWENFELS	Bowenfels Field Support Centre	9-13 Cooerwull ROAD	Other Petroleum	Regulation under CLM Act not required	-33.47514572	150.1323899
BOWRAL	Shell Coles Express Bowral Service Station	430 Bong Bong STREET	Service Station	Under assessment	-34.48269596	150.417389
BOWRAL	Former Gasworks	Merrigang STREET	Gasworks	Contamination currently regulated under CLM Act	-34.4783957	150.4255053
BOX HILL	Former Waste Management Facility	25 Terry ROAD	Landfill	Regulation under CLM Act not required	-33.65559259	150.8977986
BRANXTON	Former Service Station	70 Maitland STREET	Service Station	Under assessment	-32.65647051	151.3516199
BREWARRINA	Dowell's Fuel	39 Doyle STREET	Service Station	Under assessment	-29.96152786	146.8612561
BRIGHTON-LE-SANDS	Shell Service Station Brighton Le Sands & adjacent land	2 General Holmes DRIVE	Service Station	Contamination formerly regulated under the CLM Act	-33.9579214	151.1578665
BRIGHTON-LE-SANDS	Cook Park	General Holmes DRIVE	Service Station	Contamination formerly regulated under the CLM Act	-33.9581072	151.1579572
BROADMEADOW	Former Industrial Site	16 Broadmeadow ROAD	Service Station	Under assessment	-32.91444096	151.7300112
BROADMEADOW	Nineways Broadmeadow Coles Express SS	Corner Brunker Road and Lambton ROAD	Service Station	Under assessment	-32.92511185	151.7364247
BROKEN HEAD	South Byron Sewage Treatment Works	Broken Head ROAD	Other Industry	Under assessment	-28.67233626	153.6148974
BROKEN HILL	Former Caltex Service Station	167-173 Argent STREET	Service Station	Regulation under CLM Act not required	-31.96066663	141.4624175
BROKEN HILL	Former Caltex Depot	3 Kanandah ROAD	Service Station	Regulation under CLM Act not required	-31.98341823	141.4332211
BROKEN HILL	Tasco Petroleum (Former Mobil) Depot	5 Kanandah ROAD	Other Petroleum	Regulation under CLM Act not required	-31.9843986	141.4329127

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BROKEN HILL	Caltex Service Station	535 Argent STREET	Service Station	Regulation under CLM Act not required	-31.95311924	141.4745274
BROKEN HILL	Caltex Service Station	73-87 Oxide STREET	Service Station	Contamination currently regulated under CLM Act	-31.95519591	141.4658647
BROKEN HILL	Broken Hill Airport Mobil Refuelling Facility	Bonanza STREET	Other Petroleum	Under assessment	-31.99928312	141.4685759
BROKEN HILL	Former Mobil Depot	Corner Of Talc Street and Gossan STREET	Other Petroleum	Under assessment	-31.96018102	141.4514752
BROKEN HILL	Former Gasworks	Cornish STREET	Gasworks	Contamination formerly regulated under the CLM Act	-31.96330562	141.4470611
BROOKLYN	Former Oyster Farm	Off Government ROAD	Unclassified	Under assessment	-33.54716867	151.2229744
BROOKVALE	Little Drycleaning	123 Old Pittwater ROAD	Other Industry	Under assessment	-33.76759121	151.2625932
BROOKVALE	Coles Express Brookvale Service Station	198 Harbord ROAD	Service Station	Under assessment	-33.76332299	151.2794028
BROOKVALE	Brookvale Depot	630-636 Pittwater ROAD	Other Petroleum	Under assessment	-33.76641698	151.2705659
BROOKVALE	Caltex Service Station	740-742 Pittwater ROAD	Service Station	Under assessment	-33.76146721	151.2745358
BROOKVALE	Harrison Manufacturing Co Pty Ltd	75 Old Pittwater ROAD	Unclassified	Under assessment	-33.76498388	151.2638048
BROOKVALE	Woolworths Petrol Brookvale	756 Pittwater ROAD	Service Station	Under assessment	-33.76170587	151.2762411
BROOKVALE	AMP Warringah Mall	Cnr Condamine Street, Old Pittwater Rd & Cross STREET	Other Industry	Regulation under CLM Act not required	-33.76729923	151.2657272
BROWNSVILLE	Caltex Service Station	342 Kanahooka ROAD	Service Station	Under assessment	-34.48591734	150.8064373
BRUNSWICK HEADS	Caltex Service Station	5 Tweed STREET	Service Station	Under assessment	-28.5381619	153.5487135
BUDGEWOI	Colongra Power Station	Off Scenic DRIVE	Other Industry	Under assessment	-33.21463137	151.5529338
BULAHDELAH	Former Caltex Service Station	53-59 Bulahdelah WAY	Service Station	Under assessment	-32.40729992	152.2110142
BULAHDELAH	Mobil Service Station	59-63 Booloombayt STREET	Service Station	Under assessment	-32.40971018	152.2105785
BULAHDELAH	Caltex Service Station	8 Red Gum Road, Corner Mahogany STREET	Service Station	Under assessment	-32.39837094	152.2106015
BULLABURRA	Former Burmah Bullaburra Service Station	367 - 369 Great Western HIGHWAY	Service Station	Under assessment	-33.72482995	150.4124537
BULLI	Scrap Yard	7 Molloy STREET	Other Industry	Contamination currently regulated under CLM Act	-34.33663195	150.9131154
BULLI	Bulli Brickworks	Quilkey PLACE	Other Industry	Regulation under CLM Act not required	-34.33263113	150.9086247
BUNGENDORE	Former Timber Treatment Plant	Corner King Street and Butmaroo STREET	Other Industry	Contamination formerly regulated under the CLM Act	-35.26151273	149.4434907
BURONGA	Caltex Service Station	Sturt Hwy Cnr Silver City HIGHWAY	Service Station	Under assessment	-34.17056496	142.1813847
BURWOOD	Burwood STA Depot	Cnr Shaftesbury and Parramatta ROADS	Other Industry	Contamination formerly regulated under the CLM Act	-33.86982934	151.1089057
BYRON BAY	Residential Development	Lot 15 Seaview STREET	Unclassified	Regulation under CLM Act not required	-28.65214464	153.6165573
CABARITA	Cabarita Wellcome	33 Phillips STREET	Landfill	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.85250251	151.1176366
CABARITA	Dulux (Orica Australia)	Cabarita ROAD	Chemical Industry	Contamination formerly regulated under the CLM Act	-33.84643972	151.1157115
CABRAMATTA	Caltex Service Station	166 John STREET	Service Station	Under assessment	-33.89422314	150.9279279
CALGA	Former service station	101 Peats Ridge ROAD	Service Station	Contamination formerly regulated under the CLM Act	-33.37592138	151.2254951

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CALLALA BEACH	Callala Beach General Store	(formerly 1 Quay Rd) 114A Quay ROAD	Service Station	Regulation under CLM Act not required	-35.0101817	150.6964322
CAMBRIDGE PARK	Caltex Cambridge Park	Star COURT	Service Station	Under assessment	-33.74068794	150.717174
CAMDEN	Caltex Camden Service Station	21 Barsden STREET	Service Station	Regulation under CLM Act not required	-34.05808413	150.6914744
CAMDEN	Camden High School (former)	John STREET	Gasworks	Regulation under CLM Act not required	-34.05114079	150.6951285
CAMDEN SOUTH	Coles Express Service Station Camden South	273 Old Hume HIGHWAY	Service Station	Regulation under CLM Act not required	-34.08660995	150.6945444
CAMELLIA	James Hardie Factory (former, eastern portion)	1 Grand AVENUE	Other Industry	Contamination currently regulated under CLM Act	-33.8182384	151.0261019
CAMELLIA	Council Reserve	11B Grand AVENUE	Metal Industry	Regulation under CLM Act not required	-33.81850502	151.0302425
CAMELLIA	Bitumen Manufacturer	12 Grand AVENUE	Other Industry	Contamination currently regulated under CLM Act	-33.82189695	151.0429251
CAMELLIA	Wrigg	13 Grand AVENUE	Metal Industry	Under assessment	-33.81971361	151.0321525
CAMELLIA	Hymix Concrete	14 Grand AVENUE	Metal Industry	Contamination currently regulated under CLM Act	-33.82243454	151.044789
CAMELLIA	Hambear	14 Thackeray STREET	Metal Industry	Regulation under CLM Act not required	-33.81920482	151.0419394
CAMELLIA	Mauri Foods	15 Grand AVENUE	Other Industry	Regulation being finalised	-33.81996985	151.0335725
CAMELLIA	Railway Land	27 Grand AVENUE	Other Industry	Regulation under CLM Act not required	-33.81910822	151.0382483
CAMELLIA	Maritime Services Board	33A Grand AVENUE	Metal Industry	Regulation under CLM Act not required	-33.81836086	151.0401249
CAMELLIA	Veolia	37 Grand AVENUE	Chemical Industry	Contamination currently regulated under CLM Act	-33.81980027	151.0430689
CAMELLIA	Former Asciano Properties	39 Grand AVENUE	Chemical Industry	Contamination currently regulated under CLM Act	-33.82056014	151.0443331
CAMELLIA	Sydney Water	41 Grand AVENUE	Chemical Industry	Contamination formerly regulated under the CLM Act	-33.8217493	151.0453367
CAMELLIA	Former Akzo Nobel site	6 Grand AVENUE	Chemical Industry	Contamination currently regulated under CLM Act	-33.82238826	151.0319264
CAMELLIA	Former Shell Clyde Refinery	Durham STREET	Other Petroleum	Contamination currently regulated under POEO Act	-33.82804924	151.0378966
CAMMERAY	Coles Express Cammeray	477-483 Miller STREET	Service Station	Under assessment	-33.82141124	151.2108658
CAMMERAY	Tunks Park	Brothers AVENUE	Landfill	Contamination formerly regulated under the CLM Act	-33.81734704	151.2113338
CAMPBELLTOWN	Former vehicle wrecking yard	38 Blaxland ROAD	Unclassified	Under assessment	-34.06055735	150.8130598
CAMPBELLTOWN	BP Denham Court	505 Campbelltown ROAD	Service Station	Under assessment	-33.982313	150.846669
CAMPBELLTOWN	Mobil Service Station	96-98 Queen STREET	Service Station	Regulation under CLM Act not required	-34.06407588	150.8170082
CAMPBELLTOWN	BP Macarthur Service Station	Cnr Blaxland ROAD and Campbelltown ROAD	Service Station	Under assessment	-34.05312872	150.8234349
CAMPERDOWN	Former Gee Graphics	27 Church STREET	Other Industry	Regulation under CLM Act not required	-33.88737747	151.1773616
CAMPERDOWN	O'Dea Reserve	Salisbury LANE	Landfill	Contamination formerly regulated under the CLM Act	-33.89072786	151.1736948
CAMPSIE	Budget Petroleum and adjacent property	403 Canterbury Road and 1 Una STREET	Service Station	Contamination currently regulated under CLM Act	-33.91605617	151.1086596

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CAMPSIE	Former Sunbeam factory	60 Charlotte STREET	Other Industry	Contamination formerly regulated under the CLM Act	-33.92254225	151.1025796
CANLEY HEIGHTS	Caltex Service Station	280-286 Canley Vale ROAD	Service Station	Under assessment	-33.88393501	150.9241656
CANLEY HEIGHTS	Former Caltex Canley Heights	368 Canley Vale ROAD	Service Station	Under assessment	-33.88271081	150.9154176
CANLEY VALE	Former Mobil Service Station	96 Canley Vale ROAD	Service Station	Regulation under CLM Act not required	-33.88591573	150.9369801
CANOWINDRA	BP Service Station (Reliance Petroleum)	76 Rodd STREET	Service Station	Under assessment	-33.56131773	148.6682805
CANTERBURY	Metro Petroleum Service Station	13-19 Canterbury ROAD	Service Station	Contamination currently regulated under CLM Act	-33.90783455	151.125207
CARDIFF	Former Caltex Service Station	367 Main ROAD	Service Station	Regulation under CLM Act not required	-32.93761223	151.6577781
CARDIFF	7-Eleven Service Station	399 Main ROAD	Service Station	Regulation under CLM Act not required	-32.93391137	151.6562111
CARDIFF	Former Mobil Service Station	43 Macquarie ROAD	Service Station	Under assessment	-32.94118246	151.6578195
CARDIFF	Former Mobil Depot	7 Ranton STREET	Other Petroleum	Regulation under CLM Act not required	-32.94516764	151.6470387
CARDIFF	BP Service Station (Reliance Petroleum)	Corner Sturt and Main ROADS	Service Station	Under assessment	-32.93792229	151.6569905
CARDIFF	Maneela Oval	Main ROAD	Other Industry	Regulation under CLM Act not required	-32.93018443	151.6435559
CARDIFF	Settlement Pond	Off Main ROAD	Unclassified	Under assessment	-32.94001389	151.6604919
CARINGBAH	Adjacent to Spirent Australia	101-103 Cawarra ROAD	Other Industry	Contamination currently regulated under CLM Act	-34.03360747	151.1245577
CARINGBAH	Spirent Australia	105 Cawarra ROAD	Other Industry	Contamination formerly regulated under the CLM Act	-34.03425343	151.1245092
CARINGBAH	Former Consumer Health Products Manufacturer	32-40 Cawarra ROAD	Other Industry	Regulation under CLM Act not required	-34.03024369	151.1277755
CARINGBAH	7-Eleven Service Station	367 The Kingsway	Service Station	Under assessment	-34.03948677	151.1203268
CARLINGFORD	Caltex Service Station	131 Pennant Hills ROAD	Service Station	Under assessment	-33.78762398	151.0279422
CARLINGFORD	Caltex Service Station	797 Pennant Hills ROAD	Service Station	Under assessment	-33.7757819	151.0516532
CARLTON	Shell Coles Express Service Station	274-281 Princes HIGHWAY	Service Station	Under assessment	-33.9748579	151.1272732
CARRINGTON	Carrington redevelopment site	11 Howden STREET	Other Industry	Regulation under CLM Act not required	-32.91309509	151.7625341
CARRINGTON	Commercial Metals Company (CMC) Australia Pty Ltd	117-121 Bourke STREET	Other Industry	Regulation under CLM Act not required	-32.9148832	151.7677193
CARRINGTON	Forgacs Dockyard	81 Denison STREET	Other Industry	Regulation under CLM Act not required	-32.9207441	151.764816
CARRINGTON	NAT vacant land	Bourke STREET	Unclassified	Regulation under CLM Act not required	-32.91276029	151.7685894
CARRINGTON	Carrington Coal Tar Pavements	Bourke Street to Dyke ROAD	Other Industry	Regulation under CLM Act not required	-32.91441348	151.770271
CARRINGTON	Pasminco Ship Loader	Dyke Berth 2 (off Bourke Street) OTHER	Metal Industry	Regulation under CLM Act not required	-32.9148698	151.7716837
CARRINGTON	Dyke Point Containment Cell	Dyke ROAD	Other Industry	Under assessment	-32.9169089	151.772423
CARSS PARK	Vacant Property	334 Princes HIGHWAY	Other Industry	Regulation under CLM Act not required	-33.98628486	151.1133908
CARWELL	Cement Australia Carwell Creek Quarries	Quarry ROAD	Other Industry	Under assessment	-32.85413742	149.923172

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CASINO	Former Gasworks	134-136 North STREET	Gasworks	Regulation under CLM Act not required	-28.86080712	153.0526043
CASINO	Caltex Casino Service Station	32 Dyraaba STREET	Service Station	Under assessment	-28.85488567	153.044806
CASINO	Caltex Service Station	96 Centre STREET	Service Station	Regulation under CLM Act not required	-28.86539567	153.0450654
CASINO	Woolworths Service Station Casino	Canterbury Street Cnr Summerland WAY	Service Station	Under assessment	-28.86231341	153.0464642
CASULA	Caltex Casula Service Station	646 Hume HIGHWAY	Service Station	Regulation under CLM Act not required	-33.95641262	150.8934783
CATHERINE HILL BAY	Catherine Hill Bay Coal Handling and Preparation Plant	1A Keene STREET	Other Industry	Regulation under CLM Act not required	-33.16120556	151.6302456
CESSNOCK	Former Mobil Service Station	102 Wollombi ROAD	Service Station	Under assessment	-32.83844074	151.3436022
CESSNOCK	Caltex Cessnock Service Station	105 Wollombi (Cnr James Street) ROAD	Service Station	Under assessment	-32.83936243	151.3430078
CESSNOCK	Former Service Station	2-4 Allandale ROAD	Service Station	Under assessment	-32.83118911	151.3560677
CHARBON	Charbon Colliery	Charbon ROAD	Other Industry	Under assessment	-32.92390131	149.9839098
CHARLESTOWN	7-Eleven Charlestown (Formerly BP Charlestown)	273 Charlestown ROAD	Service Station	Under assessment	-32.95802555	151.6897931
CHARLESTOWN	Ausgrid Powell Street Depot	8 Powell STREET	Other Industry	Regulation under CLM Act not required	-32.95912375	151.6944136
CHARLESTOWN	Caltex Service Station	81 Pacific HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-32.96708479	151.6955919
CHARLESTOWN	BP Service Station	91-93 Pacific HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-32.96633569	151.6959051
CHARMHAVEN	Caltex Service Station	13-15 Pacific HIGHWAY	Service Station	Under assessment	-33.21655768	151.5091452
CHATSWOOD	Auto Repairs	2 Devonshire STREET	Service Station	Regulation under CLM Act not required	-33.8015482	151.1859632
CHATSWOOD	Caltex Service Station Chatswood	572 Pacific HIGHWAY	Service Station	Under assessment	-33.80381271	151.1789656
CHATSWOOD	Former Caltex Chatswood Service Station	607 Pacific HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-33.80396472	151.1795766
CHATSWOOD	Coles Express Service Station Chatswood	877-879 Pacific HIGHWAY	Service Station	Under assessment	-33.79182176	151.1804867
CHATSWOOD WEST	Chatswood Toyota	728 Pacific HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-33.79654247	151.1776136
CHERRYBROOK	Caltex Service Station	67 Shepherds DRIVE	Service Station	Under assessment	-33.72069183	151.0451415
CHESTER HILL	Former Orica, Chester Hill	127 Orchard ROAD	Chemical Industry	Contamination formerly regulated under the CLM Act	-33.8869823	150.9952873
CHIPPENDALE	Frasers Development	Wellington STREET	Unclassified	Under assessment	-33.886691	151.201582
CHIPPING NORTON	Former Mobil Depot Chipping Norton	49-51 Riverside ROAD	Other Petroleum	Under assessment	-33.91621314	150.9696948
CHIPPING NORTON	Former ACR	85-107 Alfred STREET	Chemical Industry	Contamination currently regulated under CLM Act	-33.92226795	150.9586496
CHISWICK	Former Sydney Wiremills (BHP) site	Blackwall Point ROAD	Other Industry	Regulation under CLM Act not required	-33.85131849	151.1369131
CHITTAWAY BAY	Former Caltex Chittaway Point	100 Chittaway ROAD	Service Station	Regulation under CLM Act not required	-33.32707555	151.4293546
CHULLORA	Chullora Railway Workshops	Worth STREET	Other Industry	Under assessment	-33.88639388	151.0598201
CLARENCE	Clarence Colliery	Chifley ROAD	Other Industry	Under assessment	-33.46450217	150.2522729
CLARENDON	Coles Express Clarendon	244 Hawkesbury Valley WAY	Service Station	Under assessment	-33.6083729	150.7890956

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CLEARFIELD	Former Pamplings Dip Site	Off Clearfield ROAD	Cattle Dip	Regulation under CLM Act not required	-29.16287185	152.882974
CLYBUCCA	BP Service Station	2171 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-30.93913118	152.9417395
CLYDE	7-Eleven Clyde	3 Parramatta (Cnr Harbord Street) ROAD	Service Station	Under assessment	-33.83494433	151.0222628
COBAR	Former Caltex (Bogas) Service Station Cobar	56-58 Marshall STREET	Service Station	Regulation under CLM Act not required	-31.49793339	145.8346684
COBAR	Caltex Service Station Cobar	99 Marshall (formerly Cnr Barrier Highway and Bathurst Street) STREET	Service Station	Regulation under CLM Act not required	-31.49631924	145.8275727
COBAR	Mckinnons Gold Mine	Cobar ROAD	Metal Industry	Under assessment	-31.78179755	145.693
COBAR	Caltex Service Station	Lot 10 Railway PARADE	Service Station	Regulation under CLM Act not required	-31.49350124	145.8442372
COFFS HARBOUR	Dan Murphy's Coffs Harbour	10 Elbow STREET	Service Station	Under assessment	-30.29439262	153.115069
COFFS HARBOUR	BP Service Station	134-136 Pacific HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-30.29187037	153.1182106
COFFS HARBOUR	Caltex Service Station	157 Orlando STREET	Service Station	Under assessment	-30.28975334	153.1306354
COFFS HARBOUR	Aussitel Backpackers Hostel	312 Harbour DRIVE	Service Station	Contamination formerly regulated under the CLM Act	-30.3057	153.132
COFFS HARBOUR	Mobil Service Station	314-316 Harbour DRIVE	Service Station	Contamination formerly regulated under the CLM Act	-30.3056983	153.131966
COFFS HARBOUR	Coffs Harbour Slipway	38 Marina DRIVE	Other Industry	Under assessment	-30.30325637	153.1441437
COFFS HARBOUR	Mobil Coffs Harbour Airport	Aviation DRIVE	Other Petroleum	Contamination formerly regulated under the CLM Act	-30.313385	153.1175018
COFFS HARBOUR	Woolworths Petrol	Park Beach Plaza, Pacific HIGHWAY	Service Station	Under assessment	-30.28101154	153.132027
COLEAMBALLY	Former Coleambally Mobil Depot	19 Bencubbin AVENUE	Other Petroleum	Under assessment	-34.80279552	145.8945239
COLLARENEBRI	Former Shell Depot	Corner Narran Street and Queen STREET	Other Petroleum	Regulation under CLM Act not required	-29.54114772	148.5789365
COLONGRA	Endeavour Colliery	Scenic DRIVE	Other Industry	Under assessment	-33.21297737	151.5416882
COLYTON	Ampol Service Station	88 Great Western HIGHWAY	Service Station	Regulation being finalised	-33.7754	150.7954
CONCORD	Caltex Service Station	87-89 Parramatta ROAD	Service Station	Under assessment	-33.86785624	151.0993769
CONCORD WEST	Caltex Service Station	369-375 Concord ROAD	Service Station	Regulation under CLM Act not required	-33.84113835	151.0888843
CONDOBOLIN	BP-Branded Service Station	38 Denison Street, corner Molong STREET	Service Station	Under assessment	-33.08520378	147.1524976
CONDOBOLIN	Former Mobil Depot	6 Burnett STREET	Other Petroleum	Contamination currently regulated under CLM Act	-33.08010515	147.1642972
CONDOBOLIN	Former Ampol Depot	Cnr Parkes Road and Goobang STREET	Service Station	Regulation under CLM Act not required	-33.08034753	147.1642436
CONDOBOLIN	Caltex Service Station	Parkes ROAD	Service Station	Under assessment	-33.08275986	147.1586456
CONDOBOLIN	Mobil Condobolin Depot Railway Siding	Railway Siding behind 6 Burnett STREET	Other Petroleum	Under assessment	-33.08058612	147.164225
CONSTITUTION HILL	Sydney Water Land	Caloola ROAD	Unclassified	Regulation under CLM Act not required	-33.79776636	150.9697715
COOGEE	Caltex Service Station	146-148 Coogee Bay ROAD	Service Station	Under assessment	-33.91989232	151.2517454
COOGEE	Caltex Service Station	169-173 Malabar ROAD	Service Station	Under assessment	-33.93233184	151.2574377
COOKS HILL	Former Council depot	115 Corlette STREET	Other Industry	Under assessment	-32.93525537	151.7641074
COOLAC	Coolac Service Station	Corner Hume Highway and Coleman STREET	Service Station	Regulation under CLM Act not required	-34.95435052	148.1595525

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
COOLAH	BP Depot (Reliance Petroleum)	72 (formerly 17-23) Cunningham STREET	Other Petroleum	Regulation under CLM Act not required	-31.82275896	149.7243171
COOLONGOLOOK	Caltex Service Station	Pacific HIGHWAY	Service Station	Under assessment	-32.21648325	152.322813
COOMA	Former Mobil Cooma Depot	2 Commissioner STREET	Other Petroleum	Under assessment	-36.23267537	149.1346338
COOMA	Former Caltex Cooma Depot	2 Short STREET	Service Station	Regulation under CLM Act not required	-36.2338672	149.1348862
COOMA	Lowes Petroleum Cooma Depot and Service Station (Former BP Reliance Petroleum)	2-4 Sharp STREET	Other Petroleum	Regulation under CLM Act not required	-36.22862603	149.1356483
COOMA	Caltex Service Station	44 Sharp STREET	Service Station	Under assessment	-36.23323489	149.1304134
COOMA	Former Shell Depot	48-50 Bradley STREET	Other Petroleum	Regulation under CLM Act not required	-36.23448955	149.1347987
COOMA	Former Shell Service Station	48-52 Sharp STREET	Service Station	Contamination formerly regulated under the CLM Act	-36.23350402	149.1299514
COOMA	Woolworths Caltex Cooma Service Station	Bombala Street Cnr Massie STREET	Service Station	Under assessment	-36.23364626	149.1267469
COONABARABRAN	Shell Coles Express Service Station	2-6 John STREET	Service Station	Under assessment	-31.27706775	149.27836
COONABARABRAN	Former Mobil Depot	49 Cowper STREET	Other Petroleum	Regulation under CLM Act not required	-31.27096226	149.2818461
COONABARABRAN	Caltex Service Station	85-87 John STREET	Service Station	Under assessment	-31.27231215	149.2771297
COONABARABRAN	Caltex Service Station	Cnr Dawson & Drummond STREET	Service Station	Under assessment	-31.26994941	149.28183
COONABARABRAN	Former Shell Coonabarabran CVRO	Corner Cowper St and Dawson St (formerly 51 Cowper) STREET	Other Petroleum	Regulation under CLM Act not required	-31.27003745	149.281788
COONAMBLE	Former Shell Coonamble Depot	Corner Aberford Street and Quambone ROAD	Other Petroleum	Regulation under CLM Act not required	-30.95349182	148.3793432
COONAMBLE	Caltex Service Station	Quambone ROAD	Service Station	Under assessment	-30.95410067	148.3792167
COORANBONG	Former Poultry Farm	64 - 98 Alton ROAD	Unclassified	Regulation under CLM Act not required	-33.06860138	151.4512156
COOTAMUNDRA	Cootamundra Gasworks	140-146 Hovell STREET	Gasworks	Contamination currently regulated under CLM Act	-34.64572841	148.0255049
COOTAMUNDRA	Former BP Depot	1-5 Murray STREET	Other Petroleum	Under assessment	-34.62915841	148.0306962
COOTAMUNDRA	Former Caltex Depot	219 Sutton STREET	Service Station	Under assessment	-34.65126548	148.0145283
COOTAMUNDRA	Caltex Service Station	26-34 Hovell STREET	Service Station	Under assessment	-34.63616276	148.0348299
COOTAMUNDRA	Former Amoco Depot	68-72 Hovell STREET	Other Petroleum	Contamination currently regulated under CLM Act	-34.63871124	148.0321134
COOTAMUNDRA	Former Ampol service station	72 Parker STREET	Service Station	Under assessment	-34.63471008	148.0296112
COOTAMUNDRA	Former Ampol Cootamundra Rail Siding	Back Brawlin ROAD	Other Petroleum	Under assessment	-34.65326425	148.0143068
CORAMBA	Martin Street	End of Martin Street and adjacent car park OTHER	Service Station	Ongoing maintenance required to manage residual contamination (CLM Act)	-30.22125208	153.0156997
COROWA	Former Ampol Corowa	10 Bow STREET	Service Station	Under assessment	-35.99364786	146.3901259
COROWA	Corowa Shire Council Works Depot	12 - 18 Poseidon ROAD	Other Petroleum	Under assessment	-35.98807923	146.3652266
COROWA	Cignall Corowa	280 Hume STREET	Service Station	Under assessment	-36.00996015	146.3760437
CORRIMAL	7-Eleven Corrimal	138-146 Princes HIGHWAY	Service Station	Under assessment	-34.36986923	150.8978271
CORRIMAL	Woolworths Petrol	275-277 Princes HIGHWAY	Service Station	Under assessment	-34.37527426	150.8962637
COWRA	Lowes Petroleum (former BP Cowra Depot)	10-12 Campbell STREET	Other Petroleum	Under assessment	-33.83803706	148.6977873

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
COWRA	Former Gasworks	30 Brougham STREET	Gasworks	Contamination currently regulated under CLM Act	-33.8389659	148.6963482
COWRA	Shell Depot	34 Brougham STREET	Other Petroleum	Contamination formerly regulated under the CLM Act	-33.83932421	148.6976295
COWRA	Landmark Fertiliser Storage	Corner Young Road & Waratah STREET	Chemical Industry	Under assessment	-33.84321832	148.6722578
CRANGAN BAY	Big T Road House.	555 and 565 Pacific HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-33.17326538	151.6083864
CREMORNE	Shell Coles Express Service Station	225 Military ROAD	Service Station	Regulation under CLM Act not required	-33.83063306	151.226223
CRINGILA	Cringila Public School	Sheffield STREET	Landfill	Regulation under CLM Act not required	-34.4719665	150.8695522
CROA	Breen Holdings	Bate Bay ROAD	Other Industry	Regulation under CLM Act not required	-34.03861737	151.1614114
CROWS NEST	Caltex Service Station	111-121 Falcon STREET	Service Station	Under assessment	-33.82868236	151.2060317
CROYDON	Caltex Service Station	404-410 Liverpool ROAD	Service Station	Under assessment	-33.88853994	151.115879
CROYDON	BP Ashfield	582-586 Parramatta ROAD	Service Station	Under assessment	-33.87399409	151.1267296
CROYDON PARK	Mobil Service Station	334 Georges River ROAD	Service Station	Regulation under CLM Act not required	-33.89771626	151.0999194
CULCAIRN	Caltex Service Station	Olympic WAY	Service Station	Under assessment	-35.67441635	147.0356845
CULLEN BULLEN	Baal Bone Colliery	Castlereagh HIGHWAY	Other Industry	Under assessment	-33.27193875	150.0587194
CUNDLETOWN	Caltex Service Station	Old Pacific HIGHWAY	Service Station	Under assessment	-31.89329598	152.5068225
CURL CURL	John Fisher Park	Corner Harbord and Abbott ROADS	Landfill	Regulation under CLM Act not required	-33.76352692	151.2798462
DACEYVILLE	Astrolabe Park	Cook AVENUE	Landfill	Regulation being finalised	-33.92963704	151.221773
DAPTO	RailCorp Dapto	(Rear of property) 12-14 Hamilton STREET	Other Industry	Regulation under CLM Act not required	-34.50045405	150.787353
DARLINGHURST	Proposed Retail Unit	139-155 Palmer STREET	Unclassified	Regulation under CLM Act not required	-33.87504688	151.2168106
DARLINGHURST	Cross City Tunnel	Riley Street and William STREET	Service Station	Contamination was addressed via the planning process (EP&A Act)	-33.87424636	151.2158305
DEE WHY	United Dee Why	1 The Strand STREET	Service Station	Under assessment	-33.75569207	151.2959451
DEE WHY	Caltex Service Station	793-797 Pittwater ROAD	Service Station	Under assessment	-33.74566596	151.2920719
DEE WHY	Roche Products Dee Why Facility	Inman ROAD	Other Industry	Contamination currently regulated under CLM Act	-33.73834964	151.2876392
DEE WHY	Dee Why Town Centre	Pittwater ROAD	Other Industry	Under assessment	-33.753169	151.2875805
DENHAM COURT	Service Station, Denham Court	505 Campbelltown ROAD	Service Station	Under assessment	-33.98208395	150.8459471
DENILIQUIN	Former Deniliquin Caltex Depot	116-118 Hardinge (Cnr Wood St) STREET	Service Station	Regulation under CLM Act not required	-35.53196985	144.9544597
DENILIQUIN	Former Shell Depot	143-147 Napier STREET	Other Petroleum	Regulation under CLM Act not required	-35.5342355	144.953169
DENILIQUIN	Shell Coles Express Service Station	336 Victoria STREET	Service Station	Contamination formerly regulated under the CLM Act	-35.52373613	144.9807345
DENILIQUIN	Deniliquin Gasworks	365 and 369 George St and 380 Charlotte STREET	Gasworks	Under assessment	-35.52663248	144.9634981
DENILIQUIN	Landmark Chemicals Storage	90-101 Davidson STREET	Chemical Industry	Under assessment	-35.52534735	144.975142
DENILIQUIN	BP Depot (Reliance Petroleum)	Corner Hardinge Street and Sloane STREET	Service Station	Under assessment	-35.53222124	144.9517397
DENMAN	Former Industrial Site	10 Fontana WAY	Metal Industry	Regulation under CLM Act not required	-32.37945456	150.6868239

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DENMAN	Former Industrial Site	9 Fontana WAY	Metal Industry	Regulation under CLM Act not required	-32.37911159	150.6869866
DOYALSON	Munmorah Power Station	(Central Coast Highway) Scenic DRIVE	Unclassified	Regulation under CLM Act not required	-33.20678347	151.540795
DOYALSON	Part Lot 3 DP 259306	Off David STREET	Other Industry	Regulation under CLM Act not required	-33.20436131	151.5232558
DOYALSON	Mannering Colliery (formerly Wyee)	Rutleys ROAD	Other Industry	Under assessment	-33.17179576	151.5419248
DOYALSON	Munmorah Colliery	Scenic DRIVE	Other Industry	Under assessment	-33.21297737	151.5416882
DOYALSON NORTH	Shell Coles Express Service Station	260-270 Pacific HIGHWAY	Service Station	Under assessment	-33.18636608	151.5482399
DRUMMOYNE	Caltex Service Station	191-195 Lyons ROAD	Service Station	Under assessment	-33.85699216	151.1460356
DRUMMOYNE	Former Dry Cleaners	225 Victoria ROAD	Chemical Industry	Under assessment	-33.8507152	151.1537113
DRUMMOYNE	Shell Coles Express Drummoyne (Westbound)	35-51 Victoria ROAD	Service Station	Under assessment	-33.85606575	151.1589061
DRUMMOYNE	Shell Coles Express Drummoyne (Eastbound)	36 - 46 Victoria ROAD	Service Station	Regulation under CLM Act not required	-33.85576628	151.1593519
DUBBO	Lowes Petroleum (BP-Branded) Depot, Dubbo	105 Erskine STREET	Service Station	Regulation under CLM Act not required	-32.24423247	148.6101676
DUBBO	BP Reliance Petroleum Service Station (Former Mobil Depot)	107 Erskine STREET	Other Petroleum	Regulation under CLM Act not required	-32.24441287	148.6111704
DUBBO	Former Shell Depot	109-111 Erskine STREET	Other Petroleum	Under assessment	-32.24470512	148.6124108
DUBBO	Caltex Service Station	119 Bourke STREET	Service Station	Under assessment	-32.24336464	148.6091931
DUBBO	Shell Coles Express Service Station	131-133 Cobra STREET	Service Station	Under assessment	-32.25511317	148.6126147
DUBBO	Dubbo Police Station	143 Brisbane STREET	Other Petroleum	Under assessment	-32.24652288	148.6034702
DUBBO	Former Ambulance Station	165 Brisbane STREET	Other Petroleum	Contamination formerly regulated under the CLM Act	-32.24850755	148.6031749
DUBBO	Service Station at Harvey Norman Centre	219-233 Cobra STREET	Service Station	Under assessment	-32.2565155	148.6228586
DUBBO	Former Mobil depot	40-44 Morgan STREET	Other Petroleum	Regulation under CLM Act not required	-32.23912277	148.6182711
DUBBO	Shell Coles Express Service Station	45-49 Whylandra STREET	Service Station	Under assessment	-32.2474598	148.5932769
DUBBO	Caltex Service Station, Dubbo	60 Windsor PARADE	Service Station	Regulation under CLM Act not required	-32.25459322	148.6318
DUBBO	Caltex Service Station, Dubbo	Cnr Brisbane Street and Cobra STREET	Service Station	Contamination currently regulated under CLM Act	-32.25322183	148.603164
DUBBO	Caltex Service Station	Phillip St Cnr Fitzroy STREET	Service Station	Under assessment	-32.24534863	148.6150144
DUBBO WEST	Mobil Service Station	Corner Whylandra Street and Victoria STREET	Service Station	Under assessment	-32.24827657	148.5927084
DULWICH HILL	Former Tyre Recapping	115-117 Constitution ROAD	Other Industry	Regulation under CLM Act not required	-33.90300876	151.1387724
DULWICH HILL	Denison Road Playground	194 Denison ROAD	Landfill	Regulation under CLM Act not required	-33.90121956	151.1404637
DUNEDOO	Former Shell Depot Dunedoo	Cnr Bolaro and Redbank STREET	Other Petroleum	Regulation under CLM Act not required	-32.01565761	149.3922418
DUNGOG	Lot 54 Common Rd	54 Common ROAD	Unclassified	Regulation under CLM Act not required	-32.39490989	151.739821
DUNGOG	Former HWC Maintenance Depot for Civil Engineering Works	86 Abelard STREET	Other Industry	Under assessment	-32.40429396	151.7514073

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DUNMORE	Equestrian Centre	71 Fig Hill LANE	Unclassified	Regulation under CLM Act not required	-34.62313393	150.8421544
DURAL	Caltex Service Station	530 Old Northern ROAD	Service Station	Regulation under CLM Act not required	-33.69348472	151.0202716
DURAL	Woolworths Service Station	532 Old Northern ROAD	Service Station	Under assessment	-33.69348472	151.0202716
DURAL	BP Dural Service Station	582 Old Northern ROAD	Service Station	Under assessment	-33.69569985	151.0283357
DURAL	Caltex Service Station	917-923 Old Northern ROAD	Service Station	Under assessment	-33.68312075	151.0287519
EAGLE VALE	BP Service Station	Corner Eagle Vale Drive and Gould ROAD	Service Station	Under assessment	-34.03128043	150.816363
EARLWOOD	RTA Land	3 Jackson PLACE	Unclassified	Contamination currently regulated under CLM Act	-33.9272087	151.1432854
EARLWOOD	Wolli Creek Aqueduct	Unwin STREET	Unclassified	Regulation under CLM Act not required	-33.92788788	151.1480807
EAST BALLINA	Caltex East Ballina Service Station	34 Links AVENUE	Service Station	Regulation under CLM Act not required	-28.85009113	153.5829246
EAST GOSFORD	Mobil Service Station	44 Victoria STREET	Service Station	Contamination formerly regulated under the CLM Act	-33.43804781	151.353303
EAST GOSFORD	Presbyterian Aged Care Facility	8-18 Enid CRESCENT	Landfill	Regulation under CLM Act not required	-33.4376675	151.3577947
EAST MAITLAND	United (Former Mobil) Service Station	250 Newcastle STREET	Service Station	Under assessment	-32.75244962	151.5869042
EAST MAITLAND	Former Gasworks Site	Corner Melbourne Street and Brisbane STREET	Gasworks	Regulation under CLM Act not required	-32.74939199	151.5788783
EAST MAITLAND	Caltex Service Station	Newcastle Rd Cnr William STREET	Service Station	Under assessment	-32.74883712	151.5829296
EAST TAMWORTH	Caltex Service Station	358 New England HIGHWAY	Service Station	Under assessment	-31.11401974	150.9613327
EASTERN CREEK	Caltex Service Station M4 Motorway Westbound	M4 Westbound OTHER	Service Station	Regulation under CLM Act not required	-33.80255701	150.8829211
EASTERN CREEK	Caltex Service Station	M4Eastbound MOTORWAY	Service Station	Under assessment	-33.801607	150.8857989
EASTERN CREEK	Pioneer Road Services	Old Walgrove ROAD	Other Industry	Under assessment	-33.81190491	150.8392181
EASTLAKES	Budget Petroleum Eastlakes	102 Maloney STREET	Service Station	Regulation being finalised	-33.9316936	151.2093135
EASTLAKES	Former Shell Rosebery service station and adjacent land	275-279 Gardeners ROAD	Service Station	Contamination formerly regulated under the CLM Act	-33.92470279	151.2100722
EASTLAKES	73 Gardeners Road	73 Gardeners ROAD	Unclassified	Regulation under CLM Act not required	-33.92541594	151.2182856
EASTLAKES	Eastlakes Reserve	Evans AVENUE	Service Station	Contamination formerly regulated under the CLM Act	-33.92497291	151.2102725
EASTWOOD	Former Mobil Service Station Eastwood	3-5 Trelawney (Cnr Rutledge St) STREET	Service Station	Regulation under CLM Act not required	-33.79273381	151.079584
EDEN	Caltex Service Station	159 Imlay STREET	Service Station	Under assessment	-37.06324099	149.9044022
EDEN	Caltex Service Station	80-86 Imlay STREET	Service Station	Under assessment	-37.0570984	149.9038538
EDENSOR PARK	7-Eleven (former Mobil) Service Station	Corner Cowpasture Road and Elizabeth DRIVE	Service Station	Under assessment	-33.88326139	150.865591
EDGECLIFF	Shell Coles Express Service Station	67 New South Head ROAD	Service Station	Under assessment	-33.8769602	151.2311617
EDGEWORTH	Caltex Service Station	662 Main ROAD	Service Station	Under assessment	-32.92566329	151.6278888
EMERALD BEACH	Shell Coles Express Woolgoolga Service Station	1850 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-30.16450856	153.1826673
EMERTON	7-Eleven Emerton	135-137 Popondetta ROAD	Service Station	Regulation under CLM Act not required	-33.74463908	150.8102251
EMU HEIGHTS	7-Eleven Service Station	126 Old Bathurst ROAD	Service Station	Regulation under CLM Act not required	-33.74299098	150.6547098

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EMU HEIGHTS	Woolworths Service Station	132 Old Bathurst ROAD	Service Station	Regulation under CLM Act not required	-33.7429739	150.6559655
EMU PLAINS	Woolworths Service Station	283 Great Western HIGHWAY	Service Station	Under assessment	-33.75371349	150.6530165
ENGADINE	BP Service Station	1234 Princes HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-34.07735416	151.01121
ENGADINE	BP Branded Service Station	963 Old Princes HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-34.06428454	151.0167121
ENGADINE	Former Caltex Service Station	995 Old Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-34.06413459	151.0155734
EPPING	7-Eleven (former Mobil) Service Station	246 Beecroft ROAD	Service Station	Under assessment	-33.77073552	151.080581
ERINA	Former Frozen Food Distribution Depot	1 Aston ROAD	Other Petroleum	Contamination currently regulated under CLM Act	-33.434878	151.3845431
ERINA	Caltex Service Station	155 The Entrance ROAD	Service Station	Regulation under CLM Act not required	-33.43824871	151.3801096
ERINA	Coles Express Service Station Erina	211 The Entrance ROAD	Service Station	Regulation under CLM Act not required	-33.43547804	151.3850522
ERINA	7-Eleven Erina	214 The Entrance ROAD	Service Station	Regulation under CLM Act not required	-33.43494257	151.3879511
ERINA	7-Eleven Service Station	96 The Entrance ROAD	Service Station	Regulation under CLM Act not required	-33.43786868	151.3729331
ERMINGTON	Caltex Service Station	562 Victoria ROAD	Service Station	Under assessment	-33.81392814	151.0547543
ERSKINE PARK	Western Sydney Service Centre	25-55 Templar ROAD	Landfill	Under assessment	-33.81897822	150.7937394
ERSKINEVILLE	Redevelopment Site	36/1A Coulson STREET	Unclassified	Under assessment	-33.90325501	151.1855668
ERSKINEVILLE	Department of Housing	52 John STREET	Other Industry	Regulation under CLM Act not required	-33.8982925	151.1840284
ERSKINEVILLE	RailCorp land	Coulson STREET	Other Industry	Under assessment	-33.90279502	151.1846827
EUABALONG WEST	BP Euabalong West Depot (Reliance Petroleum)	Corner Illawong Street and Murrin STREET	Other Petroleum	Under assessment	-33.05720426	146.3946386
EVANS HEAD	Evans Head Residential subdivision	Bounded by Currajong, Woodburn, Carrabeen Streets and Tuckeroo CRESCENT	Unclassified	Regulation under CLM Act not required	-29.1080969	153.4243577
EVANS HEAD	Evans Head Aerodrome	Memorial Airport DRIVE	Other Industry	Regulation under CLM Act not required	-29.10389976	153.4216791
EVANS HEAD	Bundjalung National Park	The Gap ROAD	Unclassified	Under assessment	-29.24433977	153.3626472
EVELEIGH	Macdonaldtown Triangle	Burren STREET	Gasworks	Contamination being managed via the planning process (EP&A Act)	-33.89803492	151.186059
EVELEIGH	Australian Technology Park	Henderson ROAD	Other Industry	Regulation under CLM Act not required	-33.89634136	151.1944915
FAIRFIELD	Endeavour Energy Fairfield Zone Substation	22 Hedges STREET	Other Industry	Regulation under CLM Act not required	-33.86133019	150.9555899
FAIRFIELD	Speedway Petroleum	251 The Horsley DRIVE	Service Station	Under assessment	-33.8711661	150.9630077
FAIRFIELD HEIGHTS	7-Eleven Fairfield Heights	234 Hamilton (Cnr The Boulevarde) ROAD	Service Station	Under assessment	-33.87208474	150.9373134
FAIRY MEADOW	Caltex Fuel Depot and adjoining land	46 Montague STREET	Service Station	Contamination formerly regulated under the CLM Act	-34.40050499	150.8953125
FAIRY MEADOW	Woolworths Petrol Service Station	49 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-34.39399705	150.8925369
FAIRY MEADOW	Deynal (Seeman)	51-59 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-34.39437085	150.8924666

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FARLEY	Farley Waste Water Treatment Works	Owl Pen LANE	Other Industry	Under assessment	-32.74431314	151.5194217
FASSIFERN	Former Arsenic Smelter	Fassifern ROAD	Other Industry	Under assessment	-32.99649819	151.5618283
FASSIFERN	Newstan Colliery	Fassifern ROAD	Other Industry	Under assessment	-32.97942521	151.5660046
FEDERAL	Federal General Store	3-6 Federal DRIVE	Service Station	Contamination currently regulated under CLM Act	-28.65190728	153.4552976
FERN BAY	Former service station	37 Fullerton (1006 Nelson Bay Road) STREET	Service Station	Under assessment	-32.87245004	151.7939904
FIVE DOCK	7-Eleven Service Station	231-235 Great North ROAD	Service Station	Under assessment	-33.86488376	151.130002
FIVE DOCK	Caltex Five Dock Service Station	47 Ramsay Rd (Cnr Fairlight St) OTHER	Service Station	Under assessment	-33.87002804	151.1301835
FORBES	Forbes Fuel Depot	13-15 Union STREET	Other Petroleum	Under assessment	-33.37751977	148.0101422
FORBES	Former Gasworks	24-26 Union STREET	Gasworks	Under assessment	-33.37752036	148.0090064
FORBES	Woolworths (Former Save on Fuel) Service Station	26 Dowling STREET	Service Station	Regulation under CLM Act not required	-33.38148764	148.0109845
FORBES	Caltex Forbes Service Station	Cnr Parkes Road and Wyndham Avenue OTHER	Service Station	Under assessment	-33.36333714	148.0223727
FORBES	BP Forbes Service Station (Reliance Petroleum)	Corner Johnson Street and Dowling STREET	Other Petroleum	Under assessment	-33.38121776	148.0100351
FORBES	Former Shell Depot	Stephen STREET	Other Petroleum	Regulation under CLM Act not required	-33.37704755	148.0103001
FORESTVILLE	BP Service Station	632 Warringah ROAD	Service Station	Contamination currently regulated under CLM Act	-33.75997969	151.2142944
FORESTVILLE	Shell Service Station	667 Warringah ROAD	Service Station	Contamination currently regulated under CLM Act	-33.76035336	151.2184929
FORRESTERS BEACH	Caltex Service Station	The Entrance Rd Cnr Bellevue ROAD	Service Station	Regulation under CLM Act not required	-33.40057818	151.4687631
FORSTER	Caltex Service Station	16-18 Lake STREET	Service Station	Regulation under CLM Act not required	-32.18306967	152.5162492
FORSTER	Shell (Kneebone's) Service Station	2-6 The Lakes WAY	Service Station	Regulation under CLM Act not required	-32.1946108	152.5145662
FORSTER	United (Former Mobil) Service Station	86-88 Macintosh STREET	Service Station	Under assessment	-32.19079468	152.5154847
FREDERICKTON	Former Service station	2-4 Great North ROAD	Service Station	Regulation under CLM Act not required	-31.03513998	152.8794105
FRENCHS FOREST	Former 7-Eleven / Mobil Beacon Hill Service Station, Frenchs Forest	312 Warringah ROAD	Service Station	Under assessment	-33.75129647	151.2469656
FRENCHS FOREST	Former BP Service Station	Russell AVENUE	Service Station	Regulation being finalised	-33.75018093	151.2245005
FRESHWATER	Prime (former Mobil) Service Station Freshwater	117 Harbord ROAD	Service Station	Regulation under CLM Act not required	-33.77286748	151.2794354
GEORGETOWN	Caltex Service Station	4 Georgetown ROAD	Service Station	Under assessment	-32.91121105	151.7319693
GERRINGONG	Gerringong Cooperative	18 Belinda STREET	Other Petroleum	Regulation under CLM Act not required	-34.74518835	150.8181054
GILGANDRA	Mobil Service Station	15 Castlereagh STREET	Service Station	Under assessment	-31.71715641	148.6581574
GILGANDRA	Former Mobil Depot	2 Federation STREET	Other Petroleum	Regulation under CLM Act not required	-31.70937362	148.6522102
GILGANDRA	Former Mobil Depot	20 Federation STREET	Other Petroleum	Under assessment	-31.70771744	148.6514198
GILGANDRA	Caltex Service Station Gilgandra	6425 Newell HIGHWAY	Service Station	Regulation under CLM Act not required	-31.72545524	148.65281

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GIRRAWEEN	Industrial Galvanizers site	20-22 Amax AVENUE	Metal Industry	Contamination currently regulated under POEO Act	-33.80500693	150.9396743
GLADESVILLE	Caltex Service Station	116 Victoria ROAD	Service Station	Under assessment	-33.83575319	151.1277863
GLADESVILLE	Caltex Service Station	287-295 Victoria ROAD	Service Station	Under assessment	-33.8285374	151.1268639
GLADESVILLE	Glade View Business Park	436-484 Victoria ROAD	Other Industry	Under assessment	-33.82382382	151.1223941
GLADESVILLE	Road Reserve	Pittwater ROAD	Other Industry	Under assessment	-33.81603924	151.1355085
GLEBE	The Hill and Jubilee Embankment	12 Maxwell ROAD	Other Industry	Regulation under CLM Act not required	-33.87573032	151.1776027
GLEN INNES	Ambulance Station	106 Bourke STREET	Unclassified	Regulation under CLM Act not required	-29.73805854	151.7313138
GLEN INNES	Telstra Depot Glen Innes	126 Lambeth STREET	Unclassified	Regulation under CLM Act not required	-29.73565341	151.7278271
GLEN INNES	Caltex Glen Innes Service Station	154 Church STREET	Service Station	Under assessment	-29.75608853	151.7344106
GLEN INNES	Caltex Glen Innes Service Station	Church St Cnr Meade STREET	Service Station	Under assessment	-29.73699014	151.7379335
GLEN INNES	Caltex Service Station	Cnr Taylor Street & Church STREET	Service Station	Regulation under CLM Act not required	-29.73289036	151.739653
GLEN INNES	Former Shell Depot	Lambeth STREET	Other Petroleum	Regulation under CLM Act not required	-29.7376309	151.7276309
GLEN INNES	Former Caltex Depot, Glen innes	Lot 1 DP785636 Lambeth STREET	Other Petroleum	Regulation under CLM Act not required	-29.73525485	151.7279167
GLEN INNES	Council-owned Laneway	Lot 2 Lang STREET	Gasworks	Regulation under CLM Act not required	-29.74385432	151.7323049
GLENBROOK	Caltex Service Station Glenbrook	78 Great Western HIGHWAY	Service Station	Under assessment	-33.76545234	150.6215447
GLENDALE	Former Service Station	334-342 Lake ROAD	Unclassified	Regulation under CLM Act not required	-32.92775076	151.6433463
GLENDALE	Coles Express Glendale	593 Main ROAD	Service Station	Under assessment	-32.92709242	151.637946
GLENDALE	Woolworths Service Station	Stockland DRIVE	Service Station	Regulation under CLM Act not required	-32.93250548	151.6404097
GLENDENNING	7-Eleven Plumpton Service Station Glendenning	1 Dublin (Cnr Richmond Rd) STREET	Service Station	Regulation under CLM Act not required	-33.73988232	150.8603323
GLENORIE	Caltex Glenorie Service Station	912 Old Northern ROAD	Service Station	Under assessment	-33.60550946	151.0126731
GLOUCESTER	Caltex Service Station	141 Church STREET	Service Station	Under assessment	-32.01222514	151.9579521
GOONELLABAH	Invercauld Road Cattle Dip	161 Invercauld ROAD	Cattle Dip	Contamination currently regulated under CLM Act	-28.8308417	153.3098878
GOSFORD	United (former Mobil) Depot	Corner Merinee Road and Bowen CRESCENT	Other Petroleum	Under assessment	-33.41523225	151.3257069
GOULBURN	Former Goulburn Gasworks	1 Blackshaw ROAD	Gasworks	Contamination currently regulated under CLM Act	-34.75237525	149.725507
GOULBURN	Mobil Service Station	129 Lagoon STREET	Service Station	Contamination currently regulated under CLM Act	-34.74618793	149.7330484
GOULBURN	Goulburn Tannery	13 Gibson STREET	Other Industry	Regulation under CLM Act not required	-34.73756525	149.72059
GOULBURN	Caltex Depot	13 Sloane STREET	Other Petroleum	Regulation under CLM Act not required	-34.77423152	149.7088626
GOULBURN	Mobil Depot	23 Braidwood ROAD	Other Petroleum	Under assessment	-34.76217302	149.7170897
GOULBURN	Caltex Service Station	315 Auburn STREET	Service Station	Under assessment	-34.74942293	149.7232692
GOULBURN	Former Mobil Service Station Goulburn	422-426 Auburn STREET	Service Station	Under assessment	-34.74869879	149.7229392
GOULBURN	Caltex Service Station	68 Goldsmith STREET	Service Station	Under assessment	-34.75054432	149.7192098
GOULBURN	Caltex Service Station	72-74 Clinton STREET	Service Station	Regulation under CLM Act not required	-34.75728157	149.7135824

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
GOULBURN	Coles Express Service Station	90 Cowper (Corner Clinton Street) STREET	Service Station	Regulation under CLM Act not required	-34.75566648	149.7107831
GOULBURN	Former Shell Autoport Service Station	Corner Bruce Street and Lagoon STREET	Service Station	Regulation under CLM Act not required	-34.74807885	149.7266246
GRAFTON	Lowes Petroleum (BP-Branded) Depot, Grafton	13 Orara STREET	Other Petroleum	Regulation under CLM Act not required	-29.67016421	152.918161
GRAFTON	Turf Street Shop	161 Turf STREET	Service Station	Under assessment	-29.67412811	152.9336609
GRAFTON	Caltex Service Station	179 Prince STREET	Service Station	Under assessment	-29.68600117	152.9371093
GRAFTON	Former Shell Depot	2 Milton STREET	Other Petroleum	Regulation under CLM Act not required	-29.67723019	152.9205374
GRAFTON	Former BP Service Station (Reliance Petroleum)	202 Queen STREET	Service Station	Regulation under CLM Act not required	-29.67645469	152.9423977
GRAFTON	Former Mobil Depot Grafton	2-16 Bruce STREET	Other Petroleum	Regulation under CLM Act not required	-29.68093591	152.9231289
GRAFTON	Grafton Works Depot	26-28 Bruce STREET	Other Petroleum	Regulation under CLM Act not required	-29.67975507	152.9249357
GRAFTON	BP Service Station (Reliance Petroleum)	58 Fitzroy STREET	Service Station	Under assessment	-29.69345456	152.9373123
GRAFTON	Caltex Service Station	72 Swallow ROAD	Service Station	Under assessment	-29.73168549	152.944024
GRAFTON	Woolworths Petrol	75 - 77 Fitzroy Street Cnr of Duke STREET	Service Station	Under assessment	-29.69221713	152.9343562
GRAFTON	Shell Coles Express Service Station	91 Bent STREET	Service Station	Under assessment	-29.70605829	152.9400329
GRAFTON	Caltex Service Station	Corner Villiers St and Fitzroy STREET	Service Station	Regulation under CLM Act not required	-29.69296308	152.9366431
GRAFTON	Caltex Service Station	Pacific Hwy Cnr Gwyder HIGHWAY	Service Station	Under assessment	-29.70739015	152.9425508
GRANVILLE	Caltex Service Station	144 Parramatta ROAD	Service Station	Regulation under CLM Act not required	-33.83039605	151.0109216
GRANVILLE	Australand	15-17 Berry STREET	Other Industry	Contamination being managed via the planning process (EP&A Act)	-33.83600073	151.0211988
GRANVILLE	7-Eleven Service Station	154-160 Parramatta ROAD	Service Station	Regulation under CLM Act not required	-33.83022685	151.0101322
GRANVILLE	Old Granville Depot	23 Elizabeth STREET	Unclassified	Regulation under CLM Act not required	-33.83765925	151.008528
GRANVILLE	Evans Deacon Ind	2B Factory STREET	Other Industry	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.84173556	151.0165687
GRANVILLE	A'Becketts Creek	Albert STREET	Unclassified	Under assessment	-33.827228	151.011089
GREENACRE	Former Plating Works	12 Claremont STREET	Unclassified	Regulation under CLM Act not required	-33.89992254	151.0386128
GREENACRE	7-Eleven (former Mobil) Service Station	301-305 Hume HIGHWAY	Service Station	Regulation under CLM Act not required	-33.90524488	151.0419971
GREENACRE	Caltex Service Station	87 - 91 Roberts ROAD	Service Station	Regulation under CLM Act not required	-33.90461089	151.0648581
GREENWICH	Gore Creek Reserve - Drainage Line	St Vincents ROAD	Other Industry	Regulation under CLM Act not required	-33.82888693	151.1819101
GRENFELL	Grenfell Gasworks	Corner Gooloogong Road & Bourke STREET	Gasworks	Regulation under CLM Act not required	-33.89006016	148.1615443

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GRENFELL	Former SRA Fuel Depot	Grafton STREET	Other Petroleum	Regulation under CLM Act not required	-33.89351237	148.1560188
GRETA	redevelopment site	112-114 High STREET	Other Industry	Regulation under CLM Act not required	-32.67706709	151.3876682
GRETA	Coles Express Greta	122 New England HIGHWAY	Service Station	Regulation under CLM Act not required	-32.67656357	151.3872818
GRETA	Former landfill	Hollingshed ROAD	Landfill	Regulation under CLM Act not required	-32.66705287	151.3923474
GREYSTANES	United (former Mobil) Service Station	73 Ettalong ROAD	Service Station	Under assessment	-33.81822648	150.9513946
GRIFFITH	Landmark Fertiliser Storage	2 - 8 Jensen ROAD	Chemical Industry	Under assessment	-34.29365599	146.0536413
GRIFFITH	Caltex Service Station	2-4 Mackay AVENUE	Service Station	Under assessment	-34.2908766	146.0630815
GRIFFITH	Belford Petroleum (former Mobil) Depot	30 Banna AVENUE	Other Petroleum	Under assessment	-34.29042827	146.0595497
GRIFFITH	Caltex Service Station	32-34 Mackay AVENUE	Service Station	Under assessment	-34.2933331	146.0679503
GRIFFITH	Former Murrumbidgee Irrigation Depot	55-77 Banna AVENUE	Other Industry	Regulation under CLM Act not required	-34.28858242	146.0567509
GRIFFITH	Shell Griffith CVRO	6-10 Mackay AVENUE	Other Petroleum	Under assessment	-34.2910045	146.063824
GRIFFITH	BP Service Station (Reliance Petroleum)	81 Banna AVENUE	Service Station	Under assessment	-34.28851251	146.0540815
GRIFFITH	Mobil Depot - Griffith Airport	Off Rememberance DRIVE	Other Petroleum	Under assessment	-34.25618872	146.0620449
GUILDFORD	Rawson Road Service Station	2 Rawson ROAD	Service Station	Under assessment	-33.86366193	151.0088768
GUILDFORD WEST	7-Eleven Service Station	176 Fowler ROAD	Service Station	Under assessment	-33.85149493	150.9722491
GULGONG	Lowes Petroleum (former BP Depot) Gulgong	6 Railway STREET	Other Petroleum	Under assessment	-32.35950625	149.5461499
GULGONG	The Oval Site	Queen STREET	Unclassified	Under assessment	-32.36169815	149.531075
GULMARRAD	BP Service Station Maclean	3976 Pacific HIGHWAY	Service Station	Under assessment	-29.48537407	153.2004311
GUMLY GUMLY	Caltex Service Station	3723 Sturt HIGHWAY	Service Station	Regulation under CLM Act not required	-35.13590309	147.4424551
GUMLY GUMLY	Brick Kiln Reserve	Eunony Bridge ROAD	Landfill	Regulation under CLM Act not required	-35.12098411	147.4196309
GUNDAGAI	Former Mobil Depot	98 Mount STREET	Other Petroleum	Under assessment	-35.08206783	148.096221
GUNNEDAH	Mobil Gunnedah Depot	16-24 Wentworth STREET	Other Petroleum	Regulation under CLM Act not required	-30.98428725	150.260609
GUNNEDAH	Caltex Service Station	21 Abbott STREET	Service Station	Under assessment	-30.98021001	150.2561856
GUNNEDAH	Mobil Service Station	341 Conadilly STREET	Service Station	Contamination currently regulated under CLM Act	-30.9807394	150.2578428
GUNNEDAH	State Property Authority Site	35 -37 Abbott STREET	Other Petroleum	Under assessment	-30.9789841	150.25737
GUNNEDAH	Former Caltex Depot	61 Railway AVENUE	Other Petroleum	Contamination formerly regulated under the CLM Act	-30.97953242	150.2494457
GUNNEDAH	Former Telstra Line Depot	81 Barber STREET	Other Petroleum	Regulation under CLM Act not required	-30.97933809	150.2503121
GUNNEDAH	Former Shell Depot Gunnedah	85-89 Barber STREET	Other Petroleum	Regulation under CLM Act not required	-30.97949284	150.2507401
GUNNEDAH	BP Service Station	Corner Conadilly Street & Henry STREET	Service Station	Contamination currently regulated under CLM Act	-30.98116266	150.2583066
GUNNEDAH	Adjacent to Service Station	Intersection of Henry Street and Conadilly STREET	Service Station	Contamination currently regulated under CLM Act	-30.98072588	150.2582802
GUNNING	Gunning Motors	56 Yass STREET	Service Station	Under assessment	-34.78159326	149.2684791
GUYRA	Caltex-branded Service Station	4352 New England HIGHWAY	Service Station	Under assessment	-30.20601937	151.6757291

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
GUYRA	StateRail land leased to Incitec	Starr ROAD	Other Industry	Regulation under CLM Act not required	-30.23157011	151.6707135
GWANDALAN	Metro Petroleum Gwandalan (Formerly Gwandalan Auto Care)	47 Orana ROAD	Service Station	Under assessment	-33.13632941	151.5813396
GWANDALAN	Former Gwandalan Landfill	Kanandra DRIVE	Landfill	Regulation under CLM Act not required	-33.17497722	151.5917107
GYMEA	7-Eleven (former Mobil) Gymea Service Station	110 Gymea Bay ROAD	Service Station	Regulation under CLM Act not required	-34.03745848	151.0848547
GYMEA BAY	Former Shell Gymea Bay Service Station	Gymea Bay ROAD	Service Station	Under assessment	-34.04129676	151.0841328
HABERFIELD	7-Eleven Haberfield	25-35 Parramatta ROAD	Service Station	Contamination currently regulated under CLM Act	-33.887956	151.142868
HALEKULANI	Former Halekulani Landfill	Macleay DRIVE	Landfill	Under assessment	-33.21446301	151.5527625
HAMILTON	SRA Land	10 Maitland ROAD	Unclassified	Regulation under CLM Act not required	-32.91994358	151.7512417
HAMILTON	Taxi Services	116 Tudor STREET	Service Station	Contamination formerly regulated under the CLM Act	-32.92351606	151.7454742
HAMILTON	Caltex Hamilton	59-63 Tudor STREET	Service Station	Under assessment	-32.92498593	151.7509313
HAMILTON	Newcastle Toyota	65 Tudor STREET	Other Petroleum	Under assessment	-32.925171	151.7504048
HAMILTON	Hamilton Gasworks	Clyde STREET	Gasworks	Contamination currently regulated under CLM Act	-32.91362741	151.7406241
HAMILTON	Hamilton Bus Depot	Cnr Denison Street and Gordon AVENUE	Other Petroleum	Regulation under CLM Act not required	-32.92542648	151.7512512
HAMILTON NORTH	Shell Newcastle Terminal	5 Chatham STREET	Other Petroleum	Contamination currently regulated under CLM Act	-32.91630469	151.7408712
HAMILTON NORTH	ELMA	54 Clyde STREET	Other Industry	Contamination currently regulated under CLM Act	-32.91145768	151.7367691
HAMILTON NORTH	Black and Decker	56 Clyde STREET	Metal Industry	Contamination currently regulated under CLM Act	-32.91080413	151.7358236
HARBORD	Former Dry Cleaners	121 Wyndora AVENUE	Other Industry	Regulation under CLM Act not required	-33.77425321	151.2821553
HARDEN	SRA Site	31 Aurvill ROAD	Unclassified	Regulation under CLM Act not required	-34.54998656	148.3689577
HARDEN	SRA Site	51 Whitton LANE	Unclassified	Contamination formerly regulated under the CLM Act	-34.55396035	148.3713349
HARTLEY VALE	Former Shale Oil Refinery	Lot 52 Hartley Vale ROAD	Unclassified	Contamination currently regulated under CLM Act	-33.52925119	150.24216
HASTINGS POINT	Coles Express Hastings Point	99 Tweed Coast ROAD	Service Station	Regulation under CLM Act not required	-28.36914103	153.5725676
HAY	Former Shell Hay Depot	391 Murray STREET	Other Petroleum	Regulation under CLM Act not required	-34.50028195	144.8463999
HAY	SRA Land	429, 431, 435, 437 & 439 Murray STREET	Other Industry	Regulation under CLM Act not required	-34.49965611	144.840976
HAY	SRA Land	443 Murray STREET	Other Industry	Contamination formerly regulated under the CLM Act	-34.49966753	144.8410778
HAY	Former Mobil Hay Depot	Corner Lachlan Street and Murray STREET	Other Petroleum	Under assessment	-34.50019184	144.8456578
HAY SOUTH	Caltex Service Station	429-431 Moama STREET	Service Station	Under assessment	-34.52001427	144.8380121
HAZELBROOK	Caltex Service Station	198 Great Western HIGHWAY	Service Station	Under assessment	-33.72106175	150.4520976
HEATHCOTE	Caltex Service Station	1344 Princes HIGHWAY	Service Station	Under assessment	-34.08841066	151.0072048

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HEATHCOTE	Shell Coles Express Service Station	1355 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-34.08780042	151.0069741
HEATHCOTE	Caltex Service Station	1403 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-34.09059834	151.003752
HEATHERBRAE	Shell Coles Express Motto Farm Service Station	2137 Pacific HIGHWAY	Service Station	Under assessment	-32.79835449	151.7176284
HEATHERBRAE	Bogas (Former Caltex) Service Station	3 Speedy Lock LANE	Service Station	Regulation under CLM Act not required	-32.78057822	151.7372135
HEXHAM	QR National - Hexham Precinct	179 & 3/67 Maitland ROAD	Other Industry	Regulation under CLM Act not required	-32.83474038	151.6821895
HEXHAM	Cummins Newcastle	21 Galleghan STREET	Other Industry	Under assessment	-32.83186739	151.686709
HEXHAM	Caltex-Bogas Warehouse	239 Old Maitland ROAD	Service Station	Under assessment	-32.82899942	151.6861849
HEXHAM	Industrial Galvanizers	312 Pacific HIGHWAY	Metal Industry	Contamination currently regulated under POEO Act	-32.83457186	151.6884941
HEXHAM	Caltex Service Station	360 Old Maitland ROAD	Service Station	Under assessment	-32.82844873	151.6851063
HEXHAM	BP Service Station (Reliance Petroleum)	Corner Pacific Highway and Old Maitland ROAD	Service Station	Regulation under CLM Act not required	-32.82756403	151.6846929
HEXHAM	Forgacs Site	Sparke STREET	Chemical Industry	Contamination currently regulated under CLM Act	-32.85464558	151.6988053
HILLSTON	Former BP Depot Hillston	141-143 Cowper STREET	Other Petroleum	Regulation under CLM Act not required	-33.48823546	145.5381623
HOLBROOK	Caltex Truckstop	Hume HIGHWAY	Service Station	Under assessment	-35.71332625	147.3207237
HOMEBUSH	Ausgrid Mason Park Substation	1 Underwood ROAD	Other Industry	Regulation under CLM Act not required	-33.85674677	151.0747044
HOMEBUSH	Caltex Service Station	334-336 Parramatta ROAD	Service Station	Under assessment	-33.8581543	151.0681261
HOMEBUSH BAY	WSN Auburn Waste and Recycling Centre	Corner Pondage Link and Hill ROAD	Landfill	Under assessment	-33.84359299	151.0593656
HOMEBUSH WEST	Former Ford Landfill	22 Mandemar AVENUE	Landfill	Under assessment	-33.86180526	151.0635664
HORNSBY	Coles Express Hornsby	194- 206 Pacific HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-33.7071993	151.0991452
HORNSBY	Hornsby Train Maintenance Centre	1B Stephen STREET	Other Industry	Under assessment	-33.69342449	151.1035295
HORNSBY	Midas Car Care Centre Hornsby	2A Linda STREET	Unclassified	Regulation under CLM Act not required	-33.70052215	151.1004786
HOXTON PARK	Endeavour Energy Hoxton Park	490 Hoxton Park ROAD	Other Industry	Regulation under CLM Act not required	-33.92766437	150.8689069
HUNTERS HILL	Coles Express Hunters Hill	4 Ryde ROAD	Service Station	Regulation under CLM Act not required	-33.8317985	151.141655
HUNTERS HILL	Former Radium Factory	7-9 Nelson PARADE	Other Industry	Under assessment	-33.84218911	151.164968
HUNTERS HILL	Foreshore Land	Rear of 7, 9 & 11 Nelson PARADE	Unclassified	Contamination currently regulated under CLM Act	-33.84248362	151.1649249
HURLSTONE PARK	Former Speedway Petroleum Service Station	610 - 618 New Canterbury ROAD	Service Station	Contamination currently regulated under CLM Act	-33.90541228	151.1322009
HURLSTONE PARK	7-Eleven Hurlstone Park	670 New Canterbury ROAD	Service Station	Regulation under CLM Act not required	-33.90510388	151.1299825
HURLSTONE PARK	Former Telstra Depot	82 Canterbury ROAD	Service Station	Regulation under CLM Act not required	-33.90803171	151.1258121
HURSTVILLE GROVE	Moore Reserve	Morshead DRIVE	Landfill	Contamination currently regulated under CLM Act	-33.97920603	151.0873578
INVERELL	Caltex Service Station	139-143 Otho STREET	Service Station	Under assessment	-29.77819403	151.1145699

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INVERELL	Former Service Station	20 Oliver STREET	Service Station	Regulation under CLM Act not required	-29.77229743	151.1152692
INVERELL	Former Shell Depot	25 Edward STREET	Other Petroleum	Regulation under CLM Act not required	-29.76151684	151.1182033
INVERELL	Former Mobil Inverell Depot	29-33 Edward STREET	Other Petroleum	Under assessment	-29.76135322	151.1171412
INVERELL	Caltex Service Station	4 Edward STREET	Service Station	Under assessment	-29.76123104	151.1147983
INVERELL	Caltex Service Station	55-59 Ring STREET	Service Station	Under assessment	-29.76204512	151.1141737
INVERELL	Former Mobil Service Station	Corner Otho Street and Henderson STREET	Service Station	Under assessment	-29.7786926	151.1149921
ISLINGTON	Shell Pipeline Easement (vacant land)	24 Fern STREET	Other Petroleum	Under assessment	-32.91706254	151.7473809
ISLINGTON	Caltex Service Station	240 Maitland ROAD	Service Station	Under assessment	-32.91138868	151.7457699
JAMISONTOWN	BP Jamisontown	126 Mulgoa ROAD	Service Station	Under assessment	-33.76978323	150.6764977
JAMISONTOWN	Former Caltex Jamisontown	229-231 Mulgoa ROAD	Service Station	Under assessment	-33.76661447	150.6784735
JAMISONTOWN	7-Eleven Service Station	92 Mulgoa ROAD	Service Station	Contamination currently regulated under CLM Act	-33.7667231	150.6796488
JANNALI	Former Mobil Service Station	121 Georges River ROAD	Service Station	Regulation under CLM Act not required	-34.01614613	151.0681921
JENNINGS	Former Arsenic Poison Factory	Duke Street, Manor Street and King STREET	Chemical Industry	Under assessment	-28.92833023	151.9301552
JESMOND	Caltex Service Station	27 Bluegum ROAD	Service Station	Under assessment	-32.9029287	151.691164
JINDABYNE	Caltex Service Station	4-6 Kosciuszko ROAD	Service Station	Under assessment	-36.41395847	148.6225113
JINDABYNE	BP Service Station (Reliance Petroleum)	8 Kosciuszko ROAD	Service Station	Regulation under CLM Act not required	-36.41478692	148.6178882
JUNEE	Subdivision Proposal	5858 Gundagai ROAD	Unclassified	Regulation under CLM Act not required	-34.87783587	147.6067578
KANAHOOKA	Former Smelter Site	Kanahooka ROAD	Metal Industry	Under assessment	-34.49406369	150.8227583
KANDOS	Cement Australia Kandos Cement Works	1 Jamieson STREET	Other Industry	Under assessment	-32.86399912	149.9779259
KARIONG	Coles Express Kariong	6-8 Central Coast HIGHWAY	Service Station	Under assessment	-33.43443192	151.2963401
KARIONG	Caltex Service Station	Lot 2 Langford DRIVE	Service Station	Under assessment	-33.43934827	151.2935447
KARUAH	BP Roadhouse Karuah	403 Tarean ROAD	Service Station	Under assessment	-32.65371781	151.9629963
KATOOMBA	Aldi Stores	201 Katoomba STREET	Service Station	Regulation under CLM Act not required	-33.71756625	150.3101649
KATOOMBA	Former Katoomba/Leura Gasworks	Megalong STREET	Gasworks	Contamination currently regulated under CLM Act	-33.71318559	150.3187284
KELLYVILLE	BP Service Station	19-21 Windsor ROAD	Service Station	Under assessment	-33.71280997	150.9590756
KELLYVILLE	Caltex Service Station	3-5 Windsor ROAD	Service Station	Regulation under CLM Act not required	-33.71436125	150.9602175
KELSO	Caltex Service Station Kelso	19 Sydney ROAD	Service Station	Regulation under CLM Act not required	-33.41904247	149.6023985
KELSO	BP Service Station (Reliance Petroleum)	63 Sydney ROAD	Service Station	Under assessment	-33.41925328	149.6076677
KEMBLA GRANGE	ShawCor Australia	66 West Dapto ROAD	Other Petroleum	Regulation under CLM Act not required	-34.46875328	150.8106326
KEMBLAWARRA	Griffins Bay, Lake Illawarra	Shellharbour ROAD	Landfill	Regulation under CLM Act not required	-34.49653984	150.8943776
KEMPS CREEK	Caltex Service Station	1163 Mamre ROAD	Service Station	Under assessment	-33.86972102	150.7966074
KEMPSEY	Former Mobil Service Station	108-112 Smith STREET	Service Station	Under assessment	-31.07492508	152.8431945
KEMPSEY	Former Mobil depot	14 Hopetoun STREET	Other Petroleum	Regulation under CLM Act not required	-31.07603107	152.8350132

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KEMPSEY	Mobil Depot	154 Belgrave STREET	Service Station	Regulation under CLM Act not required	-31.07965043	152.8326303
KEMPSEY	Kempsey Showground	19 Sea STREET	Unclassified	Contamination being managed via the planning process (EP&A Act)	-31.07334836	152.8308795
KEMPSEY	Former Shell Depot	43-51 Gladstone STREET	Other Petroleum	Regulation under CLM Act not required	-31.07500944	152.8346699
KEMPSEY	Shell Coles Express Service Station	Corner Pacific Highway and Cochrane STREET	Service Station	Under assessment	-31.07036743	152.8461571
KENSINGTON	Footpath adjacent to 10-20 Anzac Parade	10-20 Anzac PARADE	Service Station	Regulation under CLM Act not required	-33.9032124	151.2237836
KENSINGTON	7-Eleven Kensington	135 Anzac PARADE	Service Station	Under assessment	-33.91035885	151.2228537
KENSINGTON	Caltex Service Station	219a Anzac PARADE	Service Station	Under assessment	-33.91460752	151.2251266
KENSINGTON	Former Ampol Service Station	76-82 Anzac PARADE	Service Station	Regulation under CLM Act not required	-33.9059246	151.2242891
KENTHURST	Vacant Land	259 McCylmonts ROAD	Unclassified	Regulation under CLM Act not required	-33.61283529	150.9425303
KHANCOBAN	Khancoban Tip	Alpine WAY	Landfill	Regulation under CLM Act not required	-36.21994191	148.1542718
KIAMA	Former Gasworks	105 to 109 and 113 Shoalhaven STREET	Gasworks	Regulation under CLM Act not required	-34.67416881	150.8504143
KIAMA HEIGHTS	Former Mobil Service Station Kiama Heights	7-9 South Kiama DRIVE	Service Station	Under assessment	-34.69553931	150.8437977
KILLARA	Former BP Service Station Lindfield	478 Pacific HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-33.7719298	151.1613874
KILLARA	7-Eleven Service Station (Former Mobil)	496 Pacific HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-33.77146554	151.1606903
KILLARA	Killara Garage	544 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.76974164	151.1599696
KILLARA	Land Adjacent to Former Service Station Site	684-684a, 690, 692 and 696 Pacific HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-33.76312226	151.1549237
KILLARA	Former Caltex Service Station	692B-694 Pacific HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-33.76306802	151.1550109
KINGS PARK	Multi-Fill	14 Garling ROAD	Unclassified	Regulation being finalised	-33.74478046	150.9111964
KINGS PARK	Former Dow Corning Factory	21 Tattersall ROAD	Chemical Industry	Contamination currently regulated under CLM Act	-33.75012653	150.9138477
KINGSFORD	Shell Coles Express Service Station Kingsford	58 Gardeners ROAD	Service Station	Under assessment	-33.9250054	151.2257601
KINGSFORD	Caltex Service Station	603-611 Anzac PARADE	Service Station	Under assessment	-33.93435787	151.2371198
KINGSGROVE	Shell Coles Express Service Station	137 Kingsgrove ROAD	Service Station	Regulation under CLM Act not required	-33.93276948	151.099026
KINGSGROVE	State Transit Authority Depot	17-23 Richland STREET	Other Petroleum	Regulation under CLM Act not required	-33.93646086	151.0973617
KINGSGROVE	Caltex Kingsgrove	351-357 Stoney Creek ROAD	Service Station	Regulation under CLM Act not required	-33.95132175	151.0926872
KIRRAWEE	Caltex-branded Kirrawee Service Station	(1-3 Waratah Street) 487 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-34.02915971	151.0808279
KIRRAWEE	Ingal Civil Products	127-141 Bath ROAD	Metal Industry	Regulation under CLM Act not required	-34.03029516	151.0754469
KIRRAWEE	Coles Express Kirrawee	470 Princes HIGHWAY	Service Station	Under assessment	-34.02735302	151.0845079

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
KIRRAWEE	7-Eleven (former Mobil) Service Station	542 Princes HIGHWAY	Service Station	Under assessment	-34.03238179	151.0758071
KOGARAH	Caltex Service Station	29 President AVENUE	Service Station	Under assessment	-33.96516866	151.141145
KOGARAH	Woolworths Petrol Service Station	69 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-33.96330397	151.1371182
KOGARAH	7-Eleven Service Station	736 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-33.96406472	151.1376011
KOGARAH	Scarborough Park South	Production AVENUE	Landfill	Regulation being finalised	-33.97922253	151.140276
KOOLKHAN	Former Koolkhan Power Station	Summerland WAY	Other Industry	Regulation under CLM Act not required	-29.61688704	152.9300645
KOORAGANG	Orica Kooragang Island	15 Greenleaf ROAD	Chemical Industry	Contamination currently regulated under CLM Act	-32.89654619	151.7771372
KOORAGANG	Former Boral Timber Export Facility	16 Heron ROAD	Other Industry	Regulation under CLM Act not required	-32.89710295	151.7739966
KOORAGANG	NPC, berths 2 and 3	Heron ROAD	Metal Industry	Regulation being finalised	-32.89260063	151.7742527
KOORAGANG	Kooragang Island Waste Facillity	Lot 121 DP874949 OTHER	Metal Industry	Contamination currently regulated under POEO Act	-32.88250732	151.7466125
KOORAGANG	Transpacific Technical Services	Raven STREET	Unclassified	Under assessment	-32.8634857	151.7414904
KOORINGAL	Caltex Service Station	265-267 Lake Albert ROAD	Service Station	Under assessment	-35.14078443	147.3755442
KOSCIUSZKO	Sawpit Creek landfill	13km from Jindabyne, off Kosciuszko ROAD	Landfill	Regulation under CLM Act not required	-36.34858097	148.5673374
KOSCIUSZKO	Khancoban Spoil Dump	Alpine WAY	Landfill	Regulation under CLM Act not required	-36.21982803	148.1527401
KOSCIUSZKO	Smiggin Holes Snow Clearing Shed	Link ROAD	Landfill	Regulation under CLM Act not required	-36.39098211	148.4304981
KURMOND	BP Service Station	501 Bells Line of road ROAD	Service Station	Contamination formerly regulated under the CLM Act	-33.55096662	150.6911676
KURNELL	Caltex Refinery	2 Solander STREET	Other Petroleum	Contamination currently regulated under POEO Act	-34.0175214	151.2159572
KURNELL	Former Phillips Imperial Chemicals site	260 Captain Cook DRIVE	Chemical Industry	Regulation under CLM Act not required	-34.02493837	151.1952149
KURNELL	Abbott Australasia	Captain Cook DRIVE	Chemical Industry	Contamination formerly regulated under the CLM Act	-34.02339937	151.19921
KURNELL	Former Caltex Kurnell Service Station	Captain Cook Drive Corner Solander STREET	Service Station	Under assessment	-34.01269846	151.2094347
KURRI KURRI	Caltex Service Station	279-281 Lang STREET	Service Station	Contamination currently regulated under CLM Act	-32.82047175	151.477646
KURRI KURRI	Kurri Kurri Smelter	Hart ROAD	Metal Industry	Regulation under CLM Act not required	-32.7873063	151.4828827
KYOGLE	Caltex Service Station	26 Summerland WAY	Service Station	Under assessment	-28.61806766	153.003862
LAKE HAVEN	Caltex Service Station	Goobarabah Ave Cnr Gorokan DRIVE	Service Station	Under assessment	-33.24337276	151.5065335
LAKE MUNMORAH	Caltex Service Station	1135 Pacific HIGHWAY	Service Station	Under assessment	-33.18501024	151.5526114
LAKEMBA	Former Lakemba Police Station	59 Quigg STREET	Unclassified	Regulation under CLM Act not required	-33.92199239	151.079412
LAKEMBA	Caltex Service Station	81 Wangee ROAD	Service Station	Under assessment	-33.91153044	151.073306
LAKEMBA	Caltex Service Station	961-967 Canterbury ROAD	Service Station	Regulation under CLM Act not required	-33.92671102	151.0814905
LAMBTON	Caltex Service Station	422 Newcastle ROAD	Service Station	Under assessment	-32.9095592	151.7109684
LANE COVE	7-Eleven Service Station	203 Burns Bay ROAD	Service Station	Regulation under CLM Act not required	-33.81458334	151.1543844

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LANE COVE	Coles Express Service Station Burns Bay	254 Burns Bay ROAD	Service Station	Under assessment	-33.81719214	151.1518774
LANE COVE	BP Service Station	62 Epping ROAD	Service Station	Under assessment	-33.81108427	151.1641531
LANE COVE	Pacific Power	Sirius ROAD	Landfill	Contamination formerly regulated under the CLM Act	-33.80701776	151.1449658
LANE COVE NORTH	Former Caltex Service Station	428-432 Mowbray ROAD	Service Station	Regulation under CLM Act not required	-33.80804563	151.1721538
LANE COVE WEST	Caltex Lane Cove West	235-245 Burns Bay ROAD	Service Station	Under assessment	-33.81719214	151.1518774
LANE COVE WEST	Ventemans Reach Bushland	Off Mars ROAD	Unclassified	Under assessment	-33.80615015	151.1451474
LANSVALE	Mobil Service Station	161 Hume HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-33.89442261	150.9571507
LANSVALE	Mobil Service Station	44 Hume HIGHWAY	Service Station	Regulation under CLM Act not required	-33.89172416	150.9656537
LANSVALE	Coles Express Lansvale	65 Hume HIGHWAY	Service Station	Under assessment	-33.89295753	150.9606136
LAURIETON	Caltex Service Station	461 Ocean DRIVE	Service Station	Under assessment	-31.64367775	152.7977735
LAVENDER BAY	SRA Land	French STREET	Unclassified	Regulation under CLM Act not required	-33.84560621	151.2030148
LAVINGTON	Former Caltex Service Station	373-375 Wagga ROAD	Service Station	Regulation under CLM Act not required	-36.04797551	146.9385325
LAVINGTON	Caltex Service Station	436 Wagga (corner Dick Road) ROAD	Service Station	Regulation under CLM Act not required	-36.04500034	146.9444932
LAVINGTON	Former ERS liquid waste treatment and storage facility	819 Knights ROAD	Other Industry	Under assessment	-36.06763885	146.942143
LEETON	Yenda Producers (formerly Incitec) Leeton	1 - 2 Canal STREET	Other Petroleum	Under assessment	-34.55181457	146.3863516
LEETON	Caltex Service Station	1 Belah STREET	Service Station	Regulation under CLM Act not required	-34.55421752	146.3998431
LEETON	Former Mobil Depot	108 Calrose STREET	Other Petroleum	Under assessment	-34.55813326	146.3921296
LEETON	Former Fuel Depot, Leeton	1-3 Short St STREET	Other Petroleum	Under assessment	-34.55253237	146.3864507
LEICHHARDT	SRA Land	10-11 Balmain ROAD	Other Industry	Contamination formerly regulated under the CLM Act	-33.87774852	151.1590952
LEICHHARDT	Former Kolotex site	22 George STREET	Other Industry	Contamination currently regulated under CLM Act	-33.888	151.148
LEICHHARDT	Former Labelcraft Site	30-40 George STREET	Chemical Industry	Contamination currently regulated under CLM Act	-33.887795	151.148486
LEICHHARDT	RailCorp Leichhardt	7 Darley ROAD	Other Industry	Regulation under CLM Act not required	-33.87520846	151.1539012
LEICHHARDT	Bus Depot (Area E)	Cnr Balmain Rd and City West LINK	Other Industry	Under assessment	-33.87589727	151.1598073
LENNOX HEAD	Spoors Dip	13 Fig Tree Hill DRIVE	Cattle Dip	Contamination formerly regulated under the CLM Act	-28.78258175	153.5752527
LENNOX HEAD	Former Caltex Lennox Head	Byron STREET	Service Station	Regulation under CLM Act not required	-28.79189328	153.5883225
LEPPINGTON	Coles Express Leppington	1443 Camden Valley WAY	Service Station	Regulation under CLM Act not required	-33.96631609	150.8154793
LEUMEAH	Caltex Service Station	6 Rudd ROAD	Service Station	Under assessment	-34.05398325	150.8299209
LEURA	Former Leura Garage	126-128 Leura MALL	Service Station	Under assessment	-33.7125311	150.3315386
LIDDELL	Liddell Power Station	New England HIGHWAY	Other Industry	Under assessment	-32.37393962	150.9756283
LIDSDALE	Angus Place Colliery	Wolgan ROAD	Other Industry	Under assessment	-33.35274573	150.0996773
LIDSDALE	Kerosene Vale Colliery	Wolgan ROAD	Other Industry	Under assessment	-33.38145755	150.0940097

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LIGHTNING RIDGE	Former Ambulance Station	18 - 42 Pandora STREET	Other Industry	Regulation under CLM Act not required	-29.43133877	147.9812981
LIGHTNING RIDGE	Caltex Service Station	Onyx St Cnr Morilla STREET	Service Station	Under assessment	-29.42922885	147.9747954
LILLI PILLI	Caltex Service Station	477-481 Port Hacking ROAD	Service Station	Under assessment	-34.05243807	151.1216353
LILLIAN ROCK	Former 'Peters Dip' Cattle Tick Dip Site	427 Lillian Rock ROAD	Cattle Dip	Regulation under CLM Act not required	-28.5314327	153.1556392
LINDFIELD	7-Eleven (former Mobil) Service Station	238 Pacific HIGHWAY	Service Station	Under assessment	-33.7788603	151.1689594
LISAROW	Lisarow Recycling Site	902-909 Pacific HIGHWAY	Metal Industry	Under assessment	-33.38420179	151.3655856
LISMORE	Shell Coles Express Service Station	100 Dawson STREET	Service Station	Under assessment	-28.81140865	153.2800472
LISMORE	Former Shell Depot	116 Wilson STREET	Other Petroleum	Regulation under CLM Act not required	-28.81070081	153.2621577
LISMORE	Caltex Lismore Service Station	136 Woodlark STREET	Service Station	Under assessment	-28.80807597	153.2807591
LISMORE	Caltex Service Station	73-75 Dawson STREET	Service Station	Regulation under CLM Act not required	-28.80894415	153.2809619
LISMORE	Lismore Gasworks	Cnr John Street & Keen STREET	Gasworks	Ongoing maintenance required to manage residual contamination (CLM Act)	-28.81764489	153.2710196
LISMORE	SRA Land	Norco LANE	Unclassified	Regulation under CLM Act not required	-28.810742	153.2702306
LISMORE HEIGHTS	Coles Express Lismore Heights	426 Ballina ROAD	Service Station	Contamination currently regulated under CLM Act	-28.81068067	153.3053065
LITHGOW	Jasbe BP-branded Service Station (Former Reliance Petroleum)	1106 Great Western HIGHWAY	Service Station	Under assessment	-33.48426647	150.134992
LITHGOW	Mobil Depot	353 Main STREET	Other Petroleum	Under assessment	-33.48235166	150.1383012
LITHGOW	Lithgow Thales	4 Martini PARADE	Metal Industry	Contamination formerly regulated under the CLM Act	-33.49012248	150.1415389
LITHGOW	Former Shell Depot	6 Gasworks LANE	Other Petroleum	Under assessment	-33.47995091	150.162216
LITHGOW	Caltex Lithgow (Quota Park)	Adjacent to 1131 Great Western HIGHWAY	Unclassified	Regulation under CLM Act not required	-33.47927554	150.1366238
LITHGOW	Former Gasworks	Mort STREET	Gasworks	Regulation under CLM Act not required	-33.47995167	150.1635401
LIVERPOOL	AC McGrath (Wholesale) Pty Ltd	20 Shepherd (Cnr Atkinson St) STREET	Other Industry	Under assessment	-33.9320192	150.9236862
LIVERPOOL	Former Car Park	4 - 6 Rose STREET	Unclassified	Regulation under CLM Act not required	-33.93258955	150.9157936
LIVERPOOL	Woolworths Service Station	59-67 Orange Grove ROAD	Service Station	Regulation under CLM Act not required	-33.90711248	150.9178855
LOFTUS	BP Freedom Fuel Service Station Loftus	127 Loftus AVENUE	Service Station	Under assessment	-34.04570765	151.0508004
LONG JETTY	7-Eleven (former Mobil) Service Station	184-186 The Entrance ROAD	Service Station	Under assessment	-33.35089363	151.4924904
LONG JETTY	Westside Petroleum Service Station	290-294 The Entrance ROAD	Service Station	Under assessment	-33.35688982	151.4862246
LONG JETTY	Brocks Garage	326 The Entrance ROAD	Service Station	Under assessment	-33.35897356	151.4847709
LONG JETTY	Caltex Service Station	431 The Entrance ROAD	Service Station	Under assessment	-33.36022468	151.4826553
LONGUEVILLE	Caltex Service Station	5-7 Northwood ROAD	Service Station	Under assessment	-33.82452775	151.1725758
LUCAS HEIGHTS	Harringtons Quarry	access from Little Forest ROAD	Landfill	Contamination currently regulated under CLM Act	-34.03555347	150.9751826

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LUCAS HEIGHTS	IWC landfill	Little Forest ROAD	Landfill	Contamination currently regulated under CLM Act	-34.03214889	150.9753474
LUDDENHAM	Caltex Service Station	The Northern ROAD	Service Station	Under assessment	-33.87536093	150.6888872
MACKSVILLE	Caltex Service Station	Pacific (22-24 Cooper Street) HIGHWAY	Service Station	Regulation under CLM Act not required	-30.70977455	152.9198448
MACLEAN	MacLean Outdoors	255 River STREET	Service Station	Under assessment	-29.45782683	153.1970725
MACQUARIE FIELDS	Caltex Service Station	68 Harold STREET	Service Station	Under assessment	-33.98557276	150.8933681
MACQUARIE PARK	Waterloo Road	1 Waterloo ROAD	Other Petroleum	Under assessment	-33.78806	151.133209
MACQUARIE PARK	Caltex North Ryde Service Station	41-43 Epping ROAD	Service Station	Regulation under CLM Act not required	-33.79138236	151.1312248
MAITLAND	Coles Express Service Station	235 High STREET	Service Station	Regulation under CLM Act not required	-32.73923807	151.5620399
MAITLAND	Maitland Gasworks	Charles STREET	Gasworks	Contamination currently regulated under CLM Act	-32.73603658	151.5578926
MAITLAND	Hannan and High Street	Hannan Street and High STREET	Service Station	Regulation under CLM Act not required	-32.72731682	151.5515673
MALABAR	ANZAC Rifle Range former landfill	Franklin STREET	Landfill	Regulation being finalised	-33.95792671	151.2566373
MANDALONG	Mandalong Mine	Mandalong ROAD	Other Industry	Under assessment	-33.11725583	151.4616452
MANGROVE MOUNTAIN	Poultry Litter Containment Pit site	258 Waratah ROAD	Unclassified	Regulation under CLM Act not required	-33.28917277	151.167235
MANILLA	Tamworth Regional Council Works Depot - Manilla	73 River STREET	Other Petroleum	Regulation under CLM Act not required	-30.746085	150.725363
MANLY	St Patrick's Estate	151 Darley ROAD	Unclassified	Regulation under CLM Act not required	-33.8044568	151.2938595
MANLY	Caltex Service Station	86 Pittwater ROAD	Service Station	Under assessment	-33.79306889	151.2858638
MANLY	Former Little Manly Point Gasworks	End of Stuart STREET	Gasworks	Regulation under CLM Act not required	-33.80842005	151.2877784
MANLY	Little Manly Point	Stuart STREET	Gasworks	Contamination formerly regulated under the CLM Act	-33.80814626	151.2876245
MANLY VALE	Caltex Service Station	236-238 Condamine STREET	Service Station	Under assessment	-33.78508231	151.2674386
MANLY VALE	Former Landfill Addiscombe Road	Addiscombe ROAD	Landfill	Contamination currently regulated under CLM Act	-33.78307439	151.2747846
MANNERING PARK	Parkview General Store (a former service station)	2 Vales ROAD	Service Station	Under assessment	-33.14753814	151.5387832
MANNERING PARK	Mannering Park Mini Mart	70 Vales ROAD	Service Station	Under assessment	-33.15236501	151.5371767
MARAYONG	7-Eleven (former Mobil Blacktown West) Service Station Marayong	173 Richmond ROAD	Service Station	Regulation under CLM Act not required	-33.75472796	150.8913605
MARAYONG	Woolworths Petrol Service Station Marayong	Corner Vardys Road and Turbo ROAD	Service Station	Regulation under CLM Act not required	-33.7452356	150.9041601
MARDI	Former Mardi Landfill	70-90 McPherson ROAD	Landfill	Regulation under CLM Act not required	-33.29273289	151.4100941
MARKS POINT	Former Mobil Service Station (now 7-Eleven)	770-772 Pacific HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-33.05646268	151.6533795
MARKS POINT	Former Mobil Aviation Depot Belmont Airport	864 Pacific HIGHWAY	Other Petroleum	Under assessment	-33.06657244	151.6497674
MAROUBRA	Coles Express Pagewood Service Station, Maroubra	299 Bunnerong PARADE	Service Station	Regulation under CLM Act not required	-33.94071282	151.2285063
MARRANGAROO	Mobil Service Station	394-398 Great Western HIGHWAY	Service Station	Under assessment	-33.45253322	150.1181023

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MARRICKVILLE	2 Carrington Road	2 Carrington ROAD	Unclassified	Regulation under CLM Act not required	-33.91596071	151.1597199
MARRICKVILLE	TRW Steering and Suspension	22-28 Carrington ROAD	Other Industry	Contamination formerly regulated under the CLM Act	-33.92012667	151.1566181
MARRICKVILLE	RailCorp	361 Victoria ROAD	Other Industry	Regulation under CLM Act not required	-33.91404835	151.1557132
MARRICKVILLE	Former Mobil Service Station	384 Illawarra ROAD	Service Station	Under assessment	-33.91534969	151.1506717
MARRICKVILLE	Woolworths Petrol Service Station Marrickville	490 Illawarra ROAD	Service Station	Regulation under CLM Act not required	-33.91845177	151.1459951
MARRICKVILLE	Mackey Park	Cnr Richardsons Crescent and Carrington ROAD	Landfill	Regulation under CLM Act not required	-33.9220263	151.1547903
MARRICKVILLE	Dry Cleaners and Loading Dock (adjacent Lot 1 DP612551)	Smidmore STREET	Other Industry	Under assessment	-33.90707592	151.171701
MARRICKVILLE	Cooks River Aqueduct	Thornley STREET	Unclassified	Contamination formerly regulated under the CLM Act	-33.92204604	151.1480332
MARSDEN PARK	266 Grange Ave	266 Grange AVENUE	Unclassified	Under assessment	-33.702662	150.838287
MARSFIELD	Coles Express Marsfield	189 Epping ROAD	Service Station	Under assessment	-33.77519246	151.1053691
MARULAN	BP Express Marulan (Northbound)	(Northbound) Hume HIGHWAY	Service Station	Regulation under CLM Act not required	-34.7188332	149.9949547
MARULAN	BP Service Station	(Southbound) Hume HIGHWAY	Service Station	Regulation under CLM Act not required	-34.71932066	150.0014827
MARYVILLE	7-Eleven (former Mobil) Service Station	184-188 Hannell STREET	Service Station	Under assessment	-32.91336028	151.7579315
MASCOT	Caltex Service Station	125 O'Riordan STREET	Service Station	Under assessment	-33.92309169	151.1911539
MASCOT	Former Zinc Smelter and Paint Manufacturing Facility	163 O'Riordan STREET	Metal Industry	Regulation under CLM Act not required	-33.92526513	151.1892582
MASCOT	Ing Industrial Fund (unoccupied Land and General Parking)	19-33 Kent ROAD	Landfill	Regulation under CLM Act not required	-33.922765	151.185262
MASCOT	Mascot Pioneer Plating	25-29 Ricketty STREET	Metal Industry	Contamination currently regulated under CLM Act	-33.92075288	151.1824801
MASCOT	Former Mascot Galvanising	336-348 King STREET	Metal Industry	Contamination currently regulated under CLM Act	-33.92902126	151.185874
MASCOT	Sokol Corporation	50-56 Robey STREET	Other Industry	Regulation under CLM Act not required	-33.93162265	151.1904955
MASCOT	Business Centre	5-9 Ricketty STREET	Unclassified	Under assessment	-33.92029202	151.1816656
MASCOT	Former Shell Service Station Mascot	746 Botany ROAD	Service Station	Contamination currently regulated under CLM Act	-33.92352295	151.1955852
MASCOT	Telstra Exchange	904-922 Botany ROAD	Other Industry	Regulation under CLM Act not required	-33.9293166	151.1942777
MATRAVILLE	Former Golden Fleece Terminal No1	133 -149 Beauchamp ROAD	Other Petroleum	Contamination formerly regulated under the CLM Act	-33.95776666	151.2248518
MATRAVILLE	Former Golden Fleece Terminal No2	151 Beauchamp ROAD	Other Petroleum	Contamination formerly regulated under the CLM Act	-33.95719404	151.2259884
MATRAVILLE	Vacant Lot	3 Wilkes AVENUE	Other Industry	Contamination being managed via the planning process (EP&A Act)	-33.96006406	151.2431087
MATRAVILLE	7-Eleven Service Station Matraville	515 Bunnerong ROAD	Service Station	Under assessment	-33.95943536	151.2317598
MATRAVILLE	Former Rieco Incinerator	Kain AVENUE	Other Industry	Contamination being managed via the planning process (EP&A Act)	-33.95980534	151.2423679

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MAYFIELD	Waratah Steel Mill	23 Frith STREET	Metal Industry	Regulation under CLM Act not required	-32.89426592	151.7257429
MAYFIELD	7-Eleven (former Mobil) Service Station	412-416 Maitland ROAD	Service Station	Under assessment	-32.89292005	151.7300948
MAYFIELD	Shell Coles Express Service Station	63-69 Maud STREET	Service Station	Under assessment	-32.89358962	151.7221298
MAYFIELD	BHP Closure Site (Hunter River Sediments)	Bed Sediments of the Hunter adjacent to Lot 221 DP1013964 RIVER	Metal Industry	Contamination formerly regulated under the CLM Act	-32.89203741	151.7646702
MAYFIELD	Australian Tube Mills Newcastle Site	Industrial DRIVE	Metal Industry	Under assessment	-32.88835767	151.7450751
MAYFIELD	OneSteel (BHP)	Industrial DRIVE	Metal Industry	Contamination currently regulated under CLM Act	-32.88366987	151.7449491
MAYFIELD	Newcastle Wire Mill	Ingall STREET	Metal Industry	Under assessment	-32.89008485	151.752949
MAYFIELD	BHPB Supply site	Lot 223 South and West - Industrial DRIVE	Metal Industry	Contamination currently regulated under CLM Act	-32.88583041	151.7388423
MAYFIELD	BHP Steel River	The Buffer Zone' extending directly adjacent to the Hunter River; near the Tourle Street Bridge STREET	Metal Industry	Contamination currently regulated under CLM Act	-32.8773556	151.7252427
MAYFIELD WEST	Stevenson Park landfill	2/559 Maitland ROAD	Landfill	Regulation under CLM Act not required	-32.88472556	151.7224791
MAYFIELD WEST	Koppers Coal Tar	East of Woodstock Street and Tourle STREET	Other Industry	Contamination currently regulated under CLM Act	-32.88591801	151.7361906
MAYFIELD WEST	Tourle Street Bridge Project	Tourle STREET	Landfill	Regulation under CLM Act not required	-32.88075518	151.7330073
MCDOUGALLS HILL	Caltex Service Station	4949 New England HIGHWAY	Service Station	Under assessment	-32.54484714	151.1490757
MEADOWBANK	Former Council Works Depot	2 Parsonage STREET	Unclassified	Regulation under CLM Act not required	-33.82191421	151.0951974
MENAI	7-Eleven (former Mobil) Service Station	189-190 Menai ROAD	Service Station	Under assessment	-34.01579095	151.0131737
MENAI	Caltex Service Station	Menai Rd Cnr Carter ROAD	Service Station	Under assessment	-34.01654043	151.0124133
MEREWETHER	Merewether Childcare Centre	2/23 Caldwell STREET	Unclassified	Regulation under CLM Act not required	-32.94249653	151.7504279
MERIMBULA	Caltex Service Station	19-25 Merimbula DRIVE	Service Station	Under assessment	-36.88757881	149.9089159
MERIMBULA	Former Mobil Service Station	27 Market STREET	Service Station	Under assessment	-36.88941693	149.9103485
MERRYLANDS	Society of St Vincent de Paul	11-19 Centenary ROAD	Other Petroleum	Regulation under CLM Act not required	-33.83083025	150.9698915
MERRYLANDS	Caltex Merrylands	148 Woodville ROAD	Service Station	Under assessment	-33.83818499	150.9997199
MERRYLANDS	Former Stockfeed Manufacturing Site	1-7 & 9-11 Neil STREET	Other Petroleum	Regulation under CLM Act not required	-33.83390257	150.9947449
MERRYLANDS	Stockland Merrylands Court	227-259 Merrylands ROAD	Unclassified	Under assessment	-33.83560901	150.9875552
MERRYLANDS	Caltex Service Station	229 Woodville ROAD	Service Station	Under assessment	-33.84547463	150.9983413
MERRYLANDS	7-Eleven Service Station	295-297 Merrylands ROAD	Service Station	Under assessment	-33.83533205	150.9851801
MERRYLANDS WEST	Former Mobil Service Station	3 Centenary ROAD	Service Station	Regulation under CLM Act not required	-33.83214226	150.9698958
MILLER	Caltex Service Station	86 Cartwright AVENUE	Service Station	Under assessment	-33.91878146	150.8827514
MILLERS FOREST	Chichester Trunk Gravity Main	water pipeline	Other Industry	Contamination currently regulated under POEO Act	-32.772877	151.6826841
MILLERS POINT	Former AGL Gasworks	30 - 34 Hickson ROAD	Gasworks	Regulation under CLM Act not required	-33.86179594	151.2031726

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
MILLERS POINT	Former AGL Gasworks	36 Hickson ROAD	Gasworks	Contamination currently regulated under CLM Act	-33.86243824	151.2032514
MILLERS POINT	Former AGL Gasworks	38 Hickson ROAD	Gasworks	Contamination being managed via the planning process (EP&A Act)	-33.86280104	151.2032452
MILLERS POINT	Port Services (Moores) Facility	4 Towns PLACE	Other Petroleum	Contamination currently regulated under POEO Act	-33.85581123	151.2024759
MILLERS POINT	Former AGL Gasworks	Berths 5, 6 and 7 (already demolished) and part Hickson ROAD	Gasworks	Contamination currently regulated under CLM Act	-33.86053571	151.2015022
MILLERS POINT	Former AGL Gasworks	Road reserve fronting 30-38 Hickson ROAD	Gasworks	Contamination currently regulated under CLM Act	-33.86241531	151.2024634
MILPERRA	Caltex Service Station	264 Milperra ROAD	Service Station	Regulation under CLM Act not required	-33.93018101	150.9910964
MILPERRA	Heatcraft Australia Pty Ltd	286 Horsley ROAD	Other Industry	Under assessment	-33.94031556	150.9958606
MILPERRA	United Group Rail Pty Limited	373 Horsley ROAD	Landfill	Regulation under CLM Act not required	-33.93286283	150.9934071
MILTON	Caltex Milton Service Station and Depot	331 Princes HIGHWAY	Service Station	Under assessment	-35.33154474	150.4492852
MILTON	Former Sanitary Depot	Slaughterhouse ROAD	Other Industry	Regulation under CLM Act not required	-35.33819825	150.4471917
MINCHINBURY	BP Service Station	1055 Great Western Highway corner Archibold ROAD	Service Station	Under assessment	-33.78211857	150.8244185
MINCHINBURY	7-Eleven (former Mobil) Service Station	815 Great Western HIGHWAY	Service Station	Under assessment	-33.78812909	150.8495992
MINTO	Shell Coles Express Service Station	73 Pembroke STREET	Service Station	Regulation under CLM Act not required	-34.02316454	150.8503118
MINTO	Land adjacent to Former Shell depot	Airds Road and Essex STREET	Other Petroleum	Regulation under CLM Act not required	-34.02110921	150.8414029
MINTO	Former Endeavour Energy's Depot	Pembroke ROAD	Unclassified	Regulation under CLM Act not required	-34.0331168	150.8464722
MIRANDA	Woolworth's Service Station	455 Kingsway OTHER	Service Station	Contamination currently regulated under CLM Act	-34.03492814	151.1124681
MITTAGONG	Enhance (former Coles Express) Service Station	224 Old Hume HIGHWAY	Service Station	Under assessment	-34.44746118	150.4326183
MITTAGONG	Caltex Service Station	65 Bowral ROAD	Service Station	Under assessment	-34.45245915	150.4381291
MITTAGONG	Lots 1 and 2 Alfred St.	Alfred STREET	Other Petroleum	Contamination formerly regulated under the CLM Act	-34.44738105	150.4565159
MOAMA	Caltex Service Station	73 Meninya STREET	Service Station	Under assessment	-36.10815134	144.752849
MOLONG	Cabonne BP Service Station	2 Gidley STREET	Service Station	Contamination currently regulated under CLM Act	-33.09026307	148.8695809
MOLONG	Former Gasworks	Hill STREET	Gasworks	Contamination currently regulated under CLM Act	-33.09074595	148.8703262
MONA VALE	BP Service Station Mona Vale	1721 Pittwater ROAD	Service Station	Under assessment	-33.68043443	151.3023553
MONA VALE	7-Eleven (former Mobil) Service Station	24 Barrenjoey ROAD	Service Station	Under assessment	-33.676909	151.3082515
MONA VALE	Mona Vale Bus Depot	58 Darley STREET	Other Petroleum	Contamination currently regulated under CLM Act	-33.67452414	151.3074246
MONA VALE	Former Caltex service station and adjacent properties	79 Barrenjoey Road, 2 Polo Avenue, 6 Polo Avenue, 45 Bassett STREET	Service Station	Contamination formerly regulated under the CLM Act	-33.6743659	151.3096932

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
MONA VALE	BP Express Service Station	Corner Barrenjoey Road and Darley STREET	Service Station	Under assessment	-33.67670799	151.3090068
MONA VALE	Caltex Investigation Area	Polo Ave, Perak STREET	Service Station	Regulation being finalised	-33.67431333	151.3091148
MOOBALL	Mooball General Store	5913 Tweed Valley WAY	Service Station	Under assessment	-28.44204594	153.4887648
MOONBI	Caltex Service Station	New England HIGHWAY	Service Station	Under assessment	-31.02264369	151.069094
MOORE PARK	Area 2, Moore Park	Driver AVENUE	Unclassified	Regulation under CLM Act not required	-33.89426868	151.2226839
MOOREBANK	ABB Australia Pty Ltd	(a) 1 Bapaume ROAD	Other Industry	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.94143741	150.9208754
MOOREBANK	ABB Australia Pty Ltd	1 Bapaume ROAD	Other Industry	Under assessment	-33.94140315	150.9209285
MOOREBANK	Caltex Service Station	2 Bridges ROAD	Service Station	Under assessment	-33.92839682	150.9327012
MOOREBANK	Caltex Service Station	216 Newbridge ROAD	Service Station	Under assessment	-33.92930835	150.9551469
MOOREBANK	Joyce Foam Products	5-9 Bridges ROAD	Chemical Industry	Regulation under CLM Act not required	-33.92596302	150.9335273
MOOREBANK	Former Landfill Site	Newbridge ROAD	Landfill	Under assessment	-33.93907207	150.9654125
MOORLAND	Caltex Service Station	99 Jericho ROAD	Service Station	Regulation under CLM Act not required	-31.79436622	152.6514849
MOREE	Former Freedom Service Station Site Moree	1 Dover STREET	Service Station	Contamination currently regulated under CLM Act	-29.4715814	149.8440279
MOREE	Caltex Depot	101 Gosport STREET	Other Petroleum	Under assessment	-29.47603684	149.8476728
MOREE	Caltex Service Station	54 Alice STREET	Service Station	Contamination currently regulated under CLM Act	-29.47158492	149.8433182
MOREE	Former Shell Depot	Adelaide STREET	Other Petroleum	Contamination formerly regulated under the CLM Act	-29.47655335	149.8465698
MOREE	Shell Coles Express Service Station	Corner Gwydir and Balo STREET	Service Station	Regulation under CLM Act not required	-29.46081826	149.8419975
MOREE	Former Mobil Depot	Gosport STREET	Other Petroleum	Contamination currently regulated under CLM Act	-29.47771921	149.8478438
MOREE	Former Golden Fleece	Gosport STREET	Other Petroleum	Contamination currently regulated under CLM Act	-29.47698315	149.8477108
MOREE	Moree Airport Evaporation Pond	Newell HIGHWAY	Unclassified	Regulation under CLM Act not required	-29.50289837	149.8411301
MOREE	BP Truckstop and Depot Moree	Newell Highway - 423 Frome STREET	Service Station	Under assessment	-29.48223274	149.8463679
MORISSET	Railcorp Station Masters Cottage	24 Dora STREET	Unclassified	Regulation under CLM Act not required	-33.10849681	151.4880317
MORPETH	Telstra Cable Installation and RTA Bridge work	Northumberland STREET	Other Petroleum	Regulation under CLM Act not required	-32.72489729	151.6266795
MORPETH	Former Service Station	Swan STREET	Service Station	Regulation under CLM Act not required	-32.72477413	151.6250642
MORTLAKE	Former Petroleum Storage Site	108-116 Tennyson ROAD	Other Petroleum	Regulation under CLM Act not required	-33.83979033	151.1064889
MORTLAKE	Former AGL site	Tennyson ROAD	Gasworks	Contamination formerly regulated under the CLM Act	-33.84287407	151.1109313
MORTLAKE	Kendall Bay Sediments		Gasworks	Contamination currently regulated under CLM Act	-33.83905999	151.1120458
MORUYA	Former Fuel Depot Moruya	11 to 13 Ford STREET	Other Petroleum	Under assessment	-35.9112243	150.0826475
MORUYA	Caltex Service Station	26 Campbell STREET	Service Station	Under assessment	-35.9104985	150.0711419
MORUYA	Caltex Service Station	80-84 Campbell STREET	Service Station	Under assessment	-35.91195596	150.0824213

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
MOSMAN	7-Eleven Mosman	162A Spit Road Corner Mitchell ROAD	Service Station	Under assessment	-33.81747016	151.2433633
MOSMAN	BP Service Station	175 Ourimbah ROAD	Service Station	Under assessment	-33.82106757	151.233291
MOSMAN	7-Eleven Service Station Mosman	45 Spit ROAD	Service Station	Under assessment	-33.82302718	151.2435627
MOSS VALE	Shell Service Station	579 Argyle STREET	Service Station	Under assessment	-34.55313422	150.364684
MOSS VALE	Woolworths Service Station Moss Vale	609 Argyle STREET	Service Station	Under assessment	-34.55409411	150.3609797
MOSS VALE	Moss Vale Refuelling Facility	Lackey ROAD	Other Petroleum	Under assessment	-34.54662421	150.3721525
MOUNT ANNAN	Great Southern Railways Aqueduct	Off Narellan ROAD	Unclassified	Regulation under CLM Act not required	-34.07308479	150.7707436
MOUNT COLAH	Caltex Service Station	603 Pacific HIGHWAY	Service Station	Under assessment	-33.67034662	151.1151861
MOUNT DRUITT	Caltex (former Mobil) Service Station	17 Mount STREET	Service Station	Under assessment	-33.76567994	150.8244544
MOUNT HUTTON	Woolworths Service Station	46 Wilsons ROAD	Service Station	Under assessment	-32.98506321	151.671559
MOUNT PRITCHARD	7-Eleven Service Station	352 Elizabeth DRIVE	Service Station	Under assessment	-33.90260656	150.8963326
MOUNT THORLEY	Lowes Petroleum (Former BP) Depot Mount Thorley	74 Mount Thorley ROAD	Other Petroleum	Regulation under CLM Act not required	-32.62443074	151.1025122
MOUNT VICTORIA	Caltex Service Station	36a Great Western HIGHWAY	Service Station	Regulation under CLM Act not required	-33.58436517	150.2465528
MOUNT VICTORIA	Former Mobil Service Station	81 Great Western HIGHWAY	Service Station	Regulation under CLM Act not required	-33.5889727	150.2511783
MUDGEE	Caltex Service Station	114-116 Church STREET	Service Station	Regulation under CLM Act not required	-32.59428029	149.5876199
MUDGEE	Former Essential Energy Depot	27-31 Inglis STREET	Other Industry	Under assessment	-32.60073	149.585658
MUDGEE	Shell Coles Express Service Station	47 Church STREET	Service Station	Under assessment	-32.59347493	149.5884623
MUDGEE	BP Mudgee (Reliance Petroleum)	77 Church STREET	Service Station	Under assessment	-32.59545872	149.588123
MUDGEE	Mobil Depot	Cnr Inglis Street & Douro STREET	Other Petroleum	Contamination currently regulated under CLM Act	-32.60023979	149.5823448
MUDGEE	Former Caltex Depot Mudgee	cnr Nicholson Street & Atkinson STREET	Other Petroleum	Regulation under CLM Act not required	-32.60125298	149.5851398
MUDGEE	Mudgee Gasworks	Mortimer Street and Court STREET	Gasworks	Regulation under CLM Act not required	-32.59168859	149.5817705
MULGRAVE	7-Eleven (former Mobil) Service Station	Corner Windsor Road and Mulgrave ROAD	Service Station	Regulation under CLM Act not required	-33.61687781	150.8341809
MULWALA	Mulwala ADI Explosives Factory	Bayly STAIRS	Other Industry	Regulation being finalised	-35.97572689	145.9809786
MURWILLUMBAH	Puma Murwillumbah (formerly Matilda)	182 Tweed Valley WAY	Service Station	Contamination currently regulated under CLM Act	-28.3263681	153.4103824
MURWILLUMBAH	Caltex Service Station	204 Tweed Valley WAY	Service Station	Under assessment	-28.32687988	153.4093274
MURWILLUMBAH	Former Norco Butter Factory	230 Tweed Valley WAY	Other Petroleum	Under assessment	-28.32791359	153.4073052
MURWILLUMBAH	Murwillumbah Ambulance Depot	27 Queen STREET	Other Petroleum	Regulation under CLM Act not required	-28.32552576	153.4000182
MURWILLUMBAH	Caltex Service Station	32 Lundberg DRIVE	Service Station	Under assessment	-28.33246149	153.4195721
MURWILLUMBAH	Caltex Service Station	39-41 Lunderg DRIVE	Service Station	Under assessment	-28.33274114	153.4215186
MURWILLUMBAH	Former Mobil Depot	45 Wardrop STREET	Other Petroleum	Under assessment	-28.33421395	153.3993772
MUSWELLBROOK	Caltex Service Station	12-16 Sydney STREET	Service Station	Under assessment	-32.26789925	150.8879263
MUSWELLBROOK	Caltex Service Station	1-9 William STREET	Service Station	Under assessment	-32.26564196	150.8866925
MUSWELLBROOK	SRA Site	27 Brook STREET	Unclassified	Regulation being finalised	-32.26346086	150.8873181
MUSWELLBROOK	Former Mobil Depot Muswellbrook	43-51 Ford STREET	Other Petroleum	Under assessment	-32.2599725	150.887573
MUSWELLBROOK	Caltex Service Station	47-50 Victoria STREET	Service Station	Under assessment	-32.26788823	150.8930609

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
MUSWELLBROOK	Former Mobil Service Station	49-51 Maitland STREET	Service Station	Under assessment	-32.27218162	150.8900206
MUSWELLBROOK	Woolworths Petrol	72 Brook STREET	Service Station	Under assessment	-32.26325377	150.8905966
MUSWELLBROOK	Caltex Muswellbrook Service Station	84-86 Maitland ROAD	Service Station	Under assessment	-32.27793094	150.8980938
MUSWELLBROOK	Former Gasworks	Cnr Carl St and Foley STREET	Gasworks	Regulation under CLM Act not required	-32.26672337	150.8935982
MUSWELLBROOK	Former Industrial Site	Lot 89 Rathmore STREET	Other Industry	Regulation under CLM Act not required	-32.30544071	150.8823657
MUSWELLBROOK	Bayswater Power Station	New England HIGHWAY	Other Industry	Under assessment	-32.3954046	150.9502683
NABIAC	Caltex Service Station	Pacific Hwy Cnr Krambach ROAD	Service Station	Under assessment	-32.09864883	152.3754346
NAMBUCCA HEADS	Former Mobil Service Station	6 Bowra STREET	Service Station	Under assessment	-30.64282127	153.0035884
NARELLAN	Former Landfill	1 Elyard STREET	Landfill	Regulation under CLM Act not required	-34.043474	150.7393256
NARELLAN	Caltex Service Station	Narellan Rd Cnr Maxwell PLACE	Service Station	Under assessment	-34.03963992	150.7432386
NAROOMA	Narooma Service Station	60 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-36.21617955	150.126261
NAROOMA	Former Caltex - Narooma	82 Princes HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-36.21711766	150.1279305
NARRABEEN	7-Eleven Service Station	1234 Pittwater ROAD	Service Station	Under assessment	-33.71958892	151.298272
NARRABEEN	Shell Coles Express Service Station	1418 Pittwater ROAD	Service Station	Regulation under CLM Act not required	-33.70013931	151.3002782
NARRABEEN	Caltex Service Station	1509-1511 Pittwater ROAD	Service Station	Regulation under CLM Act not required	-33.70455756	151.2969352
NARRABRI	Caltex Service Station	12 Reid STREET	Service Station	Under assessment	-30.32282764	149.7901182
NARRABRI	Caltex Service Station	13 Doyle STREET	Service Station	Regulation under CLM Act not required	-30.3239182	149.7843052
NARRABRI	Lowes Petroleum (Former Mobil) Narrabri Depot	3 Old Gunnedah ROAD	Other Petroleum	Regulation under CLM Act not required	-30.33473586	149.789587
NARRABRI	Caltex Service Station	31-35 Cooma ROAD	Service Station	Regulation under CLM Act not required	-30.33968576	149.7657241
NARRABRI	Caltex Narrabri Service Station	Anne St (Corner of Dangar Street) STREET	Service Station	Under assessment	-30.32989667	149.7756598
NARRABRI	Caltex Service Station	James STREET	Service Station	Under assessment	-30.33016168	149.7940732
NARRABRI	Cargill Soapstock Disposal Site	Westport ROAD	Unclassified	Contamination formerly regulated under the CLM Act	-30.4698458	149.6981931
NARRANDERA	Former Mobil Narrandera Depot	24 Whitton STREET	Other Petroleum	Regulation under CLM Act not required	-34.7410523	146.5620667
NARRANDERA	Former Mobil Emoleum Narrandera Depot	5-7 Margaret STREET	Other Petroleum	Regulation under CLM Act not required	-34.74105391	146.5628144
NARRANDERA	Caltex (Former Mobil) Service Station Narrandera	Newell HIGHWAY	Service Station	Under assessment	-34.76124219	146.5398604
NARROMINE	Caltex Service Station	60 Alagalah STREET	Service Station	Under assessment	-32.191182	148.261934
NELLIGEN	Former Clay Target Shooting Range	1398 Kings Highway and adjoining land on Old Bolaro Mountain ROAD	Unclassified	Contamination currently regulated under CLM Act	-35.64392469	150.0955224
NELLIGEN	Lot 2 Old Bolaro Road	Old Bolaro ROAD	Unclassified	Contamination formerly regulated under the CLM Act	-35.64485609	150.0937341
NELSON BAY	Shell Coles Express Service Station	23 Stockton ROAD	Service Station	Under assessment	-32.72265762	152.1437317
NELSON BAY	Former Caltex Service Station Nelson Bay	38 Stockton STREET	Service Station	Regulation under CLM Act not required	-32.72335662	152.1429384

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
NEMINGHA	Caltex Service Station	16 New England HIGHWAY	Service Station	Under assessment	-31.12425169	150.9909054
NEUTRAL BAY	Caltex Service Station	16-38 Military ROAD	Service Station	Regulation being finalised	-33.82907162	151.2163342
NEUTRAL BAY	Shell Coles Express Service Station	200-204 Ben Boyd ROAD	Service Station	Regulation under CLM Act not required	-33.82915781	151.219437
NEW LAMBTON	BP Service Station	105 St James ROAD	Service Station	Regulation under CLM Act not required	-32.92910325	151.7155801
NEW LAMBTON	Caltex Service Station	148 Bridges ROAD	Service Station	Under assessment	-32.93283668	151.7141748
NEW LAMBTON	7-Eleven (former Mobil) Service Station	291 Turton ROAD	Service Station	Regulation under CLM Act not required	-32.91773864	151.7243096
NEWCASTLE	Reclaimed Land	26-28 Honeysuckle DRIVE	Unclassified	Contamination formerly regulated under the CLM Act	-32.92604705	151.7649508
NEWCASTLE	Wharf Road Newcastle Car Park	313-317 Wharf ROAD	Unclassified	Regulation under CLM Act not required	-32.92570385	151.7744076
NEWCASTLE	Newcastle Foreshore	40 Stevenson Place STREET	Other Industry	Regulation under CLM Act not required	-32.92556503	151.7876742
NEWCASTLE	BHP Steelworks (Closure site)	Bound by Hunter River, Selwyn Street & Industrial DRIVE	Metal Industry	Ongoing maintenance required to manage residual contamination (CLM Act)	-32.89439868	151.7591272
NEWCASTLE	SRA Land	Scott STREET	Gasworks	Regulation under CLM Act not required	-32.92641425	151.7837817
NEWCASTLE WEST	Former Mobil Service Station	113 Parry STREET	Service Station	Regulation under CLM Act not required	-32.92560628	151.7558542
NEWPORT	7-Eleven (former Mobil) Service Station	307-311 Barrenjoey ROAD	Service Station	Under assessment	-33.65632902	151.3182089
NEWPORT	Former Caltex Service Station Newport	316-324 Barrenjoey ROAD	Service Station	Regulation under CLM Act not required	-33.65634516	151.3191571
NEWTOWN	Caltex Service Station Newtown	26 - 36 Enmore ROAD	Service Station	Under assessment	-33.89851331	151.17714
NEWTOWN	Aluminium Enterprises	66 Brocks LANE	Metal Industry	Contamination was addressed via the planning process (EP&A Act)	-33.89467126	151.1847528
NEWTOWN	Adjacent to Former Service Station	79 Wilson STREET	Service Station	Contamination formerly regulated under the CLM Act	-33.89630155	151.1826567
NEWTOWN	Former Service Station	81 Wilson STREET	Service Station	Contamination formerly regulated under the CLM Act	-33.89626791	151.1827556
NORAVILLE	Former Toukley Landfill	Wilfred Barrett DRIVE	Landfill	Under assessment	-33.27734185	151.5537784
NORTH BOAMBEE VALLEY	Caltex Service Station	Cnr Pacific Hwy & Halls ROAD	Service Station	Regulation under CLM Act not required	-30.30639482	153.1007996
NORTH BONDI	Caltex Service Station North Bondi	321 Old South Head ROAD	Service Station	Under assessment	-33.88463526	151.268551
NORTH NARRABEEN	7-Eleven Service Station	1501-1503 Pittwater ROAD	Service Station	Regulation under CLM Act not required	-33.70749859	151.296351
NORTH RICHMOND	Caltex Service Station	50 Bells Line Of ROAD	Service Station	Regulation under CLM Act not required	-33.57991338	150.7202346
NORTH ROCKS	7-Eleven Service Station	340 North Rocks ROAD	Service Station	Under assessment	-33.76895144	151.0305952
NORTH ST MARYS	BP Service Station	76 Glossop STREET	Service Station	Under assessment	-33.76020183	150.7818149
NORTH STRATHFIELD	Budget Service Station	143 Concord ROAD	Service Station	Regulation under CLM Act not required	-33.85945248	151.0927853
NORTH STRATHFIELD	Former Caltex Service Station	92a Concord ROAD	Service Station	Regulation under CLM Act not required	-33.86244297	151.0932434
NORTH SYDNEY	Iora	1 Kiara PLACE	Gasworks	Regulation under CLM Act not required	-33.843145	151.2161142

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
NORTH SYDNEY	Neutral Bay Sediments	Adjacent to HMAS Platypus, 118 High STREET	Gasworks	Contamination currently regulated under CLM Act	-33.842724	151.2174523
NORTH SYDNEY	HMAS Platypus Neutral Bay	High STREET	Gasworks	Contamination currently regulated under CLM Act	-33.84325935	151.2170347
NORTH WOLLONGONG	Former Mobil Depot	122-126 Montague STREET	Other Petroleum	Under assessment	-34.40988259	150.8939374
NORTH WOLLONGONG	Caltex Service Station	9 Flinders STREET	Service Station	Under assessment	-34.41505616	150.8932515
NORTHMEAD	Shell Coles Express Service Station Northmead	197 Windsor ROAD	Service Station	Under assessment	-33.77741733	151.0001719
NORTHMEAD	Former Prestige Plastics	1C Redbank ROAD	Other Industry	Under assessment	-33.79716925	150.989926
NORTHMEAD	Sydney Water Land	51c Hammers ROAD	Landfill	Regulation under CLM Act not required	-33.7887535	150.9858088
NORTHMEAD	7-Eleven (former Mobil) Service Station	56 Windsor ROAD	Service Station	Under assessment	-33.79090731	150.9967332
NORTHMEAD	Caltex Service Station	98-100 Windsor ROAD	Service Station	Under assessment	-33.78786563	150.9945909
NOWRA	Woolworths Service Station	2 Berry STREET	Service Station	Regulation being finalised	-34.87266278	150.6014052
NOWRA	Former Gasworks Managers Residence	24 Osborne STREET	Gasworks	Regulation under CLM Act not required	-34.8708875	150.5992586
NOWRA	Shell Coles Express Service Station	55 Kinghorne STREET	Service Station	Under assessment	-34.87633757	150.6023481
NOWRA	Fire Station	69 Bridge ROAD	Gasworks	Regulation under CLM Act not required	-34.87081582	150.6004881
NOWRA	Historically Filled Land	70 Bridge ROAD	Unclassified	Regulation under CLM Act not required	-34.87081809	150.6013231
NOWRA	Former Hollingworth Scrap Yard	72-74 Jervis and 117 East STREET	Other Industry	Under assessment	-34.88324216	150.6034361
NOWRA	Harry Sawkins Park	Bounded by Princes Hwy, Graham St & McGrath AVENUE	Gasworks	Regulation under CLM Act not required	-34.87093993	150.6037157
NOWRA	Former gasworks	Lamonds LANE	Gasworks	Contamination currently regulated under CLM Act	-34.87111182	150.6000803
NOWRA EAST	Mobil Service Station	Lot 3 Kalandar STREET	Service Station	Contamination currently regulated under CLM Act	-34.88850535	150.6093504
NYNGAN	Caltex Service Station	126 Pangee STREET	Service Station	Under assessment	-31.56482841	147.2002892
NYNGAN	Caltex Service Station	39-41 Pangee STREET	Service Station	Under assessment	-31.56101006	147.1914997
OAK FLATS	Shellharbour City Works Depot	132 Industrial ROAD	Other Industry	Under assessment	-34.56546013	150.8087225
OBERON	Former Shell Depot	32 O'Connell ROAD	Other Petroleum	Regulation under CLM Act not required	-33.6997172	149.8450057
OBERON	Caltex Service Station	Lowes Mount ROAD	Service Station	Under assessment	-33.69509055	149.8570553
OBERON	Oberon Timber Complex	Lowes Mount ROAD	Other Industry	Regulation under CLM Act not required	-33.69264862	149.8564588
OBERON	CSR Ltd Property and King's Stockyard Creek	Off Endeavour STREET	Other Industry	Contamination formerly regulated under the CLM Act	-33.6922152	149.8686909
OCEAN SHORES	Former Ocean Shores Service Station	Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-28.51270299	153.5301496
OLD GUILDFORD	Caltex Service Station	640-644 Woodville ROAD	Service Station	Under assessment	-33.86670857	150.9879189
ORANGE	Former Mobil Service Station	168 Peisley STREET	Service Station	Under assessment	-33.28525478	149.1037259
ORANGE	Caltex Orange Depot	184 Byng STREET	Service Station	Regulation under CLM Act not required	-33.28285589	149.1050273
ORANGE	BP-Branded Lowes Petroleum Depot	197 - 201 Margaret STREET	Other Petroleum	Regulation under CLM Act not required	-33.27145977	149.1078103
ORANGE	Former Mobil Service Station	24-28 Bathurst ROAD	Service Station	Under assessment	-33.2866912	149.1066505
ORANGE	Woolworths Orange Service Station	357-361 Summer (Cnr William St) STREET	Service Station	Regulation under CLM Act not required	-33.28445811	149.1053604

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
ORANGE	Electrolux Orange	5-17 Edward STREET	Other Industry	Regulation being finalised	-33.29874849	149.1038449
ORANGE	BP (Reliance Petroleum) Service Station Orange	56-60 Bathurst ROAD	Service Station	Regulation under CLM Act not required	-33.28980053	149.1086212
ORANGE	Caltex Summer Street Service Station Orange	70-74 Summer (Cnr Hill St) STREET	Service Station	Regulation under CLM Act not required	-33.28311722	149.0940712
ORANGE	BP Service Station (Reliance Petroleum)	76 Peisley STREET	Service Station	Under assessment	-33.29025034	149.1027194
ORANGE	BP Orange Service Station (Reliance Petroleum)	81 Summer STREET	Service Station	Regulation under CLM Act not required	-33.2825884	149.0951535
OURIMBAH	Palmdale Service Centre Pty Ltd	3130 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.3381336	151.374586
OURIMBAH	Shell Coles Express Service Station	78-80 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.3468202	151.3710098
OYSTER BAY	Shell Coles Express Service Station	20 Carvers ROAD	Service Station	Contamination currently regulated under CLM Act	-34.00934475	151.0758626
OYSTER COVE	Cove Marine Pty Ltd	60 Frederick STREET	Unclassified	Contamination currently regulated under POEO Act	-32.73549959	151.952446
PADDINGTON	7-Eleven Service Station	59 Oxford STREET	Service Station	Contamination currently regulated under CLM Act	-33.88322921	151.2205024
PADSTOW	Caltex Service Station	115 Fairford ROAD	Service Station	Regulation under CLM Act not required	-33.9434571	151.0345671
PADSTOW	Selleys / Dulux	1-29 Gow STREET	Unclassified	Under assessment	-33.93904125	151.0381725
PADSTOW	Galvatech	49 Gow STREET	Metal Industry	Contamination currently regulated under POEO Act	-33.93808679	151.0346862
PADSTOW	Foseco Australia Pty Ltd	7 Stuart STREET	Chemical Industry	Under assessment	-33.94342957	151.0377316
PADSTOW	Sebel Furniture	Parts 64 and 92 Gow STREET	Other Industry	Regulation under CLM Act not required	-33.93606752	151.0322057
PAGEWOOD	Former Email Site	Corner of Page Street and Holloway STREET	Other Industry	Contamination currently regulated under CLM Act	-33.94302462	151.2132036
PAMBULA	Offsite area (roadways) adjacent to United Service Station Pambula (former Shell Self Serve)	Corner Quondola Street and Bullara STREET	Service Station	Under assessment	-36.93104481	149.8746763
PARKES	BP Truckstop	(Newell Highway) 1 Forbes ROAD	Other Petroleum	Regulation under CLM Act not required	-33.14309226	148.1710282
PARKES	BP Service Station Telescope (Reliance Petroleum)	339 Clarinda STREET	Service Station	Under assessment	-33.13216152	148.1743239
PARKES	Caltex Service Station Parkes	352-360 Clarinda STREET	Service Station	Under assessment	-33.13317454	148.173643
PARKES	BP Reliance East End Service Station Parkes	46 Clarinda STREET	Service Station	Under assessment	-33.14243539	148.1846227
PARKES	Caltex Service Station	Eugowra ROAD	Service Station	Under assessment	-33.19007031	148.224822
PARKLEA	Caltex Parklea Service Station	Old Windsor (north of Miami Street) ROAD	Service Station	Under assessment	-33.72407662	150.9336021
PARRAMATTA	BP Service Station	435 Church STREET	Service Station	Under assessment	-33.80498714	151.0056151
PARRAMATTA	7-Eleven (former Mobil) Service Station	81 Victoria ROAD	Service Station	Under assessment	-33.80919769	151.0142894
PARRAMATTA	Coleman Oval Embankment	Cnr of Pitt STREET and Maquarie STREET	Unclassified	Regulation under CLM Act not required	-33.80441625	150.9954841
PARRAMATTA	Parramatta Park Toilet Block Demolition	The Cresent Toilet Block Parramatta PARK	Unclassified	Regulation under CLM Act not required	-33.81054034	150.9961968

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PAUPONG	Former Timber Treatment Plant	Off Paupong ROAD	Other Industry	Regulation under CLM Act not required	-36.57657408	148.6624998
PENDLE HILL	7-Eleven Service Station	217 Wentworth AVENUE	Service Station	Under assessment	-33.8017814	150.9577994
PENDLE HILL	Caltex Service Station	602-606 Great Western HIGHWAY	Service Station	Under assessment	-33.80827518	150.9421511
PENNANT HILLS	Shell Coles Express Pennant Hills West	386 Pennant Hills ROAD	Service Station	Contamination currently regulated under CLM Act	-33.73936462	151.0680237
PENRITH	Caltex Penrith Service Station	153 Coreen AVENUE	Service Station	Regulation under CLM Act not required	-33.74287244	150.6927071
PENRITH	Former Mobil Depot	174 Coreen AVENUE	Other Petroleum	Under assessment	-33.74484268	150.6980504
PENRITH	Mirvac Industrial Site	2101 Castlereagh ROAD	Other Industry	Regulation under CLM Act not required	-33.73497514	150.6954097
PENRITH	7-Eleven (former Mobil) Service Station	212-222 Andrews ROAD	Service Station	Under assessment	-33.73059678	150.6952571
PENRITH	7-Eleven Service Station	30 Henry ROAD	Service Station	Under assessment	-33.75408799	150.7045594
PENRITH	Caltex Service Station	Castlereagh Rd Cnr Lugard STREET	Service Station	Regulation under CLM Act not required	-33.73426843	150.6933382
PENRITH	Crane Enfield Metals	Castlereagh ROAD	Metal Industry	Contamination currently regulated under CLM Act	-33.73734959	150.696442
PENRITH	BP Express Service Station	Corner Coreen Avenue and Castlereagh ROAD	Service Station	Under assessment	-33.74385498	150.6925743
PENSHURST	7-Eleven Service Station	612 Forest ROAD	Service Station	Under assessment	-33.96153533	151.0793525
PENSHURST	Caltex Service Station	641 King Georges ROAD	Service Station	Under assessment	-33.95985335	151.0891118
PERISHER VALLEY	Perisher Centre Loading Dock	Kosciuszko ROAD	Other Petroleum	Regulation under CLM Act not required	-36.40392862	148.4111593
PERISHER VALLEY	Perisher Ski Resort	Kosciuszko ROAD	Other Petroleum	Regulation under CLM Act not required	-36.41106374	148.4005469
PETERSHAM	Fanny Durack Aquatic Centre	Station STREET	Unclassified	Regulation under CLM Act not required	-33.89194583	151.151824
PHEASANTS NEST	7-Eleven (former Mobil) Service Station	(Northbound) Hume HIGHWAY	Service Station	Under assessment	-34.28274509	150.6394175
PHEASANTS NEST	7-Eleven Service Station	(Southbound) Hume HIGHWAY	Service Station	Under assessment	-34.28318211	150.6362986
PICTON	McDonalds	69 -71 Argyle STREET	Service Station	Regulation under CLM Act not required	-34.16711877	150.6121524
PICTON	Coles Express Picton	93-99 Argyle STREET	Service Station	Under assessment	-34.16844337	150.6114236
PLUMPTON	Woolworths Service Station Plumpton	Jersey ROAD	Service Station	Under assessment	-33.74478874	150.8369408
PORT BOTANY	Caltex Banksmeadow	1 -3 Penrhyn ROAD	Chemical Industry	Contamination currently regulated under POEO Act	-33.96335328	151.2171062
PORT BOTANY	Port Botany Bus Depot	1 Bumborah Point ROAD	Other Petroleum	Under assessment	-33.96880413	151.2255889
PORT BOTANY	Vopak B	20 Friendship ROAD	Chemical Industry	Under assessment	-33.97946548	151.2121752
PORT BOTANY	Smith Bros	4 Bumborah Point ROAD	Other Petroleum	Regulation under CLM Act not required	-33.9681757	151.2239505
PORT BOTANY	Terminals	45 Friendship ROAD	Chemical Industry	Under assessment	-33.97609287	151.2174402
PORT BOTANY	Vopak A	49 Friendship ROAD	Chemical Industry	Regulation under CLM Act not required	-33.97426175	151.2206228
PORT BOTANY	Bunnerong Canal	Between Brotherson Dock and Bumborah Point ROAD	Unclassified	Regulation under CLM Act not required	-33.96800557	151.2227633
PORT BOTANY	Sydney Ports Bulk Liquids Berth	Charlotte ROAD	Other Petroleum	Contamination currently regulated under POEO Act	-33.97418047	151.2123791
PORT BOTANY	Port Botany Railway Corridors	Friendship ROAD	Unclassified	Under assessment	-33.95467008	151.2178012
PORT BOTANY	Sydney Ports Marine Services	Interterminal Access ROAD	Other Petroleum	Under assessment	-33.97214594	151.2173122

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PORT KEMBLA	Coates Hire	1 Flinders STREET	Other Industry	Under assessment	-34.47104817	150.89162
PORT KEMBLA	Caltex Service Station	16 Flinders STREET	Service Station	Under assessment	-34.47058088	150.8945864
PORT KEMBLA	Shell Port Kembla CVRO	87-89 Flinders STREET	Other Petroleum	Regulation under CLM Act not required	-34.46964995	150.8953859
PORT KEMBLA	Darcy Road Rail Sidings	Darcy ROAD	Other Industry	Under assessment	-34.47792834	150.9105503
PORT KEMBLA	No 2 Steelworks	Five Islands ROAD	Metal Industry	Contamination currently regulated under CLM Act	-34.45965024	150.8844432
PORT KEMBLA	Port Kembla Steelworks - No.1 Works Site	Five Islands ROAD	Metal Industry	Under assessment	-34.47386606	150.8794912
PORT KEMBLA	Port Kembla Steelworks - Steelhaven	Five Islands ROAD	Other Industry	Under assessment	-34.47605247	150.891144
PORT KEMBLA	Manildra Park	Flinders STREET	Other Petroleum	Contamination currently regulated under CLM Act	-34.46946878	150.8935731
PORT KEMBLA	Port Kembla Orica	Foreshore Road and Darcy ROAD	Other Industry	Contamination currently regulated under CLM Act	-34.47773583	150.9054545
PORT KEMBLA	Port Kembla, Auszinc Metals and Alloys	Lot 2 Shellharbour ROAD	Metal Industry	Regulation under CLM Act not required	-34.49335414	150.8961205
PORT KEMBLA	South Yard Rail Sidings	Lot 3 Old Port ROAD	Unclassified	Regulation under CLM Act not required	-34.47500551	150.8951759
PORT KEMBLA	Port Kembla Copper Smelter	Military ROAD	Metal Industry	Contamination formerly regulated under the CLM Act	-34.4810006	150.9063426
PORT KEMBLA	Commonwealth Rolling Mills (CRM)	Old Port ROAD	Metal Industry	Under assessment	-34.47476117	150.8974746
PORT KEMBLA	Port Kembla, Former Electricity Commission Site	Old Port Road/Christie Drive ROAD	Other Industry	Regulation under CLM Act not required	-34.46899143	150.8982854
PORT KEMBLA	BHP Area 21	Springhill ROAD	Metal Industry	Contamination formerly regulated under the CLM Act	-34.45244614	150.8676517
PORT KEMBLA	Port Kembla Springhill Works	Springhill ROAD	Metal Industry	Under assessment	-34.45905808	150.8749558
PORT KEMBLA	Port Kembla Steelworks Recycling Area	Springhill ROAD	Unclassified	Under assessment	-34.45271181	150.8677127
PORT MACQUARIE	Caltex Service Station	100 Hastings River DRIVE	Service Station	Under assessment	-31.42934052	152.8830188
PORT MACQUARIE	Caltex Service Station	112-114 Gordon STREET	Service Station	Under assessment	-31.43491709	152.9047618
PORT MACQUARIE	Shell Coles Express Port Macquarie Service Station	121 Gordon STREET	Service Station	Under assessment	-31.4343131	152.9046869
PORT MACQUARIE	Caltex Service Station	12-14 Bolwarra ROAD	Service Station	Under assessment	-31.45015286	152.8854769
PORT MACQUARIE	Former Mobil Depot	211 Lake ROAD	Other Petroleum	Under assessment	-31.44688513	152.8864499
PORT MACQUARIE	Car park	28 Hayward STREET	Other Industry	Regulation under CLM Act not required	-31.43385131	152.9072399
PORT MACQUARIE	Caltex Port Macquarie Service Station	29 Lord STREET	Service Station	Under assessment	-31.43326436	152.9169873
PORT MACQUARIE	Coles Myer	43 John Oxley DRIVE	Service Station	Regulation under CLM Act not required	-31.45741442	152.8739626
PORT MACQUARIE	Port Macquarie Airport	99 Boundary STREET	Other Petroleum	Under assessment	-31.43555856	152.868776
PORT MACQUARIE	Former Mobil Service Station	Corner Oxley Highway and Major Innes DRIVE	Service Station	Regulation under CLM Act not required	-31.45738931	152.873956
PORT MACQUARIE	Port Macquarie Council Depot	Koala STREET	Unclassified	Regulation under CLM Act not required	-31.45341586	152.9032764
PORTLAND	Mt Piper Power Station	350 Boulder ROAD	Other Petroleum	Under assessment	-33.35581541	150.0350801
PORTLAND	Ivanhoe Colliery	Pipers Flat ROAD	Other Industry	Under assessment	-33.36595748	150.0099577
PRAIRIEWOOD	7-Eleven (former Caltex) Service Station	485-487 Smithfield ROAD	Service Station	Regulation under CLM Act not required	-33.87102509	150.9031383

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PROSPECT	7-Eleven (former Mobil) Service Station Prospect	354 Flushcombe ROAD	Service Station	Under assessment	-33.79541624	150.9049417
PROSPECT	Gatehouse, 544 Reservoir Road	544 Reservoir ROAD	Unclassified	Regulation under CLM Act not required	-33.81049244	150.9157439
PROSPECT	Pincott's Cottage, Gate C1	Off Reservoir ROAD	Unclassified	Regulation under CLM Act not required	-33.816151	150.914353
PROSPECT	Cottage 3, William Lawson Drive	William Lawson DRIVE	Unclassified	Regulation under CLM Act not required	-33.815055	150.914975
PUNCHBOWL	Caltex Service Station	1285-1289 Canterbury ROAD	Service Station	Under assessment	-33.93146308	151.0596348
PUNCHBOWL	Former BP Service Station	1375 Corner Canterbury & Victoria ROADS	Service Station	Under assessment	-33.93170424	151.0537302
PUNCHBOWL	Punchbowl Laundry	42-44 Belmore ROAD	Chemical Industry	Under assessment	-33.93582701	151.0562638
PUTNEY	Putney Marina	20 Waterview STREET	Other Industry	Under assessment	-33.82608091	151.1003966
PYMBLE	Caltex Service Station	1117 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.74102977	151.1385257
PYMBLE	Shell Coles Express Service Station	21 Ryde ROAD	Service Station	Under assessment	-33.75198512	151.1438115
PYRMONT	Former Council Works Depot (Fig and Wattle Depot)	14-26 Wattle STREET	Other Industry	Under assessment	-33.8752655	151.1942645
QUAKERS HILL	Caltex Service Station	450 Quakers Hill PARKWAY	Service Station	Under assessment	-33.72998613	150.9023617
QUAKERS HILL	7-Eleven (former Mobil) Service Station	83 Lalor ROAD	Service Station	Under assessment	-33.72759077	150.8966764
QUEANBEYAN	Mobil Depot	109 High STREET	Other Petroleum	Under assessment	-35.3396115	149.237556
QUEANBEYAN	Former Mobil Service Station	151-153 Uriarra STREET	Service Station	Under assessment	-35.34425514	149.2148687
QUEANBEYAN	Bill Lilley Automotive	169 Crawford STREET	Service Station	Under assessment	-35.35138121	149.232486
QUEANBEYAN	Woolworths Queanbeyan Service Station	196 Crawford (Cnr Morisset St) STREET	Service Station	Regulation under CLM Act not required	-35.35163055	149.2335759
QUEANBEYAN	Former Caltex Depot	20-30 Railway STREET	Other Petroleum	Regulation under CLM Act not required	-35.34523	149.22333
QUEANBEYAN	Caltex Depot	5 Stephens ROAD	Service Station	Under assessment	-35.34615546	149.207807
QUEANBEYAN	BP Queanbeyan	50 Yass ROAD	Service Station	Under assessment	-35.34126641	149.2445103
QUEANBEYAN	Former BP Queanbeyan	64 Uriarra ROAD	Service Station	Under assessment	-35.34646177	149.2246263
QUEANBEYAN	Caltex Service Station	Bungendore ROAD	Service Station	Under assessment	-35.34930535	149.2438607
QUEANBEYAN	Caltex Service Station	Lanyon Dr Cnr Mccrae STREET	Service Station	Under assessment	-35.36372923	149.2067531
QUIRINDI	Caltex Service Station, Quirindi	199-201 George STREET	Service Station	Regulation under CLM Act not required	-31.50654793	150.6803589
QUIRINDI	Former Mobil Depot, Quirindi	4-6 Cross STREET	Other Petroleum	Under assessment	-31.49903355	150.681972
QUIRINDI	Tamarang Service Centre	Lot 1 Station STREET	Service Station	Under assessment	-31.50179204	150.6814611
RAMSGATE	Shell Coles Express Service Station	Grand Parade cnr Ramsgate ROAD	Service Station	Regulation under CLM Act not required	-33.98537988	151.1471234
RANDWICK	Caltex Service Station	2 Alison ROAD	Service Station	Regulation under CLM Act not required	-33.9065752	151.2320697
RANDWICK	Service Station, Randwick	33-37 Carrington ROAD	Service Station	Contamination currently regulated under CLM Act	-33.90655015	151.2525065
RANDWICK	Metro Petroleum	345 Avoca STREET	Service Station	Regulation under CLM Act not required	-33.92544832	151.2396799
RAVENSWORTH	Ravensworth Operations Narama Mine	Lemington ROAD	Other Industry	Under assessment	-32.47115903	151.0359579
RAVENSWORTH	Cumnock Colliery	Old New England HIGHWAY	Other Industry	Under assessment	-32.40218281	150.9960082
RAYMOND TERRACE	Shell Coles Express Raymond Terrace	107 Adelaide (formerly Pacific Highway) STREET	Service Station	Under assessment	-32.76110922	151.7492847

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RAYMOND TERRACE	Former Motor Registry	53 William STREET	Other Petroleum	Under assessment	-32.76286473	151.7445839
RAYMOND TERRACE	Caltex Service Station	Cnr Adelaide Street & Glenelg STREET	Service Station	Under assessment	-32.76503842	151.7425264
REDFERN	Former Printing Works	101a Marriott STREET	Other Industry	Regulation under CLM Act not required	-33.89512556	151.2113422
REDFERN	BP Service Station	116 Regent STREET	Service Station	Under assessment	-33.89367876	151.1995256
REDFERN	BP-branded Jasbe Surry Hills	411 Cleveland STREET	Service Station	Under assessment	-33.89183974	151.2132466
REVESBY	Caltex Service Station Revesby	181 The River ROAD	Service Station	Under assessment	-33.95573605	151.0171779
REVESBY	Dorf Clark Industries	184-194 Milperra ROAD	Metal Industry	Regulation under CLM Act not required	-33.93387149	151.000553
REVESBY	Mirotone Pty Ltd	21 Marigold STREET	Chemical Industry	Contamination currently regulated under POEO Act	-33.93559608	151.0002207
REVESBY	Bituminous Products	33-35 Violet STREET	Chemical Industry	Contamination currently regulated under CLM Act	-33.93702092	151.0067896
RHODES	Former Glad factory site	10-16 Marquet STREET	Chemical Industry	Regulation under CLM Act not required	-33.82884048	151.0848716
RHODES	Homebush Bay sediments adjoining former Berger Paint factory	Oulton AVENUE	Chemical Industry	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.83535308	151.083238
RHODES	Former Allied Feeds site	Walker STREET	Other Industry	Contamination was addressed via the planning process (EP&A Act)	-33.82465376	151.0870401
RHODES	Former UCAL site	Walker STREET	Chemical Industry	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.82727505	151.0853195
RHODES	Homebush Bay Sediments adjoining the former UCAL and Allied Feeds sites		Chemical Industry	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.8263749	151.0839216
RICHMOND	Caltex Service Station	98 March STREET	Service Station	Under assessment	-33.59937996	150.7514483
RIVERSTONE	Axalta Coating Systems	15-23 Melbourne ROAD	Other Industry	Regulation under CLM Act not required	-33.6636649	150.8557519
RIVERSTONE	7-Eleven Riverstone	55 Garfield ROAD	Service Station	Under assessment	-33.677946	150.86367
RIVERSTONE	Vacant Commercial Land	88-94 Junction ROAD	Unclassified	Regulation under CLM Act not required	-33.66226398	150.8789967
RIVERWOOD	7-Eleven Riverwood	30 Bonds ROAD	Service Station	Regulation under CLM Act not required	-33.9523701	151.0583887
ROCKDALE	7-Eleven (former Mobil) Service Station	293 West Botany STREET	Service Station	Under assessment	-33.94995672	151.1484667
ROCKDALE	7-Eleven Service Station	99 Railway STREET	Service Station	Under assessment	-33.95247322	151.1356785
ROOTY HILL	7-Eleven (former Mobil) Service Station	1042 Great Western HIGHWAY	Service Station	Under assessment	-33.78214955	150.8287656
ROOTY HILL	7-Eleven (former Mobil) Service Station	106 Rooty Hill Road South ROAD	Service Station	Under assessment	-33.78036181	150.8501998
ROSE BAY	Caltex Service Station	488 Old South Head ROAD	Service Station	Under assessment	-33.87475145	151.2723847
ROSE BAY	Rose Bay Budget Service station	638 -646 New South Head ROAD	Service Station	Contamination currently regulated under CLM Act	-33.87062149	151.2677617
ROSEBERY	Former Industrial Site (Former Electroplating Facility)	108 Dunning AVENUE	Other Industry	Under assessment	-33.91630811	151.201557
ROSEBERY	Autofoil P/L	2 Mentmore AVENUE	Other Industry	Regulation under CLM Act not required	-33.91121318	151.2054882
ROSEBERY	Caltex Service Station Rosebery	321 Gardeners ROAD	Service Station	Under assessment	-33.92302898	151.2059541

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ROSEBERY	Rosebery Service Station	395 Gardeners ROAD	Service Station	Contamination formerly regulated under the CLM Act	-33.92246784	151.2024589
ROSEHILL	James Hardie Factory (former, western portion)	181 James Ruse DRIVE	Other Industry	Contamination currently regulated under CLM Act	-33.81605834	151.0238145
ROSEHILL	James Hardie	Devon STREET	Other Industry	Contamination currently regulated under CLM Act	-33.82539019	151.0339466
ROSELANDS	7-Eleven (former Mobil) Service Station	91 Canary's ROAD	Service Station	Under assessment	-33.93362588	151.0736538
ROSELANDS	Roselands Shopping Centre	Roselands DRIVE	Service Station	Under assessment	-33.93499281	151.0691284
ROSEVILLE	Mobil Service Station	2 Boundary STREET	Service Station	Regulation under CLM Act not required	-33.78769177	151.1796011
ROSEVILLE CHASE	Coles Express Roseville Chase	388 Eastern Valley WAY	Service Station	Regulation under CLM Act not required	-33.78337722	151.1973901
ROZELLE	Caltex Service Station	121 Victoria ROAD	Service Station	Under assessment	-33.86252996	151.168497
ROZELLE	Kennards Rozelle	15-39 Wellington STREET	Other Petroleum	Regulation under CLM Act not required	-33.86176757	151.1686519
ROZELLE	7-Eleven (former Mobil) Service Station	178-180 Victoria ROAD	Service Station	Under assessment	-33.8630268	151.1680857
ROZELLE	BP Service Station	Corner Darling Street and Thornton STREET	Service Station	Regulation under CLM Act not required	-33.8591647	151.1716591
ROZELLE	White Bay Power Station	Robert STREET	Other Industry	Regulation under CLM Act not required	-33.86674636	151.1772204
RUFUS RIVER	SA Water Depot - Rufus River	Old Wentworth STREET	Other Petroleum	Regulation under CLM Act not required	-34.04191512	141.2679475
RUSHCUTTERS BAY	d'Albora Marinas	1b New Beach ROAD	Other Industry	Contamination currently regulated under POEO Act	-33.87351297	151.2345082
RUTHERFORD	Rutherford Transpacific	11 Kyle STREET	Other Industry	Regulation under CLM Act not required	-32.71105203	151.500311
RUTHERFORD	Shell Coles Express Service Station Rutherford	118 New England HIGHWAY	Service Station	Under assessment	-32.7208703	151.5394595
RUTHERFORD	Caltex Service Station	134-138 New England HIGHWAY	Service Station	Under assessment	-32.7202589	151.5381526
RUTHERFORD	Transpacific Industrial Services/Nationwide Oil Pty Ltd	99 Kyle STREET	Chemical Industry	Under assessment	-32.71262159	151.5013865
RYDALMERE	Rheem Australia	1 Alan STREET	Other Industry	Contamination formerly regulated under the CLM Act	-33.81545013	151.0295476
RYDALMERE	Former Service Station	262-272 Victoria ROAD	Service Station	Under assessment	-33.81006724	151.032377
RYDALMERE	BP Service Station	265 Victoria ROAD	Service Station	Under assessment	-33.8109483	151.0328101
RYDALMERE	Caltex Service Station	309 Victoria ROAD	Service Station	Under assessment	-33.81196193	151.0371185
RYDALMERE	Mitsubishi Electric	348 Victoria ROAD	Other Industry	Contamination currently regulated under CLM Act	-33.81040138	151.0392812
RYDALMERE	Hunter Douglas	Victoria ROAD	Chemical Industry	Regulation under CLM Act not required	-33.81009112	151.0384732
RYDE	Caltex Service Station	110 Lane Cove ROAD	Service Station	Under assessment	-33.80142973	151.1137925
RYDE	7-Eleven (former Mobil) Service Station	326-328 Blaxland ROAD	Service Station	Under assessment	-33.80242183	151.1004278
RYDE	Shell Coles Express Ryde	45 Lane Cove ROAD	Service Station	Under assessment	-33.80726028	151.109981
RYDE	Ryde Bus Depot	49 - 75 Buffalo ROAD	Unclassified	Under assessment	-33.81679771	151.1225255
SANCTUARY POINT	United Service Station, Sanctuary Point	147 Larmer AVENUE	Service Station	Regulation under CLM Act not required	-35.09918861	150.6329537
SANDGATE	North Limited Storage Handling facility	Maitland ROAD	Other Industry	Contamination formerly regulated under the CLM Act	-32.86598453	151.7012866

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
SANDGATE	Caltex Service Station	Pacific HIGHWAY	Service Station	Under assessment	-32.86501596	151.706161
SANS SOUCI	Former 7-Eleven Ramsgate	368 Rocky Point ROAD	Service Station	Contamination currently regulated under CLM Act	-33.98631668	151.135849
SANS SOUCI	7-Eleven Service Station	474-478 Rocky Point ROAD	Service Station	Under assessment	-33.99088939	151.1333779
SANS SOUCI	Former Service Station	542-544 Rocky Point ROAD	Service Station	Contamination was addressed via the planning process (EP&A Act)	-33.99376148	151.1316131
SANS SOUCI	Kendall Street Reserve	Lawson Street and Kendall STREET	Landfill	Under assessment	-33.99966431	151.13005
SCONE	Scone Works Depot	220 Susan STREET	Other Petroleum	Regulation under CLM Act not required	-32.04444892	150.879152
SCONE	Shell Coles Express Service Station	91- 93 Kelly STREET	Service Station	Contamination currently regulated under CLM Act	-32.04715941	150.8676346
SCONE	BP - Former Depot	Scone St, Guernsey St & Susan STREET	Service Station	Contamination formerly regulated under the CLM Act	-32.04599284	150.8662046
SCONE	Mobil Scone Airport Elt	Walter Pye AVENUE	Other Petroleum	Under assessment	-32.03596733	150.8323698
SEVEN HILLS	Transport Infrastructure Development Corporation	1 Powers ROAD	Other Industry	Regulation under CLM Act not required	-33.77387442	150.9379787
SEVEN HILLS	Caltex Service Station	105 Station ROAD	Service Station	Under assessment	-33.77435881	150.9448733
SEVEN HILLS	7-Eleven (former Mobil) Service Station	151 Prospect HIGHWAY	Service Station	Under assessment	-33.76894646	150.9427004
SEVEN HILLS	Former BP Service Station	154-156 Prospect HIGHWAY	Service Station	Under assessment	-33.76906502	150.9414821
SEVEN HILLS	Australian Waste Oil Refineries	27 Powers ROAD	Other Industry	Contamination currently regulated under CLM Act	-33.77536127	150.9511122
SEVEN HILLS	Australia Post	3 Powers ROAD	Unclassified	Regulation under CLM Act not required	-33.77434009	150.9395495
SEVEN HILLS	Caltex Service Station	38 Abbott ROAD	Service Station	Regulation under CLM Act not required	-33.76692649	150.9548271
SHELLY BEACH	Former Shelly Beach Landfill	Oaks AVENUE	Landfill	Under assessment	-33.36700551	151.4913631
SHORTLAND	Former Astra St landfill	1, 2 & 28 Astra STREET	Landfill	Contamination currently regulated under CLM Act	-32.86716222	151.6966948
SHORTLAND	Tuxford Park landfill	10 King STREET	Landfill	Regulation under CLM Act not required	-32.87721139	151.6936837
SHORTLAND	7-Eleven (Former BP) Service Station	298-302 Sandgate ROAD	Service Station	Regulation under CLM Act not required	-32.8861645	151.6953912
SHORTLAND	Former Lorna St landfill	8/475 Sandgate ROAD	Landfill	Regulation under CLM Act not required	-32.87888726	151.7023245
SILVERWATER	Vacant property	103-105 Silverwater ROAD	Other Industry	Under assessment	-33.83831374	151.0472576
SILVERWATER	Former Printing Facility	46-58 Derby STREET	Unclassified	Under assessment	-33.83855869	151.0478649
SILVERWATER	Storage Facility	54-58 Derby STREET	Unclassified	Under assessment	-33.83855869	151.0478649
SILVERWATER	Silverwater Landfill	Carnarvon ROAD	Landfill	Regulation under CLM Act not required	-33.83506394	151.033214
SINGLETON	Putty Saw Mill	(via Singleton) Putty ROAD	Unclassified	Contamination currently regulated under CLM Act	-32.99958725	150.7111684
SINGLETON	BP Service Station Singleton	53 George (Cnr Macquarie St) STREET	Other Petroleum	Regulation under CLM Act not required	-32.56182325	151.1748054
SINGLETON	Singleton Gasworks	55-57 John STREET	Gasworks	Contamination currently regulated under CLM Act	-32.56774715	151.1658188
SINGLETON	Shell Coles Express Service Station	69-73 George STREET	Service Station	Under assessment	-32.56297156	151.1755215
SINGLETON	Bulga Surface Operations	Broke ROAD	Other Industry	Under assessment	-32.68325751	151.1206158

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
SINGLETON	Mobil Singleton Airport Elt	Range ROAD	Other Petroleum	Under assessment	-32.60270846	151.1944828
SMITHFIELD	Freestones	1 Hume ROAD	Other Petroleum	Under assessment	-33.83577694	150.9310112
SMITHFIELD	Liquip International	13 Hume ROAD	Other Industry	Under assessment	-33.83802635	150.9319034
SMITHFIELD	Caltex Smithfield	16-18 Tait STREET	Service Station	Regulation under CLM Act not required	-33.84596441	150.9435497
SMITHFIELD	Coles Express (former Mobil) Service Station	678 The Horsley Drive, corner Smithfield ROAD	Service Station	Under assessment	-33.85376154	150.9400104
SMITHFIELD	Former Landfill	Little STREET	Landfill	Contamination being managed via the planning process (EP&A Act)	-33.85025253	150.9411561
SOUTH ALBURY	BP Border Service Station	Corner Ebden Street and Wodonga PLACE	Service Station	Contamination currently regulated under CLM Act	-36.08875942	146.9093882
SOUTH BOWENFELS	Shell Coles Express Service Station	Lot 1 Great Western HIGHWAY	Service Station	Under assessment	-33.50589001	150.1238487
SOUTH GRAFTON	Caltex Service Station	46-58 Schwinghammer STREET	Service Station	Under assessment	-29.71128273	152.9458313
SOUTH GRAFTON	Mobil Service Station	Corner Pacific Highway and Charles STREET	Service Station	Under assessment	-29.70814828	152.9412928
SOUTH KEMPSEY	Caltex Service Station	52 Lachlan STREET	Service Station	Under assessment	-31.09361084	152.8370796
SOUTH LISMORE	Former Mobil Service Station	126 - 128 Union STREET	Service Station	Regulation under CLM Act not required	-28.81242175	153.267541
SOUTH LISMORE	North Coast Petroleum (Former Mobil) Depot Lismore	19-21 Elliot ROAD	Other Petroleum	Regulation under CLM Act not required	-28.81212046	153.2661935
SOUTH LISMORE	Caltex Service Station	237 Union STREET	Service Station	Under assessment	-28.82052708	153.2648111
SOUTH LISMORE	Former Mobil Depot	26-32 Phyllis STREET	Other Petroleum	Regulation under CLM Act not required	-28.81005206	153.2660073
SOUTH NOWRA	Caltex South Nowra	100 Princes HIGHWAY	Service Station	Under assessment	-34.90516081	150.6029621
SOUTH PENRITH	7-Eleven Service Station	45 Aspen STREET	Service Station	Regulation under CLM Act not required	-33.77727694	150.7107228
SOUTH TAMWORTH	Caltex Service Station	Kent Street Cnr Kathleen STREET	Service Station	Regulation under CLM Act not required	-31.10361712	150.9186343
SOUTH WENTWORTHVILLE	Caltex Service Station	313 Great Western Hwy GROVE	Service Station	Under assessment	-33.81643692	150.9718802
SOUTH WENTWORTHVILLE	Aldi Stores Development	331-339 Great Western HIGHWAY	Metal Industry	Regulation under CLM Act not required	-33.81605854	150.9697429
SOUTH WEST ROCKS	Former Shell Trial Bay Depot	Phillip DRIVE	Other Petroleum	Regulation under CLM Act not required	-30.89273836	153.0612772
SOUTH WEST ROCKS	Former Trial Bay Caltex Depot	Phillip DRIVE	Other Petroleum	Under assessment	-30.89190078	153.0573056
SOUTH WEST ROCKS	Residential area and Reserve opposite Former Caltex terminal	Phillip DRIVE	Other Petroleum	Under assessment	-30.89172594	153.0573164
SPRINGVALE	Springvale Colliery	Castlereagh HIGHWAY	Other Industry	Under assessment	-33.40334736	150.1070462
ST CLAIR	7-Eleven (former Mobil) Service Station	4 Endeavour AVENUE	Service Station	Under assessment	-33.79430926	150.7885793
ST IVES	Mobil Service Station	157 Mona Vale ROAD	Service Station	Under assessment	-33.73265301	151.1563899
ST IVES	Caltex Service Station	164 Mona Vale ROAD	Service Station	Under assessment	-33.7307595	151.1570462
ST IVES	Shell Service Station	179-181 Mona Vale ROAD	Service Station	Contamination currently regulated under CLM Act	-33.73124859	151.1575827
ST IVES	Caltex Service Station	363 Mona Vale ROAD	Service Station	Under assessment	-33.71737	151.17311
ST IVES	Caltex Service Station	452 Mona Vale ROAD	Service Station	Regulation under CLM Act not required	-33.70752272	151.187545
ST MARYS	Former Woolworths Service Station	120-128 Forrester ROAD	Service Station	Under assessment	-33.75525115	150.7752897
ST MARYS	Chemcolour Industries Ltd	19-25 Anne STREET	Chemical Industry	Under assessment	-33.750314	150.772519

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
ST MARYS	7-Eleven (former Mobil) Service Station	2 Christie STREET	Service Station	Under assessment	-33.74790843	150.7767667
ST MARYS	7-Eleven (former Mobil) Service Station	2 Wilson STREET	Service Station	Under assessment	-33.77790415	150.771689
ST MARYS	Integral Energy Mt Druitt Transmission Substation	69 Kurrajong North ROAD	Other Industry	Regulation under CLM Act not required	-33.76376093	150.7921691
ST MARYS	Caltex Service Station	Wordoo St Cnr Forrester STREET	Service Station	Under assessment	-33.75334263	150.7755489
ST PETERS	BP Express Service Station	2 Princes HIGHWAY	Service Station	Under assessment	-33.90982281	151.1809936
ST PETERS	Cooks River Rail Terminal	20 Canal ROAD	Unclassified	Regulation under CLM Act not required	-33.91943986	151.1726689
ST PETERS	Former Tidyburn Facility	53 Barwon Park ROAD	Chemical Industry	Contamination formerly regulated under the CLM Act	-33.9130091	151.1809912
ST PETERS	Former Industrial Manufacturing Facility	75 Mary STREET	Other Industry	Regulation under CLM Act not required	-33.913012	151.173049
ST PETERS	Camdenville Park	May STREET	Other Industry	Regulation under CLM Act not required	-33.90911815	151.176951
STANMORE	125 Corunna Road	125 Corunna ROAD	Unclassified	Regulation under CLM Act not required	-33.88937382	151.1644589
STRATHFIELD	7-Eleven (former Mobil) Service Station	577 Liverpool ROAD	Service Station	Under assessment	-33.88736091	151.0743474
STRATHFIELD SOUTH	Former Landfill Site	7-9 Dunlop STREET	Landfill	Contamination being managed via the planning process (EP&A Act)	-33.89509698	151.0796751
STROUD	Caltex Service Station	1 Cowper STREET	Service Station	Under assessment	-32.39092749	151.9563089
SUFFOLK PARK	BP Service Station	207-209 Broken Head ROAD	Service Station	Regulation under CLM Act not required	-28.68800088	153.6083821
SUFFOLK PARK	Suffolk Park dip site	Cnr Broken Head Road & Beech DRIVE	Cattle Dip	Regulation under CLM Act not required	-28.6874242	153.6072824
SURRY HILLS	Woolworths Petrol Surry Hills	475 Cleveland STREET	Service Station	Under assessment	-33.89203644	151.216217
SURRY HILLS	Legion Cabs (Trading) Cooperative	69 - 81 Foveaux STREET	Service Station	Under assessment	-33.88470082	151.2107944
SURRY HILLS	Ausgrid Road Reserve	Mary STREET	Other Industry	Regulation under CLM Act not required	-33.88292195	151.2095176
SUTHERLAND	United Service Station and Sutherland Reservoir	1 to 3 Oxford STREET	Service Station	Contamination currently regulated under CLM Act	-34.029532	151.0579906
SUTHERLAND	7-Eleven Service Station	693 Old Princes HIGHWAY	Service Station	Under assessment	-34.02976735	151.0588789
SUTTON FOREST	Coles Express Sutton Forest West	Hume HIGHWAY	Service Station	Under assessment	-34.60808989	150.2250592
SWANSEA	Caltex Service Station	126 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.08811841	151.6381764
SYDENHAM	SRA Land	117 Railway PARADE	Other Industry	Regulation under CLM Act not required	-33.91560723	151.1656846
SYDENHAM	Sydenham XPT Maintenance Facility	Way STREET	Other Industry	Regulation under CLM Act not required	-33.91698468	151.1614089
SYDNEY	Interpro House (OSP 46581)	447 Kent STREET	Other Petroleum	Regulation under CLM Act not required	-33.87225413	151.204761
SYDNEY OLYMPIC PARK	RMS Western Precinct	14A-14E and 16 Hill ROAD	Other Petroleum	Regulation under CLM Act not required	-33.82239777	151.0758664
SYDNEY OLYMPIC PARK	Haslams Creek South Area 3	At Kronos Hill, Kevin Coombes AVENUE	Landfill	Contamination formerly regulated under the CLM Act	-33.84113059	151.0602966

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
SYDNEY OLYMPIC PARK	Bicentennial Park	Bicentennial DRIVE	Landfill	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.84456248	151.0788116
SYDNEY OLYMPIC PARK	Woo-la-ra Landfill	Hill ROAD	Landfill	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.82695807	151.07282
SYDNEY OLYMPIC PARK	Blaxland Common Landfill	Jamieson STREET	Landfill	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.82638382	151.05972
SYDNEY OLYMPIC PARK	Kronos Hill Landfill	Kevin Coombes AVENUE	Landfill	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.84014442	151.0649521
SYDNEY OLYMPIC PARK	Wilson Park (Former oil gas plant site)	Newington ROAD	Gasworks	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.82633586	151.0534322
SYDNEY OLYMPIC PARK	Former Golf Driving Range Landfill	Sarah Durack AVENUE	Landfill	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.85358517	151.0713987
SYLVANIA	Caltex Service Station - Sylvania Heights	414-416 Princes HIGHWAY	Service Station	Contamination currently regulated under CLM Act	-34.02361051	151.0895394
SYLVANIA	Caltex Service Station	61 Port Hacking ROAD	Service Station	Regulation under CLM Act not required	-34.0140089	151.104212
TAHMOOR	Tahmoor Colliery	Remembrance DRIVE	Other Industry	Under assessment	-34.25090795	150.5793631
TALBINGO	Old Town Landfill	Bridle STREET	Landfill	Regulation under CLM Act not required	-35.59018237	148.3041771
TALBINGO	T3 Spoil dump and adjoining river sediments	Off Snowy Mountains HIGHWAY	Landfill	Contamination formerly regulated under the CLM Act	-35.6177268	148.2926158
TALBINGO	Former grit blasting site	Old Damsite ROAD	Other Industry	Regulation under CLM Act not required	-35.60894551	148.3030165
TAMWORTH	Former Service Station Tamworth	(Cnr Scott Rd) 254-256 Goonoo Goonoo ROAD	Service Station	Regulation under CLM Act not required	-31.1118945	150.9228523
TAMWORTH	Caltex Tamworth Service Station	109 Gunnedah ROAD	Service Station	Under assessment	-31.09723226	150.8955299
TAMWORTH	Kensell's Mitsubishi	11-14 Kable AVENUE	Other Petroleum	Regulation under CLM Act not required	-31.08921565	150.9273063
TAMWORTH	Curlew Crescent	19-29 Curlew CRESCENT	Metal Industry	Regulation under CLM Act not required	-31.06963607	150.9069306
TAMWORTH	Caltex Star Tamworth	21 White STREET	Service Station	Under assessment	-31.09255137	150.9341709
TAMWORTH	Former Service Station, Fitzpatrick Super Fund, Tamworth	210 Goonoo Goonoo ROAD	Service Station	Regulation under CLM Act not required	-31.10613594	150.9234143
TAMWORTH	Coles Express Tamworth	251 - 253 Goonoo Goonoo ROAD	Service Station	Contamination currently regulated under CLM Act	-31.11058167	150.9236721
TAMWORTH	BP Tamworth Service Station and Depot	27-29 Gunnedah ROAD	Service Station	Under assessment	-31.09642128	150.9058193
TAMWORTH	Housing NSW	29 -33 White STREET	Other Petroleum	Regulation under CLM Act not required	-31.0915651	150.9357811
TAMWORTH	Former Mobil Service Station	373-375 Armidale ROAD	Service Station	Regulation under CLM Act not required	-31.10122679	150.9441341
TAMWORTH	Gunnedah Road Site	49 GUNNEDAH ROAD	Other Industry	Contamination formerly regulated under the CLM Act	-31.095481	150.902031

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
TAMWORTH	Elovera Former Sheep Dip	730 Ascot Calala ROAD	Cattle Dip	Regulation under CLM Act not required	-31.1801846	150.962897
TAMWORTH	Mobil Depot	9 Hinkler ROAD	Other Petroleum	Under assessment	-31.09584286	150.9040493
TARCUTTA	Mobil Service Station	(Hume Highway) 32 Sydney STREET	Service Station	Contamination formerly regulated under the CLM Act	-35.2772942	147.73574
TAREE	Caltex Service Station	104-106 Commerce STREET	Service Station	Under assessment	-31.90720519	152.4500926
TAREE	Caltex Taree	12 Pitt STREET	Service Station	Regulation under CLM Act not required	-31.90551738	152.4783334
TAREE	Former BP Service Station (Reliance Petroleum)	150 Manning River DRIVE	Service Station	Under assessment	-31.93842026	152.4682056
TAREE	Caltex Service Station	44-46 Stevenson STREET	Service Station	Under assessment	-31.90563595	152.4640848
TAREE	Footpath in front of the former BP service station	53-55 Victoria STREET	Service Station	Regulation under CLM Act not required	-31.91015653	152.4659073
TAREE	Former Shell Depot	53-55 Stevenson STREET	Other Petroleum	Regulation under CLM Act not required	-31.90514622	152.4649706
TAREE	Former Mobil Depot	Corner Muldoon Street and Grey Gum ROAD	Other Petroleum	Under assessment	-31.89744109	152.4508569
TAREE SOUTH	Caltex Service Station	Corner Manning River Drive and Glenthorne ROAD	Service Station	Under assessment	-31.93842026	152.4682056
TAREN POINT	Former Oyster Farmer	(formerly 98 Woodlands Rd) 2R Alexander AVENUE	Other Industry	Contamination being managed via the planning process (EP&A Act)	-34.01698788	151.1247494
TAREN POINT	Caltex Service Station	114 Taren Point ROAD	Service Station	Regulation under CLM Act not required	-34.02065958	151.1218938
TAREN POINT	Former Oyster Farmer	1A Atkinson ROAD	Other Industry	Regulation under CLM Act not required	-34.02081803	151.1283282
TAREN POINT	Former manufacturing site	46-50 Bay ROAD	Other Industry	Regulation under CLM Act not required	-34.0236184	151.1231649
TAREN POINT	Shell Coles Express Service Station	99-103 Parraweena ROAD	Service Station	Regulation under CLM Act not required	-34.02630233	151.1200897
TAREN POINT	Mangrove Lane Cycle pathway	Mangrove LANE	Unclassified	Regulation under CLM Act not required	-34.02404025	151.1324783
TELARAH	Former Ausgrid Depot	Green STREET	Other Industry	Regulation under CLM Act not required	-32.7276446	151.5269745
TELARAH	ACIRL	Junction STREET	Other Industry	Under assessment	-32.73457183	151.5400128
TEMPE	Tempe Depot	1a Gannon STREET	Other Petroleum	Regulation under CLM Act not required	-33.92408255	151.1596469
TEMPE	Caltex Service Station	775 Princes HIGHWAY	Service Station	Under assessment	-33.9253681	151.1596532
TEMPE	Railcorp Site Renwick Street	Renwick STREET	Other Industry	Regulation under CLM Act not required	-33.91997709	151.1576058
TEMPE	Former Tempe Tip	South STREET	Landfill	Contamination currently regulated under CLM Act	-33.9255792	151.1668117
TERALBA	Teralba, Lucky's Scrap Metal	21 Racecourse ROAD	Metal Industry	Contamination currently regulated under CLM Act	-32.946805	151.61698
TERALBA	Lake Macquarie Teralba Sanitary Depot	Griffen ROAD	Landfill	Regulation under CLM Act not required	-32.9372059	151.6214528
TERANIA CREEK	Former Izzards Cattle Tick Dip	Wallace ROAD	Cattle Dip	Contamination formerly regulated under the CLM Act	-28.65425776	153.2767438
THIRLMERE	Thirlmere Rail Heritage Museum	10 Barbour ROAD	Other Industry	Regulation under CLM Act not required	-34.20689245	150.5693902
THORNLEIGH	Shell Coles Express Thornleigh	188 - 190 Pennant Hills ROAD	Service Station	Under assessment	-33.72502184	151.0850569

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THORNLEIGH	Caltex Service Station	200-202 Pennant Hills ROAD	Service Station	Under assessment	-33.72660793	151.08364
THORNTON	Energy Australia Thornton Pole Yard	55 Weakleys DRIVE	Other Industry	Regulation under CLM Act not required	-32.79973875	151.6374998
TIGHES HILL	Former Mobil Terminal	110 Elizabeth STREET	Other Petroleum	Contamination currently regulated under CLM Act	-32.90600406	151.7586907
TIGHES HILL	Holcim Australia Cement Batching Plant	340 Industrial DRIVE	Other Industry	Under assessment	-32.90532418	151.7574857
TIGHES HILL	SRA Land	73 Elizabeth STREET	Unclassified	Regulation under CLM Act not required	-32.90795794	151.754631
TIGHES HILL	Former Ampol Depot	94 Elizabeth STREET	Other Petroleum	Regulation being finalised	-32.90658137	151.757239
TOCUMWAL	Former Mobil Depot	(Murray Street) Newell HIGHWAY	Other Petroleum	Under assessment	-35.79180653	145.5648214
TOCUMWAL	Former Mobil Depot	79-83 Deniliquin ROAD	Other Petroleum	Under assessment	-35.80914914	145.5585528
TOMAGO	Minmet	25 School DRIVE	Metal Industry	Contamination currently regulated under POEO Act	-32.8301553	151.7300603
TOMAGO	Balcombe Sweat Furnace	26 Laverick AVENUE	Metal Industry	Regulation under CLM Act not required	-32.82557395	151.7056416
TOMERONG	Log Cabin Service Station (United Petroleum)	D1300 Princes HIGHWAY	Service Station	Under assessment	-35.01820959	150.5779687
TOONGABBIE	7-Eleven (former Mobil) Service Station	3 Metella ROAD	Service Station	Under assessment	-33.78692357	150.9462837
TOORMINA	Caltex Service Station	2 Minorca PLACE	Service Station	Under assessment	-30.35229568	153.0906606
TORONTO	BP Express Service Station	132 Cary STREET	Service Station	Under assessment	-33.01144673	151.5937863
TORONTO	Coles Express (former Mobil) Service Station	133-137 Cary STREET	Service Station	Under assessment	-33.01187681	151.5930879
TORONTO	Caltex Service Station	147 Cary STREET	Service Station	Under assessment	-33.01288007	151.5928388
TORONTO	Toronto Hotel	74 Victory PARADE	Unclassified	Regulation under CLM Act not required	-33.01214835	151.5958127
TOUKLEY	Former Shell Toukley Autoport	211 Main ROAD	Service Station	Regulation under CLM Act not required	-33.26383791	151.5386268
TOUKLEY	Independent (Mobil) Toukley Service Station	287 Main ROAD	Service Station	Under assessment	-33.26469166	151.5462414
TRANGIE	Caltex Service Station	(Mitchell Hwy) 76 Narromine STREET	Service Station	Under assessment	-32.03234676	147.985164
TUGGERAH	BP Tuggerah	100 Pacific HIGHWAY	Service Station	Under assessment	-33.30578167	151.4198083
TUMBARUMBA	Caltex Service Station	150 Albury STREET	Service Station	Under assessment	-35.77024081	147.9927182
TUMBI UMBI	Former Tumbi Landfill	140 Bellevue ROAD	Landfill	Under assessment	-33.3993472	151.456471
TUMUT	Telstra Depot	26 Carey STREET	Other Industry	Under assessment	-35.29873079	148.2191122
TUMUT	CSR Railway cutting	Jepsen AVENUE	Unclassified	Regulation being finalised	-35.30422002	148.1942579
TUMUT	CSR Blue Dam	Jepsen AVENUE	Other Industry	Regulation being finalised	-35.30098337	148.1958308
TUROSS HEAD	Tern Inn Restaurant (abandoned UPSS)	2 Trafalgar ROAD	Service Station	Regulation under CLM Act not required	-36.05871059	150.1308443
TURRAMURRA	Woolworths Service Station (Former Mobil)	1243 Pacific HIGHWAY	Service Station	Under assessment	-33.73317594	151.1313195
TURRAMURRA	7-Eleven (former Mobil) Service Station	1408 Pacific HIGHWAY	Service Station	Under assessment	-33.73326389	151.1264194
TURRELLA	Tulloch Australia Pty Limited	61 Turrella STREET	Chemical Industry	Contamination currently regulated under CLM Act	-33.92857213	151.1475387
TURVEY PARK	Former Mobil Depot	Corner Bimbeen Street and Coleman STREET	Other Petroleum	Under assessment	-35.12173871	147.3576651

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
TWEED HEADS	Former Mobil Quix Service Station	60 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-28.20143775	153.5445381
TWEED HEADS	Francis Street Road Reserve adjacent to 79-81 Wharf Street, Tweed Heads	79-81 Wharf STREET	Other Petroleum	Regulation under CLM Act not required	-28.17351959	153.542262
TWEED HEADS SOUTH	Former BP Depot	142 Minjungbal DRIVE	Other Petroleum	Regulation under CLM Act not required	-28.20860702	153.5455932
TWEED HEADS SOUTH	Woolworths Plus Petrol (Woolworths Caltex Tweed Heads South)	98-102 Pacific (100 Minjungbal Drive) HIGHWAY	Service Station	Regulation under CLM Act not required	-28.20488521	153.5448675
TWEED HEADS SOUTH	Coles Express Service Station	Corner Minjungbal Dr and Heffron STREET	Service Station	Regulation under CLM Act not required	-28.19459987	153.5419978
TWEED HEADS WEST	Caltex Service Station	96 to 98 Kennedy DRIVE	Service Station	Regulation being finalised	-28.1871486	153.5229866
ULAN	Ulan Coal Mine	3600 Ulan ROAD	Other Industry	Under assessment	-32.25620603	149.7558075
ULLADULLA	Coles Express Ulladulla	153 Princes HIGHWAY	Service Station	Under assessment	-35.36288274	150.47272
ULLADULLA	Woolworths Petrol Station	155-157 Princes HIGHWAY	Service Station	Under assessment	-35.36301123	150.4725092
ULLADULLA	Caltex Service Station	Princes Hwy Cnr Deering STREET	Service Station	Under assessment	-35.36258645	150.4727798
ULTIMO	Shell Coles Express Service Station	387-429 Wattle STREET	Service Station	Under assessment	-33.88138825	151.1966791
UNANDERRA	BlueScope Stainless Steel	13 Marley PLACE	Metal Industry	Contamination currently regulated under CLM Act	-34.44959798	150.8571632
UNANDERRA	Endeavour Energy Springhill Field Service Centre	195 Five Island ROAD	Other Industry	Regulation under CLM Act not required	-34.45837706	150.8598825
UNANDERRA	Unanderra Weekend Detention Centre	34-40 Lady Penryhn DRIVE	Landfill	Under assessment	-34.4620226	150.8473821
UNANDERRA	Former Prime Service Station and adjoining lands	41-49 Princes HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-34.45056105	150.8490833
UNANDERRA	Caltex Service Station	86-98 Princes HIGHWAY	Service Station	Under assessment	-34.45414951	150.845165
UNANDERRA	Veolia Environmental Services	9 Waynote PLACE	Other Industry	Regulation under CLM Act not required	-34.46042393	150.863232
URALLA	Caltex Service Station	103 Bridge STREET	Service Station	Under assessment	-30.64524911	151.4934484
URALLA	Phoenix Foundry	44 Duke STREET	Metal Industry	Regulation under CLM Act not required	-30.65093272	151.5004479
URUNGA	Former Antimony Process plant	Hillside DRIVE	Chemical Industry	Contamination currently regulated under CLM Act	-30.50422942	153.0132011
VALENTINE	BP Express Service Station	855 Macquarie DRIVE	Service Station	Under assessment	-33.00801109	151.6425806
VALENTINE	Valentine Public School	Tallawalla ROAD	Unclassified	Regulation under CLM Act not required	-33.0091613	151.6423231
VILLAWOOD	Former Toll Site	110A Christina ROAD	Other Industry	Under assessment	-33.87919117	150.9812193
VILLAWOOD	Former Orica Crop Care	2 Christina ROAD	Chemical Industry	Contamination currently regulated under CLM Act	-33.880329	150.9896329
VILLAWOOD	Former Defence Site	29 Biloela STREET	Landfill	Regulation under CLM Act not required	-33.88782978	150.9886275
VILLAWOOD	Former Siemens/Westinghouse	49 Miowera ROAD	Other Industry	Contamination formerly regulated under the CLM Act	-33.87641909	150.9836746
VILLAWOOD	Former Electrical Component Manufacturer	66 Christina ROAD	Other Industry	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.88018315	150.9838773
VILLAWOOD	PPG Industries	9 Birmingham AVENUE	Chemical Industry	Under assessment	-33.87800757	150.9887929
VINEYARD	Shell Coles Express Service Station	731 Windsor ROAD	Service Station	Regulation under CLM Act not required	-33.65780463	150.8753245

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VINEYARD	Woolworths Petrol	Corner of Windsor Road and Melbourne STREET	Service Station	Under assessment	-33.65607641	150.8724067
WAGGA WAGGA	Caltex Service Station	(Uranquinty Rd) 6876 Olympic HIGHWAY	Service Station	Under assessment	-35.15319793	147.3085469
WAGGA WAGGA	Caltex (former Mobil) Service Station	106 Edward STREET	Service Station	Regulation under CLM Act not required	-35.11910909	147.3682364
WAGGA WAGGA	Former Shell Depot	11-15 Lake Albert ROAD	Other Petroleum	Under assessment	-35.12273113	147.3786005
WAGGA WAGGA	Caltex Service Station	170 Fitzmaurice STREET	Service Station	Regulation under CLM Act not required	-35.10289587	147.3679002
WAGGA WAGGA	BP Wagga Wagga	180 Edward STREET	Service Station	Under assessment	-35.118505	147.363953
WAGGA WAGGA	Former Iron Foundry	212-230 Hammond STREET	Metal Industry	Regulation under CLM Act not required	-35.12605478	147.4045461
WAGGA WAGGA	BP Service Station (Reliance Petroleum)	31 Bourke STREET	Service Station	Under assessment	-35.12626628	147.3547199
WAGGA WAGGA	Former Caltex Service Station	343 Hammond AVENUE	Service Station	Regulation under CLM Act not required	-35.12420793	147.4157959
WAGGA WAGGA	Coles Express Wagga Wagga	357-359 Edward STREET	Service Station	Under assessment	-35.11606625	147.3509339
WAGGA WAGGA	Former Gasworks	54 Chaston STREET	Gasworks	Contamination currently regulated under CLM Act	-35.12262069	147.3482778
WAGGA WAGGA	Former Caltex Depot	60 Lake Albert DRIVE	Service Station	Regulation under CLM Act not required	-35.12316794	147.37724
WAGGA WAGGA	Caltex-branded (former Mobil) Service Station	7 Lake Albert ROAD	Service Station	Under assessment	-35.12239591	147.3769936
WAGGA WAGGA	Former Gasworks	Cnr Tarcutta Street and Cross STREET	Gasworks	Contamination currently regulated under CLM Act	-35.10871183	147.3737933
WAGGA WAGGA	Ashmont Autoport	Cnr Tobruk Street and Bardia STREET	Service Station	Regulation under CLM Act not required	-35.12517373	147.329919
WAGGA WAGGA	Caltex Service Station	Docker St Cnr Edward STREET	Service Station	Under assessment	-35.11737947	147.3558145
WAGGA WAGGA	Former Wiradjuri landfill	Narrung STREET	Landfill	Under assessment	-35.09628532	147.3619535
WAHROONGA	7-Eleven Service Station	1579 Pacific HIGHWAY	Service Station	Under assessment	-33.71974617	151.1168106
WAHROONGA	Coles Express Wahroonga	1601 Pacific HIGHWAY	Service Station	Regulation under CLM Act not required	-33.71945571	151.1163002
WAITARA	Caltex Service Station	59-61 Pacific HIGHWAY	Service Station	Under assessment	-33.71064349	151.1024644
WALGETT	Former Shell Depot	Castlereagh HIGHWAY	Other Petroleum	Regulation under CLM Act not required	-30.00861179	148.1239938
WALLERAWANG	Wallerawang Power Station	1 Main STREET	Other Petroleum	Under assessment	-33.40339296	150.0855101
WALLERAWANG	Lidsdale Coal Loading Facility	Main STREET	Other Industry	Under assessment	-33.39996523	150.0737717
WALLSEND	Coles Express Wallsend East	15 Thomas STREET	Service Station	Under assessment	-32.90719444	151.6693426
WALLSEND	Caltex Maryland Service Station Wallsend	41 Minmi ROAD	Service Station	Regulation under CLM Act not required	-32.88967866	151.6619253
WALLSEND	OneSteel Recycling	64-80 Sandgate ROAD	Metal Industry	Regulation under CLM Act not required	-32.89425477	151.6799648
WALLSEND	Ausgrid Wallsend Depot	Abbott STREET	Other Industry	Regulation under CLM Act not required	-32.90162796	151.6857267
WAMBERAL	Caltex Service Station	654 The Entrance ROAD	Service Station	Under assessment	-33.42338668	151.4375685
WANGI WANGI	Myuna Colliery	Wangi Point ROAD	Other Industry	Under assessment	-33.06139532	151.5697186
WARATAH	Waratah Area Health	Turton ROAD	Unclassified	Regulation under CLM Act not required	-32.90961233	151.7260867
WARILLA	Woolworths Petrol Warilla	43 -57 Shellharbour ROAD	Service Station	Regulation under CLM Act not required	-34.5470966	150.863748
WARKWORTH	United Collieries	134 Jerry Plain ROAD	Other Industry	Under assessment	-32.5654356	150.9916698

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WARKWORTH	Emulsion Plant, Dyno Nobel Asia Pacific Pty Ltd	186 Long Point ROAD	Chemical Industry	Under assessment	-32.5781708	151.0834387
WARNERS BAY	7-Eleven (former Mobil) Service Station	393 Hillsborough ROAD	Service Station	Under assessment	-32.9659363	151.6543264
WARNERS BAY	Historically Filled Land	41-43 Charles STREET	Unclassified	Regulation under CLM Act not required	-32.97340461	151.6464383
WARNERS BAY	Caltex Service Station	55 King STREET	Service Station	Under assessment	-32.97418806	151.6476184
WARNERVALE	Former Timber Treatment Plant	Aldenham and Railway ROADS	Other Industry	Contamination formerly regulated under the CLM Act	-33.24732018	151.4469037
WARRAGAMBA	Warragamba Dam Viewing Platform	Eighteenth STREET	Unclassified	Under assessment	-33.88546354	150.6024501
WARRAWONG	Caltex Service Station	75-77 King STREET	Service Station	Regulation under CLM Act not required	-34.49037817	150.888802
WARREN	Caltex Warren Service Station	1 Coonamble ROAD	Service Station	Under assessment	-31.69508383	147.8405578
WARREN	Former Mobil Warren Depot	16 Dubbo STREET	Other Petroleum	Contamination currently regulated under CLM Act	-31.6943058	147.8314606
WARREN	Former Shell Depot	8 Dubbo STREET	Other Petroleum	Regulation under CLM Act not required	-31.69379262	147.8308088
WATERLOO	Diversity Waterloo	1-13 Archibald AVENUE	Other Industry	Under assessment	-33.90204305	151.2097328
WATERLOO	Proposed Construction Site	2 John STREET	Other Industry	Regulation under CLM Act not required	-33.89989686	151.2010324
WATERLOO	22-24 Archibald Avenue	22-24 Archibald AVENUE	Other Petroleum	Under assessment	-33.902133	151.213844
WATERLOO	Waverley Woollahra Process Plant	355 Botany ROAD	Other Industry	Regulation under CLM Act not required	-33.9063092	151.2042672
WATERLOO	Shell Coles Express Service Station	867-877 South Dowling STREET	Service Station	Regulation under CLM Act not required	-33.90179774	151.2143789
WATERLOO	Lawrence Dry Cleaners	887-893 Bourke STREET	Unclassified	Contamination currently regulated under CLM Act	-33.89897433	151.2101436
WAUCHOPE	Expressway Spares UST	3 Sancrox ROAD	Other Petroleum	Regulation under CLM Act not required	-31.44421922	152.8218723
WAUCHOPE	Former Shell Depot	56-64 High STREET	Other Petroleum	Regulation under CLM Act not required	-31.45804845	152.7314151
WAUCHOPE	Wauchope Service Station	57 High STREET	Service Station	Regulation under CLM Act not required	-31.45737022	152.7305018
WAUCHOPE	Shell Coles Express Service Station	64 High STREET	Service Station	Under assessment	-31.45764495	152.7315975
WAUCHOPE	Former Timber Treatment Site	Blackbutt DRIVE	Other Industry	Regulation under CLM Act not required	-31.46575645	152.7228555
WAVERTON	Berry's Bay Woodley's Marina	1 Balls Head DRIVE	Other Industry	Contamination formerly regulated under the POEO Act	-33.84441851	151.1947433
WAVERTON	Oyster Cove AGL	2 King STREET	Gasworks	Contamination formerly regulated under the CLM Act	-33.83637995	151.193541
WAVERTON	SRA Land	95 Bay ROAD	Unclassified	Contamination formerly regulated under the CLM Act	-33.83716728	151.1969497
WELLINGTON	Former Caltex Service Station	124-128 Lee STREET	Service Station	Regulation under CLM Act not required	-32.55082729	148.9411537
WELLINGTON	BP Wellington Service Station	35A Maxwell STREET	Service Station	Under assessment	-32.55835121	148.9447284
WELLINGTON	Woolworths Petrol Wellington	79 Lee STREET	Service Station	Under assessment	-32.54874227	148.9408531
WENTWORTH	Caltex - Wentworth	110 Adams STREET	Service Station	Regulation under CLM Act not required	-34.1024927	141.9160539

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WENTWORTH FALLS	Bodington Hospital	Bodington DRIVE	Unclassified	Contamination formerly regulated under the CLM Act	-33.73201608	150.3874102
WENTWORTH POINT	TNT Express	23 Bennelong Parkway PARK	Other Petroleum	Under assessment	-33.83115118	151.0726636
WENTWORTH POINT	RMS Eastern Precinct	3-7 Burroway ROAD	Other Petroleum	Regulation under CLM Act not required	-33.8233882	151.0815668
WENTWORTHVILLE	Former Workshop	2 Rawson Rd and 8 Barfil CRESCENT	Unclassified	Regulation under CLM Act not required	-33.81568808	150.9671853
WERRINGTON	Caltex Service Station	Cnr Dunheved Rd and Henry Lawson DRIVE	Service Station	Under assessment	-33.74577725	150.7409877
WERRINGTON	Claremont Meadows Former landfill	Gipps STREET	Landfill	Regulation under CLM Act not required	-33.77341076	150.7557628
WERRINGTON COUNTY	7-Eleven Werrington	Lot 122 Dunheved ROAD	Service Station	Regulation under CLM Act not required	-33.74699408	150.7428609
WEST BALLINA	Caltex Big Prawn Service Station	Pacific HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-28.86374913	153.5321482
WEST GOSFORD	Caltex Service Station	283 Manns ROAD	Service Station	Under assessment	-33.41659727	151.325219
WEST GOSFORD	Caltex Service Station	30a Pacific HIGHWAY	Service Station	Under assessment	-33.42778813	151.3190581
WEST GOSFORD	Caltex Service Station	69-71 Pacific HIGHWAY	Service Station	Under assessment	-33.42729985	151.3214621
WEST NOWRA	Integral Energy Nowra Field Service Centre	20 Depot ROAD	Other Industry	Under assessment	-34.88993085	150.5878854
WEST PENNANT HILLS	7-Eleven (former Mobil) Service Station	552 Pennant Hills ROAD	Service Station	Under assessment	-33.74686545	151.0508067
WEST RYDE	JHM Property Development	2A Mellor Street STREET	Metal Industry	Under assessment	-33.81207534	151.094598
WEST RYDE	Pfizer Australia Pty Ltd	38-42 Wharf ROAD	Chemical Industry	Under assessment	-33.81021085	151.0693631
WEST RYDE	Reckitt Benckiser	44 Wharf ROAD	Chemical Industry	Under assessment	-33.81172205	151.0692752
WEST RYDE	7-Eleven (former Mobil) Service Station	917 Victoria ROAD	Service Station	Under assessment	-33.80921103	151.0932917
WEST TAMWORTH	Woolworths Petrol	119 Bridge STREET	Service Station	Under assessment	-31.09358262	150.9167693
WEST WOLLONGONG	Woolworths Service Station	425 Crown STREET	Service Station	Contamination currently regulated under CLM Act	-34.42637378	150.8799288
WEST WYALONG	Caltex Depot	(Wyalong By-pass Rd) Lot 1-3 Showground ROAD	Service Station	Regulation under CLM Act not required	-33.92556	147.1981659
WEST WYALONG	Former Mobil Depot	104 Compton ROAD	Other Petroleum	Regulation under CLM Act not required	-33.93449194	147.2147948
WEST WYALONG	Lowes Petroleum (Former BP) Depot West Wyalong	Compton (formerly known as Town Bypass/Railway Road) ROAD	Other Petroleum	Regulation under CLM Act not required	-33.93440247	147.2154596
WESTON	Illegal Dumping Site	Corner Kline Street & First STREET	Unclassified	Regulation under CLM Act not required	-32.81367986	151.4551507
WETHERILL PARK	Former Fuel Storage Depot	200-212 Cowpasture ROAD	Other Petroleum	Regulation under CLM Act not required	-33.84568871	150.8764012
WETHERILL PARK	Sims Wetherill Park	35-37 Frank STREET	Metal Industry	Regulation under CLM Act not required	-33.84056122	150.9086265
WETHERILL PARK	BOC Sydney Operations Centre	428-440 Victoria STREET	Other Industry	Regulation under CLM Act not required	-33.84400237	150.8967556
WETHERILL PARK	Shell Coles Express Service Station	565 Polding STREET	Service Station	Regulation under CLM Act not required	-33.8569731	150.8992804
WETHERILL PARK	Nationwide Oil Pty Ltd/transpacific Industrial Services	6 Davis ROAD	Other Industry	Under assessment	-33.83770038	150.9045197

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WETHERILL PARK	Camide Former Landfill	Newton ROAD	Landfill	Regulation under CLM Act not required	-33.83898879	150.8963813
WICKHAM	Former Warehouse	10 Dangar STREET	Unclassified	Regulation under CLM Act not required	-32.92383206	151.759761
WICKHAM	Caltex Terminal	156 Hannell STREET	Other Petroleum	Contamination currently regulated under CLM Act	-32.91520778	151.7563638
WICKHAM	Fuchs Lubricants (Australasia) Pty Ltd Wickham	2 Holland STREET	Other Industry	Under assessment	-32.9214709	151.7556928
WICKHAM	Former Wool Store Building	33 Annie STREET	Unclassified	Under assessment	-32.91585059	151.755215
WICKHAM	Railcorp Wickham	50 Railway STREET	Other Industry	Under assessment	-32.9210433	151.7544687
WICKHAM	Former Factory	57 Annie STREET	Other Industry	Regulation under CLM Act not required	-32.91524827	151.7539893
WILBERFORCE	Former Drum Reconditioners	12-14 Box AVENUE	Other Industry	Contamination formerly regulated under the CLM Act	-33.5453884	150.8587934
WILBERFORCE	Former Solvent Recycling Site	13 Box AVENUE	Chemical Industry	Regulation under CLM Act not required	-33.54557427	150.8577006
WILEY PARK	Sydney Water Property	1B Hillcrest STREET	Other Industry	Under assessment	-33.923907	151.067654
WILLIAMTOWN	Hunter Land	38 Cabbage Tree ROAD	Other Industry	Under assessment	-32.80750069	151.8310107
WILLOUGHBY	Caltex Service Station	157 Penhur STREET	Service Station	Regulation under CLM Act not required	-33.79793513	151.1981926
WILLOUGHBY	Shell Coles Express Service Station	616-626 Willoughby ROAD	Service Station	Regulation under CLM Act not required	-33.80593769	151.1988559
WILLOUGHBY EAST	Willoughby Bus Depot	Corner Ann Street and Stan STREET	Other Industry	Regulation under CLM Act not required	-33.7982569	151.2038993
WILTON	Condell Park Homestead	(Part Lot 17 DP 270536) Condell Park ROAD	Unclassified	Regulation under CLM Act not required	-34.21910141	150.6837962
WINDANG	Caltex Service Station	244-248 Windang ROAD	Service Station	Under assessment	-34.5274434	150.8691161
WINDSOR	Former Caltex Service Station	46-52 Macquarie STREET	Service Station	Regulation under CLM Act not required	-33.60783315	150.8213428
WINDSOR	Former Caltex Windsor Depot and Service Station	48-50 Mileham STREET	Service Station	Regulation under CLM Act not required	-33.61538627	150.8157517
WINDSOR	Woolworths (former Caltex) Service Station	Cnr Macquarie Street & Baker STREET	Service Station	Regulation under CLM Act not required	-33.60569346	150.8232803
WINGHAM	Caltex Service Station	52 Wingham ROAD	Service Station	Under assessment	-31.86236594	152.3805752
WINGHAM	Bogas Service Station	Cnr Primrose Street and Isabella STREET	Service Station	Under assessment	-31.86833656	152.3716346
WINMALEE	Prime (Caltex supplied) (former Mobil) Winmalee Service Station	281 Hawkesbury ROAD	Service Station	Under assessment	-33.68223276	150.5997203
WIRLINGA	Former Liquid Waste Disposal Facility	704 Riverina ROAD	Unclassified	Regulation under CLM Act not required	-36.07103958	147.0193522
WOLLI CREEK	Former Ausgrid Substation 10061	13 Gertrude STREET	Other Industry	Regulation under CLM Act not required	-33.93364031	151.1543818
WOLLONGONG	Former Wollongong Gasworks	120 and 122 Smith STREET	Gasworks	Under assessment	-34.42030173	150.8906745
WOLLONGONG	Redevelopment site	33 - 39 Beatson STREET	Other Petroleum	Regulation under CLM Act not required	-34.43196083	150.8976661
WOLLONGONG	Greenhouse Park	Springhill ROAD	Landfill	Under assessment	-34.44119949	150.8931764
WOLLONGONG	Wollongong Harbour Central Spur	via Endeavour DRIVE	Other Petroleum	Under assessment	-34.42066879	150.906821
WOODBURN	Caltex Service Station	129 River STREET	Service Station	Under assessment	-29.07206887	153.3409769
WOODBURN	Crown Reserve Woodburn	Crown Reserve 88037 OTHER	Landfill	Under assessment	-29.065783	153.354232
WOOLGOOLGA	Caltex Service Station	16-18 Bosworth ROAD	Service Station	Under assessment	-30.12569561	153.1946006

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WOOLGOOLGA	United Petroleum	56 Clarence STREET	Service Station	Under assessment	-30.11045544	153.1904609
WOOLLAHRA	Caltex Woollahra Service Station	116 Old South Head ROAD	Service Station	Contamination formerly regulated under the CLM Act	-33.88959697	151.2553736
WOOLLAHRA	Former Service Station	20 Wallis STREET	Service Station	Regulation under CLM Act not required	-33.8901965	151.2372752
WOOLLAHRA	Proposed Jewish Care Centre	7 -21 Saber STREET	Unclassified	Regulation under CLM Act not required	-33.8904055	151.2480062
WOOLLOOMOOLOO	Former BP Service Station	2 Dowley STREET	Service Station	Contamination being managed via the planning process (EP&A Act)	-33.86940191	151.2218741
WOOLOMIN	Woolomin Gold Rush Store	65 Nundle ROAD	Service Station	Under assessment	-31.304149	151.149724
WOOLOOWARE	Caltex Service Station	100 Woolooware ROAD	Service Station	Under assessment	-34.05274635	151.1408413
WOONGARRAH	Former Warnervale Landfill	236-264 Hakone ROAD	Landfill	Regulation under CLM Act not required	-33.2376313	151.464362
WOOTTON	Former Chemical Spill Site	11859 Pacific HIGHWAY	Chemical Industry	Regulation under CLM Act not required	-32.28168548	152.3117819
WOY WOY	Mobil Former Woy Woy Service Station and adjacent land	177-181 Blackwall ROAD	Service Station	Contamination formerly regulated under the CLM Act	-33.49254403	151.3270829
WOY WOY	Barry Robertson Holden	231 Blackwall ROAD	Service Station	Regulation under CLM Act not required	-33.49621068	151.3285128
WOY WOY	Bogas Service Station	66 Memorial AVENUE	Service Station	Contamination currently regulated under CLM Act	-33.5069738	151.3315579
WYALONG	Caltex Service Station	50 Neeld (Newell Highway) STREET	Service Station	Under assessment	-33.92665025	147.2446546
WYOMING	Caltex Service Station	465 Pacific HIGHWAY	Service Station	Under assessment	-33.40945391	151.3499812
WYONG	Wyong Bayer/Kemcon	16 Lucca ROAD	Chemical Industry	Contamination formerly regulated under the CLM Act	-33.26192339	151.4429446
WYONG	Caltex Service Station	M1 Pacific (Northbound) MOTORWAY	Service Station	Regulation under CLM Act not required	-33.25641477	151.4024821
WYONG	Caltex Service Station	M1 Pacific (Southbound) MOTORWAY	Service Station	Regulation under CLM Act not required	-33.25330747	151.4053862
YAGOONA	Shell Coles Express Service Station	112 Rookwood ROAD	Service Station	Under assessment	-33.89856213	151.0370458
YAGOONA	Galserv Galvanising Services	117-153 Rookwood ROAD	Metal Industry	Contamination currently regulated under CLM Act	-33.89493085	151.0388013
YAGOONA	BP Potts Hill Service Station and Truckstop	155-159 Rookwood ROAD	Service Station	Under assessment	-33.89330525	151.0390969
YAGOONA	7-Eleven (former Mobil) Service Station	519 Hume HIGHWAY	Service Station	Under assessment	-33.90760623	151.0207783
YAGOONA	Sydney Water Potts Hill Complex	91 Brunker ROAD	Other Industry	Under assessment	-33.89887589	151.0289165
YALLAH	Tallawarra Power Station site	Princes HIGHWAY	Unclassified	Contamination formerly regulated under the CLM Act	-34.52412143	150.8062159
YALLAH	Tallawarra Lands	Yallah Bay ROAD	Other Industry	Regulation under CLM Act not required	-34.52848931	150.8008925
YAMBA	Caltex Service Station	22 Treelands DRIVE	Service Station	Regulation under CLM Act not required	-29.42701701	153.3279204
YANCO	Former Service Station	14 Main AVENUE	Service Station	Contamination formerly regulated under the CLM Act	-34.60356494	146.4105016
YASS	Caltex Service Station	1715 Yass Valley WAY	Service Station	Regulation under CLM Act not required	-34.80708856	148.8824228
YASS	Caltex Service Station	228 Comur STREET	Service Station	Under assessment	-34.84440036	148.9140179

Suburb	Site Name	Site Address	Contamination Activity Type	EPA Management Class	Latitude	Longitude
YASS	Former Mobil Depot Yass	54-58 Laidlaw STREET	Service Station	Contamination currently regulated under CLM Act	-34.83227507	148.9069678
YASS	Former Gasworks	Dutton STREET	Gasworks	Contamination currently regulated under CLM Act	-34.83982614	148.9060029
YENNORA	Former Caltex Service Station	137-141 Fairfield STREET	Service Station	Regulation under CLM Act not required	-33.86824768	150.9706137
YENNORA	Spicer Axle Australia Manufacturing Facility	205-231 Fairfield ROAD	Other Industry	Regulation under CLM Act not required	-33.85655114	150.9579167
YENNORA	Former Metal Plant	44 Larra STREET	Metal Industry	Contamination formerly regulated under the CLM Act	-33.86340576	150.9764349
YENNORA	TetraPak Site	6 Foray STREET	Other Industry	Contamination formerly regulated under the CLM Act	-33.8557183	150.9561605
YETHOLME	Yetholme CCA Timber Treatment Plant	351 Eusdale ROAD	Other Industry	Contamination formerly regulated under the CLM Act	-33.45386256	149.8537787
YOUNG	Former Mobil Depot and Service Station Young	149 Lovell STREET	Service Station	Under assessment	-34.31024587	148.290424
YOUNG	Former Shell Depot	166 Nasmyth STREET	Other Petroleum	Regulation under CLM Act not required	-34.31025192	148.2931008
YOUNG	Mobil Depot	186 Nasmyth STREET	Other Petroleum	Contamination currently regulated under CLM Act	-34.30954389	148.2908476
YOUNG	Former battery recycler	45 Nasmyth STREET	Metal Industry	Contamination currently regulated under CLM Act	-34.31201571	148.306772
YOUNG	Adjacent to former battery recycler	47 Nasmyth STREET	Metal Industry	Contamination formerly regulated under the CLM Act	-34.31176273	148.3064765
YOUNG	Former Caltex Depot	95 Lovell STREET	Service Station	Regulation under CLM Act not required	-34.31127119	148.2955092
ZETLAND	Energy Australia/ Ausgrid Zetland Depot	122 - 138 Joynton AVENUE	Other Industry	Regulation under CLM Act not required	-33.90883116	151.2101184
ZETLAND	Zetland, Goodrich Control Systems site	84 - 92 Epsom ROAD	Other Industry	Under assessment	-33.91025707	151.2078048

APPENDIX O TIMBER PLANTATION AUTHORISATION

NEW SOUTH WALES

NSW DEPARTMENT OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES

Authorisation for timber plantation
issued under the *Plantations and Reafforestation Act 1999*

Registered number	GR0412P

Plantation application

Applicant name(s)	Hastings Council
Postal address	PO Box 84 PORT MACQUARIE 2444
Property address	Cairncross Waste Management Facility, Pacific Highway, Telegraph Point
Land and area under application	Lots 4 & 5 DP1041766 Parish Cairncross, County Macquarie

Authorisation

Class of plantation	Timber plantation
Made on (date)	The date of the signature below.
Authorisation	☐ granted in accordance with the Code and the attached Plantation Plan ☐ granted in accordance with the Code and subject to conditions described in Attachment 1 and the attached Plantation Plan ☐ Refused. See Attachment 2
Authorisation to operate from	The date of the signature below.
Duration	The authorisation of a plantation remains in force unless it is cancelled by the Minister in accordance with this Act.

Right of appeal

If you are dissatisfied with this decision, under section 24 of the *Plantation and Reafforestation Act 1999* you have the right to appeal to the Land and Environment Court within 28 days after which you receive this notice.

Signed

on behalf of the consent authority

Signature

Name

John Ball
Regional Plantations Officer

by delegation from the Hon. Craig Knowles
Minister for Natural Resources

Date

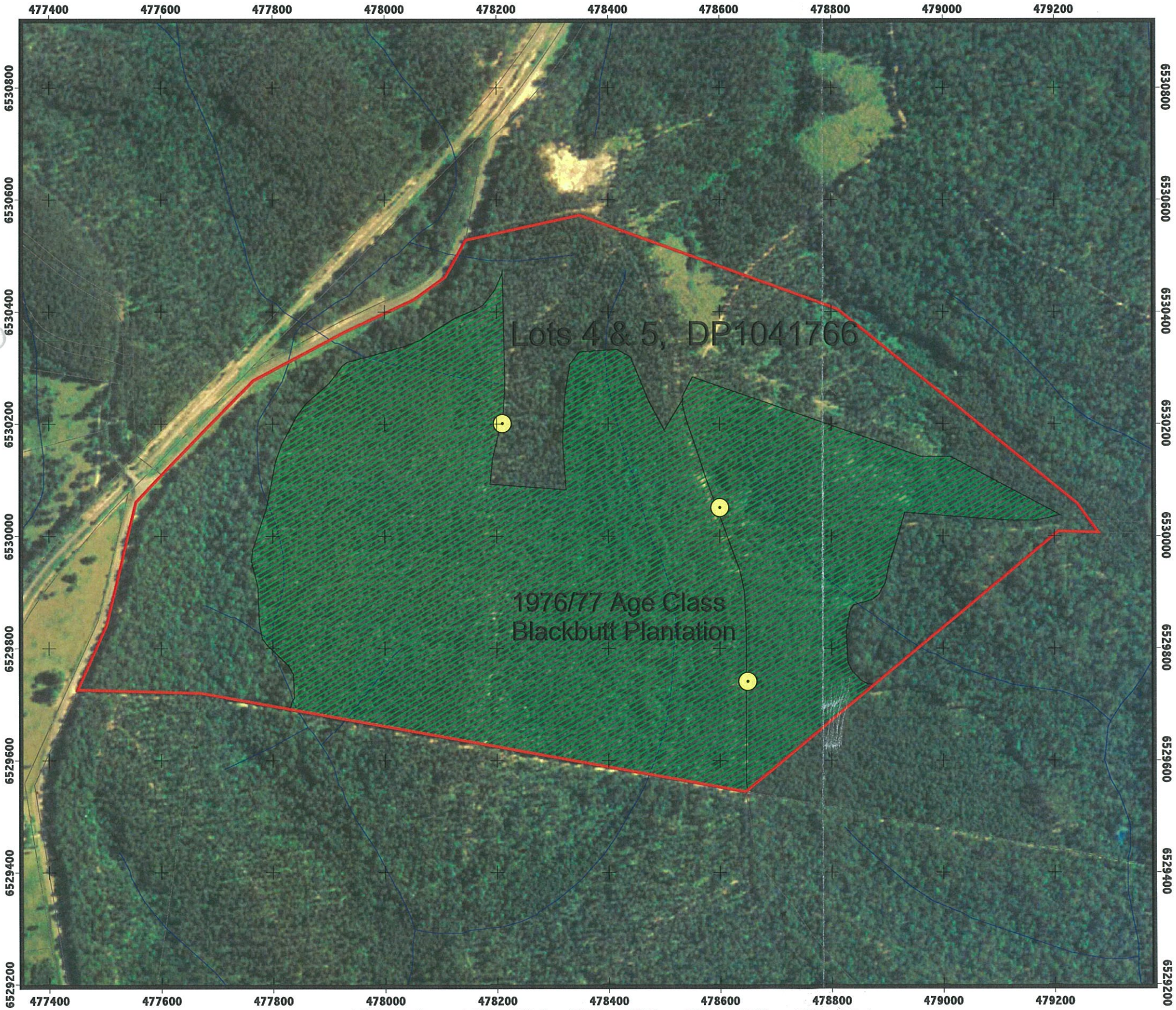
26th October 2004

Attachment No. 1: Conditions of authorisation for GR0412P

Authorisation is granted subject to the conditions described below:

1. Areas of the authorised plantation that are cleared and withdrawn from plantation activities to facilitate expansion of the waste management facility are to be advised to the Department of Infrastructure, Planning and Natural resources on a biennial basis commencing in December 2006.

Plantation Plan GR0412P - Map 1 of 1



Department of Infrastructure, Planning and Natural Resources

Registered Number: GR0412P
Name of Applicants: Hastings Council

Property Name: Cairncross Waste Facility
Locality: Pembroke

Property Details: Lots 4 & 5, DP1041766
Parish: Cairncross
County: Macquarie

Local Government Area: Hastings

Soil Regolith Class: R3
Rainfall Erosivity: 4800

Legend

- Property boundary
- Plantation area authorised as per Plantations & Reafforestation Act 1999
- Aboriginal Sites (10 metre buffer)

Scale 1: 7,500

N

This plan is not AGD compliant. The plan is projected using Australian Map Grid (AMG). The accuracy of the cadastre at 1:25,000 is +/- 15 metres. Some variation between the cadastre and the photo base may be evident due to the inherent characteristics of the aerial photograph.

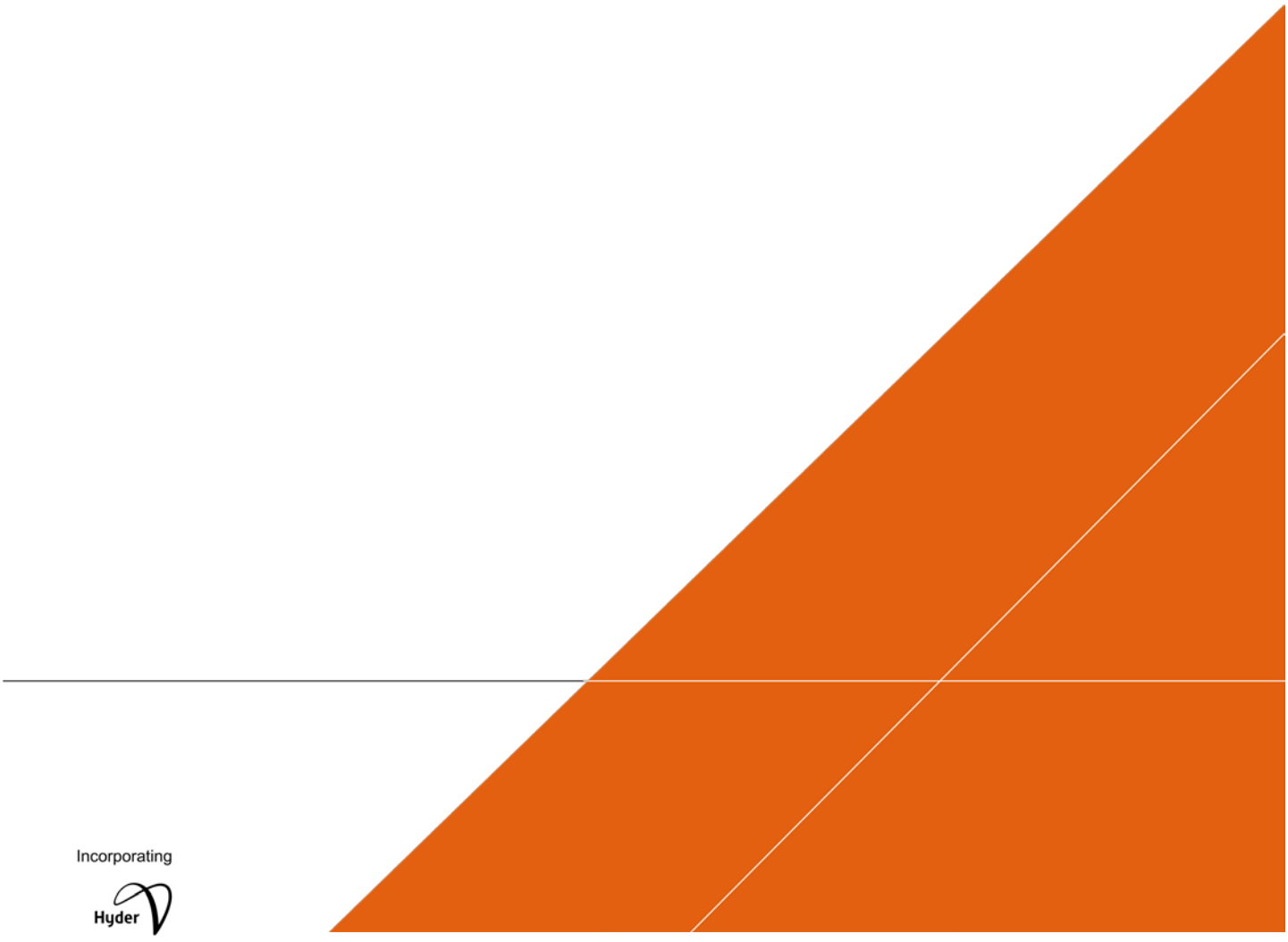
APPENDIX P BIODIVERSITY ASSESSMENT REPORT

ARCADIS Design & Consultancy for natural and built assets

CAIRNCROSS WASTE MANAGEMENT FACILITY

Biodiversity Assessment Report

01 JUNE 2017



Incorporating Hyder

CONTACT

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PORT MACQUARIE – HASTINGS COUNCIL
CAIRNCROSS WASTE MANAGEMENT FACILITY

Biodiversity Assessment Report

Author	Jane Rodd, Kate Carroll	
Checker	Zoe Wood	
Approver	Bradley Searle	
Report No	AA007398	
Date	1/06/2017	
Revision Text	Final Draft	

This report has been prepared for Port Macquarie – Hastings Council in accordance with the terms and conditions of appointment for Cairncross Waste Management Facility dated 27 November 2014. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
1	17/03/2016	Draft 1	J Rodd K Carroll	Zoe Wood
2	01/06/2017	Final draft	K Carroll	Jane Rodd

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APPENDIX B

Flora and fauna species recorded on the Proposal site

APPENDIX C

Likelihood of occurrence of threatened species

APPENDIX D

EPBC Act Assessments of Significance

***Cynanchum elegans*, White-flowered Wax Plant**

Koala, *Phascolarctos cinereus* (combined populations of QLD, NSW and the ACT)

Spot-tailed Quoll, *Dasyurus maculatus maculatus*

Grey-headed Flying-fox, *Pteropus poliocephalus*

Giant Barred Frog, *Mixophyes iteratus*

Rufous Fantail, *Rhipidura rufifrons*

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Cairncross Landfill site – EPBC Act Koala referral advice

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Major Projects Calculator Credit Report

1 INTRODUCTION

Port Macquarie-Hastings Council (PMHC) proposes to expand the existing landfill (Cairncross Landfill) at the Cairncross Waste Management Facility (WMF), located at 8395 Pacific Highway, Telegraph Point, NSW on Lot 5/DP 1041766, Lot 6/DP 1106420 and Part Lot 7/DP 1106420). PMHC is seeking development approval to extend Cairncross Landfill to cover the remaining area identified for landfilling in the Environmental Impact Statement (EIS) that was prepared in 1999 to support the development application for the first stage of the landfill (the 1999 EIS).

The Proposal would involve the progressive expansion, filling and rehabilitation of the existing landfill, as well as three additional cells, following a staged approach with implementation over a 36 year timeframe.

1.1 Purpose and scope of this report

The Proposal qualifies as State Significant Development and therefore is subject to assessment by the Department of Planning and Environment and approval by the Minister for Planning under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This Biodiversity Assessment Report (BAR) is one of a number of technical documents that forms part of the Environmental Impact Statement (EIS). The purpose of this BAR is to identify and assess the biodiversity impacts of the project during both construction and operation. In doing so it responds directly to the Secretary's Environmental Assessment Requirements (SEARs) outlined in Section 1.2.

This BAR is based on a desktop review of database searches, regional biodiversity mapping and relevant existing site-specific reports, as well as site inspection and detailed targeted field surveys. This biodiversity assessment will:

- Identify and describe the flora and fauna species, habitat, populations and ecological communities (including groundwater dependent ecosystems) that occur or are considered likely to occur
- Assess the direct and indirect impacts of the project on terrestrial and aquatic flora and fauna species, populations, ecological communities and their habitats, and groundwater dependent ecosystems
- Assess the impacts of the project on species, ecological communities and populations, and groundwater dependent ecosystems listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the NSW *Threatened Species Conservation Act 1995* (TSC Act) and *Fisheries Management Act 1991* (FM Act) that occur or are considered likely to occur
- Identify and describe mitigation measures using the principles of 'avoid, minimise, mitigate', and
- Outline the requirement to offset where residual impacts occur. Offsets would be determined in accordance with the NSW *Biodiversity Offsets Policy for Major Projects* (Office of Environment and Heritage, 2014).

1.2 Secretary's environmental assessment requirements

The NSW Department of Planning and Environment (DPE) issued the SEARs for the Proposal on 7 May 2015 (SSD 13-5792). PMHC requested an extension of time to the SEARs on 31 January 2017. DPE responded with an extension of time to November 2017 on 17 February 2017

The SEARs specify the following requirement for flora and fauna assessment:

An assessment of the proposal under the Framework for Biodiversity Assessment (Oct 2014) including an assessment of any potential impacts on riparian vegetation and groundwater dependent ecosystems.

1.3 Development Site

Under the Framework for Biodiversity Assessment (FBA) (OEH 2014), the area subject to impact assessment is referred to as the 'Development Site'. In this assessment, the Development Site is considered to comprise of the area of native vegetation within the Proposal Site that is not already subject to approval for clearing.

The Proposal Site (Figure 1) covers an area of approximately 47.4 hectares, including the existing landfill, and is owned by the PMHC.

The proposed site layout is shown in Figure 2 and includes the area proposed for three additional landfill cells as well as an area to be designated as a 50 metre wide Koala connectivity corridor. The Proposal Site is located at the top of a shallow valley feature extending south from a low east-west ridge passing along the northern part of the site.

The majority of the Proposal Site is subject to an authorisation for timber plantation under the NSW *Plantations and Reafforestation Act 1999.* (Appendix A). The authorisation, dated 26 October 2004, grants approval to manage the area as a plantation in accordance with the Plantations and Reafforestation Code and for the areas of the authorised plantation that are cleared to be withdrawn from plantation activities to facilitate expansion of the waste management facility. As discussed in Section 7.1.1, the plantation area was the subject of a SIS which resulted in a 57 hectare compensatory habitat site being established in the west of the Cairncross WMF. As the clearing of vegetation within the authorised plantation area has been approved, the impacts of clearing this vegetation are not assessed as part of this biodiversity assessment report.

In the east of the Proposal Site is an area of native vegetation that is excluded from the authorisation for timber plantation. This remaining area of native vegetation, approximately 3.4 hectares, is the Development Site for the current assessment.

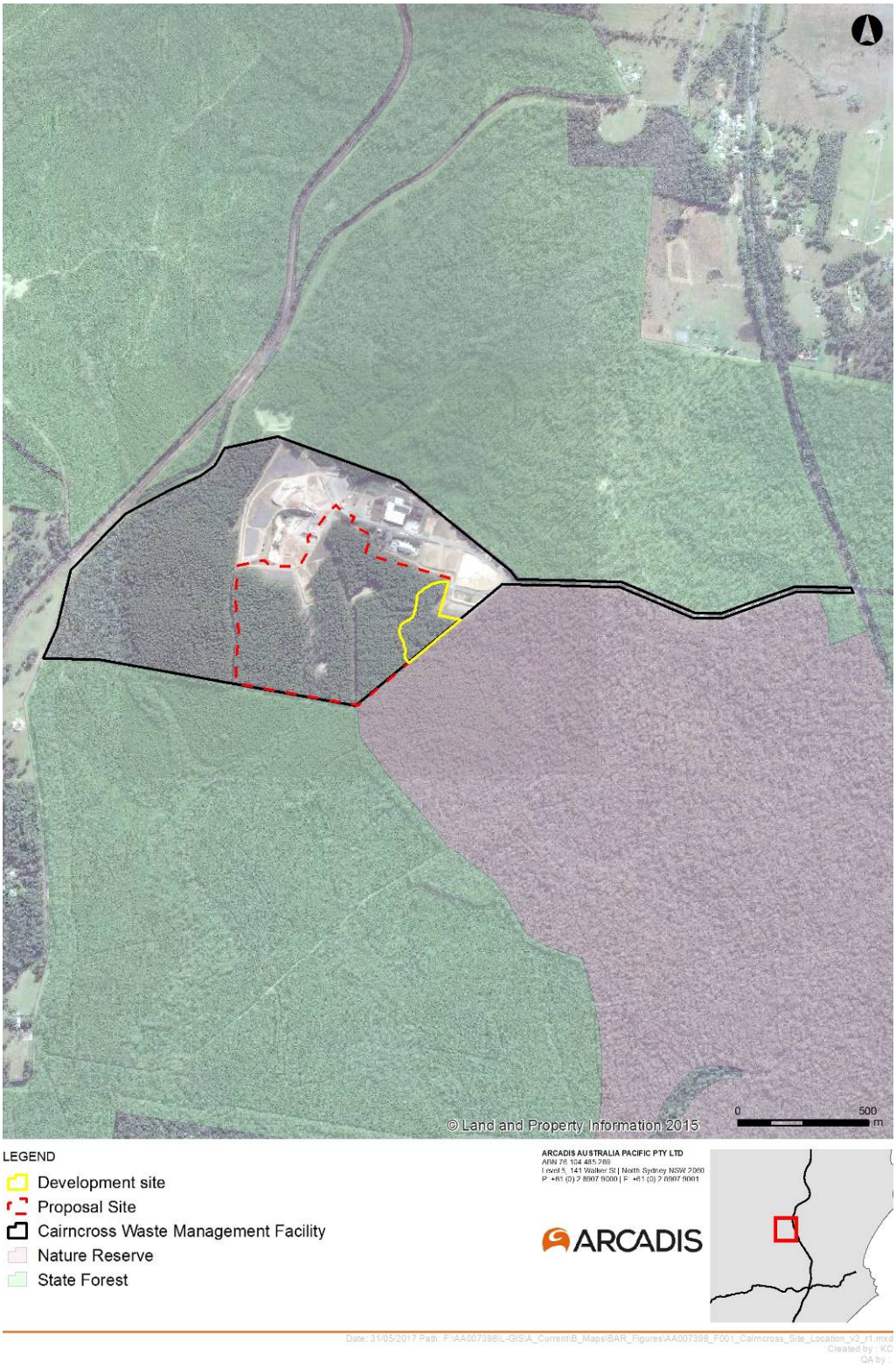


Figure 1 Site location

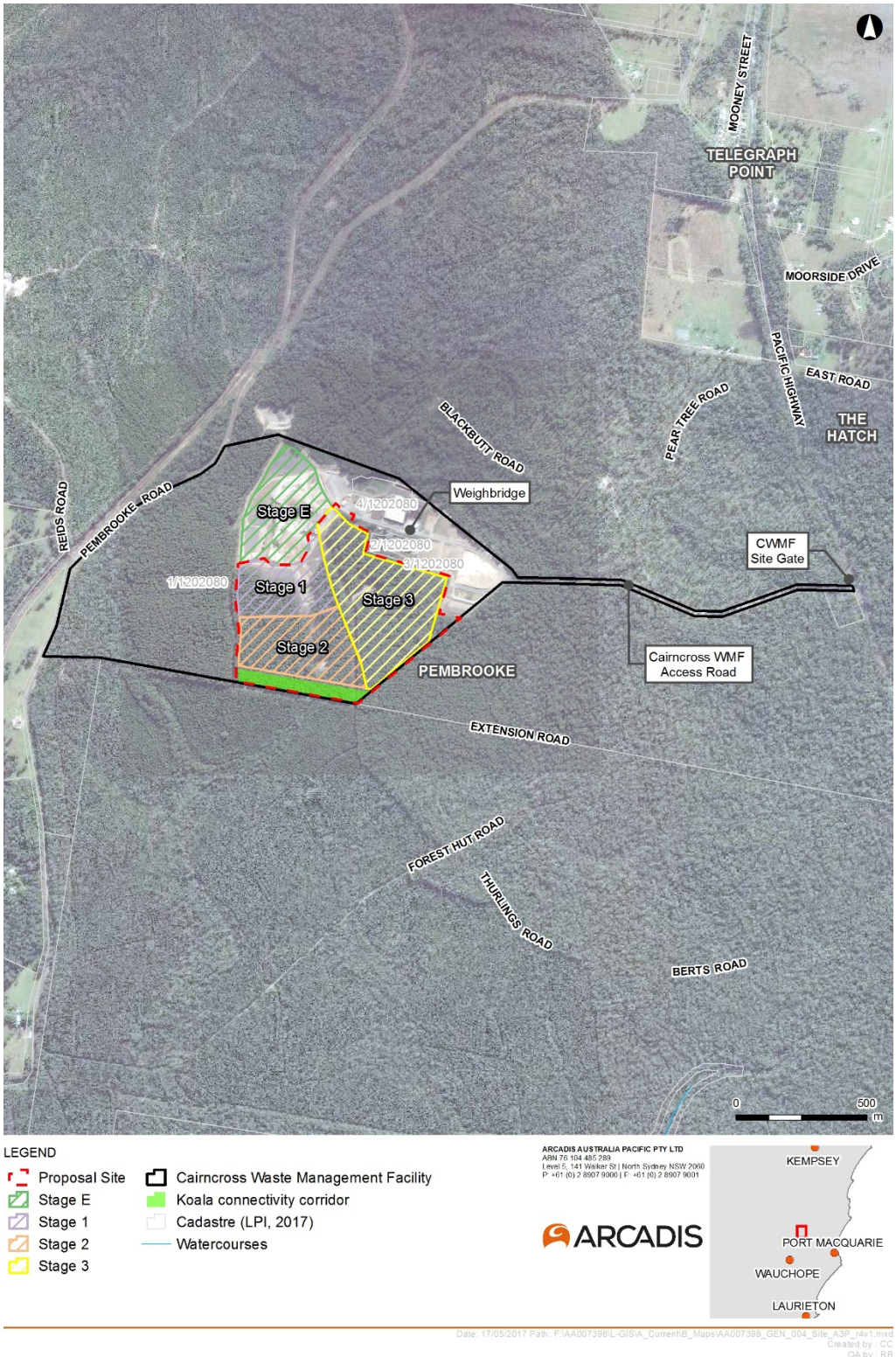


Figure 2 Proposed site layout

2 LEGISLATION AND POLICY

2.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). MNES identified in the Act include:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Threatened species and communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).

Under the EPBC Act, actions that have, or are likely to have, a significant impact on a MNES require approval from the Australian Government Minister for the Environment (the Minister).

The Proposal could potentially have impacts on threatened species listed under the EPBC Act. This report assesses and quantifies the impacts to these threatened species.

2.2 NSW Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides the framework for assessing developments in NSW. Under the EP&A Act, a project is classified as State Significant Development (SSD), pursuant to Part 4, Division 4.1, Section 89C, if it is declared as SSD by a State Environmental Planning Policy (SEPP) or declared SSD by an order of the Minister published on the NSW legislation website. The Minister is the consent authority for SSD in accordance with Part 4, Division 4.1 of the EP&A Act.

2.2.1 NSW Biodiversity Offsets Policy for Major Projects

The *NSW Biodiversity Offsets Policy for Major Projects* was released in October 2014 and is applicable to projects that are SSD or State Significant Infrastructure (SSI) under the EP&A Act. The NSW Biodiversity Offsets Policy for Major Projects requires proponents to apply the *Framework for Biodiversity Assessment* (FBA) to assess impacts on biodiversity. The FBA also guides the identification of reasonable measures and strategies that can be taken to avoid and minimise impacts on biodiversity associated with a proposal.

2.3 NSW Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides for the protection and management of threatened species, populations and ecological

communities listed under schedules 1, 1A and 2 of the Act. The purpose of the TSC Act is to:

- Conserve biological diversity and promote ecologically sustainable development.
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities.
- Protect the critical habitat of those species, populations and ecological communities that are endangered.
- Eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities.
- Ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.
- Encourage the conservation of threatened species, populations and ecological communities through co-operative management.

The Proposal could potentially have impacts on threatened species and ecological communities listed under the TSC Act. This report assesses and quantifies the impacts to these threatened entities in accordance with the FBA requirements and outlines the corresponding offsetting requirements.

3 METHODOLOGY

3.1 Nomenclature

The plant taxonomy used in this report follows the system and nomenclature presented in the most recent edition of Flora of New South Wales (Harden 1990-1993, 2002), supplemented by subsequent advice from The Royal Botanic Gardens and Domain Trust (2015). In this report plant species are referred to by both their scientific and common names (if applicable) when first mentioned. Subsequent references to these species cite the scientific name only.

The names of vertebrate fauna follow the Census of Australian Vertebrates database maintained by Department of the Environment and Energy (DoEE) and as used by OEH in the Atlas of NSW Wildlife (OEH 2015). In this report, fauna species are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

3.2 Database Interrogation

Database searches were undertaken to identify State and Commonwealth records of threatened entities and Commonwealth matters of national environmental significance (MNES). Databases interrogated for this purpose were:

- The NSW Threatened Species Profile Database (TSPD) which is managed by OEH.
- The Vegetation Information System (VIS) classification database which is managed by OEH.
- The over-cleared landscapes database (Mitchell landscapes).
- The Directory of Important Wetlands of Australia (DIWA), maintained by the Australian Government.
- The Protected Matters Search Tool which is managed by the Department of Environment and Energy (DoEE). A coordinate search using the centre point of the Proposal Site (33.95444,150.9263) was undertaken in November 2015 (updated in February 2017) to determine threatened species records listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) to within 10 km of the Proposal Site.

3.3 Literature Review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the Proposal Site and wider region. Reports, vegetation maps, topographic maps, aerial photography and literature reviewed included, but were not limited to, the following:

- *Cairncross Waste Depot Species Impact Statement* (Milledge 1998).
- *Statutory Ecological Impact Assessment: Proposed Industrial Waste Precinct, Cairncross Waste Management Facility, Cairncross State Forest* (Darkheart Eco-Consultancy 2013).

3.4 Vegetation mapping

Vegetation mapping reviewed for this study is as follows:

- *A Vegetation Map for the Northern Rivers Catchment Management Authority to support application of the Biodiversity Forecasting Toolkit* (Eco Logical Australia 2005).
- *Vegetation of the Port Macquarie-Hastings Local Government Area* (Biolink 2013).

3.5 Field assessment

Terrestrial flora and fauna surveys of the Proposal Site were conducted by Arcadis on 13-15 April 2015, and on 6 and 7 May 2015.

The weather conditions at the time of survey were mild and sunny. The weather records from the Port Macquarie Airport weather station (station 060139) (BOM 2015) for the survey dates are shown in Table 3-1.

Table 3-1 Weather records from Port Macquarie Airport weather station for the survey dates

Survey date	Temperature (°C)		Rain (mm)	Maximum wind gust	
	Min	Max		Direction	Speed (km/h)
13 April 2015	15.7	23.6	0	SSW	41
14 April 2015	12.1	24.7	0	W	28
15 April 2015	12.9	26.2	0	E	26
6 May 2015	13.6	22.2	0.2	S	24
7 May 2015	8.3	21.7	0	W	26

3.5.1 Flora

Terrestrial flora surveys of the Proposal Site were conducted from 13 to 15 May 2015. In order to comprehensively describe the structure and floristics of each sampled plant community, plot-based surveys were used. Plot-based surveys also provide a concentrated search area for the detection of inconspicuous plant species that may be present at a particular site. The surveys were conducted in accordance with the guidelines in Section 5 of the FBA. The structure and floristics of the Plant Community Type (PCT) present in the Proposal Site were sampled using 13, 0.1 hectare quadrats. The quadrats were in the form of a 20 metre x 50 metre plot with a nested 20 metre x 20 metre plot (Figure 3).

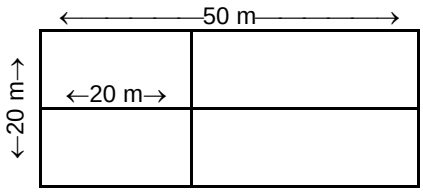


Figure 3 Flora quadrat layout

The extent of vegetation sampling required was established through review of regional vegetation mapping and site reconnaissance to determine the vegetation

type and condition. Once preliminary vegetation zones were identified and mapped, the minimum number of quadrats for each zone was identified with reference to Table 3 of the FBA. Plots were established randomly within each vegetation zone, with some plots placed deliberately to sample any observed variation in vegetation structure within a vegetation zone. Of the 13 quadrats, two (Q4 and Q5) were within the Development Site. The quadrat locations are shown on Figure 4, however only data from Quadrats 4 and 5 (within the Development Site) are considered further in this BAR.

Floristic data were collected from each plot in accordance with Table 1 of the FBA. (Table 3-2).

Table 3-2 Data collected from vegetation plots

Variable	Data collected
Stratum (and layer)	Stratum and layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name (where applicable)
Cover	A measure or estimate of the appropriate cover measure for each species recorded within the 20 m x 20 m plot. Recorded from 1–5% and then to the nearest 5%. If the cover of a species is less than 1% and the species is considered important, then the estimated cover is entered (e.g. 0.4)
Abundance rating	A relative measure of the number of individuals or shoots of a species within the 20 m x 20 m plot using the following intervals (numbers above 20 are estimates only): 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000 or specify a number greater than 1000 if required

During the terrestrial flora survey the vegetation condition was assessed and rated according to the degree to which it resembled relatively natural, undisturbed vegetation. The initial condition assessment was based on visual assessment of the current habitat condition for each of the PCTs identified in the Proposal Site.

Site attribute data were collected from each plot in accordance with Table 2 of the FBA (Table 3-3).

Table 3-3 Site attribute data collected from vegetation plots

Site attribute	Data collected
Indigenous plant species richness	Number of indigenous plant species within 20 m x 20 m plot
Native over-storey cover	Estimate of percent foliage cover at 10 points (every 5 m) along the 50 m transect
Native mid-storey cover	Estimate of percent foliage cover at 10 points (every 5 m) along the 50 m transect
Native ground cover (grasses)	At 50 points along the 50 m transect (every 1 m), recorded whether native grass intersects that point.

Site attribute	Data collected
Native ground cover (shrubs)	At 50 points along the 50 m transect (every 1 m), recorded whether native ground cover (shrub) intersects that point.
Native ground cover (other)	At 50 points along the 50 m transect (every 1 m), recorded whether native ground cover (other) intersects that point.
Exotic plant cover	Measured as total percent foliage cover of all exotics in all strata; exotic cover measured using the same method as for native over-storey, mid-storey and ground cover.
Number of trees with hollows	Count of the number of living and dead trees within the 50 m x 20 m plot that have at least one hollow.
Regeneration	Measured as the proportion of over-storey species present in the zone that are regenerating (i.e. with diameter at breast height < 5 cm).
Total length of fallen logs	Total length of logs at least 10 cm in diameter and at least 0.5 m long.

The vegetation condition data collected in quadrats was used to obtain site attribute scores and given a weighting as per Table 2 in the FBA. The scores were assessed against the Vegetation Type Benchmarks for the identified vegetation type in the VIS classification database.

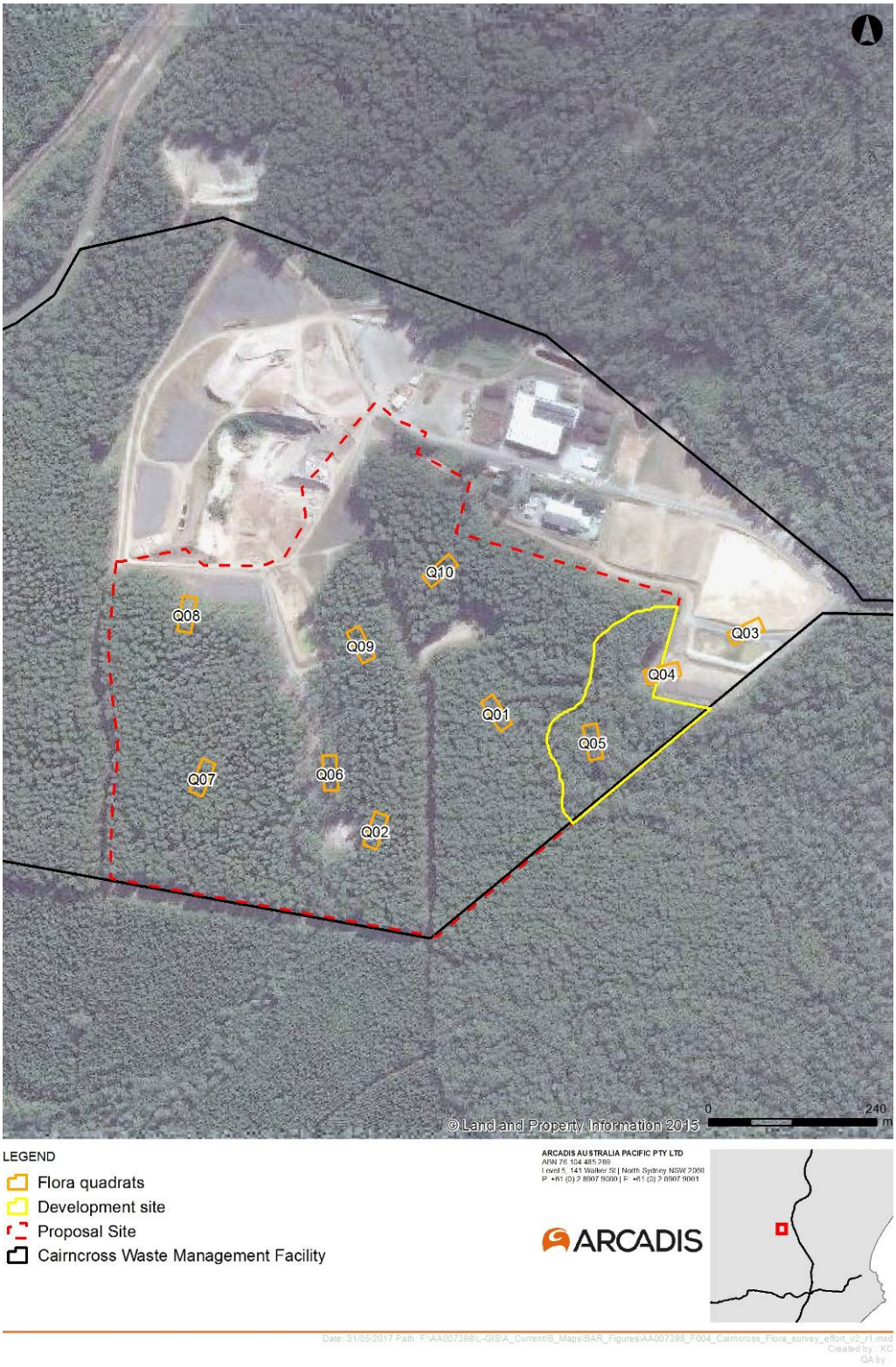


Figure 4 Location of flora survey quadrats

3.5.2 Fauna

Targeted fauna surveys undertaken in the Proposal Site included the following:

- Diurnal bird surveys at dawn.
- Arboreal hair tube surveys.
- Ground hair tube surveys.
- Remote camera sampling.
- Koala Spot Assessment Technique (SAT) (Phillips and Callaghan 2011) and call playback surveys.
- Anabat surveys.
- Spotlight surveys.
- Frog call playback, nocturnal searches and tadpole surveys.
- Owl call playback.
- Reptile survey.
- Habitat assessment.

Hair tubes and cameras were left for three weeks and were rebaited in the middle of this period. The locations of surveys are shown in Figure 5 and details are provided in Table 3-4.

Table 3-4 Fauna survey details

Survey type	Method	Timing	# of repetitions	Targeted species	Surveys within Development Site	Surveys in Proposal Site (outside of Development Site)
Diurnal bird survey	Walking transect	30 minute surveys at dawn April 2015	2	All threatened diurnal birds	1 survey	1 survey
Arboreal hair tubes	Small tree-mounted hair tubes baited with honey, oats, peanut butter and sardines	3 weeks April/May 2015	30 tubes	Common Planigale	9 x tubes	21 x tubes
Ground hair tubes	Small and large hair tubes fixed to ground baited with honey, oats and peanut butter	3 weeks April/May 2015	1 line of 5 x hair funnels 1 Line of 10 x large, 10 x small hair tubes	Threatened ground-dwelling mammals	4 x large, 4 x small	5 x hair funnels 6 x large, 6 x small
Remote cameras	Scoutguard cameras baited with either honey, walnuts, oats and peanut butter or tuna oil, sardines, flour	3 weeks April/May 2015	4 x carnivore 5 x ground herbivore/ omnivore 1 x arboreal (herbivore/omnivore)	Spot-tailed Quoll Long-nosed Potoroo, arboreal fauna	4 (1 x carnivore, 2 x ground herbivore/omnivore, 1 x arboreal)	6
Koala SAT	Scat searches in clusters of Koala feed trees in accordance	April 2015	3	Koala	1	2

Survey type	Method	Timing	# of repetitions	Targeted species	Surveys within Development Site	Surveys in Proposal Site (outside of Development Site)
	with the SAT outlined by Phillips and Callaghan (2011)					
Koala call playback	Broadcasting Koala call for 5 minutes, listen for 10 minutes	April 2015	3 nights	Koala	1	2
Anabat	Stationary placement of Anabat	April 2015	2 nights	All threatened microbats	1 Anabat	1 Anabat
Spotlight	Spotlight for 1 hour by foot Spotlight for 20 minutes driving	April/May 2015	4 nights by foot 2 nights driving	Reptiles, arboreal mammals	1	5
Frog call playback, nocturnal searches and tadpole surveys	Simultaneous spotlight and call playback at swamps dip netting for any tadpoles observed	April 2015	3 nights	Green-thighed Frog Giant Barred Frog Stuttering Frog	1	2
Owl call playback	1 hour survey including listening, spotlighting and broadcasting call	April/May 2015	5 nights	Powerful Owl	0	5
Reptile survey	30 minute searches including raking grass, leaf litter and inspecting hollow logs, branches,	April 2015	2 searches	Threatened reptiles	1 search	1 search

Survey type	Method	Timing	# of repetitions	Targeted species	Surveys within Development Site	Surveys in Proposal Site (outside of Development Site)
	loose bark, turning rocks, and fallen timber.					
Habitat assessment	Recording habitat features within a 20m x 20m plot	April 2015	7 plots	All	1	6

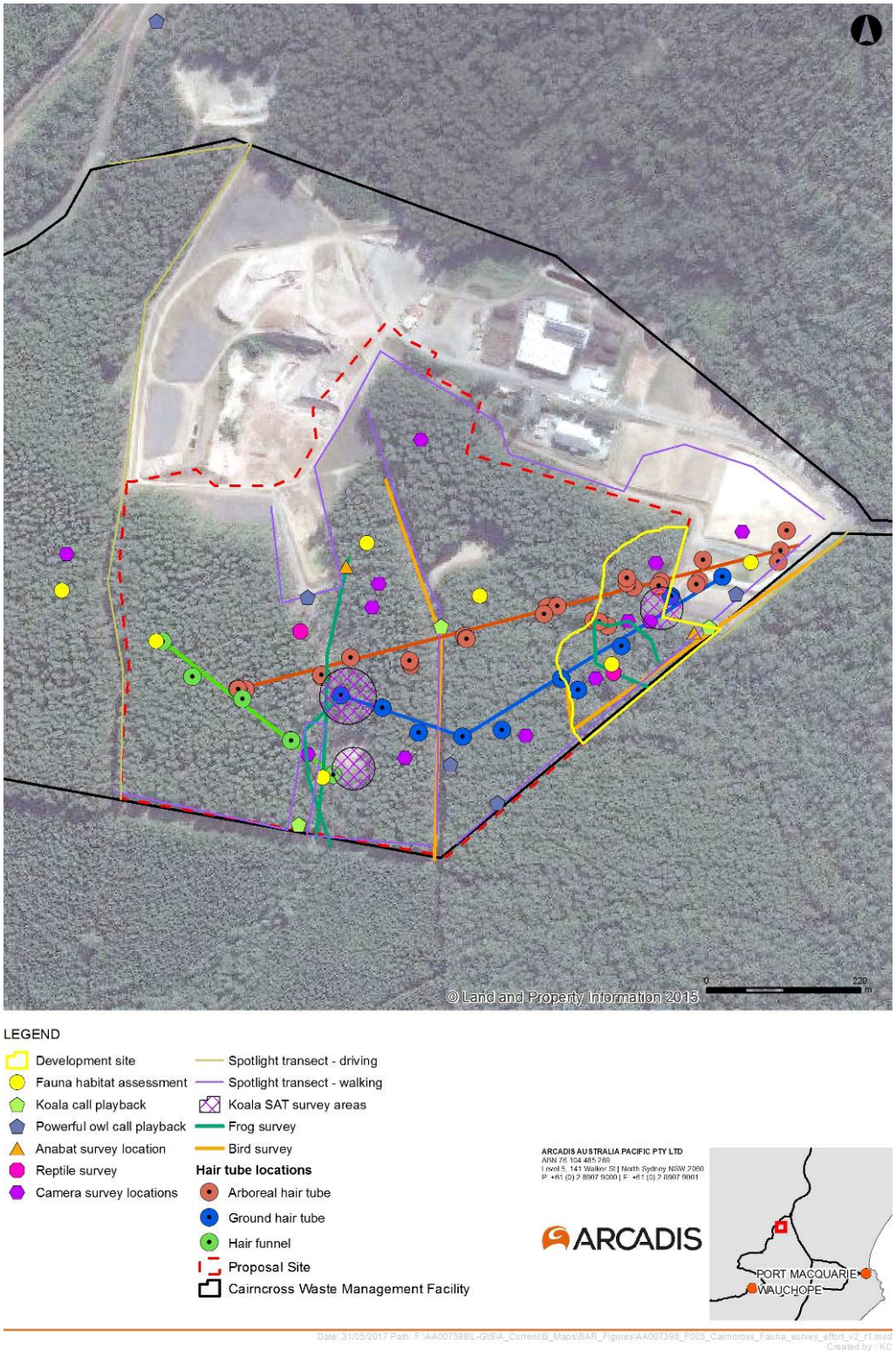


Figure 5 Fauna survey locations

3.6 Limitations

The flora and fauna survey for this assessment was carried out over five days in autumn 2015. This assessment is based on the condition of the Proposal Site at the time of field investigation and the information available at the date of publication of this document.

The duration and timing of the investigation mean that the full spectrum of flora and fauna species likely to occur in the Proposal Site cannot be fully quantified or described in this report. Some plant species that occur in the local area, including cryptic species, are annuals and are present only in the seed bank for much of the year. Other plant species are perennial but are inconspicuous or difficult to identify unless flowering.

Similarly, some fauna species that have been recorded in the local area occur on a seasonal or migratory basis, and may be absent from the locality for much for the year. Fauna behaviours may have also affected detectability; species that are easily disturbed or cryptic may not have been detected during surveys. It is possible that a number of species occurring in the Proposal Site were not detected during the current survey due to the above factors.

4 LANDSCAPE FEATURES

4.1 Landscape regions

4.1.1 Bioregions and landscapes

Bioregions and landscapes associated with the Proposal Site and outer assessment circle are mapped in Figure 6. The Proposal Site is located within the Northern Rivers Bioregion and the Macleay – Hastings Subregion classified under IBRA (Interim Biogeographic Regionalisation for Australia).

The Proposal Site is located within the Wauchope Coastal Foothills Mitchell landscape.

4.1.2 Soils and geology

The geology of the Hastings 1:250 000 sheet was mapped by Brunker (1968). The Proposal Site is mapped as the Permian Beechwood Beds formation (map unit Pb), comprising mudstone, siltstone and limestone.

4.2 Native vegetation extent

4.2.1 Land use

Most of the Proposal Site is occupied by a timber plantation, primarily growing *Eucalyptus pilularis* (Blackbutt). The timber plantation was established in the 1970s (Milledge 1998). To the north of the Proposal Site is an existing active landfill site. The Development Site comprises native vegetation and Development Site adjoins conserved native vegetation in Rawdon Creek Nature Reserve to the south-east. Rawdon Creek Nature Reserve was formerly part of Cairncross State Forest and was gazetted on 1 January 1999 to cover an area of 560 hectares (NPWS 2004).

4.2.2 Vegetation mapping

Biolink (2013) mapped the vegetation of the Port Macquarie-Hastings Local Government Area (LGA). The mapping was informed by a total of 595 formal field sites, comprising 0.4 hectare floristic plots as well as rapid assessment, and supported by traverses for ground-truthing purposes. A total of 79 native vegetation communities and four disturbed communities were identified and described, of which 49 conform to similarly recognised communities defined by the Northern Rivers CMA vegetation classification system.

The Development Site is mapped as Blackbutt Grassy Forest (PMVC_026), in the Northern Hinterland Wet Sclerophyll Forest class (Figure 7). Blackbutt Grassy Forest is described as a very tall to extremely tall open forest dominated by *Eucalyptus pilularis* (Blackbutt), in association with *Eucalyptus microcorys* (Tallowwood), *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus acmenoides* (White Mahogany), *Eucalyptus siderophloia* (Grey Ironbark) and *Syncarpia glomulifera* (Turpentine).

The mid stratum is characterised by *Allocasuarina torulosa* (Forest Oak) and/or *Allocasuarina littoralis* (Black She-oak), as well as *Acacia melanoxylon* (Blackwood), *Calllistemon salignus* (Willow Bottlebrush) and *Glochidion ferdinandi* (Cheese Tree).

The ground layer consists of a mid-high to tall grassland dominated by *Imperata cylindrica* (Blady Grass) with *Pteridium esculentum* (Bracken), *Themeda australis* (Kangaroo Grass) and *Lomandra longifolia* (Spiny-headed Mat-rush).

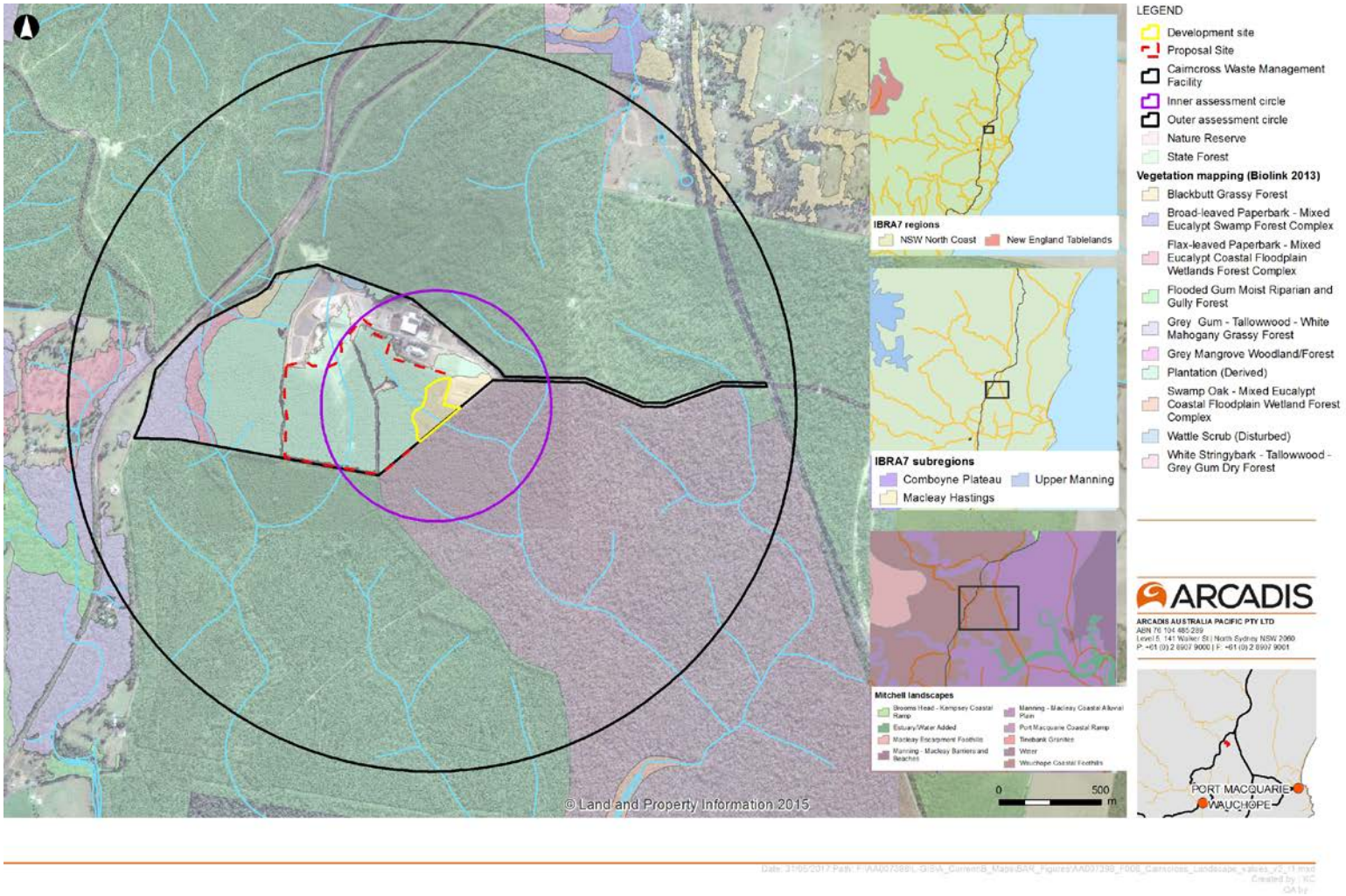
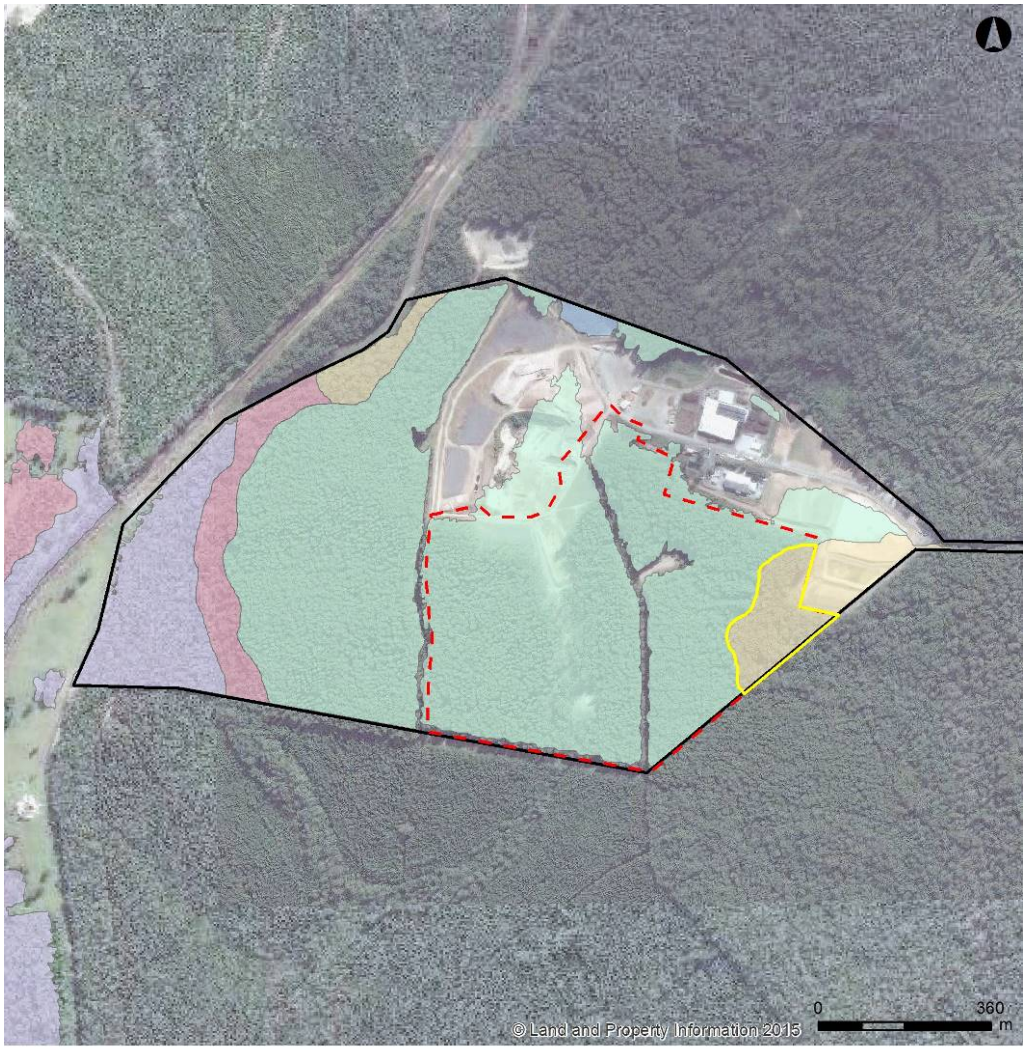


Figure 6 Landscape features



LEGEND

- Development site
- Proposal Site
- Cairncross Waste Management Facility

Vegetation mapping (Biolink 2013)

- Blackbutt Grassy Forest
- Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex
- Grey Gum - Tallowwood - White Mahogany Grassy Forest
- Plantation (Der)
- Wattle Scrub (Dist)

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Figure 7 Vegetation mapping (Biolink 2013)

Blackbutt Grassy Forest corresponds with the Plant Community Type Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117) in the OEH Vegetation Information System (VIS) Database (OEH 2015).

4.3 Rivers, streams and wetlands

An unnamed ephemeral watercourse intersects the Development Site, flowing in a south-easterly direction. The watercourse flows into a tributary of Tommy Owens Creek, which it joins approximately two kilometres south-east of the Development Site. The watercourse on the Development Site is a first order stream under the Strahler stream ordering system.

4.4 Landscape Value Score

The landscape value has been calculated from the site-based methodology outlined in Appendix 4 of the FBA (OEH 2014) by determining the following:

1. Percent native vegetation cover in the landscape – percentage of all land within the inner and outer assessment circles that contains native vegetation is to be calculated for the current extent of cover and future extent of cover once clearing for the development has occurred.
2. Connectivity value – the value determined by identifying connecting links and state or regional biodiversity links. Where the development will impact on more than one connecting link, a connectivity value must be determined for each link based on the linkage widths and conditions. State significant biodiversity links have a connectivity value of 12 and regionally significant biodiversity links have a connectivity value score of 9.
3. Patch size score – determined from the percentage of native vegetation that has been cleared within the Mitchell landscape in which most of the development occurs and the patch size class. The patch size class considers the largest patch of native vegetation occurring within or connecting to the Development Site and attributing a size class between nil or small to extra large, dependent on the size of the patch in hectares and the percentage of native vegetation cleared.

A discussion of each of these determining factors in relation to the Development Site is provided below.

4.4.1 Native vegetation cover in landscape

Two assessment circles were mapped to determine the percent current extent of native vegetation cover within and adjacent to the Development Site (Figure 6). In accordance with the allowable combinations of inner and outer assessment circles in Table 8 of the FBA, an inner circle of 100 hectares and an outer circle of 1000 hectares were used. Both circles were centred on the Development Site.

The native vegetation cover in the landscape was determined with reference to the regional vegetation mapping by Eco Logical Australia (2005). All native vegetation types mapped by Eco Logical Australia (2005) within the inner and outer assessment circles were considered to represent the current native vegetation cover. The future native vegetation cover was determined by subtracting the area of native vegetation to be cleared for the Proposal from the current summed native vegetation cover in each circle. Native vegetation cover percentages were calculated as a proportion of all land within each assessment circle that contains native vegetation. The current and future percentage of native vegetation cover in the inner and outer assessment circles has been provided in Table 4-1. Scores for each percent cover were then determined using the score criteria in Table 9, Appendix 4 of the FBA.

Table 4-1 Assessment of current and future native vegetation cover

Criteria	Assessment Circle	% cover
Current native vegetation cover	Inner assessment circle	36-40
	Outer assessment circle	51-55
Future native vegetation cover	Inner assessment circle	36-40
	Outer assessment circle	51-55

4.4.2 Connectivity value

The connectivity assessment involved an estimate of the linkage width between habitat on the Development Site and adjoining areas of habitat, both before and after development. A site is linked to adjoining vegetation where the adjoining vegetation is in moderate to good condition, has a patch size greater than one hectare, is separated by a distance of less than 100 metres (for woody vegetation) and is not separated by a hostile gap such as a dual carriageway or wider highway, railway line or large water body. The linkage width was determined by identifying the area of most limiting width between vegetation on site and connected vegetation. The current linkage width was measured using aerial photograph interpretation. The condition of the connecting link was assessed based on site inspections and aerial photograph interpretation.

There is currently full connectivity between the vegetation on the Development Site and adjoining areas. The linkage width before and after development was determined to be in the >100 m - 500 m class; clearing of all vegetation on the Development Site will not reduce the linkage width to less than 100 metres.

The condition of the vegetation link was determined to be at benchmark for overstorey condition and at greater than 25% of lower benchmark for midstorey/ground cover condition before development, and with no native over-storey, mid-storey or ground cover after development.

4.4.3 Patch size

The Development Site forms part of a larger patch of native vegetation extending into Rawdon Creek Nature Reserve to the south-east and areas of State Forest to the south and north. The continuous patch of native vegetation is bounded by the North Coast Rail Line to the west, the Pacific Highway to the east, and the Hastings River to the south and is approximately 1800 hectares in area. The vegetation in the Development Site has been assigned the maximum patch size of 1001 hectares. In accordance with the criteria in Table 15 of Appendix 4 of the FBA, the patch size class is considered to be *extra large* with a corresponding patch size score of 12.

5 NATIVE VEGETATION

5.1 Vegetation observations

The vegetation on the site consisted of a tall open forest with a mature canopy of *Eucalyptus microcorys* (Tallowwood), *Eucalyptus pilularis* (Blackbutt), *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus resinifera* (Red Mahogany) and *Eucalyptus globoidea* (White Stringybark). The midlayer included small trees and tall shrubs such as *Alphitonia excelsa* (Red Ash), *Allocasuarina littoralis* (Black She-Oak), *Acacia floribunda* (White Sally) and *Callistemon salignus* (White Bottlebrush). The ground layer was generally grassy and herbaceous, with *Gahnia sieberiana* (Red-fruit Saw-sedge), *Entolasia marginata* (Bordered Panic), *Imperata cylindrica* (Blady Grass), *Entolasia stricta* (Wiry Panic) and *Oplismenus imbecillis* (Narrow-leaved Basket-grass) being dominant.

In the eastern parts of the development area, the ground was slightly boggy and swamp forest elements of the community were dominant, with *Callistemon salignus* forming a dense midstorey and *Gahnia sieberiana* prevalent in the ground layer.

The vegetation appeared to have been recently burnt, but was regenerating. Occurrence of exotic species in the Development Site was low, limited to some small patches of *Lantana camara* (Lantana).

5.2 Plant Community Types and vegetation zones

One Plant Community Type (PCT) was identified on the Development Site: Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117). This PCT is in the North Coast Wet Sclerophyll Forests Vegetation Class and its percent cleared estimate in the Northern Rivers Major Catchment Area is 50%.

Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion was assigned based on the following evidence:

- Previous regional mapping as an equivalent vegetation type (Biolink 2013).
- Landscape position.
- Characteristic tree species present.
- Structure and species composition is consistent with descriptions in the NSW VIS database and published references.

Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion is not associated with any threatened ecological communities listed under the TSC Act or EPBC Act.

This PCT formed a single vegetation zone, as it was found to be in Moderate to Good condition.

The site value score for the vegetation zone identified on the Development Site was determined through assessment of site attribute data collected in two vegetation plots. The site attribute data was entered into the Biobanking credit calculator to generate site value scores. The site attribute data entered into the credit calculator is shown in Table 5-1. A list of flora species recorded in quadrat is provided in Appendix B.

Table 5-1 Site attribute scores on the Development Site

Plot Name	Site attributes									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL
NR117 Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion: Moderate/Good										
Benchmark	**40**	**15-100**	**25-100**	**0-90**	**0-25**	**10-50**	**-**	**1**	**1**	**10**
Q4	18	30.5	49.5	74	0	16	0	0	1	20
Q5	35	43.5	20.5	94	2	32	5	1	1	32

5.3 Fauna habitats

Open Forest

The Development Site comprised tall open forest. The canopy was up to 30 metres in height and dominated by eucalypts such as Blackbutt and Tallowwood. The canopy would provide shelter and foraging habitat for arboreal fauna, including Koalas. Koala feed trees comprised about 45% of the canopy species in this habitat. Hollow-bearing trees were present in low densities; four were recorded on the Development Site (Figure 8). Trees with large basal cavities were present. The midstorey was dominated by paperbarks approximately five metres in height with a dense cover of approximately 70%.

The understorey comprised dense grassy groundcover interspersed with soaks and scattered patches of dense sedges. Hollow logs and fallen timber were present in high densities. Grasses and timber would provide shelter for ground-dwelling fauna. Cavernous areas in the grass and runs/tracks and diggings were common in the ground-layer indicating high activity of ground-dwelling fauna in this habitat type. Camera traps identified a diversity of fauna in this habitat including Swamp Wallaby, Eastern Grey Kangaroo, Northern Brown Bandicoot and Bush Rat.

Habitat Connectivity

Rawdon Creek Nature Reserve lies east and south of the Development Site, separated by a vehicle access track, approximately 5 metres wide. The canopy is well connected over the access track and woodland birds were frequently observed moving between the site and nature reserve.

West of the Development Site lies tall open forest that is connected to Cairncross State Forest. It is regularly burnt and harvested under a forestry agreement. The understorey was recently burnt at the time of the field survey which resulted in minimal groundcover and midstorey vegetation. Connectivity for species that require adequate vegetation cover would therefore be limited after burns or timber harvesting.

5.4 Groundwater dependent ecosystems

Mapping in the Australian Government's Atlas of Groundwater Dependent Ecosystems (Bureau of Meteorology 2016) shows that the area within approximately 3 km of the Proposal Site has been classified as having moderate to high potential for groundwater interaction with the presence of surface GDEs that rely on the subsurface expression of groundwater. Potential impacts on groundwater dependent ecosystems are discussed below.

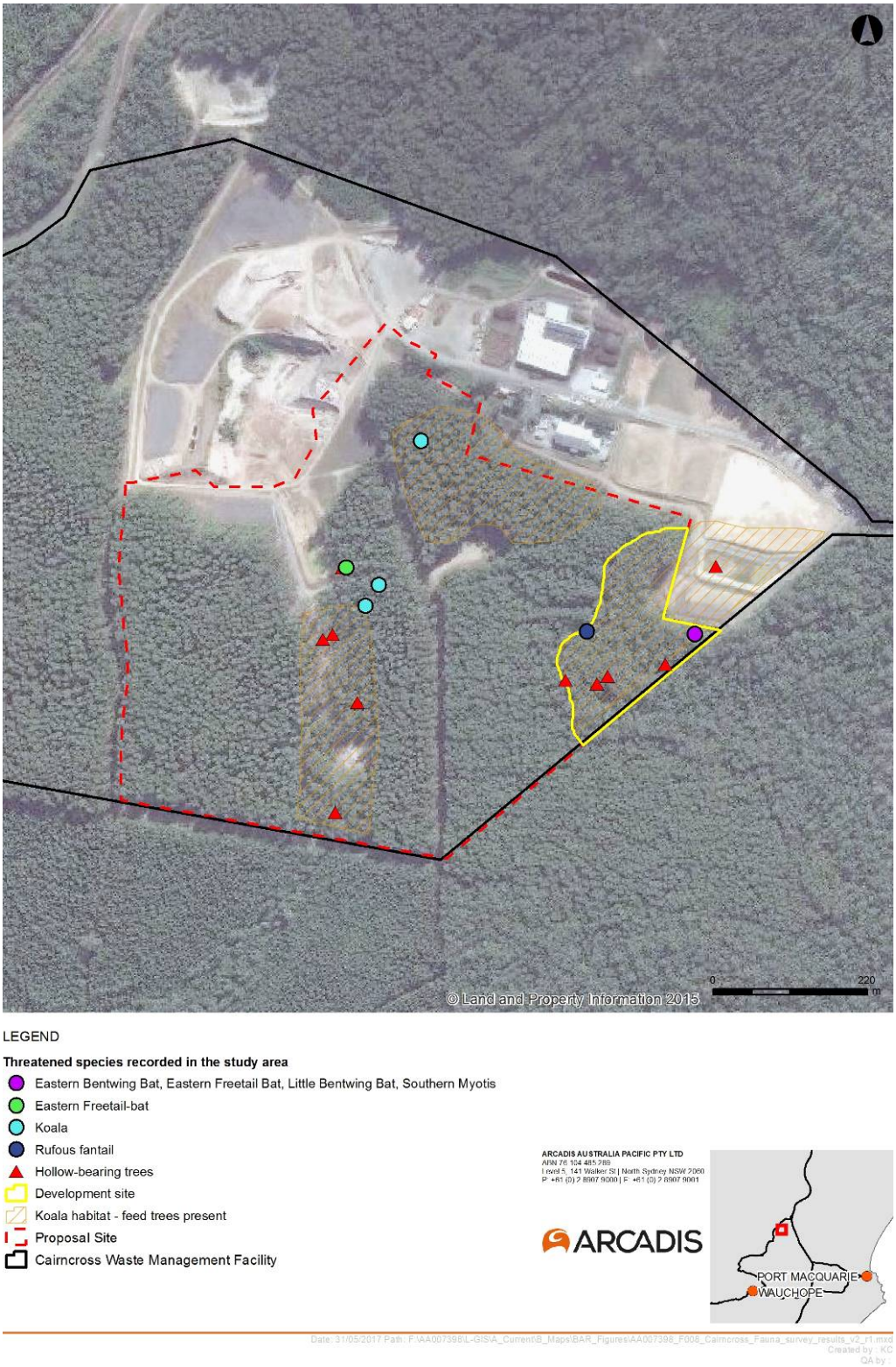


Figure 8 Fauna survey results

5.5 Noxious weeds and pests

Two of the exotic species recorded on the Development Site are listed as noxious weeds in the Local Control Authority area of Port Macquarie-Hastings Council (Table 5-2).

Table 5-2 Noxious weeds recorded on the Development Site

Scientific name	Common name	Control class
Lantana camara	Lantana	4
Senecio madagascariensis	Fireweed	4

The NSW *Noxious Weeds Act 1993* imposes obligations on occupiers of land to control noxious weeds declared for their area. The control requirements for the classes of noxious weeds recorded on the Development Site are presented in Table 5-3.

Table 5-3 Weed control classes and requirements

Control class	Weed type	Control requirements
Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

Noxious weeds are managed at the Cairncross Waste Management Facility on a regular program by Council's Natural Resources/ weeds team (pers. comm. Nicky Julian, Waste Projects Officer, PMHC, 16 January 2017).

The current extent of vermin and pest infestations on the Development Site is not known. The current land uses on the Development Site are not likely to attract large numbers of vermin and pests; however there is habitat on site for vermin and pests in native vegetation.

There are records of 22 exotic vertebrate fauna species within 10 kilometres of the Development Site in the NSW Wildlife Atlas. Of these, 16 are considered to be potential pest species given that they are either listed on the Department of Primary Industries Vertebrate Pests website or as part of Key Threatening Processes under the TSC Act.

The Pest Management Plan prepared for the Cairncross Waste Management Facility (PMHC 2013) identifies three pest species that currently pose problems on the site: Feral Cats, Indian Mynas (also known as Common Mynas) and Foxes. A control action plan is described in the Plan, with the following procedure:

1. Use Game Camera footage to determine an index of cat/fox populations. Depending on system and ease of review, collect data over a number of nights.
2. Set cage traps throughout facility and maintain for minimum 3 consecutive nights
3. Undertake roosting site count at night. This may be undertaken in conjunction with a shooting control night.
4. Undertake spotlight counts/shooting.
5. Undertake post control roosting site count and Game Camera review.
6. Follow up every 3 months.

6 THREATENED SPECIES

The BioBanking assessment methodology establishes two classes of biodiversity credits: ecosystem credits and species credits. Ecosystem credits can be created or required for all impacts on biodiversity values, including threatened species that can be reliably predicted by habitat surrogates. Species credits can be created or required for impacts on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates.

For some threatened species, there is no specification in the TSPD for whether they require ecosystem or species credits, as particular habitat elements, such as breeding habitat of cave-roosting bats, may require species credits whereas foraging habitat may be offset with ecosystem credits.

6.1 Predicted Ecosystem Credit Species

The PCT identified on the Development Site is predicted to contain the following ecosystem credit species, as determined by the credit calculator:

- Barred Cuckoo-shrike (*Coracina lineata*)
- Bush Stone-curlew (*Burhinus grallarius*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
- Golden-tipped Bat (*Kerivoula papuensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Hoary Wattled Bat (*Chalinolobus nigrogriseus*)
- Little Eagle (*Hieraaetus morphnoides*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Long-nosed Potoroo (*Potorous tridactylus*)
- Masked Owl (*Tyto novaehollandiae*)
- Powerful Owl (*Ninox strenua*)
- Red-legged Pademelon (*Thylogale stigmatica*)
- Sooty Owl (*Tyto tenebricosa*)
- Spotted-tailed Quoll (*Dasyurus maculatus*)
- Square-tailed Kite (*Lophoictinia isura*)
- Varied Sittella (*Daphoenositta chrysoptera*)
- Wompoo Fruit-dove (*Ptilinopus magnificus*)
- Yellow-bellied Glider (*Petaurus australis*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

Each species has been assessed for potential presence in the Development Site in Table 6-1 using information obtained from the Threatened Species Profiles Database (TSPD). It was found that 17 species have potential habitat in the Development Site and as such would be considered ecosystem credit species.

Of these species, one was recorded on or near the Development Site, namely Eastern Freetail-bat. Another two threatened ecosystem credit species not listed in the credit calculator were also recorded (Figure 8):

- Eastern Bentwing-bat.
- Little Bentwing-bat.

Calls of these three microchiropteran bat species were recorded in the south-east of the Development Site, near the boundary with Rawdon Creek Nature Reserve. Eastern Freetail-bat was also recorded in the west of the Proposal Site.

The threatened species with the highest Threatened Species (TS) offset multiplier in each vegetation zone determines the final ecosystem credit value for that zone. Powerful Owl and Sooty Owl each have a high offset multiplier score of 3.0; this score is only relevant to breeding habitat containing large tree hollows, which does not occur in the project area. As such, the offset multiplier has been lowered to 1.5 for these species, in accordance with the Biobanking Assessment Methodology (BBAM).

Table 6-1 Predicted ecosystem credit species presence assessment

Predicted ecosystem credit species	Patch size	Threatened species offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Development Site?
Barred Cuckoo-shrike *Coracina lineata*	5-25 ha	1.5	Occurs in rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. They are usually seen in pairs or small flocks foraging among foliage of trees for insects and fruit. They are active birds, frequently moving from tree to tree.	Yes
Bush Stone-curlew *Burhinus grallarius*	5-25 ha	2.5	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	No
Eastern Bentwing-bat *Miniopterus schreibersii* subsp. *oceanensis*	<5 ha		Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. They hunt in forested areas.	Yes Species recorded in Development Site.
Eastern Freetail-bat *Mormopterus norfolkensis*	5-25 ha	2.2	Associated vegetation types provide foraging habitat for the species. Species roosts in tree hollows, loose bark or man-made structures. Breed in hollows in dead or alive trees.	Yes Species recorded in Development Site.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	<5 ha	1.8	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods.	Marginal

Predicted ecosystem credit species	Patch size	Threatened species offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Development Site?
Golden-tipped Bat *Kerivoula papuensis*	<5 ha	2.5	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, *Casuarina*-dominated riparian forest and coastal *Melaleuca* forests.	Yes
Greater Broad-nosed Bat *Scoteanax rueppellii*	<5 ha	2.2	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	Yes
Hoary Wattled Bat *Chalinolobus nigrogriseus*	5-25 ha	2.1	In NSW the Hoary Wattled Bat occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat.	No
Little Bentwing-bat *Miniopterus australis*	<5 ha	0.75 (foraging)	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas.	Yes Foraging habitat only. Species recorded on Development Site.
Little Eagle *Hieraaetus morphnoides*	<5 ha	1.4	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Yes
Little Lorikeet *Glossopsitta pusilla*	<5 ha	1.7	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher	Yes

Predicted ecosystem credit species	Patch size	Threatened species offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Development Site?
			soil fertility and hence greater productivity.	
Long-nosed Potoroo *Potorous tridactylus*	25-100 ha	1.3	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	Yes
Masked Owl *Tyto novaehollandiae*	25-100 ha	3.0	Lives in dry eucalypt forests and woodlands from sea level to 1100 m.	No
Powerful Owl *Ninox strenua*	>100 ha	(3.0) **revised to 1.5***	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.	Yes
Red-legged Pademelon *Thylogale stigmatica*	5-25 ha	2.5	Inhabits forest with a dense understorey and ground cover, including rainforest, moist eucalypt forest and vine scrub.	Yes
Sooty Owl *Tyto tenebricosa*	>100 ha	(3.0) **revised to 1.5***	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	Yes
Spotted-tailed Quoll *Dasyurus maculatus*	25-100 ha	2.9	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Yes
Square-tailed Kite *Lophoictinia isura*	<5 ha		Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Marginal
Varied Sittella *Daphoenositta chrysoptera*	5-25 ha	0.75	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Yes

Predicted ecosystem credit species	Patch size	Threatened species offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Development Site?
Wompoo Fruit-dove *Ptilinopus magnificus*	5-25 ha	0.75	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Feeds on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit.	No
Yellow-bellied Glider *Petaurus australis*	25-100 ha	0.425	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils.	Yes
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	<5 ha	0.45	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Yes

6.2 Predicted Species Credit Species

6.2.1 Flora

The following threatened flora species listed under the TSC Act were identified in the credit calculator as predicted flora species credit species:

- *Dracophyllum macranthum.*
- *Marsdenia longiloba* (Slender Marsdenia).
- *Melaleuca biconvexa* Biconvex Paperbark).
- *Melaleuca groveana* (Groves Paperbark).
- *Niemeyera whitei* (Rusty Plum, Plum Boxwood).
- *Pomaderris queenslandica* (Scant Pomaderris).
- *Senna acclinis* (Rainforest Cassia).

Table 6-2 assesses the potential for these flora species credit species to be present on the Development Site using information obtained from the TSPD. It also identifies species that cannot withstand further loss and, where applicable, whether a species polygon is required to be prepared or other further action is required.

No threatened flora species credit species were recorded within the Development Site.

Table 6-2 Flora species credit species habitat requirements

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on Development Site?
Dracophyllum macranthum	Occurs on moderate to steep slopes mostly with a southerly aspect often associated with gaps in the forest canopy. It often occurs with dense patches of Coral Fern or on roadside bluffs or on conglomerate outcrops.	No
Marsdenia longiloba Slender Marsdenia	Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.	No
Melaleuca biconvexa Biconvex Paperbark	Swamps, swamp margins or creek edges. The species generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	No
Melaleuca groveana Groves Paperbark	Grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcopping granite, rhyolite and sandstone on rocky outcrops and cliffs. Also occurs in dry shrubby open forest and woodlands.	No
Niemeyera whitei Rusty Plum	Found in gully, warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest.	No
Pomaderris queenslandica Scant Pomaderris	Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	Yes
Senna acclinis Rainforest Cassia	Grows on the margins of subtropical, littoral and dry rainforests. Often found as a gap phase shrub.	No

Table 6-3 Flora species credit species presence status on the Development Site

Predicted species credit species	Targeted survey effort/methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action
Dracophyllum macranthum	No targeted survey – no suitable habitat detected	April/May	Not present	No	None required.
Marsdenia longiloba Slender Marsdenia	No targeted survey – no suitable habitat detected	April/May	Not present	Yes	None required.
Melaleuca biconvexa Biconvex Paperbark	No targeted survey – no suitable habitat detected	April/May	Not present	No	None required.
Melaleuca groveana	No targeted survey – no	April/May	Not present	No	None required.

Predicted species credit species	Targeted survey effort/methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action
Groves Paperbark	suitable habitat detected				
Niemeyera whitei Rusty Plum	No targeted survey – no suitable habitat detected	April/May	Not present	No	None required.
Pomaderris queenslandica Scant Pomaderris	Targeted surveys	April/May	Not detected	No	None required
Senna acclinis Rainforest Cassia	No targeted survey – no suitable habitat detected	April/May	Not present	No	None required.

6.2.2 Fauna

The following were identified in the credit calculator as predicted fauna species credit species:

- Brush-tailed Phascogale (*Phascogale tapoatafa*).
- Common Planigale (*Planigale maculata*).
- Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*).
- Eastern Pygmy-possum (*Cercartetus nanus*).
- Giant Barred Frog (*Mixophyes iteratus*).
- Green-thighed Frog (*Litoria brevipalmata*).
- Koala (*Phascolarctos cinereus*).
- Pale-headed Snake (*Hoplocephalus bitorquatus*).
- Pale-vented Bush-hen (*Amaurornis moluccana*).
- Regent Honeyeater (*Anthochaera phrygia*).
- Rufous Bettong (*Aepyprymnus rufescens*).
- Squirrel Glider (*Petaurus norfolcensis*).
- Stephens Banded Snake (*Hoplocephalus stephensii*).
- Three-toed Snake-tooth Skink (*Coeranoscincus reticulatus*).
- White-eared Monarch (*Carterornis leucotis*).

Table 6-4 assesses the potential for fauna species credit species to be present on the Development Site using information obtained from the TSPD. Habitat requirements for each species were assessed against the habitat values on the Development Site. Habitat information was obtained from OEH's Threatened Species Profiles Database. Targeted survey methods and timing for each identified species is noted and an assessment of the presence status of each species was determined based on targeted survey results and habitat presence. Table 6-5 also identifies species that

cannot withstand further loss and where applicable, whether a species polygon is required to be prepared.

Of the 16 species, eight are unlikely to occur in the Development Site based on the assessment provided in Table 6-4 and Table 6-5.

Two species credit species in the list generated by the Major Projects calculator were recorded in the Development Site: Koala (*Phascolarctos cinereus*) and, tentatively, Green-thighed Frog (*Litoria brevipalmata*). These species are discussed further below.

Table 6-4 Fauna species credit species habitat requirements

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on Development Site?
Common Planigale *Planigale maculata*	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water.	Yes
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously.	Marginal Species prefers heath.
Eastern Pygmy-possum *Cercartetus nanus*	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	Yes
Giant Barred Frog *Mixophyes iteratus*	Giant Barred Frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor.	Yes
Green-thighed Frog *Litoria brevipalmata*	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland.	Yes. Species tentatively recorded on site.
Koala *Phascolarctos cinereus*	Species inhabits eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Yes. Species recorded on site.
Pale-headed Snake *Hoplocephalus bitorquatus*	Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. Shelters during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees.	Marginal

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on Development Site?
Pale-vented Bush-hen *Amaurornis moluccana*	The Pale-vented Bush-hen inhabits tall dense understorey or ground-layer vegetation on the margins of freshwater streams and natural or artificial wetlands, usually within or bordering rainforest, rainforest remnants or forests.	No
Regent Honeyeater *Anthochaera phrygia*	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	No
Rufous Bettong *Aepyprymnus rufescens*	Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter.	Yes
Square-tailed Kite *Lophoictinia isura*	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Marginal
Squirrel Glider *Petaurus norfolcensis*	Inhabits Blackbutt-Bloodwood forest with heath understorey in coastal areas. Require abundant tree hollows for refuge and nest sites. Forages for nectar, sap, invertebrates and pollen.	No
Stephens Banded Snake *Hoplocephalus stephensii*	Occurs in rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day.	Yes
Three-toed Snake-tooth Skink *Coeranoscincus reticulatus*	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils. The Three-toed Snake-tooth Skink lives in loose soil, leaf litter and rotting logs, and feeds on earthworms and beetle grubs.	Marginal
White-eared Monarch *Carterornis leucotis*	In NSW, White-eared Monarchs occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest.	Yes

Table 6-5 Fauna species credit species presence status on the Development Site

Predicted species credit species	Targeted survey effort/methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action
Common Planigale *Planigale maculata*	Arboreal hair tubes, remote cameras	April/May 2015	Species not recorded during	Yes	No

Predicted species credit species	Targeted survey effort/methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action
			targeted survey.		
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	Hair tubes, remote cameras	April/May 2015	Species not recorded during targeted survey.	Yes	No
Eastern Pygmy-possum *Cercartetus nanus*	Hair tubes, remote cameras	April/May 2015	Species not recorded during targeted survey.	Yes	No
Giant Barred Frog *Mixophyes iteratus*	Call playback, nocturnal searches and tadpole surveys	April 2015	Species not recorded during targeted survey. Unlikely breeding habitat.	No	No
Green-thighed Frog *Litoria brevipalmata*	Call playback, nocturnal searches and tadpole surveys	April 2015	Anecdotal record in Proposal Site. No tadpoles identified in Development Site.	Yes	Yes
Koala *Phascolarctos cinereus*	Call playback, spotlight, remote cameras	April/May 2015	Present in Proposal Site.	Yes	Yes
Pale-headed Snake *Hoplocephalus bitorquatus*	Spotlight surveys Reptile searches	April 2015	Species not recorded during targeted survey.	Yes	No
Pale-vented Bush-hen *Amaurornis moluccana*	Bird survey, remote cameras	April 2015	Habitat not present.	Yes	No
Regent Honeyeater *Anthochaera phrygia*	Bird survey	April 2015	Habitat not present.	Yes	No
Rufous Bettong *Aepyprymnus rufescens*	Hair tubes, remote cameras	April/May 2015	Species not recorded during targeted survey.	Yes	No

Predicted species credit species	Targeted survey effort/methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action
Square-tailed Kite *Lophoictinia isura*	Bird survey, habitat assessment including searches for raptor nests	April 2015	Species not recorded during survey. No raptor nests identified during surveys.	Yes	No
Squirrel Glider *Petaurus norfolcensis*	Spotlight, remote camera		Habitat not present.	Yes	No
Stephens Banded Snake *Hoplocephalus stephensii*	Spotlight survey	April 2015	Species not recorded during targeted survey.	Yes	No
Three-toed Snake-tooth Skink *Coeranoscincus reticulatus*	Reptile survey	April 2015	Habitat marginal, species not recorded during targeted surveys.	No	No
White-eared Monarch *Carterornis leucotis*	Bird survey	April 2015	Species not recorded during targeted surveys.	No	No

There were three records of Koala in the Proposal Site: two camera trap records (Camera 10 (C10) on 30 April and at Camera 11 (C11) on 16 April) and one scat found during SAT surveys. All records were in the west and north of the Proposal Site. Three areas within the study area were identified as supporting Koala feed trees (Figure 8); one of these encompasses the Development Site.

There was a tentative sighting of Green-thighed Frog in the drainage line in the north-west of the Proposal Site: a frog that appeared to meet the description of the species was briefly observed during diurnal surveys, however it was not seen for long enough for the identification to be confirmed. Based on the numerous recent records of the species in the locality and the presence of potential suitable habitat for the species within the Development Site, it is assumed to be present. Habitat specified in the TSPD for this species is 'land within 300 m of semi-permanent or ephemeral ponds or depressions containing leaf litter'.

Calls of Southern Myotis were recorded in the south-east of the Development Site, near the boundary with Radson Creek Nature Reserve. Southern Myotis was not in the list generated by the Major Projects calculator. Southern Myotis is classed as both an ecosystem and species credit species; species credits only apply to areas of potential breeding habitat, which for this species is defined in the TSPD as 'hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone'.

Species polygons have been mapped for Koala, Green-thighed Frog and Southern Myotis (Figure 9).

6.3 Matters of National Environmental Significance

An assessment of the likelihood of occurrence of threatened flora and fauna species listed under the EPBC Act in the Development Site was undertaken. A search of the DoEE Protected Matters Search Tool (6 February 2017) found 10 threatened flora species and 43 threatened fauna species listed under the EPBC Act that are known or likely to occur within 10 kilometres of the Development Site. The likelihood of each threatened species occurring in the development was assessed (Appendix C).

Only one threatened flora species listed under the EPBC Act, *Cynanchum elegans* (White-flowered Wax Plant) was found to have a moderate likelihood of occurrence in the Development Site. An Assessment of Significance was undertaken in Appendix D and found that impacts to this species would not be significant. A Referral to the Minister of the DoEE is not required. The other nine threatened flora species identified in the search were found to have a low likelihood of occurrence.

When species restricted to marine environments were excluded, there were 17 threatened fauna species listed under the EPBC Act known or likely to occur within 10 kilometres of the Proposal Site. Of these, one is known on the Development Site (Koala), two (Spotted-tail Quoll and Grey-headed Flying-fox) are considered to have a high likelihood of occurrence, and one (Giant Barred Frog) is considered to have a moderate likelihood of occurrence.

Two MNES were recorded in the Development Site: Koala (*Phascolarctos cinereus*), listed as Vulnerable under the EPBC Act, and the Rufous Fantail (*Rhipidura rufifrons*), listed as Migratory under the EPBC Act.

Assessments of Significance for the Koala, Spot-tailed Quoll, Grey-headed Flying-fox, Giant Barred Frog and Rufous Fantail were undertaken in Appendix D. No impacts were found to be significant for any of the species and as such, a Referral to the Minister of the DoEE is not required.

In addition, a review of the site information and the EPBC Act referral guidelines for the vulnerable Koala (Commonwealth of Australia 2014) by Biolink Ecological Consultants (Appendix D) found that:

- Activity on the site is likely to involve transient use by an individual as opposed to the presence of a resident population of several koalas.
- The subject site and the immediate surrounding vegetation is not large enough in size nor of an adequate stage of growth/quality to support a resident population of koalas.
- Any risk that the removal of vegetation at the site would result in a reduction in the overall area of occupancy of the remaining, broader koala population is negligible.

It was concluded that an EPBC referral for the species was not required.

7 AVOID AND MINIMISE IMPACTS

The FBA requires consideration of the steps taken to avoid and minimise the direct and indirect impacts of a development proposal on biodiversity values. Section 8.3.2 of the FBA sets out guidelines for the avoidance and minimisation of impacts to biodiversity during all phases of the project life cycle, comprising:

- Site selection phase.
- Planning phase.
- Construction phase.
- Operational phase.

7.1 Measures to avoid impacts

7.1.1 Site selection phase

The guidelines for site selection phase in sections 8.3.2.2 to 8.3.2.6 of the FBA were reviewed. The Development Site is located adjacent to the operational Cairncross Landfill site, and the Proposal is for an expansion of the existing landfill; the process of site selection was undertaken prior to the approval of the Cairncross Waste Management Facility EIS in 1999.

The location for the current Cairncross Landfill site was selected based on significant investigation into potential waste disposal locations within the LGA.

Investigations into potentially suitable sites commenced following the development of the 1991 Waste Disposal Strategy Study (Patterson Britton and Partners, 1991). Following the 1991 study, a site selection process was undertaken and was documented in the Hastings Regional Waste Disposal Facility Site Selection Study (Patterson Britton and Partners, 1994). The study identified a site off Houston Mitchell Drive, Cowarra as a preferred site.

An EIS for the Cowarra site was completed in 1995 (Patterson Britton and Partners, 1995). Council, in January 1996, resolved not to proceed with that proposal due to significant environmental values and likely impacts identified on the site.

An intensive site selection process was then undertaken to identify an alternate landfill site; 61 potential sites were refined to a list of 16 sites that would undergo on-site assessment. Six of these sites were identified as having substantially lower flora and fauna habitat values relative to the others (Milledge 1998). Four of the six sites were shortlisted for more detailed investigation, with constraints assessment including the following considerations:

- Presence or likely presence of threatened species
- Presence of regionally significant vegetation associations and species
- Presence of core Koala habitat.

The study of the four shortlisted sites found that there appeared to be no legislative constraints on development of any of the sites with respect to flora and fauna issues. However it was recommended that a Species Impact Statement (SIS) be prepared for whichever site was selected, due to the occurrence of Koalas at two of the sites and likely occurrence of other threatened species in all sites.

The Council adopted site 10, now the location of the Cairncross WMF, as the preferred site. The site was mostly covered with 20 year old Blackbutt plantation and was one of the sites where Koala had been recorded. As a result, an SIS was prepared (Milledge 1998). Field investigation identified one Koala using the site, and threatened species Little Bentwing-bat, Greater Broad-nosed Bat, Square-tailed Kite, Glossy Black Cockatoo, Powerful Owl and Common Bentwing-bat present or likely to occur on the site. The SIS concluded that no threatened flora and fauna species would be significantly affected by the proposal. Although 50 hectares of habitat known to be used by Koalas and threatened species would be removed, there would also be 57 hectares of compensatory habitat acquired, reserved and managed.

PMHC resolved to proceed with the preparation of an EIS for the proposed Cairncross WMF. The 1999 EIS documented the site selection process identified above and included provision for five landfill stages, with the first being for immediate implementation and the following four stages to be implemented progressively as each cell reached capacity. Following submission of the EIS, the proposal was granted approval under Part V of the EP&A ACT on 26 July 1999. The current Proposal provides for extension of the landfill (in additional three instead of four stages) on the selected site, as per the 1999 EIS.

7.1.2 Planning phase

The guidelines for the planning phase in sections 8.3.2.7 to 8.3.2.8 of the FBA and the biodiversity assessment process undertaken for the Proposal are presented in Table 7-1.

Table 7-1 Planning phase FBA guidelines for avoidance and minimisation of biodiversity impacts

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
8.3.2.7	Once a suitable Development Site has been selected, further analysis of the biodiversity constraints of the proposed Development Site can then be used to inform concept planning, project siting and design. This includes the proposed location of temporary construction infrastructure such as roads, camps, stockpile sites and parking bays.	The identified biodiversity constraints have been considered during the development of the Proposal; allowance for a 50 m wide Koala connectivity corridor has been included in the site layout. Further information is provided on the Koala connectivity corridor in Section 7.1.3
8.3.2.8	The Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value) or which avoid an EEC or CEEC. The following matters should be considered for this purpose: 1. siting of the project – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC. 2. minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native	The majority of the Proposal is located within areas of eucalypt plantation subject to a forestry approval, which allows clearing and withdrawal of areas of the authorised plantation from plantation activities to facilitate landfill expansion. .

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
	vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development footprint is minimised), and/or in areas where other impacts to biodiversity will be the lowest 3. loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile gaps. 4. other site constraints – any other constraints that the assessor has considered in determining the siting and layout of the Major Project, e.g. bushfire protection requirements including clearing for asset protection zones, flood planning levels, servicing constraints.	

7.1.3 Koala connectivity corridor

Establishment of the Koala corridor would involve fencing off the Stage 2 landfill area adjacent to the corridor to prevent migration of Koalas onto the Proposal Site. In order to maintain connectivity, the Koala corridor would not be fenced on other sides. The enhancement of this habitat corridor with additional Koala food trees, and the control of all invasive weeds will be undertaken as part of Council's Public Bushland Management Programme. This area plus the compensatory habitat to the west shown in Figure 9 are under Councils ownership and will be managed in perpetuity and rezoned for environmental protection with the next standard LEP instrument amendment by Council.. The management activities would cover the following requirements:

- Initial and ongoing weed removal
- Pest animal control measures (including monitoring and trapping where necessary)
- Planting of supplementary trees and shrubs to improve the habitat value of the corridor, if required, as determined by a qualified ecologist
- Bushfire control measures
- Litter removal / removal of illegally dumped rubbish.

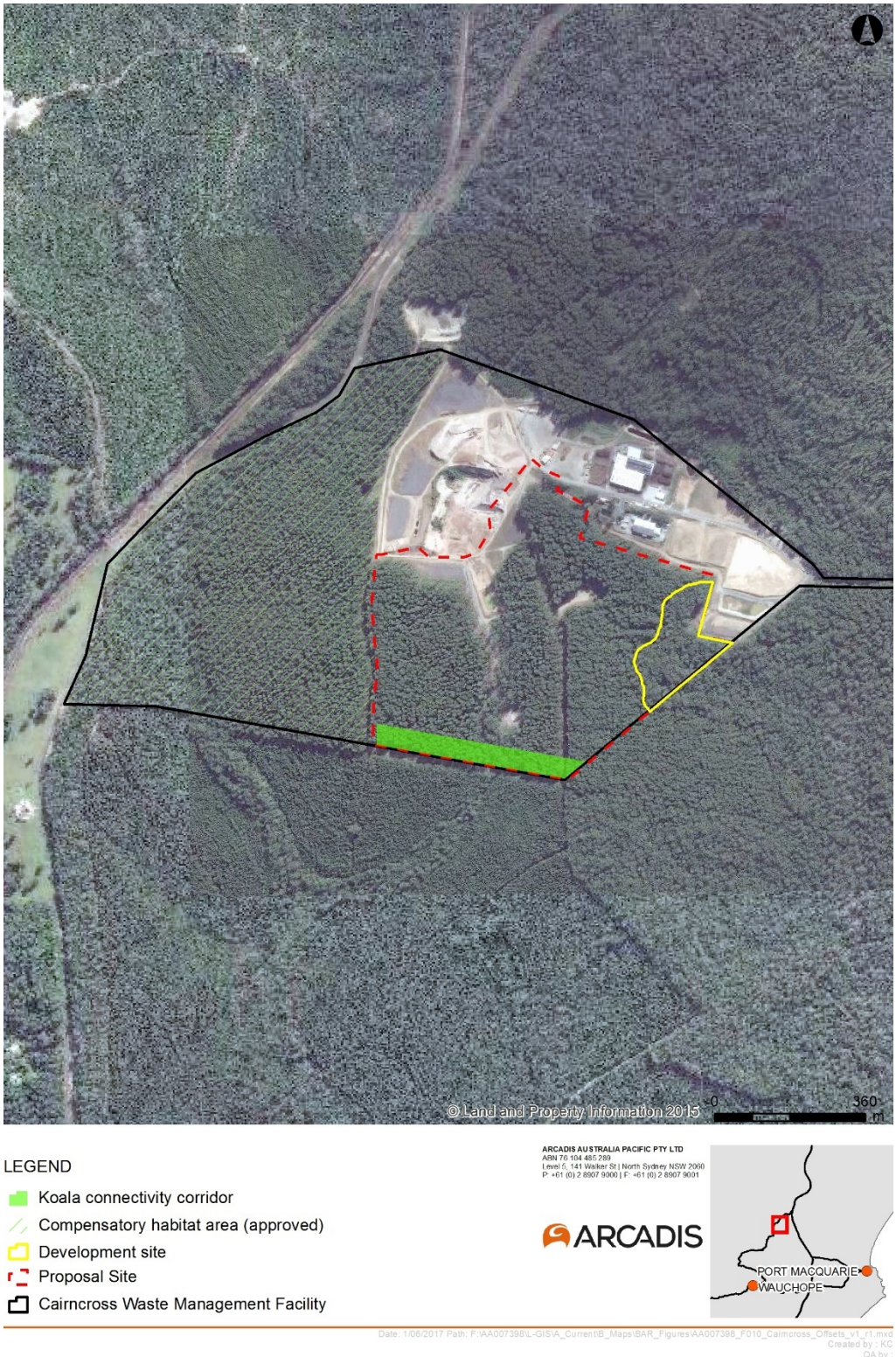


Figure 9 Koala connectivity corridor and approved compensatory habitat area

7.2 Unavoidable impacts

7.2.1 Construction phase

The Proposal will receive waste from all areas within the Port Macquarie-Hastings local government area (LGA) including the major townships of Port Macquarie, Wauchope and Camden Haven. Waste will include general solid waste (i.e. putrescible and non-putrescible materials) and asbestos from domestic and commercial and industrial (C&I) sources.

- Progressive landfill cell construction, operation and rehabilitation of three landfill stages (Stages 1-3) including:
  - Clearing of 3.4 ha of existing vegetation
  - Construction of access tracks
  - Earthworks for cell formation including extraction and stockpiling of materials and the reapplication to form the leachate barrier (cell liner) as well as for daily, intermediate and final cover
  - Installation of leachate management structures including the leachate barrier, collection, storage and disposal system
  - Construction of a rising main to transfer leachate to the adjacent sewage treatment plant (STP)[1]
  - Installation of a stormwater management system
  - Progressively increasing the annual waste acceptance rate at the landfill
  - Signage and other ancillary works
  - Rehabilitation of closed cells
- Delineation and ongoing management of a 50 m wide Koala connectivity corridor around the south-western border of the site.

The Proposal is expected to receive a total of approximately 3.2 million tonnes of additional waste over the life of the expanded landfill.

7.2.1.1 Likely impacts

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the construction of the Proposal.

Loss of native vegetation

Clearing of native vegetation is required for the Proposal. A total of 3.4 ha of the PCT Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion will be cleared from within the Development Site.

Loss of terrestrial fauna habitat including habitat for threatened and migratory species

Clearing of native vegetation for the Proposal will result in the removal of terrestrial fauna habitat. The clearing of vegetation will result in the loss of specific fauna habitat components, including live trees, tree hollows, foraging resources (myrtaceous and flowering trees and shrubs), groundlayer habitats such as ground timber and well-

[1] The STP is proposed to be built in 2018 and is being designed to be capable of accepting leachate from the Proposal.

developed leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna occurring within the locality. A total of 3.4 hectares of terrestrial fauna habitat occurs within the Development Site and would be removed during construction of the proposal. The tree hollows and size classes to be removed are outlined in Table 7-2.

Table 7-2 Tree hollows to be removed for the Proposal

Small hollows (<10cm diameter)	Medium hollows (10cm – 20cm diameter)	Large hollows (>20cm diameter)
1	10	5

The area of habitat to be cleared does not comprise a significant area of habitat within the wider locality. Habitat features and vegetation communities that will be cleared are prevalent within the wider landscape, particularly within Rawdon Creek Nature Reserve to the east and south-east of the Proposal.

Habitat fragmentation/ loss of fauna habitat connectivity

The Proposal is not considered likely to reduce fauna movement throughout the locality. Clearing of vegetation within the Development Site may reduce the capacity of some less mobile fauna to move within, and between patches of remaining habitat. This is particularly relevant to locally occurring small, ground-dwelling fauna such as amphibians, reptiles and small ground-dwelling and arboreal mammals. In order to maintain connectivity between larger areas of native vegetation adjoining the site, a 50 m wide Koala connectivity corridor would be maintained across the southern boundary of the Proposal Site.

Impacts to Groundwater Dependent Ecosystems

A detailed hydrogeological investigation of the Proposal Site was undertaken by Trace Environmental (2016), including an assessment of the potential impacts of the Proposal on groundwater. During excavation it is possible that groundwater heads will be higher than average as a result of a long wet weather period. In this case, dewatering for Stages 1 and 2 may be required. Groundwater inflow from these areas may result in drawdown impact extending within the shale aquifer to a maximum of 1 km after 100 days. During this period, the drawdown is predicted to be within the range of 0.01 m to 0.1 m. While drawdown of 0.1 m is not insignificant, given that this scenario may only occur following a long wet weather period it is considered unlikely that groundwater dependent ecosystems would be subject to impacts as a result of the drawdown. Trace Environmental (2016) predicts the drawdown to be negligible at a distance of 1.2 km from the Proposal Site boundary (<0.001 m maximum drawdown during excavation).

Fauna mortality

Fauna injury or mortality is most likely to occur during vegetation clearing activities, but also may result from collisions with construction vehicles or plant, or accidental entrapment in plant, trenches or other earthworks.

The majority of fauna species recorded within the Proposal Site were highly mobile bird species and these species are likely to be able to move away from vegetation clearing activities quite readily. Any fauna inhabiting the hollows in hollow-bearing trees may be injured during tree-felling. This could potentially include hollow-dependent birds and mammals and threatened microchiropteran bat species. Those animals that are unable to disperse away from areas under active clearing are also particularly susceptible to injury or death. This includes amphibians, reptiles and fish.

Edge effects and weed invasion

Fragmentation of vegetation results in sections of edge habitat. Edge effects include alterations in humidity, light, moisture, wind, temperature and noise and soil profile conditions. These effects impact on the adjoining native vegetation by affecting seed germination, flora and fauna species composition and weed establishment. The south-eastern boundary of the Development Site, which borders Rawdon Creek Nature Reserve, currently adjoins a dirt vehicle access track.

Alteration to air quality and noise levels

The construction phase of the Proposal may impact upon the roosting, breeding and foraging activities of locally occurring fauna, as a result of increased exposure to light, noise, dust, construction vehicles and people.

Indirect impacts

The Proposal has a risk of indirect impacts to remnant native vegetation adjacent to construction areas. This includes a risk of increased sedimentation and changes to hydrology which could affect the health of native vegetation communities and flora populations.

7.2.2 Operational phase

7.2.2.1 Operational Activities

The operation of the Proposal involves the filling of landfill cells with waste, compaction of waste, covering with daily and intermediate cover, and finally capping the landfill.

7.2.2.2 Likely Impacts

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the operation of the Proposal. Likely impacts include:

Fauna mortality

Fauna injury or mortality may result from collisions with vehicles or plant in operation of the Proposal, or as a result of increased truck movements.

Edge effects and weed invasion

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the introduction or spread of weeds in adjacent areas of native vegetation.

Alteration to air quality and noise environments

Operation of the Development Site may increase utilisation of the site by both people and vehicles from current levels. This may impact upon the roosting, breeding and foraging activities of locally occurring fauna, as a result of increased exposure to light, noise, dust, vehicles and people.

7.3 Key Threatening Processes

The Proposal is likely to result in the operation of one or more key threatening processes or the exacerbation of one or more key threatening processes currently in operation in the Proposal Site. Key threatening processes are listed under the TSC Act and EPBC Act.

7.3.1 Threatened Species Conservation Act 1995

Key threatening processes are processes that "threaten or could threaten the survival or evolutionary development of species, populations or ecological communities". They are listed under Schedule 3 of the TSC Act and may adversely affect threatened species, populations or ecological communities or could cause species, populations or ecological communities that are not threatened to become threatened. The Proposal may contribute to the key threatening processes listed in Table 7-2.

Table 7-3 Key threatening processes

Key threatening process	Relevance to Proposal
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	The Proposal will have a minor impact on overland flow regimes. Given the low intensity of this impact and the already modified hydrology of the Development Site, this impact is unlikely to be significant.
Clearing of native vegetation	The Proposal would result in the clearing of approximately 3.4 ha of native vegetation.
Competition and habitat degradation by feral goats (*Capra hircus*)	Goats were recorded in the Proposal Site. It is unlikely that the Proposal will exacerbate this KTP.
Infection of native plants by *Phytophthora cinnamomi*	The Proposal is unlikely to result in the spread of Phytophthora due to the proposed measures for minimising the spread of weeds and plant pathogens.
Invasion of native plant communities by exotic perennial grasses	Exotic perennial grasses were observed at the edges of access tracks near the Development Site, however weed control measures would reduce this threat to native vegetation in adjacent areas.
Invasion, establishment and spread of *Lantana camara*	Lantana was recorded on the Development Site, however weed control measures would reduce this threat to native vegetation in adjacent areas.
Loss of hollow-bearing trees.	The Proposal will require removal of four hollow-bearing trees from the Development Site.
Predation by the European Red Fox	The European Red Fox was recorded on the Development Site. It is unlikely that the Proposal will exacerbate this KTP.
Removal of dead wood and dead trees	Dead wood and dead trees were recorded on the Development Site at low density. Some of these would be removed. Dead wood within the clearing footprint and selected trunks and large branches from cleared areas would be removed from areas to be cleared and relocated to suitable nearby habitat.

7.3.2 Environment Protection and Biodiversity Conservation Act 1999

The Proposal may contribute to the following key threatening processes listed under the EPBC Act:

- Land clearance - the Proposal would result in the clearing of approximately 3.4 ha of native vegetation.

7.4 Mitigation of Impacts

Biodiversity impacts cannot be avoided for many aspects of the Proposal as detailed above. As such, the measures in Table 7-3 should be implemented to mitigate these impacts during construction and operation.

It is noted that the establishment of the Koala connectivity corridor is considered part of the Proposal, and therefore is not repeated in the mitigation measures.

Table 7-4 Measures to be implemented to minimise impacts on biodiversity

Activity	Impact	Mitigation measure
Management framework	Flora and fauna impacts	All relevant flora and fauna mitigation measures will be incorporated into the Operational Environmental Management Plan (OEMP). All offset land will be funded and managed in perpetuity under Councils Public Bushland Management Programme.
Earthworks and other construction activities involving soil disturbance	Sedimentation and erosion leading to a reduction in water quality and degradation of downslope swamp forest habitats	Clearing of vegetation and excavation activities would not be undertaken during overland flow events (where there is surface runoff present after rainfall and prior to entering a waterway).
		Stabilisation of disturbed areas adjacent to retained native vegetation, including revegetation where appropriate, would be undertaken as soon as feasible and reasonable after disturbance.
	Weed establishment and invasion	. All offset land will be funded and managed in perpetuity under Councils Public Bushland Management Programme. Management actions would include, but not be limited to, the following: - Identification of type and location of weeds of concern within the site. - Identification of sensitive receivers (such as native vegetation and waterways) within or adjacent to the Proposal Site. - Management and disposal of weeds (including declared noxious weeds) in accordance with requirements of the Noxious *Weeds Act 1993* -
		Any application of herbicide for weed management would be undertaken in accordance with the requirements of the *Pesticides Act 1999* and an herbicide that is appropriate to the sensitivity of the area would be used.

Activity	Impact	Mitigation measure
Vegetation clearance	Loss of fauna habitat	Fauna microhabitat such as logs would be removed from areas to be cleared and relocated to suitable nearby habitat.
		Extent of clearing would be fenced with highly visible temporary fencing to ensure that clearing does not extend beyond the area necessary.
		A hollow replacement program would be implemented in the Koala corridor and on any proposed offset site. Hollows would be replaced at 1:1 ratio to offset the impacts to 1 small hollow, 10 medium hollows and 5 large hollows.
	Fauna injury/mortality	All injured fauna to be reported to the site manager. Contact details would be kept on site for the local animal rescue group (Fawna Wildlife Rescue, Port Macquarie) and veterinarian if any fauna are injured on site or require capture and/or relocation.
		A two-stage clearing process will be implemented for hollow-bearing trees. An experienced ecologist would be present on site to supervise all stages of removal of hollow bearing trees, as well as relocation of any fauna.
		If feasible and reasonable, vegetation clearing should not be undertaken during the breeding seasons for threatened fauna species with potential habitat on the Development Site. This will not be possible for all identified threatened species as breeding seasons collectively span a large portion of the year. In order of preference of avoidance, the breeding periods are: - Koala – September to February (breeding season) - Glossy Black Cockatoo – March to August (breeding season) - Spotted-tail Quoll – June to January (maternal den season)

Activity	Impact	Mitigation measure
		- Grey-headed Flying Fox – October to March (breeding season) - Southern Myotis – November to February (breeding season) Scheduling the vegetation removal for Autumn months would generally avoid the breeding season of most species that could occur on site.
Alteration to air quality and noise environments during construction and operation	Disruption of fauna foraging, nesting or roosting behaviours	Frequent maintenance of construction machinery and plant would be undertaken to minimise unnecessary noise.
		Dust suppression activities would be undertaken where appropriate.

8 OFFSET REQUIREMENTS

8.1 Impacts requiring offset determination

Under the *NSW Biodiversity Offsets Policy for Major Projects*, a biobanking agreement is required to be used to secure an offset site. The ecosystem and species credit offset requirements for the biodiversity impacts of the Proposal are detailed below.

8.1.1 Impacts on native vegetation

Loss of landscape and site value for the PCT and its associated ecosystem species, as determined using the credit calculator, is presented in Table 8-1. The vegetation to be offset is shown in Figure 9. The full credit report is provided in Appendix F.

Table 8-1 Impact summary for PCTs and associated ecosystem credit species requiring offsets and their required credits

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystem credits required
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117): Moderate/Good	▪ Spotted-tailed Quoll	15.00	84.38	221

8.1.2 Impacts on threatened species

Impacts to threatened species credit species and their associated species are summarised in Table 8-2. The full credit report is provided in Appendix F.

Table 8-2 Impact summary for threatened species credit species requiring offsets and their required credits

Common name	Scientific name	Status	Impacts	Number of species credits required
Koala	*Phascolarctos cinereus*	Vulnerable	3.4 ha	84
Green-thighed Frog	*Litoria brevipalmata*	Vulnerable	3.4 ha	248
Southern Myotis	*Myotis macropus*	Vulnerable	0.12 ha	3

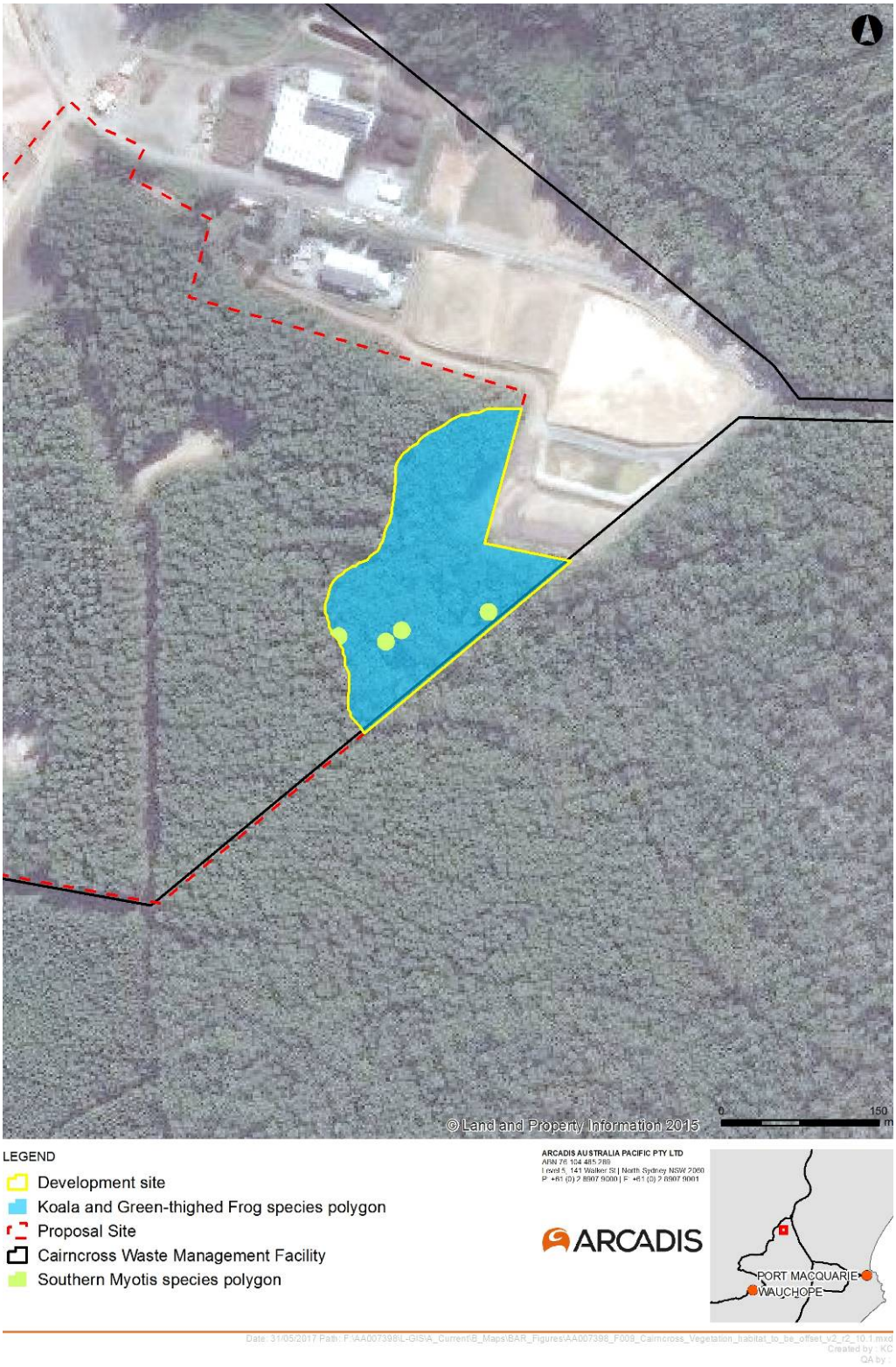


Figure 10 Vegetation/habitat to be offset

9 CONCLUSION

This Biodiversity Assessment Report (BAR) has been prepared for the Proposal in accordance with the Framework for Biodiversity Assessment (FBA), as required by the SEARs.

The assessment is based on desktop research and detailed field surveys, undertaken in April and May 2015. The biodiversity impacts and offset requirements for the Proposal were calculated using the FBA Credit Calculator in accordance with the FBA guidelines.

The majority of the Proposal Site is subject to an authorisation for timber plantation under the NSW *Plantations and Reafforestation Act 1999.* As the clearing of vegetation within the authorised plantation area has been approved, the impacts of clearing this vegetation are not assessed as part of this biodiversity assessment report.

In the east of the Proposal Site is an area of native vegetation that is excluded from the authorisation for timber plantation. This remaining area of native vegetation, approximately 3.4 hectares, is the Development Site for the current assessment.

The vegetation on the Development Site consisted of a tall open forest with a mature canopy of eucalypts. The midlayer included small trees and tall and the ground layer was generally grassy and herbaceous. In the eastern parts of the Development Site, the ground was slightly boggy and swamp forest elements of the community were dominant. The vegetation appeared to have been recently burnt, but was regenerating. Occurrence of exotic species in the Development Site was low, limited to some small patches of *Lantana camara* (Lantana).

One native Plant Community Type (PCT) was identified on the Development Site following review of existing information and structural and floristic attributes recorded during site assessments: Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117). This PCT does not fall within the definition of any threatened ecological communities listed under the TSC Act and/or the EPBC Act.

Seven threatened flora species were identified in the FBA credit calculator as predicted flora species credit species. None of the predicted threatened flora species credit species were recorded on the Development Site.

A total of 19 threatened fauna species were identified, based on the PCTs identified on the Development Site, as predicted ecosystem credit species. Assessment of the potential presence of each species in the Development Site found that there is potential habitat for thirteen species, marginal habitat for two species and no potential habitat for four species. Three threatened fauna ecosystem credit species were recorded on or near the Development Site, namely Eastern Freetail-bat, Eastern Bentwing-bat and Little Bentwing-bat, all of which are listed as Vulnerable under the TSC Act.

Fifteen threatened fauna species were identified in the credit calculator as predicted fauna species credit species. The Development Site is considered to support suitable potential habitat for eight of these species, with marginal habitat present for an additional four species. Targeted surveys for these species identified two species credit species from the list generated by the calculator: Koala and Green-thighed Frog. An additional species not listed in the calculator, Southern Myotis, was also identified on the Development Site.

An additional assessment of the likelihood of occurrence of threatened flora and fauna species listed under the EPBC Act in the Development Site was undertaken. A search of the DoEE Protected Matters Search Tool found 10 threatened flora species and 43 threatened fauna species listed under the EPBC Act that are known or likely to occur within 10 kilometres of the Development Site. Of these, one flora species and one

fauna species are considered to have a moderate likelihood of occurrence, and 17 fauna species are considered to have a high likelihood of occurrence. Two MNES were recorded on or immediately adjacent to the Development Site: Koala, listed as Vulnerable under the EPBC Act, and the Rufous Fantail, listed as Migratory under the EPBC Act.

Assessments of Significance were undertaken for *Cynanchum elegans*, Koala, Spot-tailed Quoll, Grey-headed Flying-fox, Giant Barred Frog and Rufous Fantail which found that impacts would not be significant and a Referral to the Minister for the DoEE is not required.

In addition, a review of the site information and the EPBC Act referral guidelines for the vulnerable Koala (Commonwealth of Australia 2014) by Biolink Ecological Consultants (Appendix D) found that:

- Activity on the site is likely to involve transient use by an individual as opposed to the presence of a resident population of several koalas.
- The subject site and the immediate surrounding vegetation is not large enough in size nor of an adequate stage of growth/quality to support a resident population of koalas.
- Any risk that the removal of vegetation at the site would result in a reduction in the overall area of occupancy of the remaining, broader koala population is negligible.

It was concluded that an EPBC referral for the species was not required.

The assessment considered the construction and operational impacts of the Proposal. The potential biodiversity impacts of the Proposal are as follows:

- Clearing of native vegetation, comprising 3.4 ha of Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion.
- Loss of specific fauna habitat components, including live trees, tree hollows, foraging resources (myrtaceous and flowering trees and shrubs), groundlayer habitats such as ground timber and well-developed leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna occurring within the locality. A total of 3.4 hectares of terrestrial fauna habitat occurs within the Development Site and would be removed during construction of the proposal.
- Minimal impact on wildlife and habitat corridors, as the Proposal is not considered likely to reduce fauna movement throughout the locality, although clearing of vegetation may reduce the capacity of some less mobile fauna to move within, and between patches of remaining habitat. In order to maintain connectivity between larger areas of native vegetation adjoining the site, a 50 metre wide Koala connectivity corridor would be maintained across the southern boundary of the Proposal site.
- During excavation for the Proposal it is possible that groundwater heads may be higher than average in the event of a long wet weather period; in this case, dewatering for Stages 1 and 2 may be required. During this period, the drawdown is predicted to be within the range of 0.01 m to 0.1 m. While drawdown of 0.1 m is not insignificant, given that this scenario would only occur following a long wet weather period it is considered unlikely that groundwater dependent ecosystems would be subject to impacts as a result of the drawdown. Drawdown is predicted to be negligible at a distance of 1.2 km from the Proposal Site boundary.
- Fauna injury or mortality could occur during vegetation clearing activities or construction. The majority of fauna species recorded were highly mobile bird species and these species are likely to be able to move away from vegetation clearing activities quite readily. Any fauna inhabiting the hollows in hollow-bearing

trees or that are unable to disperse away from areas under active clearing may be injured during clearing.

- Edge effects in fragmented vegetation, include alterations in humidity, light, moisture, wind, temperature and noise and soil profile conditions. These effects impact on the adjoining native vegetation by affecting seed germination, flora and fauna species composition and weed establishment.
- The construction phase of the Proposal may impact upon the roosting, breeding and foraging activities of locally occurring fauna, as a result of increased exposure to light, noise, dust, construction vehicles and people.
- Risk of indirect impacts to remnant native vegetation adjacent to construction areas. This includes a risk of increased sedimentation and changes to hydrology which could affect the health of native vegetation communities and flora populations.

Impacts on the identified ecological values should be avoided as far as practicable. Where impacts cannot be avoided, the scale and extent of impacts has been determined, and a range of mitigation measures have been recommended to ameliorate impacts on the biodiversity values during and following construction.

The Proposal includes establishment and management of a 50 metre wide Koala connectivity corridor along the southern edge of the Proposal Site. The Koala connectivity corridor will be managed to encourage use by native species, specifically Koalas. Management for this area would be incorporated into the Operational Environmental Management Plan (OEMP) to be prepared for the Proposal.

Under the *NSW Biodiversity Offsets Policy for Major Projects*, a biobanking agreement is required to be used to secure an offset site. The ecosystem and species credit offset requirements have been determined for the Proposal:

- 221 ecosystem credits for Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion.
- 84 species credits for Koala.
- 248 species credits for Green-thighed Frog.
- 3 species credits for Southern Myotis.

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APPENDIX A

Authorisation for timber plantation issued under the *Plantations and Reafforestation Act 1999*

NEW SOUTH WALES

NSW DEPARTMENT OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES

Authorisation for timber plantation
issued under the *Plantations and Reafforestation Act 1999*

Registered number	GR0412P

Plantation application

Applicant name(s)	Hastings Council
Postal address	PO Box 84 PORT MACQUARIE 2444
Property address	Cairncross Waste Management Facility, Pacific Highway, Telegraph Point
Land and area under application	Lots 4 & 5 DP1041766 Parish Cairncross, County Macquarie

Authorisation

Class of plantation	Timber plantation
Made on (date)	The date of the signature below.
Authorisation	☐ granted in accordance with the Code and the attached Plantation Plan ☐ granted in accordance with the Code and subject to conditions described in Attachment 1 and the attached Plantation Plan ☐ Refused. See Attachment 2
Authorisation to operate from	The date of the signature below.
Duration	The authorisation of a plantation remains in force unless it is cancelled by the Minister in accordance with this Act.

Right of appeal

If you are dissatisfied with this decision, under section 24 of the *Plantation and Reafforestation Act 1999* you have the right to appeal to the Land and Environment Court within 28 days after which you receive this notice.

Signed

on behalf of the consent authority

Signature

Name

John Ball
Regional Plantations Officer

by delegation from the Hon. Craig Knowles
Minister for Natural Resources

Date

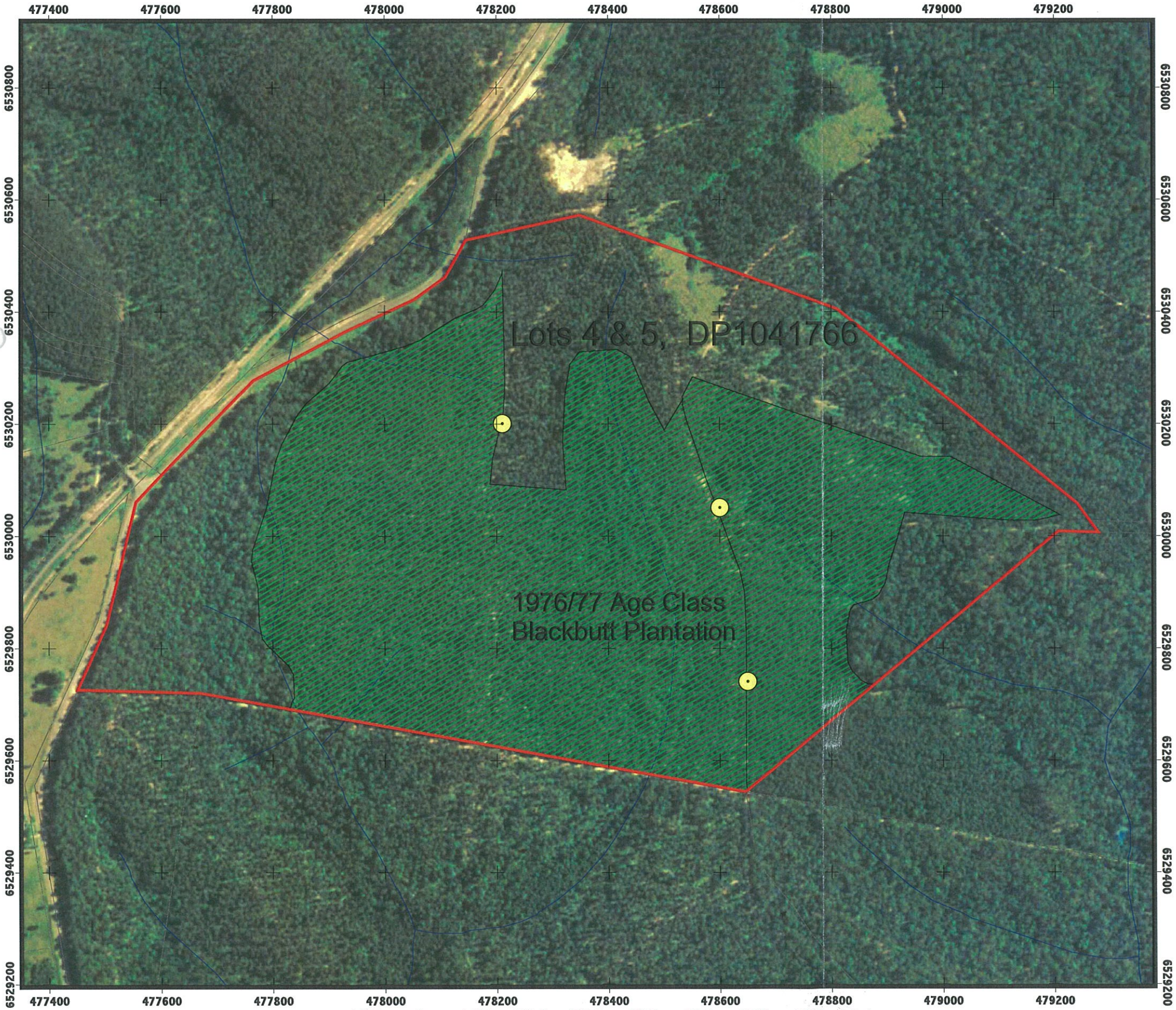
26th October 2004

Attachment No. 1: Conditions of authorisation for GR0412P

Authorisation is granted subject to the conditions described below:

1. Areas of the authorised plantation that are cleared and withdrawn from plantation activities to facilitate expansion of the waste management facility are to be advised to the Department of Infrastructure, Planning and Natural resources on a biennial basis commencing in December 2006.

Plantation Plan GR0412P - Map 1 of 1



Department of Infrastructure, Planning and Natural Resources

Registered Number: GR0412P
Name of Applicants: Hastings Council

Property Name: Cairncross Waste Facility
Locality: Pembroke

Property Details: Lots 4 & 5, DP1041766
Parish: Cairncross
County: Macquarie

Local Government Area: Hastings

Soil Regolith Class: R3
Rainfall Erosivity: 4800

Legend

- Property boundary
- Plantation area authorised as per Plantations & Reafforestation Act 1999
- Aboriginal Sites (10 metre buffer)

Scale 1: 7,500

N

This plan is not AGD compliant. The plan is projected using Australian Map Grid (AMG). The accuracy of the cadastre at 1:25,000 is +/- 15 metres. Some variation between the cadastre and the photo base may be evident due to the inherent characteristics of the aerial photograph.

APPENDIX B

Flora and fauna species recorded on the Proposal site

Flora species recorded on the Proposal Site and in Quadrats 4 and 5 on the Development Site.

*Notes: 1. * indicates exotic species*

2. Values in quadrat columns denote estimated cover of the species within the 20 m x 20 m quadrat.

Family		Botanical name	Common name	Q04	Q05
Pteridophytes					
Blechnaceae		*Blechnum cartilagineum*	Gristle Fern		
Dennstaedtiaceae		*Pteridium esculentum*	Bracken		1
Dicksoniaceae		*Calochlaena dubia*	Rainbow Fern, False Bracken		
Angiosperms - Dicotyledons					
Acanthaceae		*Pseuderanthemum variabile*	Pastel Flower	1	1
Apiaceae		*Hydrocotyle peduncularis*			1
Apocynaceae		*Marsdenia rostrata*	Common Milkvine	1	
		Parsonsia straminea	Common Silkpod, Monkey Rope		
Araliaceae		*Polyscias sambucifolia*	Elderberry Panax	1	1
Asteraceae	*	*Ageratum houstonianum*	Floss Flower		
	*	*Bidens pilosa*	Cobblers Pegs		
		Ozothamnus diosmifolius	White Dogwood		
	*	*Senecio madagascariensis*	Fireweed, Madagascar Ragwort		
		Sigesbeckia orientalis	Indian Weed		
	*	*Sonchus oleraceus*	Common Sow-thistle, Milk-thistle		
		Vernonia cinerea			
Casuarinaceae		*Allocasuarina littoralis*	Black She-Oak	2	
Convolvulaceae		*Dichondra repens*	Kidney-weed, Mercury Bay Weed		1
		Polymeria calycina	Polymeria		1
Dilleniaceae		*Hibbertia aspera*	Rough Guinea-flower		1
		Hibbertia scandens	Twining Guinea-flower		

Family	Botanical name	Common name	Q04	Q05
Ericaceae Styphelioideae	*Leucopogon juniperinus*	Long-flowered Beard-heath		
Fabaceae Caesalpinioideae	* *Senna septemtrionalis*	Smooth Cassia, Arsenic Bush		
Fabaceae Faboideae	*Desmodium rhytidophyllum*	Tick-trefoil		
	Glycine clandestina	Twining Glycine		
	Hardenbergia violacea	False Sarsaparilla		
	Kennedia rubicunda	Dusky Coral-pea		
	Pultenaea retusa	Notched Bush-pea		
Fabaceae Mimosoideae	*Acacia falcata*	Sickle Wattle		
	Acacia floribunda	White Sally		5
Goodeniaceae	*Dampiera sylvestris*	Blue Dampiera	1	1
	Goodenia hederacea	Ivy Goodenia		
Haloragaceae	*Gonocarpus tetragynus*	Common Raspwort		1
Lobeliaceae	*Pratia purpurascens*	Whiteroot	1	1
Menispermaceae	*Stephania japonica*	Snake Vine		
Myrtaceae	*Callistemon salignus*	White Bottlebrush, Pink-tips	60	15
	Corymbia intermedia	Pink Bloodwood	5	2
	Eucalyptus globoidea	White Stringybark	2	2
	Eucalyptus microcorys	Tallowwood	10	5
	Eucalyptus pilularis	Blackbutt		
	Eucalyptus propinqua	Small-fruited Grey Gum		
	Eucalyptus resinifera subsp. resinifera	Red Mahogany	3	1
	Eucalyptus saligna	Sydney Blue Gum		
	Eucalyptus siderophloia	Grey Ironbark		
	Lophostemon confertus	Brush Box		
	Melaleuca linariifolia	Flax-leaved Paperbark		1

Family		Botanical name	Common name	Q04	Q05
		Melaleuca quinquenervia	Broad-leaved Paperbark		
Oxalidaceae		*Oxalis perennans*			1
Phyllanthaceae		*Breynia oblongifolia*	Coffee Bush	1	1
		Glochidion ferdinandi	Cheese Tree		1
Phytolaccaceae	*	*Phytolacca octandra*	Inkweed		
Pittosporaceae		*Billardiera scandens*	Hairy Apple Berry		1
Polygonaceae	*	*Acetosa sagittata*	Rambling Dock, Turkey Rhubarb		
Proteaceae		*Persoonia conjuncta*			1
Rhamnaceae		*Alphitonia excelsa*	Red Ash, Soap Tree	2	1
Rosaceae		*Rubus moluccanus*	Molucca Bramble		1
Rubiaceae		*Opercularia diphylla*	Stinkweed		
Sapindaceae		*Dodonaea triquetra*	Hopbush		
Solanaceae	*	*Solanum mauritianum*	Tree Tobacco, Wild Tobacco		
Thymelaeaceae		*Pimelea linifolia*	Slender Rice Flower		
Verbenaceae	*	*Lantana camara*	Lantana	2	3
Vitaceae		*Cissus hypoglauca*	Native Grape, Water Vine		
Angiosperms - Monocotyledons					
Anthericaceae		*Thysanotus juncifolius*			
Cyperaceae		*Carex sp.*	Sedge		1
		Gahnia clarkei	Tall Saw-sedge	50	20
		Lepidosperma laterale	Variable Sword-sedge		
Lomandraceae		*Lomandra longifolia*	Spiny-headed Mat-rush		1
		Lomandra multiflora	Many-flowered Mat-rush		
Luzuriagaceae		*Eustrephus latifolius*	Wombat Berry	1	
Orchidaceae		*Cryptostylis sp.*			1
		Pterostylis sp.	Greenhood Orchid		
Phormiaceae		*Dianella caerulea*	Blue Flax-lily		1

Family	Botanical name	Common name	Q04	Q05
Poaceae	*Aristida vagans*	Threeawn Speargrass		
	Entolasia marginata	Bordered Panic		40
	Entolasia stricta	Wiry Panic		20
	Imperata cylindrica	Blady Grass	10	1
	Microlaena stipoides	Weeping Grass, Meadow Rice-grass		10
	Oplismenus aemulus	Broad-leaved Basket Grass		
	Oplismenus imbecillis	Narrow-leaved Basket Grass	2	5
	Panicum simile	Two-colour Panic		
	* *Paspalum dilatatum*	Paspalum		
	Themeda australis	Kangaroo Grass		

Fauna species recorded on the Proposal Site

Observation type

H	Hair, feathers or skin	Q	Camera
O	Observed	U	Ultrasonic recording
OW	Observed and heard call	W	Heard call
P	Scat		

Fauna species list

Conservation Status	Common Name	Scientific name	Observation type	Survey/Opportunistic observation	Certainty of ID
Amphibians					
	Broad-palmed Frog	*Litoria latopalmata*	O	Tadpole survey	Probable
	Common Eastern Froglet	*Crinia signifera*	W	Opportunistic & Frog survey	
	Eastern Dwarf Tree frog	*Litoria fallax*	W	Opportunistic & Frog survey	
	Striped Marsh Frog	*Limnodynastes peronii*	O	Opportunistic & Tadpole survey	
V-TSC Act	Green-thighed Frog	*Litoria brevipalmata*	Anecdotal	Opportunistic	Probable
	Great Barred Frog	*Mixophyes fasciolatus*	O	Tadpole survey	Probable

Conservation Status	Common Name	Scientific name	Observation type	Survey/Opportunistic observation	Certainty of ID
Birds					
	Australian King Parrot	*Alisterus scapularis*	W	Bird survey	
	Australian Magpie	*Cracticus tibicen*	W	Opportunistic	
	Australian Raven	*Corvus coronoides*	W	Opportunistic	
	Australian Wood Duck	*Chenonetta jubata*	O	Opportunistic	
	Bar-shouldered Dove	*Geopelia humeralis*	O	Opportunistic	
	Bell Miner	*Manorina melanophrys*	W	Opportunistic	
	Black-faced Cuckoo Shrike	*Coracina novaehollandiae*	W	Bird survey, Opportunistic	
	Brown Thornbill	*Acanthiza pusilla*	W	Bird survey	
	Brush Cuckoo	*Cacomantis variolosus*	W	Opportunistic Bird survey	
Exotic	Common Myna	*Sturnis tristis*	O	Opportunistic	
	Crimson Rosella	*Platycercus elegans*	W	Opportunistic	

Conservation Status	Common Name	Scientific name	Observation type	Survey/Opportunistic observation	Certainty of ID
	Eastern Spinebill	*Acanthorhynchus tenuirostris*	W	Opportunistic	
	Eastern Whipbird	*Psophodes olivaceus*	W	Bird survey, Opportunistic	
	Eastern Yellow Robin	*Eopsaltria australis*	W	Opportunistic	
	Fan-tailed Cuckoo	*Cacomantis flabelliformis*	W	Bird survey	
	Golden Whistler	*Pachycephala pectoralis*	W	Bird survey	
	Grey Fantail	*Rhipidura albiscapa*	W	Bird survey	
	Lewin's Honeyeater	*Meliphaga lewinii*	W	Bird survey	
	Little Raven	*Corvus mellori*	W	Bird survey	
	Magpielark	*Grallina cyanoleuca*	W	Bird survey	
	Masked Lapwing	*Vanellus miles*	OW	Opportunistic, Spotlight	
	Noisy Friarbird	*Philemon corniculatus*	W	Opportunistic	
	Pied Currawong	*Strepera graculina*	O W	Spotlight survey, Opportunistic	

Conservation Status	Common Name	Scientific name	Observation type	Survey/Opportunistic observation	Certainty of ID
	Red-browed Finch	*Neochmia temporalis*	OW	Opportunistic	
M-EPBC	Rufous Fantail	*Rhipidura rufifrons*	O	Opportunistic	
	Rufous Whistler	*Pachycephala rufiventris*	O	Opportunistic	
	Scarlet Honeyeater	*Myzomela sanguinolenta*	W	Bird survey, Opportunistic	
	Spotted Pardalote	*Pardalotus punctatus*	W	Bird survey, Opportunistic	
	Variegated Fairy-wren	*Malurus lamberti*	W	Bird survey, Opportunistic	
	Wedge-tailed Eagle	*Aquila audax*	O	Opportunistic – pair circling over canopy	
	Welcome Swallow	*Hirundo neoxena*	O	Opportunistic	
	White-throated Treecreeper	*Cormobates leucophaeus*	W	Bird survey, Opportunistic	
	White-necked Heron	*Ardea pacifica*	O	Opportunistic	
	Willie Wagtail	*Rhipidura leucophrys*	O		
	Yellow-faced Honeyeater	*Lichenstomus chrysops*	W	Bird survey	
	Yellow Thornbill	*Acanthiza nana*	W	Bird survey, Opportunistic	

Conservation Status	Common Name	Scientific name	Observation type	Survey/Opportunistic observation	Certainty of ID
Mammals					
Exotic	Black Rat	*Rattus rattus*	Q/H	Camera, hair tube	
	Brown Antechinus	*Antechinus stuartii*	Q/H	Camera, hair tube	Probable (camera)
	Bush Rat	*Rattus fuscipes*	Q/H	Camera, hair tube	
	Chocolate Wattle Bat	*Chalinolobus morio*	U	Anabat survey at dam	Probable
	Common Dunnart	*Sminthopsis murina*	Q	Camera	Probable
	Common Ringtail Possum	*Pseudocheirus peregrinus*	P	Opportunistic	
V-TSC Act	Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	U	Anabat survey in Development Site	Confident
	Eastern Horseshoe Bat	*Rhinolophus megaphyllus*	U	Anabat survey in Development Site Anabat survey at dam	Confident
	Eastern Forest Bat	*Vespadelus pumilus*	U	Anabat survey in Development Site Anabat survey at dam	Probable

Conservation Status	Common Name	Scientific name	Observation type	Survey/Opportunistic observation	Certainty of ID
V-TSC Act	Eastern Freetail-bat	*Mormopterus norfolkensis*	U	Anabat survey in Development Site Anabat survey at dam	Confident
	Eastern Grey Kangaroo	*Macropus giganteus*	O/Q	Opportunistic, camera	
Exotic	Fox	*Vulpes vulpes*	Q	Camera	
Exotic	Goat	*Capra hircus*	O	Opportunistic	
Exotic	House Mouse	*Mus musculus*	H	Hair tube	
V-TSC Act **VP-EPBC Act**	Koala	*Phascolarctos cinereus*	Q/P	Camera, Koala SAT survey	
V-TSC Act	Little Bentwing-bat	*Miniopterus australis*	U	Anabat survey in Development Site	Confident
	Long-nosed Bandicoot	*Perameles nasuta*	H	Hair tube	
	Northern Brown Bandicoot	*Isoodon macrourus*	Q	Camera	Confident
	Red-necked Wallaby	*Macropus rufogriseus*	P	Opportunistic	Possible
	Short-beaked Echidna	*Tachyglossus aculeatus*	Q	Camera	

Conservation Status	Common Name	Scientific name	Observation type	Survey/Opportunistic observation	Certainty of ID
V-TSC Act	Southern Myotis	*Myotis macropus*	U	Anabat survey in Development Site	Probable
	Sugar Glider	*Petaurus breviceps*	O	Spotlight	Probable
	Swamp Wallaby	*Wallabia bicolor*	O/P	Opportunistic	
	Unidentified Antechinus	*Antechinus sp.*	Q/H	Camera (probable), hair tube	
	Unidentified Brushtail Possum	*Trichosurus sp.*	H	Hair tube	
	Unidentified Nyctophilus	*Nyctophilus sp.*	U	Anabat survey in Development Site Anabat survey at dam	Probable
	Unidentified Vespadelus	*Vespadelus sp.*	U	Anabat survey in Development Site Anabat survey at dam	Probable
	White-striped Freetail-bat	*Austronomus australis*	U	Anabat survey in Development Site	Confident
Reptiles					
	Red-tailed Calyptotis	*Calyptotis ruficauda*	O	Reptile survey	

APPENDIX C

Likelihood of occurrence of threatened species

Likelihood of threatened flora species listed under the EPBC Act to occur on the Development Site

Scientific name	EPBC Act Status	Habitat	Likelihood of occurrence on Proposal Site
Allocasuarina defungens Dwarf Heath Casuarina	Endangered	From the Nabiac area north to Byron Bay. Grows mainly in tall heath on sand, but can also occur on clay soils and sandstone. Also extends onto exposed nearby-coastal hills or headlands adjacent to sandplains.	Low. Development Site does not support preferred habitat.
Arthraxon hispidus Hairy Jointgrass	Vulnerable	Moisture and shade-loving species found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Low. Development Site does not support preferred habitat.
Cryptostylis hunteriana Leafless Tongue-orchid	Vulnerable	Orchid with an upright flower-stem to 45 cm tall. Sparse distribution along east coast. Known from a range of communities including swamp, heath and most typically woodland dominated by *Eucalyptus sclerophylla, E. sieberi, Corymbia gummifera and Allocasuarina littoralis*.	Low Development Site does not support preferred habitat.
Cynanchum elegans White-flowered Wax Plant	Endangered	A climber restricted to the east coast of NSW, inland to Merriwa. Occurs on margins of dry rainforest, also littoral rainforest, open forest and woodland, and scrub.	Moderate. Development Site supports potential habitat. Closest record is approximately 8 km to west of Development Site.

Scientific name	EPBC Act Status	Habitat	Likelihood of occurrence on Proposal Site
Euphrasia arguta	Critically Endangered	An erect annual herb 20-35 cm high, branches densely hairy. Recently rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008. Current known populations are located in the Nundle State Forest in eucalypt forest with a mixed grass and shrub understorey. Has been observed to die off over the winter months. Active growth and flowering is between January and April.	Low. Development Site does not support preferred habitat.
Macadamia integrifolia Macadamia Nut	Vulnerable	Grows in remnant rainforest, preferring partially open areas such as rainforest edge.	Low. Development Site does not support preferred habitat.
Melaleuca biconvexa Biconvex Paperbark	Vulnerable	Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low. Development Site does not support preferred habitat.
Parsonsia dorrigoensis Milky Silkpod	Endangered	Subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest up to 800 m, on brown clay soils.	Low. Development Site does not support preferred habitat.
Phaius australis Lesser Swamp-orchid	Endangered	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Low. Development Site does not support preferred habitat.

Scientific name	EPBC Act Status	Habitat	Likelihood of occurrence on Proposal Site
Thesium australe Austral Toadflax	Vulnerable	A small, straggling herb to 40 cm tall. Occurs in grassland or grassy woodland, commonly in association with *Themeda australis* in damp areas.	Low. Development Site does not support preferred habitat.

Likelihood of threatened fauna species listed under the EPBC Act to occur on the Development Site

Note: Species restricted to marine environments and offshore islands have been excluded from this table.

Name	EPBC Act Status	Habitat	Likelihood of occurrence on Development Site
Anthochaera phrygia Regent Honeyeater	Critically Endangered	Occurs in temperate eucalypt woodlands, most commonly box-ironbark associations and wet lowland coastal forests. Nests usually constructed in eucalypts, casuarinas or mistletoes. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes	Low. Development Site does not support preferred habitat.
Botaurus poiciloptilus Australasian Bittern	Endangered	Widespread distribution but uncommon across south-eastern Australia. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spike rushes (*Eleocharis* spp), where it forages at night for amphibians, invertebrates and crustaceans. Nests are built within densely vegetated wetlands on a platform of reeds.	Low. Development Site does not support preferred habitat.
Chalinolobus dwyeri Large-eared Pied Bat	Vulnerable	Found mainly in areas with extensive cliffs and caves. It is generally rare with a very patchy distribution in NSW, with scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*). Forage in low to mid-elevation dry open forest and woodland and well-timbered areas containing gullies close to roosting habitat, for small, flying insects. Most likely hibernates through coolest months.	Low. Development Site does not support preferred habitat.

Name	EPBC Act Status	Habitat	Likelihood of occurrence on Development Site
Dasyornis brachypterus Eastern Bristlebird	Endangered	Distribution confined to three disjunct areas in NSW: the Queensland/NSW border, the Illawarra and the NSW/Victoria border. Species inhabits dense, low vegetation including heath and open woodland with a heathy understorey. Forages on the ground for insects, rarely flies. Nest constructed on the ground amongst dense vegetation.	Low. No records in the locality. Development Site does not support preferred habitat.
Dasyurus maculatus maculatus Spotted-tailed Quoll	Endangered	Found along the escarpments, tablelands and coast of the eastern seaboard from the Bundaberg area in south-east Qld south through NSW to Victoria and Tasmania. Known from dry and moist eucalypt forests and rainforest. Species tends to move along drainage lines and make dens in fallen hollow logs or among large rocky outcrops. Usually nocturnal but are known to hunt and bask during the day. Hunts terrestrially and arboreally.	High. Numerous records within 10 km of the Development Site. Development Site supports preferred habitat.
Erythrotriorchis radiates Red Goshawk	Vulnerable	Inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	Low. No records in the locality. Development Site does not support preferred habitat.
Grantiella picta Painted Honeyeater	Vulnerable	Nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern	Low. No records in the locality.

Name	EPBC Act Status	Habitat	Likelihood of occurrence on Development Site
		Queensland. Inhabits Boree/ Weeping Myall, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	Development Site does not support preferred habitat.
Lathamus discolor Swift Parrot	Critically Endangered	Migrates from breeding grounds in Tasmania to the Australian mainland in winter. Preferred over-winter habitat is woodlands and riparian vegetation where there are winter flowering eucalypts such as the Swamp Mahogany, *Eucalyptus robusta*, in coastal areas.	Low. No records within 10km of the Development Site. Winter flowering eucalypts are present within the Development Site and may provide seasonal foraging habitat.
Litoria aurea Green and Golden Bell Frog	Vulnerable	Isolated, scattered populations throughout coastal NSW, several within the Sydney metropolitan area, Shoalhaven and mid-north coast. Breeding habitat comprises natural and constructed waterbodies including wetlands, stormwater detention basins, marshes, dams and streams-side, preferably those that are unshaded but with fringing vegetation. Forage for invertebrates within grassy habitats near breeding habitat. May shelter under vegetation, rocks and building materials such as fibro, sheet iron or bricks.	Low. Only one record of the species, dated from 1974, within 10km of the Development Site. Development Site does not support preferred habitat.

Name	EPBC Act Status	Habitat	Likelihood of occurrence on Development Site
Mixophyes balbus Stuttering Frog	Vulnerable	Typically found in association with permanent streams through temperate and sub-tropical rainforest and wet sclerophyll forest, rarely in dry open tableland riparian vegetation, and also in moist gullies in dry forest. In north-east NSW, the species has a preference for the interiors of large forest tracts in areas with relatively cool mean annual temperatures. These sites are typically free from any disturbance with a thick canopy and relatively simple understorey. Not associated with ponds or ephemeral pools.	Low. Species has not been recorded within 10km of the Development Site. Development Site does not support preferred habitat.
Mixophyes iteratus Giant Barred Frog	Endangered	Occurs from the east coast west to the Hawkesbury River, where it inhabits rainforests, moist eucalypt forest or nearby dry eucalypt forest below elevations of 1000m. Require shallow, flowing rocky streams for breeding in summer. Outside of breeding period, is found sheltering and foraging amongst deep, damp leaf litter.	Moderate. No breeding habitat present, however, foraging habitat and shelter present. Species has not been recorded within 10km of the Development Site.
Petauroides volans Greater Glider	Vulnerable	Largely restricted to eucalypt forests and woodlands. Typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species	Low. Records from 1998 and 2001 located over 7 km west of the Development Site.

Name	EPBC Act Status	Habitat	Likelihood of occurrence on Development Site
			No breeding habitat present, however foraging habitat present.
Phascolarctos cinereus Koala	Vulnerable	Distribution of the species throughout Australia is highly fragmented. In NSW it mainly occurs on the central and north coasts with some populations in the western region inhabiting eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Known. Species recorded on Development Site. Koala feed trees are present.
Potorous tridactylus tridactylus Long-nosed Potoroo	Vulnerable	Distribution in NSW restricted to coastal heaths and forests east of the Great Dividing Range. Also known from dry and wet sclerophyll forest. Requires dense understorey and groundlayer vegetation for sheltering. Forages from fungi, roots tubers and insects in the soil.	Low. Species has not been recorded within 10km of the Development Site. Preferred habitat present, however not recorded in targeted surveys.
Pseudomys novaehollandiae New Holland Mouse	Vulnerable	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes	Low. Species has not been recorded within 10km of the Development Site.

Name	EPBC Act Status	Habitat	Likelihood of occurrence on Development Site
			Preferred habitat present, however not recorded in targeted surveys.
Pteropus poliocephalus Grey-headed Flying-fox	Vulnerable	Found within 200km of the east coast of Australia. Roosting camps commonly found in gullies, close to water, in vegetation with a dense canopy. Camps typically located within 20km of a regular food source; nectar and pollen of native trees and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	High. Numerous records within 10 km of the Development Site. Foraging habitat present.
Rostratula australis Australian Painted Snipe	Endangered	Occurs throughout Australia. Inhabits shallow freshwater wetlands, vegetated ephemeral and permanent lakes and swamps, and inundated grasslands. Roosts during the day in dense vegetation and is active at dusk, throughout the night and dawn. It nests on the ground amongst tall reed-like vegetation near water, and forages near the water's edge and on mudflats for invertebrates and seeds.	Low. Development Site does not support preferred habitat. Species has not been recorded within 10km of the Development Site.

APPENDIX D

EPBC Act Assessments of Significance

Cynanchum elegans, White-flowered Wax Plant

Cynanchum elegans (White-flowered Wax Plant) is listed as Endangered under the EPC Act. *C. elegans* is a climber restricted to the east coast of NSW, inland to Merriwa. It occurs on margins of dry rainforest, also littoral rainforest, open forest and woodland, and scrub. The Development Site supports potential habitat. The closest record is approximately 8 km to west of Development Site and as such, the species was considered to have a moderate likelihood of occurrence and could be impacted by the Proposal.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- **Lead to a long-term decrease in the size of a population**

Cynanchum elegans was not recorded on the Development Site, however potential habitat for this species was identified. Approximately 3.4 hectares of potential habitat would be removed. This does not represent a large proportion of potential habitat for the species, and given its low occurrence in the locality, it is unlikely to lead to a decrease in population size.

- **Reduce the area of occupancy of the species**

The Proposal would require the removal of 3.4 hectares of Blackbutt - Pink Bloodwood shrubby open forest which provides potential habitat for *Cynanchum elegans*. The extent of habitat to be removed is considered to be minor given the availability of substantial areas of suitable habitat remaining in nearby areas. This would not reduce the area of occupancy of the species.

- **Fragment an existing population into two or more populations**

The Proposal would not fragment the population of *C. elegans* into two or more populations. It would be undertaken on the edge of cleared land resulting in a reduction in suitable habitat for the species, but would not isolate any pockets of habitat leading to a fragmentation of any existing population.

- **Adversely affect habitat critical to the survival of a species**

No areas pertaining to *C. elegans* are identified on the registers of critical habitat kept for the DoEE or OEH. Given the species was not identified on the Development Site and the site is located on the edge of a cleared landfill site and adjacent to forestry plantation, it is unlikely to contain habitat critical to the species survival. The 3.4 hectares of potential habitat to be impacted is therefore not likely to adversely affect habitat critical to the survival of the species.

- **Disrupt the breeding cycle of a population**

The following disturbances are thought to impact on the lifecycle of *Cynanchum elegans* (NPWS 2002a):

- Loss of individuals – the proposal is not likely to result in the loss of any individuals of *Cynanchum elegans.*
- Fragmentation of habitat – the proposal would not greatly increase fragmentation of potential habitat for the species.
- Modification of habitat – the proposal may create a greater disturbed edge area adjoining potential habitat, but is not likely to modify habitat.
- Damage to the soil seed bank – seeds of this species are wind dispersed and released in a non-dormant state, hence are unlikely to persist in the soil seedbank.

- Altered fire regime – the proposed development is not likely to alter the fire regime of the local area.

Impacts to the breeding cycle of *C. elegans* are considered unlikely due to the absence of a population of the species on the Proposal site.

- **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Cynanchum elegans was not recorded on the Development Site, however potential habitat for this species was identified. Approximately 3.4 hectares of potential habitat would be removed. This does not represent a large proportion of potential habitat for the species, and given its low occurrence in the locality, it is unlikely to lead to a decline in the species.

- **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**

The action is unlikely to result in the establishment of an invasive species that is harmful to the *C. elegans*. The action will involve the clearing of native vegetation and establishment of a landfill site. The risk of invasive species spread during clearing and landfill operations would be managed through weed control measures in the CEMP and OEMP.

- **Introduce disease that may cause the species to decline, or**

Potential introduction of plant pathogens into adjacent habitat is unlikely as soil and water, vegetation clearing and other activities would be actively managed during construction and operation of the landfill with an EMP. The action is therefore highly unlikely to introduce disease that may cause the *C. elegans* to decline.

- **Interfere with the recovery of the species.**

There is currently no Recovery Plan in place for *Cynanchum elegans*. Although the proposal will remove potential habitat for the species, it is unlikely that it would interfere with the recovery of *C. elegans*.

Conclusion

Under the EPBC Act an action requires approval from the Australian Government Minister for the Environment and Energy (DoEE) if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance such as *Cynanchum elegans*. Based on the above assessment, it is concluded that the action would not have a significant impact on *C. elegans* as it would result in the removal of a relatively small amount of potential habitat and would not reduce the area of occupancy of the species. Furthermore, it is unlikely to introduce diseases or invasive species that would impact this species. As such the action does not require referral to DoEE.

Koala, *Phascolarctos cinereus* (combined populations of QLD, NSW and the ACT)

Koala (*Phascolarctos cinereus*), combined populations of QLD, NSW and the ACT, is listed as Vulnerable under the EPBC Act. Distribution of the species throughout Australia is highly fragmented. In NSW it mainly occurs on the central and north coasts with some populations in the western region inhabiting eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Due to the presence of the species and habitat in the Development Site, it would be impacted by the Proposal.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **Lead to a long-term decrease in the size of an important population of a species**

EPBC Act Referral advice provided by Biolink Ecological Consultants (Appendix E) found that koala activity on the site is likely to involve transient use by an individual as opposed to the presence of a resident population of several koalas. The development site and the immediate surrounding vegetation is not large enough in size nor of an adequate stage of growth/quality to support a resident population of koalas. Subsequently, the removal of 3.4 hectares of this vegetation is unlikely to lead to a decrease in the size of an important koala population.

- **Reduce the area of occupancy of an important population**

EPBC Act Referral advice provided by Biolink Ecological Consultants (Appendix E) found that any risk that the removal of vegetation at the site would result in a reduction in the overall area of occupancy of the remaining, broader koala population is negligible.

- **Fragment an existing important population into two or more populations**

The removal of potential foraging habitat from the Development Site would not fragment the local koala population into two or more populations. It would be undertaken on the edge of cleared land resulting in a reduction in suitable habitat for the species, but would not isolate any pockets of habitat leading to a fragmentation of the existing population.

- **Adversely affect habitat critical to the survival of a species**

No areas pertaining to Koala are identified on the registers of critical habitat kept for the DoEE or OEH. EPBC Act Referral advice provided by Biolink (Appendix E) concludes that while koalas have recently been recorded on the site, the observations do not appear to be supported by anything beyond the finding of a single koala faecal pellet at one SAT site, hence implying that activity is likely to involve transient use by an individual as opposed to the presence of a resident population of several koalas. Biolink further determines that despite the presence of patches of remnant/regrowth vegetation at the site containing preferred koala food tree species, the development site and the immediate surrounding vegetation is not large enough in size nor of an adequate stage of growth/quality to support a resident population of koalas. The habitat to be removed is therefore not likely to be habitat critical to the survival of this species.

- **Disrupt the breeding cycle of an important population**

The development site is likely to involve transient use by an individual as opposed to the presence of a resident population of several koalas and as such, vegetation removal in the site is unlikely to disrupt the breeding cycle of the species.

- **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Biolink (appendix E) determined that the development site and the immediate surrounding vegetation is not large enough in size nor of an adequate stage of growth/quality to support a resident population of koalas. As such, the removal of a relatively small area (3.4 hectares) of habitat supporting transient koalas is unlikely to impact the species such that they decline.

- **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The action will involve the clearing of native vegetation and establishment of a landfill site. The risk of invasive fauna species harmful to the Koala (e.g. dogs) being attracted to adjacent native vegetation as a result of clearing and landfill operations is low, particularly with planned pest control measures to be implemented. The action is unlikely to result in the establishment of an invasive species that is harmful to the koala.

- **Introduce disease that may cause the species to decline, or**

Koalas are susceptible to Chlamydia and Koala Retrovirus (Department of the Environment 2017). Chlamydia is sexually transmitted and Koala Retrovirus is transmitted genetically (by inheritance) from parents to offspring, though may also spread from Koala to Koala (horizontal spread) by close contact, and from infected mothers to their joeys via the milk. The Proposal involves the clearing of vegetation that Koalas may inhabit. Though Koalas may be present on the site during clearing and may require handling (if injured/requiring rescue), individuals are unlikely to come in to contact with one another during the clearing process and as such, are unlikely to spread diseases between them.

- **Interfere with the recovery of the species**

There is an adopted national recovery plan for the koala. However, there is an approved Recovery Plan in place for the koala for NSW (DECC 2008). The Recovery Plan lists seven general objectives and a number of specific objectives and actions under each objective. Of these, one could be considered relevant to the proposal:

- Objective 1b: Assess the impact of habitat loss and fragmentation on koala populations

The Proposal assesses the impact of habitat loss through this Assessment of Significance and is therefore consistent with the objectives of the Recovery Plan for the species. Although the proposal will remove potential habitat, there are opportunities to implement some of the management actions in the Recovery Plan on the proposed koala corridor offset site.

Conclusion

Under the EPBC Act an action requires approval from the Australian Government Minister for the Environment and Energy (DoEE) if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance such as the koala. Based on the above assessment and the assessment conducted by Biolink (Appendix D), it is concluded that the action would not have a significant impact on the koala. As such the action does not require referral to DoEE.

Spot-tailed Quoll, *Dasyurus maculatus maculatus*

Spot-tailed Quoll (*Dasyurus maculatus maculatus*) is listed as Endangered under the EPBC Act. It is found along the escarpments, tablelands and coast of the eastern seaboard from the Bundaberg area in south-east Qld south through NSW to Victoria and Tasmania. The Spot-tailed Quoll is known from dry and moist eucalypt forests and rainforest. It tends to move along drainage lines and make dens in fallen hollow logs or among large rocky outcrops. Usually nocturnal but also known to hunt and bask during the day. It hunts terrestrially and arboreally.

Due to the presence of preferred habitat in the Development Site, and the abundance of local records, the species was considered to have a high likelihood of occurrence and could be impacted by the Proposal.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- **Lead to a long-term decrease in the size of a population**

The Spot-tailed Quoll occupies a large home ranges several hundred to several thousand hectares in size (DoE 2016). The removal of 3.4 hectares of potential habitat for the purposes of the Proposal is a small proportion of their habitat in the broader locality. As such, it is unlikely to lead to a long-term decrease in the size of the population. However, the cumulative loss of habitat across the landscape is a general threat to the Spot-tailed Quoll and the Proposal would contribute to this.

- **Reduce the area of occupancy of the species**

The Proposal would result in the removal of up to 3.4 hectares of potential habitat for the Spot-tailed Quoll. This habitat is on the edge of a waste facility. Given the large home range of the species, its removal is unlikely to reduce the area of occupancy of the species.

- **Fragment an existing population into two or more populations**

The Proposal would not fragment the population of Spot-tailed Quolls into two or more populations. It would be undertaken on the edge of cleared land resulting in a reduction in suitable habitat for the species, but would not isolate any pockets of habitat leading to a fragmentation of any existing population.

- **Adversely affect habitat critical to the survival of a species**

No areas pertaining to Spot-tailed Quoll are identified on the registers of critical habitat kept for the DoEE or OEH. Given the species was not identified on the Development Site and the site is located on the edge of a cleared landfill site and adjacent to forestry plantation, it is unlikely to contain habitat critical to the species survival. The 3.4 hectares of potential habitat is not likely to be habitat critical to the survival of the species.

- **Disrupt the breeding cycle of a population**

The Spot-tailed Quoll use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Though no Spot-tailed Quolls were identified in targeted surveys, the species may still den in hollow-bearing trees and/or hollow logs in the Development Site. As such, it is possible that the Proposal could impact breeding individuals and disrupt the breeding cycle.

- **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposal would result in the removal of a small amount of potential habitat for the Spot-tailed Quoll. Given the large home ranges of the species and the low densities at which they live, it is unlikely that the removal of 3.4 hectares of potential habitat is

likely to lead to a decline in the species. However, the Proposal would contribute to the cumulative loss of habitat within the region which is leading accelerating the species decline.

- **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**

The action will involve the clearing of native vegetation and establishment of a landfill site. The risk of invasive fauna species harmful to the Spot-tailed Quoll (e.g. cats, foxes) being attracted to adjacent native vegetation as a result of clearing and landfill operations is low, particularly with planned pest control measures to be implemented. The action is therefore unlikely to result in the establishment of an invasive species that is harmful to the Spot-tailed Quoll.

- **Introduce disease that may cause the species to decline, or**

There are no diseases identified as a threat to the Spot-tailed Quoll on the SPRAT profile or OEH profile for the species. Given the nature of the proposal and that fauna would be actively managed through the construction and operation of the proposal, it is considered highly unlikely that a disease would be introduced that may cause the Spot-tailed Quoll to decline.

- **Interfere with the recovery of the species**

A National Recovery Plan for the Spot-tailed Quoll was prepared by the Victorian Department of Environment, Land, Water and Planning and Published by the Australian Government Department of the Environment in 2016. The recovery plan has 11 different objectives as follows:

1. Determine the distribution and status of Spotted-tailed Quoll populations throughout the range, and identify key threats and implement threat abatement management practices.

2. Investigate key aspects of the biology and ecology of the Spotted-tailed Quoll to acquire targeted information to aid recovery.

3. Reduce the rate of habitat loss and fragmentation on private land.

4. Evaluate and manage the risk posed by silvicultural practices.

5. Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations.

6. Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations.

7. Reduce deliberate killings of Spotted-tailed Quolls.

8. Reduce the frequency of Spotted-tailed Quoll road mortality.

9. Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary.

10. Determine the likely impact of climate change on Spotted-tailed Quoll populations.

11. Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program.

The Proposal would generally not interfere with these objectives, however it would result in habitat loss, which is largely inconsistent with objective number 3.

Conclusion

Under the EPBC Act an action requires approval from the Australian Government Minister for the Environment and Energy (DoEE) if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance such as the Spot-tailed Quoll. Based on the above assessment, it is concluded that the

action would not have a significant impact on the Spot-tailed Quoll as it would result in the removal of a relatively small amount of potential habitat and would not reduce the area of occupancy of the species. Furthermore, it is unlikely to introduce diseases or invasive species that would impact this species. As such the action does not require referral to DoEE.

Grey-headed Flying-fox, *Pteropus poliocephalus*

Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as Vulnerable under the EPBC Act. They are found within 200km of the east coast of Australia. Roosting camps are commonly found in gullies, close to water, in vegetation with a dense canopy. Camps are typically located within 20km of a regular food source; nectar and pollen of native trees and fruits of rainforest trees and vines.

Due to the presence of potential foraging habitat in the Development Site, and the abundance of local records, the species was considered to have a high likelihood of occurrence and could be impacted by the Proposal.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **Lead to a long-term decrease in the size of an important population of a species**

Important populations are those that may be identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

The Grey-headed Flying-fox has no separate or distinct populations (DoE 2014a). The species constantly exchanges genetic information between camps throughout its geographic range. At the time of survey, no established roosting camps were found in the Development Site, however it could be utilised by individuals from nearby camps. Native trees across the study area provide a food resource for the Grey-Headed Flying-Fox, however this foraging resource does not comprise a significant area of foraging habitat within the locality. However, the loss of foraging habitat is considered the primary threat to the species (DECCW 2009) and there has been an overall reduction in foraging habitat in the region and across the species geographic range. Therefore the Proposal would contribute to the cumulative loss of habitat for this species which is a factor in the decline in the national population.

- **Reduce the area of occupancy of an important population**

The removal of a relatively small portion of potential foraging habitat from the Development Site of 3.4 hectares would not significantly reduce the area of occupancy of the species.

- **Fragment an existing important population into two or more populations**

The removal of potential foraging habitat from the Development Site would not fragment the population of the Grey-Headed Flying-Fox into two or more populations. It would be undertaken on the edge of cleared land resulting in a reduction in suitable habitat for the species, but would not isolate any pockets of habitat leading to a fragmentation of any existing population.

- **Adversely affect habitat critical to the survival of a species**

No areas pertaining to Grey-headed Flying-fox are identified on the registers of critical habitat kept for the DoEE or OEH. Given the species was not identified on the Development Site and the site is located on the edge of a cleared landfill site and adjacent to forestry plantation, it is unlikely to contain habitat critical to the species survival. Whilst the Proposal would result in the removal of potential foraging habitat, this habitat is not likely to be habitat critical to the survival of this species.

- **Disrupt the breeding cycle of an important population**

There is no known maternity roosting camp of Grey-headed Flying-foxes within the Development Site. As such, the removal of a small amount of potential foraging habitat (non-breeding habitat) of 3.4 hectares is unlikely to impact the breeding cycle of an important population of Grey-headed Flying-foxes.

- **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The Proposal would involve the removal of potential foraging habitat for the Grey-Headed Flying-Fox. This foraging resource does not comprise a significant area of foraging habitat within the Development Site or the locality. It is not likely to be significant to the species such that it is likely to decline, however, the Proposal would contribute to the cumulative loss of habitat within the region and geographic extent of the species which is leading to a decline in the national population.

- **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The action is unlikely to result in the establishment of an invasive species that is harmful to the Grey-Headed Flying-Fox. Known predators of the species include native reptiles and birds; no invasive exotic fauna species are known to predate upon Grey-Headed Flying-Foxes. The action is highly unlikely to result in the establishment of invasive flora species that are harmful to the Grey-Headed Flying-Fox.

- **Introduce disease that may cause the species to decline, or**

The Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW 2009) identify Australian bat lyssavirus (ABL) as having the potential to cause clinical disease and mortality in Grey-headed Flying-foxes. The incidence of ABL in the species is low (< 1%). However, when flying-foxes undergo significant ecological stress, the incidence of ABL can increase to the point where the disease is no longer in equilibrium and the population is impacted. The proposal would involve the clearing of a small area of potential foraging habitat which is unlikely to place ecological stress of the species. As such, the action is highly unlikely to cause the Grey-Headed Flying-Fox to decline as a result of disease.

- **Interfere with the recovery of the species**

There is currently no approved Recovery Plan in place for the Grey-Headed Flying-Fox. A Draft National Recovery Plan for the Grey-headed Flying-fox was prepared in July 2009 (DECCW 2009). The Draft National Recovery Plan lists 13 specific objectives for the five-year timeframe of the Plan. Of these, two could be considered relevant to the proposal:

- Objective 1: To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range.
- Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes.

Whilst the Proposal would result in the removal of potential foraging habitat, this habitat is not likely to be key foraging habitat or habitat critical to the survival of this species.

Conclusion

Under the EPBC Act an action requires approval from the Australian Government Minister for the Environment and Energy (DoEE) if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance such

as the Grey-Headed Flying-Fox. Based on the above assessment, it is concluded that the action would not have a significant impact on the Grey-Headed Flying-Fox as it would result in the removal of a relatively small amount of potential foraging habitat which is not likely to be critical to the survival of the species. It is unlikely to introduce diseases or invasive species that would impact this species. As such the action does not require referral to DoEE.

Giant Barred Frog, *Mixophyes iteratus*

The Giant Barred Frog (*Mixophyes iteratus*) is listed as Endangered under the EPBC Act. It occurs from the east coast west to the Hawkesbury River, where it inhabits rainforests, moist eucalypt forest or nearby dry eucalypt forest below elevations of 1000m. It requires shallow, flowing rocky streams for breeding in summer. Outside of breeding period, the species is found sheltering and foraging amongst deep, damp leaf litter.

Though no breeding habitat is available, potential foraging habitat and shelter is present in the Development Site. The species has not been recorded within 10km of the Development Site. As such, the species was considered to have a moderate likelihood of occurrence and could be impacted by the Proposal.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- **Lead to a long-term decrease in the size of a population**

Several records of the species are present more than 5 kilometres north and southwest of the Development Site, in Cooperabung and Pembrooke, respectively. The Proposal would remove a relatively small amount of potential foraging habitat and shelter for the Giant Barred Frog – 3.4 hectares. No breeding habitat would be impacted. As the Development Site is located at a distance from known populations and would not impact breeding habitat, it is unlikely that the Proposal would result in a long-term decrease in the local population of Giant Barred Frog.

- **Reduce the area of occupancy of the species**

The Proposal would remove a relatively small amount of potential foraging habitat and shelter for the Giant Barred Frog – 3.4 hectares. The removal of this habitat could reduce the occupancy of the species if it inhabits the site. The species was not found during targeted surveys.

- **Fragment an existing population into two or more populations**

The Proposal would not fragment an existing population of Giant Barred Frog into two or more populations. It would be undertaken on the edge of cleared land resulting in a reduction in suitable habitat for the species, but would not isolate any pockets of habitat leading to a fragmentation of any existing population.

- **Adversely affect habitat critical to the survival of a species**

No areas pertaining to Giant Barred Frog are identified on the registers of critical habitat kept for the DoEE or OEH. Given the species was not identified on the Development Site despite targeted surveys and the site is located on the edge of a cleared landfill site and adjacent to forestry plantation, it is unlikely to contain habitat critical to the species survival. The 3.4 hectares of potential habitat is not likely to be habitat critical to the survival of the species.

- **Disrupt the breeding cycle of a population**

Potential breeding habitat for the Giant Barred Frog is not present on the Development Site. As such, the Proposal is unlikely to disrupt the breeding cycle of the species.

- **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Due to the availability of larger expanses of suitable habitat in the broader landscape, the removal of a small amount of non-breeding habitat for Giant Barred Frog would not decrease availability or quality of habitat such that the species is likely to decline.

- **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat**

The action will involve the clearing of native vegetation and establishment of a landfill site. The risk of invasive fauna species harmful to the Giant Barred Frog (e.g. foxes) being attracted to adjacent habitat as a result of clearing and landfill operations is low, particularly with planned pest control measures to be implemented. The action is therefore unlikely to result in the establishment of an invasive species that is harmful to the Giant Barred Frog.

- **Introduce disease that may cause the species to decline, or**

Chytrid is a disease that is a known threat to Australian frogs, including the Giant Barred Frog. The spread of chytrid can occur when the frog's skin comes into contact with water containing spores from infected animals. Water quality controls would be employed for the proposal to redirect stormwater runoff and reuse and treat dirty and clean water on site. It is not anticipated that this would substantially change the existing situation with regard to the risk of water-borne chytrid transfer in the local environment. It is therefore considered unlikely that the Proposal would result in the introduction and/or spread of chytrid such that the species declines.

- **Interfere with the recovery of the species**

DoEE have adopted the *Recovery plan for stream frogs of south-east Queensland 2001-2005* to manage the recovery of the Giant Barred Frog. The overall objective of the plan is to significantly improve the conservation status and long term survival of each frog species through protection of its habitat, and through location of additional populations or expansion of existing populations into areas currently uninhabited. The specific objectives relevant to the Giant Barred Frog include:

1 To secure existing populations of extant species.

2. To investigate disease as a key threatening process.

3. To increase the number of populations of extant species by facilitating expansion into their former range.

Whilst the Proposal would remove potential habitat for the species, it would otherwise not impede on these objectives. It is unlikely that the Proposal would interfere with the species recovery.

Conclusion

Under the EPBC Act an action requires approval from the Australian Government Minister for the Environment and Energy (DoEE) if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance such as the Giant Barred Frog. Based on the above assessment, it is concluded that the action would not have a significant impact on the Giant Barred Frog as it would result in the removal of a relatively small amount of potential foraging habitat and shelter which is not likely to be critical to the survival of the species and is not likely to lead to the species decline. It is unlikely to introduce diseases or invasive species that would impact this species. As such the action does not require referral to DoEE.

Rufous Fantail, *Rhipidura rufifrons*

The Rufous Fantail, *Rhipidura rufifrons*, is listed as a Migratory species under the EPBC Act. The Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests. They occasionally occur in secondary regrowth, following logging or disturbance in forests or rainforests. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, often with a shrubby or heath understorey. They are also recorded from parks and gardens when on passage. In north and north-east Australia, they often occur in tropical rainforest and monsoon rainforests, including semi-evergreen mesophyll vine forests, semi-deciduous vine thickets or thickets of Paperbarks. This species was recorded in the Development Site during field surveys.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- **substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

The *Draft referral guideline for 14 birds listed migratory under the EPBC Act* (DoE 2015) define important habitat for the Rufous Fantail as: 'Moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands.' The habitat within the development site would meet this definition of important habitat for the Rufous Fantail. However, the Proposal would result in the removal of important habitat, the area to be removed is relatively small (3.4 hectares), in relation to habitat availability in the broader landscape.

- **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or**

The action will involve the clearing of native vegetation and establishment of a landfill site. The risk of invasive fauna species harmful to the Rufous Fantail (e.g. cats, foxes) being attracted to adjacent habitat as a result of clearing and landfill operations is low, particularly with planned pest control measures to be implemented. The action is therefore unlikely to result in the establishment of an invasive species that is harmful to the Rufous Fantail.

- **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

The Development Site comprises a very small area that does not support an ecologically significant proportion of the population of Rufous Fantail.

Conclusion

Under the EPBC Act an action requires approval from the Australian Government Minister for the Environment and Energy (DoEE) if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance such as the Rufous Fantail. Based on the above assessment, it is concluded that the Proposal would not have a significant impact on the Rufous Fantail as it would not

substantially destroy important habitat for the species, it is unlikely to result in an invasive species becoming established within the Development Site and would not impact an ecologically significant proportion of the Rufous Fantail population. As such the action does not require referral to DoEE.

APPENDIX E

Cairncross Landfill site – EPBC Act Koala referral advice

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General Manager
Attn: Mr. Thor Asso
Port Macquarie Hastings Council
PO Box 84
Port Macquarie NSW 2444

25 August 2015

Dear Thor,

Re: Cairncross Landfill site – EPBC Act koala referral advice

As requested during a telephone conversation with Steve Phillips last week, we have considered the initial EPBC Act koala referral assessment advice that Council received and provide the following additional remarks for consideration.

Context:

1. The total area of planned vegetation disturbance involves approximately 30 ha, divided into three stages for purposes of undertaking the proposed development.

2. It is evident from air photos and the EPBC Act assessment that the site predominantly supports a former forestry plantation, within which a relatively small area of regrowth remnant forest occurs that contain preferred koala food tree species on the eastern fringe of the site and in association with an apparent drainage depression in the central section of the site.

3. Koala food tree species occurring on the site include tallowwood *E. microcorys*, swamp mahogany *E. robusta* and small-fruited grey gum *E. propinqua*.

4. We estimate the total area of proposed direct impact that is likely to contain preferred koala food trees to be approximately 4 ha, beyond which the remaining forest area would at best meet criteria for classification as Secondary (C) koala habitat based on the soil landscape and the potential presence of occasional koala food trees.

In formulating the comments that follow, further reference is made to the *EPBC Act referral guidelines for the vulnerable koala* as well as the *EPBC Act Matters of National Environmental Significance - Significant impact guidelines 1.1*.

Habitat critical to survival of the species includes areas necessary for foraging, breeding, roosting or dispersal, maintaining genetic diversity and long term evolutionary development, or for population reintroduction or species recovery. In this context an *important population* is defined as one that is necessary for long term survival and recovery of the species such as key source populations for breeding or dispersal, or those necessary for maintaining genetic diversity and/or populations near the limit of the species range.

The significant impact guidelines indicate that an action is likely to result in a *significant impact on a vulnerable species* if, amongst other things, there is a real possibility that it will lead to long-term decrease in size of an important population, reduce the area of occupancy, fragment an important population, adversely affect habitat critical to survival to the extent that the species is likely to decline, or interfere substantially with the recovery of the species.

Comments:

1. While koalas have recently been recorded on the site, the observations do not appear to be supported by anything beyond the finding of a single koala faecal pellet at one SAT site, hence implying that activity is likely to involve transient use by an individual as opposed to the presence of a resident population of several koalas.

2. Despite the presence of patches of remnant/regrowth vegetation at the site containing preferred koala food tree species (estimated to total approximately 4 ha), the subject site and the immediate surrounding vegetation is not large enough in size nor of an adequate stage of growth/quality to support a resident population of koalas.

3. Given the above and with particular regard to the significant impact guidelines, we consider any risk that the removal of vegetation at the site would result in a reduction in the overall area of occupancy of the remaining, broader koala population to be negligible.

Taking the above-mentioned factors into consideration, we advise that in this instance we do not consider it necessary for Council to proceed with EPBC referral for the koala. Further considerations include progressive clearing of the site commensurate with expansion of the landfill area over an estimated time frame of 80 years, in addition to provision being made for a 50 m wide corridor to be planted with koala food trees in order to maintain longer-term connectivity options.

Please contact me should any further information be required.

Yours Sincerely,



John Callaghan
Director/Conservation Biologist
Biolink Ecological Consultants

APPENDIX F

Major Projects Calculator Credit Report

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 17/03/2017 Time: 3:43:57PM Calculator version: v4.0

Major Project details

Proposal ID:	0023/2014/1302D
Proposal name:	Cairncross WMF
Proposal address:	Pacific Highway Telegraph Point NSW
Proponent name:	Port Macquarie Hastings Council
Proponent address:	Burrawan Street Port Macquarie NSW 2444
Proponent phone:	0265818111
Assessor name:	Jane Rodd
Assessor address:	Level 5, 141 Walker Street NORTH SYDNEY NSW 2060
Assessor phone:	8907 8266
Assessor accreditation:	0023

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	3.40	221.00
Total	3.40	221

Credit profiles

1. Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR117)

Number of ecosystem credits created 221

IBRA sub-region Macleay Hastings - Northern Rivers

Offset options - Plant Community types	Offset options - IBRA sub-regions
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR117) Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast, (NR159) Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast, (NR160) Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion, (NR219) Spotted Gum - Brush Box moist forest of ranges of the southern Clarence Valley of the NSW North Coast Bioregion, (NR243) Spotted Gum - Grey Ironbark shrubby open forest of the Richmond Range of the NSW North Coast, (NR248) Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast, (NR258) Tallowwood - Brush Box moist open forest of the coastal ranges of the central NSW North Coast, (NR260) Tallowwood - Narrow-leaved White Mahogany - Spotted Gum moist open forest in the Washpool area of the NSW North Coast, (NR261) Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion, (NR274)	Macleay Hastings - Northern Rivers and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Koala	Phascolarctos cinereus	3.22	84
Green-thighed Frog	Litoria brevipalmata	3.22	248
Southern Myotis	Myotis macropus	0.12	3

APPENDIX Q BUSHFIRE ASSESSMENT REPORT

BUSHFIRE PROTECTION ASSESSMENT

FOR THE CAIRNCROSS LANDFILL EXPANSION

ON

LOT 1 in DP 1202080,

No. 8395 PACIFIC HIGHWAY,

TELEGRAPH POINT

FOR

PORT MACQUARIE - HASTINGS COUNCIL

Australian Bushfire Protection Planners Pty Limited

Bushfire Mitigation Consultants
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BUSHFIRE PROTECTION ASSESSMENT

FOR THE CAIRNCROSS LANDFILL EXPANSION

ON

LOT 1 in DP 1202080,

No. 8395 PACIFIC HIGHWAY,

TELEGRAPH POINT

FOR

PORT MACQUARIE - HASTINGS COUNCIL

Report Number	Document	Preparation Date	Issue Date	Directors Approval
B142336 - 4	Final	1.8.2016	16.2.2017	*G.L.Swain*

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EXECUTIVE SUMMARY

Australian Bushfire Protection Planners Pty Limited has been commissioned by *Arcadis Australia Pacific Pty Limited,* on behalf of *Port Macquarie - Hastings Council* [PMHC], to prepare a Bushfire Protection Assessment to provide advice on the bushfire protection measures required for the Cairncross Landfill Expansion on Lot 1 in DP 1202080, 8395 Pacific Highway, Telegraph Point.

Port Macquarie-Hastings Council (PMHC) oversees the operation of the Cairncross Waste Management Facility (Cairncross WMF), which includes the operation of a landfill, Waste Transfer Station (WTS), an Organics Resource Recovery Facility (ORRF) and a Material Recovery Facility (MRF). The Cairncross WMF was granted approval under Part 4 and Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for Stage 1 (now referred to as the existing landfill or 'Stage E') in 1999 and commenced operations in September 2001.

The Part 4 development approval (DA) for extractive industries for the current landfill operational area (Stage E), DA No. 1999/178, was limited to 20 years. In February 2013, an extension of five years was sought on the original approval and was subsequently granted by PMHC. The current Part 4 approval is now due to conclude in 2026.

A Part 5 approval was granted in 1999 for land-filling activities on the site, which was also limited to 20 years. A Review of Environmental Factors (REF) was prepared by PMHC in 2013 (the 2013 REF), to support an application for extension of the approved operational life of the Stage E landfill to 2026. The 2013 REF was approved by PMHC in October 2013.

PMHC is now seeking approval for an additional three landfill stages from the Department of Planning and Environment (the Department) as State Significant Development (SSD) under Part 4, Division 4.1 of the EP&A Act.

The Department, in response to the request for SEARs for the Proposal, suggested consolidation of the approvals associated with the Cairncross WMF. PMHC proposes to consolidate the approval for operation of the existing landfill with the SSD approval being sought.

The Secretary's Environmental Assessment Requirements [SEAR's] were issued in May 2015 under Application Number SSD13_5792 which involves extending the operational life of the existing Cairncross landfill and includes the staged construction of new landfill cells and progressively increasing the annual waste rate at the landfill.

The 'Key Issues' identified in SEAR's do not require for bushfire to be addressed however, reference is made under Hazards in the 'Technical & Policy Guidelines', to *'Planning for Bushfire Protection (NSW Rural Fire Service).*

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The Proposal Site is a parcel of vacant, vegetated land which is located to the south of the Stage E [existing landfill site] and to the west of the MRF.

The land to the west of the Proposal Site is owned by PMHC and forms a vegetated compensatory habitat area. The land to the south of the Proposal Site is zoned 1(f) and forms part of the adjoining Cairncross State Forest estate whilst to the southeast the adjoining land is zoned 8(a) and contains the Rawdon Creek Nature Reserve.

The Proposal Site and adjoining vacant land contains forest vegetation which has been recorded on the PMHC Bushfire Prone Land Map as Category 1 Bushfire Prone Vegetation. Therefore, the Proposal may be subject to the impact from future bushfires that could occur in this vegetation and consideration must be given to bushfire protection measures.

Planning for Bushfire Protection 2006 provides specific deemed-to-satisfy provisions on the bushfire protection measures necessary for rural & residential subdivisions, the construction of *"Special Fire Protection Purpose Developments"* and the construction of Class 1, 2, 3 & 4 buildings in Bushfire Prone areas.

The document also identifies limited advice on the bushfire protection measures required for Class 5 to 10 structures, as defined by the Building Code of Australia. The proposal is not classified by the Building Code of Australia (BCA). The proposal involves the construction of partially above ground leachate collection tanks which are classified as a Class 10 structure under the BCA. The tanks would need to be designed and constructed to comply with the BCA.

This Bushfire Protection Assessment undertakes an assessment of the bushfire risk to the Proposal and examines the:

- Adequacy of the setbacks [defendable spaces] to the landfill cells from the bushfire prone vegetation;
- Defendable Spaces to the Leachate Tanks;
- Fire-fighting access;
- Provision of fire-fighting water supplies; and
- Fuel management protocols and other matters considered necessary to mitigate any potential bushfire threat to persons, property and the environment.

The characteristics of the site as discussed in this report, together with the recommendations contained in this assessment, confirms that the site is suitable in terms of its intended use.



Graham Swain,
Australian Bushfire Protection Planners Pty Limited.

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SECTION 1

INTRODUCTION

1.1 Development Proposal.

This Bushfire Protection Assessment has been prepared, at the request of *Arcadis Australia Pacific Pty Limited*, on behalf of *Port Macquarie - Hastings Council* (PMHC), for the construction of the proposed Cairncross Landfill Expansion on Lot 1 in DP 1202080, No. 8395 Pacific Highway, Telegraph Point.

The Cairncross WMF was granted approval under Part 4 and Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for Stage 1 (now referred to as the existing landfill or 'Stage E') in 1999 and commenced operations in September 2001.

The Part 4 development approval (DA) for extractive industries for the current landfill operational area (Stage E), DA No. 1999/178, was limited to 20 years.

In February 2013, an extension of five years was sought on the original approval and was subsequently granted by PMHC. The current Part 4 approval is now due to conclude in 2026.

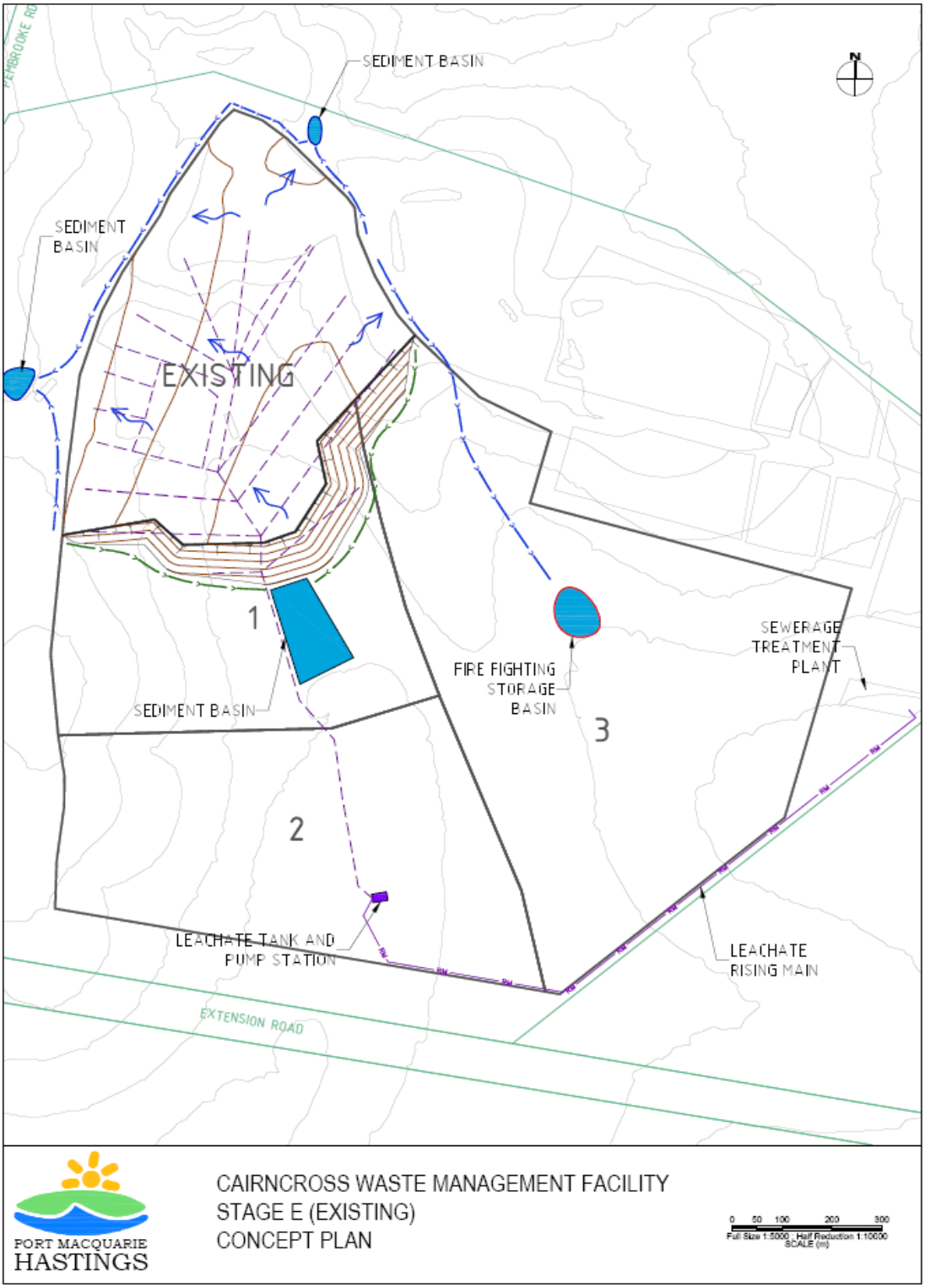
A Part 5 approval was granted in 1999 for land-filling activities on the site, which was also limited to 20 years. A Review of Environmental Factors (REF) was prepared by PMHC in 2013 (the 2013 REF), to support an application for extension of the approved operational life of the Stage E landfill to 2026. The 2013 REF was approved by PMHC in October 2013.

PMHC is now seeking approval for an additional three landfill stages from the Department of Planning and Environment (the Department) as State Significant Development (SSD) under Part 4, Division 4.1 of the EP&A Act.

The following figures provide details on the location of the existing landfill cell [Stage E] and proposed Stage 1; Stage 2 and Stage 3 Landfill Cells.

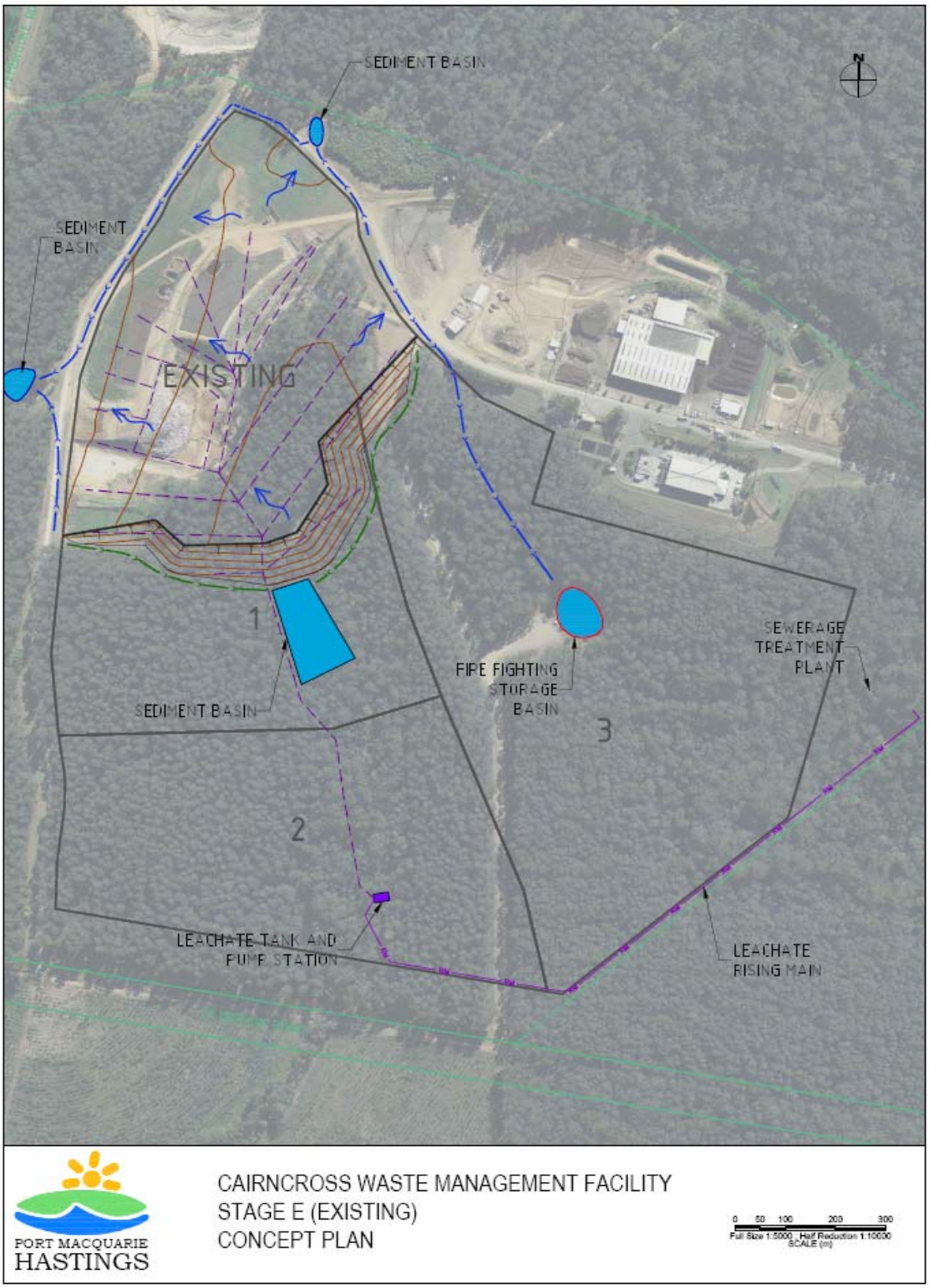
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Figure 1 – Concept Plan – Cairncross Waste Management Facility – Stage E (Existing)



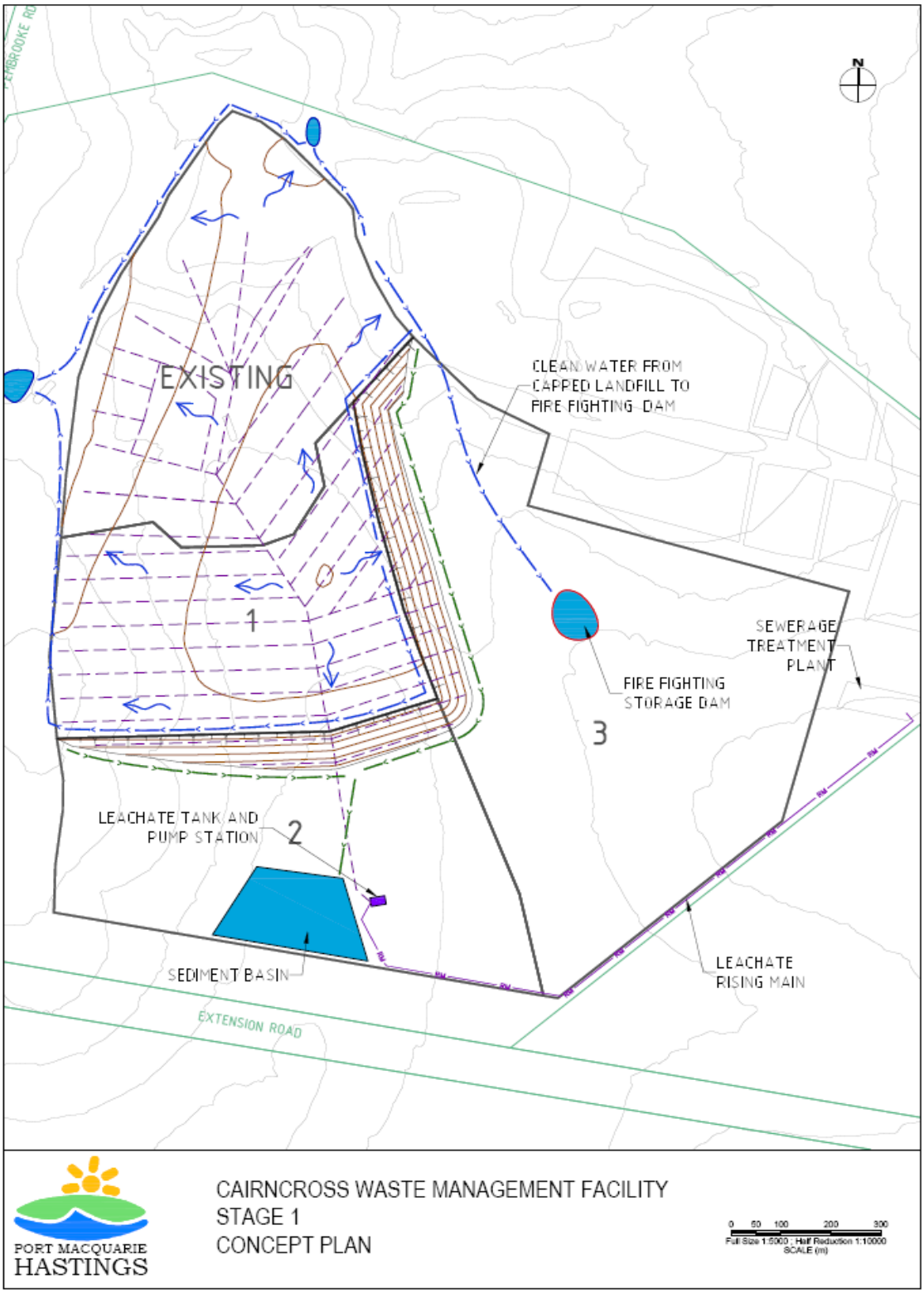
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Figure 1A – Concept Plan – Cairncross Waste Management Facility – Stage E (Existing) – Aerial



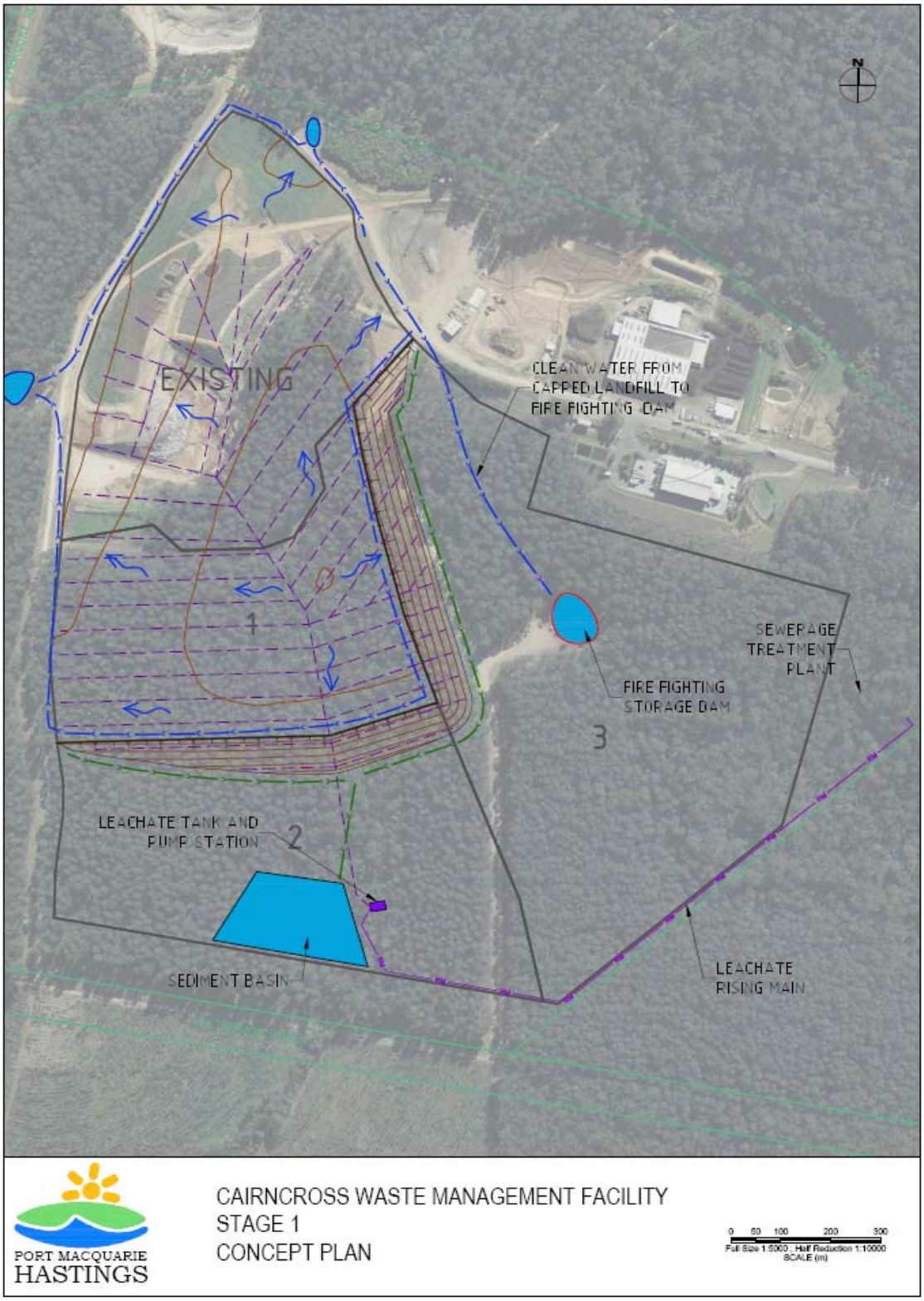
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Figure 2 – Concept Plan – Cairncross Waste Management Facility – Stage 1



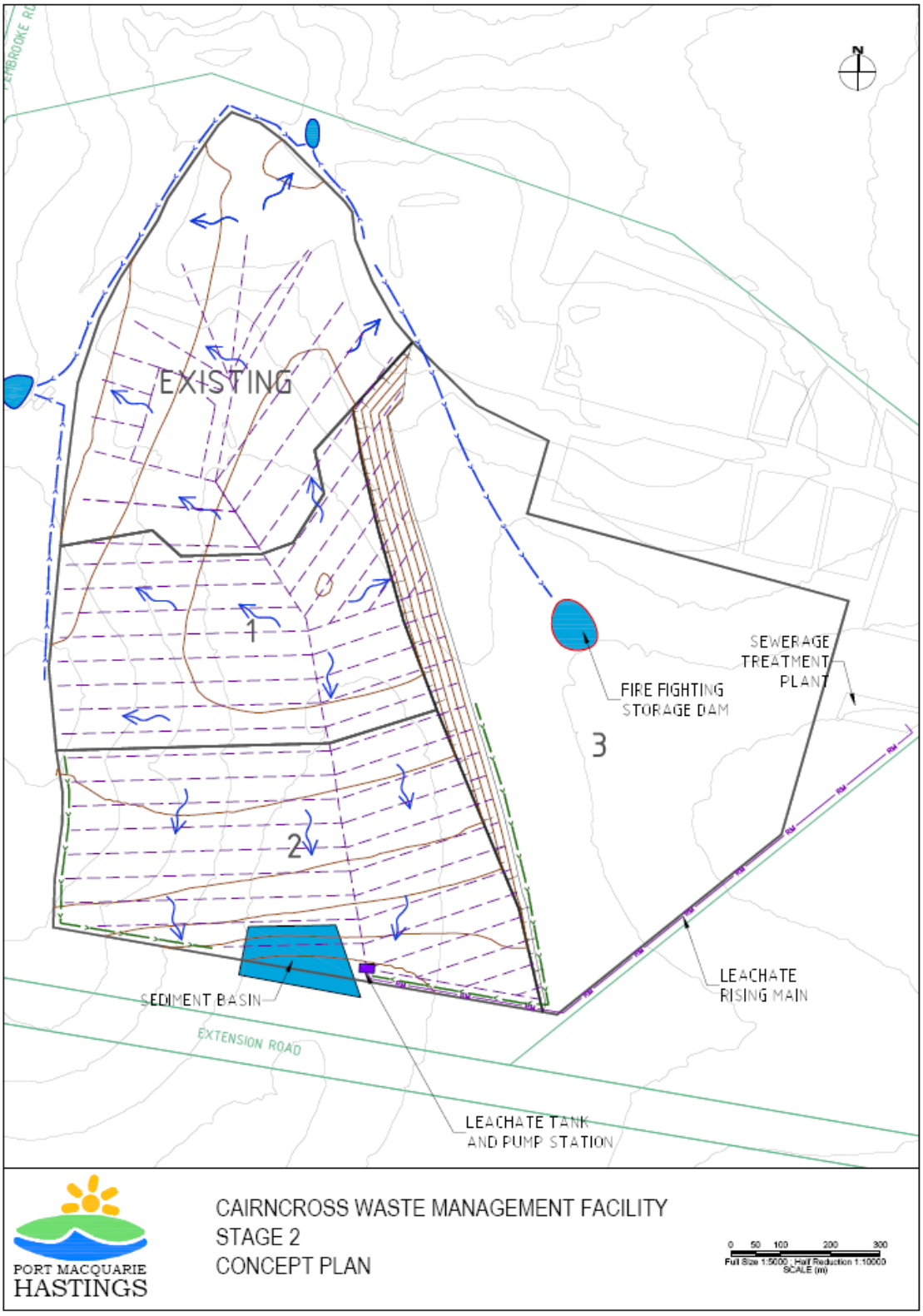
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Figure 2A – Concept Plan – Cairncross Waste Management Facility – Stage 1 – Aerial



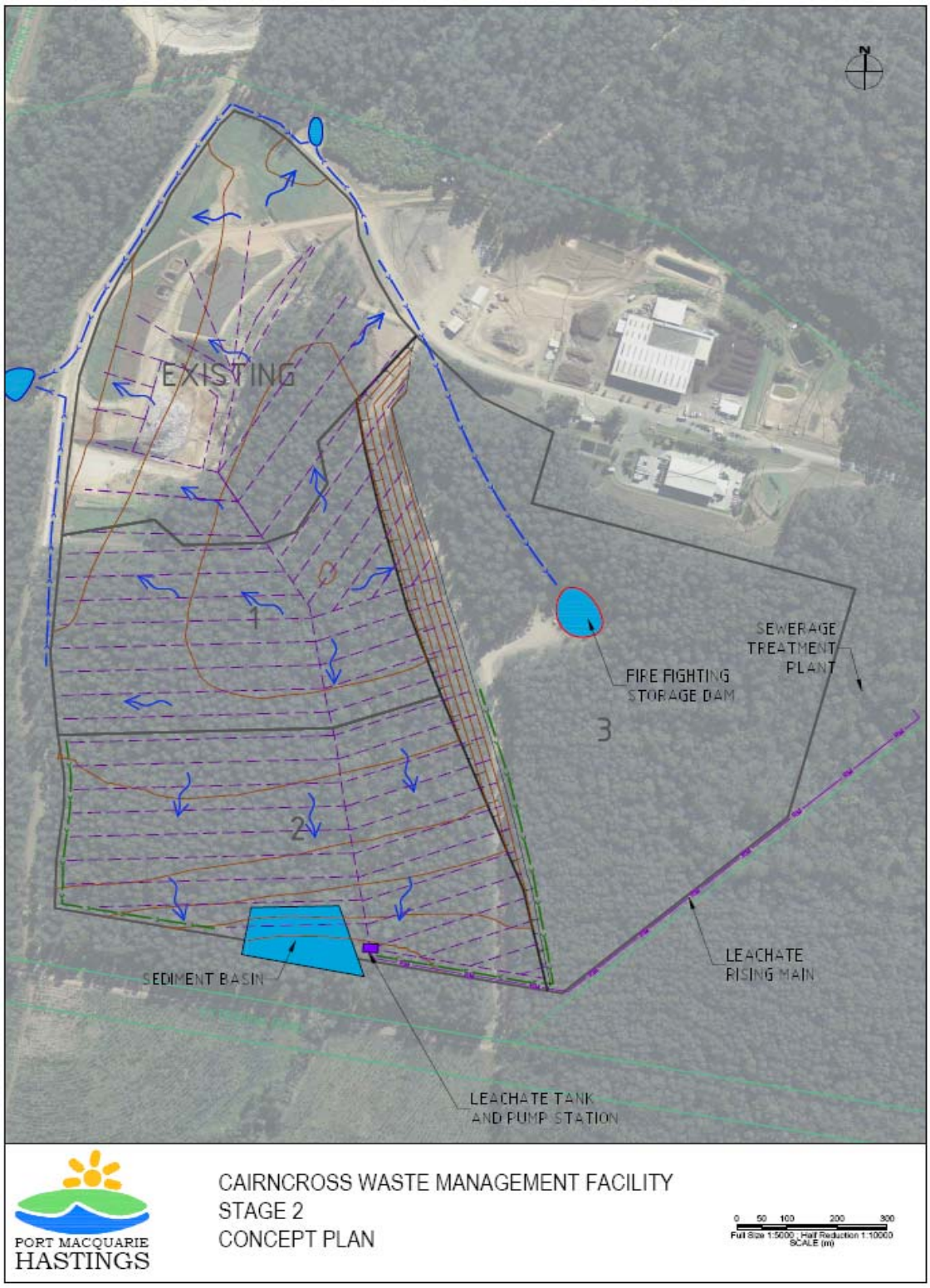
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Figure 3 – Concept Plan – Cairncross Waste Management Facility – Stage 2



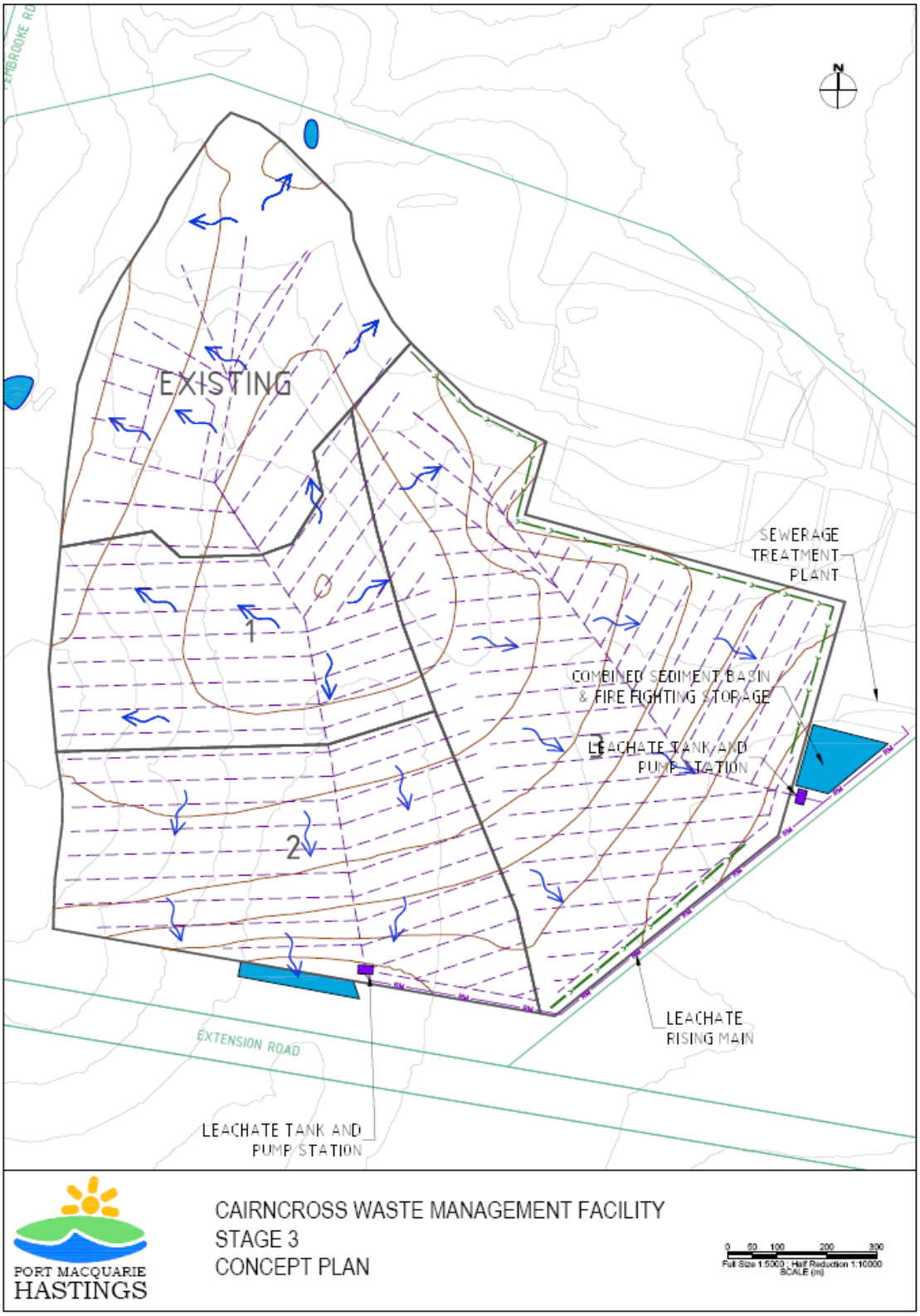
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Figure 3A – Concept Plan – Cairncross Waste Management Facility – Stage 2 – Aerial



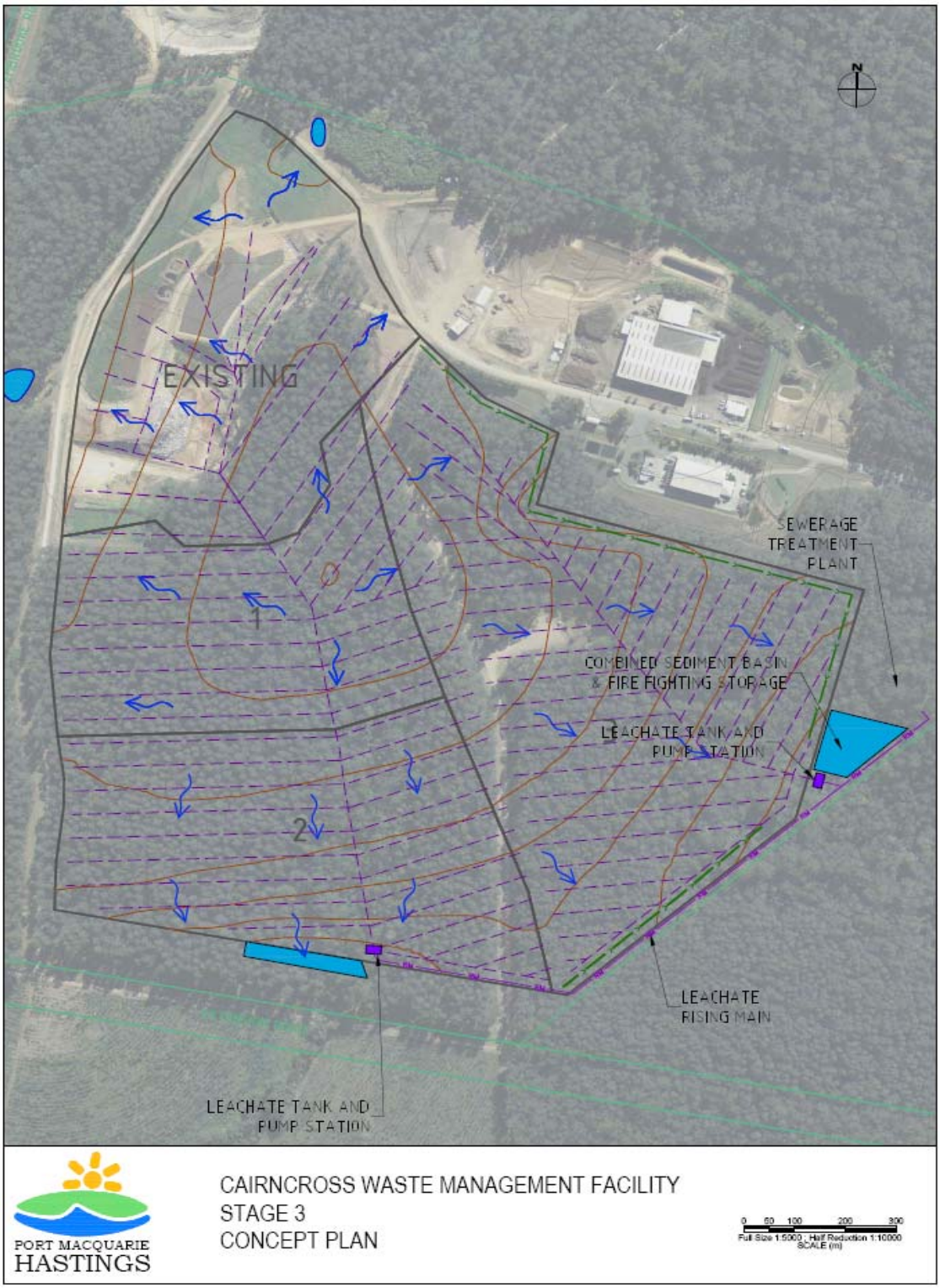
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Figure 4 – Concept Plan – Cairncross Waste Management Facility – Stage 3



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Figure 4A – Concept Plan – Cairncross Waste Management Facility – Stage 3 – Aerial



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1.2 Aim of this Assessment.

The aim of this Bushfire Protection Assessment is to identify the bushfire risk to the Proposal and the risk posed by the operation of the Proposal in order to address the aim & objectives of *Planning for Bushfire Protection 2006* including:

- Determine the classification of the vegetation on and surrounding the site in accordance with the vegetation classification system contained in *Planning for Bushfire Protection 2006*;

- Undertake an assessment to determine the slope of the land on and surrounding the Proposal Site;

- Undertake a Bushfire Protection Assessment to determine bushfire protection strategies for the Proposal that address the following matters:

  (i) The provision of setbacks (Defendable Space) from vegetated areas;

  (ii) Fire fighting water supplies;

  (iii) Access requirements for emergency service vehicles;

  (iv) Land management responsibilities;

  (v) Evacuation management; and

  (vi) Identification of mitigation measures.

1.3 Statutory Requirements.

This assessment has been prepared having regard to the following legislative and planning requirements:

1.3.1 Secretaries Environmental Assessment Requirements (SEARs).

The 'Key Issues' identified in SEAR's do not require for bushfire to be addressed however, reference is made under Hazards in the 'Technical & Policy Guidelines', to *'Planning for Bushfire Protection (NSW Rural Fire Service).*

This document provides deemed-to-satisfy requirements in relation to the provision of bushfire protection measures for rural residential/residential subdivision and the construction of *'Special Fire Protection Purpose Development'* in bushfire prone areas.

The document also provides guidance on the protection of industrial, commercial and retail development subject to the risk of bushfires.

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1.3.2 Rural Fires Act 1997

The objectives of the *Rural Fires Act* are to provide:

- The prevention, mitigation and suppression of fires;
- Coordination of bushfire fighting and prevention;
- Protection of people and property from fires; and
- Protection of the environment.

Sections 63(1) and 63(2) require public authorities and owners / occupiers of land to take all practicable steps to prevent the occurrence of bushfires on, and to minimize the danger of the spread of bushfires.

1.3.3 Threatened Species Conservation Act 1995 (TSC Act).

The TSC Act aims to protect and encourage the recovery of threatened species, populations and communities as listed under the Act. The TSC Act is integrated with the EP&A Act and requires consideration of whether a development or an activity (such as the implementation of hazard reduction and asset protection) is likely to significantly affect threatened species, populations and ecological communities or their habitat.

1.3.4 Native Vegetation Act 2003 (NV Act).

The *N.V. Act* states indigenous vegetation within 20 metres of the bed or bank of a river or lake, or on slopes over 18 degrees, requires clearing consent under the *NV Act,* unless during an emergency fire event as authorized under the *Rural Fires Act 1997.*

1.4 Documentation Reviewed.

The following documents were reviewed in the preparation of this assessment:

- State Significant Development – Secretary's Environmental Requirements (SEAR's) Cairncross Waste Management Facility, Port Macquarie - Hastings LGA – Application Number SSD13_5792 issued on the 14.2.2013;
- Concept Plans for the existing Landfill Cell [Stage E]; Stages 1, 2 & 3 Landfill Cells;
- Aerial Photograph of the site;
- PMHC Certified Bushfire Prone Land Map;

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- *Planning for Bushfire Protection 2006* prepared by the NSW Rural Fire Service.

1.5 Site Inspection.

Graham Swain of *Australian Bushfire Protection Planners Pty. Limited* inspected the development property on the 10th May 2016 to assess the topography, slopes, vegetation classification and land use within and adjoining the Proposal Site.

Visual assessment was undertaken to determine likely fire runs, influence of terrain on wind patterns within the bushfire prone vegetation and an assessment of access and egress to the Proposal Site.

Adjoining properties were also inspected to determine the surrounding land use / land management.

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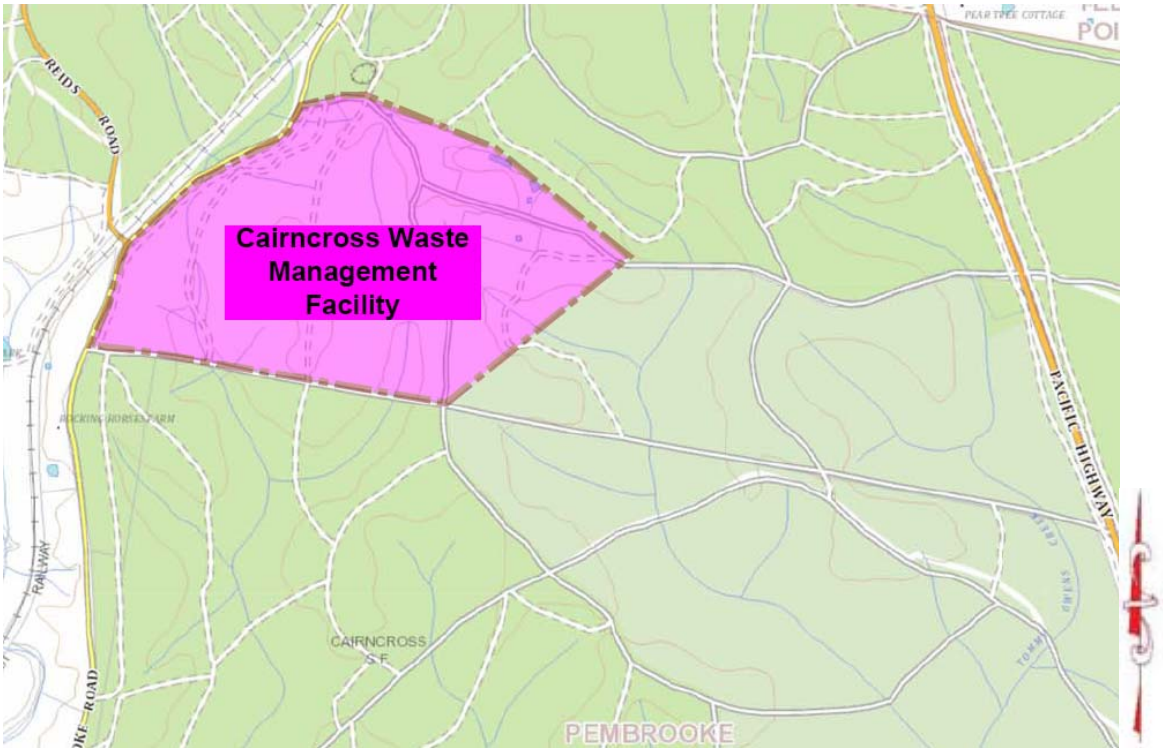
SECTION 2

DESCRIPTION OF PROPOSAL SITE

2.1 Location & Description.

The Proposal Site consists of vacant land located to the south and southeast of the existing [Stage E] landfill site and forms part of the Cairncross Waste Management Facility on Lot 1 in DP 1202080 No. 8395 Pacific Highway, Telegraph Point.

Figure 5 – Location of the Cairncross Waste Management Facility.



2.2 Existing Land Use.

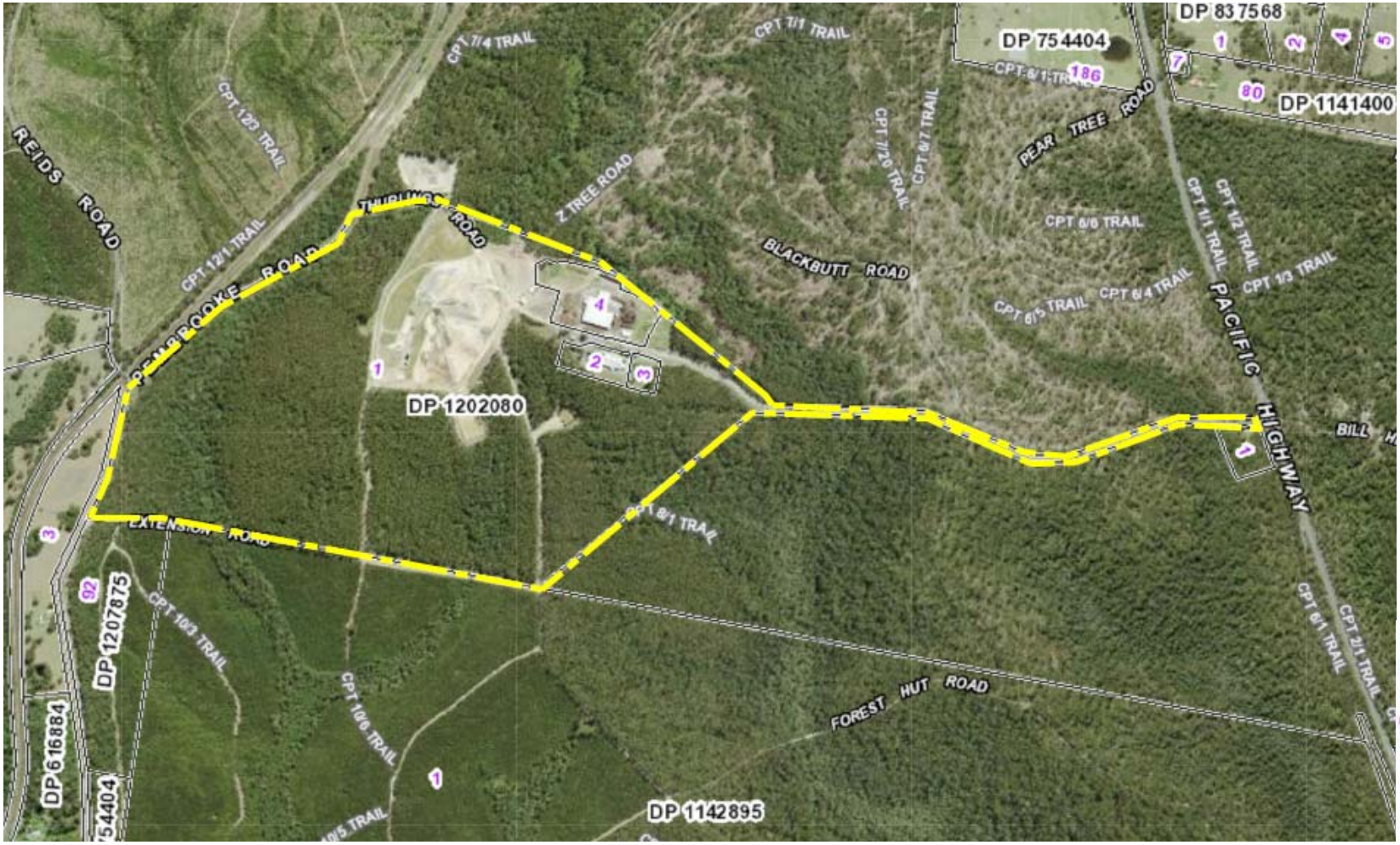
The Proposal Site is a parcel of vacant, vegetated land which is located to the south of the Stage E [existing landfill site] and to the west of the MRF.

2.3 Adjoining Land Use.

The land to the west of the Proposal Site is owned by PMHC and forms a vegetated compensatory habitat area. The land to the south of the Proposal Site is zoned 1(f) and forms part of the adjoining Cairncross State Forest estate whilst to the southeast the adjoining land is zoned 8(a) and contains the Rawdon Creek Nature Reserve.

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Figure 6 – Aerial Photograph showing the location of the Cairncross Waste Management Facility.



Source – SIX Viewer – accessed September 2016

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Figure 7 – Most recent Aerial Photograph showing the Cairncross Waste Management Facility.



Source – Google Maps – accessed September 2016

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Figure 8 – Location of the Proposal Site.



LEGEND

- Proposal Site
- Lot Boundary - Cairncross Waste Management Facility
- Forests and Reserves
- Streams

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2.4 Topography.

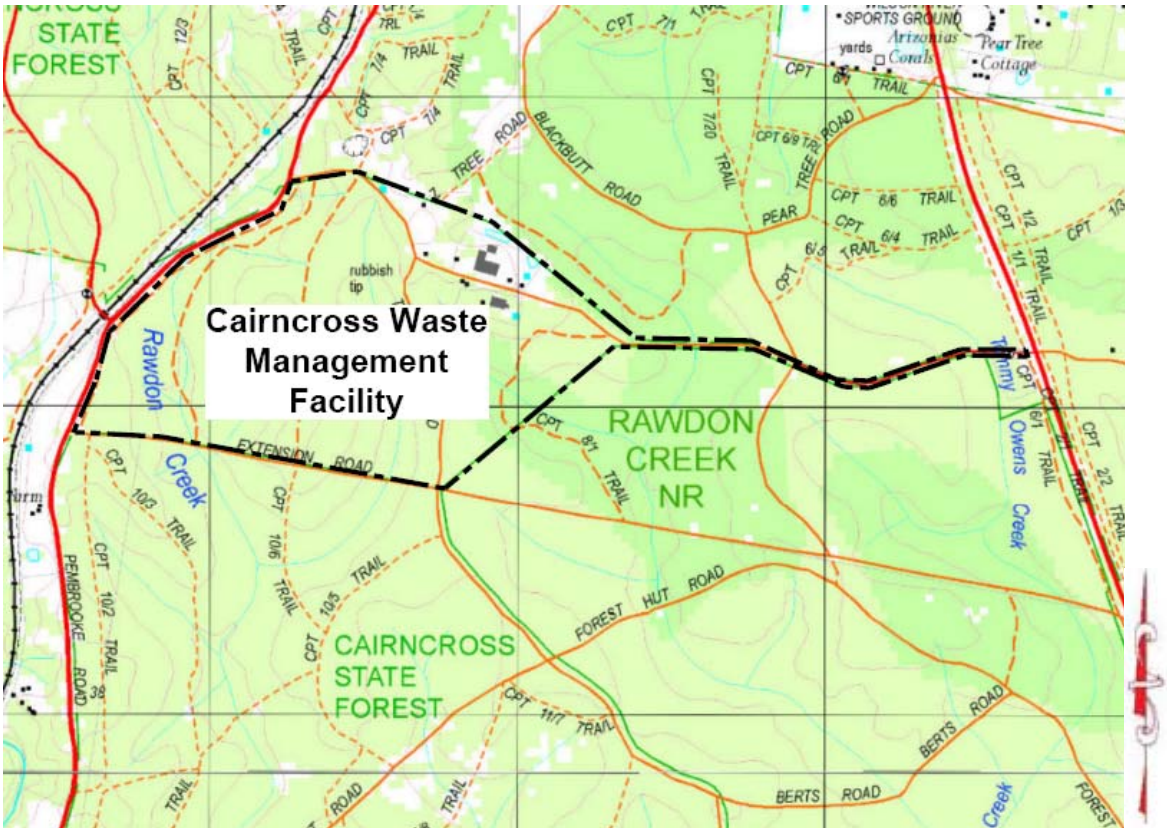
Appendix 2 of *Planning for Bushfire Protection 2006* states that slopes should be assessed, over a distance of at least 100 metres and that the gradient of the land should be determined which will most significantly influence the fire behaviour on the site.

The Proposal site occupies land each side of a drainage line that is a tributary to Rawdon Creek which flows to the south from Stage E, between Stages 1 & 2 and Stage 3, turning to the southwest and flowing across the forestry land to the south of Stage 2.

The land to the west and southwest of Stages 1 & 2 falls to the west/southwest at less than 3 degrees into Rawdon Creek. The land to the south of Stage 2 falls to the south into Rawdon Creek at less than 3 degrees.

The land within the adjacent Nature Reserve, to the southeast of Stage 3 falls to the southeast at 1 - 2 degrees.

Figure 9 – Topographic Map of Proposal Site and adjoining lands.



Source – Six Viewer – accessed September 2016

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2.5 Vegetation Communities on the land within the Proposal Site.

Appendix A2.3 of *Planning for Bushfire Protection 2006* provides a methodology for determining the predominant bushfire prone vegetation for at least 140 metres in all directions from the proposed building. Vegetation is classified using Table A2.1 of *Planning for Bushfire Protection 2006,* which classifies vegetation types into the following groups:

(a) Forests [wet & dry sclerophyll forests];
(b) Woodlands;
(c) Plantations – being pine plantations not native plantations;
(d) Forested Wetlands;
(e) Tall Heaths;
(f) Freshwater Heaths;
(g) Short Heaths;
(h) Alpine Complex;
(i) Semi – arid Woodlands;
(j) Arid Woodlands; and
(k) Rainforests.

The vegetation on the site consisted of a tall open forest with a mature canopy of *Eucalyptus microcorys* (Tallowwood) *Eucalyptus pilularis* (Blackbutt), *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus resinifera* (Red Mahogany) and *Eucalyptus globoidea* (White Stringybark).

The midlayer included small trees and tall shrubs such as *Alphitonia excelsa* (Red Ash), *Allocasuarina littoralis* (Black She-Oak), *Acacia floribunda* (White Sally) and *Callistemon salignus* (White Bottlebrush). The ground layer was generally grassy and herbaceous, with *Gahnia sieberiana* (Red-fruit Saw-sedge), *Entolasia marginata* (Bordered Panic), *Imperata cylindrica* (Blady Grass), *Entolasia stricta* (Wiry Panic) and *Oplismenus imbecillis* (Narrow-leaved Basket-grass) dominant.

In the eastern parts of the development area, the ground was slightly boggy and swamp forest elements of the community were dominant, with *Callistemon salignus* forming a dense midstorey and *Gahnia sieberiana* prevalent in the ground layer.

The vegetation appeared to have been recently burnt, but was regenerating.

Occurrence of exotic species in the development site was low, limited to some small patches of *Lantana camara* (Lantana).

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Refer to Figure 10 – Plan of Vegetation Communities prepared by BioLink (2013) below.

Figure 10 – Plan of Vegetation Communities.



Source – BioLink 2013

Vegetation mapping (Biolink 2013)

- Blackbutt Grassy Forest
- Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex
- Grey Gum - Tallowwood - White Mahogany Grassy Forest
- Plantation (Der)
- Wattle Scrub (Dist)

2.6 Vegetation Communities adjoining the Proposal Site.

The vegetation on the land to the west and southwest of the Proposal site consists of Tall Open Forest. The land to the south of Stage 2 and Stage 3 contains forest plantation in the early stages of growth.

The Nature Reserve to the southeast of Stage 3 contains Dry Sclerophyll Tall Open Forest.

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2.7 Site Photographs.



Photograph No. 1 taken looking to the south along the fire trail to the west of Stage E. Stage 1 on the left in the background. Habitat area is on the right.



Photograph No. 2 taken looking to the north along the fire trail which separates Stage 1 & 2 [on the right] from the habitat area on the left.

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Photograph No. 3 taken looking to the east along the fire trail which separates Stage 2 [on the left] from the Forestry Estate on the right.



Photograph No. 4 taken looking to the north along the fire trail which separates Stage 2 [on the left] from Stage 3 on the right.

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Photograph No. 5 taken looking to the south along the fire trail which separates Stage 3 [on the left] from Stage 2 on the right.



Photograph No. 6 taken looking to the southwest with Stage E on the right; Stage 1 in the background and Stage 3 on the left.

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Photograph No. 7 taken looking to the east along the fire trail separating the WMF and MRF on left and Stage 3 on the right.

2.8 Significant Environmental Features on the land within the Proposal Site.

The Proposal Site does not contain any significant environmental features such as SEPP 14 – Coastal Wetlands; SEPP 26 Littoral Rainforests; SEPP 44 – Koala Habitat; Areas of Geological interest; Steep Lands [>18 degrees]; Land slip areas or National Parks Estate. An ephemeral drainage line (a tributary of Rawdon Creek) runs between the Stage 1 and 2 cells on the west and the Stage 3 cell on the east.

2.9 Known Threatened Species, Populations, Endangered Ecological Communities or Critical Habitat on the land within the Proposal Site.

Blackbutt Grassy Forest corresponds with the Plant Community Type Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117) in the OEH Vegetation Information System (VIS) Database (OEH 2015).

Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion is not associated with any threatened ecological communities listed under the TSC Act or EPBC Act.

Two Matters of National Environmental Significance (MNES) were recorded in the study area: Koala (*Phascolarctos cinereus*), listed as Vulnerable under the EPBC Act, and the Rufous Fantail (*Rhipidura rufifrons*), listed as Migratory under the EPBC Act.

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SECTION 3
FIRE MANAGEMENT RESPONSIBILITIES

Fire management within the Proposal Site is the responsibility of:

3.1 Port Macquarie - Hastings Council.

PMHC has responsibility, under Section 66 of the *Rural Fires Act*, to issue a notice in writing requiring an owner / occupier of any land within the Local Government Area [LGA] to carry out bushfire hazard reduction works on that land. Section 100E of the *Rural Fires Act* requires Council to issue bushfire hazard reduction certificates for hazard reduction to be undertaken on private lands.

3.2 New South Wales Rural Fire Service.

The NSW Rural Fire Service (RFS) has the responsibility for undertaking fire suppression activities, hazard management activities and other functions relative to emergency management, within its areas of operation. *Section 73* of the *Rural Fires Act (1997)* enables the Commissioner to carry out bush fire hazard reduction works on any land as required by a bush fire risk management plan if the work has not been carried out satisfactorily. Incurred costs can be recovered as a debt owed to the Crown.

3.3 Fire & Rescue New South Wales.

The Fire & Rescue NSW has the responsibility for undertaking fire suppression activities, and other functions relative to emergency management, within its area of operation and through Mutual Aid Agreements, provide assistance to the NSW Rural Fire Service, particularly for structural fire operations within the NSW Rural Fire Brigade Districts. Hazmat management within New South Wales is the responsibility of Fire & Rescue NSW.

3.4 Port Macquarie - Hastings Bush Fire Management Committee.

The Port Macquarie - Hastings Bushfire Management Committee has the responsibility for planning for coordinated fire fighting activities / hazard management activities on a local government level. It is not an operational organization, a fire fighting organization or a funding source for fire management activities.

The Bush Fire Management Committee is supported by the following provisions of the Rural Fires Act 1997:

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- **Section 52** requires each Bush Fire Management Committee to prepare and submit a draft bush fire risk management plan and a plan of operations.

- **Section 54** of the Act specifies that a draft bush fire risk management plan is to 'set out schemes for the reduction of bush fire hazards in the rural fire district or other part of the State'.

  A draft bush fire risk management plan may also restrict or prohibit the use of fire or other fire hazard reduction activities in all or specified circumstances or places to which the plan applies.

3.5 Public Authorities & owners/occupiers of land.

The Rural Fires Act, 1997 provides several legislative opportunities to require Public Authorities, land owners and occupiers to manage hazardous fuels. These include:

- **Section 63(1)** states that it is the duty of a public authority to take any practicable steps to prevent the occurrence of bushfires on, and to minimise the danger of the spread of a bushfire on or from:

  (a) any land vested in or under its control or management, or

  (b) any highway, road, street, land or thoroughfare, the maintenance of which is charged on the authority.

- **Section 63(2)** states that 'it is the duty of the owner or occupier of land to take the notified steps (if any) and any other practicable steps to prevent the occurrence of fires on, and to minimise the danger of the spread of fires on or from that land'.

3.6 Management of the Defendable Spaces to the Development.

The management of the bushfire protection measures within the Proposal Site shall remain the responsibility of PMHC.

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SECTION 4

BUSHFIRE HAZARD ASSESSMENT

4.1 Definitions.

Planning for Bushfire Protection 1991 defines *Bushfire Hazard* as the "*availability of fuel".* The document also defines threat as being a *"measure of the scale of impact or significance in terms of hazard and risk".*

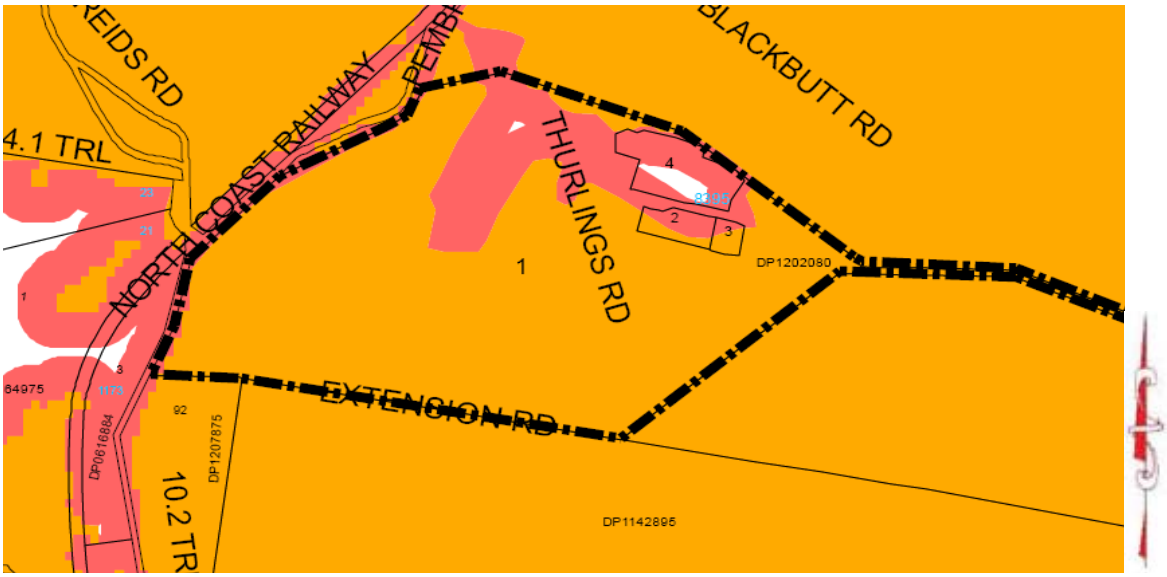
Planning for Bushfire Protection 2006 defines bushfire risk as *"the chance of a bushfire igniting, spreading and causing damage to assets of value to the community. Risk may be rated as extreme, major, moderate, minor or insignificant and is related to the vulnerability of the asset".*

4.2 Bushfire Prone Land Map.

PMHC has prepared a Bushfire Prone Land Map under the provisions of Section 146 of the *Environmental Planning & Assessment Act 1979.* An extract of this map is provided as Figure 11 below and shows that the Proposal Site contains Category 1 (forest) Bushfire Prone Vegetation.

The site inspection undertaken on the 10th May 2016 confirmed the accuracy of the Bushfire Prone Land Map.

Figure 11 – Extract of the PMHC Bushfire Prone Land Map.



Legend: *Orange – Category 1 Bushfire Prone Vegetation; Red – Buffer Zone to Bushfire Prone Vegetation; White – Non Bushfire Prone Land*

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4.3 Bushfire Hazard Assessment.

Planning for Bushfire Protection 2006 does not provide a methodology for determining bushfire hazard – it defers instead to Bushfire Prone Land determined in accordance with the "*Bushfire Prone Land Mapping Guideline"*, issued by the Rural Fire Service on the 7th April 2004.

To be able to undertake a bushfire hazard assessment the *Department of Planning* document *Circular C10 (1983)* provides a suitable methodology. This methodology rates the vegetation and slope and provides an index value to each.

The overall Bushfire Hazard Score is determined by multiplying the Vegetation Index by the Slope Index.

4.3.1 Assessment to Determine the Bushfire Hazard to the Development.

The vegetation that presents the potential bushfire threat to the development is the forest on the Proposal Site and on the adjoining land, to the west, southwest, south and southeast.

The forest vegetation has a vegetation index score of 2.8. The effective slope of the land adjoining the Proposal Site is downslope 5% - 10% to the west, southwest and south and downslope 0 - 5% to the southeast.

The slope index for downslope land is 1.5.

Therefore the Bushfire Hazard Score for the forest vegetation to the west, southwest and south and southeast of the Proposal site is 2.8 x 1.5 = 4.2, which equates to a numerical bushfire hazard rating of high.

4.4 Assessment of Bushfire Threat.

Bushfire Threat is the "*measure of scale of impact or significance in terms of hazard and risk*".

The bushfire hazard to the Proposal Site, from the forest bushfire prone vegetation on the land adjoining the site, has been determined to be high, using the methodology provided by *Circular No. C10* prepared by the Department of Planning [1983].

The bushfire risk to the Proposal Site is high as the adjoining forest vegetation has the potential to produce high intensity fires that will develop into crown fires which will impact upon the development by producing levels of radiant heat which may cause injury to workers and ignite exposed waste and equipment.

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This vegetation also gives off excessive amounts of burning embers, potentially resulting in burning ember ignition of combustible materials, including exposed waste in the landfill cells.

The bushfire threat to the proposed facility is therefore high.

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SECTION 5
BUSH FIRE PROTECTION ASSESSMENT

5.1 Introduction.

Chapter 1 of *Planning for Bushfire Protection 2006* states that the aim of the document is to use the NSW development assessment system to provide for protection of human life [including firefighters] and to minimize impacts on property from the threat of bushfire, while having due regard to development potential, onsite amenity and protection of the environment.

The objectives of the document are:

- Afford occupants of any building adequate protection from exposure to the impacts of a bushfire;
- Provide for a defendable space to be located around buildings;
- Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;
- Ensure that safe operational access/egress for emergency service personnel and occupants relocating is provided and/or available;
- Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads within the Asset Protection Zone/s; and
- Ensure that utility services are adequate to meet the needs of firefighters [and others assisting in bushfire fighting operations].

Chapter 1, Section 1.3 of *Planning for Bushfire Protection 2006* states that the construction of Class 5 – 10 buildings on bushfire prone land, or land impacted by bushfire prone land, must meet the aim and objectives of the document.

Chapter 4, Section 4.3.6(f) discusses the bushfire protection to buildings of Class 5 to 8 and 10b of the Building Code of Australia.

The Proposal involves the construction of partially above ground leachate collection tanks which are classified as a Class 10 structure under the BCA and therefore need to be designed and constructed to comply with the BCA and the requirements of *Planning for Bushfire Protection 2006*.

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5.2 Assessment of Bushfire Risk to the Proposal.

5.2.1 Likely Fire Scenarios.

An assessment of the fire scenarios likely to affect the Proposal has been undertaken, based on the potential fire paths identified during the site inspection.

Scenario 1:

A fire burning through the forest vegetation within the Compensatory Habitat Area, west of Stages 1 & 2 and spreading, upslope, under north-westerly, westerly and south-westerly winds.

This fire occurrence is likely during fire seasons when conditions are such that the vegetation has not been managed to remove the fuel hazard, the Fire Danger Index is Extreme (FDI > 50) and the prevailing wind is from the northwest, west and southwest.

Scenario 2:

A fire burning through the forest vegetation on the adjoining State Forest, south of Stage 2 and spreading, upslope, under south-westerly winds.

This fire occurrence is likely during fire seasons when conditions are such that the vegetation has not been managed to remove the fuel hazard, the Fire Danger Index is Extreme (FDI > 50) and the prevailing wind is from the southwest.

Scenario 3:

A fire burning through the forest vegetation on the adjoining Nature Reserve, southeast of Stage 3 and spreading, upslope, under strong south-easterly winds.

This fire occurrence is likely during fire seasons when conditions are such that the vegetation has not been managed to remove the fuel hazard, the Fire Danger Index is Extreme (FDI > 50) and the prevailing wind occurs during periods of strong south-easterly wind changes.

Scenario 4:

A fire that occurs in the forest vegetation within the undeveloped landfill stages.

This potential fire impact will occur if the operator of the facility does not continue to manage the bushfire fuels and immediately acts to extinguish an outbreak of fire in the forest vegetation and the fire spreads into the adjoining Compensatory Habitat Area to the west, State Forest Estate to the southwest and south and the Nature Reserve to the southeast.

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Scenario 5:
A fire created by the landfill operation, igniting and spreading across the adjoining forest vegetation.

This potential impact will occur if the operator of the landfill does not immediately act to extinguish an outbreak of fire in the landfill material and the fire spreads into unmanaged forest vegetation either within the facility or on adjoining lands.

5.2.2 Risk Statement.

Table 1 provides a qualitative risk analysis matrix – used to determine the level of risk in Table 2.

Table 2 provides a statement of risk for the potential fire scenarios [prior to mitigation measures being adopted/implemented] and assigns risk levels reflecting identified levels of likelihood and consequences for a 'catastrophic' fire occurrence during severe fire weather conditions.

Table 1 – Qualitative risk analysis matrix – used to determine the level of risk in Table 4

Likelihood	Consequence				
	Minimal	*Minor*	*Moderate*	*Major*	*Catastrophic*
Remote	Negligible	Negligible	Very low	Low	Medium
Unlikely	Negligible	Very low	Low	Medium	High
Possible	Very low	Low	Medium	High	Very high
Likely	Low	Medium	High	Very high	Significant
Almost certain	Medium	High	Very high	Significant	Significant

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Table 2 – Bushfire Risk Register – Severe Bushfire Event – if high levels of combustible fuels / unmanaged vegetation exist and ignition occurs.

The Risk What can happen?	The consequences & likelihood of an event happening Consequences	Likelihood	Consequence Rating	Likelihood Rating	Level of Risk	Risk Priority
Scenario 1: Fire burning in unmanaged forest vegetation in the Compensatory Habitat Area, spreading across the landscape under north-westerly, westerly and south-westerly winds	Ignition of exposed waste. Burns to people exposed to radiant heat	Likely to occur during severe / catastrophic fire danger periods	Moderate	Likely to occur when fires are burning to the NW, W & SW of the site	High	1
Scenario 2: Fire burning in unmanaged forest vegetation on the State Forest to the south of Stage 2, spreading across the landscape under south-westerly winds	Ignition of exposed waste. Burns to people exposed to radiant heat	Likely to occur during severe/ catastrophic fire danger periods	Moderate	Likely to occur when fires are burning to the NW, W & SW of the site	High	1
Scenario 3: Fire burning in unmanaged forest vegetation on the Nature Reserve to the southeast of Stage 3 , spreading across the landscape under south-easterly winds	Ignition of exposed waste. Burns to people exposed to radiant heat	May occur during severe fire danger periods	Moderate	Possible	Medium	2
Scenario 4: Fire burning in unmanaged forest vegetation in the undeveloped landfill stages.	Ignition of exposed waste. Burns to people exposed to radiant heat	May occur during severe fire danger periods	Moderate	Possible	Medium	2
Scenario 5: Fire burning in landfill, spreading into the adjoining forest vegetation within the facility or on the adjoining lands	Ignition of unmanaged vegetation on adjoining land. Burns to people exposed to radiant heat	May occur if a fire within the landfill material is not immediately extinguished during severe fire danger periods	Moderate	Possible	Medium	2

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5.2.3 Summary of Bushfire Risk.

Table 2 identifies the potential level of risk to the Proposal, prior to the implementation of the recommended mitigation measures. Table 2 also identifies the potential level of risk from a fire which ignites within the landfill operations and escapes into the vegetation either within the facility or on the adjoining lands

Staff and equipment may be exposed to high levels of radiant heat and smoke and therefore the Standard Operating Procedures [SOP] should identify protocols for the fire scenarios identified in this report.

The Proposal involves the construction of partially above ground leachate collection tanks which will be subject to the impact of bushfires. Therefore, as a precautionary measure, it is proposed to provide a 20 metre width Defendable Space to the tanks.

5.2.4 Assessment of Bushfire Risk created by the Land Fill operation.

The operation of the Stage 1, 2 & 3 landfill will continue the current practices which include compaction of waste with heavy machinery and progressive sealing of the face of the landfill.

All waste is covered with 150mm of day cover material with no waste left exposed when the landfill is not operating.

PMHC has provided advice that fire occurrences do occur when ashes and other hot materials/acids etc are deposited in the waste material. Outbreaks of fire which may occur during operating hours will be extinguished using heavy machinery and water carts.

These facilities are maintained on ‘stand-by’ readiness during days of Total Fire Ban status.

The management of fire ignitions within the landfill reduces the risk of ignition of the forest vegetation on the adjoining land and the vegetation retained within the future expansion stages of the extended landfill precinct.

However, work practices should be established in recognition of the likely risk of ignition of the retained vegetation on the site and on adjoining lands by the operation of machinery such as slashers etc. These should include the provision of portable fire extinguishers during maintenance activities that involve cutting, grinding, welding and slashing etc.

Such operations should not occur in the open during periods of high fire danger and declared Total Fire Ban days.

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SECTION 6

PROTECTION MEASURES TO BE IMPLEMENTED TO REDUCE THE BUSHFIRE RISK TO THE PROPOSAL.

6.1 Provision of Defendable Space to the Leachate Tanks.

A 20 metre wide Defendable Space shall be provided to each Leachate Tank.

The Defendable Space shall be maintained by regular slashing to limit vegetation [grass] height to 150 mm during the Bushfire Danger Period.

6.2 Provision of Strategic Fire Advantage Zone adjacent to the south east boundary of the Landfill Site.

A 30 metre wide Strategic Fire Advantage Zone shall be provided and maintained along the boundary with the adjoining Nature Reserve.

This zone shall be managed in accordance with the prescriptions provided by the NSW Rural Fire Service's 'Environmental Assessment Code 2006'.

6.3 Provision of temporary Fire Break to landfill cells.

A 10 metre wide temporary cleared fire break shall be provided to the outer edge of the incremental landfill cells.

6.4 Management of the residual vegetation within the Stage 1, 2 & 3 Landfill precincts.

The forest vegetation retained within each landfill stage, being the residual vegetation beyond the operating cell, shall be fuel managed by hazard reduction burning in accordance with the prescriptions provided by the NSW Rural Fire Service's 'Environmental Assessment Code 2006'.

Management of the combustible fuels shall be undertaken to maintain a Low – Moderate Overall Fuel Hazard, pursuant to the DSE Overall Fuel Hazard Guide.

6.5 Management of the risk of fire ignition within the Landfill Operation.

The Landfill facilities such as Water Tankers and heavy earth moving plant shall be maintained on 'stand-by' readiness during days of Total Fire Ban status.

Work practices shall be established in recognition of the likely risk of ignition of the vegetation on the adjoining land and the vegetation retained on site by the operation of machinery such as slashers etc.

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These should include the provision of portable fire extinguishers during maintenance activities that involve cutting, grinding, welding and slashing etc.

6.6 Access.

The existing fire trail adjacent to the south-eastern boundary shall be upgraded and maintained to provide an all-weather access having a width of 4.0 metres within a 6.0 metre corridor kept clear of shrubs and grasses. The trail shall be located within the Strategic Fire Advantage Zone and shall be constructed to provide access for a fully laden 15 tonne [GVM] Rural Fire Service/State Forests Category 1 Tanker

The existing Fire Trail to the west of Stage 1 & 2 and between Stages 2 & 3 shall be retained and maintained to provide an all-weather access for a fully laden 15 tonne [GVM] Rural Fire Service/State Forests Category 1 Tanker.

There should be provided to the perimeter of each incremental landfill cell a temporary fire trail which connects to the existing/proposed perimeter/internal fire trail network. The temporary trail should be capable of carrying a fully laden NSW Rural Fire Service/State Forests Category 1 Tanker.

6.7 Provision of Portable Fire Fighting Equipment.

To mitigate the risk of ignition of the surrounding vegetation, contractors undertaking drilling, cutting, grinding, welding and slashing operations on the site shall not undertake such works without the provision of a portable fire extinguisher.

6.8 Works on Total Fire Ban Days.

Contractors should not undertake drilling, cutting, grinding, welding and slashing operations on Total Fire Ban days – unless during an emergency in which case a firefighting appliance should be on stand-by at the facility.

6.9 Fire-fighting Water Supplies.

The volume of the existing fire-fighting water storage dam is approximately 3000m^3. This storage dam will remain in its current location during Stage 1 and 2, being relocated to the eastern side of Stage 3 prior to the commencement of landfilling in the Stage 3 area.

This volume satisfies the fire-fighting water supply requirements.

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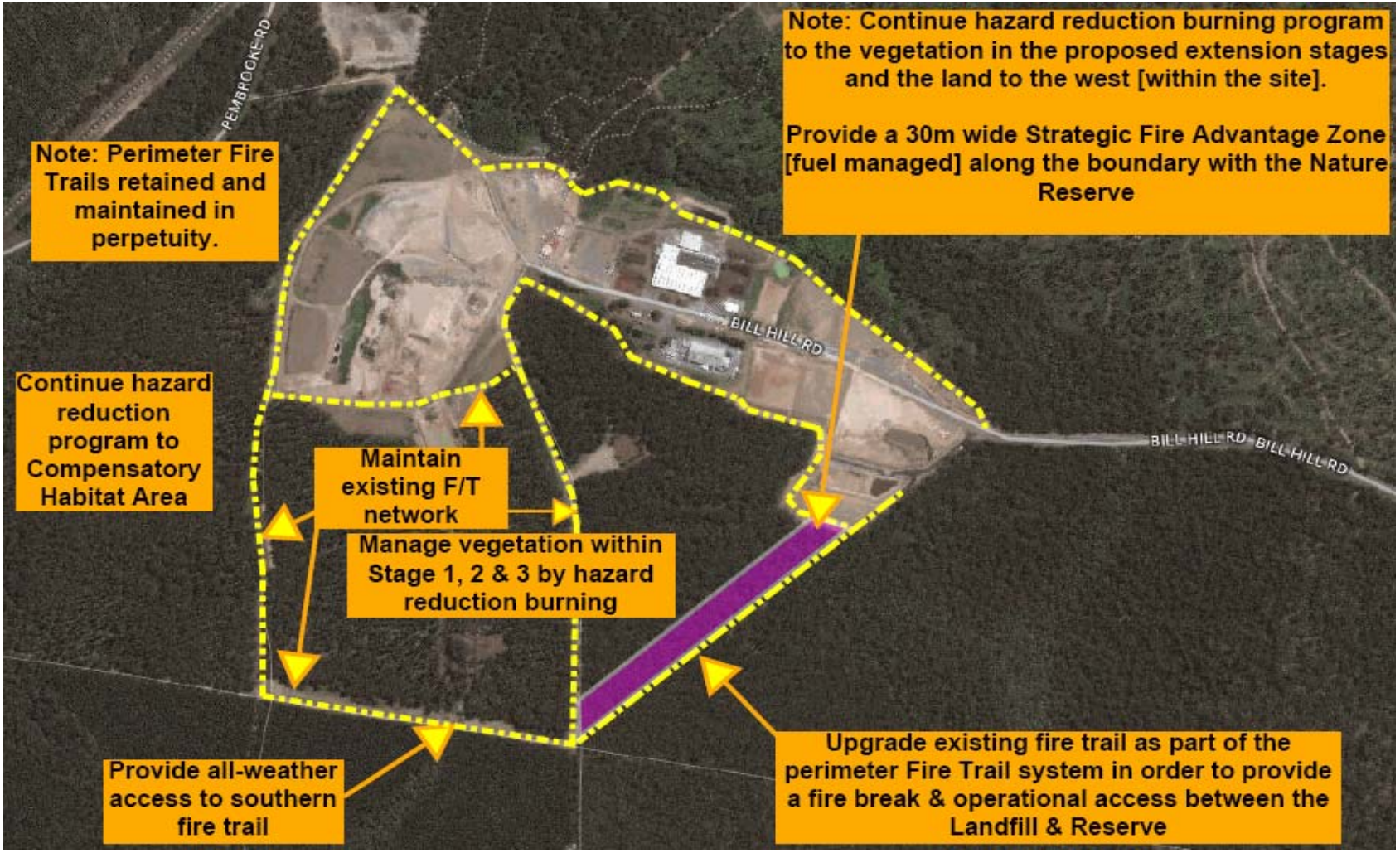
6.10 Ongoing Fire Management.

For the purpose of fuel reduction from hazard reduction burning, the following should be part of the ongoing management:

- All perimeter trails clear and maintained;
- Internal trails maintained to allow for mosaic burning;
- Asset Protection Zones/Defendable Spaces to be constructed and maintained around infrastructure;
- Provide and maintain temporary fire trails, Asset Protection Zones/Defendable Spaces adjacent to each stage.

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Figure 12 – Plan of Bushfire Protection Measures.



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SECTION 7

ASSESSMENT OF RESIDUAL RISK

Table 3 provides a statement of risk for the potential fire scenarios [post mitigation measures have been adopted/implemented] and assigns risk levels reflecting identified levels of likelihood and consequences for a 'catastrophic' fire occurrence during severe fire weather conditions.

Table 3 – Bushfire Risk Register – Severe Bushfire Event – post implementation of mitigations measures.

The Risk What can happen?	The consequences & likelihood of an event happening, prior to mitigation measures Consequences	Likelihood	Consequence Rating, prior to mitigation measures	Likelihood Rating, prior to mitigation measures	Level of Risk, prior to mitigation measures	Risk Rating post implementation of mitigation measures
Scenario 1: Fire burning in unmanaged forest vegetation in the Compensatory Habitat Area, spreading across the landscape under north-westerly, westerly and south-westerly winds	Ignition of exposed waste. Burns to people exposed to radiant heat	Likely to occur during severe / catastrophic fire danger periods	Moderate	Likely to occur when fires are burning to the NW, W & SW of the site	High	Moderate
Scenario 2: Fire burning in unmanaged forest vegetation on the State Forest to the south of Stage 2, spreading across the landscape under south-westerly winds	Ignition of exposed waste. Burns to people exposed to radiant heat	Likely to occur during severe/ catastrophic fire danger periods	Moderate	Likely to occur when fires are burning to the NW, W & SW of the site	High	Moderate
Scenario 3: Fire burning in unmanaged forest vegetation on the Nature Reserve to the southeast of Stage 3 , spreading across the landscape under south-easterly winds	Ignition of exposed waste. Burns to people exposed to radiant heat	May occur during severe fire danger periods	Moderate	Possible	Medium	Low
Scenario 4: Fire burning in unmanaged forest vegetation in the undeveloped landfill stages.	Ignition of exposed waste. Burns to people exposed to radiant heat	May occur during severe fire danger periods	Moderate	Possible	Medium	Low

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Scenario 5: Fire burning in landfill, spreading into the adjoining forest vegetation within the facility or on the adjoining lands	Ignition of unmanaged vegetation on adjoining land. Burns to people exposed to radiant heat	May occur if a fire within the landfill material is not immediately extinguished during severe fire danger periods	Moderate	Possible	Medium	Low

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SECTION 8

CONCLUSION

The Proposal site and surrounding land contains unmanaged vegetation which is bushfire prone.

This assessment has reviewed the bushfire threat to the Proposal and made recommendations on the measures designed to mitigate the threat to the Proposal from fire entering site and fire escaping from the Proposal site onto adjoining land.

Implementation of the strategies provided in Section 5.2.4 and Section 6 of this report are considered necessary to provide the level of protection required to the Proposal and to ensure compliance with legislative requirements in respect to the management of the land to prevent bushfires occurring within and escaping from the site and the provision of access for fire-fighting operations.

The assessment of the bushfire protection requirements and potential levels of bushfire attack on the Proposal indicates that the development of the site can be undertaken in a manner that balances development opportunities and the protection of life, property and the environment.

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REFERENCES:

- N.S.W Rural Fire Service – *Planning for Bushfire Protection 2006*;
- *Environmental Planning & Assessment Act – 1979*;
- *Rural Fires Act – 1997*;
- *Rural Fires and Environmental Assessment Legislation Amendment Act 2002*;
- *Rural Fires Regulation 2013*;
- NSW Rural Fire Service – *Guideline for Bushfire Prone Land Mapping 2015*;
- *Threatened Species Conservation Act 1995*;
- *Native Vegetation Act 2003*;
- *Bushfire Environmental Assessment Code 2006*;
- Building Code of Australia;
- Australian Standard A.S 3959 - 2009 "*Construction of Buildings in Bushfire Prone Areas"*;
- *Port Macquarie - Hastings [PMHC] Bushfire Prone Land Map.*

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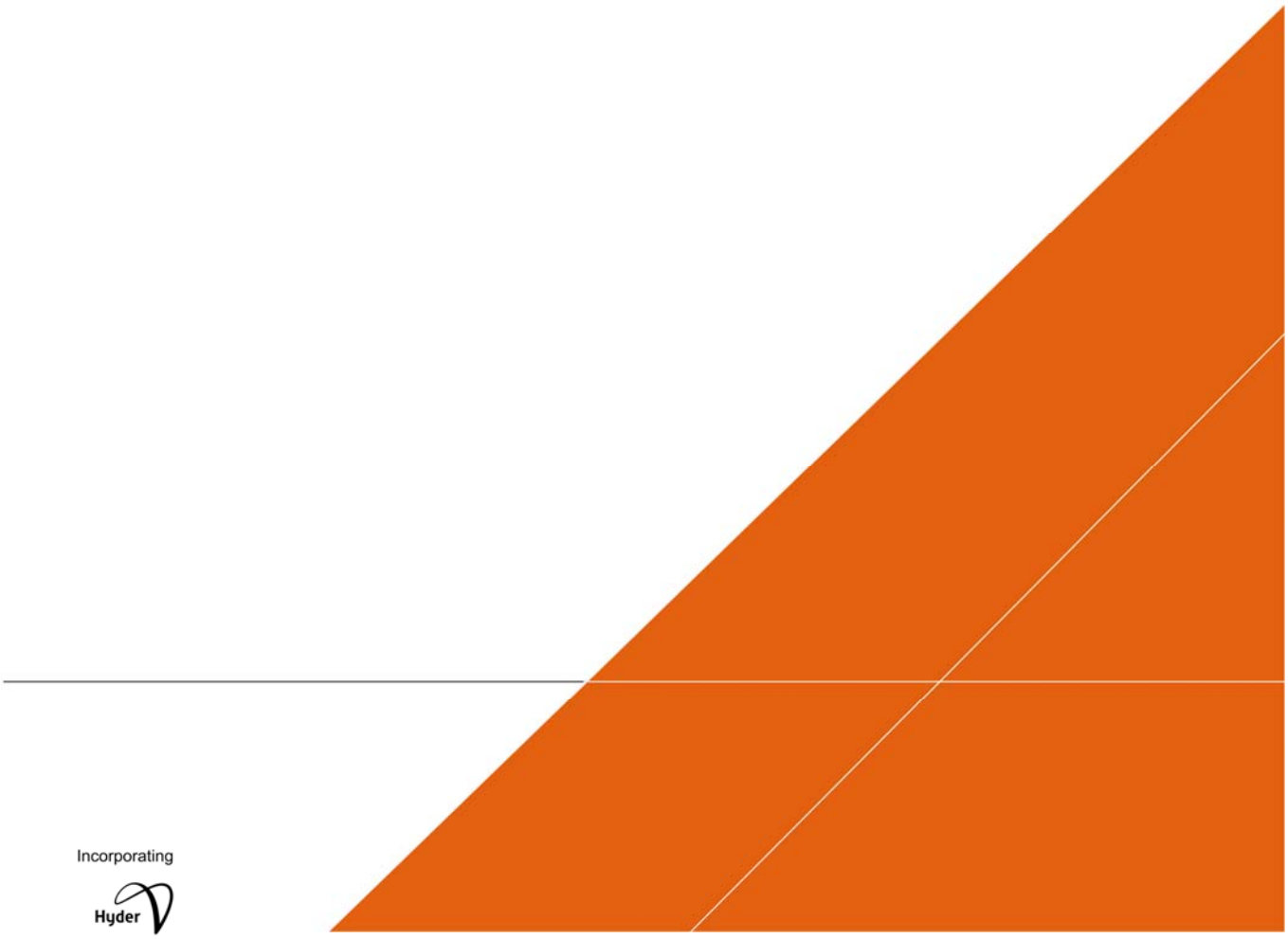
APPENDIX R GREENHOUSE GAS ASSESSMENT

ARCADIS Design & Consultancy for natural and built assets

CAIRNCROSS LANDFILL EXPANSION

Greenhouse Gas Assessment

29 MAY 2017



Incorporating Hyder

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PORT MACQUARIE HASTINGS COUNCIL

CAIRNCROSS LANDFILL EXPANSION
Environmental Impact Statement

Author Ben Matthews

Checker Claire Hodgson

Approver Zoe Wood

Report No 001

Date 26/04/2017

Revision Text A

This report has been prepared for Port Macquarie-Hastings Council in accordance with the terms and conditions of appointment for the expansion of Cairncross Waste Management Facility project dated 27 November 2014. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	26/4/2017	Draft Greenhouse Gas Assessment	BM	ZW
B	29/05/2017	Final Greenhouse Gas Assessment	BM	ZW

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GLOSSARY

Term	Definition
BAU	Business as usual
C&D	Construction and demolition waste
C&I	Commercial and Industrial waste
CFL	Compact Fluorescent Lamp
CH_4	Methane
CO_2	Carbon Dioxide
CO_2-e	Carbon Dioxide Equivalent
DA	Development Application
DoE	Department of Environment
DP&E	NSW Department of Planning and Environment
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	New South Wales Environment Protection Authority
EPL	Environment Protection Licence
EP&A Act	*Environmental Planning and Assessment Act 1979*
GHG	Greenhouse Gas
GWP	Global Warming Potential
HVAC	Heating, Ventilation and Air Conditioning
ID	Identity Document
KPI	Key Performance Indicators
kW	Kilowatt
LEMP	Landfill Environmental Management Plan
LGA	Local government area

Term	Definition
m2	Meters squared
MJ/t	Mega-Joules per tonne
mm	Millimetres
Mt	Mega tonnes
MSW	Municipal solid waste
N_2O	Nitrous Oxide
NGA	National Greenhouse Accounts
NGER	*National Greenhouse and Energy Reporting Act 2007*
NSW	New South Wales
LEMP	Landfill Environmental Management Plan
OPF	Organics Processing Facility
OSD	On-site Detention
PMHC	Port Macquarie-Hastings Council
SSD	State Significant Development
t	tonnes
tpa	tonnes per annum
WMF	Waste Management Facility
WRI/WBCSD	The World Resources Institute/World Business Council for Sustainable Development

EXECUTIVE SUMMARY

Port Macquarie-Hastings Council (PMHC) operates a licensed landfill site at the Cairncross Waste Management Facility (WMF)The current approved area of the Cairncross Landfill is nearing the end of its capacity and additional waste disposal capacity is required to service the needs of the local government area (LGA). The existing landfill is expected to reach capacity in approximately 2020. The expansion would be conducted in three key stages over a 36-year period from 2020-2056. Construction, filling, capping and closure of the new landfill sites would, within each stage, occur concurrently.

A modern, well-managed and engineered landfill provides an important service to the community by handling its waste in a cost-effective, environmentally responsible way. PMHC have made substantial advances in diverting waste from landfill through establishing recycling programs and infrastructure projects such as organics resource recovery and materials resource recovery facilities. Nevertheless, a need for landfill infrastructure will remain into the foreseeable future. For certain wastes, there is no current or foreseeable reuse, treatment or recycling option.

Approval for the Proposal is being sought under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979 (EP&A Act).* This report has been prepared as part of the environmental assessment process required under the *EP&A Act*, and includes greenhouse gas (GHG) emissions projections and mitigation measures for both construction and operation of the Proposal.

GHG emissions from the Proposal will peak in the year 2057, with approximately 126,000 tonnes of carbon dioxide equivalents (CO_2-e) to be emitted that year. This represents 1.08 per cent of Australia's waste-sector GHG emissions or just 0.03 per cent of Australia's total annual GHG emissions (as at 2017). The reported modelling does not account for any methane gas capture, likely improvements in organic and general waste diversion, and does not account for the likelihood that over the lifetime of the proposal methane gas capture technology will become more effective, cheaper and easier to implement.

A GHG mitigation strategy was developed to minimise the impact of the Proposal on the community and to explore carbon mitigation avenues. While all efforts have and will be undertaken to minimise waste generation and associated GHG emissions within the PMHC local government area (LGA), it is acknowledged by PMHC that provision of a landfill is an important and required service by the greater community now and into the foreseeable future. By seeking approval for all three stages of the Proposal, PMHC is attempting to ensure economies of scale and consistency in their waste reduction and GHG mitigation efforts. Seeking combined approval also allows for a long-term, coordinated and strategic approach by PMHC on GHG emissions minimisation.

1 INTRODUCTION

Arcadis has conducted a Greenhouse Gas Assessment of the Cairncross Landfill Expansion (the Proposal) on behalf of PMHC. This report forms part of the Environmental Impact Statement (EIS) for approval of the Proposal.

1.1 Proposal overview

PMHC proposes to expand the existing landfill (Cairncross Landfill) at the Cairncross WMF, located at 8395 Pacific Highway, Telegraph Point, NSW on Lot 1 / DP 1202080 (see Figure 1-1**Error! Reference source not found.**). PMHC is seeking development approval to extend Cairncross Landfill to include the remaining area identified for landfilling in the 1999 Environmental Impact Statement (EIS)[1].

The Proposal would involve the progressive construction, operation and rehabilitation of three additional landfill stages (Stages 1-3), following a staged approach with implementation over approximately 36 years. Stage 1 would commence construction/operation in approximately 2019/2020 and Stage 3 would reach capacity in approximately 2056 with a landfill closure period to follow. Despite recent and expected future increases in diversion of waste from landfill, the annual waste acceptance rate would progressively increase over the life of the Proposal due to predicted population and waste generation growth per capita.

The Proposal Site is defined as the area shown on Figure 1-2 and is located south-west of Telegraph Point, approximately two kilometres (km) west of the Pacific Highway. The Proposal Site covers an area of approximately 40.2 hectares (ha) (including the landfill and ancillary areas such as access roads and a biodiversity corridor) and is owned by PMHC. The Proposal Site is within the broader Cairncross WMF which is bordered by the Rawdon Creek Nature Reserve to the south-east, by Cairncross State Forest to the north and south and by farmland to the west.

Approval is sought for the Proposal in the form of a Development Application (DA) under *Part 4, Division 4.1 (SSD) of the EP&A Act*. PMHC submitted a request for the Director General's Requirements (DGRs) (now Secretaries Environmental Assessment Requirements (SEARs)) for the Proposal on 24 February 2015. The SEARs were subsequently issued on 7 May 2015 (Reference SSD 13_5792). An extension to the SEARs was granted on 20 February 2017.

The Proposal will receive waste from all areas within the Port Macquarie-Hastings local government area (LGA) including the major townships of Port Macquarie, Wauchope and Camden Haven. Waste will include general solid waste (i.e. putrescible and non-putrescible materials) and asbestos from domestic and commercial and industrial (C&I) sources.

The key works for which approval is sought include:

- Progressive landfill cell construction, operation and rehabilitation of three additional landfill stages (Stages 1-3) including:
  - Clearing of 3.4 ha of existing vegetation
  - Construction of access tracks
  - Earthworks for cell formation including extraction and stockpiling of materials and the reapplication to form the leachate barrier (cell liner) as well as for daily, intermediate and final cover

[1] The 1999 EIS was prepared by ERM to support the development application, and subsequent approval, for the first stage of the landfill. The EIS proposed the additional stages for which approval is now being sought.

  - Installation of leachate management structures including the leachate barrier, collection, storage and disposal system
  - Construction of a rising main to transfer leachate to the adjacent sewerage treatment plant (STP)[2]
  - Installation of a stormwater management system
  - Progressively increasing the annual waste acceptance rate at the landfill
  - Signage and other ancillary works
  - Rehabilitation of closed cells
- Delineation and ongoing management of a 50 m wide Koala connectivity corridor around the south-western border of the site.

The Proposal is expected to receive a total of approximately 3.2 million tonnes of waste over the life of the expanded landfill and would be developed in three stages as can be seen in Figure 1-2.

[2] The STP is proposed to be built in 2017 and is being designed to be capable of accepting leachate from Stages 1-3 of the Proposal.

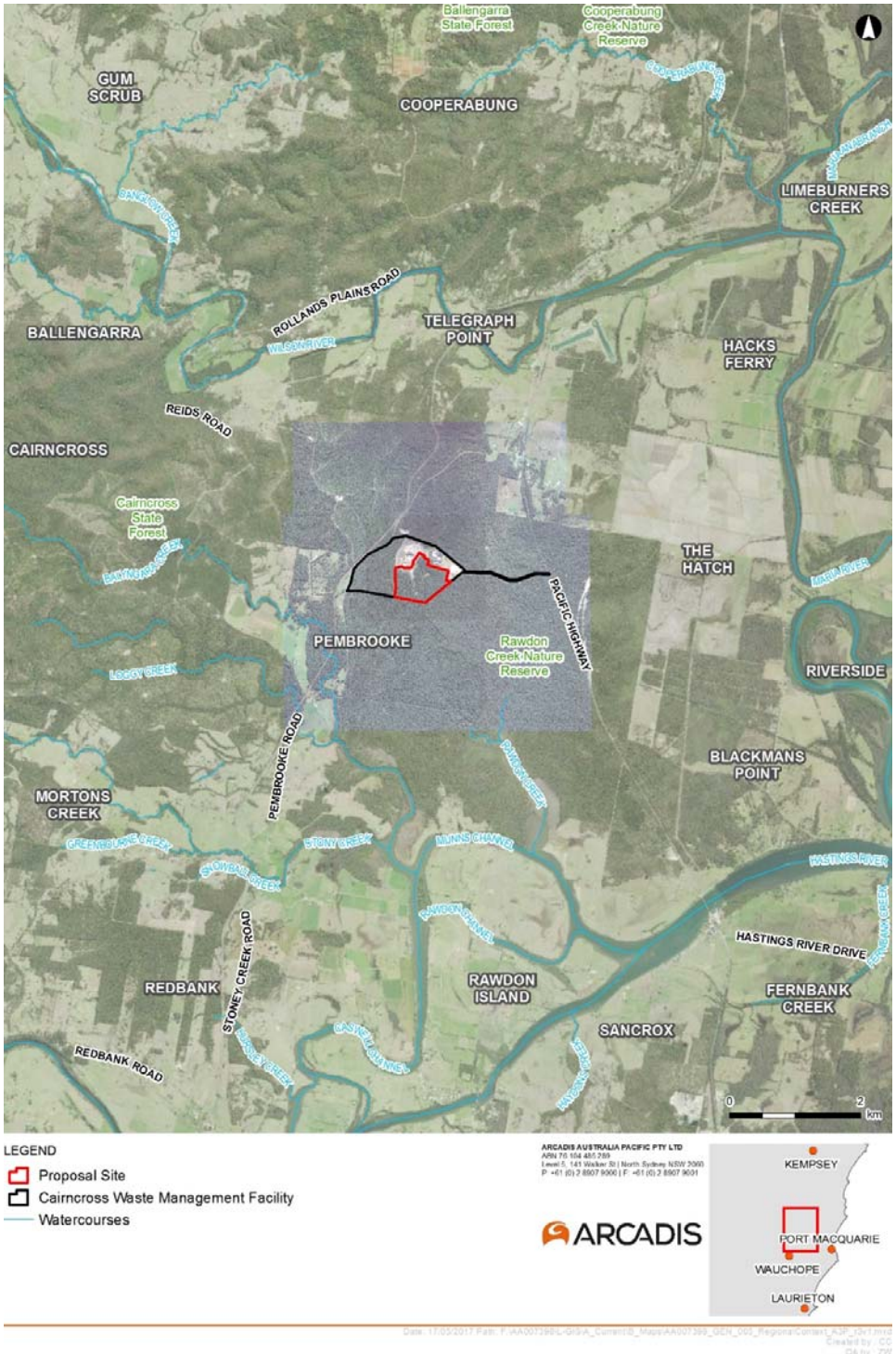


Figure 1-1 Site location

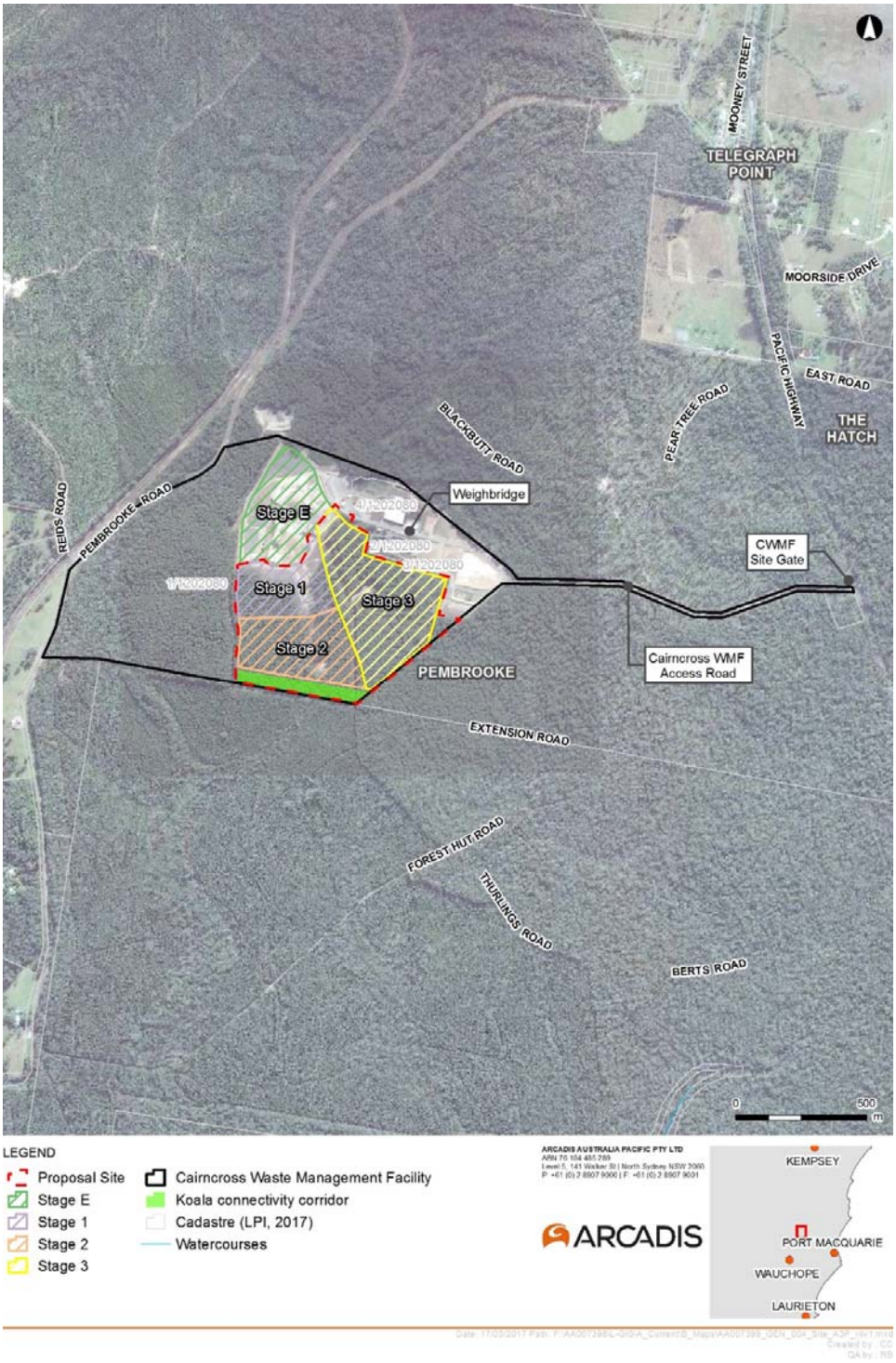


Figure 1-2 Site layout

The timeframes provided in Table 1-1 for each stage of the landfill are based on waste generation modelling undertaken for the PMHC LGA and are indicative only. The start and end dates for each stage represent the likely timeframe for accepting waste, however the preparatory and completion works for each stage (e.g. landfill cell construction, construction of leachate barrier systems, and final rehabilitation) may commence/conclude up to two years before/after the timeframes provided below. The filling rates and landfill capacity would be reviewed on an ongoing basis.

Table 1-1 Details of landfill stages

Stage	Timeframe[3]	Area (ha)	Capacity (t)	Duration (years)	Activities
Stage 1	2020 – 2040	7.9	1,231,789	20	Progressive landfill cell construction, operation and rehabilitation.
Stage 2	2040 – 2047	10.4	777,779	7	
Stage 3	2047 – 2056	16.9	1,179,414	9	
Total	**2020 – 2056**	**45.4**	**3,188,982**	**36**	

The existing landfill (referred to herein as Stage E) is already approved and operational and therefore does not form part of the Proposal. However, the GHG emissions from Stage E ('legacy emissions') have been considered within this assessment due to the lag times associated with GHG generation, the potential to manage emissions from Stage E collectively with those from Stages 1-3 and a proactive management approach by PMHC in addressing these emissions from the entire landfill. By the end of its lifecycle in 2020 Stage E will have run for 19 years and have reached its capacity of 1,098,537 t.

The landfill would continue to operate during the following hours:

- Monday to Friday: 7am – 5pm
- Saturday, Sunday, public holidays: 8am – 4pm.

Site management activities, such as covering operations, may continue one hour after closure. The concept design for the Proposal has been developed in accordance with the Environmental Guidelines: Solid Waste Landfills, Second Edition, 2016 (EPA, 2016) (Landfill Guidelines).

1.2 Background

PMHC oversees the operation of the Cairncross Waste Management Facility (Cairncross WMF), which includes the operation of a landfill, Waste Transfer Station (WTS), an Organics Resource Recovery Facility (ORRF) and a Material Recovery Facility (MRF). The Cairncross WMF was granted approval under Part 4 and Part 5 of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* for the Stage 1 landfill (now referred to as the existing landfill or 'Stage E') in 1999 and commenced operations in September 2001.

The current approved area of the Cairncross Landfill is nearing the end of its capacity and additional waste disposal capacity is required to service the needs of the LGA. The existing landfill is expected to reach capacity in approximately 2020. The Part 4 development approval (DA) for extractive industries for the current landfill operational area, DA No. 1999/178, was limited to 20 years. In February 2013, an extension of five years was sought on the original approval and was subsequently granted by PMHC.

[3] Timeframes are approximate and subject to change (e.g. based on altered resource recovery and waste generation rates which would influence landfill life expectancy)

A Part 5 approval (REF 1999-002) was granted in 1999 for landfilling activities on the site, which was also limited to 20 years. A Review of Environmental Factors (REF) was prepared by PMHC in 2013 (the 2013 REF), to support an application for extension of the approved operational life of the Stage E landfill to 2026. The 2013 REF was approved by PMHC in October 2013.

The Stage E landfill is expected to reach capacity in approximately 2020. PMHC is now seeking approval for three additional landfill stages from the Department of Planning and Environment (the Department) as State Significant Development (SSD) under *Part 4, Division 4.1 of the EP&A Act*. This Proposal aims to provide the additional landfill capacity in the same geographical location identified in the 1999 EIS however proposes that future landfilling is undertaken in three stages rather than the four stages previously proposed.

PMHC is committed to the reduction of waste being directed to landfill. It should be noted that the proposed landfill facility is not being considered in isolation of other waste management efforts being considered by PMHC, including organics and materials recovery through the ORRF and MRF at the Cairncross WMF which aim to further increase resource recovery rates and thus to reduce waste to landfill volumes in the future.

Arcadis has been engaged by PMHC to prepare the EIS for the Cairncross Landfill Expansion.

1.3 Purpose and scope of this assessment

This report supports the EIS for the Proposal and has been prepared as part of a SSD Application for which approval is sought under *Part 4, Division 4.1 of the EP&A Act*.

This report has been prepared to address:

- The Secretary's Environmental Assessment Requirements (SEARs) (SSD 5792 for the Proposal, issued by NSW DP&E on 7 May 2015.

The SEARs relevant to this study, and the section of this report where they have been addressed are provided in Table 1-2

Table 1-2 Secretary's Environmental Assessment Requirements relevant to this study

Section	Environmental Assessment Requirement	Where addressed
Greenhouse Gas	- a quantitative assessment of the scope 1, 2 and 3 greenhouse gas emissions of the project; - a detailed description of the measures that would be implemented to minimise the methane emissions of the proposed landfill operations and ensure that the project is energy efficient.	This report

1.4 Structure of report

This report is structured according to the following:

- Section 2 documents the GHG emissions estimation approach
- Section 3 provides a summary of the existing environment including an emissions profile for Australia and NSW within the waste sector
- Section 4 and Section 5 outline and summarise the expected emissions from the Proposal's operational activities
- Section 5.1 documents a number of mitigation strategies to minimise GHG emissions at the Proposal Site.

2 GHG EMISSIONS ESTIMATION APPROACH

This section outlines the GHG emission estimation approach; policy framework; methodology and assessment boundary for the proposal.

2.1 Policy framework

In September 2013, the Intergovernmental Panel on Climate Change (IPCC) Working Group I released its Fifth Assessment Report (AR5) on climate change. The AR5 stated that warming of the climate system is unequivocal and, since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased. Furthermore, the AR5 stated that it is extremely likely (95 to 100 per cent confidence) that human influence has been the dominant cause of the observed warming since the mid-20th century (IPCC 2014).

In Australia, there are a number of regulations, policies and targets which have been developed to manage and reduce GHG emissions. These include the following:

Table 2-1 Australian regulatory and policy context for GHG emissions and climate change

Level	Type	Name	Description
Commonwealth Government	Agreement	Paris Agreement	A global climate change mitigation agreement, adopted by 195 countries including Australia in December 2015, that aims to limit the increase in global temperatures to 1.5ºC above pre-industrial levels.
	Regulation	*The National Greenhouse and Energy Reporting Act 2007*	Introduced in 2007 and requires corporations to register and report emissions, energy consumption or production that meets certain thresholds every year. In 2014, an amendment was passed which establishes a framework for the safeguard mechanism, a core element of the Emissions Reduction Fund. The safeguard mechanism requires Australia's largest emitters (more than 100,000 t CO_2-e per year) to keep emissions at or below baseline levels. This took effect from 1 July 2016.
	Target	Direct Action Plan	Targets set in the Direct Action Plan aim to cut emissions to five per cent below 2000 levels by 2020 and to 26 to 28 per cent below 2005 levels by 2030. It comprises an element to credit emissions reductions, a fund to purchase emissions reductions, and a safeguard mechanism.

Level	Type	Name	Description
NSW Government	Framework	*NSW Climate Change Policy Framework*	This framework was introduced in 2016 and: • Defines the NSW Government's role in reducing carbon emissions and adapting to the impacts of climate change • Sets policy directions to guide implementation of the framework • Commits NSW to achieving aspirational long-term objectives of net-zero emissions by 2050 and to help NSW become more resilient to a changing climate.
	Legislation	*Environmental Planning & Assessment Act 1979*	The EP&A Act contains a general requirement to address environmentally sustainable principles, including climate change, within development applications.
	Target	NSW State Plan 2021	The NSW Plan 2021 has goals and targets towards climate change including: • 20 per cent renewable energy by 2020 • Assistance for businesses and households to realise annual energy savings of 16,000 gigawatt-hours by 2020 compared with 'business as usual' trends • Support for 220,000 low-income households to reduce their energy use by up to 20 per cent by June 2014 • An increase in the share of commuter trips made by public transport, including increasing the proportion of total journeys to work by public transport in the Sydney Metropolitan Region to 28 per cent by 2016 • Targets to increase walking and cycling • Planning policy to encourage job growth in centres close to where people live and to provide access by public transport.

2.2 Assessment methodology

The scoping processes used for the assessment of GHG emissions for the Proposal are based on the following guidelines and regulations:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition (WRI/WBCSD, 2004)
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (DoE, 2014a)
- The Department of Environment (DoE) National Greenhouse and Energy Reporting System Measurement: Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia (DoE, 2014b)
- National Greenhouse Accounts (NGA) Factors (DoE, 2016a).

Under 'The Greenhouse Gas Protocol' (WRI/WBCSD, 2004), a Proposal's direct and indirect emissions sources can be delineated into three 'scopes' (Scope 1, Scope 2 and Scope 3) for GHG accounting and reporting purposes. These scopes are associated within an organisations operational boundaries as shown in Figure 2-1.

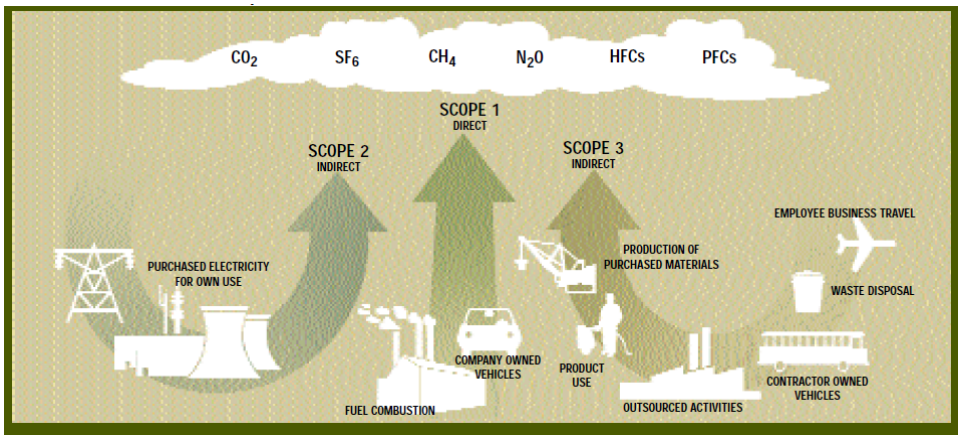


Figure 2-1 Overview of scopes and GHG emissions sources (WRI/WBCSD, 2004)

Further details of GHG operational scopes are outlined below:

- **Scope 1: direct greenhouse gas emissions -** Scope 1 emissions are direct GHG emissions from sources that are owned or controlled by PMHC. Scope 1 can include direct emissions sources such as fuel consumption within machinery used during construction and operation.
- **Scope 2: electricity indirect greenhouse gas emissions -** These account for GHG emissions arising from purchased electricity consumed on-site. Scope 2 emissions are considered indirect as they occur at an off-site facility where electricity is generated. There are no Scope 2 emissions associated with the Proposal (i.e. the landfill expansion will not be serviced by any electricity supply).
- **Scope 3: other indirect greenhouse gas emissions -** Scope 3 emissions are those that are a consequence of PMHC, but occur outside the site operational boundary and are not under PMHC control, such as waste delivery vehicles. Scope 3 emissions also include the upstream and downstream emissions associated with the production of fuel and electricity. Scope 3 emissions are an optional reporting category that allows for the treatment of all other indirect emissions.

Quantification of potential emissions from the Proposal has been undertaken in relation to carbon dioxide (CO_2) and other non-CO_2 GHG emissions, including methane (CH_4) and nitrous oxide (N_2O). To report these emissions, they are converted to carbon dioxide equivalents (CO_2-e) as specified under the Kyoto Protocol. The Global Warming

Potential (GWP) adopted for each GHG is as follows: carbon dioxide GWP of 1; methane GWP of 25; and nitrous oxide GWP of 298, as detailed in the NGA Factors (DoE, 2016a).

This assessment has been undertaken using the best available current and historical data. Assumptions have been outlined, where appropriate to maintain transparency.

2.3 Assessment approach

This assessment identifies emissions associated with each of the three stages of the Proposal and provides a summary of the highest average annual emissions. Potential Scope 1 and Scope 3 emissions sources have been identified. Scope 2 emissions are not considered as the landfill expansion will not be serviced by an electricity supply.

The key sources of GHG emissions, the assessment boundary and the assumptions underpinning this assessment are discussed below.

2.3.1 Emissions sources

The Proposal would generate emissions from:

- Waste decomposition
  - Decomposition of putrescible waste on-site would be the most substantial emissions source over the life of the Proposal
- Transportation:
  - Movement of waste between the originating location and the Proposal Site
- Machinery used during construction and operation:
  - Fuel consumption within operational machinery (predominantly excavators, compactors and earthmoving equipment used to construct, compact and close landfill sections)
- Vegetation clearing:
  - Loss of carbon sequestration due to 3.4 ha of cleared vegetation. This would occur during Stage 3 of the Proposal.

The most substantial source of emissions within the Proposal would be from decomposition of putrescible waste which generates GHGs (primarily methane). Stage 1 of the Proposal is proposed to operate for 20 years and with an approximate average yearly accepted waste of 61,589 tonnes per annum (tpa) and total accepted waste of 1,231,789 tonnes (t). Stage 2 would operate for seven years and is expected to have an approximate average yearly accepted waste of 111,111 tpa and a total waste of 777,779 t. Stage 3 would operate for nine years and is expected to have an approximate average yearly accepted waste of 131,046 tpa and total accepted waste of 1,179,414 t.

Stage E is scheduled to continue accepting waste until 2020 and does not form part of this Proposal. However, waste deposited in Stage E will continue to produce methane well into the Proposal's lifecycle. To ensure a complete picture of methane generation is represented, these 'legacy emissions' are considered in Section 4 and Section 5 of this report. For the purposes of this assessment, legacy emissions are defined as GHG emissions from the decomposition of putrescible waste deposited within Stage E prior to the commencement of the Proposal.

The Proposal would be developed progressively, with construction, landfilling and capping occurring concurrently within the stages and sub-stages. A 'typical' development sequence is detailed in Table 2-2.

Table 2-2 Typical development sequence

Year	2047	2048	2049	2050
Construction of Cell 3A	X			
Landfilling Cell 3A		X		
Capping and closure of Cell 2F	X	X		
Clearing Stage 3B		X		
Construction of Cell 3B		X		
Landfilling Cell 3B			X	
Capping and closure of Cell 3A		X	X	
Clearing Stage 3C			X	
Construction of Cell 3C			X	
Landfilling Cell 3C				X

2.3.2 Assessment boundary

The GHG assessment boundary is illustrated in Figure 2-2. The assumptions considered for the quantum of GHG emissions of the Proposal are explained in the following section.

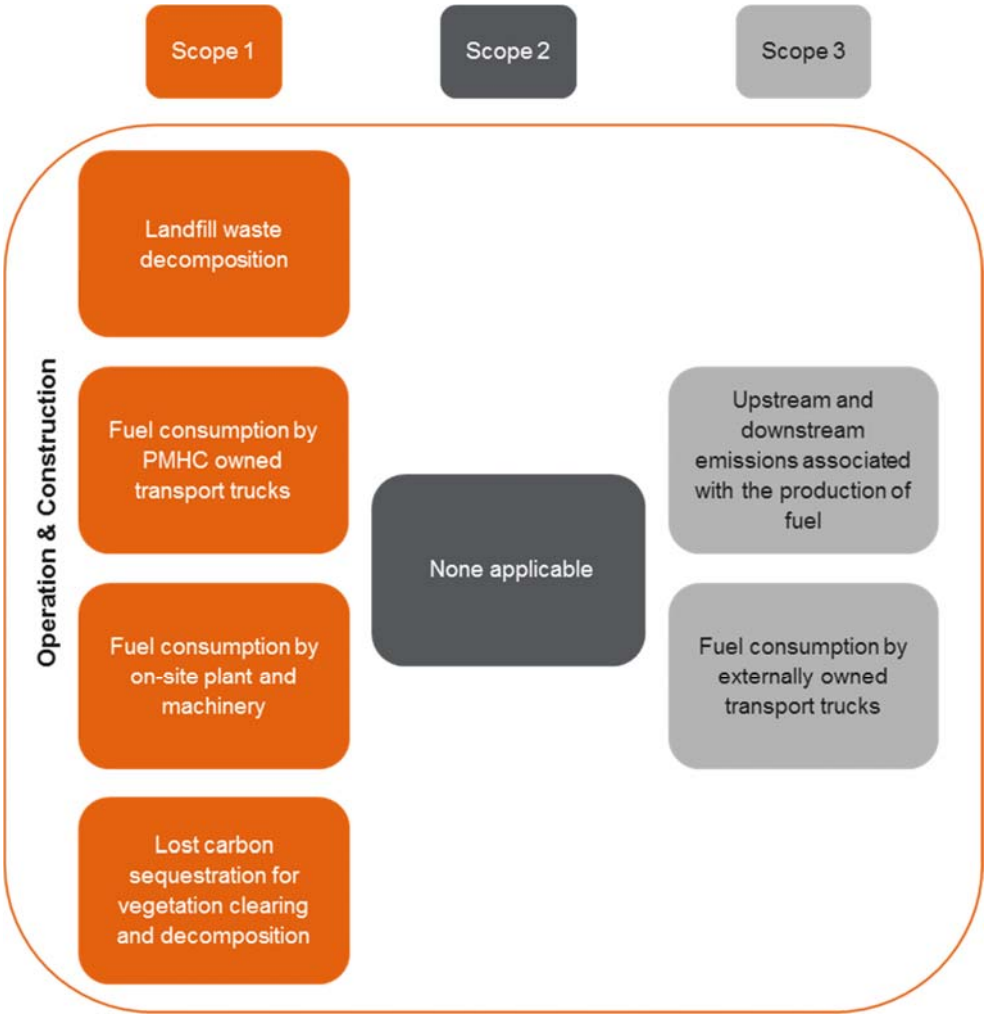


Figure 2-2 GHG assessment boundary

2.3.3 Assumptions

This assessment has been undertaken using the best available data at the time of writing. Assumptions have been outlined, where appropriate, to maintain transparency.

Where specific assumptions have been made for the calculation of GHG emissions arising from an individual activity, they have been identified within the corresponding section of this report. The following provides a list of the general assumptions used in this assessment:

- To provide a conservative approach to the assessment, and report on worst-case emissions, methane gas capture was assumed to be zero. Pending the results of a landfill gas capture trial currently being undertaking by PMHC for Stage E, landfill gas capture or flaring may be implemented at the Proposal Site and this would reduce the emissions predicted herein
- Us of on-site operational machinery was assumed to increase over the life of the Proposal as more waste is accepted to the landfill
- Only plant and machinery that would substantially contribute to CO_2-e emissions were considered in the assessment
- Scope 2 emissions were not considered as part of this assessment as landfill expansion will not be serviced by any electricity supply

- Truck movements were assumed to increase at the same rate as the increase in waste to be accepted at the Proposal Site. This is considered conservative as it is likely that as waste volumes increase, larger trucks could be used, increasing the efficiency of transport movements.
- The modelling for on-site methane emissions assumes a reduction in the percentage of organic waste received over time. This is assumed because PMHCs waste diversion strategies have been shown to be effective and are predicted to continue improving.

3 EXISTING EMMISSIONS ENVIRONMENT

Existing accounts of greenhouse gases provided by the Commonwealth Department of the Environment (DoE) estimate that approximately 523.3 Mega tonnes (Mt) CO2-e were emitted in Australia during the 2013-14 financial year (DoE, 2016c). Table 3-1 presents a breakdown of the individual State and Territory GHG emissions contribution.

Table 3-1 Australia State and Territory GHG emissions (DoE, 2016c)

State or Territory	Total Emissions ($MtCO_2$-e)	Percentage of Total Australian Emissions
New South Wales	130.1	24.9
Victoria	119.0	22.7
Queensland	145.1	27.7
Western Australia	83.4	15.9
South Australia	28.4	5.4
Tasmania	2.3	0.4
Australian Capital Territory	1.5	0.3
Northern Territory	12.6	2.4
External Territories	0.0	0.0
Total	523.3	100.0

*The difference between the national and the sum of the State and Territory emissions reflects the inclusion of military transport and a small balancing item.

As per the Intergovernmental Panel on Climate Change (IPCC), and reported within Australia's Greenhouse Gas Inventory (Ageis.climatechange.gov.au, 2014), solid waste disposal forms a sub-sector of the waste disposal sector. The combined waste disposal subsectors (including solid waste disposal) were the second smallest generators of GHG sector emissions in Australia in 2014, comprising just 2.3 per cent of Australia's total emissions (523.3 Mt) (DoE, 2016b).

The solid waste disposal sector accounted for 1.7 per cent (8.9 $MtCO_2$-e) of Australia's GHG emissions in 2014 and 3.1 per cent of total GHG emissions in NSW (DoE, 2016b). Approximately 74.3 per cent of emissions produced by the waste sector are attributable to the solid waste disposal subsector. Further, trend analysis of the sector shows that since 1990 net GHG emissions from the NSW waste sector have declined by 44 per cent while nationally emissions have dropped by 39 per cent.

4 GHG EMISSIONS ASSESSMENT

The Proposal would be undertaken in three key stages over a period of 36 years. Construction and operation of the site would occur concurrently and would include construction, landfilling, capping and closure of each landfill cell. These activities require the use of fuels, vegetation clearing (Stage 3), transportation and waste storage which would result in associated GHG emissions. Where relevant, this section reports the GHG emissions for the Proposal based on both the stage in which they occur and the source of the emissions.

Emissions were calculated by estimating fuel use and waste decomposition rates using available data. Emissions in tonnes CO_2-e were calculated using factors and methods from the *Australian Government National Greenhouse Accounts Factors – August 2016* (DoE, 2016a). Specific assumptions were made regarding fuel use, consumption, construction schedule, material quantities, waste transport and waste decomposition. For the purposes of consistency, the emissions of on-site machinery have been reported on an average yearly basis. The emissions from transportation and decomposing waste have been reported as both an annual average and highest emitting year to provide greater clarity to the largest emissions sources within the Proposal. Emissions from vegetation removal associated with the Proposal has been reported as a total emissions amount in one year (i.e. worst case) however vegetation is likely to be cleared progressively during all stages.

4.1 Machinery emissions

Table 4-1 provides a list of indicative machinery and their likely uses however this is subject to change over the course of operations.

Table 4-1 Indicative machinery for the Proposal

Type	Model	Size	No. on site	Used for
Boggy tipper	Mack	12 tonnes	1	Excavation
Diesel compactor	TANA	380	1	Waste compaction
Excavator	Kamatsu PC 200	20 tonnes	2	Excavation
Single cab diesel ute	Ford Ranger	2.2L TD	2	Fuel for excavator and compactor
Diesel pump	Hatz	1D5OZ	2	Leachate management
Diesel pump	Ruggerini	MD 191	1	Pumping water into water cart at dam.
Water cart	Rapid Spray	2500 L	1	Dust suppression

The use of machinery on-site would generate Scope 1 GHG emissions from fuel combustion (diesel). Additionally, the upstream and downstream emissions associated with the production of fuel would be incurred by the operation of the above machinery. This would represent a Scope 3 GHG emission for the Proposal.

4.1.1 Stage 1 machinery emissions

Scope 1 emissions generated from Stage 1 machinery would be approximately 262 tCO_2-e per annum over the 20 year stage lifecycle. As shown in Table 4-2 an additional 13 tCO_2-e per annum of Scope 3 emissions would be produced as a result of the up and downstream production of the fuel required for operational machinery.

Table 4-2 Summary of Stage 1 annual GHG emissions generated from the operation of on-site machinery

Emissions source	Stage 1 emissions from on-site machinery (tCO_2-e/yr)		
	Scope 1	Scope 2	Scope 3
Boggy tipper	34.2	-	1.75
Diesel compactor	103.98	-	5.31
Excavator	112.18	-	5.73
Single cab diesel ute	7.3	-	0.37
Diesel pump	1.91	-	0.1
Diesel pump	0.96	-	0.05
Water cart	0.96	-	0.05
TOTAL	**262**	**-**	**13**

4.1.2 Stage 2 machinery emissions

Scope 1 emissions that would be generated by Stage 2 machinery are estimated to be approximately 606 tCO_2-e per annum, as shown in Table 4-3. An additional 31 tCO_2-e per annum of Scope 3 emissions would be produced as a result of the upstream and downstream production of the fuel required for operational machinery.

Table 4-3 Summary of Stage 2 annual GHG emissions generated from the operation of on-site machinery

Emissions source	Stage 2 emissions from on-site machinery (tCO_2-e/yr)		
	Scope 1	Scope 2	Scope 3
Boggy tipper	79.81	-	4.07
Diesel compactor	242.61	-	12.39
Excavator	261.76	-	13.36
Single cab diesel ute	14.59	-	0.75
Diesel pump	3.82	-	0.20
Diesel pump	1.91	-	0.1
Water cart	1.91	-	0.1
TOTAL	**606**	**-**	**31**

4.1.3 Stage 3 machinery emissions

Stage 3 Scope 1 emissions that would be generated from machinery use would be approximately 784 tCO_2-e per annum, as shown in Table 4-4. An additional 40 tCO_2-e per annum of Scope 3 emissions would be produced.

Table 4-4 Summary of Stage 3 annual GHG emissions generated from the operation of on-site machinery (tCO_2-e per annum)

Emissions source	Stage 3 emissions from on-site machinery (tCO_2-e/yr)		
	Scope 1	Scope 2	Scope 3
Boggy tipper	102.61	-	5.24
Diesel compactor	311.93	-	15.93
Excavator	336.55	-	17.18
Single cab diesel ute	21.89	-	1.12
Diesel pump	5.73	-	0.29
Diesel pump	2.87	-	0.15
Water cart	2.87	-	0.15
TOTAL	**784**	**-**	**40**

The average yearly machinery emissions for the Proposal overall are 551 tCO_2-e per annum in Scope 1 emissions and 28 tCO_2-e per annum in Scope 3 emissions.

4.2 Vegetation clearing

Vegetation clearing would generate emissions from a number of potential sources; including the loss of carbon sequestration, diesel consumption in machinery used (assessed above) for clearing and mulching, and vegetation decomposition.

Approximately 3.4 hectares (ha) of vegetation would need to be cleared to prepare the Stage 3 site for landfilling[4]. Clearing would commence in approximately 2046 to enable commencement of landfilling in Stage 3 in 2047.

The loss of carbon sequestration, while not a true GHG emission, would result in less carbon dioxide being removed from the atmosphere. The net effect would therefore be that a greater amount of carbon dioxide would remain. Consequently, the loss of sequestration has been assessed as a Scope 1 source of emissions. Different vegetation types characteristically sequester carbon at different rates and to a different extent. Based on the vegetation types, the likely tonnes of dry vegetation per hectare, and the average emissions factor have been used to determine the loss of sequestration (TAGG, 2013). Loss of sequestration has included all carbon pools including woody, non-woody, debris and soil.

The vegetation being cleared is in Plant Community Type (PCT) Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion. The equivalent Major Vegetation Group (MVG) is Eucalypt Tall Open Forest and is considered a class 4 coverage.

Total emissions from vegetation clearing are estimated to be 1,402 tCO_2-e as shown in Table 4-5.

[4] Vegetation clearing on other areas of the Proposal Site has been approved under an authorisation for timber plantation under the NSW *Plantations and Reafforestation Act 1999* and therefore does not form part of the Proposal and is not considered in this GHG assessment.

Table 4-5 Summary of GHG emissions (tCO_2-e) arising from cleared vegetation

Emissions source	Total emissions due to vegetation clearing (tCO_2-e)		
	Scope 1	Scope 2	Scope 3
Loss of carbon sequestration	1,360	-	-
Emissions from vegetation disposal	42	-	-
TOTAL	**1402**	**-**	**-**

4.3 Transportation

Traffic related to the Proposal would typically comprise of Austroads Class 5 Four Axel trucks with minimal cars permitted to access the landfill. Peak volumes have been determined based on existing vehicle access patterns at the Cairncross Waste Facility.

Table 4-6 shows the average weekday and weekend vehicle trips associated with the existing landfill for the year of 2017, as well as the year of opening (2020) and final year of operation (2056).

Table 4-6 Waste disposal traffic generation (two-way trips/day)

Vehicle Type	Existing Year (2017)		Opening Year (2020)		Future Year (2056)	
	Average Weekday	Average Weekend	Average Weekday	Average Weekend	Average Weekday	Average Weekend
LV	11	8	13	9	41	37
HV	70	27	78	30	255	98
Total	81	35	91	39	296	135

Note: A 3.36 per cent annual compounded growth rate was applied to vehicle movements to account for a potential increase in population and total accepted waste volumes.

4.3.1 Waste collection vehicle emissions

Fuel consumed by vehicles transporting waste to the Proposal Site were determined using 2015 weighbridge data provided by PMHC[5]. The 2015 data was then grown by 3.36 per cent per annum to account for the increase in waste delivered to the Proposal Site over the life of the Proposal.

Movement of waste to and from the Proposal Site would be undertaken 10 hrs/day on weekdays and eight hrs/day on weekends. Waste collection would predominantly be undertaken by third party contractors, and therefore represents a Scope 3 emissions source.

Fuel consumption from third party vehicles depositing waste at the Proposal Site were assumed to be from articulated vehicles. Waste collection vehicles are likely to comprise a mix of truck types. It has been assumed for the purpose of this assessment that all vehicles would be rigid trucks (although some smaller and larger vehicles may be utilised). It is likely that as waste volumes increase over time traffic

[5] During the period 1 January 2015 to 31 December 2015, a total of 11,820 trucks entered the site to deliver waste to landfill. Arcadis assumed the furthest point in the PMHC landfill catchment area to calculate the distance travelled by a waste vehicle. This represents a worst-case scenario.

movements could be consolidated and larger trucks could be utilised. This assessment therefore represents a worst case scenarios.

In the highest emitting year for Stage 1 (2040), the Proposal would generate approximately 1,128 tCO_2-e of Scope 3 emissions. In the highest emitting year for Stage 2 (2047), the Proposal would generate approximately 1,451 tCO_2-e Scope 3 emissions. In the highest emitting year for Stage 3 (2056), the Proposal would generate approximately 1,913 tCO_2-e Scope 3 emissions. This is summarised below in Table 4-7.

Table 4-7 Summary of waste collection vehicles emissions (tCO_2-e)

Emissions source / highest emitting year	Waste collection vehicles - highest emitting year (tCO_2-e)		
	Scope 1	Scope 2	Scope 3
Stage 1 - 2040		-	1,128
Stage 2 - 2047		-	1,451
Stage 3 - 2056		-	1,913

4.4 Waste decomposition

4.4.1 Arcadis waste decomposition modelling

This report includes an estimate of possible emissions from decomposing putrescible waste. The estimate was generated using best practice GHG modelling, as per the guidelines detailed in Section 2.2 of this report. The numbers provided assume a worst-case scenario of zero methane gas capture, despite the potential for installation of a gas capture/flaring system at the Proposal Site in future. All waste decomposition would occur on-site and is therefore regarded as a source of Scope 1 emissions.

Legacy emissions have been included in the below calculations to ensure a complete picture of methane generation is presented. Even though waste generated during Stage E has already been approved and therefore does not form part of this Proposal. PMHC records of the waste deposited (types and composition) at the Stage E landfill were used to generate a decomposition profile for each waste stream. The split in waste types recorded in the Stage E waste was adopted as the basis for modelling future decomposition for the Proposal. The current split in waste was modified based on expected improvements in waste diversion (including increased diversion of green waste). The improvements applied were conservative and it is possible that a greater portion of the waste stream could be processed in the ORRF (Organics Resource Recovery Facility) in future, which would reduce the amount of organic content within the waste and in effect reduce emissions.

As shown in Table 4-8 and Figure 4-2, GHG emissions from waste decomposition would steadily increase as the yearly volume of waste accepted also increases. The peak in GHG emissions would be in 2057, one year after the peak in accepted waste. This is due to the profile of methane emissions as materials decay and the lag between when waste is deposited and when it peaks in methane generation.

Municipal solid waste (MSW) is expected to be the largest source of methane emissions within the Proposal. Annual waste emissions are predicted to increase substantially as the Proposal progresses in its lifecycle. Table 4-8 shows that total waste emissions would be expected to peak at 122,161 tCO_2-e in 2057, one year after the closure of the landfill. It is again useful to note that this estimation assumes zero gas capture or flaring on the Proposal Site and therefore represents a worst-case scenario.

Table 4-8 GHG emissions from waste decomposition

Emissions source / highest emitting year	Waste decomposition emissions in the worst emitting year (tCO_2-e)			
	Scope 1	Scope 2	Scope 3	Per cent of emissions from legacy waste (%)
Stage 1 - 2040	61,478	-	-	5.5%
Stage 2 - 2047	80,814	-	-	2.8%
Stage 3 - 2057	122, 161	-	-	1.2%

Table 4-9 represents the average waste emissions over each stage of the Proposal. The emissions profile shows that the most substantial emissions would occur much later in the Proposal. This provides the opportunity for gas capture technologies to become both more technologically advanced and economically viable. Therefore, an opportunity potentially exists to substantially reduce the emissions profile of the Proposal over its lifetime, particularly its later peak. Table 4-8 and Table 4-9 also show the impact of legacy waste on the GHG emissions. While legacy waste has a smaller impact in the later years of the Proposal where emissions are highest, the average impact of legacy waste is more substantial, in Stage 1 of the Proposal at 18.9 per cent.

Table 4-9 Summary of average decomposition emissions

Emissions source	Average annual waste emissions (tCO_2-e)			
	Scope 1	Scope 2	Scope 3	Per cent of emissions from legacy waste
Stage 1	39,872	-	-	18.9%
Stage 2	72,294	-	-	3.2%
Stage 3	103,874	-	-	1.8%

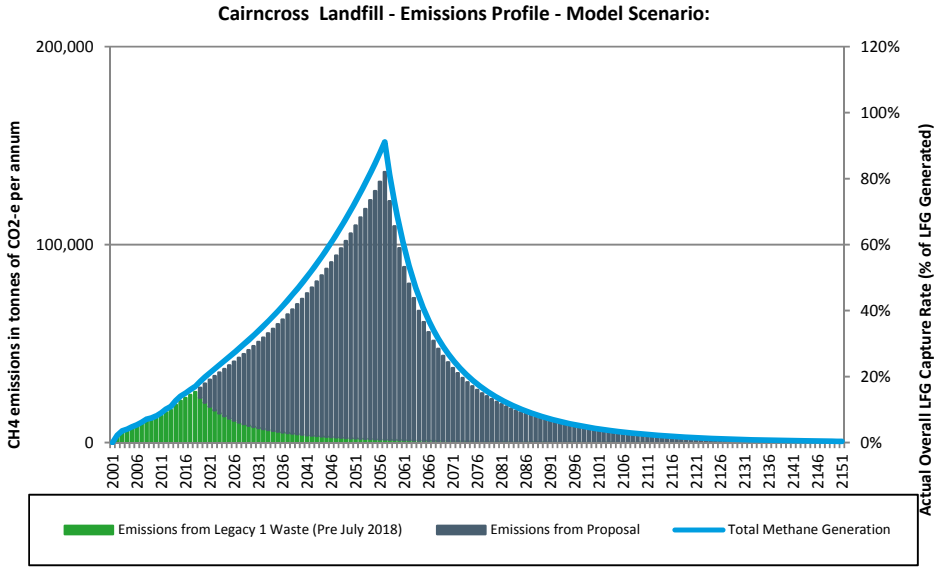


Figure 4-1 Landfill emissions profile for the Proposal, including legacy waste

4.4.2 Effects of climate on methane generation

A varying climate can have a substantial impact on the overall emission rate of decaying putrescible waste. Applied modelling on differing climate scenarios are presented below in Figure 4-2. As shown in Figure 4-2 a wet and tropical climate would have the most severe emissions variation profile. Port Macquarie being on the mid north coast of NSW can have large variations in weather conditions depending on the time of year and climate conditions.

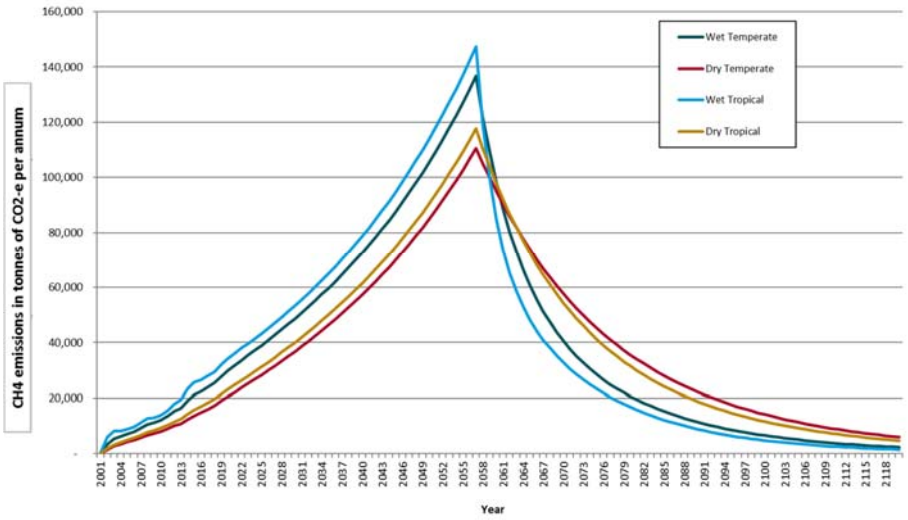


Figure 4-2 Comparison of emissions profiles with different climate types & k-values[6]

4.4.3 Previous investigations

In 2012, PMHC commissioned Mike Ritchie and Associates (MRA) to estimate the predicted rate of landfill gas generation from the existing and proposed landfill stages.

Using the First Order Decay model, MRA calculated that Cairncross landfills GHG emissions would triple in the coming decades. The model indicated that in 2011/12 the Cairncross landfill would generate approximately 13,000 tCO_2-e. Modelling completed for this report (Arcadis, 2017) indicated that a total of approximately 14,962 tCO_2-e would have been produced in 2011/12.

The difference in results between the MRA and Arcadis GHG modelling is likely due to a change in the Global Warming Potential (GWP) for methane. Advances in our understanding of greenhouse gases led the Australian Government to officially increase the GWP of methane from 21 to 25 in 2014 (after the MRA report was prepared).

Differences in results between the MRA report and this assessment highlight the complexity of predicting GHG emissions. Differences in results are attributable to changes in the methane GWP and, more critically, differences in predicted waste volumes and growth rate assumptions.

4.4.4 Gas pumping trial

As noted above in Section 4.4.3, the predicted greenhouse gas emissions varied between the Arcadis (2017) and MRA (2012) investigations. d This highlights the difficulty in modelling greenhouse gas emissions.

PMHC are thus currently conducting a landfill gas pumping trial at Cairncross WMF to confirm the actual rate of methane generation from a 'typical' zone within the landfill, the concentration of methane during active extraction, and provide a forecast of future extraction rates / concentrations within the landfill. The trial will also make recommendations on the future landfill gas management at the site. It is expected that the trial will be completed by late-2017.

---

[6] Within Figure 4-2, K-values are defined as a measure of anaerobic rate of decay of organic material (Zheng et al., 2013)

The extent of gas controls to be designed and implemented for the existing and future stages of landfill will be guided by the results of the gas pumping trial. PMHC will develop a landfill gas management plan based on the findings of the trial. Mitigation measures will also be designed around the results of this trial.

5 SUMMARY OF TOTAL GHG EMISSIONS FROM THE PROPOSAL

This section summarises the GHG emissions that would be generated by the Proposal. The single largest contributor to GHG emissions would be methane gas generated from landfill waste decomposition. Yearly landfill waste emissions would increase steadily over the course of the Proposal and peak in 2057, the year after the landfills closure, at 122,161 tCO_2-e.

As shown in Table 5-1, overall GHG emissions from the Proposal at its highest emitting point for each GHG source is 128,232.2 t CO_2-e. This represents approximately 0.03 per cent of Australia's total annual GHG emissions (as at 2017) and 0.1 per cent of NSW's total emissions.

Table 5-1 Overall GHG emissions from the Proposal (at highest emitting point)

Emissions source	Highest emitting year	Scope 1	Scope 2	Scope 3	Total
Putrescible waste decomposition	2057	122,161	-	-	122,161
Machinery	2056	784	-	40	824
Vegetation clearing	Approx. 2046	1,402	-	-	1,402
Transportation	2056		--	1,913	1,913
GHG emissions		**124,347**	**--**	**1,953**	**126,300**

While Table 5-2 summarises the average annual estimated emissions for the Proposal, broken down by emissions source.

Table 5-2 Average annual estimated GHG emissions

Emissions source		Average annual emissions summary			
		Scope 1	Scope 2	Scope 3	Total
Putrescible waste decomposition	Average	65,041	-	-	65,041
Machinery	Average	551	-	28	579
Vegetation clearing	Total	1,402	-	-	1,402
Transportation	Average			1,487	1,487
Average GHG emissions over the Proposal lifetime		**66,994**	**-**	**1,515**	**68,509**

5.1 NGER reporting

The NGER Act establishes a threshold beyond which companies are required to report on GHG emissions. The threshold is set at 25,000 tCO_2-e per year for a facility. Those facilities reaching and/or exceeding this threshold are required to report their emissions, are generally considered to be large emitters and are expected to implement GHG abatement measures. Based on Figure 4-1 and the summary presented in Section 5 the legacy emissions estimated from Stage E alone may trigger the reporting thresholds in 2018/19 (i.e. before the Proposal is scheduled to commence).

6 GHG MITIGATION STRATEGIES

The carbon management principles (shown in Figure 6-1) provide a robust framework for the management and reduction of GHG emissions.

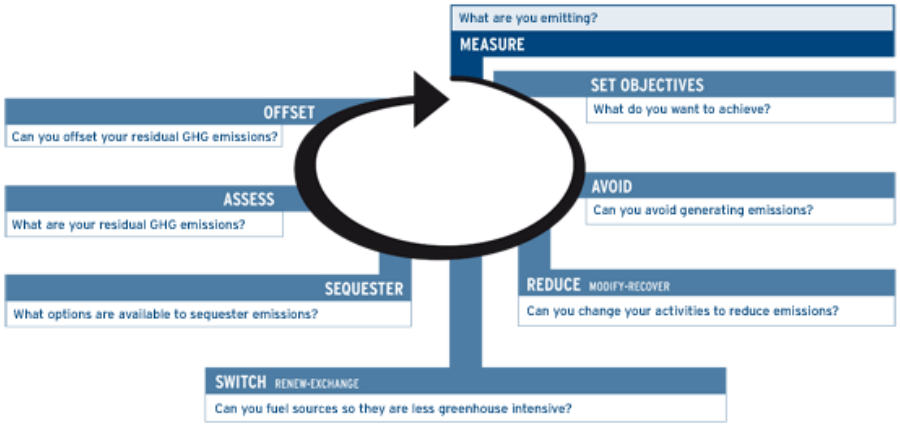


Figure 6-1 Carbon management principles for GHG emissions reduction (EPA Victoria, 2012)

The earlier sections in this assessment represent the GHG emissions measurement and setting objectives components of the carbon management principles. GHG emissions reduction actions should ideally be prioritised according to the carbon management principles as illustrated in Table 6-1.

Table 6-1 Carbon management principles

Management principle	Description
Avoid	Actions which avoid emissions, in the first instance, should be considered as a priority
Reduce	Actions which result in a reduction of emissions should be considered next
Switch	Actions which switch energy sources to reduce emissions should be the next considered
Sequester	Actions which sequester GHG emissions do not reduce emissions but store them
Offset	Offsetting of emissions through the purchase of offsets. This should be considered as a last resort.

6.1 Mitigation measures

The Cairncross Waste Management Facility Operational Environmental Management Plan (OEMP) will be updated to address the following landfill gas mitigation measures:

- Cover waste daily, and at intermediate stages of operation, to minimise the emission of landfill gas.
- Undertake project planning to ensure that on-site vehicle movements and construction activities are efficient, avoid double handling of materials and avoid unnecessary fuel use.
- Undertake a landfill gas monitoring program for Stages 1 to 3, as described in the EIS for the Proposal.

- Develop a landfill gas management plan based on the findings of the 2017 landfill gas pumping trial. The extent of landfill gas controls to be designed and implemented for the existing and proposed stages of the landfill would be guided by the results of the gas pumping trial. If feasible, the implementation of a gas capture or flaring system will be considered.

7 CONCLUSION

PMHC commissioned Arcadis to prepare a greenhouse gas (GHG) assessment to support a State Significant Development Environmental Impact Statement (EIS) under *Part 4, Division 4.1 of the Environmental Planning and Assessment Act 1979* for the Cairncross Landfill Expansion (the Proposal).

GHG emissions from the Proposal are expected to peak at approximately 126,000 tCO_2-e in the year 2057. However, average yearly emissions from the Proposal are estimated to be only 68,500 t CO_2-e. Furthermore, first year emissions are expected to only be approximately 22,000 t CO_2-e.

Peak GHG emissions from the Proposal (in 2057) represent 1.08 per cent of Australia's waste-sector GHG emissions or just 0.03 per cent of Australia's total annual GHG emissions (as at 2017).

The reported modelling does not account for any methane gas capture, likely improvements in organic and general waste diversion, and does not account for the likelihood that over the lifetime of the proposal methane gas capture technology will become more effective, cheaper and easier to implement.

A GHG mitigation strategy was developed to minimise the impact of the Proposal on the community and to explore carbon mitigation avenues. While all efforts have and will be undertaken to minimise both emissions and waste from landfill within the PMHC local government area (LGA), it is acknowledged by PMHC that provision of a landfill is an important and required service by the greater community now and into the foreseeable future. By seeking approval for all three stages at once PMHC is attempting to ensure economies of scale and consistency in their GHG mitigation efforts. Seeking combined approval will also allow for long term planning to the area and to better integrate associated resource recovery activities. The Proposal would allow for a coordinated and consolidated waste disposal and diversion system and enable PMHC to take a long term and strategic view on GHG emissions minimisation.

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APPENDIX S LEACHATE GENERATION MODELLING REPORT

Pacific Environment Limited

Consulting • Technologies • Monitoring • Toxicology



Report

Cairncross Landfill Leachate Generation Modelling

Arcadis

DLB3888_S005089

24th August 2016

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JOB ID:	DLB3888_S005089
PREPARED FOR:	Arcadis
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1 INTRODUCTION

Pacific Environment and DLA Environmental Services (DLA) has prepared this report to summarise the results of leachate generation modelling using the Hydrological Evaluation of Landfill Performance (HELP) program undertaken for the Cairncross Waste Management Facility, Telegraph Point, New South Wales (the Site).

1.1 Objectives

Arcadis has been commissioned to prepare an Environmental Impact Statement (EIS) in accordance with Secretary's Environmental Assessment Requirements (SEARs) for the Cairncross Landfill Expansion (SSD 13_5792).

This report presents leachate generation modelling undertaken in accordance with the requirements of the SEARs, to be used to inform the long-term leachate management strategy for the Cairncross Landfill Expansion by:

- Providing sufficient information to inform the progression of the landfill design, in accordance with industry best practice
- Being a sufficient level to support a project approval for completion of the existing landfill cell (Stage E) as well as for the three additional stages proposed (Stage 1, Stage 2 and Stage 3).

1.2 Scope of Work

The scope of work was developed in accordance with the relevant principles in Section 2.3 of the NSW *Environmental Guidelines: Solid Waste Landfills, Second Edition* (2016 NSW EPA) including:

- Modelling undertaken with the *Hydrological Evaluation of Landfill Performance* (HELP) model (version 3.95D; Berger, 2013).
- Model run over a monthly basis with 45 years of metrological data (1971 to 2015).
- Multiple climate scenarios were considered to develop the most conservative approach, including the 90th percentile and wettest years over the 45-year period.
- Potential leachate impacts presented as five scenarios based on landfill staging across the existing stage including present condition and future three stages, as well as at completion of all cells.
- Review of existing leachate discharge data (February to July 2016).
- Review of documentation relevant to the management of the site (in particular the waste covering and capping) including:
    - The Site's 2008 Environment Management Plan (EMP)
    - EPA Licence (11189; 9-Mar-2015) (the EPA Licence)
    - Cairncross Landfill Expansion - Future disposal capacity requirements (Arcadis 2015)
    - NSW Draft Environmental Guidelines: Solid Waste Landfills, 2016 Second Edition
    - Review of historical aerial images of the site (Google Earth)

2 METHODOLOGY

2.1 Model Selection

Leachate generation modelling was undertaken using the HELP Model version 3.95D (Berger 2013). HELP is a landfill rainfall infiltration model that incorporates climate, soil, waste type and landfill design data, and is recommended in Section 2.3 of the Draft Environmental Guidelines: Solid Waste Landfills, Second Edition 2015 (NSW EPA 2015) (NSW Guidelines) as a suitable leachate simulation program.

2.2 Model Inputs

Model inputs included daily weather data (average temperature, precipitation, solar radiation, average wind speed and average humidity) obtained from the Bureau of Meteorology from the nearby weather station located at Port Macquarie Airport. *Soil and Design Data* was determined from:

- Final capping, intermediate cover and daily cover specifications for Stage E are drawn from the EPA Licence (conditions O6.13 to O6.19).
- Estimations of slope angle (%) and length were obtained from the *Cairncross Waste Management Facility Environmental Management Plan* (July 2008).
- Final capping, interim and daily cover requirements for Stages 1-3 were obtained from the *NSW Environmental Guidelines: Solid Waste Landfills, Second Edition 2016*.
- Existing permeability and compaction testing results (*Provided by Port Macquarie-Hastings Council*).

2.3 Calibration Model Assumptions

Calibration assessment of the Stage E landfill was undertaken in order to validate the accuracy and assumptions used for HELP modelling and therefore assess whether the leachate management infrastructure will be adequate for future expansion stages.

2.3.1 Stage E Leachate Pump-Out Data

Section 2.3 of the NSW Guidelines recommends water balances should be validated from time to time using site specific data. In this case the HELP model was calibrated to Site specific characteristics using leachate pump out data (February to July 2016) supplied by Council (*Cairncross leachate pump out volumes and tank sizing*). The following data was obtained:

- A total leachate pump out volume of 2,138 m^3
- An average leachate pump out volume of 427 m^3/month; and
- An average leachate pump out volume of 14 m^3/day.

This data set is assumed to be suitably representative for the purpose of validation of this model.

2.3.2 Stage E Cell Area

Port Macquarie-Hastings Council (PMHC) has indicated the Stage E Cell is 10.2 ha in total area as shown in Appendix B. For modelling purposes, the Stage E Cell is assumed to be under 75% final cap based on the Cell opening in 2001 and due to be closed in 2020 (Arcadis, 2015). Final capping is progressive in operating cells (EMP, 2008). From aerial imagery, it was determined that the extent of grassed area is progressively capped (final cap) with 25% of the area being active and 75% finally capped. For calibration modelling purposes, Stage E was noted to contain the following areas as shown in **Table 1**:

Table 1 – Stage E – Landfill Area

Stage E	Area (ha)	Justification
Total area	10.2	Council data
Final Cap	7.55	Aerial imagery (26/03/15)
Intermediate Cap	2.45	Aerial imagery (26/03/15)
Daily Cover	0.2	Aerial imagery (26/03/15)

2.3.1 Stage E Waste Hydraulic Conductivity

PMHC have confirmed that the target waste density of 850 kg/m^3 noted within the Operational EMP (2008) is being achieved. It should be understood that due to the inherent heterogeneity of municipal waste it is difficult to accurately define the corresponding hydraulic properties of waste. It is likely this heterogeneity will result in some portions of the waste having a low density (high permeability) and other portions with no effective permeability and high compaction (dead zones).

Based upon a collation of studies, comparing hydraulic conductivity and dry density for a variety of waste types, an estimate of the expected hydraulic conductivity of landfilled waste for the modelled waste densities is presented in **Table 2**.

Table 2 – Estimated hydraulic conductivity of landfilled waste for the modelled waste densities

Waste Density (kg/m^3)	Hydraulic Conductivity (m/s)
700	1×10^{-6}
850	5×10^{-7}
1000	1×10^{-7}

Source: Landss University of Southampton, 2016

Based upon model calibration, three waste compaction densities (700 kg/m^3, 850 kg/m^3 and 1000kg/m^3) were assessed. Result presented herein are based on 850kg/m^3 as this compaction density was found to correlate best with actual leachate collection records.

2.3.2 Stage E Soil Properties

Baseline HELP soil permeability data (obtained from United States Department of Agriculture soil textures) were initially incorporated into the Stage E model as shown in **Table 3**.

Table 3 – Initial Assumptions

Layer	Soil type	Initial HELP Default Permeability (m/s)
Daily	Clay	1.7×10^{-7}
Interim	Sandy clay loam to silty loam	3.3×10^{-7}
Seal-bearing	Clay	6.8×10^{-9}
Sealing	Clay	6.8×10^{-9}
Revegetation	Sandy clay loam	1.0×10^{-5}

Daily and Interim Cover Calibration

Calibration was undertaken to assess the hydraulic performance of in-situ daily and interim cover soils on site by an iterative process. This was done by varying the performance (saturated hydraulic conductivity) of the soil type from the baseline initial assumptions. Changes to soil properties from the baseline HELP assumptions are validated on the basis that permeability information of cover materials and leachate pump-out data is known and can therefore be adjusted to more closely reflect actual Site conditions than what is assumed under baseline soil properties. It was found that a daily cover of 1.7×10^{-7} m/s (*no adjustment to baseline assumption*) and interim cover of 1.0×10^{-7} m/s (*minor adjustment*) correlated most closely with the actual leachate collection records to date.

Seal-bearing and Sealing Layer Calibration

Calibration was undertaken to assess the hydraulic performance of in-situ seal-bearing and sealing clay soils on site by an iterative process. This was done by varying the performance (saturated hydraulic conductivity) of the soil type from the baseline initial assumptions. Particular attention was given to performance of the final sealing (barrier) layers' hydraulic conductivity as it has the most influence on overall leachate generation rates. Cover material is sourced from excess excavated material from landfill cells and this material consists of clay with permeability ranging between 1.3×10^{-6} and 7.77×10^{-11} m/s (EMP, 2008). It is therefore possible that once this material is won and reworked that covering and capping material may exceed, (i.e. permeability be reduced), the assumptions defined in the baseline. The hydraulic conductivity for the barrier layer was determined to likely represent actual sealing layer field performance of 1×10^{-9} m/s – 1×10^{-10} m/s. It was found that a seal-bearing cover of 1.0×10^{-9} m/s and a sealing cover of 1.0×10^{-9} m/s correlated most closely with the actual leachate collection records to date.

Table 4 presents the soil hydraulic properties used in HELP modelling based upon Site permeability testing and calibration modelling.

Table 4 – Adopted Stage E Soil Properties

	Stage E	
Layer	Thickness (m)	Permeability (m/s)
Daily	0.15	1.0×10^{-7}
Interim	0.3	1.0×10^{-7}
Seal-bearing	0.3	1.0×10^{-9}
Sealing	0.3	1.0×10^{-9}
Revegetation	0.5	2.5×10^{-7}

Table 5 presents a summary of the HELP inputs utilised for Stage E calibration assessment.

Table 5 – Summary of the HELP inputs used for Stage E calibration assessment

Cover Type		Final Cap	Interim Cap	Daily Cover
SURFACE LAYER				
Slope % (length)		5% (200 m)	5% (100m)	1% (30m)
Approximate texture		Revegetation Layer (uncompacted Sandy Clay Loam)	Compacted sandy clay loam to silty loam	Uncompacted clay
Thickness	M	0.50	0.30	0.15
Porosity	VOL/VOL	0.471	0.437	0.475
Field capacity	VOL/VOL	0.342	0.373	0.378
Wilting point	VOL/VOL	0.210	0.266	0.265
Initial soil water content	VOL/VOL	0.388	0.3235	0.265
Saturated hydraulic conductivity	M/SEC	2.5×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
SEAL BEARING AND SEALING LAYER				
Thickness	M	0.60	NA	NA
Porosity	VOL/VOL	0.427		
Field capacity	VOL/VOL	0.418		
Wilting point	VOL/VOL	0.367		
Initial soil water content	VOL/VOL	0.427		
Sat hydraulic conductivity	M/SEC	1.0×10^{-9}		
WASTE				
Thickness	M	15.0	15.0	15.0
Porosity	VOL/VOL	0.168	0.168	0.168
Field capacity	VOL/VOL	0.073	0.073	0.073
Wilting point	VOL/VOL	0.019	0.019	0.019
Initial soil water content	VOL/VOL	0.073	0.073	0.073
Saturated hydraulic conductivity (850 kg/m^3)	M/SEC	5.0×10^{-7}	5.0×10^{-7}	5.0×10^{-7}

2.3.3 Stage E calibrated model output

Table 6 presents a summary of results from HELP modelling showing leachate generation rates over the calibration period (five months) for Stage E based on the assumptions previously discussed. The imbalance between modelled leachate generation and collection data is within variation (±64%) typically associated with HELP model outputs (Scanlon, B et al. 2002). This calibrated model is considered suitably conservative for the purpose of this investigation.

Table 6 – Stage E model estimation of leachate generation

Cap/Cover Type	Leachate Generation (mm)	Leachate Generation (m^3/Ha)	Area (ha)	Total leachate generated (m^3)
Final	21.8	217.9	7.55	1645.1
Interim	39.0	389.7	2.45	954.8
Daily	17.7	176.5	0.2	35.3
HELP Model Total (m^3)				**2635.2**
Actual Collected (m^3)				**2138**
Difference (%)**				**18.9**

*Soil hydraulic properties are described in Section 2.3.2

** Difference refers to the percentage difference between the HELP Model Result and Actual Collected.

3 LEACHATE GENERATION MODELLING

3.1 Climate Scenarios

Leachate generation modelling was undertaken based on both average (all years) and worse case (high rainfall) years over the 45-year period from FY1970/71 to FY2014/15. Worse cases presented include: 90th percentile rainfall; highest rainfall year; and the highest three year rolling average. The relevant climate scenarios are shown in **Table 7**.

Table 7 – Climate scenarios modelled

	Year	Rainfall (mm)
Average	1971-2015	1,370
90th Percentile	1989	1,784
Highest rainfall year	2009	2,314
Wettest Period (Highest three year rolling average)	1988-1990	1,795 (three-year average)

The HELP model results are presented in **Appendix A**, showing monthly leachate generation (mm) for each cover type and climate scenario. Of all scenarios tested, the highest three year rolling average consistently

provided the highest monthly and annual averages. In this period (1988 to 1990) all years recorded rainfall above the 87th percentile range.

3.2 Future Stage Assumptions

Model inputs for Stage 1-3, as agreed by Council and Arcadis, are depicted in **Table 8**.

Table 8 – Summary of the inputs utilised for Stage 1-3 HELP assessment

Layer	Thickness (m)	Permeability (m/s)	Rationale
Waste	Stage 1: 20m Stage 2: 10m Stage 3: 9m	5.0 x 10^{-7}	Based upon Stage E calibration modelling it was found that a waste compaction density of 850kg/m^3 is suitable for use in future stages.
Daily	0.15	1.0 x 10^{-5}	A conservative permeability of 1.0 x 10^{-5} m/s is deemed appropriate for future Stages 1-3 based upon calibration modelling and the utilisation of a clay based soil.
Interim	0.3	1.0 x 10^{-7}	A permeability of 1.0 x 10^{-7} m/s for an intermediate cover soil is deemed appropriate based upon Stage E calibration modelling and soil compaction efforts to this layer.
Seal-bearing	0.3	1.0 x 10^{-9}	As per Stage E calibration modelling results, a permeability of 1.0 x 10^{-9} m/s for a seal-bearing cover soil is appropriate.
Sealing	0.3	1.0 x 10^{-9}	As per Stage E calibration modelling results, a permeability of 1.0 x 10^{-9} m/s for a bearing cover soil is appropriate.
Revegetation	0.5	1.0 x 10^{-5}	As a light compaction effort is utilised for this layer and for conservative estimation of leachate generation, it is expected that this layer will perform similarly to a daily cover. It is therefore recommended that 1x10^{-5} is utilised.
Topsoil	0.2	1.0 x 10^{-3}	As no compaction effort is utilised for this layer and for conservative estimation of leachate generation, a highly permeable rate is recommended.

3.3 Leachate Generation: Operational Scenarios

Leachate generation rates were assessed under five scenarios based on landfill staging across the current and future staging areas and at completion of filling, expected in approximately 2056. Scenario one covers the staged development of the Stage E landfill. Scenarios two, three and four cover the staged development of the landfill (Stages 1, 2, 3) and Scenario five covers post completion of the landfill.

All scenarios consider leachate generation rates based on an average rainfall year, 90th Percentile rainfall year and an average wet period (1988-1990) within years 1971 to 2015. The scenarios consider the highest rate of leachate generation for each cell (i.e. when waste covers the full cell area).

3.3.1 Scenario 1

The first operational scenario modelled over three different climate scenarios is an active Stage E. Active Stage E composes of:

- 75% Final Cap
- 22.5% Interim Cover
- 2.5% Daily Cover

Table 9 describes Stage E areas which comprise Scenario 1.

Table 9 – Stage Areas modelled under Scenario 1 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	7.55	2.45	0.2	**10.2**

Table 10 Describes Scenario 1 - the expected leachate generation under an active Stage E cell.

Table 10 – Stage E leachate generation (m^3/month)

		Final Cap	Interim Cover	Daily Cover	Total
Stage E	**Area (ha)**	**7.55**	**2.45**	**0.2**	**10.2**
Climate Scenario	Average (m^3)	262.0	345.6	7.3	**614.9**
	90th Percentile (m^3)	295.5	360.0	5.9	**661.4**
	Highest Rainfall Year (m^3)	321.1	356.0	6.8	**683.9**

3.3.2 Scenario 2

Scenario 2 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap; and
- Active Stage 1 composing of:
  - No Final Cap in place
  - 97.5% Interim Cover
  - 2.5% Daily Cover

Table 11 describes both Stage E and Stage 1 areas which comprise Scenario 2.

Table 11 – Stage Areas modelled under Scenario 2 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	0.0	7.74	0.2	7.94
Combined Total (ha)	**10.2**	**7.74**	**0.2**	**18.13**

Table 12 Describes Scenario 2 - the expected leachate generation under a closed Stage E and an active Stage 1 cell.

Table 12 – Scenario 2 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	433.8	0.0	0.0	433.8
Stage 1	**Area (ha)**	**0.0**	**7.74**	**0.2**	**7.94**
Climate Scenario	Average (m^3)	0.0	1091.7	7.3	1099.0
	90th Percentile (m^3)	0.0	1137.3	5.9	1143.2
	Highest Rainfall Year (m^3)	0.0	1124.6	6.8	1131.4
Stage E and Stage 1 (Combined)	**Area (ha)**	**10.2**	**7.74**	**0.2**	**18.13**
Climate Scenario	Average (m^3)	354.0	1091.7	7.3	1453.0
	90th Percentile (m^3)	399.2	1137.3	5.9	1542.4
	Highest Rainfall Year (m^3)	433.8	1124.6	6.8	1565.2

3.3.3 Scenario 2A

Scenario 2A comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap; and
- Active Stage 1 composing of:
  - 75% Final Cap
  - 22.5% Interim Cover
  - 2.5% Daily Cover

Table 13 describes both Stage E and Stage 1 areas which comprise Scenario 2A.

Table 13 – Stage Areas modelled under Scenario 2

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	5.96	1.78	0.2	7.94
Combined Total (ha)	**16.15**	**1.78**	**0.2**	**18.13**

Table 14 Describes Scenario 2A - the expected leachate generation under a closed Stage E and an active Stage 1 cell.

Table 14 – Scenario 2 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**5.96**	**1.78**	**0.2**	**7.94**
Climate Scenario	Average (m^3)	206.9	251.1	7.3	465.2
	90th Percentile (m^3)	233.3	261.6	5.9	500.7
	Highest Rainfall Year (m^3)	253.5	258.6	6.8	518.9
Stage E and Stage 1 (Combined)	**Area (ha)**	**16.15**	**1.78**	**0.2**	**18.13**
Climate Scenario	Average (m^3)	560.9	251.1	7.3	819.3
	90th Percentile (m^3)	632.5	261.6	5.9	900.0
	Highest Rainfall Year (m^3)	687.3	258.6	6.8	952.7

3.3.4 Scenario 3

Scenario 3 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap;
- Closed Stage 1 with the assumption of 100% under a final cap; and
- Active Stage 2 composing of:
  - 75% Final Cap
  - 22.5% Interim Cover
  - 2.5% Daily Cover

Table 15 and **Table 16** describes both Stage E, Stage 1 and Stage 2 areas and leachate generation rates which comprise Scenario 3.

Table 15 – Stage Areas modelled under Scenario 3 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	7.94	-	-	7.94
Stage 2 (ha)	7.79	2.33	0.2	10.39
Combined Total (ha)	**25.93**	**2.33**	**0.2**	**28.53**

Table 16 – Scenario 3 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**7.94**	**-**	**-**	**7.94**
Climate Scenario	Average (m^3)	275.6	0.0	0.0	275.6
	90th Percentile (m^3)	310.8	0.0	0.0	310.8
	Highest Rainfall Year (m^3)	337.7	0.0	0.0	337.7
Stage 2	**Area (ha)**	**7.79**	**2.33**	**0.2**	**10.39**
Climate Scenario	Average (m^3)	270.4	328.6	7.3	606.3
	90th Percentile (m^3)	304.9	342.4	5.9	653.2
	Highest Rainfall Year (m^3)	331.3	338.5	6.8	676.7
Stage E, Stage 1 and Active Stage 2 (Combined)	**Area (ha)**	**25.93**	**2.33**	**0.2**	**28.53**
Climate Scenario	Average (m3)	900.0	328.6	7.3	1235.9
	90th Percentile (m3)	1014.9	342.4	5.9	1363.2
	Highest Rainfall Year (m^3)	1072.9	338.5	6.8	1418.2

3.3.5 Scenario 4

Scenario 4 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap;
- Closed Stage 1 with the assumption of 100% under a final cap; and
- Closed Stage 2 with the assumption of 100% under a final cap;
- Active Stage 3 composing of:
  - 75% Final Cap
  - 22.5% Interim Cover
  - 2.5% Daily Cover

Table 17 and **Table 18** describes both Stage E and Stage 1 areas and leachate generation rates which comprise Scenario 4.

Table 17 – Stage Areas modelled under Scenario 4 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	7.94	-	-	7.94
Stage 2 (ha)	10.39	-	-	10.39
Stage 3 (ha)	12.66	3.8	0.2	16.89
Combined Total (ha)	**41.19**	**3.8**	**0.2**	**45.44**

Table 18 – Scenario 4 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**7.94**	**-**	**-**	**7.94**
Climate Scenario	Average (m^3)	275.6	0.0	0.0	275.6
	90th Percentile (m^3)	310.8	0.0	0.0	310.8
	Highest Rainfall Year (m^3)	337.7	0.0	0.0	337.7
Stage 2	**Area (ha)**	**10.39**	**-**	**-**	**10.39**
Climate Scenario	Average (m^3)	360.6	0.0	0.0	360.6
	90th Percentile (m^3)	406.7	0.0	0.0	406.7
	Highest Rainfall Year (m^3)	441.9	0.0	0.0	441.9
Stage 3	**Area (ha)**	**12.66**	**3.8**	**0.2**	**16.89**
Climate Scenario	Average (m3)	439.4	536.0	7.3	982.7
	90th Percentile (m3)	495.5	558.4	5.9	1059.8
	Highest Rainfall Year (m^3)	538.5	552.1	6.8	1097.4
Stage E, Stage 1, Stage 2 and Active Stage 3 (Combined)	**Area (ha)**	**41.19**	**3.8**	**0.2**	**45.44**
Climate Scenario	Average (m^3)	1429.6	536.0	7.3	1972.9
	90th Percentile (m^3)	1612.2	558.4	5.9	2176.5
	Highest Rainfall Year (m^3)	1722.0	552.1	6.8	2280.9

3.3.6 Scenario 5

Scenario 5 comprises of the following:

- Closed Stage E with the assumption of 100% under a final cap;
- Closed Stage 1 with the assumption of 100% under a final cap; and
- Closed Stage 2 with the assumption of 100% under a final cap;
- Closed Stage 3 with the assumption of 100% under a final cap;

Table 19 and **Table 20** describes both Stage E and Stage 1 areas and leachate generation rates which comprise Scenario 5.

Table 19 – Stage Areas modelled under Scenario 4 (ha)

	Final Cap	Interim Cap	Daily Cap	Total (ha)
Stage E (ha)	10.2	-	-	10.2
Stage 1 (ha)	7.94	-	-	7.94
Stage 2 (ha)	10.39	-	-	10.39
Stage 3 (ha)	16.89	-	-	16.89
Combined Total (ha)	**45.44**	**-**	**-**	**45.44**

Table 20 – Scenario 5 leachate generation (m^3/month)

		Final Cap	Interim Cap	Daily Cap	Total
Stage E	**Area (ha)**	**10.2**	**-**	**-**	**10.2**
Climate Scenario	Average (m^3)	354.0	0.0	0.0	354.0
	90th Percentile (m^3)	399.2	0.0	0.0	399.2
	Highest Rainfall Year (m^3)	403.9	0.0	0.0	403.9
Stage 1	**Area (ha)**	**7.94**	**-**	**-**	**7.94**
Climate Scenario	Average (m^3)	275.6	0.0	0.0	275.6
	90th Percentile (m^3)	310.8	0.0	0.0	310.8
	Highest Rainfall Year (m^3)	337.7	0.0	0.0	337.7
Stage 2	**Area (ha)**	**10.39**	**-**	**-**	**10.39**
Climate Scenario	Average (m^3)	360.6	0.0	0.0	360.6
	90th Percentile (m^3)	406.7	0.0	0.0	406.7
	Highest Rainfall Year (m^3)	441.9	0.0	0.0	441.9
Stage 3	**Area (ha)**	**16.89**	-	-	**16.89**
Climate Scenario	Average (m3)	586.2	0.0	0.0	586.2
	90th Percentile (m3)	661.1	0.0	0.0	661.1
	Highest Rainfall Year (m^3)	718.4	0.0	0.0	718.4
Stage E, Stage 1, Stage 2 and Active Stage 3 (Combined)	**Area (ha)**	**45.44**	**-**	**-**	**45.44**
Climate Scenario	Average (m3)	1577.1	0.0	0.0	1577.1
	90th Percentile (m3)	1778.6	0.0	0.0	1778.6
	Highest Rainfall Year (m^3)	1932.8	0.0	0.0	1932.8

The results above demonstrate that leachate generation will vary based upon the total area of the final cap, interim cap, daily cover and total area. The maximum peak monthly leachate generation will occur under Scenario 4 of the landfilling operation with an average 1972 m^3/month of leachate generated and approximately 2280 m^3/month during a high rainfall year.

3.3.7 Leachate collection, storage and disposal system and spacing of discharge pipes

Based on leachate generation from a highest rainfall month, the following leachate flow rates are generated as described in **Table 21**. Stages E, 1 and 2 are grouped as they are within the one catchment and will drain to a central location. Stage 3 is presented independently as it is in a separate catchment and will drain to a separate location.

Table 21 – Leachate flow rates

Catchment	Leachate Generation m^3/Ha/month	Total ha	Flow Rate (m^3/month)	Flow Rate (m^3/d)	Flow Rate (m^3/hr)	Flow Rate (m^3/s)	Pipe Discharge Velocity (m/s)		
							200mm	150mm	2 x 100mm
Stage E, Stage 1 & 2	265.0	28.5	1183.5	39.45	1.64	0.00045	0.014	0.025	0.028
Stage 3		16.9	1097.4	36.58	1.52	0.00042	0.013	0.023	0.026

As described within **Table 21**, the modelled velocities are predicted to range from 0.013 m/s to 0.028 m/s. Based upon the Hazen-Williams formula, the following maximum water velocity and discharge rates were assessed for each pipe size as described within **Table 22**.

Table 22 – Maximum allowable velocity and flow rates

	200mm	150mm	2 x 100mm
Maximum allowable discharge velocity (m/s)	2.33	1.94	3.0
Maximum allowable discharge flow rate (m^3/s)	0.073	0.034	0.023

Based upon the findings contained within **Table 21**Table 22, the predicted flow rate and discharge velocities are considered to be well below the maximum allowable discharge velocity and flow rates shown in **Table 22**. It is therefore considered that leachate reticulation pipes utilised for Stage E (2 x 100mm diameter pipes), will be suitable for all future stages with regards to discharge velocity and flow rate.

Leachate collection pipes should be placed on the floor at intervals of not more than 25 m (running the length of the cell), and be laid at gradients of at least 1% longitudinally into the sump and 3% in transverse directions. (*NSW EPA Landfill Guidelines*, 2016).

The collection pipework should be perforated such that the size, frequency and layout of the perforations are sufficient to facilitate leachate inflow and extraction without clogging and prevent entry of drainage gravel and maintain adequate pipe strength complying with the requirements of Australian Standard AS 2566.1-1998 Buried flexible pipelines – Structural design.

The leachate extraction and level-control system should include a collection sump and leachate riser(s) to facilitate extraction of leachate from each cell. The riser should be stable under the load of the surrounding waste mass and should be able to withstand stresses due to settling of the surrounding waste. The leachate extraction system should be designed for a maximum level of leachate of 300 mm over the upper liner and be able to continue to function effectively until the landfill is considered stable.

It is recommended that leachate is stored in above ground bunded tanks in preference to sumps. Above ground bunded tanks must have sufficient leachate storage volume, as determined by using a water balance methodology. The bunded tanks must have a visible marker to indicate the bottom depth of the required freeboard. If the freeboard is exceeded, the occupier must re-establish and maintain the required freeboard. The tanks and associated connection points must be surrounded by a bund with a capacity of at least 110% of the tanks volume.

3.3.8 Discussion

The results presented in **Table 21** can be used to inform leachate system capacity requirements. In doing this it is important to consider statutory requirements along with the method of leachate management, disposal and any other contingency requirements.

The results of leachate generation modelling demonstrate the importance of quality capping materials and related site management practices. The requirements for final capping under the NSW Guidelines state that final caps must be completed to all *cells* within six months of final waste delivery. It is noted PMHC are progressively capping Stage E which is assumed to be in line with the EMP (2008) which requires capping to commence within 30 days of completion of a landfilling *area*. Whilst the current practices under the EMP appear to exceed the requirements of the NSW Guidelines, the extremely high rate of leachate generation modelled under Scenario 2A demonstrates the risk of maintaining interim stage capping until *cell* completion in accordance with the guidelines. It is therefore recommended that progressive capping along with the maintenance of minimal areas under interim and daily cover (assumed in this investigation) continue as per current practice.

4 LIMITATIONS

Whilst the HELP model is the industry standard for this application it should be recognised that it is a simplified version of the real situation and the results may deviate significantly from actual generation rates. The model can handle water routing through or storage in different waste layers and liner systems. However the model cannot simulate a capillary break or unsaturated lateral drainage. There are also simplifying assumptions or default values that may need to be incorporated into the model in the absence of real site data. Therefore any decision relating to final selection of leachate storage infrastructure should be cognisant of these limitations.

5 REFERENCES

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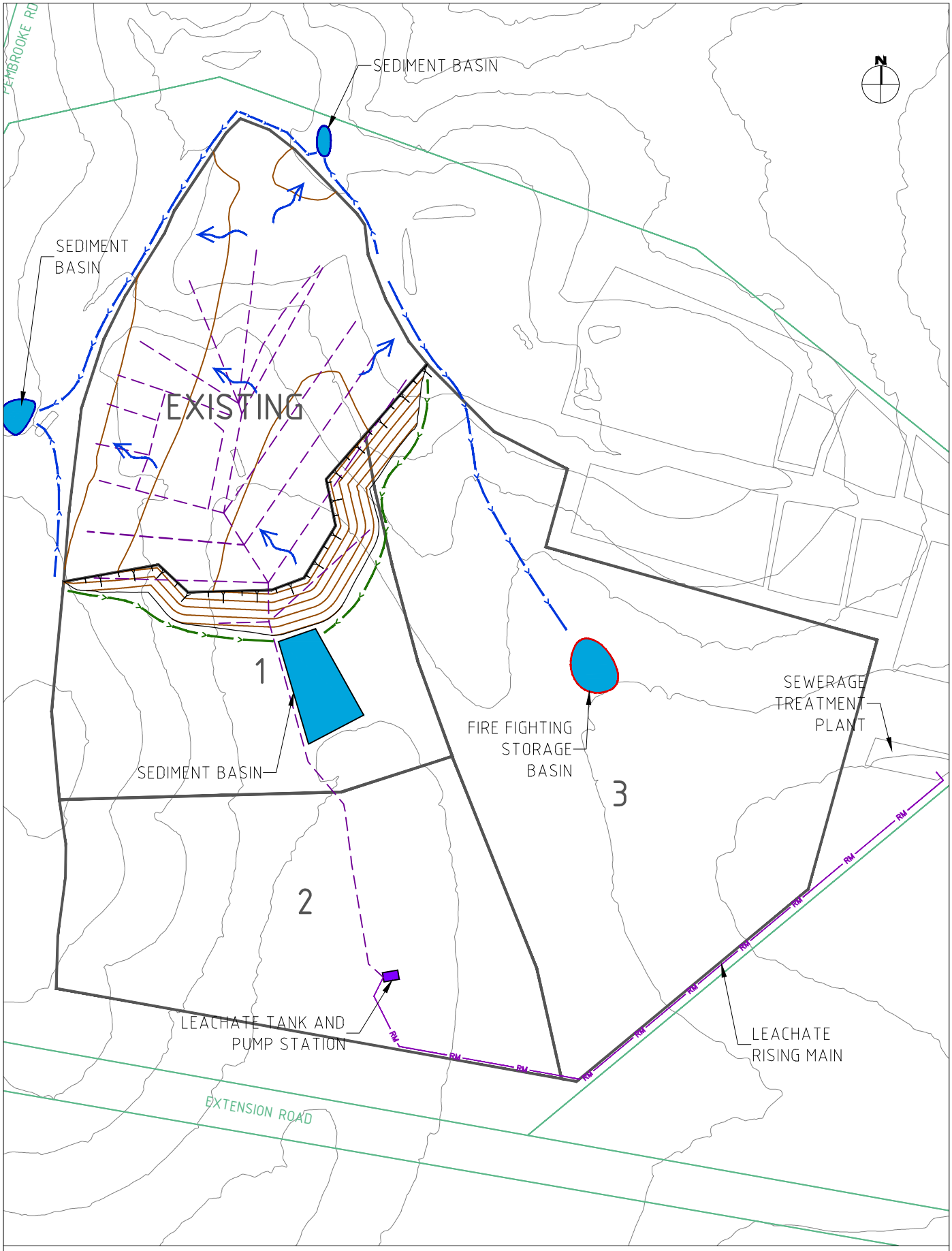
Appendix A CALIBRATED HELP 3.95D MODELLING RESULTS

Leachate Generation mm per month Final Cover 2014/15					
July	**August**	**September**	**October**	**November**	**December**
4.17	3.89	4.62	4.53	4.56	4.31
January	**February**	**March**	**April**	**May**	**June**
4.55	4.57	4.36	4.41	4.09	4.36
Average year					
July	**August**	**September**	**October**	**November**	**December**
3.44	3.12	3.42	3.35	3.52	3.57
January	**February**	**March**	**April**	**May**	**June**
3.67	3.62	3.48	3.57	3.4	3.49
Average					3.47
90th Percentile					
July	**August**	**September**	**October**	**November**	**December**
3.84	3.54	3.67	3.85	3.89	3.97
January	**February**	**March**	**April**	**May**	**June**
4.28	4.27	3.94	3.94	3.84	3.94
Average					3.91
Wettest year					
July	August	September	October	November	December
4.29	4.04	4.38	4.26	4.36	4.36
January	February	March	April	May	June
4.23	4.29	4.211	4.31	3.99	4.32
Average					4.25
Wettest period					
July	**August**	**September**	**October**	**November**	**December**
4.29	3.94	4.42	4.33	4.55	4.38
January	**February**	**March**	**April**	**May**	**June**
4.27	4.29	4.01	4.33	3.96	4.33
Average					4.26

Leachate Generation mm per month					
Interim Cover					
2014/15					
July	**August**	**September**	**October**	**November**	**December**
24.47	20.11	21.6	14.037	16.5	19.04
January	**February**	**March**	**April**	**May**	**June**
18.34	11.75	6.4	4.55	9.63	6.64
Average year					
July	**August**	**September**	**October**	**November**	**December**
12.6	13.7	18.72	18.41	19.1	14.34
January	**February**	**March**	**April**	**May**	**June**
13.16	13.77	10.87	10.65	10.72	13.22
Average					14.11
90th Percentile					
July	**August**	**September**	**October**	**November**	**December**
10.94	8.51	25.21	16.49	23.71	23.46
January	**February**	**March**	**April**	**May**	**June**
13.63	10.99	1.15	17.79	9.3	15.15
Average					14.69
Wettest year					
July	**August**	**September**	**October**	**November**	**December**
9.28	18.8	20.76	14.15	17.53	21.55
January	**February**	**March**	**April**	**May**	**June**
16.4	21.54	13.31	8.37	5.25	7.42
Average					14.53
Wettest period					
July	**August**	**September**	**October**	**November**	**December**
20.1	24.6	23.9	22.4	19.7	9.5
January	**February**	**March**	**April**	**May**	**June**
13.06	11.62	19.9	11.6	26.5	27.3
Average					19.18

Leachate Generation mm per month					
Daily Cover					
2014/15					
July	**August**	**September**	**October**	**November**	**December**
6.6	8.29	6.17	2.81	2.1	6.43
January	**February**	**March**	**April**	**May**	**June**
4.87	5.56	4.28	3.36	2.85	1.6
Average year					
July	**August**	**September**	**October**	**November**	**December**
3.31	2.64	3.28	4.06	4.87	4.49
January	**February**	**March**	**April**	**May**	**June**
3.86	4.27	3.78	3.39	2.69	2.94
Average					3.63
90th Percentile					
July	**August**	**September**	**October**	**November**	**December**
1.3	0.22	4.8	5.94	2.81	5.45
January	**February**	**March**	**April**	**May**	**June**
5.82	4.53	1.56	1.73	0.08	1.06
Average					2.94
Wettest year					
July	**August**	**September**	**October**	**November**	**December**
1.35	0.17	3.27	2.52	3.02	4.9
January	February	March	April	May	June
2.81	6.44	6.29	4.18	1.35	0.4
Average					3.06
Wettest period					
July	**August**	**September**	**October**	**November**	**December**
2.24	1.60	3.81	3.74	4.61	4.20
January	**February**	**March**	**April**	**May**	**June**
4.05	4.02	2.82	4.29	2.75	2.72
Average					3.40

Appendix B LANDFILL STAGING



PORT MACQUARIE HASTINGS

CAIRNCROSS WASTE MANAGEMENT FACILITY
STAGE E (EXISTING)
CONCEPT PLAN

0 50 100 200 300
Full Size 1:5000 ; Half Reduction 1:10000
SCALE (m)

STAGE	STAGE AREA	AVERAGE TOPSOIL DEPTH	TOPSOIL STRIPPING VOL	NS vs LANDFILL BASE VOL	LEACHATE COLLECTION GRAVEL THICKNESS	ADDITIONAL EXCAVATION FOR LEACHATE COLLECTION	CLAY EXCAVATED	CLAY CAP DEPTH	VEGETATION LAYER CLAY DEPTH	TOTAL CAP CLAY VOL	VEGETATION LAYER TOPSOIL DEPTH	VEG LAYER TOPSOIL VOL	CUM LANDFILL BASE vs LANDFILL FINAL VOL	LANDFILL BASE vs LANDFILL FINAL VOL	LANDFILL VOID VOL	DAY COVER CLAY % WITHIN LANDFILL	DAY COVER CLAY REQUIRED	ACTUAL LANDFILL VOID VOL (REMOVES DAY COVER)	TOTAL CLAY REQUIRED (DAY COVER + CAP)	EARTHWORKS BALANCE (-VE = DEFICIT)
E	102,063	0.3	30,619	493,124	0.0	0	462,505	0.6	0.2	81,650	0.3	30,619	1,548,266	1,548,266	1,435,997	10%	143,600	1,292,397	225,250	237,255
1	79,453	0.3	23,836	211,215	0.3	23,836	211,215	0.9	0.7	127,125	0.3	23,836	3,309,408	1,761,142	1,610,181	10%	161,018	1,449,163	288,143	-76,928
2	103,992	0.3	31,198	181,825	0.3	31,198	181,825	0.9	0.7	166,387	0.3	31,198	4,523,698	1,214,290	1,016,705	10%	101,671	915,035	268,058	-86,233
3	168,907	0.3	50,672	536,274	0.3	50,672	536,274	0.9	0.7	270,251	0.3	50,672	6,386,339	1,862,641	1,541,718	10%	154,172	1,387,546	424,423	111,851
	454,415			1,422,438			1,391,819											5,044,141		185,945

APPENDIX T CAIRNCROSS LANDFILL OPERATIONAL ENVIRONMENTAL MANAGEMENT PLAN (2008)

OPERATIONAL ENVIRONMENTAL MANAGEMENT PLAN

CAIRNCROSS WASTE MANAGEMENT FACILITY
Pacific Highway,
Telegraph Point



JULY 2008

Revision History				
No	Issue Date	Revision Notes	Prepared By	Approved By

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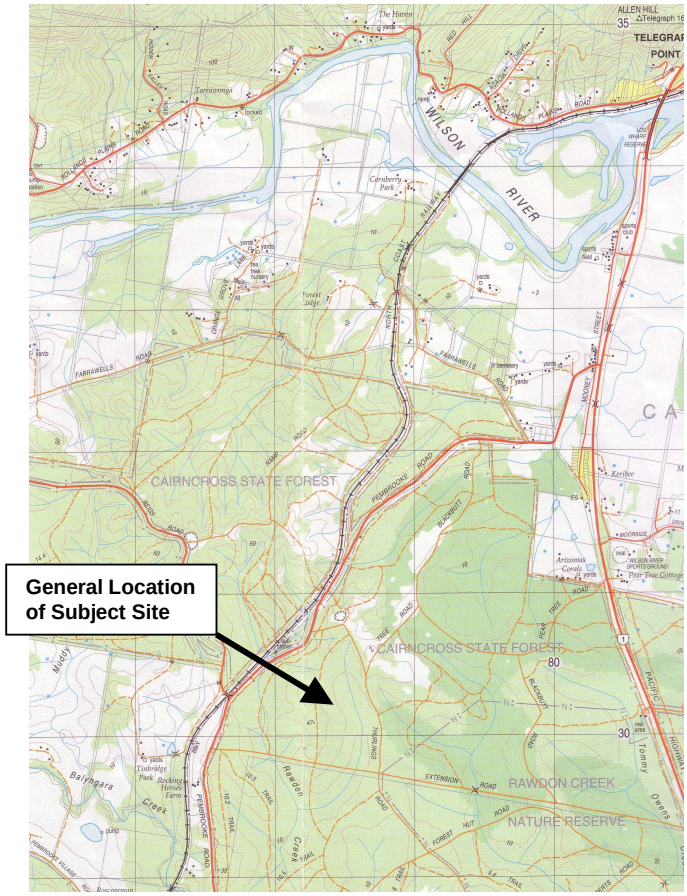
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1.0 INTRODUCTION

1.1 Cairncross Waste Management Facility

The Cairncross Waste Management Facility is located to the north west of Port Macquarie. Access to the site is via the Pacific Highway. The site is bounded by Cairncross State Forest to the north, east and south; National Park reserve to the southeast; and by Pembroke Road to the west. The location of the facility is shown on Figure 1.

Figure 1
Site Location



The Waste Management Facility was constructed to replace the existing Port Macquarie landfill which was closed in 2001.

The facility includes a receival area including weighbridge, office and staff amenities. A waste transfer station is also present for local domestic use. This removes the need for domestic vehicles to travel onto the landfill area.

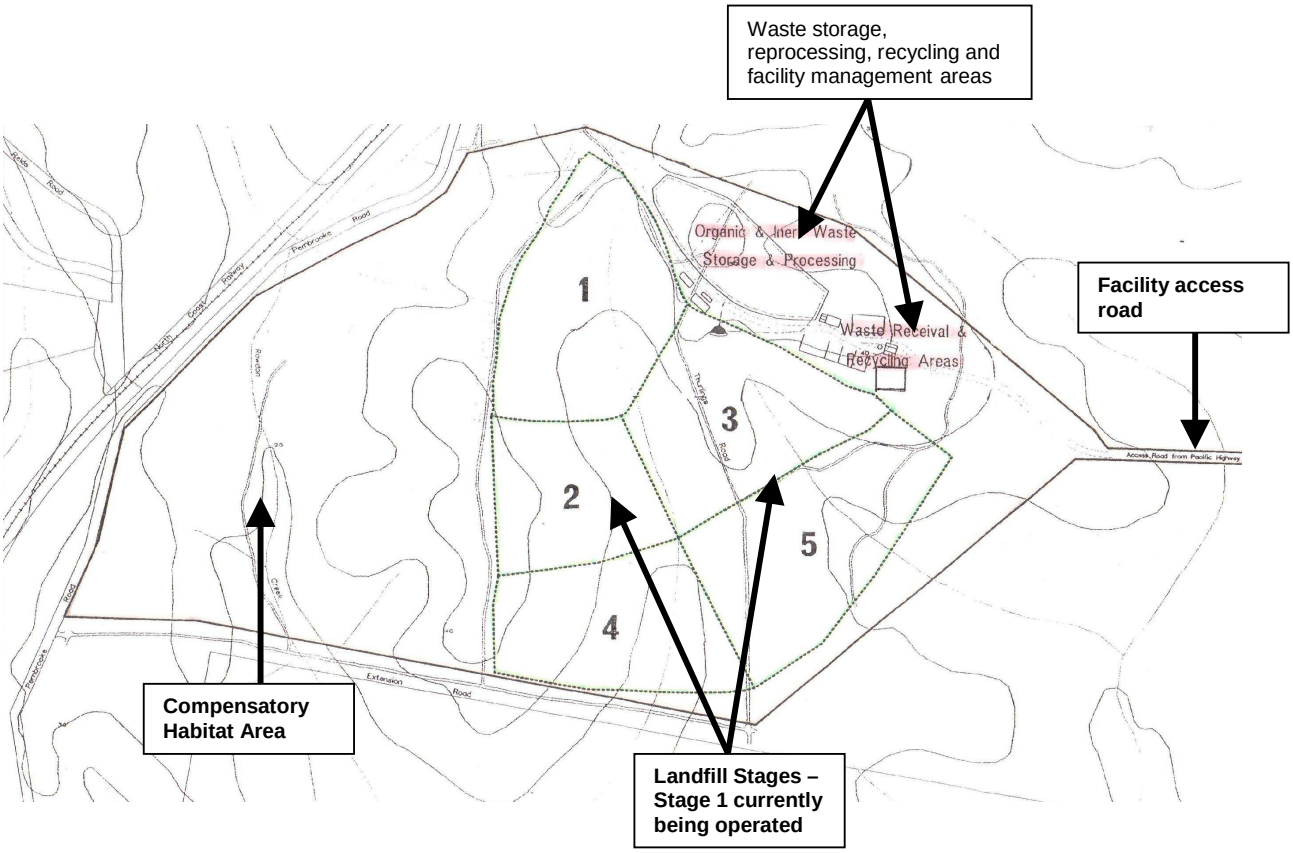
Receival and storage facilities are also provided for materials not able to be land filled for which processing and reuse alternatives are available. Other facilities include waste processing and recovery area, vehicular storage facility, water supply dam and site infrastructure.

An organics (domestic and commercial) waste processing facility is present at the Facility. This material is mulched and incorporated with bio-solids from Councils sewage treatment plants, which are also received at this site. Composting of these materials is undertaken at the site.

A Materials Recover Facility (MRF) is also present on the site. This Facility processes all the recyclable material collected as part of the domestic collection service.

The general plan of the site and the major functional areas of the site are shown in Figure 2 as well as future stages of landfill development.

Figure 2
Site Plan



Putrescible wastes from both domestic and commercial collection services are transported directly to the Cairncross Waste Management Facility. Additionally all recyclable and green wastes collected as part of the domestic kerbside collection service are also transported to the Caincross Waste Management Facility where resource recovery, processing, reuse and land filling activities are undertaken.

The Facility also receives all commercial and industrial waste, such as building and demolition waste and waste hauled in bulk from transfer stations located at Port Macquarie, Wauchope and Camden Haven. Upon the closure of the Dunbogan Landfill a waste transfer station will be constructed to service the Camden Haven area.

The Cairncross facility services a population of approximately 78,000.

The landfill is being developed in cells over a number of years. Each cell is progressively excavated to a predetermined level and lined with compacted clay. Excavated material is stockpiled and used to meet daily cover requirements over the deposited waste. The landfill will be filled to final contour levels in sections and progressively capped with stockpiled material and the surface rehabilitated.

A Landfill Environmental Management Plan (LEMP) was prepared for the site in 2001 however with changes to onsite practices and reflecting the need for ongoing review of management practice this document has been prepared to replace the 2001 LEMP.

1.2 Port Macquarie-Hastings Council Environmental Policy

Port Macquarie-Hastings Council's Environmental Policy has been taken into account when preparing this Operational Environmental Management Plan (OEMP). The policy is as follows:

1.2.1 Organisational Vision

Our vision is to maintain a community proud of its heritage, living in harmony with its environment and planning its future.

1.2.2 Landfill Management Mission

The operation and management of Council landfill facilities in a manner which protects and preserves the local environment.

1.2.3 Environment Management

Port Macquarie-Hastings Council recognises that environmental management is an integral and important organisational priority, and will develop and implement an Environment Management System in accordance with ISO 14001 to demonstrate commitment to the environment.

Council will implement practices and to prevent significant environmental impacts and aim to promote support and implement ecological practices and procedures.

1.2.4 Pollution Prevention

Council is committed to protecting and enhancing the environment by:

- Assessing environmental impact before, during and after carrying out activities;
- Conducting environmental monitoring at operating and closed waste management centres;
- Progressively rehabilitating our operating sites and maintaining closed sites.

1.2.5 Conservation of Resources

Port Macquarie-Hastings Council will use energy and natural resources effectively and efficiently, minimise waste and generation and, where possible, provide for energy and resource recovery.
Council will also provide and use products that can be reused, recycled and/or disposed of safely, and will encourage contracting suppliers and partners to adopt this practice in delivering their products and services.

Council will establish services and systems to recover, reuse and recycle materials from the waste stream.

1.2.6 Continual Improvement

Port Macquarie-Hastings Council is committed to meeting all applicable environmental regulations and guidelines and to achieve community expectations. Council will continually improve its environmental performance by conducting regular management reviews, environmental audits and assessments.

1.2.7 Education and Training

Council will educate, train and motivate its employees and promote environmental awareness among its customers. Council will also include in its contracts the requirement for contracting partners, contractors and suppliers to assist in the implementation of this policy.

1.3 Purpose and Scope of the OEMP

This document has been designed to be used as a management tool which will provide direction for the management and operation of the Waste Management Facility. It outlines the processes and procedures to ensure the safe, environmentally sound and cost efficient management of the Facility.

The objectives of the Cairncross Waste Management Facility Operational Environmental Management Plan are:

- To ensure compliance with all statutory requirements
- To ensure the safe and cost effective management of the site
- To ensure the maximum life span of the site is achieved
- To ensure the effective closure of the site
- To ensure the preservation and protection of the surrounding environment and neighbouring communities
- To provide for ongoing environmental management and monitoring

The Operational Environmental Management Plan (OEMP) prescribes the requirements and performance standards to be met by the operation of the Facility, to ensure that the objectives of the OEMP are achieved. The OEMP has been prepared in accordance with the Environment Protection Authority (EPA) Guidelines “Solid Waste Landfills”.

The OEMP should be read in conjunction with a series of specific standard operating procedures (SOP’s) which provide further details of environmental and operational controls described in the 0EMP.

The standard operating procedures are contained within Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual.

Where relevant this document makes reference to specific standard operating which can be found within Councils Solid Waste Management Procedures Manual.

It is also noted that the operation of the organic waste storage and processing facility and the materials recovery facility are the subject of separate operational environmental management plans and standard operating procedures which have been prepared specifically for the operation of these components of the site. These documents together with this environmental management plan therefore form the environmental management manual for the entire site.

In this regard this OEMP primarily covers those aspects of the operation of the site which are the responsibility of Port Macquarie-Hastings Council. However in order to provide an overall management context for the Facility references are made to the operational requirements for the organic waste storage and processing facility and the materials recovery facility.

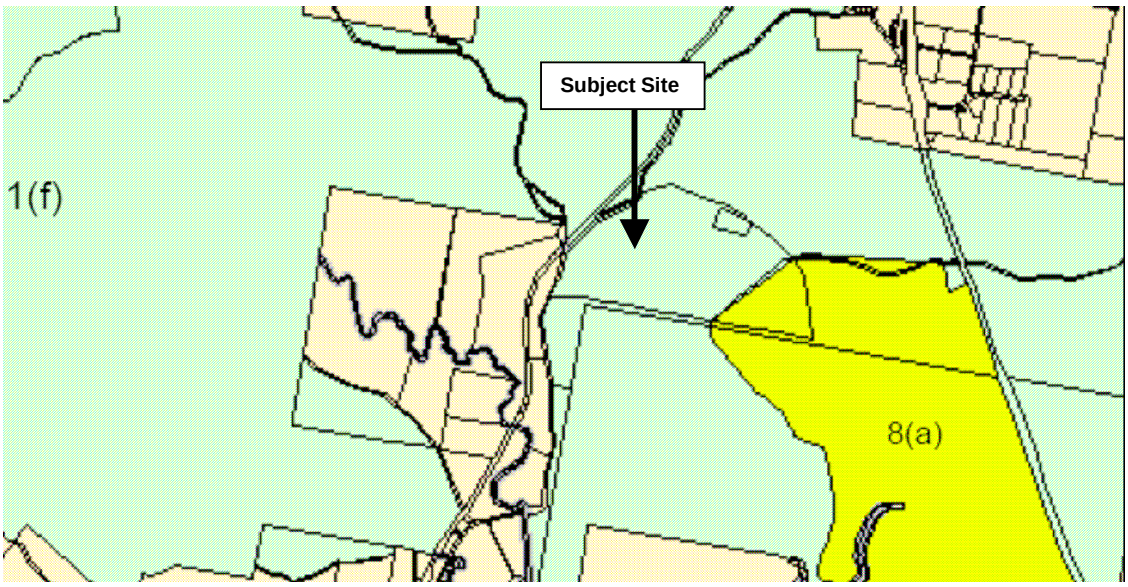
2.0 SITE OVERVIEW

2.1 Property Description

The Cairncross Waste Management Facility is located off the Pacific Highway at Telegraph Point, NSW. The site is under the control of Port Macquarie-Hastings Council as operational land described as Lot 5 DP1041766, Lot 6 DP1106420 and Part Lot 7 DP1106420 Pacific Highway, Pembrooke.

The site is zoned State Forest 1(f) under Port Macquarie-Hastings Local Environment Plan 2001.

Figure 3
Subject Site



The site is irregular in shape with a total area of 143.8 hectares of which Stage 1, the subject of this OEMP, is approximately 10.9 hectares. Over 55 hectares of the site has been set aside as buffer for the landfill and to provide compensatory habitat. The remainder of the site has been set aside for the provision of future landfill stages, in addition to areas of the site which are actively used for inert and organic waste processing, site infrastructure, (including gate house and weighbridge), plant workshop, materials recovery facility, waste transfer station and recyclable materials storage areas.

2.2 Site History and Future

The Cairncross Waste Management Facility has been used by Port Macquarie-Hastings Council for waste disposal and resource recovery activities for approximately 7 years. Prior to the purchase and development of the site the land formed part of the Cairncross State Forest this at that time was owned by NSW Forests. The site had been developed by State Forests as a blackbutt plantation since 1975/1976.

Following an extensive site selection process the land which now forms the Facility was identified as being the most suitable site for the management of solid wastes for the Port Macquarie-Hastings local government area. The land was subsequently purchased from NSW Forests and developed as a solid waste management facility. The facility became operational in October 2001.

Since its initial commissioning the Facility has undergone further development such as the relocation of the Materials Recovery Facility from the Port Macquarie Waste Management Facility in June 2006 and more recently the establishment of a gas bottle recycling centre at the site.

The landfill component of the Facility will be filled to final contour levels in sections and progressively capped with stockpiled material and the surface rehabilitated.

The current land filling operations at the site are expected to extend for a total period of 20 years within stage 1 from its commencement in 2001. The overall design of the site proposes five stages, each of which has the potential for the receival of waste for 20 years. The development and use of the site beyond the first stage will be the subject of further environmental assessment and approvals processes.

2.3 Description of Existing Environment

2.3.1 Topography

The natural topography of the site is gently undulating with the site selected for stage 1 land filling being at the head of a valley feature. The highest part of the site is approximately AHD 50m along the northern ridge of the site with the lowest part being approximately AHD 20m at the southern end of the site near Extension Road. The land filling operations have however altered the natural topography of the site.

There are no defined water courses on the site, however during periods of heavy rain, water flows from the natural valley features within the site discharging to the south and the northeast.

2.3.2 Climate

The Port Macquarie-Hastings area has a warm temperate climate with warm wet summers and mild dry winters. Average rainfall and evaporation data is not recorded at Telegraph Point. The closest long term data which is available is from Port Macquarie, which is assumed to be similar to the Telegraph Point area.

Port Macquarie receives an average rainfall of 1500mm per annum on an average 133 days. The median monthly rainfall is shown in Table 1 below. The wettest month is February (159mm) and the driest is August (57mm).

Table 1
Median Monthly Rainfall

MONTH	MEAN RAINFALL (mm)
January	114
February	159
March	153
April	140
May	112
June	99
July	80
August	57
September	64
October	77
November	82
December	101
TOTAL	**1445**

Average long term evaporation data has not been recorded at Telegraph Point or Port Macquarie. The closest long term data is from Taree which is assumed to be similar to the Telegraph Point area. The average daily pan evaporation at Taree has been recorded since 1970 and is shown in Table 2 below.

Table 2
Average Daily Pan Evaporation at Taree

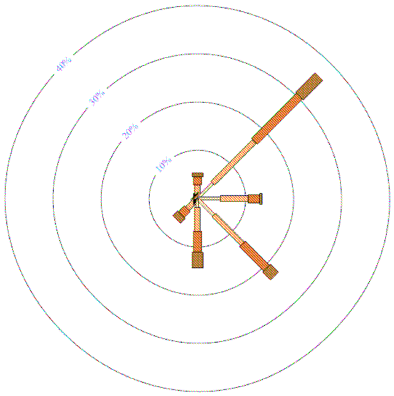
MONTH	AVERAGE DAILY PAN EVAPORATION (mm)
January	5.8
February	5.3
March	4.4
April	3.4
May	2.2
June	1.9
July	2.1
August	2.8
September	3.9
October	4.8
November	5.3
December	6.3

The total average yearly evaporation is 1460mm which is approximately equal to the median annual rainfall at Port Macquarie.

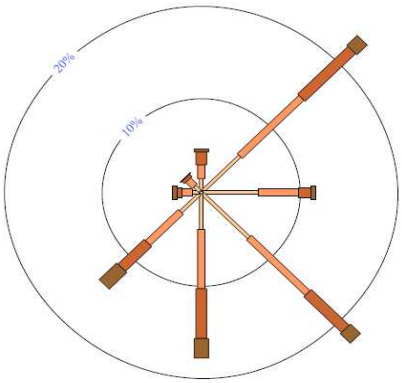
The predominant winds on the site are from the northeast in the spring and summer and from the west and south westerly during winter. Autumn is a transitional season with the majority of winds from the south and west.

Wind direction and velocity information for the site is presented in Figure 4.

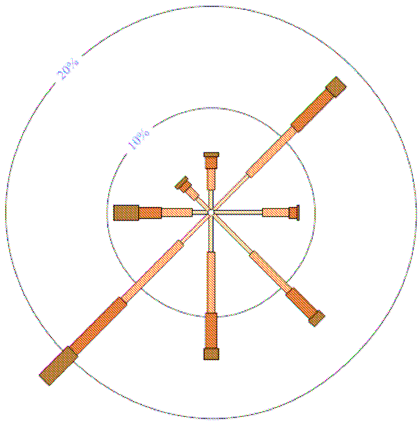
Figure 4
Seasonal Wind Direction and Velocity (3pm)



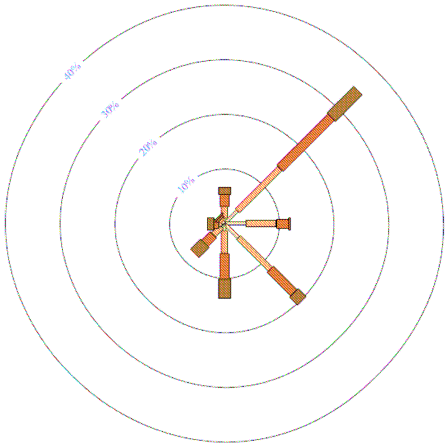
Summer



Autumn



Winter



Spring

2.3.3 Soils and Geology

Topsoil across the site is present to a depth of 0.1m to 0.2m and consists of very stiff medium placidity clay with silt and root fibres. Two distinct horizons were encountered within the residual clay profile, the upper consisting of very stiff pale brown clay of high placidity, generally with a thickness of 0.4m and 0.7m. The lower horizon consists of hard grey pale brown clay of high placidity which continues down to the siltstone bedrock.

The thickness of the combined residual clay strata varies from 1.5m to 2.0m on the ridges and up to 4m to 5m in the lower areas of the site. Siltstone bedrock is present beneath the residual clays. The siltstone is highly weathered, very weak to weak in strength and fragmented to highly fractured.

The siltstone stratum is in the range of 4m to 5m in thickness and at the base grades into shale. A shale stratum is present underlying the siltstone, the shale is moderately to slightly weathered, weak to medium in strength, highly fractured to fractured.

2.3.4 Hydrology

(i) Surface Water

The catchment for the landfill area drains towards the south whilst the location of the remaining Facility infrastructure (MRF, green waste processing, transfer station, etc) is such that the catchment for these areas is split between the south and northeast.

The catchment of the site is characterised by a high point of 52m AHD to a level of 20m AHD at the down stream end of the site, at an average grade of 3.5% with steeper grades of up to 8% in the lower parts of the catchment area

There are no defined water courses on the site, however during periods of heavy rain, water flows from the natural valley features within the site discharging to the south and northeast.

(ii) Ground Water

The ground water table lies within the siltstone/shale bedrock underlying the site. The ground water surface approximately mirrors the topographical surface with some localized areas where ground water is at a greater depth. This tends to occur at the points of higher relative level, (RL) that is the tops of crests. Underlying rock formations at the site are fine grained siltstones and shales. Rocks of this type have a very low porosity which corresponds to the very low values of hydraulic conductivity. Therefore the movement of ground water through strata of this type will be governed by fracture flow rather than flow through parent material as an intact rock mass.

A low hydraulic gradient of approximately 0.7% following the line of the valley towards the south-east has previously been determined. No discreet rock strata were determined which might act as individual aquifers, thus the ground water model for the site is expected to behave as an unconfined aquifer. The low hydraulic gradient of the unconfined aquifer combined with the low hydraulic conductivity of the rock mass will result in low rates of flow through the rock mass.

Laboratory test results indicate that the groundwater has raised levels of iron, manganese, sodium, ammonia and chloride when compared with NHMRC guidelines.

2.3.5 Flooding

No detailed flood studies have been carried out for the site. The site is however well above known flood levels. Localized flooding of the lower areas of the site may occur after periods of high rainfall. The Port Macquarie-Hastings region is one of the highest rainfall areas in NSW. High intensity storms are often experienced during the summer months. Table 3 contains the design storm intensities for different annual recurrence intervals and storm event durations.

Table 3
Design Storm Event Intensities

STORM EVENT DURATION	RAINFALL INTENSITIES (mm/h) FOR VARYING ANNUAL OCCURANCE INTERVALS (ARI) (yr)				
	1yr	5yr	10yr	50yr	100yr
6min	95	159	180	245	273
10min	78	132	150	205	229
30min	46	80	92	129	145
1 hour	31	56	64	91	103
3 hour	16	29	33	47	53
6 hour	11	19	22	31	35
12 hour	7.1	12	14	20	23
24 hour	4.5	8	9.3	13	15
48 hour	2.8	5.1	5.9	8.3	9.4

72 hour	2.1	3.8	4.4	6.2	7.1

2.3.6 Ecological Characteristics

The subject site contains areas of Blackbutt Eucalyptus pilularis plantation, stands of intensively managed dry sclerophyll forest and less heavily managed riparian forest along drainage lines. Areas of vegetation have been removed from the site as part of the establishment and operation of the Facility.

Surveys undertaken as part of the initial planning and approvals processes for the site recorded 93 vascular plants and 96 vertebrate species. The lowered level of biodiversity which was found was attributed to the operation of a timber plantation on the site. The vegetation surveys indicated that no threatened plant species or ROTAP species wand only a very small area of a regionally significant vegetation association which occurs in the area are affected by the development and operation of the Facility.

Three threatened fauna species, the koala, little bent wing bat (Miniplerus australis) and greater broad nosed bat (Scoteanax rueppellii) have been previously recorded on the site whilst two other species, the square-tailed kit and powerful owl have been recorded in the wider area.

Previous records of two other threatened species, the glossy black cockatoo and brush-tail Phascogale are known to be in areas adjacent to Facility site and together with the common bent wing bat are considered likely to be present.

Development of the Facility over the first 20 years of its operation will remove approximately 50 ha of habitat known to be used by the Koala, little bent wing bat and greater broad-nosed bat and probably by the square-tailed kite, glossy black-cockatoo, powerful owl, brush-tailed phascogale and common bent-wing bat. However the reservation and management of approximately 57 ha of compensatory habitat assists in protecting the habitat components required by all of these species and allow others such as old growth elements to develop. This will increase the carrying capacity for threatened species already present and may allow other sensitive species to recolonize the area.

2.3.7 Acoustic Characteristics

Information from assessments carried out as part of the approvals processes for the establishment and operation of the Facility provide that the daytime, (during the times of 7.00am and 6.00pm), background noise conditions which exist are in the order of 31 to 36dB(A). Evening background noise levels where in the order of 31 to 36dB(A) whilst the night time background levels are in the order of 30 - 32dB(A).

Offensive noise is unlikely to be generated on the site due to the nature of the activities at the Facility and the absence of noise receivers in close proximity to the site.

2.3.8 Archaeological Characteristics

(i) Archaeology

The ground surface of the actively occupied area of the site has been extensively disturbed through clearing, removal of top soil, mining of soils and other on site excavations. An Archaeological assessment was carried out as part of the approvals processes for the establishment and operation of the Facility. This assessment found that whilst there was historical evidence of aboriginal use of parts of the site which has been or are proposed to be developed as a solid waste management facility the artefacts which were present had a low level of archaeological/scientific significance. Consequently artefacts which were at risk of destruction through the development and operation of the Facility have been removed from the site in accordance with Statutory and Local Aboriginal Lands Council requirements.

Some artefacts remain on site in areas which have not been developed as part of the operation of the Facility. Approval from the NP&WS to destroy these aboriginal relics has however been issued. Consent No N37/CDS/2000

(ii) Heritage

There are no known heritage values on the site.

2.3.9 Natural Resources

Given that the site was a blackbutt plantation all commercial timber was harvested from the area which has been developed for operational purposes.

Not withstanding the above the currently undeveloped areas of the site contains areas of plantation timbers which will be managed and harvested as part of any future development of the site. The NSW Department of Natural Resources has provided "Authorization for Timber Plantation" registration number GR0507P, which allows for plantation harvesting.
The areas of vegetation which are contained within the compensatory habitat areas of the site will however be retained in their natural state. The management of approximately 57 ha of compensatory habitat will assist in protecting the habitat components of the area and allow others such as old growth elements to develop

A small quarry is located immediately to the north of the subject site and has not been impacted upon by the development or operation of the Facility.

Natural soil resources within the site have been quarried as part of the initial construction of the Facility and continue to be quarried as part of operational requirements including the provision of cover material for the operation of the land filling component of the Facility.

2.3.10 Visual Characteristics

The vegetation cover provided by the forested land surrounding the Facility and the undulating topography which is present provide adequate screening of the Facility from critical viewing points. These natural features mitigate the visual impacts which the Facility causes.

3.0 STATUTORY ISSUES

3.1 Relevant Legislation

Activities carried out on site must comply with the relevant provisions of all legislation relating to the operation of the Facility. This included but is not limited to the following:

- Protection of the Environment Operations Act 1997
- Soil Conservation Act 1938
- Dangerous Goods Act 1975
- Environmental Restoration and Rehabilitation Act 1990
- Environmentally Hazardous Chemicals Act 1985
- Waste Minimisation and Management Act 1995
- Ozone Protection Act 1989
- Rivers and Foreshores Improvement Act 1948
- Heritage Act 1977
- Water Act 1912
- Bushfire Act 1949

- Native Vegetation Conservation Act 1997
- Threatened Species Conservation Act 1995
- Environmental Planning and Assessment Act 1979
- Fisheries Management Act 1998
- Waste Management Act 2000

The Environment Protection Authority's "Environmental Guidelines; Solid Waste Landfills, 1996" has significant importance in terms of the Waste Minimisation and Management Act 1995, and forms part of the regulatory framework for the operation and management of the Facility.

3.2 Consents and Approvals

An Environmental Impact Statement was prepared for the Cairncross Waste Management Facility by ERM Mitchell McCotter in January 1999. Following preparation and submission of the EIS, Port Macquarie-Hastings Council approved the Cairncross Waste Management Facility under Part V of the Environmental Planning and Assessment Act 1979 on July 26th 1999. In a letter to the Hastings Council General Manager dated 6th September 1999, approval was granted subject to forty three (43) conditions. Conditions relevant to the operation of the facility have been addressed in this OEMP.

Under the Protection of the Environment Operations Act (1997), the Waste Management Facility is listed on Schedule 1 as a Scheduled Activity. The Facility therefore, requires an Environment Protection Licence for its operation. Port Macquarie-Hastings Council has an Environment Protection Licence for the operation of the Facility.

The Council will obtain advice on an ongoing basis with respect to amendments to, or additional legislation that may relate to the operation of the Waste Management Facility.

4.0 TYPES AND QUANTITIES OF WASTE RECEIVED AT THE FACILITY

4.1 Waste Quantities and Composition

4.1.1 Waste Composition

Port Macquarie-Hastings is a part of the Non Regulated Area (NRA) described by the Department of Environment and Climate Change (DECC) in its NSW Waste Avoidance & Resource Recovery Strategy and Performance Report 2006. The report states that 'Proportions across the three waste streams in rural and regional NSW are estimated to be similar to the Hunter, Central Coast and Illawarra regions with the municipal waste stream the dominant stream.' In the Hunter, Central Coast and the Illawarra municipal waste is 43%, commercial and industrial is 24% and construction and demolition is 25% of the total waste stream.

(i) Commercial and Industrial Waste (C & I)

It is difficult to estimate exactly the breakdown using Port Macquarie – Hastings Council weighbridge data, particularly for Commercial and Industrial (C&I) as some smaller commercial premises can choose to use the domestic collection to service their business. Also other materials like paper and cardboard and scrap metal can be removed by a local business for free and therefore is not always weighed over a weighbridge into a facility. For the 2005/2006 financial year, 1648 tonnes of waste was

weighed in specifically as C&I at Cairncross, and 7543 tonnes of green and woody waste was from C&I sources. 857 tonnes of waste material that same year was from Council's commercial waste collection service combined with street litter bin collection.

(ii) Construction and Demolition Waste (C & D)

C&D waste is slightly easier to estimate, as most of this material is received as skip bins and weighed in. For the 2005/2006 financial year 8285.98 tonnes of materials were received from skip bins, and 16,417 tonnes of concrete and scrap metal were received . 17,088 tonnes of concrete and masonry were processed by the contractor (this figure includes additional concrete from the processor, a demolition business).

(iii) Domestic Waste

It is difficult to compare Port Macquarie-Hastings domestic data with the above DECC report as a per capita value cannot be calculated. This is because a proportion of the Port Macquarie-Hastings is rural land and does not receive a waste service. Data calculated per household is listed below.

For the 2005/2006 financial year (calculated *per household receiving a waste service):

- Domestic waste: 424 kilos
- Domestic recycling: 302 kilos
- Domestic organics: 303 kilos

**Note this is kerbside collected domestic material and does not include any away from home waste disposal.*

Figure 5 below provides information as to the composition of the domestic waste collection between 1999 – 2006 inclusive.

Figure 5
Domestic Waste Composition (1999 – 2006)

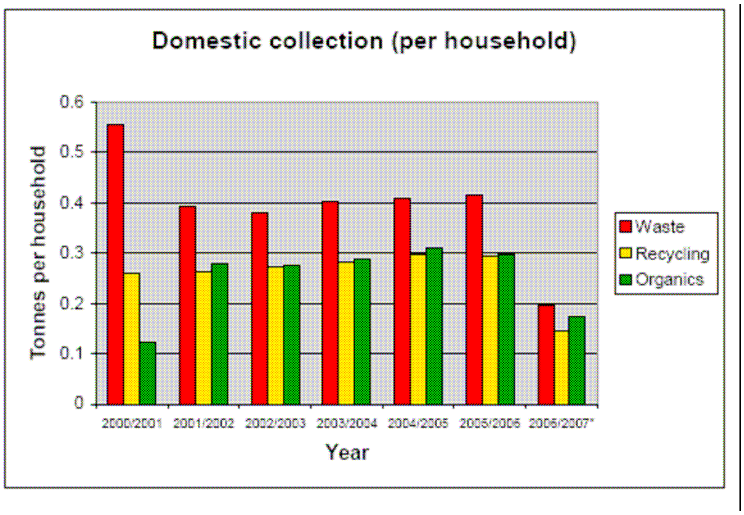


Table 4 below provides details of the volume of wastes disposed of at the Cairncross Facility for the 2007/2008 reporting period.

Table 4
Volumes of Waste Accepted to Facility

ACCEPTED WASTES	2007/2008
Total wastes accepted at Facility (tonnes)	**96994**
Organic wastes diverted for reuse/recycling (tonnes)	**19399**
Recyclables diverted from land filling	**10669**
Other recoverables	**18429**
Wastes land filled (tonnes)	**48497**

4.2 Accepted Wastes

The Facility receives the types of waste approved by the EPA for disposal at a Solid Waste Class 1 landfill. The environmental guidelines for solid waste landfills EPA 1996, defines the waste to be accepted at such landfills as being 'all solid waste including putrescible waste and other wastes approved by the EPA".

Solid waste means any of the types of waste listed below, or any waste otherwise assessed and classified as solid waste in accordance with the EPA guidelines "Assessment and Classification of Liquid and Non Liquid Wastes".

- *Municipal waste, being household domestic waste that is set aside for kerbside collection, other types of domestic waste (eg. Domestic cleanup and residential garden waste),or local council generated waste (eg waste resulting from street sweeping, litter bins and parks.)*
    - *Biosolids categorised as Restricted Use 2 or 3 in accordance with such criteria as may be approved, manure and night soil.*
    - *Waste contaminated with lead from domestic premises and educational/child care centres.*
    - *Cleaned pesticide, biocide, herbicide or fungicide containers.*
    - *Drained and mechanically crushed oil filters, and rags and oil absorbent materials (not containing free liquids) from automotive workshops.*
    - *Nursing Home waste (excluding infectious waste, bulk blood, cytotoxic waste, laboratory chemicals, poisons, recognisable body parts and sharps.*
    - *Food waste generated by businesses involved in the preparation of foods, or from the manufacturing of foods and grocery products.*
    - *Vegetative waste generated from agriculture or horticulture.*
    - *Non chemical waste generated from manufacturing and services (including metal, timber, paper, ceramics, plastics, thermosets and composites).*

Solid waste does not include waste which is classified as 'industrial waste' or hazardous waste' under the EPA Guidelines.

4.3 Excluded Wastes

The following wastes are excluded from landfill disposal at the Cairncross Facility.

- Liquid wastes
- Radioactive wastes
- Any explosive or flammable material including material derived from grease, oil, tar, shale or coal.
- Any sludge or refuse material (unless it can be shown to be harmless) from any:
    - Tanning or leather processing plant
    - Petroleum or petrochemical plant
    - Chemical plant

  - Paint manufacturing plant
  - Metal treatment plant
  - Vegetable oil or mineral oil plant
  - Pharmaceutical or drug manufacturing plant.
- Any material containing arsenic, cadmium, cyanide, lead, mercury, selenium and sulphide
- Any toxic inorganic material, including an soluable salt of barium, boron, chromium manganese, silver or zinc
- Any toxic organic material, including any pesticide or herbicide, in particular any containing:
  - Chlorinated Hydrocarbons
  - Fluorinated Hydrocarbons
  - Organophosphates
  - Organochlorines
  - Carbamates or thiocarbamates and Phenols
- Any soluble acid or alkali or acidic or basic compound, unless it can be shown that it may be beneficial.
- Clinical wastes
- Contaminated wastes
- Cytotoxic wastes
- Hazardous wastes

5.0 ENVIRONMENTAL MANAGEMENT

5.1 Potential Environmental Impacts

There are a number of environmental issues which were identified through the environmental assessment of the Facility that require careful management. These include the following:

- Potential impacts to groundwater through leaching of water percolating through the landfill
- Surface water quality impacts due to site
- Noise from traffic travelling to and from the facility as well as operational noise
- Gaseous emissions (particularly methane and possible hydrogen sulphide)
- Odour from decomposing waste
- Inappropriate waste disposal at the facility
- Dust emissions due to hot, dry and windy conditions, particularly during covering of waste
- Weed proliferation on the site and adjacent areas
- Feral species infestation (eg rats, foxes etc)
- Traffic impacts to local roads.

In order to minimise these potential impacts, a range of mitigative measures have been implemented and are proposed. These mitigative measures are detailed in this section.

5.2 Environmental Goals and Benchmark Techniques

The EPA Guidelines “Solid Waste Landfills” prescribe a number of Environmental Goals aimed at protecting the environment from the impacts associated with Landfills. The Environmental Goals (EG’s) described in this section provide the basis for performance based environmental management and regulation of landfills. The EPA guidelines also prescribed specific environmental benchmark techniques (BT’s) which provide guidance on how to achieve those goals. Where appropriate the application of BT’s has been extended to include other areas of the site. In addition best management

practice techniques have been identified to address environmental management issues not identified in the EPA guidelines.

This section of the OEMP includes management strategies, procedures and mitigative measures aimed at achieving identified Environmental Goals.

Specific actions arising from the benchmark techniques and best management practices have been addressed through an Environmental Management Action Plan (Section 7). This plan draws out specific actions for environmental management and defines responsibility, timing and actions to be undertaken to achieve the environmental goal.

The reporting structure adopted in this section is consistent with that provided in the EPA guidelines.

5.2.1 Preventing Water Pollution by Leachate (EG1)

This environmental goal aims to prevent the pollution of local ground and surface water from leachate originating from the site. Mitigative measures include the installation of a leachate barrier and collection system, surface water controls and water quality monitoring.

Leachate Barrier System (BT1)

A leachate barrier system has been installed at the site in conjunction with the development of the existing landfill footprint. This system will minimise the migration of leachate into the groundwater, soil and substrata. The leachate barrier system will be extended to other areas as they become required for landfilling.

The barrier installed at the Cairncross landfill consists of a re-compacted clay layer which is 900mm thick. Clay for the liner with permeability ranging between 1.3×10^{-6} and 7.77×10^{-11} metres per second has been extracted from around the site. Further compaction and testing of the clay layer has been undertaken to ensure that the permeability is less than 10^{-9} metres per second.

The detailed engineering analysis of the site indicated that a flexible membrane liner would not be required.

The leachate barrier system will be extended as required for future stages of the land filling area.

Leachate Collection System (BT2)

Over the top of the clay liner, is a series of 200mm diameter drainage lines covered with 80mm plus aggregate, that provides both protection to the pipeline and acts as a drainage medium layer of 20-50mm aggregate has been installed.

Leachate is collected into temporary dry wells and pumped back into the upper reaches of the landfill. The leachate being pumped directly into a number pits which are formed in the crown of the landfill mass.

The deleaching wells include submersible pumps, (main pump and emergency pump), which are set to operate automatically using a 'float switch'. An emergency leachate overflow dam capable of holding 7 days of leachate has been constructed downstream of the central leachate wells. The dam is to be kept empty by pumping to the dry wells, (if leachate), or to the environment, (if clean rainwater).

Details of the leachate collection system, for Stage 1, are shown in Appendix 1. The final leachate collection system is shown in Appendix 2.

Essentially the entire leachate interception, collection and recirculation system is located underground; beneath the clayey soil cover such that all surface water is diverted off the landfill and off-site.

As with the leachate barrier system the leachate collection system will be progressively extended to other areas as they become required for land filling.

Any hazardous materials used in the day to day operation of the site are to be stored in a bunded area away from drainage lines. Material Safety Data Sheets will be retained onsite for such materials where they are required to be stored onsite. The storage and management of hazardous materials being in accordance with Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP H1).

Surface Water Controls (BT3)

The initial site selection, within the head of a catchment, has ensured that necessary surface drainage control will be limited to the operational area of the landfill and a small lateral catchment area immediately adjoining the landfill.
All workings on the site will be undertaken according to the following principles for surface water management;

- Minimize the extent of disturbed areas.
- Divert clean runoff around disturbed areas.
- Collect rain water runoff from disturbed areas and direct to settling basins sized to contain runoff from a six hour duration, once in a ten year, storm.
- Where possible shape the final landform to drain runoff around the contour slopes rather than directly down gradient.

The landform of the landfill will be shaped to direct surface water runoff to a series of drains located at the toe of the landfill. These drains gravitate to a series of silt trap/water quality ponds. As the landfill is progressively filled, the location and number of these drains and pits will be moved to accommodate new landfill areas. Appendices 3 to 7 inclusive indicate the locations of the surface water management infrastructure which is required for new areas of the landfill and upon completion of land filling activities. Surface water which percolates through the landfill will be collected by the leachate collection system (refer to BT2).

To minimise erosion of the landfill, completed areas of the landfill will be revegetated as soon as practicable. Hydro-seeding or hydro-mulching will be applied to the landfill surface to minimise the effects of erosion.

A number of sediment/water quality control basins/dams have been provided downstream of other usage areas of the site, (green waste stockpiling and waste storage areas). Contaminated surface water generated from these areas is conveyed to these structures where it is held before being pumped back and irrigated onto vegetated areas of the Facility for disposal via infiltration/evapotranspiration. This approach also provides for reuse opportunities for dust suppression. No collected water from the surface water management infrastructure will be discharged to the natural surface water collection system unless it complies with Environment Protection Authorities discharge standards and requirements.

It is also noted that the disposal of treated wastewater from onsite sewage management systems servicing the site is handled in a similar manner with treated wastewater from the system being spray irrigated onto designated vegetated disposal areas.

Where necessary additional erosion and sediment controls such as sediment basins and sediment barrier fencing have be utilized to manage sediment ladened water migrating from the disturbed areas of the Facility including hardstand and waste storage and processing areas.

Further details are provided in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP 01 and I1).

An oil and grease separation unit has been incorporated into the design and operation of the vehicle wash down facility which has been constructed adjacent to the Facility Plant shed. The oil and grease separation facility will be inspected every 3 months with maintenance of the unit provided as required. Additionally the design and operation of the wash down bay is to provide for the minimization of stormwater treatment by the oil and grease separation unit.

Leachate Monitoring Progam (BT8)

Initial testing of leachate water quality characteristics has been undertaken at the leachate collection dam for the following elements;

Table 5
Leachate Monitoring Parameters

Contaminant	Test Method
Poly Aromatic Hydrocarbons	USEPA 8270
Volatile Organic Compounds	USEPA 8260
Volatile Halogenated Compounds	USEPA 8021
Phenols	USEPA 8270

The results of the testing have been forwarded to the EPA.

Additional sampling and characterization of leachate is undertaken on the site in conjunction with groundwater and surface water quality monitoring program, refer to Figure 6.

Methods of disposal of excess leachate water with appropriate leachate water quality criteria would be agreed to with the EPA prior to operation.

Leachate sampling shall be undertaken in accordance with the procedure for Leachate Monitoring which is contained in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP L1).

5.2.2 Detecting Water Pollution (EG2)

The objective of this environment goal is to establish a network of surface and groundwater monitoring sites to enable analysis and assessment of water quality impacts from site activities.

Groundwater Monitoring Network (BT4)

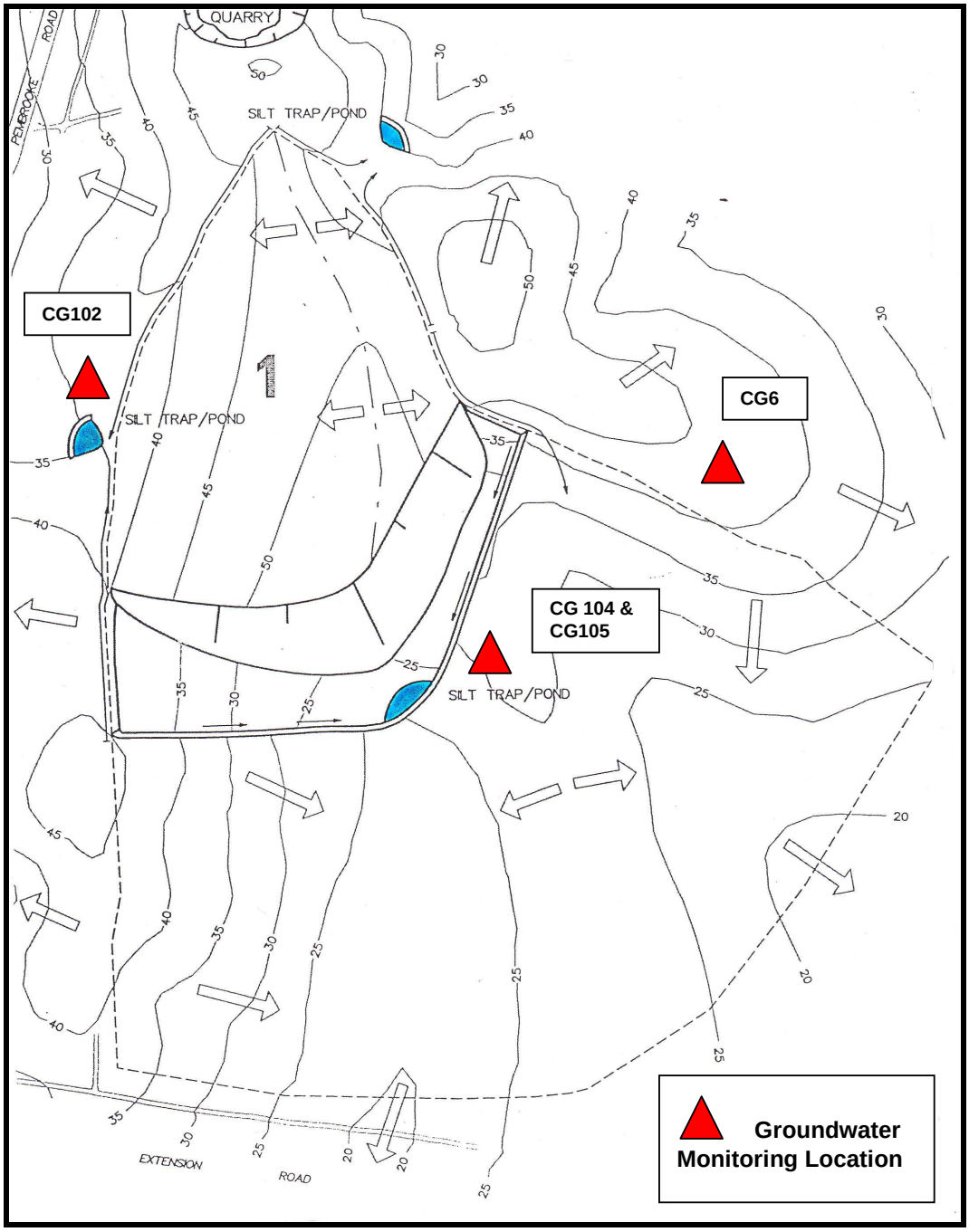
A series of boreholes have previously been installed at the site. The existing groundwater monitoring network is shown in Figure 6.

Groundwater monitoring bores consist of slotted 50mm PVC at the base of the well with a graded sand filter and a bentonite seal installed at the top of the slotted section. The remainder of the wells are constructed from unslotted PVC with a concrete plug at the ground surface. A security cover and end cap has been placed over the top of each well to ensure security.

The existing monitoring network will be applicable for Stage 1. Additional monitoring bores may be required for stages 2-5. Additional monitoring locations will need to be established for future stages of the land filling operation.

Future monitoring locations will be identified and established as part of the formalization of the filling plans for future stages of the landfill and as part of the ongoing review of this OEMP.

Figure 6
Ground Water Monitoring Wells (Stage 1)



Groundwater Monitoring Program (BT5)

Groundwater monitoring will be undertaken at all groundwater monitoring locations as indicated in Figure 6. The sampling frequency will be quarterly. The sampling frequency, analytes to be tested for and monitoring locations will be reviewed every five years of operation.

Current minimum groundwater parameters and detection limits are identified in Table 6.

Table 6
Groundwater Monitoring Parameters

Chemical or Property	Required Detection Limit (RDL) µg/l
Absorbable organic halogens (AOX)	10
Alkalinity	1000
Ammonia	50
Calcium	5000
Chloride	5000
Fluoride	500
Iron	300
Magnesium	5000
Manganese	50
Nitrate	100
pH	0.1 pH unit
Total phenolics	50
Potassium	5000
Sodium	5000
Sulphate	5000
Total Organic Carbon	50

Groundwater sampling shall be undertaken in accordance with the Groundwater Quality Monitoring Standard Operating Procedure which is contained in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP G1).

Groundwater Assessment Program (BT6)

Groundwater quality criteria have been agreed to with the EPA. If these criteria are exceeded, the following actions will be taken:

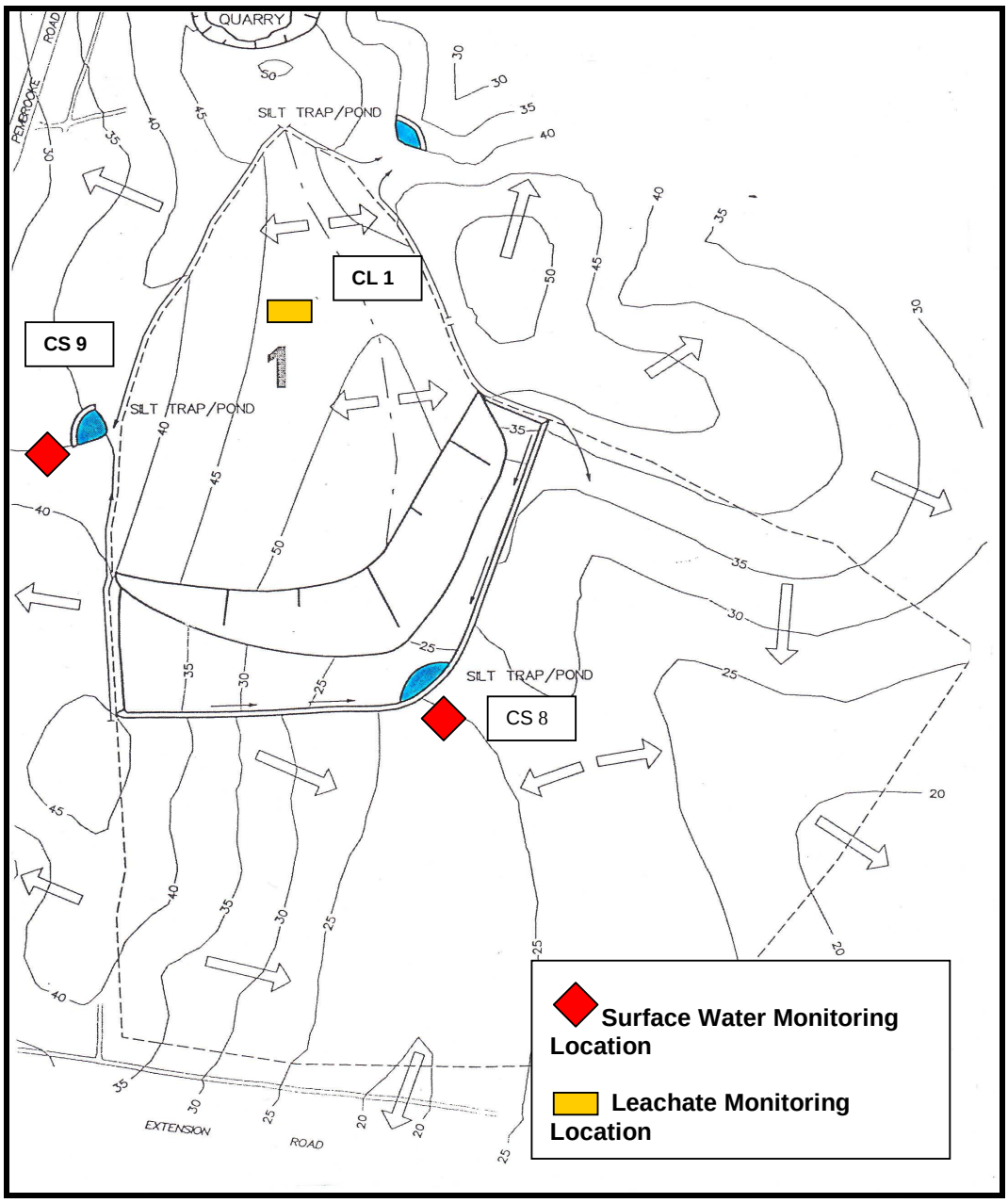
- The affected sampling location and indicator parameters will be resampled and analysed as soon as possible to verify the exceedance.
- If resampling indicates that there is still a breach, the EPA will be notified as soon as practicable by telephone and in writing 14 days of verification of the breach.
- A groundwater assessment plan will be prepared within 28 days of notification to assess the extent of groundwater pollution. The Plan will identify the specific contaminants and the nature and extent of the pollution. The plan will also detail a monitoring listing analytes and location of sample points.
- If the ground water assessment plan confirms pollution of groundwater, a Groundwater Contamination Remediation Plan will be prepared in accordance with BT9.

Surface Water Monitoring (BT7)

The surface water monitoring program will assay the contaminants indicated in Table 6 as well as suspended solids. Sampling will be undertaken on a quarterly basis when surface water is present.

The locations for surface water quality monitoring are shown in Figure 7. Details of the methodology for Surface Water Monitoring are found in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP S1).

Figure 7
Surface Water Quality Monitoring Locations



Additional monitoring locations may be required for stages 2-5. Additional monitoring locations will need to be established for future stages of the land filling operation.

Future monitoring locations will be identified and established as part of the formalization of the filling plans for future stages of the landfill and as part of the ongoing review of this OEMP.

5.2.3 Remediating Water Pollution (EG3)

This environmental goal is aimed at providing a procedure to ensure appropriate actions are taken to mitigate the effects of water pollution should contamination be detected in the ground or surface water.

Water Contamination Remediation Plan (BT9)

A groundwater remediation plan will be developed if contamination is confirmed via groundwater assessment plan (refer BT6). The plan will detail the process to return the groundwater to its original quality down the hydraulic gradient from the site and will describe the process to protect the groundwater resource from future contamination. The groundwater remediation plan should be prepared and implemented as soon as possible after detection of the breach.

If surface water pollution is detected, the surface water remediation procedure will include the following actions:

- Take immediate action to contain any known breach as far as practicable.
- Report to be prepared and submitted to the EPA detailing the nature and source of contamination, any actions taken and future actions that will be carried out to prevent recurrence.
- Implementation of future actions on approval from the EPA.

5.2.4 Preventing Landfill Gas Emissions (EG4)

This environmental goal is aimed to ensuring the safe release of gases due to the decomposition of waste and to ensure that fires do not break out as a result of gaseous emissions.

Landfill Gas Containment System (BT10)

A Landfill Gas Containment System *(BT10)* consisting of Benchmark Techniques (1), (28) and (33) is not currently employed at the Facility.

Controls for gas emissions throughout the site will be initially limited to a network of gas monitoring wells. The gas monitoring wells provide a sampling location for detection and measurement of gas qualities generated within the landfill. The locations of gas monitoring wells are the same as the groundwater monitoring wells and are shown in Figure 4.

Extraction and Disposal of Landfill Gas (BT11)

The proposed method of managing gas emissions at the site is through passive release. There are a number of alternatives including deep well gas extraction systems and reuse of gas as an alternative energy supply.

The need for and use of alternative management methods will be considered through the ongoing review of this management plan.

Fire Prevention (BT12)

Fires will be prevented at the site through the following measures:

- Clear signs will be displayed at the site entrance to notify the public that flammable liquids are not permitted on the site.
- Upon entering the site, loads will be inspected to ensure flammable liquids are not allowed on site.
- Combustible materials including tyres, wood and vegetation will be divided into small piles to ensure any burning material can be kept away from other fuels.
- Waste will be covered on a daily basis to prevent the occurrence of fire.
- Burning off will not be permitted at the facility.
- Implementation of the Bushfire and Fuel Management Plan which has been developed for the site, refer to Appendix 8.

- Stockpiles of green waste will be regularly processed so as to reduce the possibility of spontaneous combustion due to decomposition processes.
- Processed green waste (mulch) is to be divided into small piles to minimize the risk of spontaneous combustion due to decomposition processes. Stockpiles will be regularly inspected and the temperature of the piles monitored. Where necessary mulch stockpiles are to be provided with aeration in order to reduce pile temperatures.

Controlled Burning (BT13)

There will be no controlled burning undertaken at the site.

Site Closure (BT14)

Refer to BT 28 – Site Capping and Revegetation.

5.2.5 Detecting Landfill Gas Emissions (EG5)

This environmental goal aims to ensure a rigorous gas monitoring is implemented to detect off site gaseous emissions, particularly of methane.

Subsurface Gas Monitoring Devices (BT15)

Subsurface gas monitoring devices will be installed in the groundwater monitoring wells as shown in Figure 6. The devices will consist of individual slotted probes with bentonite seals between monitoring zones. The monitoring zones are backfilled with pea gravel to facilitate the movement of gas.

Subsurface Gas Monitoring Program (BT16)

Subsurface monitoring will be undertaken on a quarterly basis at the gas monitoring wells. Detection of methane above 1.25% volume/volume (v/v) will require notification to the EPA within 24 hours. If this concentration is detected, the frequency of monitoring will also be increased (as agreed with the EPA).

During operation, if odours present a concern (rotten egg gas), hydrogen sulphide gas may also need to be measured. This testing would be undertaken in-situ with a properly maintained, calibrated and zeroed field instrument. Appropriate H_2S criteria will be agreed with the EPA.

Surface Gas Emissions Monitoring (BT17)

Surface gas monitoring will be undertaken on a monthly basis five centimetres above the intermediate or final cover over locations where waste has been placed.

The procedure will involve measurement at a point 5m from the site perimeter with samples undertaken at 25m intervals across the entire filled area. This monitoring will be conducted on calm days with wind speeds below 10km/hour.

Depressions in the cover materials or surface fissures away from the sampling grid will also be tested for gaseous emissions. Gas accumulation monitoring will also be undertaken within structures within 250 metres of deposited waste.

The threshold concentration for closer investigation is 500 parts per million (v/v) of methane at any point on the landfill surface.

Corrective action will be necessary if this concentration is exceeded. Corrective action may include repairing or replacing the cover material or installation of gas extraction equipment.

5.2.6 Remediating Landfill Gas Emissions (EG6)

This environmental goal is aimed at providing a procedure to ensure appropriate actions are taken to remediate the effects of uncontrolled gas emissions, particularly methane.

Remediation of Uncontrolled Landfill Gas Emissions (BT19)

If methane concentrations greater than 1.25% (v/v) are detected by the surface, subsurface or building, a written assessment of the emissions and management controls implemented will be forwarded to the EPA within 14 days after the incident. Controls may include repair/replacement of cover material or installation of gas extraction equipment.

5.2.7 Assuring Quality of Design, Construction and Operation (EG7)

This environmental goal is aimed at ensuring the construction of the landfill is undertaken in accordance with Quality Assurance Systems and Procedures.

Assurance of Quality (BT20)

Stage 1 of the facility has been designed and constructed in accordance with rigorous quality systems and procedures.

Development of further landfill areas will be in accordance with similar industry recognised quality standards, (eg ISO 9001).

Port Macquarie-Hastings Council intends to implement an Environmental Management System for its whole operations in accordance with ISO 14001, which is the international standard for Environmental Management Systems.

5.2.8 Assuring Quality of Incoming Waste (EG8)

This environmental goal is aimed at providing a procedure to ensure that only the waste types which are permitted to be disposed of at the landfill are accepted and that all other waste is rejected.

Screening of Waste Received (BT21)

To ensure only 'acceptable wastes' are permitted to be disposed of at the facility, the following procedure will be followed:

- Signs will be displayed at the point of entry which clearly indicates the type of waste that is to be accepted and not accepted.
- All incoming loads will be inspected by Facility staff prior to acceptance to the site. A detailed Methodology for screening waste is described in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP S3).
- The EPA will be notified of any incident where hazardous wastes have been found on the site. Parties responsible for dumping hazardous wastes will be reported to the EPA.
- Soil waste will only be accepted if it has been classified in accordance with the EPA guidelines. "Assessment and Classification of Liquid and Non Liquid Waste".

Contaminated soil must be accompanies by a consultant's report which states the classification of the soil. Only soil classified as 'solid' or 'inert' is permissible at the facility. Soil classified as "hazardous" or "industrial" is not permitted at the facility.

- Selected loads will be diverted to an area for close inspection. The load will be dumped and inspected for unapproved wastes. The frequency of this will be at the discretion of the Site Supervisor.
- Any incident involving exclusion or detailed inspection is to be entered in the incident register with supporting documentation.

Accepted Wastes

The landfill will receive the types of waste approved by the EPA for disposal at a Solid Waste Class 1 landfill. The environmental guidelines for solid waste landfills EPA 1996, defines the waste to be accepted at such landfills as being 'all solid waste including putrescible waste and other wastes approved by the EPA".

Solid waste means any of the types of waste listed below, or any waste otherwise assessed and classified as solid waste in accordance with the EPA guidelines "Assessment and Classification of Liquid and Non Liquid Wastes".

- *Municipal waste, being household domestic waste that is set aside for kerbside collection, other types of domestic waste (eg. Domestic cleanup and residential garden waste),or local council generated waste (eg waste resulting from street sweeping, litter bins and parks.)*
    - *Biosolids categorised as Restricted Use 2 or 3 in accordance with such criteria as may be approved, manure and night soil.*
    - *Waste contaminated with lead from domestic premises and educational/child care centres.*
    - *Cleaned pesticide, biocide, herbicide or fungicide containers.*
    - *Drained and mechanically crushed oil filters, and rags and oil absorbent materials (not containing free liquids) from automotive workshops.*
    - *Nursing Home waste (excluding infectious waste, bulk blood, cytotoxic waste, laboratory chemicals, poisons, recognisable body parts and sharps.*
    - *Food waste generated by businesses involved in the preparation of foods, or from the manufacturing of foods and grocery products.*
    - *Vegetative waste generated from agriculture or horticulture.*
    - *Non chemical waste generated from manufacturing and services (including metal, timber, paper, ceramics, plastics, thermosets and composites).*

Solid waste does not include waste which is classified as 'industrial waste' or hazardous waste' under the EPA Guidelines.

Excluded Wastes

The following wastes are excluded from disposal at the Facility.

- Liquid wastes
- Radioactive wastes
- Any explosive or flammable material including material derived from grease, oil, tar, shale or coal.
- Any sludge or refuse material (unless it can be shown to be harmless) from any:
    - Tanning or leather processing plant
    - Petroleum or petrochemical plant
    - Chemical plant

  - Paint manufacturing plant
  - Metal treatment plant
  - Vegetable oil or mineral oil plant
  - Pharmaceutical or drug manufacturing plant.
- Any material containing arsenic, cadmium, cyanide, lead, mercury, selenium and sulphide
- Any toxic inorganic material, including an soluable salt of barium, boron, chromium manganese, silver or zinc
- Any toxic organic material, including any pesticide or herbicide, in particular any containing:
  - Chlorinated Hydrocarbons
  - Fluorinated Hydrocarbons
  - Organophosphates
  - Organochlorines
  - Carbamates or thiocarbamates and Phenols
- Any soluble acid or alkali or acidic or basic compound, unless it can be shown that it may be beneficial.
- Clinical wastes
- Contaminated wastes
- Cytotoxic wastes
- Hazardous wastes

5.2.9 Recording of Waste Received (EG9)

This environmental goal aims to create a procedure to measure and record the types and quantities of waste received. This data will provide input to reports required by the EPA.

Measurement of Quantities of Waste Received (BT22)

To accurately measure the qualities of waste received at the facility, the following measures will be implemented.

- Weighbridges for incoming and outgoing vehicles have been installed.
- The weighbridges will have a valid calibration certificate from the Department of Consumer Affairs at all times. This will be kept on the premises.
- The weighbridges will be operational at all times. If, at any time, the weighbridges should cease operation, the EPA will be notified immediately and the weighbridges repaired immediately.
- If the weighbridges become inoperable vehicles will be assessed in accordance with the vehicle factors in Appendix D of the EPA Environmental Guidelines “Solid Waste Landfills”.
- A report on the quantity of waste will be lodged with the EPA every 12 months.

Recording of the Quantities, Types and Sources of Waste Received (BT23)

Each month, data will be provided to the EPA regarding the amount, type and source of waste according to the National Waste Classification System. The report will be submitted in accordance with the EPA reporting form in Appendix D of the EPA document “Environmental Guidelines: Solid Waste Landfills”.

Each twelve months, a survey of the site will be undertaken by a registered surveyor to confirm the volume of landfill space consumed in the previous twelve months. This report will be submitted to the EPA to demonstrate that the qualities of waste recorded by the weighbridge (for the twelve month period) are the same as those committed to the landfill.

The details of all vehicles entering and exiting the site will be permanently recorded.

5.2.10 Minimising Landfill Space Used (EG10)

The aim of this environmental goal is to ensure procedures for compaction of waste and filling is undertaken in a systematic manner.

Compaction of Waste (BT24)

As the landfill is likely to receive over 50,000 tonnes of waste per annum, the appropriate waste compaction goal is 850kg/m³. If the landfill were to receive less than 50,000 tonnes of waste per annum, the appropriate waste compaction goal would be 650 kg/m³.

On an annual basis, a survey of the landfill will be undertaken to determine the actual compaction rate. This information will be forwarded to the EPA with the annual report.

Filling Plan/Contours (BT27)

A filling plan has been prepared for the site and is included in Appendices 3 to 6 inclusive. The final landfill landform is also provided in Appendix 7. The filling plan is to be updated annually and submitted to the EPA with the annual report.

5.2.11 Maximisation of Recycling (EG11)

The environmental goal aims to minimise the amount of waste sent to the landfill through the implementation of a waste recycling and reuse programs.

Recycling (BT25)

Port Macquarie-Hastings Council has an existing kerbside recycling collection service. All residents are provided with a recycling bin which is collected every second week in conjunction with the domestic weekly waste collection service.

This service provides for the collection of recyclable products including:

- Paper and cardboard
- Plastic containers (PET and HDPE Plastics)
- Aluminium/steel cans
- Aerosol cans
- Gas bottles and jars

Collected recyclables are processed by Council's contractor at the Cairncross Materials Recovery Facility. The marketing of the processed recyclables is carried out by Council's contractor. The principle markets for these recyclable materials are in Sydney and Wollongong.

Waste which is not acceptable is segregated and disposed of appropriately. Material which may be accepted at the facility is placed in accordance with the filling plan. Material which is not acceptable at the landfill will be rejected to the person delivering the material to the facility for disposal at their cost.

Additionally all green wastes collected as part of the existing kerbside recycling collection service, (collected every week in conjunction with the domestic weekly waste collection service), is processed together with other materials such as sewerage sludge in a organics processing facility to create compost which is solid commercially by the operator of the Facility.

The following waste reuse and recycling activities are also actively provided for at the Cairncross Waste Management Facility;

- Scrap metal (ferrous and non ferrous)
- Green waste
- Paper and Cardboard
- Glass
- Waste engine oils/Cooking oils and fats
- Batteries (car, truck, boat etc)
- Gas bottles
- Tyres
- Inert materials (concrete, bricks, soils)

The operation of the Materials Recovery and Organics Processing Facilities is subject to compliance with specific Environmental Management Plans for these activities.

In this regard copies of the compliance inspection and auditing reports which are applicable to the operation of these Facilities are required to be provided to Port Macquarie-Hastings Council.

In addition a biannual environmental management audit is to be undertaken of the entire Cairncross Facility with representatives of each service provider present on the site. This will assist in providing an integrated approach to site environmental management.

5.2.12 Remediating Landfill after Closure (EG12)

The aim of this environmental goal is to ensure adequate resources and plans are available to ensure the long term safety of the landfill following closure. This includes adequate financial resources, engineered capping layer and an ongoing environmental monitoring program to ensure the effectiveness of permanent environmental controls.

Financial Assurance (BT26)

The Financial Assurance Benchmark Technique is addressed through the provision of funding from Council's Waste Management Reserve Fund.

Financial resources are available for emergency actions, monitoring, closure and post closure activities. The reserve funding available for use at Council's landfill sites, if necessary, is considered adequate to ensure for any emergency closure and associated activities.

Site Capping and Revegetation (BT28)

The final landform will meet the following specification which has been approved by the EPA:

- Capping will commence within 30 days of completion of land filling in the area.
- The final capping layer will comprise the following parts:
    - placement of a 300mm layer of compacted clay which is tested for permeability.
    - where the permeability of the first layer is adequate a further 300 mm layer of compacted clay is provided. Again the permeability characteristics of the capping layer is tested.

- Where the permeability characteristics of the clay layers are shown to be unsuitable as a result of testing additional clay layers are applied until the required permeability specification has been achieved
- Where the clay capping meets specification then a 300mm layer of revegetation material is place over the capped area and seeded.

- To minimise scouring and erosion, the final settlement of the seal bearing surface will have a gradient of greater than 5% to defined drainage points.

- Clay layers are to have a permeability less than $K = 10^{-8} ms^{1}$.

- If the sealing layer is left for a period exceeding seven days before being covered by the vegetation layer, it should be covered by a flexible membrane.

Landfill Closure and Post Closure Monitoring and Maintenance (BT29)

Three months prior to the completion of the Facility's waste operations, Port Macquarie-Hastings Council will submit to the EPA a written closure plan. The aim of this plan will be to ensure that the landfill continues to be non-polluting and does not cause environmental harm after closure.

Specifically, the plan will:

- State the steps in closing and stabilising the premises
- Ensure all leachate collection, gas collection and stormwater sediment controls, monitoring and reporting practices are maintained.
- Ensure that neighbouring residents are advised of contact persons to discuss any problems (eg odour emissions).

5.2.13 Preventing Unauthorised Entry (EG13)

The environmental goal aims to ensure that unauthorised persons do not enter the site to dump rubbish, vandalise the site or steal equipment or goods located at the site.

Security of the Site (BT30)

To ensure security of the site, a 2.1m high wire mesh and barbed wire perimeter fence has been installed with lockable gates. This will ensure that unauthorised dumping of rubbish and trespassing on the site does not occur.

The ongoing integrity of the perimeter fence will be checked on a weekly basis.

5.2.14 Preventing Degradation of Local Amenity (EG14)

Potential impacts to the local amenity include deposition of site litter, wind blown dust, dirt and mud deposited from trucks and cars, odour from decomposing waste and the proliferation of weeds and vermin.

Litter Control (BT31)

To minimise the potential migration, (off site), of litter, the following measures have been or will be implemented:

- Waste will be compacted and covered on a daily basis.
- Litter/security fences have been installed around the perimeter of the site.
- Daily inspection of the litter fences and clearing as required.
- Signage will be placed at the entry/exit points to advise the customers that if they drop or transport waste in an inappropriate fashion, they will be liable for prosecution.

Cleaning of Vehicles (BT32)

In order to minimise litter, sediment and mud from leaving the site, a wheel wash facility has been installed to enable vehicles to clean their wheels down prior to departure.

The standard of construction and maintenance of the internal access roads are such that the opportunities for the offsite tracking of soils and litter are minimized. Where necessary any accumulations of materials on the internal bitumen road system are to be removed where required manually.

Additionally the location and operation of the tipping area is to be visually monitored during wet weather events so as to ensure that the accumulation of materials on vehicles is minimized.

Signs will be displayed at key locations advising customers of the need to pass through the wheel wash prior to departing the site.

Signage is provided at the gatehouse and access road to advise customers of their responsibilities with respect to ensuring that the remnants of their load and material stuck to vehicles does not litter public roads.

Daily Covering of Waste (BT33)

Waste will be tipped in a defined filling area which may vary from day to day. Staff will restrict the tipping face to approximately 20 metres in length, depending on the level of demand.

Daily cover will be at least 150mm. All wastes should be covered prior to ceasing operations at the end of the day.

An intermediate cover of 300mm will be applied to surfaces which will be exposed for a period of 90 days or more.

Cover material will be sourced from excess excavated material from landfill cells.

A detailed methodology for the covering of waste is provided in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP C2).

Dust Controls (BT34)

To minimise the emissions of dust, the following measures will be implemented:

- Water sprays and water carts will be available, when required, to minimise dust emissions during hot, dry or windy conditions.
- Mulching and revegetation of exposed areas is carried out to minimize the potential for dust creation.
- A sealed bitumen road is present from the gate house towards the active landfill area.

- Where necessary accumulation of materials on the internal bitumen road leading to and from the gatehouse towards the active landfill area are to be removed manually.
- Visual assessment of dust generation by Facility personnel.

Given the location of the Facility, the prevailing winds and the nature of surrounding land uses, the creation of dust nuisances is unlikely.

Formal dust monitoring will not be undertaken on the site as it is considered that such monitoring is unjustified.

Should complaints be received dust monitoring of the Facility is to be undertaken to assess the impact of dust on Facility occupants/users and adjoining and adjacent areas.

Dust complaints are to be recorded so that they can be correlated with climatic conditions and management practices on the site.

Pest/Vermin and Noxious Weed Controls (BT35)

Typical weeds in the vicinity of the site include Lantana, Crofton Weed, Wild Tobacco Tree and Whisky Grass. Common pests and vermin include the black rat, feral cats and foxes.
To minimise/eliminate the presence of pests, vermin and weeds, the following measures have been implemented:

- Waste will be compacted and covered on a daily basis to keep the amount of exposed waste to a minimum.
- A security fence has been installed around the site to prevent the entry of larger pests.
- The landfill (final contours), has been designed to ensure surfaces are adequately drained to prevent pondage of water which may promote weed growth.
- Trapping of feral animals when required.
- Baiting of flies during the summer months.
- A range of techniques to eradicate weeds include chemical spraying and removal of weeds by mechanical means (eg by hand).

If noxious weeds become a problem at the site, a weed management plan will be implemented. A range of techniques to eradicate weeds include chemical spraying and removal of weeds by mechanical means (eg by hand).

If chemical means are implemented, all personnel undertaking the treatment work would be trained in the handling and use of herbicides. Visual monitoring would determine the effectiveness of the weed eradication program.

It is also noted that the development consent for the establishment and operation of the Facility requires the implementation of management measures specific for the compensatory habitat area of the site. These measures relate to pest and noxious weed monitoring and management.

A proactive pest and noxious weeds management plan is required to be developed for the Facility including the compensatory habitat area of the site.

Odour Control (BT36)

To minimise odour impacts of the Facility operations, the following measures will be employed:

- Biosolids will be incorporated into the existing composting process on the day it is delivered or as soon as possible after it is received.

- Good housekeeping practices including prompt compaction and covering of the incoming waste.
- Informal odour assessment by Facility personnel.
- Inspection of green waste stockpiles with corrective action to be initiated where any anaerobic storage conditions are encountered.
- Regular maintenance of onsite sewage management systems.
- Regular reuse of water from water quality control ponds so as to reduce the potential for the creation of anaerobic storage conditions.
- Use of proprietary bacterial odour control agent injected into the leachate return line

Odour complaints are to be recorded so that they can be correlated with climatic conditions and management practices on the site.

5.2.15 Preventing Noise Pollution (EG15)

Potential noise impacts from the operation of the site include vehicles travelling to and from the site, operation of excavators, plant and machinery and operation of waste processing facilities.
Preventing Noise Pollution (BT37)

The EPA noise criteria for the site (when measured at the nearest receptor) are as follows:

Table 7
Operational Noise Criteria

Noise Receptor	Location	EPA Noise Criteria – Operation (LA10)dB(A)	EPA Noise Criteria Traffic (LAeq,1hr)dB(A)
Rocking Horse Farm	Approximately 1500m south west of site	40	55
Residences near Pacific Highway (Gougeville)	Approximately 1800m north east of site	41	60

The nearest residence (Rocking Horse Farm) is located approximately 1500m to the south west of the site. This distance, topography and the vegetation screening provides a natural attenuation of noise.

Noise impacts from the operation of the facility are not expected to breach EPA criteria.

In this regard the original noise assessment prepared for the operation of the facility recommended that all equipment be fitted with residential class mufflers.

The proper maintenance of equipment operating on the site and the operating hours of the Facility are measures which assist in reducing the impact of the operation of the Facility on the acoustic environment of the locality.

Should complaints be received noise monitoring of the Facility is to be undertaken to assess the impact of the noise.

Noise complaints are to be recorded so that they can be correlated with the use of equipment on the site and climatic conditions.

5.2.16 Adequate Fire Fighting Capacity (EG16)

This environmental goal aims to ensure that the site is equipped with adequate fire fighting capacity to respond to and extinguish fires. This goal should be read in conjunction with EG 4.

Fire Fighting Capacity (BT38)

Fire Prevention

The prevention of fire is covered under Benchmark Techniques 12 and 13.

Minor Fires

Fires occurring on site within operating hours that may be extinguished using site resources will be controlled using the following procedure:

- NSW Fire Brigade/Rural Fire Service is to be notified of the fire (by dialling 000 and asking for "fire) and nominating proposed actions to extinguish the fire.
- Surface landfill fires will be extinguished using water and or earth.
- Underground landfill fires may be extinguished by isolating the fire, excavating a trench around the burning area, digging out the burning refuse and extinguishing with water or earth (clean fill).
- Major fires which are off site and/or cannot be extinguished using available resources will be fought under the direction of the NSW Fire Brigade and NSW Rural Bushfire Service.

Major Fires

Major fires are those which cannot be controlled with site resources or have extended beyond the site boundary. In this event, the following procedure will be implemented.

- The NSW Fire Brigade/Rural Fire Service will be immediately notified by contacting 000 (and asking for 'Fire'). Details to be provided to the fire brigade/fire service will include site address, size/extent of fire (onsite or offsite) and type of fire (eg burning rubber, fuel etc), and contact details of relevant site personnel.
- All Facility personnel are required to cooperate with the Fire Brigade and Rural Fire Service when fighting fires at the site. All on site equipment including plant and machinery will be made available for fire fighting.
- When required, personnel evacuate the Facility in accordance with the Emergency Response Procedure which can be found in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP E1).

For fires at the site occurring outside normal operating hours, the Site Supervisor is to immediately notify the NSW Fire Brigade/Rural Fire Service to attend the site. The Site Supervisor will also notify plant operating staff to attend the site and assist with fire fighting.

Available Resources

Fire fighting equipment installed and available at the facility includes the following:

- Portable fire extinguishers within site buildings
- Fire hydrants
- Portable extinguishers attached to all site plant and equipment for immediate use in the event of a fire (eg. Landfill compactor and Excavator).

Clearly visible signs will be installed on site to ensure that all site personnel and the fire brigade are aware of the locations of this equipment.

Fire fighting equipment and facilities will be visually inspected on a weekly basis and tested on a quarterly basis.

All waste management facility staff will receive basic training in the operation of available fire fighting equipment and fire fighting methods (refer to EG17).

Officers of the NSW Fire Brigades and the NSW Rural Fire Service will be invited to inspect the facility on an annual basis to ensure familiarity with site and its fire fighting capabilities.

Given the location of the Facility and the possibility of a bushfire impacting upon the facility the Bushfire and Fuel Management Plan which has been prepared for the Facility, refer to Appendix 8, will be implemented.

A detailed procedure for Fire Prevention and Management is provided in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP F1).

5.2.17 Adequate Staffing and Training

To ensure the safe and effective management of the facility, it is essential that all relevant staff receive training appropriate to their position, duties and level of responsibility.

Staff and Training Requirements (BT39)

Staffing and training requirements shall be adequate to ensure effective management and operation of the Cairncross Waste Management Facility.

The Facility will be permanently staffed by the following personnel:

- Excavator Operator (EO)
- Plant Operators – compactor, excavator and haulage truck (CO, EO and PO)
- Waste Depot Attendant/Weighbridge Operator (WDO)

Other staff involved in the operation of the Landfill includes:

- Port Macquarie-Hastings Council Manager, Waste Services and Building (MWSB).
- Port Macquarie-Hastings Council Waste Services Supervisor (WSS)
- Port Macquarie-Hastings Council Natural Resource Management Officers (NRMO).
- Port Macquarie-Hastings Council Laboratory Staff (LS)

The roles and responsibilities of these personnel are detailed in Section 6.1.

Staff at the site will undergo a variety of training to ensure an adequate level of skill and education is possessed to enable all tasks and activities to be carried out successfully. Training will be conducted in house, on the job and through external formats. The proposed training is presented in Table 8.

Table 8
Minimum Staff Training Requirements

STAFF	TRAINING PROGRAMS			
	A	B	C	D
Manager, Waste Services and Building (MWSB)	Yes			Yes
Waste Services Supervisor (WSS)	Yes	Yes	Yes	
Waste Depot Attendant (WDO)	Yes	Yes	Yes	
Excavator Operator (EO)	Yes	Yes	Yes	
Compactor Operator (CO)	Yes	Yes	Yes	
Plant Operator (PO)	Yes	Yes	Yes	
Natural Resource Management Officers (NRMO)	Yes		Yes	Yes
Laboratory Staff (LS)	Yes			Yes

A description of specific training programs integral to the operation of the site is described below:

PROGRAM A - Site Environmental Induction (OEMP)

Key points to be covered in this program may include:

- Environmental impacts of the landfill
- Requirements of the EPA operating licence
- Waste identification and rejection procedures
- Waste reception and security
- Hours of operation and traffic routes
- Environmental mitigative measures and controls (eg dust/ litter)
- Record keeping and reporting
- Waste placement, compaction and covering.

This training would be in-house and would be provided by the Manager, Waste Services and Building and Natural Resource Management Officers. Training would be provided when new staff commence at the site. Ongoing 'on the job training' may also be provided by the Manager, Waste Services and Building (MWSB) and Natural Resource Management Officers on an as required basis.

PROGRAM B - Fire Fighting

Key points to be covered in this program may include:

- Types of fires (eg underground)
- Responsibilities in the event of a fire (staff/fire brigade)
- Procedures for extinguishing fires
- Types/location and maintenance of fire fighting equipment
- Prevention of fires
- Procedures for communication in the event of fire.

This training would be undertaken at the site in the form of a toolbox talk with practical demonstrations. The training would be prepared and delivered by suitably qualified personnel. Input may also be provided by the NSW Fire Brigade and/or Rural Fire Service.

PROGRAM C - Hazardous Substance and Dangerous Goods Management

Key points to be covered in this program may include:

- Use and interpretation of material safety data sheets
- Labelling of containers
- Storage and transport of hazardous substances and dangerous goods
- Spill management and basic first aid procedures
- Compatibility of materials

This training would be provided by Port Macquarie-Hastings Council's Occupational Health and Safety Manager (OH&SM) or suitable service provider.

Where required additional input may be required from external Workcover Accredited OH&S consultants.

PROGRAM D - Environmental Monitoring and Reporting

Key points covered in this program may include:

- Environmental monitoring including gas, groundwater, surface water, dust, noise and odour
- Recording and reporting data
- Calibration of equipment
- Preparation of internal and external environmental reports (eg EPA Annual Returns)

This training would be undertaken by the Manager, Waste Services and Building and/or the Natural Resource Management Officers. Where required, specialist advice regarding equipment use and calibration may be sought from manufacturers/consultants.

- Traffic control (external – Roads and Traffic Authority)
- Plant operation (testing by WorkCover Authority)
- Continuous Improvement Program (internal)
- Weighbridge and computer system training (external – manufacturer training)

A record of all training undertaken will be maintained on site and within Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP T1).

6.0 IMPLEMENTATION AND OPERATION

6.1 Roles and Responsibilities

The roles and responsibilities of personnel in regard to the environmental management of the Cairncross Waste Management Facility are generally as follows:

6.1.1 Manager, Waste Services and Building (MWSB)

The responsibilities of the Manager, Waste Services and Building include:

- Ensure adequate resources are available to effectively manage the facility
- Obtain and manage environmental licences for the facility
- Provide adequate resources to ensure the effectiveness of environmental controls
- Implement and manage auditing program for the facility

- Commission and manage construction contractors and design consultants in regards to the construction of additional stages of the landfill
- Commission and manage specialist consultants (as required)
- Review/approve Environmental Performance Reports
- Review/endorse non con conformance reports and corrective action
- Review OEMP as required.

6.1.2 Waste Services Supervisor (WSS)

The responsibilities of the Site Supervisor will include:

- Weekly site environmental inspection (refer to Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP S2))
- Ensure conformance with requirements of OEMP
- Supervision of site staff
- Preparation of site reports (as required)
- Report non conformance and implement/close out corrective action
- Maintenance of site records
- Managing complaints
- Review OEMP as required.

6.1.3 Waste Depot Attendant (WDA)

The roles and responsibilities of the Waste Depot Attendant include (but are not limited) to the following:

- Open and close the depot entrance gates at the beginning and end of the hours of operation
- Administer the operations of the gate house
- Supervise the tipping operations at the landfill tip face
- Control the green waste area
- Control the perimeter boundaries
- Control recycling activities
- Control of hazardous goods compounds and storage areas
- Gain and understanding of OEMP requirements and report non-conformance corrective action to the Site Supervisor.

6.1.4 Excavator Operator (EO)

The roles and responsibilities of the excavator operator include the following:

- Operate excavator for land filling works which require:
  - Placement of intermediate and final cover requirements
  - Stockpile management
  - Loading of trucks
  - Cleaning drains
  - General excavation work
- General maintenance
- General duties other than operating and excavator in land filling works, (eg Litter collection)
- Assist with fire fighting when required
- Gain an understanding of OEMP requirements and report non conformance corrective action to the Site Supervisor

6.1.5 Compactor and Plant Operator (CO and PO)

The roles and responsibilities of the plant operator include (but are not limited to) the following:

- Operate a landfill compactor to:
  - Place and compact landfill wastes
  - Achieve required compaction wastes
  - Optimise landfill space
  - Work to predetermined levels (in accordance with the filling plan)
- General maintenance of the compactor and equipment as required
- General duties other than operating a compactor in land filling works (eg litter collection)
- Operate other plant on the site (quad runner, haulage truck)
- Assist with fire fighting
- Gain an understanding of OEMP requirements and report non conformance/corrective action to the Site Supervisor.

6.1.6 Natural Resource Management Officers (NRMO)

The responsibilities of the Natural Resource Management Officers (NRMO) in relation to the operation of the facility includes the following:

- Review environmental monitoring data and recommend corrective action to WBSM
- Input to environmental performance reports (as required)
- Undertake internal environmental audits (as required)
- Review OEMP as required

6.1.7 Laboratory Staff (LS)

The responsibilities of the Laboratory Staff (LS) in relation to the operation of the facility include the following:

- Implement Environmental Monitoring Program
- Purchase, maintenance and calibration of environmental monitoring equipment
- Training of Natural Resource Management Officers in regards to environmental monitoring

6.2 Complaints Management

A Complaints Register will be established for recording all complaints received and actions taken in response to such complaints.

The Complaints Register records the following details:

- Date and time of complaint
- Method of receiving the compliant
- Name, address telephone number of complainant
- Nature of complaint
- Response action taken and date
- Whether or not the EPA has been advised of the complaint.

The Complaints Register will be kept on site and will be produced for inspection when requested by an authorised officer of the EPA. Detailed methodology for managing complaints is included Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP C3).

6.3 Hazardous Incident/Chemical Spills

During the operation of the Cairncross Waste Management Facility, environmental emergencies may arise due to the spillage of hazardous materials and substances (eg oil and petrol). Port Macquarie-Hastings Council has developed and implemented a procedure to respond to such incidents.

Minor spills are those which involve a small amount of identified, commonly used chemical and are caused by Council Officers and/or on Council land and may be cleaned up using Council's resources. Spills of this nature shall be reported immediately to the Site Supervisor.

An "Incident Report" should be completed and corrective actions implemented to minimise the risk of recurrence.

Major spills are those were a quantity of hazardous or unknown material spills from Council's operations. Port Macquarie-Hastings Council has details a procedure for dealing with such incidents. This procedure is included in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP H1). This procedure outlines:

- Communication channels for notifying the correct personnel and authorities in the event of a spill
- Roles and responsibilities of personnel in the event of a spill
- Protocols for contacting and dealing with emergency services

6.4 Audit, Review and Inspection Plan

The purpose of the audit, review and inspection plan is to:

- Identify non conformances to the OEMP and implement corrective action where appropriate
- Undertake audits of the implementation of the OEMP to ensure the procedures and requirements are being fulfilled
- Review the OEMP to ensure the document remains in line with current site practices
- Provide a mechanism to implement change and improve the management of the facility.

The proposed auditing program for the Cairncross Waste Management Facility is shown in Table 9.

Table 9
Audit and Inspection Plan

Type of Audit	Frequency	Responsibility
Site Inspection/Environmental Checklist	Weekly After rainfall events	WDA,WSS
Internal Site Audit	Quarterly	WSS, MWSB
Site Partners Inspection	Six Monthly	WSS, MWSB
External Site Compliance Audit	Annual	MWSB
OEMP Review	Annual and following major incident/non conformance	WSS, MWSB, NRMO

Further details of the site inspection/auditing program are provided in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP S2).

6.5 Reporting

Table 10 sets the timing, frequency and distribution of reports to be prepared in regards to the operation of the facility.

Table 10
Environmental Reporting Requirements

Report	Preparation	Frequency	Distribution
Weekly Checklist	WSS, WDA	Weekly	WSS, MWSB
Rain Event Checklist	WSS, WDA	After rainfall event >10mm	
Internal Site Audit	WSS, NRMO	Quarterly	MWSB
External Site Audit	Consultant	Annually	MWSB, WSS,GM*
Incident Report	WSS, WDA	As required	MWSB, WSS, EPA (As required)
EPA Annual Return	MWSB, NRMO	Annually	MWSB ,GM*, EPA
Quarterly returns	WSS, MWSB	Quarterly	EPA, MWSB
Incident Report	All of the above	As required	MWSB, WSS

****GM – Hastings Council General Manager***

Further details of the Environmental Reporting requirements for the site are included in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP E3).

6.6 Non-conformance and Corrective Action

Where incidents or non-compliance have occurred, an incident report form will be completed. This form specifies the details of the incident or potential incident, specifies immediate action to prevent further impact or risk and also corrective measures to prevent recurrences.

The Site Supervisor will investigate and recommend or endorse appropriate measures to mitigate the effects of the incident and to prevent recurrence.

An incident reporting procedure that includes a sample incident report form is provided in Port Macquarie-Hastings Councils Solid Waste Management Procedures Manual (SOP I4).

All incident reports will be registered and maintained on site.

7.0 ENVIRONMENTAL ACTION PLAN

An Environmental Management Action Plan has been developed for the facility, which summarizes the key actions arising from the environmental actions and strategies identified in Section 5 of this OEMP. The Action Plan covers the following;

- Actions aimed at achieving the environmental goals.
- Responsibility for actions.
- Timing for the implementation of the actions.
- Identification of the relevant environmental benchmark technique (for reference and further information).

Table 11

Environmental Action Plan

ACTION	RESPONSIBILITY	TIMING	BENCHMARK TECHNIQUE
1. Landfill Development			
1.1 Install leachate barrier system	MWSB	Prior to commissioning of new land filling areas	1
1.2 Undertake testing of clay liner	MWSB	Prior to commissioning of new land filling areas	1
1.3 Install leachate collection and management system	MWSB	Prior to commissioning of new land filling areas	2
1.4 Install surface water drains and management systems	MWSB	Prior to commissioning of new land filling areas	3
1.5 Shape final landform to direct surface water away from landfill mass	WSS	Ongoing/Upon closure	3
1.6 Revegetation of completed areas	WSS	ASAP following installation of capping layer	3
2. Water Quality			
2.1 Undertake ground water monitoring	MWSB, LS	Quarterly	5
2.2 Review ground water monitoring results	MWSB, NRMO	Quarterly	5
2.3 Undertake leachate monitoring	MWSB, NRMO	Quarterly/as required by EPA	5
2.4 Review ground water monitoring program	MWSB, NRMO	Every 5 years	5
2.5 Review condition of groundwater monitoring wells	MWSB, NRMO	Annually	5
2.6 Report breaches of ground water criteria to EPA	MWSB	Within 14 days of verification of breach	5
2.7 Prepare ground water assessment program	MWSB, NRMO, LS	Within 28 days of the notification of any breach of EPA criteria	5
2.8 Prepare ground water remediation plan	MWSB, NRMO,	ASAP following breach verification	5
2.9 Undertake surface water monitoring	MWSB, LS	Quarterly	7
2.10 Where water quality	MWSB	If breach of criteria	6

criteria has been breached, undertake corrective action as far as practical		occurs	
2.11 Report breach of surface water quality criteria to EPA	MWSB	Within 14 days of verification of breach	6
2.12 Implement actions to prevent future surface water contamination	MWSB, WSS	ASAP following breach verification	6
2.13 Manually maintain bitumen road surfaces free of sediment and litter accumulations	WDA,WSS	Ongoing	3
2.14 Provide and maintain suitable storage facilities for recyclable materials and wastes awaiting offsite disposal.	MWSB,WSS	Ongoing	3, 25
2.15 Provide and maintain hazardous incident response kit	WDA, WSS	Ongoing	3
2.16 Inspect and maintain water quality management structures and infrastructure	WDA, WSS	Inspect monthly/following rainfall events. Maintenance as required	3
2.17 Inspect and maintain stormwater irrigation areas	WDA, WSS	Inspect monthly/following rainfall events. Maintenance as required	3
2.18 Inspect and maintain leachate disposal re-injection pits	WDA, WSS	Inspect monthly/following rainfall events. Maintenance as required	3
2.19 Inspect and maintain onsite wastewater treatment and disposal facilities	WDA, WSS	Treatment facility - Inspect and maintain quarterly. Disposal areas – inspect annually/ maintenance as required	3
2.20 Inspect and maintain wash bay oil and grease separator	WDA, WSS	Treatment facility - Inspect and maintain quarterly. Disposal areas – inspect annually/ maintenance as required	3
2.21 Review deign and operation of wash bay so as to minimize stormwater infiltration	MWSB	2008/2009	3

3. Gas Emissions			
3.1 Undertake subsurface gas monitoring	WSS	Quarterly	16
3.2 Undertake surface gas monitoring	WSS	Quarterly	17
3.3 Undertake gas accumulation monitoring in buildings within 250m radius	WSS	Quarterly	18
3.4 If methane concentrations >1.25% v/v, undertake corrective action to minimize gaseous emissions (eg repair cover to landfill)	SS, WDA	Corrective action to be initiated ASAP	19
3.5 Notify EPA of methane concentration exceedance and corrective action which has been initiated	MWSB	Within 14 days of corrective action	19
3.6 Installation of capping layer	WSS, WDA	Within 30 days of completion of an area	28
4. Quality Assurance			
4.1 Install and maintain signage at the gatehouse indicating types of waste acceptable to the waste management facility	WSS, WDA	Ongoing	21
4.2 Inspect incoming waste to ensure that all waste is acceptable to the Facility	WDA	Ongoing	21
4.3 Undertake site survey to determine compaction rate and to update filling plan	MWSB	Annually	23
4.4 Prepare Environmental Management System for all Waste Management Facilities under Council operation	MWSB	2009	20
4.5 Quantities and nature of waste disposed of at the Facility to be reported to the EPA	WSS, WDA	Monthly/ Annually	23
4.6 The details of all vehicles entering and exiting the site will be permanently recorded.	WSS, WDA	Daily	23, 20

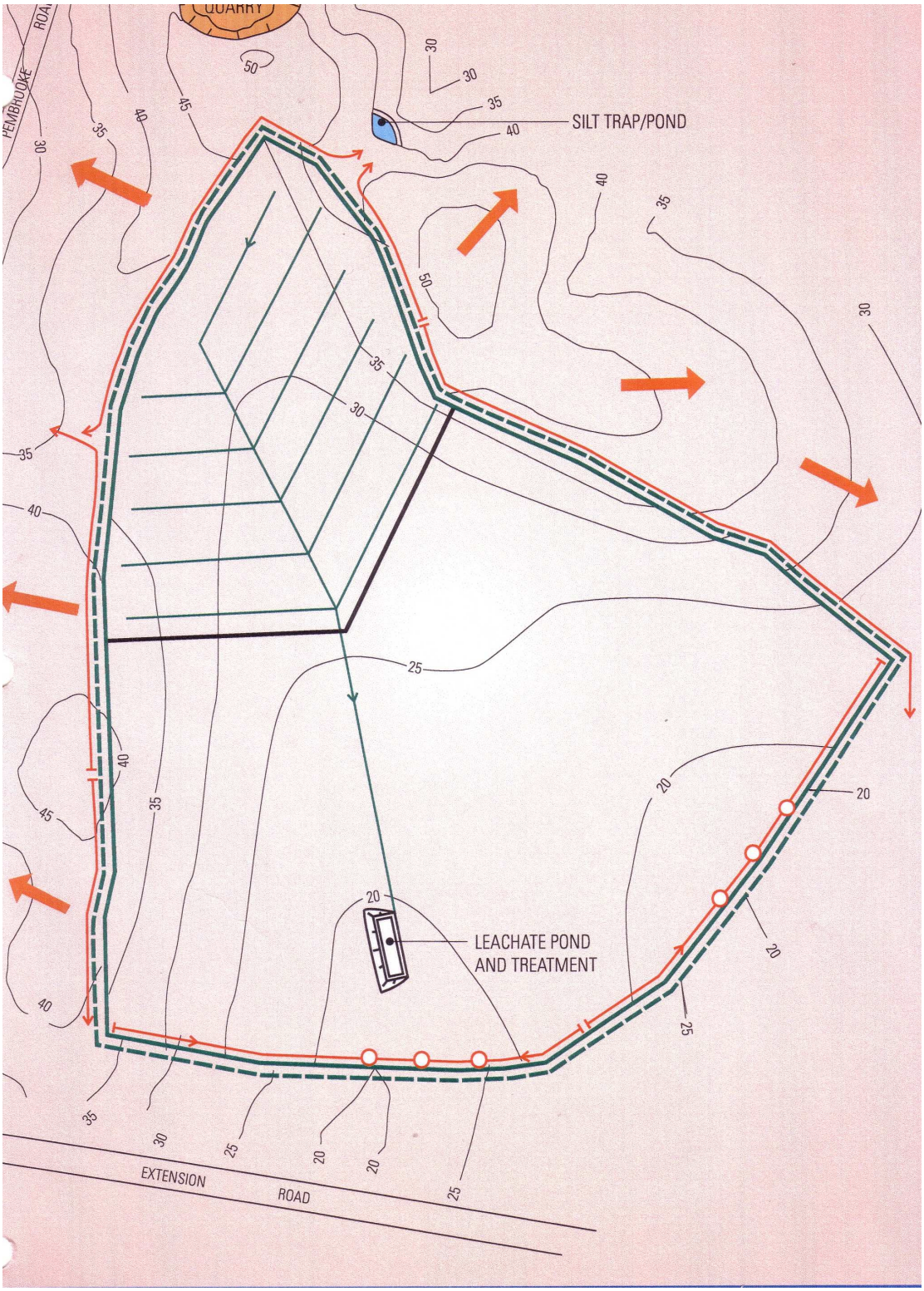
4.7 Inspection and calibration of weighbridges	MWSB	Annually	22
4.8 Repair weighbridge should it become inoperable	WSS	ASAP following weighbridge failure	22
4.9 Report weighbridge failures to EPA	WSS	Immediately following weighbridge failure	22
5. Local Amenity and Resource Management			
5.1 Compaction of waste	WSS, WDA	Daily	24
5.2 Cover waste at tip face	WSS, WDA	Daily	33
5.3 Review and update filling plan	MWSB	Annually	27
5.4 Provide updated filling plan to EPA	MWSB	Annually	27
5.5 Installation of capping layer	WSS, WDA	Within 30 days of completion of any area	28
5.6 Site revegetation	WSS, WDA	ASAP after capping layer has been provided	28
5.7 Prepare Landfill Closure Plan	MWSB	At least 3 months prior to closure of landfill	28
5.8 Submit landfill Closure Plan to EPA for approval	MWSB	At least 3 months prior to closure of landfill	28
5.9 Inspect, clean and repair litter/perimeter fences	WDA	Inspect daily/ cleaning and repair of fences as required	31
5.10 Installation and maintenance of signage advising patrons of their responsibilities to littering	WSS, WDA	Ongoing/replacement of signage as required	31
5.11 Visual inspection of dust/litter accumulations on bitumen road. Removal of accumulations	WDA	Daily/following rainfall events	34
5.12 Implementation of dust controls (water carts etc)	WDA, WSS	ASAP following identification of dust generation issue	34
5.13 Initiate formal dust monitoring of site activities	MWSB, NRMO	ASAP after dust complaint/s are received	34
5.14 Initiate noise monitoring of	MWSB, NRMO	ASAP after noise	37

site activities		complaint/s are received	
5.15 Ensure that residential class mufflers are fitted to all plant and equipment	WDA, WSS	Quarterly	37
5.16 Implement additional noise control (where required)	MWSB, WSS	ASAP after confirmation of noise criteria exceedences	37
5.17 Prepare weed/pest management plan which includes specific requirements for the Compensatory Habitat area of the site	MWSB, WSS	2008/2009	35
5.18 Implement weeds/pests management plan	WDA	In accordance with Plan	35
5.19 Visual inspection of noxious weeds/pests	WDA	Daily	35
5.20 Review weeds/pests management plan	MWSB, WSS	In accordance with Plan	35
5.21 Tipping face is to be less than 20 metres in length	WDA, WSS	Daily	33
5.22 A suitable supply of cover material to be stockpiled onsite in the vicinity of the filling area	WDA, WSS	Daily	33
5.23 Implement odour control (where required)	MWSB, WSS	ASAP after confirmation of odour complaints received	36
5.24 Inspection of green waste and mulch stockpiles to ensure that aerobic conditions are maintained	WDA, WSS	Weekly	36
6. Fire Fighting/Control			
6.1 Inspection of loads for flammable materials	WDA	Daily	38
6.2 Inspection of fire fighting equipment	WSS, MWSB	Weekly	38
6.3 Testing of fire equipment	WSS, MWSB	Quarterly	38
6.4 Maintenance of fire equipment	MWSB	Annually	38
6.5 Inspection of green waste and mulch stockpiles	WDA	Daily	38

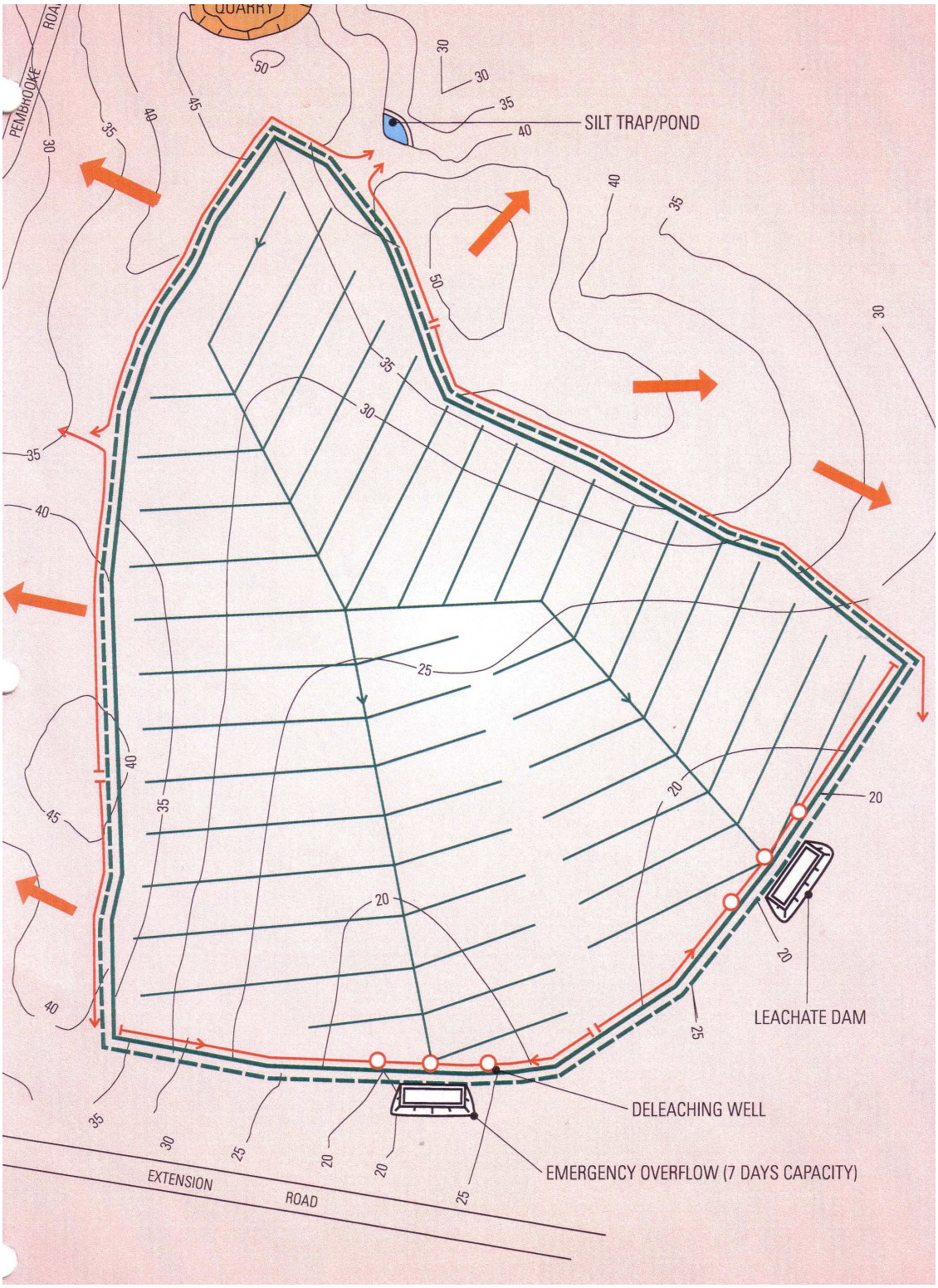
6.6 Aeration of green waste and mulch stockpiles	WDA, WSS	As required following inspection	38
6.7 Fuel management within compensatory Habitat area of site	MWSB, WSS	Ongoing in accordance with Bushfire and Fuel Management Plan	38
6.8 Creation of Asset Protection Zones surrounding Facility	MWSB	In accordance with Bushfire and Fuel Management Plan	38
6.9 Fuel management within asset protection zones surrounding the Facility	MWSB	Ongoing in accordance with Bushfire and Fuel Management Plan	38
6.10 Fuel management within the undeveloped landfill compartments	MWSB	Ongoing in accordance with Bushfire and Fuel Management Plan	38
6.11 Provide and maintain access roads and fire trails	MWSB	In accordance with Bushfire and Fuel Management Plan	38
6.12 Provide and maintain onsite fire fighting water supply	MWSB	In accordance with Bushfire and Fuel Management Plan	38
6.13 Review of Bushfire and Fuel Management Plan	MWSB	Annually	38
6.14 Inspection of site by Rural Fire Service Personnel	MWSB	Annually	38
6.15 Staff trained in basic fire fighting methods and use of equipment	MWSB	As required	38
7. Facility Management			
7.1 Provide staff training	MWSB	As required in accordance with training plan	39
7.2 Review staff training requirements	MWSB	Annually	39
7.3 Establish and maintain Complaints Register	MWSB, WSS, WDA	Ongoing	20
7.4 Review of complaints register	WSS, MWSB	Quarterly	20
7.5 Establish and maintain Incident Reporting Register	WSS, MWSB	Ongoing	20
7.6 Review of incident register	WSS, MWSB	Quarterly	20
7.7 Provide and maintain first	WSS, WDA	Ongoing	39

aid equipment onsite			
7.8 Undertake site Inspection/Environmental Management Check and prepare report	WDA, WSS	Weekly/After rainfall event >10mm	20
7.9 Undertake internal Site Audit and prepare report	WSS	Quarterly	20
7.10 Undertake inspection of partner's sites within the Facility	WSS, MWSB	Quarterly	20
7.11 Undertake External Site Compliance Audit and prepare report	MWSB	Annually	20
7.12 Undertake OEMP Review	MWSB	Annually	20
7.13 Review of operating and capital works budgets	MWSB	Quarterly	26
7.14 Preparation, implementation and review of standard operating procedures for all solid waste management activities	MWSB, WSS	2008/2009	20

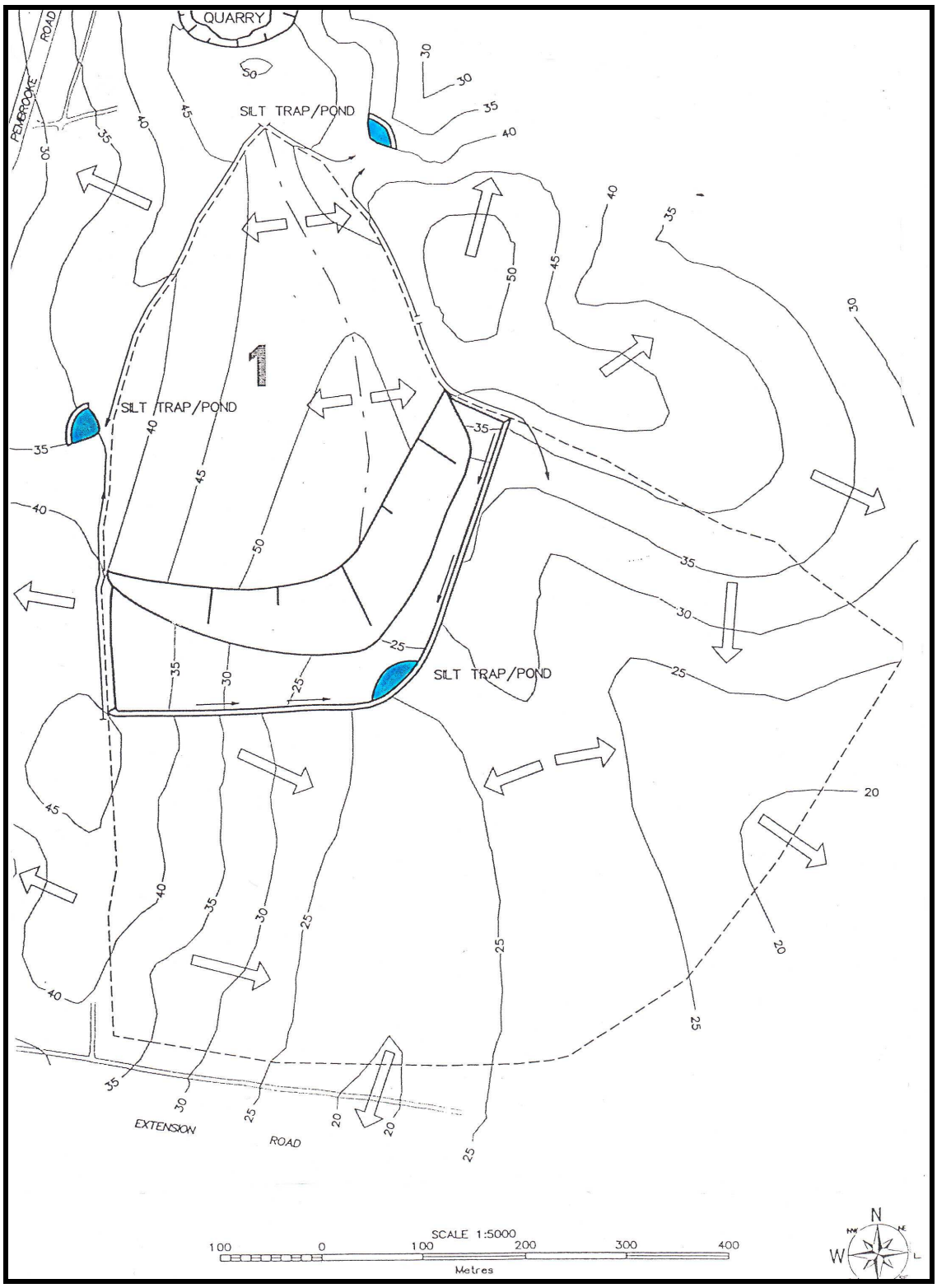
APPENDIX 1 – Stage 1 Leachate Collection System



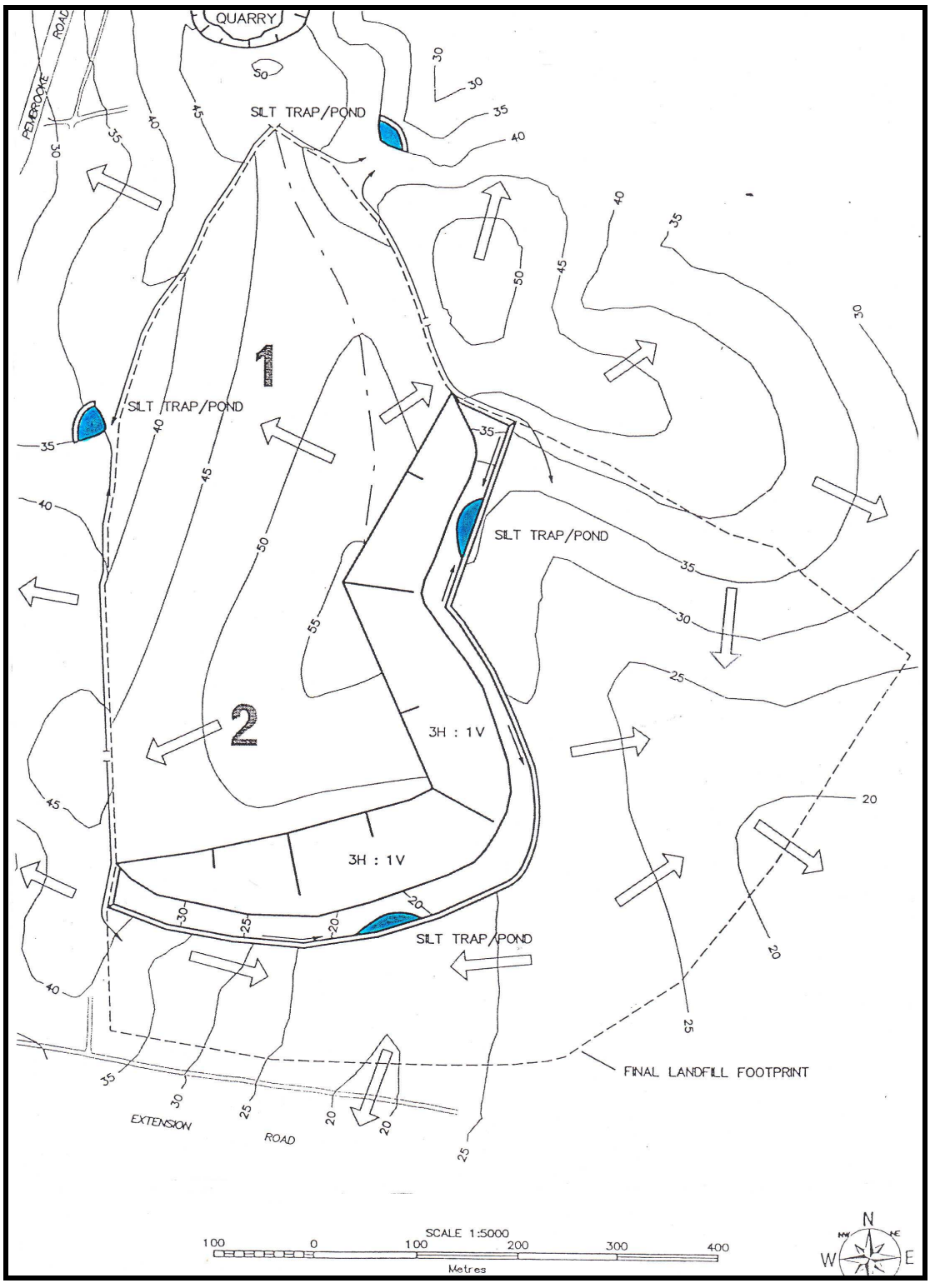
APPENDIX 2 – Final Leachate Collection System



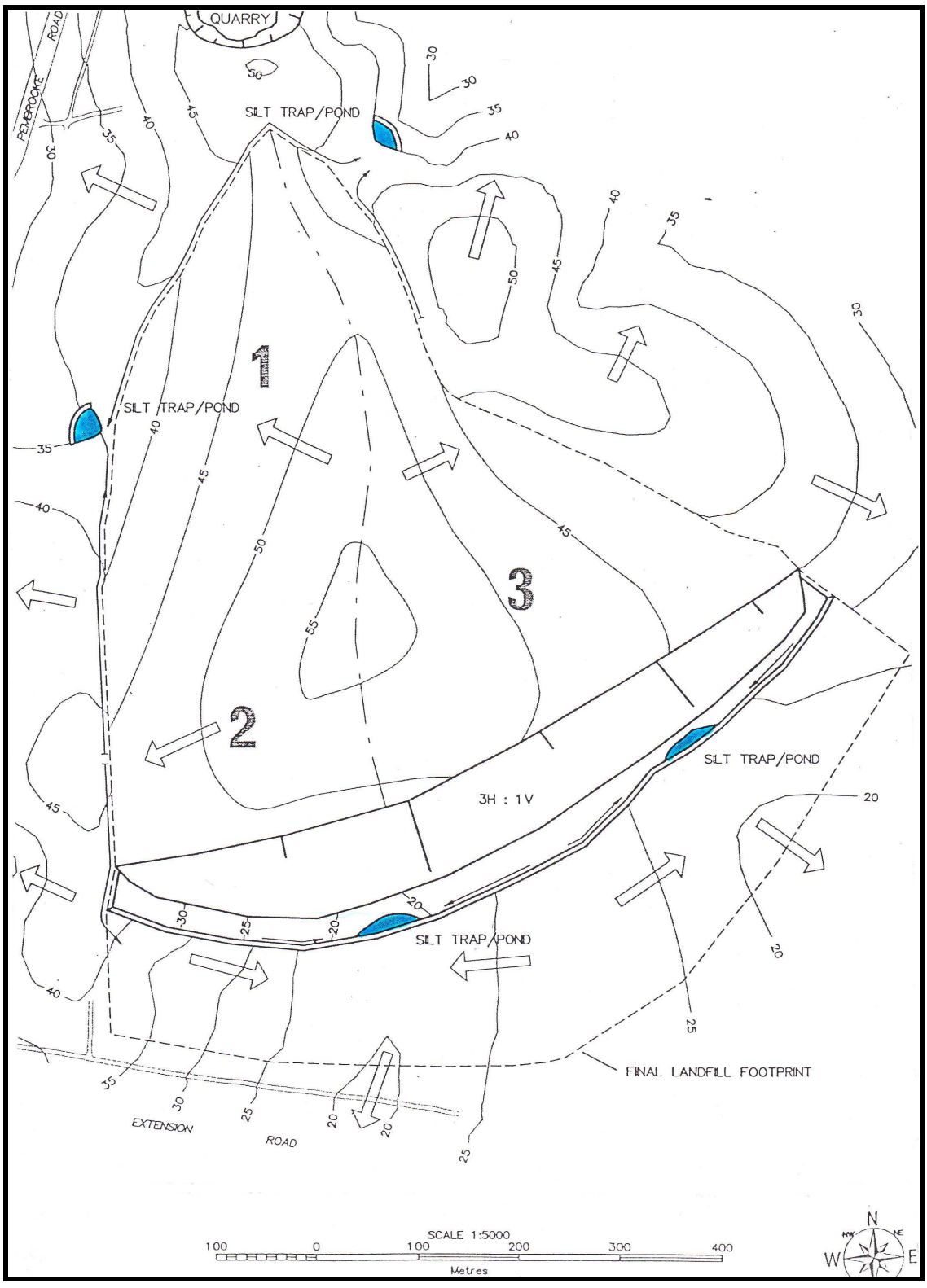
APPENDIX 3 – Stage 1 Land Filling Plan



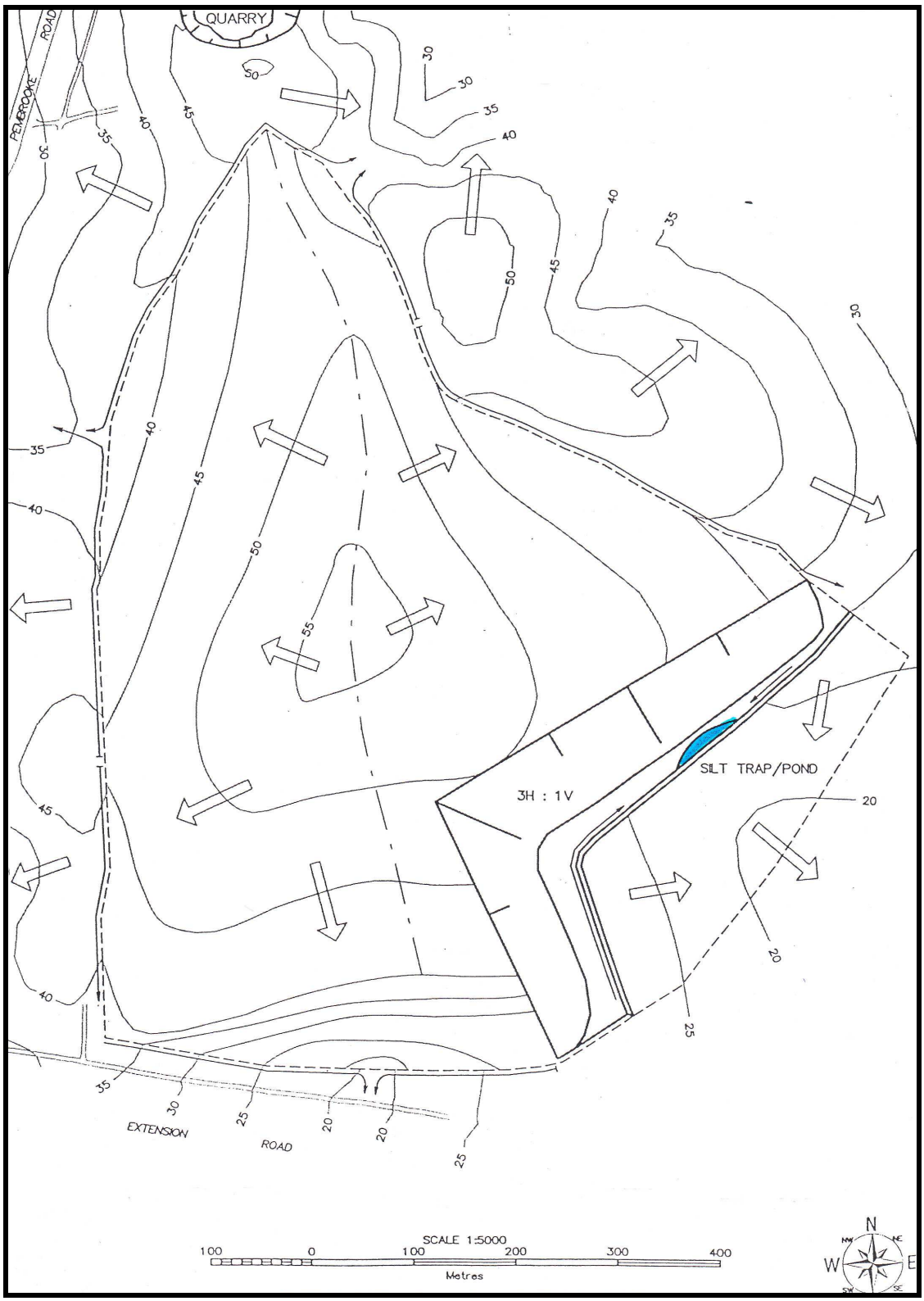
APPENDIX 4 – Stage 2 Land Filling Plan



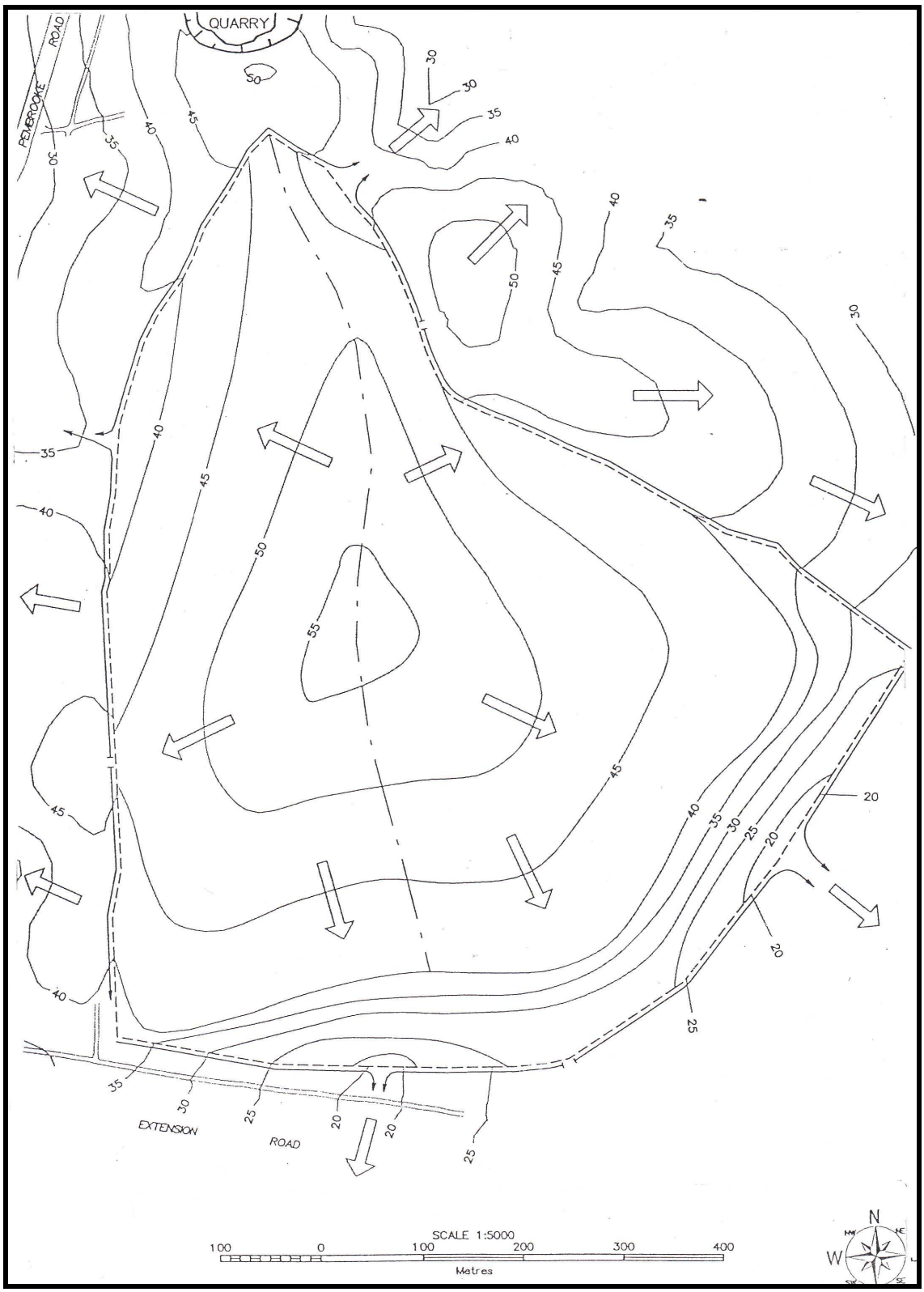
APPENDIX 5 – Stage 3 Land Filling Plan



APPENDIX 6 – Stage 4 Land Filling Plan



APPENDIX 7 – Final Landfill Landform


QUARRY
PEMBROKE ROAD
EXTENSION ROAD
SCALE 1:5000
100 0 100 200 300 400
Metres
N
W

APPENDIX 8 – Bushfire and Fuel Management Plan