Report for Eviron Road Quarry and Landfill Proposal
Part 3A Environmental Assessment

Volume 1: Environmental Assessment

November 2011

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Tweed Shire Council

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Part 3A Environmental Assessment

VOLUME 1 Environmental Assessment

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INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Declaration

Prepared under the Environmental Planning and Assessment Act 1979, Section 75H:

Environmental Assessment prepared by	Name:	Alison Marszalek
	Qualifications:	B Eng Env (Hons) M Eng Sc
	Address:	Level 13 – The Rocket 203 Robina Town Centre Drive Robina QLD 4226
	In respect of:	Eviron Road Quarry and Landfill Project
Development Application	Applicant name:	Tweed Shire Council
	Applicant address:	PO Box 816 MURWILLUMBAH NSW 2484
	Land to be developed:	The Project is to be carried out on land as shown in the Environmental Assessment.
	Lot no, DP/MPS, vol/fol etc	Lot 1 DP 34555; Lot 1 DP1159352; and Lot 602 DP 1001049.
Environmental Assessment	An Environmental Assessment is attached.	
Certificate	I certify that I have prepared the contents of this Statement and to the best of my knowledge: - It is in accordance with the requirements of Part 3A; - It contains all available information that is relevant to the Environmental Assessment of the development; and - That the information contained in the Environmental Assessment is neither false nor misleading.	
	Signature	[signature]
	Name	Alison Marszalek
	Date	2-11-11

Glossary

ADT	Average daily traffic volume for nominated location/roadway
Annual Exceedance Probability (AEP)	The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.
Australia Height Datum (AHD)	The datum that has been adopted by the National Mapping Council as to which all vertical control for mapping is to be referred.
Carbon dioxide equivalent (t CO_2e)	The amount of carbon dioxide emission that would cause the same integrated radiative forcing over a given time horizon, as an emitted amount of a well mixed greenhouse gas or a mixture of well mixed greenhouse gases. The equivalent carbon dioxide emission is obtained by multiplying the emission of a well mixed greenhouse gas by its global warming potential for the given time horizon (IPCC, 2007).
dB	Decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
dB(A)	Unit used to measure ‘A-weighted’ sound pressure levels.
Digital Elevation Model (DEM)	A continuous raster based representation of elevation data often derived from contours and/or spot heights.
Ground borne Vibration	Ground borne vibration is vibration transmitted from source to receiver via the medium of the ground.
Ground borne Noise	Ground borne noise describes noise transmitted as vibration through the ground and into structures, radiated as low frequency rumbling noise.
L_N	Statistical sound measurement recorded on the linear scale.
L_{AN}	Statistical sound measurement recorded on the “A” weighted scale.
$L_{A10\ (Time)}$	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
$L_{A10\ (1\ hour)}$	The L_{10} level measured over a 1-hour period.
$L_{A10\ (18\ hour)}$	The arithmetic average of the L_{10} levels for the 18-hour period between 0600 and 2400 hours on a normal working day. It is a common traffic noise descriptor.

$L_{Aeq\ (Time)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{Aeq\ (15\ hr)}$	The L_{Aeq} noise level for the period 7 am to 10 pm.
$L_{Aeq\ (9\ hr)}$	The L_{Aeq} noise level for the period 10 pm to 7 am.
$L_{Aeq\ (1\ hr)}$	The L_{Aeq} noise level for a one-hour period. In the context of the NSW DEC environmental criteria for road traffic noise, it represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7 am to 10 pm, or 10 pm to 7 am, (whichever is relevant). If this cannot be defined accurately, use the highest A-weighted L_{eq} noise level.
$L_{A90\ (Time)}$	The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90\ (15\ min)}$.
$L_{AMax\ (Time)}$	The maximum sound level recorded during a specified time interval.
$L_{AMin\ (Time)}$	The minimum sound level recorded during a specified time interval.
Malodorous Wastes	Waste having an unpleasant or offensive odour
Net Acid Generation (NAG)	For rocks with the potential to create acid rock drainage the NAG result is indicative of the potential for a material to produce acid after a period of exposure and weathering and is primarily used to confirm the NAPP predictions (see below) based on sulphur and ANC values.
Net Acid Producing Potentiall (NAPP)	For pyritic materials with the potential to create acid rock drainage issues, the NAPP calculation represents the balance between the acid-forming capacity, which is based on the sulphide-sulphur content, and the acid neutralisation capacity, which is measured directly. Theoretically, a sample with NAPP > 0 is classified as potentially acid forming and a sample with NAPP $\leq$ 0 is classified as non-acid forming, or potentially acid consuming.
Odour Units (OU)	Indicates concentration of odorous mixtures. The number of odour units is the concentration of a sample divided by the odour threshold or the number of dilutions required for the sample to reach the threshold. This threshold is the numerical value equivalent to when 50% of a testing panel correctly detect an odour. For complex mixtures of odours, odour is specified in OU/m3 (odour units per cubic metre) as a nose-response-time average (DEC, 2005).

Peak Particle Velocity	Current practice for assessments of the risk of structural damage to buildings use measurements of Peak Particle Velocity (PPV) ground vibration (v_p), which is the maximum vector sum of three orthogonal time-synchronized velocity components. When not directly measured by an instrument, PPV may be determined by: $v_p = \sqrt{(v_x^2 + v_y^2 + v_z^2)}$ Where v_x , v_y , v_z are the instantaneous components of particle velocity of the x, y, z primary axes, respectively.
PM_{10}	The fraction of suspended particles (airborne) that are less than 10 microns in diameter (a measure of dust in air).
Putrescible Waste	Waste containing organic matter capable of being decomposed by microorganisms. Typically includes municipal solid waste, food waste and dead animals.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day / evening / night) over the whole monitoring period (as opposed to over each 24 hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of: ◗ All the day assessment background levels over the monitoring period for the day. ◗ All the evening assessment background levels over the monitoring period for the evening. ◗ All the night assessment background levels over the monitoring period for the night.
Residual Waste	Waste that remains after resource recovery activities (e.g. recycling, source separation etc) that requires disposal to landfill.
Total suspended particulates	The term total suspended particulate (TSP) matter refers to airborne particles typically less than 50 microns (μm) in aerodynamic diameter.
Traditional knowledge	Knowledge passed down through the generations by word of mouth
Virgin Excavated Natural Material (VENM)	Natural material (such as clay, gravel, sand, soil or rock fines) that has been excavated or quarried from areas that are not contaminated with manufactured chemicals or process residues, as a result of industrial, commercial, mining or agricultural activities, and that does not contain any sulfidic ores or soils or any other waste.’

Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).
Viewshed	The areas which can be seen from a given location taking into effect the height of the observer and shielding by landform and vegetation.

Abbreviations

AAC	Aboriginal Advisory Committee
AASS	Actual Acid Sulfate Soil
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AKF	Australian Koala Foundation
ANZEC	Australian and New Zealand Environment Council
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval
ARL	Acoustic Research Laboratories
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard
ASS	Acid Sulfate Soil
AWS	Automatic Weather Station
AWT	Alternative Waste Technology
BoM	Australian Bureau of Meteorology
BS	British Standard
C&D	Construction and Demolition Waste
C&I	Commercial and Industrial Waste
CDL	Container Deposit Legislation
CFL	Compact Fluorescent Lamp
CH_4	Methane
CHMP	Cultural Heritage Management Plan
CME	Commonwealth Marine Environment
CO_2	Carbon Dioxide

CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEE	Department of Climate Change and Energy Efficiency (formerly Department of Climate change – DCC)
DCP	Development Control Plan
DEC	Department of Environment and Conservation
DECCW	New South Wales Department of Environment and Climate Change and Water (now Office of Environment and Heritage)
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts (see DSEWPC)
DGR's	Director General Requirements
DLWC	New South Wales Department of Land and Water Conservation (former NSW Government Department)
DOC	Degradable Organic Carbon
DoP	Department of Planning (New South Wales)
DPI	Department of Primary Industries (Fisheries)
DSEWPC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (formerly DEWHA, DCCEE and DCC)
E	Endangered threatened species
EA	Environmental Assessment or Ecological Assessment
ECRTN	Environmental Criteria for Road Traffic Noise
EECs	Endangered Ecological Communities
EET	Emissions estimation technique
EF	Emission factors
EMP	Environmental Management Plan
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environmental Protection Agency
EPR	Extended Producer Responsibility
EPBC Act	The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999

ESCP	Erosion and Sediment Control Plan
FM ACt	*Fisheries Management Act 1994*
FOD	First Order Decay
GHG	Greenhouse Gas
GI	Ground Surface Integrity
GIS	Geographic Information System
GLC	Ground Level Concentrations
GSV	Ground Surface Visibility
GWP	Global Warming Potential
HELP	Hydrological Evaluation of Landfill Performance (USEPA model)
IBRA	Interim Biogeographical Regions of Australia
INP	Industrial Noise Policy
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation of Standardisation
LCA	Local Control Authority
LEMP	Landfill Environmental Management Plan
LFG	Landfill Gas
LGA	Local Government Area
LNG	Liquefied Natural Gas
M	Migratory threatened species
MIC	Maximum Instantaneous Charge
MMS	Migratory marine species
MoU	Memorandum of Understanding
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
NES	Matters of National Environmental Significance
NEWF	North East Waste Forum

NGA	National Greenhouse Accounts
NOROC	Northern Rivers Regional Organisation of Councils
NP	National Park
NPI	National Pollutant Inventory
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	National Parks and Wildlife Service
NR	Nature Reserve
NSW	New South Wales
NV Act	*Native Vegetation Act 2000*
NW Act	*Noxious Weeds Act 1993*
OEH	Office of Environment and Heritage (NSW) [created April 2011 replacing DECCW]
OU	Odour Unit
PAF	Potential Acid Forming
PASS	Potential Acid Sulfate Soil
PoM	Plan of Management
PM_{10}	Particulate Matter of 10 micrometers or less
PPV	Peak particle velocity
RBL	Rating Background Level
RCS	Respirable Crystalline Silica
RF Act	*Rural Fires Act 1997*
RL	Reduce Level
RLP Act	*Rural Lands Protection Act 1998*
RMS	Root Mean Square
RRC	Resource Recovery Centre
SCA	State Conservation Area
SEPP	State Environmental Planning Policy

SEPP 14	State Environmental Planning Policy 14 – Coastal Wetlands
SEPP 26	State Environmental Planning Policy 26 – Littoral Rainforests
SEPP 44	State Environmental Planning Policy 44 – Koala Habitat Protection
SIS	Species Impact Statement
SOER	Specific Odour Emission Rate
TAPM	The Air Pollution Model
tCO_2-e	Tonnes of Carbon Dioxide Equivalent
TPH	Tonnes Per Hour
TSC	Tweed Shire Council
TSC Act	*Threatened Species Conservation Act 1995*
TSLA	*Threatened Species Legislation Amendment Act 2004*
TSP	Total Suspended Particulates
V	Vulnerable threatened species
VENM	Virgin Excavated Natural Material
WM Act	*Water Management Act 2000*

Executive Summary

Introduction

Tweed Shire Council (Council) is seeking approval to develop new infrastructure to provide for the waste management requirements of the Tweed Shire in the short term, as well as broader concept approval for the development of waste infrastructure and extractive industries to meet the needs of the Shire in the longer term.

An overall Concept Plan has been developed for the site, which is situated at Eviron Road in Eviron, and includes Lot 1 DP 34555, Lot 1 DP1159352 and Part Lot 602 DP 1001049. These allotments are located adjacent to Stotts Creek Resource Recovery Centre (RRC), the Shire's existing waste disposal facility.

It is noted that the activities forming this overall Concept Plan include shared infrastructure and access with Stotts Creek RRC. The development at Eviron Road is however separate to the activities at Stotts Creek and for this reason an assessment of cumulative impacts of the two sites was not considered relevant.

The Concept Plan outlines the proposed staged project. In summary, it is proposed to develop a waste disposal facility for residual wastes (i.e. after separate collection of organics and composting), within the existing void created by Quirks Quarry. Further to this two extractive industries would be developed to be used as waste disposal facilities after exhaustion of the quarry resource. Necessary operational infrastructure such as a haul road and other minor associated facilities would also be developed. Through adopting a staged approach, Council would have the opportunity in the interim to consider and develop alternative waste collection methods, including food organics as well as investigate and potentially introduce alternative waste technologies (AWT).

This Environmental Assessment provides information to support the applications for both approval of the Concept Plan as well as for approval of the Project Application. The document is intended to:

- Provide detailed information on the Project Application including the need for the project and alternatives considered;
- Provide broader detail of intentions for future stages outlined in the Concept Plan;
- Address the key environmental impacts of the project as identified in the DGRs;
- Identify, through an environmental risk assessment, other environmental risks not considered in the DGRs; and
- Detail the proponent's commitments in terms of measures to minimise and manage potential environmental impacts.

Note that throughout this document, the terms 'waste disposal facility' and 'extractive industry' are used interchangeably with the terms 'landfill' and 'quarry' respectively.

Site Overview

The site is located along a spur along the northern ridge of the Condong Range where it meets the floodplain of the Tweed River. It presently contains Quirks Quarry in the eastern portion of the site on Lot 602 DP 1001049. The quarry has nearly reached the limit of its resource. Two valleys known as West Valley and North Valley are located in the southern western and central northern portions of Lot 1 DP1159352. Vegetation on and surrounding the site has largely been cleared historically for agricultural purposes prior to quarrying. On the hillslopes, the site contains regrowth closed to open forest dominated by the weed species Camphor Laurel, while vegetation in the lower elevation areas is predominantly grassland with scattered patches of trees.

Approvals Sought

The project outlined in the Concept Plan was declared by the NSW Department of Planning (DoP) to be a Major Project in accordance with Part 3A of the Environmental Planning and Assessment Act, 1979 (EP&A Act). Under the Part 3A process, the targeted assessment regime for the environmental assessment has been defined by the Director-General of the DoP in the Director-General's Requirements (DGRs), which were issued on the 31st July 2008.

As of May 2011, the NSW State Government announced that it will introduce a Bill to repeal Part 3A of the EP&A Act. As part of the transitional arrangements announced, applications for project types including mining and significant infrastructure proposals that are already in the Part 3A system will continue to be assessed and determined under Part 3A pending its legislative repeal.

Concept Approval

Council, as the proponent, is seeking concept approval under Section 75M of the EP&A Act for the concept plan (DoP Project Number MP 08_0067) to develop the following infrastructure in stages:

- Two extractive industries (quarries): North Valley and West Valley;
- Three waste disposal facilities (landfills): Quirks Quarry, North Valley and West Valley; and
- Associated infrastructure.

Stage 1 of the Concept Plan (DoP Project Number P08_0068) includes:

- Construction of a haul road from Stott's Creek Resource Recovery Centre;
- Development of a landfill within the Quirks Quarry void; and
- Development of a quarry within the West Valley site.

Subsequent stages may include:

- Landfill at West Valley;
- Quarrying at North Valley; and
- Landfill at North Valley.

Project Approval

Council is seeking project approval under Section 75E of the EP&A Act for Stage 1. As indicated above, the project includes:

- Extraction, processing, and transportation of up to 200,000 tonnes of extractive material a year from a quarry established at West Valley;
- Disposal of up to 75,000 tonnes of putrescible waste a year in a landfill developed within the Quirks Quarry void;
- Development of associated infrastructure, including a haul road from Stotts Creek RRC; and
- Rehabilitation of both sites.

Project Need and Justifiable Demand

Current Practices in Waste Management and Resource Recovery

The Tweed Shire Domestic Solid Waste Management Strategy ('the Waste Strategy') was endorsed by Council after considerable community consultation. The Waste Strategy identified 35 key recommended actions and strategies to improve waste avoidance, minimisation and resource management, consistent with the goals of sustainability. Council has been progressively and strategically addressing the recommendations contained within the strategy since its endorsement.

Demand for Landfill Capacity

Stotts Creek RRC contains the only municipal waste disposal facility in the Tweed Shire. The landfill at the RRC is predicted to reach capacity by 2012. As such Council is seeking to develop new waste infrastructure to provide for the waste management requirements of the Shire in the short term, to meet the immediate need in relation to the current low capacity/demand ratio, which needs to be promptly addressed. In addition, Council seeks approval to develop additional waste infrastructure to meet projected medium and long term needs.

Alternatives Considered

The possible alternative of transporting residual waste or all wastes (excluding waste excavated materials) to an existing landfill already in operation in South East Queensland was considered in the Waste Strategy. This alternative considered large-scale landfill facilities privately operated in the Ipswich region and Gold Coast City Council operated landfills. Council chose not to pursue the option of interstate waste disposal for a number of reasons including the following:

- Community consultation on the Draft Waste Strategy revealed a strong sentiment that the Shire should take ownership and control over its own waste generation and disposal;
- Waste transportation would result in significant costs and greenhouse impacts that were considered avoidable by landfilling residual waste at Eviron Road;
- Disposal outside the Shire would mean a foregone commercial opportunity for beneficial waste processing (e.g. composting/mulching) in the Tweed; and

- Exportation of waste for disposal to South East Queensland is not in line with the intended spirit of the NSW Waste Avoidance and Resource Recovery (WARR) Strategy and would provide little incentive to achieve the WARR Strategy targets.

The use of an interstate landfill was found to not offer a sustainable waste management solution and confirmed that clear justifiable demand existed for provision of landfill capacity in the Tweed.

Alternatives to Landfilling

Council commissioned a "Situation Analysis" of Alternate Waste and Resource Recovery Technologies in 2008. A copy of this study is provided in Appendix F which concluded that there were no commercial, environmental or community best value grounds at that time, for the pursuit of AWT for the Tweed Shire. The conclusion was largely based on estimates of waste quantities generated in Tweed Shire, that were below the minimum technical feasibility level for AWT options currently in use in Australia.

Since 2008, Council has continued to seek out options for alternatives to landfilling and has in its recently finalised ten year Community Strategic Plan committed to responsibly investigating and implementing an advanced (alternative) waste treatment technology for processing of residual waste.

Site Selection

Council undertook a process of site selection in the early 1990s at a time when it was recognised that a site for the Shire's future waste disposal requirements would be necessary after the capacity of the waste disposal facility at Stotts Creek was reached. Site selection included the following criteria that are consistent with the Solid Waste Landfill Guidelines:

- The proposed site would need to be flood free;
- The proposed site would not be situated on prime agricultural land;
- The proposed site should be predominantly gently sloping;
- The proposed site should be easily accessible from major population centres;
- The proposed site should be remote from residential areas;
- The proposed site should have few adjoining landowners; and
- The existing property owners would need to be agreeable to sell the properties.

Eviron Road was chosen by Council as the most suitable site to address the selection criteria and negotiations with affected landowners were undertaken and the site was subsequently predominantly rezoned in the Tweed Local Environmental Plan (2000) to Zone 5(a) – Special Uses (Garbage Depot). One of the key advantages that was recognised in the selection of the site was the proximity to Council's existing waste facilities at Stotts Creek RRC, as the existing facilities at that site could be utilised, and construction of a haul road between the two sites could reduce potential impacts and costs associated with establishing front end infrastructure such as a site office, weigh bridge and transfer station.

Environmental Risk Assessment

An environmental risk assessment was undertaken that confirmed that the key issues identified in the DGRs should be further addressed with respect to the Concept Plan and the Project Approval for Stage 1. A brief outline of key issues, how they were addressed, and potential impacts for each are outlined following.

Surface Water and Leachate

The Quirks Quarry Landfill Concept Design Report and the West Valley Quarry Preliminary Study, were prepared as technical documents to support this Environmental Assessment. These documents included an assessment of potential impacts on surface water quality and flows and surface water and landfill leachate management. A review of the findings of baseline surface water quality monitoring was also undertaken.

Existing Conditions

Quirks Quarry is currently located on a natural ridgeline, which, combined with a diversion drain upgradient of the quarry operations, limits the catchment to the quarry footprint itself. The existing diversion drain directs upstream runoff to a small detention basin to the west of the quarry. Runoff generated on the quarry itself is directed by a series of drains, a dam, and a sediment basin.

Four catchments are situated within West Valley and North Valley. Drainage flow paths from both valleys convey surface water to a drainage channel that adjoins Stott’s Channel and eventually the Tweed River. Flood mapping of the area indicates a 1 in 100 year flood level of 3.9 m AHD.

Impact Assessment

A water balance model was developed including a model for leachate quantity and a model to design stormwater infrastructure.

Leachate

The results from the leachate model demonstrated that leachate generation would vary significantly over the life of the landfilling operation and during different climatic conditions. The conservative approach of the model, the maximum peak monthly leachate generation will occur during Stage 3 of the landfilling operation.

Stormwater

The operations for the Stage 1 Project Application will generate different types and quality of waters, including:

- Runoff from undisturbed areas of Quirks Quarry Landfill and West Valley Quarry (clean stormwater runoff);
- Runoff from rehabilitated (revegetated) areas of Quirks Quarry landfill (clean stormwater runoff);
- Runoff from disturbed areas of the landfill or quarry (potentially turbid/sediment laden stormwater runoff);
- Runoff from within the active landfilling area (potentially leachate); and

- Leachate from within the landfill.

Mitigation Measures

Leachate Management

The following will be implemented to manage leachate:

- Leachate will be stored within landfill cells; or
- Leachate disposal will be undertaken as follows:
  - Stage 1A and 1B: Irrigation onto active landfilling area, to control leachate levels in the interim period until a leachate treatment plant and irrigation area is established; and
  - Stage 2 and 3: Treatment of leachate followed by irrigation to a dedicated and contained irrigation area.

The following additional measures will also be implemented to ensure leachate does not leach from the basal lining system:

- A HDPE liner above the proposed compacted clay liner;
- Monitoring of landfill leachate levels; and
- Monitoring of leachate quantity and quality.

Stormwater Management

- Quirks Quarry Landfill (and future landfills):
  - A sediment basin will be required to intercept and retain sediment laden stormwater runoff from disturbed areas of the site following a rainfall event.
  - A perimeter landfill drain or diversion drain will be implemented around the perimeter of the landfill area as each Stage of the landfill is developed to reduce the volume of stormwater runoff from disturbed areas entering the current waste filling area, where waste batters have been intermediately covered or where the final cap has been installed but inadequate ground cover has not yet established; and to intercept stormwater runoff from perimeter access tracks.
  - Upon completion of landfilling, the sediment basins will be converted into wetlands.
- West Valley and North Valley:
  - Modelling indicated that one sediment basin at two discharge points (one for West Valley and one for North Valley) will be utilised to mitigate stormwater runoff from the four catchments.
  - Sediment basins were sized to achieve a 100 year ARI regional flood immunity and would be fenced to prevent access due to the likely depth of standing water.

Groundwater

Potential impacts on local and regional groundwater environment were assessed through review of relevant existing information including existing data, monitoring networks, published geological and acid sulfate soil maps, land classification maps, regional monitoring network databases and reports to help characterise the geology, soils and hydrogeology of the site, review of the draft acid sulfate soils management plan referred to in the Stage 1 Concept Plan.

Existing Conditions

The existing geological environment was determined through a review of water quality in a series of existing groundwater monitoring bores and newly installed bores. Geological information, including bore logs and site monitoring data and hydrographs, suggest that the main water bearing horizons beneath the site were:

- Shallow alluvial and marine deposits – in which depth to water ranged from around 1 to 3.5 m below ground surface. Seasonal variations in static water levels are between around 0.2 and 1 m in the vicinity of the floodplain, close to the channel which suggests some connectivity between shallow groundwater and surface water, given the limited range in groundwater levels. No surface water level data were available to support this.
- Fractured bedrock (Neranleigh-Fernvale beds) - Groundwater within the bedrock is expected to flow predominantly via fractures and joints (secondary porosity), towards the north-east sympathetic with the fall in topography. The existing data suggest static water levels in bedrock range between around 5 m AHD and 40 m AHD with seasonal variations of up to around 2 m.

No information on groundwater levels within the bedrock beneath the alluvial deposits is available and hence the potential for groundwater flow from the bedrock to the overlying alluvium (or vice versa) cannot be determined.

Groundwater quality, except for concentrations of iron, appeared to be relatively consistent in lower lying areas of the site and no trends are apparent in the data.

Potential Impacts

Landfilling

- Potential for a reduction in groundwater quality and surface water quality down hydraulic gradient of the landfill and downstream of the site as a result of seepage of leachate through the landfill liner; and
- Potential for compromising the integrity of the landfill liner during construction.

Quarrying

- Potential for an increase in the hydraulic conductivity of the shallow bedrock beneath and in vicinity of quarried areas as a result of induced fracturing that may occur following overburden/rock removal and blasting operations;
- The Neranleigh-Fernvale beds can contain pyritic materials, which when exposed to the atmosphere, for example through dewatering, have the potential to generate acid leachate and hence there is potential for a reduction in the quality of groundwater during and after quarrying operations;
- Potential for a reduction in flow rate in the surface water channel which flows towards the north west through the site as a result of quarry dewatering;
- Potential for lowering of groundwater levels in the shallow alluvial deposits. Dewatering of bedrock up hydraulic gradient of the floodplain deposits is likely to reduce the rate of groundwater flow to the alluvial deposits, however the extent of the impact will depend on the

degree of connectivity between groundwater in bedrock and in the overlying alluvial deposits which is currently unknown; and

- Potential for degradation of ground water quality if the permanent water table is lowered. Infiltration of rainfall through dewatered, oxidised ASS material could lead to the generation of acid leachate, increased groundwater and surface water acidity and mobilisation of metals.

Mitigation Measures

Quirks Quarry Landfill

A range of management measures aimed at addressing potential hydrogeological and groundwater impacts have been outlined in both the Concept Design Report and the Draft Landfill Environmental Management Plan for Quirks Quarry Landfill. These are principally aimed at avoiding and minimising impacts and most are also aimed at mitigating potential impacts to surface water quality.

- Base of Cell Relative to Water Table - the landfill concept design has used a minimum level of RL 2 (located at the lowest point of the landfill area, Stage 2) for design of the subgrade base levels. This would allow a minimum attenuation layer of approximately 1.9 m above the groundwater table;
- Landfill Liner Concept - landfill liner will be designed in accordance with the NSW EPA guidelines for Solid Waste landfills such that a permeability of less than 1×10^{-9}m/s is achieved; and
- Groundwater Monitoring – a baseline groundwater monitoring program will continue on a quarterly basis such that site specific trigger values can be adopted upon commissioning of the landfill.

West Valley Quarry

- Unless the current water table is lowered (i.e. through dewatering) and rock/soils which are currently below the watertable become exposed to the atmosphere then the acid generated through leaching of rock/soil is probably unlikely to change significantly from existing conditions;
- If dewatering of the Neranleigh-Fernvale beds is to be carried out as part of the development, laboratory testing and analysis will be carried out on samples obtained from rock likely to be dewatered, to assess the potential for acid generation and hence potential for impact from acid mine drainage; and
- A groundwater monitoring and management plan will be developed and implemented. Groundwater monitoring should be conducted on a quarterly basis leading up to commissioning of the quarry and during operations.

Concept Plan

Development in subsequent stages of the project, including landfilling in West Valley and quarrying and landfilling within the North Valley will be subject to further investigations prior to arriving at conceptual groundwater management options.

Acid Sulfate Soils

Potential acid sulfate soil (ASS) impacts were assessed through undertaking a review of relevant existing information including existing investigation data, published geological and acid sulfate soil maps, land classification maps and reports to help characterise the geology, soils and hydrogeology of the site as well as a review of the draft acid sulfate soils management plan referred to in the Preliminary Environmental Assessment.

Existing Conditions

The review identified the following:

- The limited laboratory analysis to date supports the regional-scale Acid Sulfate Soil Risk Mapping suggests that ASS materials (AASS and PASS) are likely to be present in lower lying parts of the site including West Valley, North Valley and Quirks Quarry;
- ASS materials are likely to be present up to at least 4 m below ground surface and have been identified in clays and clay with gravel at investigation locations;
- Sources of potential acidity at the site include a combination of organic and inorganic sulfides; and
- The ASS materials are unlikely to have sufficient self neutralising capacity and would require liming.
- The preliminary quarry study in the West Valley together has indicated that some of the Neranleigh Fernvale beds contain pyritic material with the potential to release acid drainage.

Potential Impacts

Quirks Quarry Landfill

- If alluvial deposits are proposed to be used in landfill construction then there is potential for the generation of acid from excavated potential acid sulfate soil material if the material is not properly managed and treated before use, in accordance with ASSMAC guidelines, noting that soil properties can change following treatment with lime.

West Valley Quarry

- There is potential for the generation of acid as a result of the disturbance of acid sulfate soil and pyritic material as part of quarrying operations. If not properly managed and treated, disturbance of acid sulfate soils could potentially lower the existing pH of groundwater (which is currently typically acidic) and/or surface water and result in an increase in the concentrations of metals in groundwater and surface water.

Haul Road

- A 500 m section of the proposed haul road within Lot 26 falls within the mapped acid sulfate soil risk area and will require further investigation during detail design.

Mitigation Measures

Additional investigations will be undertaken during detail design for the Stage 1 Project Application to better constrain the level of treatment required to neutralise ASS material at the site, may identify areas of lower and higher potential for ASS and may reduce the amount of material requiring treatment.

Quirks Quarry Landfill

- The use of alluvial deposits for landfill liners will not be permitted to eliminate the potential issue associated with ASS.

West Valley Quarry

- Further investigations for acid sulfate soil and pyritic material will be undertaken during the detail design phase, such that an appropriate management plan can be developed. The priority management measure for pyritic material will be to avoid disturbance. Where this is not practicable management will be aimed at maintaining saturated conditions, and excluding air to prevent oxidisation of the pyritic materials.
- A minimum bench level (i.e. the lowest elevation at which extraction will take place) of 4 m AHD has been adopted in the West Valley Quarry preliminary study with a view to minimising the impacts associated with disturbance of acid sulfate soils;

Haul Road

- Further investigation of ASS will be undertaken during detail design of the haul road, at a minimum of five locations within the mapped risk area; and
- A revised Acid Sulfate Soil Management Plan will be prepared for the activities comprising the Stage 1 Project Application.

Noise, Blasting and Vibration

A noise and vibration assessment, including attended and unattended monitoring, was undertaken to identify existing conditions, potential impacts and mitigation measures associated with noise and vibration from excavation works, blasting operations, landfilling activity and heavy vehicle movements associated with the quarry and landfill developments.

Existing Conditions

Attended observations noted that existing levels of industrial noise in the area are not a significant contributor to the existing ambient noise level in the vicinity of the development. The monitoring indicated noise sources were typical of a rural environment with local animals and nearby insects influencing the ambient noise. Distant traffic noise from the Pacific Highway was also audible during the attended monitoring. However the only audible noise from either the quarry or landfill was reversing alarms on heavy vehicles, however this was not generally measurable above the background noise levels.

Potential Impacts

Noise model simulations were conducted for three different site configurations representing different stages of operations during the entire Concept Plan.

- **Configuration 1:** Quirks Landfill and West Valley Quarry. Stage 1 of the proposed Concept Plan (2012 – 2021).

  Noise levels from normal operations of the West Valley Quarry and Quirks Landfill are expected to meet the daytime criteria at all identified residential receivers, except for at Receiver 3 (656 Eviron Road) where a potential 2 dB exceedance is predicted. Analysis of the noise contribution data shows the quarry processing plant to be the dominant source of noise at this receiver. Road traffic noise associated with the Stage 1 activities is expected to comply with the relevant criteria. On the basis of the quarry blast design and site parameters provided ground vibration and airblast overpressure criteria are also met at nearest sensitive receivers.

- **Configuration 2:** West Valley Landfill and North Valley Quarry. Stage 2 of the proposed Concept Plan (2022 – 2033).

  Noise levels from normal operations from the North Valley Quarry and West Valley Landfill are expected to meet adopted criteria at all identified residential receivers. The operation of the hard rock drill at North Valley Quarry has potential to increase noise levels by up to 5 dB(A), causing a 1 dB exceedance at Receiver 3 (656 Eviron Road). Noise levels at all other receivers are predicted to remain below the adopted criteria. As the landscape of the quarry and landfill change, the contributions of individual sources are also changed. As the quarry pit deepens and the quarry processing plant becomes more shielded by the active wall, noise levels at all receivers are generally predicted to reduce and comply with the adopted goals.

  The predicted increase in road traffic noise is expected to be less than 2 dB and total traffic noise levels should remain below the NSW ECRTN criteria for local roads

- **Configuration 3:** North Valley Landfill only (2034 – 2045). Stage 3 (or subsequent).

  At the time when North Valley landfill remains as the only activity onsite, operational noise levels are expected to readily comply with the adopted criteria at all identified residential receivers. As the landscape of the landfill changes, noise levels at receivers are predicted to increase slightly, but remain under the adopted noise goals.

Mitigation Measures

Mitigation measures proposed for quarrying and landfilling operations throughout the life of the project (Stage 1 and Concept Plan) include the following:

- Specific noise control measures:
  - When the hard rock drill is in use at the quarry, use of other quarry equipment will be limited (or ceased) to assist in minimising cumulative noise impacts on nearby receivers.
  - Measures to reduce noise impacts associated with the quarry processing plant (particularly during the operation of the West Valley Quarry) will be investigated and could include a mobile or fixed noise wall, locating the processing plant in an area naturally shielded by topography, or as a last resort treating the building facades of nearby sensitive receivers.
- Controls on blasting activities will be implemented to reduce short term impacts. This will include avoiding times of adverse weather conditions, avoiding overfilling blast holes, and firing holes in the front row with insufficient burden. In addition blasting designs will consider measures to minimise ground vibration and air overblast. Drilling and blasting at the quarry is under taken by qualified contractors.
- Site machinery:

- Review available fixed and mobile equipment fleet and prefer more recent and silenced equipment whenever possible. In any case, all equipment used on site should be in good condition and good working order;
- Plan to use equipment, which is appropriate for the required tasks in terms of power requirements;
- All engine covers should be kept closed while equipment is operating;
- As far as possible, materials dropping heights into or out of trucks should be minimised;
- All combustion engine plant should be checked to verify they produce minimal noise with particular attention to residential grade exhaust silencers;
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable;
- Where practical, machines should be operated at low speed or power and should be switched off when not being used rather than left idling for prolonged periods;
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made; and
- Although the model assumptions were deemed conservative, it is recommended that equipment noise levels be monitored once the Quarry and Landfill are operating to verify noise emissions are in line with the model assumptions.

Air Quality and Odour

An air quality assessment was undertaken to identify existing conditions, potential impacts and mitigation measures associated with landfill and quarry developments as part of Stage 1 and the overall Concept Plan.

Existing Environment

Relevant site-specific ambient air quality data was not available for Eviron at the time of this assessment. An ambient air quality was assumed for rural coastal NSW areas away from the drier inland, industrial sources and urbanised environments, although it was recognised that air quality in the Tweed Shire has historically been heavily impacted by the cane harvesting season.

Potential Impacts

Landfill

Sources of dust emissions for the Quirks Quarry landfill and the West and North Valley landfills will include:

- Earthworks and waste handling within the landfill;
- Vehicle movements on unsealed roads about the site and on the landfill area; and
- Wind erosion from disturbed/unsealed areas on the site.

Quarry

Activities at the proposed quarries include rock extraction, screening, crushing and transport of the processed rock offsite. The individual processes that generate significant amounts of particulate matter (dust) were identified to be:

- Rock quarrying e.g. blasting, excavation and bulldozer;
- Material processing and handling e.g. crushing and loading;
- Vehicle induced dust emissions in pit area; and
- Wind erosion of exposed unstable soil surfaces and localised stockpiles.

Predicted Dust and Odour Impacts

Compilation of an emissions inventory confirms that the main source of dust emissions will be the operating quarry, while the main source of odour emissions will be the operating landfill. The dominant source of dust emissions within each quarry was shown to be the processing activities, consisting of the crushers, dozer, loaders and excavator.

Dispersion modelling was undertaken for the site configurations representing different stages in the Concept Plan.

- Configuration 1: Quirks Landfill and West Valley Quarry. Stage 1 of the proposed Concept Plan (2012 – 2021).

  Configuration 1 was shown to pose the greatest potential for off-site dust impacts, particularly concentration levels of fine particulates (PM_{10}) over a 24-hour averaging period. All other constituents (dust and odour) assessed over the relevant averaging periods were predicted to be below their respective assessment criteria at the nearest sensitive receptors.
- Configuration 2: West Valley Landfill and North Valley Quarry. Stage 2 of the proposed Concept Plan (2022 – 2033).
- Configuration 3: North Valley Landfill only (2034 – 2045).

  Configurations 2 and 3 were shown to have less potential for off-site dust or odour impacts. In fact, all constituents (dust and odour) assessed over the relevant averaging periods were predicted to be below their respective assessment criteria at the nearest sensitive receptors

  Modelling results indicated that all constituents assessed over the typical averaging periods were below the respective assessment criteria at the nearest sensitive receptors for the modelled emission rate characteristics.

Predicted PM_{10} 24-hour average concentrations, modelled under a maximum quarry throughput of 400 TPH, indicate that PM_{10} concentrations may potentially exceed the 24-hour criterion at three of the identified sensitive receptors. However, when modelled under the anticipated normal production rate of 100 TPH, the model results indicate that PM_{10} concentrations would comply with the 24-hour criterion at all identified receptors.

Mitigation Measures

Mitigation measures to address potential air quality impacts for the proposed quarrying and landfilling operations throughout the life of the project (Stage 1 and Concept Plan) include the following:

Dust Management

Dust management will be outlined in the environmental management plan. Measures to be implemented would include:

- Use of water sprays to increase the moisture content of quarried product;

- Weather monitoring;
- Use of water sprays/trucks and sprays to wet down access roads;
- Clean sealed roads at access and egress points regularly to minimise the re-suspension of dust on sealed roads;
- Use water sprays to minimise truck dust emissions;
- Appropriately store and contain materials to prevent releases to the atmosphere;
- Cover loads during movement of materials in windy conditions or when materials being transported have a high level of fine particles; and
- Install spray systems on equipment and the stabilisation of the surface silt content of working surfaces around the processing site.

Odour Management

Odours will be minimised by:

- Not depositing waste in standing water;
- Depositing wastes in thin layers to optimise compaction;
- Limiting the deposition of potentially malodorous wastes;
- Covering all exposed waste at the end of each working day with daily cover material; and
- Minimising disturbance of previously filled areas.

Greenhouse Gas

A greenhouse assessment was prepared in accordance with the following general principles:

- The Greenhouse Gas Protocol (GHG Protocol), a recognised international standard;
- The *National Greenhouse Accounts (NGA) Factors – June 2009* published by the DCC (now DSEWPC);
- The DCC (now DSEWPAC) *National Greenhouse and Energy Reporting System Measurement, Technical guidelines for estimation of greenhouse gas emissions by facilities in Australia – June 2009*;

The following sources were assessed in developing the assessment:

- Methane emissions;
- On-site equipment fuel consumption; and
- On-site plant fuel use.

Potential Impacts

The result of modelling estimated that the Stage 1 Project Application (Quirks Quarry Landfill and West Valley Quarry) would result in total emissions of approximately144,968 tCO_2-e. Of this total methane emissions were the largest source contributing 97% of all emissions, with the remaining 3% arising from plant and equipment fuel use.

In subsequents stages of the project it has been estimated that the total greenhouse gas emissions may be in the order of approximately 724,605 tCO_2-e for the West Valley Landfill and

North Valley Quarry and Landfill based on the current conceptual plans for these activities. However this figure is highly dependent on the nature and duration of activities in the subsequent stages. As noted within the discussion of the project staging, there are many factors that will influence the actual period of time over which the activtieis will operate that cannot be fully quanitifed at this time. However, these emissions estimates are made on the basis of currently available information regarding landfilling and quarrying techniques and emissions factors.

Mitigation Measures

Methane Emissions

To minimise methane emissions it is recommended that:

- The landfill shall be progressively capped as soon as possible following the deposition of the waste. The cap shall be designed, constructed and maintained to minimise the emissions of gas from the decomposing waste; and
- A landfill gas management system will be installed to capture gaseous emissions including methane.

Reducing biodegradable organic content of waste going into the landfill would also reduce the methane emissions; however the quantity of landfill gas available for electricity generation along with the amount of carbon sequestered would also be reduced. To quantify the effects on the overall carbon footprint, an assessment would be required that also considers the implications of the emissions arising from the diverted waste.

Fuel

The following options may reduce diesel emissions:

- Switching to fuels with lower carbon intensity, such as biodiesel blends or liquid natural gas;
- Switching off equipment and stationary plant when not required;
- Optimising transport routes, payloads and journey timing to minimise fuel consumption;
- Selecting higher efficiency vehicles and stationary plant when making capital purchases and ensuring their size is appropriate for the intended tasks;
- Ensuring that vehicles are well maintained and have optimal tyre pressures;
- Ensuring that the operators and drivers are trained to operate vehicles and plant efficiently; and
- Reviewing the current waste network and operational procedures to identity potential opportunities to minimise transportation requirements and double handling of waste.

Carbon Offsetting

In addition to the mitigation of greenhouse gases by on-site programs, the carbon footprint of the project could be reduced by the purchase of offsets. These offsets can be generated from a variety of sources such as renewable energy, forestry plantations and energy efficiency projects.

Biodiversity

An ecological assessment was undertaken to address the Director General's Requirements with respect to biodiversity. These specifically related to:

- Vegetation clearing estimates;
- Assessment of potential impacts upon threatened species, populations, endangered ecological communities or their habitats; and
- A detailed description of the measures that would be implemented to achieve a 'maintain or improve' outcome for biodiversity values of the surrounding region in the medium to long term.

Existing Conditions

The ecological assessment identified that over 65% of the site was predominantly cleared or utilised for agricultural purposes, and 27% was camphor laurel (**Cinnamomum camphora*) dominated and thus in a relatively disturbed condition. Some areas of higher ecological vegetation comprised of eucalypt open forest (wet and dry sclerophyll) including an area containing elements consistent with the endangered ecological community lowland rainforest on floodplain were also present, and a small area of vegetation adjacent to a drainage line showed characteristics of swamp sclerophyll forest on coastal floodplain.

Vegetation at the site provided suitable habitats for a variety of threatened rainforest plants. A number of conservation significant plant species were identified in the study area. These included white lace flower *(Archidendron hendersonii*) which is listed as vulnerable under the *Threatened Species Conservation Act 1995* and a number of rare or threatened Australian plants including black walnut *(Endiandra globosa*), long-leaved tuckeroo *(Cupaniopsis newmanii*) and smooth scrub turpentine (*Rhodamnia maideniana*). Five white lace flower plants occur within the development footprint (*Archidendron hendersonii*) will be removed as a result of the proposed activity. This species was also recorded in areas outside of the development footprint.

Six threatened fauna species listed under the *Threatened Species Conservation Act 1995* were observed or recorded on site during the survey, these being:

- Birds:
  - Collared kingfisher – (*Todiramphus chloris*) - vulnerable - (presumed to be a dispersing individual); and
  - Little lorikeet – (*Glossopsitta pusilla*) - vulnerable.
- Mammals:
  - Koala (*Phascolarctos cinereus*) – vulnerable;
  - Grey-headed Flying-fox (*Pteropus poliocephalus*) – vulnerable;
  - Eastern false pipistrelle – (*Falsistrellus tasmaniensis*) - vulnerable ('almost certain' call identification confidence); and
  - Little bentwing-bat – (*Miniopterus australis*) - vulnerable ('definite' call identification confidence).

Potential Impacts

A number of existing and historical impacts have occurred within the site for a number of years. These relate to past land clearing for grazing and agriculture, and existing quarry operations in the site, as well as landfill operations at Stott's Creek RRC. These impacts relate to historical habitat loss, degradation and alteration as well as fragmentation.

Quarry impacts would be associated with development activities such as clearing, blasting, extraction, stockpiling and hauling. Associated potential impacts included:

- Habitat loss;
- Habitat fragmentation;
- Loss of biodiversity; and
- Fauna mortality or injury.

The development of the landfill will include a fully engineered liner and leachate management system. Landfill impacts would be associated with active landfilling, with the key associated potential impact being habitat degradation.

Impacts associated with the haul road predominantly relate to vegetation clearing with potential habitat loss and habitat fragmentation as well as potential for direct mortality from vehicle strike.

An assessment of threatened species potentially impacted by the proposed activity against the relevant guidelines, did not identify that the proposed development would result in any adverse impacts that were likely to result in a reduction in the viability of a threatened species, population or ecological community that was recorded or could occur in the study area.

Mitigation Measures

A series of management measures that Council will employ to achieve a 'maintain or improve' outcome were described in the ecological assessment. These included:

- Avoid:
  - Quarry development footprints and the haul road have been located and where possible reconfigured or realigned to primarily avoid areas of higher ecological value habitats and predominantly result in clearing of camphor dominated vegetation types; and
  - Landfill footprints are wholly contained within the quarry development footprints and will not result in further clearing requirements.
- Mitigate:
  - Design of the quarry and landfill components of the activity will include design features that reduce the potential for environmental impacts, such as leachate management systems, appropriate drainage and flood management systems; and
  - All components of the development will be subject to an approved Environmental Management Plan in order to actively manage potential impacts of the development throughout the course of the activity.

Some values require further consideration through provision of an offset. These measures include:

- A restriction on use on a portion of Lot 1 DP 1159532 registered on the title imposing a legal obligation in perpetuity to abide by the management actions of a Habitat Management Plan.

A plan showing the habitat areas on the lot would be registered with the S88B instrument to identify the area burdened by the restriction;

- Corridor planting and enhancement – two areas within the site have been identified for creation of connectivity and reconstruction of habitat including staged removal of camphor laurel and other weed species; and
- Supplementary nest box installation – although no hollow-bearing trees will be removed some mature eucalypts with the potential to provide hollows will be lost. Consequently, in recognition of this, a nest box plan for petaurid gliders is proposed.

Traffic

Existing Environment

The site has access currently has access onto Eviron Road. However for the proposed activities all vehicles will access the site via the existing access to Stotts Creek RRC from Leddays Creek Road. Therefore site access to and from Eviron Road was not assessed as this access will be removed as part of the Concept Plan and the key intersections assessed were Leddays Creek Road (site access) and Bartletts Road, and Leddays Creek Road and Tweed Valley Way.

Leddays Creek Road is a sealed two lane rural road (one lane each direction) that starts at the site access and joins on to Tweed Valley Way to the north. Tweed Valley Way is a two lane (one lane each direction) 100 km/hr. arterial road which follows the Tweed River and eventually loops back on to the Pacific Highway which is directly to the east of Quirks Quarry

The key intersections assessed were:

- Tweed Valley Way and Leddays Creek Road; and
- Facility access / Leddays Creek Road and Bartletts Road

Potential Impacts

- Removal of heavy vehicle quarry traffic from Duranbah Road through the closure of the quarry access on Eviron Road and establishment of haul road through to Stotts Creek RRC;
- Improved access to Pacific Highway for quarry traffic by travelling on Leddays Creek Road and Tweed Valley Way;
- Increased heavy vehicle traffic on Leddays Creek Road, potentially requiring bringing forward of maintenance program;
- Increased traffic at the Leddays Creek Road and Tweed Valley Way intersection, requiring review of safe access, particularly for quarry traffic.

Mitigation/Management Measures

- Cessation of access to the site via Eviron Road;
- Design of the haul road in accordance with good practice for heavy vehicle traffic;
- Safety audit for the Tweed Valley Way and Leddays Creek Road intersection to ensure safe access to and from the major arterial, especially for heavy quarry traffic;
- Maintenance of the Leddays Creek Road access intersection and provision of maintenance for the duration of the operation of the quarry and landfill activities;

- Preparation of traffic management plans (as part of the environmental management plans) to ensure safe movement of vehicles into and around each the site; and
- Requirement that each driver would sign a Code of Conduct (during their first visit to the operational site).

Heritage

A cultural heritage assessment was undertaken by Converge Heritage Consultants in 2009. This included consultation with the community and the Tweed Shire Council Aboriginal Advisory Committee, an assessment of the bio-geographical context of the area, a review of scientific assessments of cultural evidence, historical backgrounds, register searches, and traditional knowledge and literature available from various sources. Further consultation was undertaken to meet a request for clarification by DECCW.

Existing Environment

No areas or objects of Indigenous cultural heritage significance were identified nor were areas or objects of non-Indigenous cultural heritage significance were identified, most probably due to activities from the recent historic past including grazing, dairying and other more general farming activity, until more recent quarrying.

There were five springboard trees identified, which were thought to have historic interest, as they may be illustrative of the past activities of loggers and timber getters.

The survey results and the register searches indicated that there was a low probability that further, undetected cultural heritage material remained in the study area, either within areas of low visibility or as subsurface remains.

Potential Impacts

No areas or objects of Indigenous cultural heritage significance were identified within the study area. A Cultural Heritage Management Plan (CHMP) will be developed to reduce the risk of disturbance to items not identified.

A springboard trees, of historic interest, may be removed, as one of these is situated in close proximity to the West Valley footprint.

Mitigation Measures

Although no items of cultural heritage significance were located during the assessment the following recommendations have been provided to assist in protecting and managing the cultural heritage values of the project area.

- Development of a Cultural Heritage Management Plan (CHMP);
- On-going consultation with the local Aboriginal community to ensure cultural considerations are incorporated into future development activities and an appropriate CHMP for the site is developed, this would include:
  - A program of site monitoring by representatives of the Aboriginal Party during activities causing ground disturbance;
  - Development and implementation of procedures for managing unexpected finds; and

- Implement cultural heritage inductions so that work crews are aware of specific obligations to look for cultural heritage material.

- Springboard trees, which are items of historic interest that may be illustrative of the past activities of loggers and timber getters and should be retained *in situ* wherever possible and relocated to an appropriate location where they can be preserved and displayed along with appropriate interpretation if they cannot be retained *in situ.*

Visual Impact

A visual assessment was undertaken based upon a site visit and a geographic information system (GIS) viewshed analysis. This identified the extent to which each of eight residential dwellings could see various parts of the Stage 1 and Concept Plan activities at different times in the project's operational life.

It was identified that both Quirks Quarry Landfill and the West and North Valleys would be partially visible from each of the vantage points. Some mitigation would be possible through screen planting, however no full mitigation was available.

Hazards

Hazards typically associated with waste management facilities include:

- Health (biological) hazards;
- Occupational Health and Safety (OH&S) hazards;
- Operational hazards; and
- Hazards during excavation and construction works.

A range of management measures will be implemented to reduce the risks associated with the identified hazards.

Rehabilitation

Council intends to progressively rehabilitate the site. Quarry developments will be rehabilitated to fully lined landfills, while Council will progressively rehabilitate the landfills (and individual landfill stages) as filling is completed. This will involve placing an engineered cover layer over each tipping area as it is completed, and revegetating the final cover. A Landfill Closure Plan will be prepared and submitted to the regulatory authority at least three months prior to the last load of waste being landfilled at each of the planned waste disposal facilities.

Draft Statement of Commitments

The Environmental Assessment has identified that a number of key issues require further attention during detail design however the main potential impacts associated with the proposed activities can be effectively managed through project design features. A Draft Statement of Commitments as endorsed by Council has been developed for the project and contained within Section 10 of this report. These aim to reduce or manage potential environmental impacts. In particular it is noted that commitments made include undertaking detailed geotechnical, hydrogeological and acid sulfate soils investigations and the preparation of environmental management and operational management plans to ensure that the mitigation and management measures are developed, implemented and monitored. These plans would also ensure compliance with relevant legislation and any conditions of approval. Specific mitigation

PART A – Introduction and Context

1. Introduction

1.1 Overview

The existing waste disposal facility in Tweed Shire, the Stotts Creek Resource Recovery Centre (RRC), is predicted to reach capacity by 2012. Tweed Shire Council (Council), as the proponent, is seeking approval to develop new infrastructure to provide for the waste management requirements of the Shire in the short term. It is also seeking broader concept approval to develop waste infrastructure and extractive industries (quarries) that will meet the projected medium and long term needs of the Tweed Shire.

The new waste disposal facility is proposed to be developed upon Lot 1 DP1159352 and Part Lot 602 DP 1001049, at Eviron Road, Eviron, within the Tweed Shire Local Government Area ('the site'). It is noted that Lot 1 DP 34555 has been included in the study area for this assessment however it will not be sugject to the proposed quarry, landfill or associated infrastructure.The existing Council waste disposal facility, Stotts Creek RRC, is located immediately to the northwest of the site. The regional context and general locality of the site is shown on Figure 1, while Figure 2 shows the extent of the site.

Council has developed an overall Concept Plan for the site as shown on Figure 3. It comprises a staged project to develop a waste disposal facility within the existing void created by Quirks Quarry, develop two further extractive industries to be used as waste disposal facilities after exhaustion of the quarry resource, and install necessary operational infrastructure such as a haul road and other minor associated facilities. This proposed method of landfilling in quarry voids is consistent with the method of landfill creation in the Tweed Shire to date. Material won from quarrying is used for road building and other Council civil projects, and overburden stockpiled for road construction, clay liners (where appropriate) and site rehabilitation purposes. The staged approach will also potentially allow Council time to consider and develop alternative waste collection methods, including food organics and responsible investigation and introduction of alternative waste technologies (AWT).

The waste infrastructure as outlined in Council's Preliminary Environmental Assessment (2009) was declared by the (former) NSW Department of Planning (DoP) to be a Major Project, to which Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) applies. As identified in Planning Circular, PS 11-014 of 13 May 2011 (DPI, 2001), transitional arrangements in place under the new State Environmental Planning Policy (Major Development) Amendment 2011 (SEPP) allow existing project applications and concept plan applications to continue to be assessed under Part 3A of the Act until the proposed Bill that will repeal Part 3A of the EP&A Act is passed by Parliament and takes effect. As such, this document assumes that the Part 3A process will be maintained.

Under the Part 3A process, the targeted assessment regime for the project has been determined by key environmental issues as defined by the Director-General of DoP in the Director-General's Requirements (DGRs). These are provided in Appendix A.

Note that in this document, the term 'waste disposal facility' and 'extractive industry' are used interchangeably with the terms 'landfill' and 'quarry' respectively.

Council intends to undertake a staged approach to the proposed activity, and is seeking two approvals from DoP:

- *Project Approval* for Stage 1 of the Concept Plan, which involves landfill within Quirks Quarry, development of a new quarry in the West Valley and associated infrastructure including a haul road from Stotts Creek Resource Recovery Centre (RRC) (referred to as the 'Stage 1 Project Application'); and
- *Concept Plan Approval* for the overall Concept Plan, which includes all components of the Stage 1 Project Application, as well as the further development of a landfill in the West Valley, and a quarry and landfill in the North Valley, which are currently included in the Concept Plan (referred to as the 'Concept Plan').

In addition, separate to these approvals, the site is earmarked for the site of the future Far North Coast Regional Botanic Gardens. It is intended that all areas of the site of concern to the quarry and landfill development will be rehabilitated in a manner consistent with this future intended purpose. However a botanic gardens is not part of this project.

This Environmental Assessment (EA) has been prepared by GHD Pty Ltd (GHD) on behalf of Council to address the requirements of the Director-General of the NSW Department of Planning, issued in accordance with Part 3A of the EP&A Act on 31st July 2008 to support both the Stage 1 Project Application and Concept Plan.

The draft version of this document was subject to a review by DoP in January 2011 ('adequacy assessment'). A number of amendments have been made throughout the document in order to address areas for which additional detail was requested.

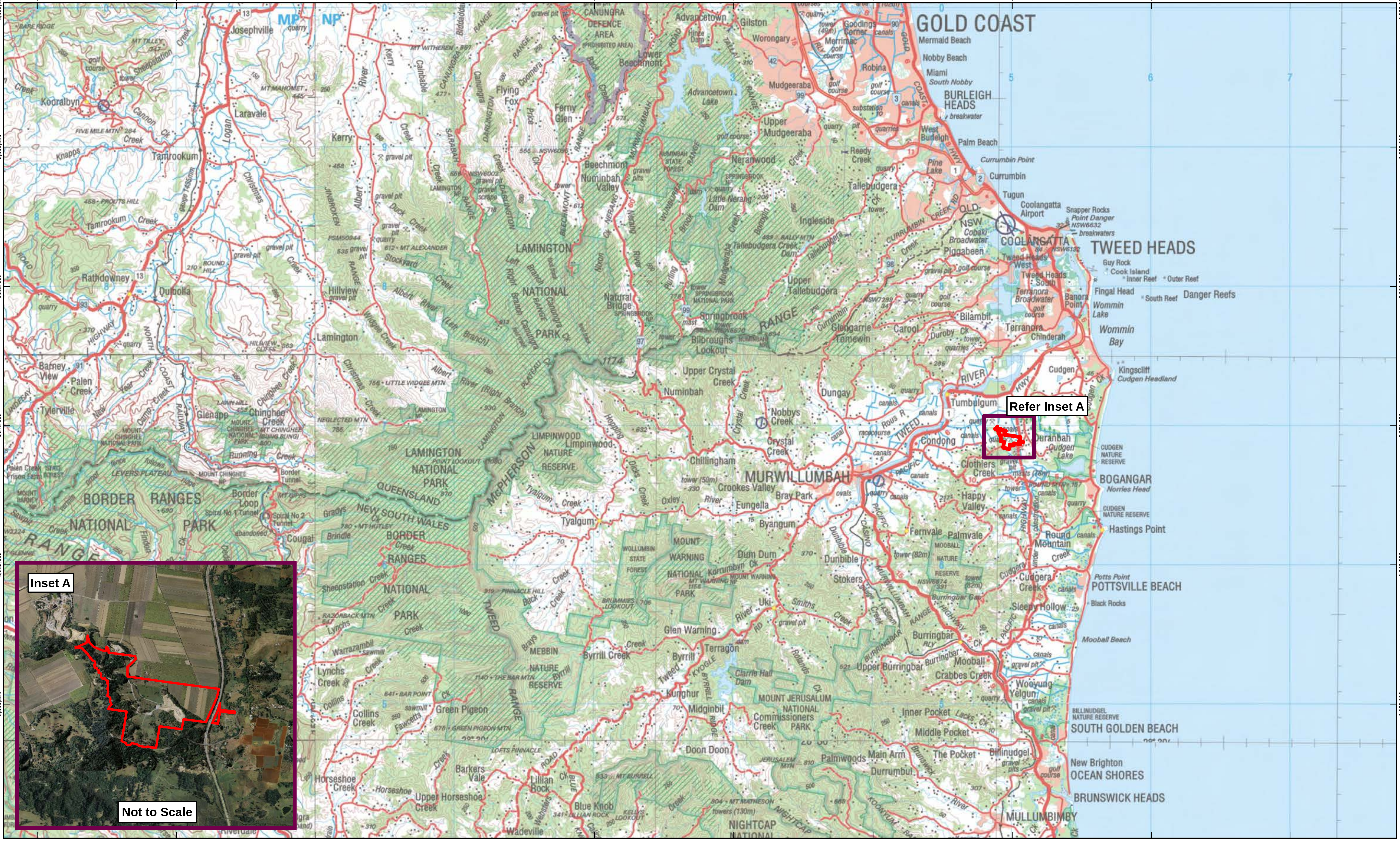
1.2 The Site

The site is situated on the northern side of Eviron Road, Eviron, in the Tweed Shire on the Far North Coast of NSW. The site is made up of three allotments that are currently in the ownership of Council:

- Lot 1 DP 34555;
- Lot 1 DP1159352;

Lot 602 DP 1001049. These allotments cover an area of approximately 113 ha and are shown on Figure 2. (Note that the proposed activity will be developed only on lands to the west of the Pacific Highway which cover an area of approximately 111.5 ha).

An existing Council owned and operated quarry, known as Quirks Quarry operates within Lot 602 DP 1001049 on the eastern portion of the site. The remainder of the site, including features referred to as the 'West Valley' and 'North Valley' (see Figure 2) displays a pattern of cleared lower slopes, while upper slopes and ridges are generally vegetated. The existing access and haul road for Quirks Quarry traverses Lot 1 DP 34555.



1:250,000 (at A3)

0 2 4 6 8 10
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Site Boundary

CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
Eviron Road Quarry and Landfill Environmental Assessment

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Locality Plan

Figure 1

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54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008). Geoscience Australia - NATMAP Raster Premium 250k (2005). GHD - Site Boundary (2011).

1:10,000 (at A3)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Site Boundary

Study Area

CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Job Number	41-20806
Revision	1
Date	27 MAY 2011

The Site

Figure 2

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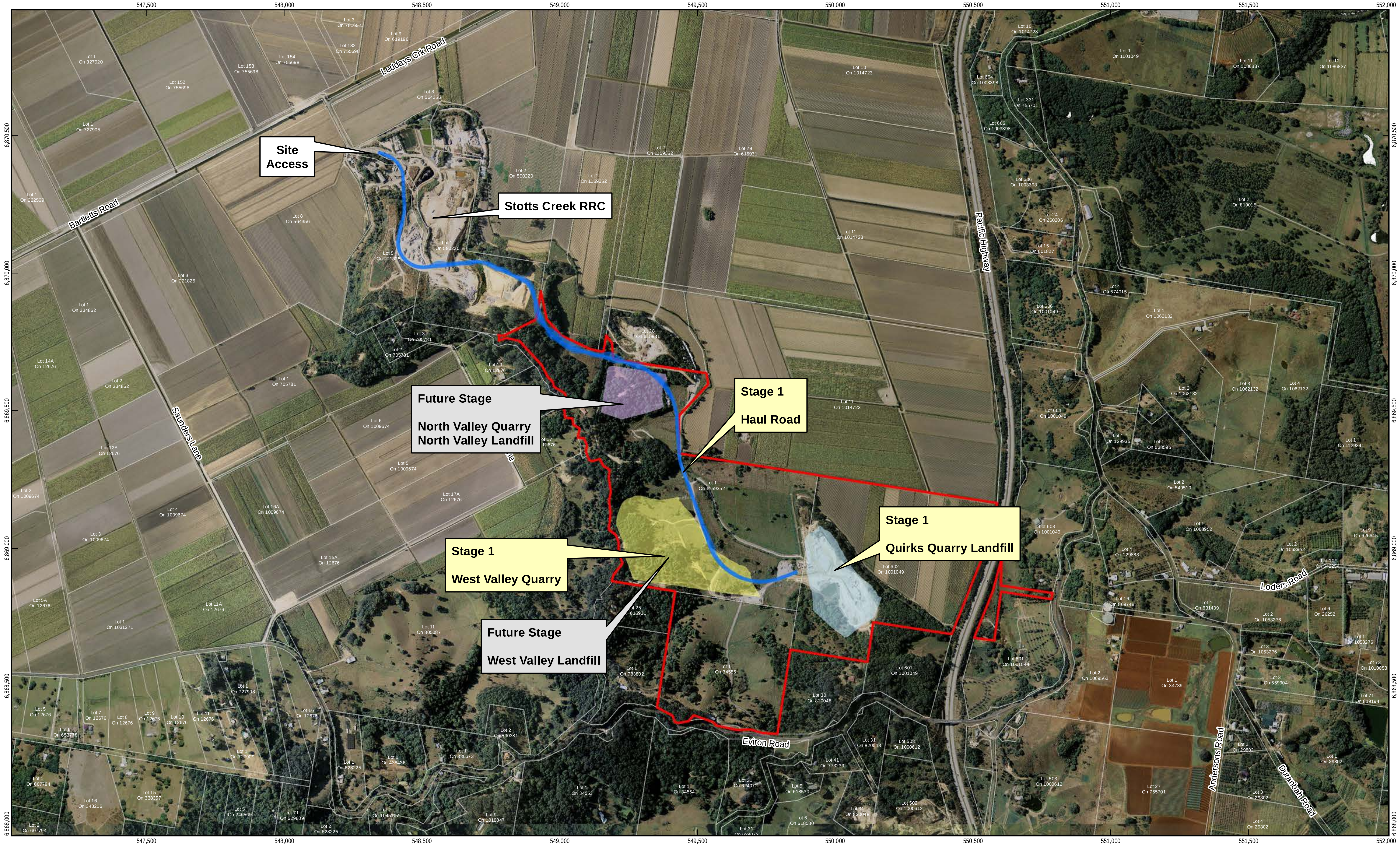
54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Cadastre boundary (2010). GHD - Site Boundary (2011), Study Area (2010).



1:12,500 (at A3)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Site Boundary
- Cadastre boundary
- Landfill footprint
- West Valley footprint
- North Valley footprint
- Haul Road

CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Concept Plan

Figure 3

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54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Proposed Haul Road (2011), Aerial Photography (2008), Cadastre boundary (2010). GHD - North Valley footprint (2011), Site Boundary (2011), Landfill footprints (2009), West Valley footprint (2009).

1.3 Project Background and Need

Approximately 20 years ago Council embarked upon a site selection process for a future waste disposal facility in the Shire, based on the knowledge that the existing landfills at that time had a limited capacity. Selection criteria for a suitable site were developed by Council with a view to identifying a proposed landfill site that would cater for the waste disposal needs of the Shire for the foreseeable future.

Council reported that after consideration of the selection criteria, that the Eviron Road site was chosen as the most suitable site to address the chosen criteria. Subsequently, negotiations with affected landowners were undertaken, and Council pursued purchase of a number of allotments in the immediate area on the basis of this outcome. The site was rezoned in the Tweed Local Environmental Plan (2000) to Zone 5(a) – Special Uses (Garbage Depot).

One of the key advantages recognised in selection of this site is that it is located close to Council's existing waste facilities at Stotts Creek RRC (see Figure 3). Construction of a haul road between the two sites, could reduce potential environmental impacts and use of existing facilities at Stotts Creek RRC would reduce the required development footprint as well as costs associated with establishing front end infrastructure such as a site office, weigh bridge and transfer station. In addition, the development of a site containing an existing void for waste disposal infrastructure development (i.e. Quirks Quarry) is also consistent with the historical method of landfilling in the Shire.

The proposed landfill component of the Concept Plan is consistent with the Shire's Domestic Solid Waste Management Strategy ('the Waste Strategy') which was completed in 2007. The Waste Strategy recommended 35 key actions that Council is progressively and strategically implementing. With regard to development of a landfill at Eviron Road, the Waste Strategy states:

> *….that concurrently with developing plans for the local landfill, Council reviews other long term disposal options for the Shire's waste…*

To this end, Council has considered options proposed in the Waste Strategy including the transport of residual waste (i.e. wastes remaining after resource recovery has been implemented) outside of the Shire for disposal. With regard to this, Council does not consider that this is a sustainable, economically viable or environmentally responsible method of disposal. Community consultation associated with the development of the Waste Strategy indicated that there was a strong desire from the local residents, businesses and Council, that the wastes generated in the Shire should be managed locally.

Of key importance to resource recovery and waste reduction, Council commissioned a Situation Analysis that investigated the potential feasibility of an Alternative Waste Technology (AWT) for the Shire. The AWT Situation Analysis completed in 2008 (Benjas, 2008), reviewed a range of AWT options including mechanical biological treatment, thermal treatment ('waste-to-energy'), and pyrolysis. The report concluded that that at present there was not an economically viable AWT option available for Tweed Shire based upon commercial, environmental and community best value grounds (Benjas, 2008). Notwithstanding this, Council has indicated that it intends to actively pursue alternatives to landfill, as evidenced by the endorsement of further investigation of AWT by Council's Executive Management Team. A copy of this report is provided in

Appendix F. If an AWT is found to be feasible, then it is anticipated that future development associated with waste infrastructure for the current Concept Plan for Eviron Road may incorporate organics treatment or similar technologies. Furthermore Council has been active in promoting resource recovery activities. Key strategies include the introduction of a voluntary green organics collection service in 2005 and changes to the waste collection contract involving bin provisions with the aim to improve resource recovery in 2009. Further details of the service implementation and resource recovery achievements to date are provided in Section 4.

Information on the activities constituting the Concept Plan and Stage 1 Project Application are provided in Part B, with details of the need for the project and justifiable demand for a waste disposal facility are contained in Section 6.

1.4 Approvals Sought and Key Features

1.4.1 Concept Plan Approval

The proponent is seeking concept approval under Section 75M of the EP&A Act for the Concept Plan to develop the following infrastructure in stages:

- Two extractive industries (quarries): North Valley and West Valley;
- Three waste disposal facilities (landfills): Quirks Quarry, North Valley and West Valley; and
- Associated infrastructure including a haul road from Stotts Creek RRC.

An overview of the Concept Plan is shown in Figure 3.

Chronologically, the proposed activity will involve:

- Stage 1 (Project Application):
  - Establishment of a new haul road from Stotts Creek RRC to Quirks Quarry, and development of a landfill within the Quarry void;
  - Progressive rehabilitation of Quirks Quarry landfill; and
  - Development of a new quarry in West Valley.
- Future stages may include:
  - Development of a landfill within the void formed from quarrying West Valley;
  - Progressive rehabilitation of the West Valley landfill;
  - Development of a new quarry within North Valley;
  - Development of a landfill within the void formed from quarrying North Valley; and
  - Progressive rehabilitation of the North Valley landfill.

At the concept planning level, Council anticipates that landfills in the West and North Valley will provide for the waste disposal requirements of the Shire until approximately 2043. The landfills and quarry will operate in sequence and there will be no overlap between landfilling in the Quirks Quarry, West Valley and North Valley, this will also be the case for the quarry operations. Further details of Concept Plan staging are provided in Section 7 and Table 7-1. Design, operation and management of the future landfills would adhere to best industry practice of the day.

The activities forming this overall Concept Plan include shared infrastructure and access with Stotts Creek RRC (as detailed in Section 7.2 and Quirks Quarry Landfill Concept Design Report in Appendix B and Draft Landfill Environmental Management Plan in Appendix C). However the activities at Eviron Road are separate to those at Stotts Creek. And for this reason an assessment of cumulative impacts of the two sites is not relevant.

It is important to note that the current footprints for Stage 1 are based on concept designs for the landfill and quarry that have been developed for the Project Approval. These are provided in Volume 2 of this EA. In addition, planning for the North Valley Quarry and Landfill has, at the request of DoP during adequacy review, included an initial estimate of a quarry footprint and the likely operational life of the quarry and landfill based on information currently available and forecast waste acceptance rates. On the basis of this initial work, the potential North Valley footprint is shown on Figure 3. This quarry has an estimated lifespan of 3.5 years based on production rate of 200,000t/Year , while it is anticipated that landfilling would occur for approximately 13 years until 2043. Further details are provided in Section 7.2 and 7.3.

Development of waste infrastructure would be subject to detailed design and project application should the future stages be implemented. It is noted that should future landfills be established in the West and North Valley they would be limited to the footprint disturbed by the preceding quarries, such that additional clearing would not be required.

As noted in Section 1.3, future development of waste infrastructure on the site may incorporate an AWT. Should this become feasible, the AWT would be considered in future project applications and be subject to concept design and approval.

1.4.2 Project Approval for Stage 1

In addition to Concept Approval, Council is seeking Project Approval under Section 75E of the EP&A Act for the construction and operation of Stage 1, which involves:

- Disposal of up to 75,000 tonnes of putrescible waste a year in a landfill to be developed in the existing void formed by Quirks Quarry;
- Extraction, processing, and transportation of up to 200,000 tonnes of material a year from the West Valley Quarry;
- Development of a haul road and other associated infrastructure; and
- Rehabilitation of both sites.

Key features of the landfill and quarry associated with this project approval are outlined below while further details are provided in Section 7.

Quirks Quarry Landfill

A concept design and draft landfill environmental management plan have been developed for the landfill to be situated in the void of Quirks Quarry (hereafter referred to as 'Quirks Quarry Landfill'). These are provided in Volume 2 of the EA (Appendix B and C).

Based on the concept design, key features of the Quirks Quarry Landfill include:

- Landfill filling rate:

- It is estimated based upon current filling rates, that the landfill will accommodate up to approximately 75,000 tonnes per annum of waste; and
- The total volumetric capacity of the Quirks Quarry landfill will be in the order of 750,000 m^3.

- Expected landfill lifespan:
  - Based on the estimated void capacity and projected waste inputs, Quirks Quarry is expected to operate as a landfill for approximately 10 years.
- Main infrastructure:
  - Active landfilling area/cells developed in three main stages;
  - Sediment basin and stormwater drains;
  - Leachate management infrastructure; and
  - Landfill gas collection and management infrastructure.

West Valley Quarry

A Preliminary Quarry Plan for the quarry to be established at West Valley ('West Valley Quarry') has been developed. The associated report is provided in Volume 2 (Appendix D).

Key features of the West Valley Quarry include:

- Projected extraction:
  - Approximately 200,000 tonnes per annum; and
  - Resource materials include siltstone/conglomerate, overburden (soil and clay), and gravel in variable quantities over the life of the quarry.
- Area and levels:
  - The quarry footprint covers an approximate area of 11 ha; and
  - A minimum pit base level of RL 4.0 m corresponding to an estimated 100 year flood level event has been adopted as the limit of extraction.
- Quarry lifespan:
  - Approximately 10-11 years.
- Main activities:
  - Pre-stripping, stripping and stockpiling of topsoil;
  - Blast hole drilling and blasting;
  - Extraction including primary screening and crushing;
  - Haulage;
  - Stockpiling; and
  - Product loading and offsite haulage.

Associated Infrastructure

An internal haul road will be constructed from Stotts Creek RRC that will connect to both Quirks Quarry Landfill and West Valley Quarry. This haul road has been designed by Council with a minimum RL of 4.0 m corresponding to a 100 year flood level event.

Rehabilitation

Rehabilitation of the Quirks Quarry landfill will take place progressively during its operational life. The overall site is earmarked to form part of the future botanical gardens and this will be taken into account when landfill closure plans are developed.

1.5 The Environmental Assessment

1.5.1 Summary of Approval Requirements

As indicated previously, although it is intended to introduce a Bill to Repeal Part 3A of the EP&A Act, transitional provisions as per SEPP (Major Development) Amendment 2011 allow for certain existing project applications and concept plan applications to remain as Part 3A applications. As such Part 3A of the EP&A Act still applies to the proposed activity. The quarry components of the proposed activity are considered to meet the definition of an extractive industry listed in Schedule 1 Clause 7(1) of *State Environmental Planning Policy 2005 (Major Projects)* as the quarry components would extract from a total resource of more than five million tonnes.

Section 75B(3) of the EP&A Act states: 'If part of any development is a project to which this Part applies, the other parts of the development are (subject to subsection (4)) taken to be a project to which this Part applies.' This means that Part 3A applies to all aspects of the project.

The NSW Minister for Planning is the approval authority for the project.

1.5.2 Purpose and Scope

The EA supports an application for both concept plan and project approval for the project from the Minister for Planning under Part 3A of the EP&A Act. The purpose of the EA is to:

- Provide detailed information on the Project Application, including the project need and alternatives considered;
- Provide broader detail of intentions for future stages outlined in the Concept Plan; Address the key environmental impacts of the project as identified in the DGRs;
- Identify, through an environmental risk assessment, other environmental risks not considered in the DGRs; and
- Detail the proponent's commitments in terms of measures to minimise and manage potential environmental impacts.

1.5.3 Document Structure

The environmental assessment is structured as follows:

VOLUME 1 – Main Report

Volume 1 includes:

- **Part A Introduction and Context**

  Part A provides an introduction to the environmental assessment (Section 1); information on the assessment requirements under relevant legislation and environmental planning instruments (Section 2), a description of the location and existing environmental features of the site and surrounds (Section 3), the current situation in relation to waste management and resource recovery in the Tweed Shire (Section 4) and a summary of the Stakeholder Consultation undertaken in relation to the project.

- **Part B Project Information**

  Part B contains a description of the need for the project and the alternatives considered as part of the project development process (Section 6) and a detailed description of the project (Section 7).

- **Part C Environmental Assessment**

  Part C includes an environmental risk analysis identifying key potential environmental issues (Section 8); and provides a summary of the key findings of the technical assessments undertaken to address the key environmental issues identified by the Director General's requirements (Chapter 9).

- **Part D Conclusion**

  For the project described in Part B, and considering the results of the assessment summarised in Part C, Part D provides a Statement of Commitments made by the proponent in relation to mitigation, management and monitoring of potential environmental impacts (Section 10) and provides the project justification and conclusion to the environmental assessment (Section 11).

VOLUME 2 and 3 - Appendices

Volumes 2 and 3 contain the Appendices to the EA. These include all technical reports prepared as part of the environmental assessment process. The appendices are as follows:

A. Director General's Requirements

B. Quirks Quarry Landfill Concept Design

C. Quirks Quarry Landfill Draft Landfill Environmental Management Plan

D. West Valley Preliminary Quarry Study

E. Tweed Shire Domestic Solid Waste Management Strategy

F. AWT Situational Analysis

G. Community Consultation Materials

H. Stormwater Report

I. Noise, Blasting and Vibration Report

J. Air Quality and Odour Report

K. Greenhouse Gas Emissions Study Report

L. Ecological Assessment

M. Traffic Impact Assessment

N. Cultural Heritage Assessment

2. Approval Framework and Legislative Requirements

2.1 Overview

The proponent seeks both concept and project approval from the Department of Planning under Part 3A of the EP&A Act.

This chapter outlines the relevant legislation requirements that apply to the project, with a focus on the planning approval requirements, and defines the environmental assessment process. It:

- Confirms the application of Part 3A of the EP&A Act, and notes any specific requirements that apply to the project;
- Summarises the permissibility of the project and the application of the Tweed Local Environmental Plan 2000;
- Considers the other approvals that may apply to the project;
- Considers relevant environmental planning instruments, including SEPPs, regional environmental plans, and other plans and strategies that apply to the project and/or the site; and
- Summarises the environmental assessment and approval process.

2.2 Application of Part 3A of the Environmental Planning and Assessment Act 1979

The EP&A Act forms the statutory framework for planning approval and environmental assessment in NSW. Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils.

The EP&A Act contains three parts that impose requirements for planning approval:

- Part 3A provides for control of 'major projects' that require approval from the Minister for Planning;
- Part 4 provides for control of 'local development' that requires development consent from the local council; and
- Part 5 provides for control of 'activities' that do not require approval or development consent under Part 3A or Part 4.

The need or otherwise for development consent is set out in environmental planning instruments – state environmental planning policies (SEPPs), regional environmental plans (REPs) or local environmental plans (LEPs).

As advised in Planning Circular PS 11-014 "Part 3A of the EP&A Act and residential, commercial, retail and coastal subdivision development" (P&I, 2011), although the Government has announced that it will introduce a Bill to repeal Part 3A of the EP&A Act, transitional provisions have been provided in the Major Development SEPP for certain existing project applications and concept plan applications, which would be assessed under Part 3A of the EP&A Act until the proposed Bill is passed by Parliament and takes effect.

2.2.1 Permissibility of The Project – The Need For Development Consent

The project is located in the Tweed local government area. The *Tweed Local Environmental Plan 2000* (LEP) applies to site. The waste disposal facility component of the project is considered to be permissible with consent under the LEP as outlined in section 2.4. The extractive industry component is not individually listed as permitted with consent but may be regarded as permitted as an ancillary use to the primary use of a waste disposal facility. In addition, under St*ate Environmental Planning Policy (Infrastructure) 2007* ('the Infrastructure SEPP') (refer section 2.4) the haul road would be permissible without consent, and the quarries and landfills would be permissible with consent.

2.2.2 Application of Part 3A

Part 3A of the EP&A Act establishes an assessment and approval regime for development that is declared to be a Part 3A project by either a state environmental planning policy or order of the Minister (section 75B(1)).

According to section 75D(1) the Minister for Planning is the approval authority for Part 3A projects.

Part 3A applies because the project meets the definitions of a Part 3A project included within Schedule 1 of the *State Environmental Planning Policy (Major Projects) 2005* (the Major Projects SEPP).

The following Part 3A project definition is included in Schedule 1, clause 7 of the Major Projects SEPP:

> *"(1) Development for the purpose of extractive industry that:*
>
> *(a) extracts more than 200,000 tonnes of extractive materials per year, or*
>
> *(b) extracts from a total resource (the subject of the development application (or other relevant application under the Act)) of more than 5 million tonnes, or"*

The quarry component of the project is captured under this definition as annual extraction rates for the Stage 1 project application are likely to be in the order of 200,000 tonnes per year however Council is seeking to apply for a maximum annual extraction of 200,000 tonnes. Taking into account the overall Concept Plan, preliminary estimates by Gilbert & Sutherland (2007) indicate that the total resource is likely to exceed the 5 million tonne threshold. It is noted that planning and design for the quarries included in the Concept Plan have been of a preliminary nature only at this stage and therefore a conservative approach to resource estimation has been taken.

Section 75B(3) of the NSW *Environmental Planning and Assessment Act 1979* states:

> *'If part of any development is a project to which this Part applies, the other parts of the development are (subject to subsection (4)) taken to be a project to which this Part applies.'*

This means that Part 3A applies to all aspects of the project. Consequently the project was declared by the Department of Planning to be a project to which Part 3A of the Environmental Planning and Assessment Act, 1979 applies (DoP Reference S07/01027).

2.2.3 Approvals Sought

The following approvals are being sought by the proponent under Part 3A of the EP&A Act.

Concept Approval

A concept plan assessment and approval process provides for a proponent to obtain an approval upfront of the concept of a major, complex project prior to undertaking more detailed studies in relation to implementing the various components of a project (as required). This provides for matters such as the suitability of a site or route etc., and environmental issues to be resolved upfront and provides for the simplification of subsequent approvals where environmental impacts can be avoided or minimised.

Concept plan approvals are used for the assessment and approval of more complex projects where there is a benefit in having strategic issues (including the overall justification of the project and suitability of a site) determined upfront, prior to undertaking more detailed assessment if required.

The Concept Plan involves working an existing approved quarry (known as Quirks Quarry) on the site until 2012, then progressively establishing two new quarry sites (referred to as West Valley and North Valley) and working these consecutively until about 2040. After exhaustion of quarry materials, each of the three quarry sites are intended to be used progressively as Tweed Shire Council's primary putrescible landfill facility. There will be no overlap of landfilling and quarrying activities meaning that at any one time there will only be a single landfill and a single quarry operating.

The proponent is seeking concept approval under Section 75M of the Act for the concept plan to develop the following infrastructure in a staged manner:

- Two quarries: North Valley and West Valley;
- Three landfills: Quirks Quarry, North Valley and West Valley; and
- Associated infrastructure.

The stages are described as:

Stage 1 would involve:

- Construction of a haul road from Stott's Creek Landfill Facility to the Quirks Quarry and Landfill site;
- Landfill within the Quirks Quarry site (due to commence in 2012 until 2021); and
- Quarrying at the West Valley site (2012 – 2021).

Subsequent stages of the project would include:

- Landfill at West Valley;
- Quarrying at North Valley; and
- Landfill at North Valley.

Project Approval

The proponent is also seeking project approval under Section 75E of the Act for Stage 1, which involves:

- Extracting, processing, and transporting up to 200,000 tonnes of extractive material a year from the West Valley Quarry;
- Disposing of up to 75,000 tonnes of putrescible waste a year at the existing Quirks Quarry;
- Developing a range of associated infrastructure including construction of a haul road from Stott's Creek Landfill Facility to the Quirks Quarry and Landfill site; and
- Rehabilitating both sites.

2.3 Other Relevant Legislation and Approvals

In addition to the EP&A Act, there are a number of relevant NSW environmental legislative requirements, as discussed below.

2.3.1 Relationship to the NSW Environmental Planning and Assessment Act 1979

Section 75U(1) of the NSW *Environmental Planning and Assessment Act 1979* identifies the approvals and licences under other NSW legislation that are not required for an 'approved project' under Part 3A:

> *'(a) the concurrence under Part 3 of the Coastal Protection Act 1979 of the Minister administering that Part of the Act,*
>
> *(b) a permit under section 201, 205 or 219 of the Fisheries Management Act 1994,*
>
> *(c) an approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977,*
>
> *(d) a permit under section 87 or a consent under section 90 of the National Parks and Wildlife Act 1974,*
>
> *(e) an authorisation referred to in section 12 of the Native Vegetation Act 2003 (or under any Act to be repealed by that Act) to clear native vegetation or State protected land,*
>
> *(f) a permit under Part 3A of the Rivers and Foreshores Improvement Act 1948,*
>
> *(g) a bush fire safety authority under section 100B of the Rural Fires Act 1997,*
>
> *(h) a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the Water Management Act 2000.'*

Section 75U (2) of the Act also states that:

> *'Division 8 of Part 6 of the Heritage Act 1977 does not apply to prevent or interfere with the carrying out of an approved project.'*

Section 75A defines 'approved project' as 'a project to the extent that it is approved by the Minister under this Part, but does not include a project for which only approval for a concept plan has been given'. Consequently, if the Minister grants project approval to carry out the project under Part 3A, the approvals identified by section 75U(1) would not be required.

Section 75V of the EP&A Act stipulates approvals and legislation that must be applied consistently to the approval of a project under Part 3A:

‘(1) An authorisation of the following kind cannot be refused if it is necessary for carrying out an approved project and is to be substantially consistent with the approval under this Part:

(a) an aquaculture permit under section 144 of the Fisheries Management Act 1994,

(b) an approval under section 15 of the Mine Subsidence Compensation Act 1961,

(c) a mining lease under the Mining Act 1992,

(d) a production lease under the Petroleum (Onshore) Act 1991,

(e) an environment protection licence under Chapter 3 of the Protection of the Environment Operations Act 1997 (for any of the purposes referred to in section 43 of that Act),

(f) a consent under section 138 of the Roads Act 1993,

(g) a licence under the Pipelines Act 1967.’

2.3.2 Protection of the Environment Operations Act 1997

Activities that are required to obtain a licence under the POEO Act are detailed in Schedule 1 of the Act.

Quirks Quarry presently operates under the terms and requirements of Environment Protection Licence No. 12777 for a ‘Fee Based Activity Hard Rock Gravel Quarry (36) Scale 50,000 - 100,000 tonnes’ issued by DECCW under the POEO Act.

There would be no increase in the rate of production at this site.

The quarry component of the project triggers the threshold requirements under clause 19 (extractive industries). The landfill component of the project triggers the threshold requirements under clause 39 (waste disposal application to land). As a result, an environment protection license under the POEO Act will be required for both quarry and landfill developments.

2.3.3 Waste Avoidance and Resource Recovery Act 2001

The *Waste Avoidance and Resource Recovery Act (2001)* (WARR Act) was implemented to achieve environmentally sound management of waste, waste avoidance and resource recovery in New South Wales. It aims to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of Ecologically Sustainable Development.

The project as a key part of Council’s overall Waste Strategy is consistent with the WARR Act, which aims to make better use of resources and minimise waste disposal. Further details on how the project fits with Council strategic direction for waste management is provided in Section 4.

2.3.4 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* provides the basis for the establishment, preservation and management of national parks, historic sites and certain other areas, and the protection of certain fauna, native plants and Aboriginal relics.

A cultural heritage assessment was undertaken for the project (refer Section 9.7 and Appendix N). No sites of Aboriginal heritage significance were identified.

2.3.5 Threatened Species Conservation Act 1995

The potential impact of the project on matters covered by the *Threatened Species Conservation Act 1995* (TSC Act) are summarised in Section 9.5 and the ecological assessment provided in Appendix L. The ecological assessment concluded that the project is unlikely to have a significant impact on threatened species or endangered ecological communities that occur or could occur.

2.3.6 Heritage Act 1977

The purpose of the *Heritage Act 1977* (Heritage Act) is to protect and conserve non-Aboriginal cultural heritage, including scheduled heritage items, sites and relics.

The heritage assessment (Section 9.7) did not identify any items on the site.

2.3.7 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas and species, populations and communities, and heritage items. The EPBC Act applies to all land, waters, seabed and airspace in, under or above Australia.

Approval under the EPBC Act is required for:

- An action which has, will have or is likely to have a significant impact on 'matters of national environmental significance';
- An action by the Commonwealth or a Commonwealth agency which has, will have or is likely to have a significant impact on the environment;
- An action on Commonwealth land which has, will have or is likely to have a significant impact on the environment; or
- An action, which has, will have, or is likely to have, a significant impact on the environment on Commonwealth land, no matter where it is to be carried out.

Where the proponent considers that an action will have or is likely to have a significant impact on matters of national environmental significance, or on Commonwealth land, a referral is made to the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA). The proponent may also, but is not required to, make a referral where they consider that the action will not have or is not likely to have a significant impact.

If it is determined through the referral process by DEWHA that a project is likely to have a significant impact on a matter of national environmental significance, or on Commonwealth land, then the project is a controlled action and approval from the Commonwealth Minister for the Environment, Heritage and the Arts would be required.

Matters of National Environmental Significance

Matters of national environmental significance are considered below:

- Listed threatened species and communities - The ecological assessment (Appendix L) found that the project would be unlikely to have a significant impact on any threatened species listed under the EPBC Act or their habitat that occur or could occur, provided the management measures identified are implemented;
- Listed migratory species - The project is not expected to have an impact on listed migratory species (Appendix L);
- Ramsar wetlands of international importance - The site is not situated near any Ramsar listed wetlands;
- The Commonwealth marine environment - No Commonwealth marine areas would be affected by the project;
- World Heritage properties - There are no world heritage properties in the vicinity of the site;
- National Heritage places - The site is approximately 20 km northeast of Mount Warning National Park and 30 km northeast of Nightcap National park (part of the Gondwana Rainforests of Australia listing). The project will not impact on the value of these places;
- Nuclear actions - The project would not involve nuclear action as defined under the EPBC Act; and
- The Great Barrier Reef Marine Park – The site is not situated in proximity to the Great Barrier Reef Marine Park

2.4 Environmental Planning Instruments

2.4.1 Tweed Local Environmental Plan 2000

Zoning

Under the Tweed Shire Council LEP 2000 the following zoning currently applies to the site:

- Lot 1 DP 34555, part Lot 1 DP1159352 and part Lot 602 DP 1001049 are in Zone 5(a) Special Uses (Garbage Depot);
- The areas outside of Zone 5(a) in Lot 1 DP1159352 and Lot 602 DP 1001049 are zoned 1(b) Agricultural Protection; and
- The eastern portion of Lot 1 DP 1159532 is currently zoned 1(a) Rural.

The majority of the site falls within Zone 5(a) Special Uses (Garbage Depot). The objectives of this zone as defined by clause 11 of the LEP are:

> *'Primary objective*
>
> - *to identify land which is developed or is proposed to be developed, generally by public bodies, for community facilities and services, roads, railways, utilities and similar things.*
>
> *Secondary objective*

- *to provide flexibility in the development of the land, particularly if it is not yet or is no longer required for the relevant special use.'*

The development consent provisions for this zone are provided below.

Item 1 allowed without consent:

- *environmental facilities;*
- *railways if on land indicated by red lettering as "Railway" on the zone map;*
- *roads (including road widening); and*
- *any use authorised by or under the Forestry Act 1916 for the purpose of State forests if on land indicated by red lettering as "Forestry" on the zone map.*

Item 2 allowed only with consent:

- *unless it is allowed without consent under Item 1, **the particular use indicated by red lettering on the zone map and any development ordinarily incidental or ancillary to that use**;*
- ***any use which is compatible with adjacent uses and with uses allowed (with or without consent) in adjacent zones;***
- *public utility undertakings; and*
- *utility installations.*

Item 3 allowed only with consent and must satisfy the provisions of clause 8(2):

- *nil.*

Item 4 prohibited:

- *any buildings, works, places or land uses not included in Item 1, 2 or 3.'*

Permissibility

The haul road component of the project is permissible without consent under item 1.

Item 2 specifies that the uses indicated by red lettering on the zone map and development ordinarily incidental or ancillary to that use are permissible with consent. The red lettering on the zone map identifies the use of the site as a 'garbage depot'. The waste disposal facility component of the development is considered to be equivalent to the use specified on the zone map (i.e. 'garbage depot').

The quarry development could be considered to be an incidental development to the waste disposal facility. For instance the definition of waste disposal facility in the Standard LEP Instrument and SEPP (Infrastructure) 2007 includes the winning of extractive material to create a void for landfill. As such, the project could be considered to be consistent with the use indicated in respect of the land by the lettering on the LEP map. In addition, the intended use is definitely considered to be compatible with adjacent uses permitted in adjacent zones due to existing quarry and landfills on adjoining land.

All components of the Project therefore would be permissible with consent under the Tweed LEP 2000 in Zone 5(a) Special Uses (Garbage Depot).

For that part of the site that falls within zone 1(a) Rural the objectives of the zone as defined by clause 11 of the LEP are:

Primary objectives

- *to enable the ecologically sustainable development of land that is suitable primarily for agricultural or natural resource utilisation purposes and associated development; and*
- *to protect rural character and amenity.*

Secondary objectives

- *to enable other types of development that rely on the rural or natural values of the land such as agri- and eco-tourism;*
- *to provide for development that is not suitable in or near urban areas;*
- *to prevent the unnecessary fragmentation or development of land which may be needed for long-term urban expansion; and*
- *to provide non-urban breaks between settlements to give a physical and community identity to each settlement.*

Development within the zone

In Zone 1(a) the following as related to the proposed activity are permissible:

Item 2 allowed only with consent:

- *any other buildings, works, places or land uses not included in Item 1, 3 or 4.*

Item 3 Allowed only with consent and must satisfy the provisions of clause 8 (2)

- *offensive or hazardous industries.*

Item 4 Prohibited:

- *industries (other than home industries, light industries, offensive or hazardous industries, rural industries or industries directly associated with or dependent on extractive industries).*

Permissibility

Roads, extractive industries and waste disposal facilities are all permissible with Council consent pursuant to Item 2 of this zone.

The balance of the site is zoned 1(b) Agricultural Protection. The objectives of this zone as defined by clause 11 of the LEP are:

Primary objective

- *to protect identified prime agricultural land from fragmentation and the economic pressure of competing land uses.*

Secondary objective

- *to allow other development that is compatible with agricultural activities.*

In Zone 1 (b) the following as related to the proposed activity are permissible:

Item 2 allowed only with consent:

- *any other buildings, works, places or land uses not included in Item 1, 3 or 4*

Item 3 Allowed only with consent and must satisfy the provisions of clause 8 (2):

- *extractive industries.*

Item 4 Prohibited

- *66 items are listed as prohibited.*

Permissibility

Roads and waste disposal facilities are permissible with Council consent pursuant to Item 2 of this zone. Extractive industries are permissible with Council consent pursuant to Item 3 of this zone if it can satisfy the provisions of clause 8(2) of Tweed LEP 2000.

Other Relevant Clauses of the LEP

Clause 8 Consent considerations

(2) The consent authority may grant consent to development specified in Item 3 of the Table to clause 11 only if the applicant demonstrates to the satisfaction of the consent authority that:

(a) the development is necessary for any one of the following reasons:

(i) it needs to be in the locality in which it is proposed to be carried out due to the nature, function or service catchment of the development,

(ii) it meets an identified urgent community need,

(iii) it comprises a major employment generator, and

(b) there is no other appropriate site on which the development is permitted with consent development (other than as advertised development) in reasonable proximity, and

(c) the development will be generally consistent with the scale and character of existing and future lawful development in the immediate area, and

(d) the development would be consistent with the aims of this plan and at least one of the objectives of the zone within which it is proposed to be located.

Part of the existing Quirks Quarry is zoned 1(b) Agricultural Protection. A quarry application within this zone would normally have to require Council to be satisfied in relation to these considerations. In this case the quarry already has an approval and no new approval for a quarry is required as this site is intended to be a landfill area.

Clause 34 refers to flood liable land and aims to minimise future potential flood damage. Clause 34 (2) requires:

'(2) Where, in the consent authority's opinion, land is likely to be subject to flooding, then it must not grant consent to development on that land unless it has considered:

(a) the extent and nature of the flooding hazard affecting the land, and

(b) whether or not the development would increase the risk or severity of flooding of other land in the vicinity, and

(c) whether the risk or severity of flooding affecting the development could be reasonably mitigated, and

(d) the impact of the development on emergency services, and

(e) the provisions of Section A3—Development of Flood Liable Land of Tweed Development Control Plan.'

Part of the site is described as flood liable by Council's Development Control Plan Development of Flood Liable Land map. As the land is considered to be flood liable then the above provision must be considered. An assessment of this is provided in Section 9.1.

Clause 35 refers to acid sulfate soils. Clause 24 (3) specifies that a person must not, without development consent, carry out works on land shown as being Class 1, 2, 3, 4 or 5 land on the series of maps held in the office of the Council and marked "Acid Sulfate Soil Planning Map", being the works specified for the class of land in the table listed under the clause.

Clause 34 (4) specifies that the consent authority must not grant consent to works specified in subclause (3) unless it has considered the matters listed under this clause.

As part of the site is classified as class 2 land, and the project would involve works below the ground surface, then these provisions much be considered. As assessment of acid sulfate soil issues is provided in Section 9.3.

Heritage provisions are set out in Part 8 of the LEP. The provisions apply to heritage items and conservation areas defined by the LEP. The project would not impact on any heritage items or conservation areas defined by the LEP. Further information on heritage is provided in Section 9.7.

2.4.2 Draft Tweed Local Environmental Plan 2010

Zoning

Under the Tweed Shire Council Draft LEP 2010 the following zoning will apply to the site.

- Lot 1 DP 34555, part Lot 1 DP1159352 and part Lot 602 DP 1001049 are zoned SP1 Special Activities – Waste Management Facilities (area previously zoned 5a Special Purposes);
- The areas outside of the SP1 zone in Lot 1 DP1159352 and Lot 602 DP 1001049 are zoned RU1 Primary Production (previously zoned 1(b2) Agricultural Protection); and
- The north western portion of Lot 1 DP1159352 is zoned RU2 Rural Landscape.

SP1 Special Activities

1 Objectives of zone

- *To provide for special land uses that are not provided for in other zones;*
- *To provide for sites with special natural characteristics that are not provided for in other zones; and*

- *To facilitate development that is in keeping with the special characteristics of the site or its existing or intended special use, and that minimises any adverse impacts on surrounding land.*

2. Permitted without consent

Environmental facilities; Environmental protection works

3. Permitted with consent

The purpose shown on the Land Zoning Map, including any development that is ordinarily incidental or ancillary to development for that purpose.

4. Prohibited

Any development not specified in item 2 or 3

Zone RU1 Primary Production

1 Objectives of zone

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base;*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area;*
- *To minimise the fragmentation and alienation of resource lands; and*
- *To minimise conflict between land uses within the zone and land uses within adjoining zones.*

2 Permitted without consent

Agriculture, Extensive agriculture; Environmental facilities; Environmental protection works; Home occupations; Roads

3 Permitted with consent

Agricultural produce industries; Animal Boarding or Training Establishment; Aquaculture; Bed and breakfast accommodation; Biosolid waste applications; Boat sheds; Cellar door premises; Dual occupancies (attached); Dwelling houses; Extractive industries; Farm buildings; Farm stay accommodation; Flood mitigation works; Forestry; Helipads; Home Based Child Care; Home businesses; Home industries; Intensive Livestock Agriculture; Mining; Roadside stalls; Rural workers' dwellings; Turf Farming; Water recreation structures; Water Storage Facilities.

4 Prohibited

Any development not specified in item 2 or 3

Zone RU2 Rural Landscape

1 Objectives of zone

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base;*

- *To maintain the rural landscape character of the land;*
- *To provide for a range of compatible land uses, including extensive agriculture;*
- *To provide for a range of tourist accommodation-based land uses, including agri-tourism, eco-tourism and any other like tourism that is linked to an environmental, agricultural or rural industry use of the land, such as bush foods, forestry, crafts and the like; and*
- *To provide for a range of compatible land uses that support tourism in the hinterlands and Tweed generally, such as teahouses, macadamia farms, specialised produce farms and the like.*

2 Permitted without consent

Agriculture; Environmental protection works; Environmental facilities; Extensive agriculture; Home occupations; Roads.

3 Permitted with consent

Airstrips; Animal Boarding or Training Establishments; Aquaculture; Bed and breakfast accommodation; Biosolid waste applications; Boat sheds; Caravan parks (camping ground only); Cellar door premises; Cemeteries; Community facilities; Crematorium; Depots; Dual occupancies (attached); Dwelling houses; Educational establishments; Extractive industries; Farm buildings; Farm stay accommodation; Flood mitigation works; Forestry; Funeral Chapels; Funeral homes; Helipads; Home-based child care; Home businesses; Home industries; Hostels; Information and education facilities; Intensive Livestock Agriculture; Landscape and garden supplies; Mining; Places of public worship; Recreation areas; Recreation facilities (major); Recreation facilities (outdoor); Research Stations; Restaurants; Roadside stalls; Rural industries; Rural Supplies; Rural workers' dwellings; Serviced Apartments; Sewerage Systems; Timber and Building Supplies; Transport Depots; Truck Depots; Turf Farming; Veterinary Hospitals; Water recreation structures; Water Supply Systems.

4 Prohibited

Any development not specified in item 2 or 3

Permissibility

Roads are permitted without consent in the RU1 and RU2 zones and are an ancillary use and therefore permitted in the SP1 zone. Extractive industries are permitted in the RU1 and RU2 zones and are in this case an ancillary use to the waste disposal facility and therefore permitted in the SP1 zone. Waste disposal facilities are permitted in the SP1 zone but are prohibited in the RU1 and RU2 zones.

2.4.3 State Environmental Planning Policies

State environmental planning policies that apply to the project are considered below:

State Environmental Planning Policy 33 - Hazardous and Offensive Development

SEPP 33 aims to identify proposed developments that have the potential for significant offsite impacts, in terms of risk and/or offence. If a development is likely to result in significant risks and/or offence to offsite receptors (for example as a result of storage of significant quantities of dangerous goods, noise and odour impacts), it is considered to be a hazardous and/or offensive development.

SEPP 33 requires that, in determining whether a development is hazardous or offensive, consideration must be given to current circulars or guidelines. The guideline relevant to SEPP 33 is ‘Applying SEPP 33 – Hazardous and Offensive Development Guidelines’ (DoP, 1994).

Hazardous Developments (Risk Impacts)

SEPP 33 defines a ‘potentially hazardous industry’ as ‘a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality: (a) to human health, life or property, or (b) to the biophysical environment, and includes a hazardous industry and a hazardous storage establishment.’

A potentially hazardous industry is one that would impose significant risks if it were to operate without measures to mitigate risk. To determine if a development is potentially hazardous and a preliminary hazard analysis is required, a preliminary risk screening is undertaken in accordance with DoP’s guidelines. A preliminary hazard analysis was undertaken for the project, and further information is provided in Section 9.11.

Offensive Developments (Offence Impacts)

SEPP 33 defines a ‘potentially offensive industry’ as ‘a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.’

A potentially offensive industry is one that would emit a polluting discharge in a manner that would have a significant adverse impact, if it were to operate without measures to mitigate these impacts.

As the project requires an environmental protection licence from DECC under the *Protection of the Environment Operations Act 1997* (POEO Act) it is a ‘potentially offensive development’. However, the level of offence would not be considered significant if the licence can be obtained. It is considered that an environmental protection licence can be obtained for the project, and therefore it is not an offensive industry as defined by SEPP 33.

Following consideration of potential water, noise, air and odour impacts (refer Section 9.1 – 9.5) it is concluded that, subject to the implementation of recommended mitigation measures, the project would not emit a polluting discharge leading to significant adverse impacts on the locality.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas in order to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

SEPP 44 applies to local government areas listed in Schedule 1. The Tweed LGA is included in Schedule 1, and the SEPP is referred to in the DGRs, therefore consideration of the potential application of SEPP 44 is required. Section 9.7 considers the potential impact of the project on koalas.

State Environmental Planning Policy No. 55 – Remediation of Land

SEPP 55 aims to provide a Statewide planning approach to the remediation of contaminated land, and in particular, promotes the remediation of contaminated land for the purpose of reducing risk of harm to human health or any other aspect of the environment.

SEPP 55 restricts consent authorities from issuing consent for development on land that may be contaminated.

A review of the site history indicates that there is no evidence of contaminating activities at the site.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

SEPP (Mining, Petroleum Production and Extractive Industries) 2007 aims to ensure the sustainable operation and management of mineral, petroleum and extractive material resources.

Clause 7 states that development for extractive industries is permissible with consent on land on which development for the purposes of agriculture or industry may be carried out.

As agriculture is permissible on the site, under clause 7 of the SEPP development for extractive industries would be permissible with consent.

Clauses 12-17 of the policy require that determining authorities consider the following:

- Compatibility of the proposed mining, petroleum or extractive development with surrounding land uses;
- Compatibility of any proposed development on land that is in the vicinity of a mine, petroleum production facility or extractive industry or on or near land that has been identified as a significant resource of minerals, petroleum or extractive materials;
- Environmental impacts of the proposal;
- Efficiency of resource recovery;
- Implications of the development on the public roads network; and
- Rehabilitation of the land, including final landforms and disposal/treatment of wastes and contaminated land.

The project is assessed according to the requirements of these clauses in Sections 3, Appendix D, Section 9.8 and Section 9.12.

State Environmental Planning Policy (Infrastructure) 2007

The aim of *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP) is to facilitate the effective delivery of infrastructure across the State.

Under Division 17 (roads and traffic), clause 94 (development permitted without consent), development for the purpose of a road or road infrastructure facilities carried out by or on behalf of a public authority is permitted without consent on any land. The road component of the project would therefore be permitted without consent.

Under Division 23 (waste or resource management facilities) both the landfill and the quarry components of the project meet the definition of waste or resource management facility:

> *'waste disposal facility means a facility for the disposal of waste by landfill, incineration or other means, including associated works or activities such as recycling, resource recovery and other resource management activities, energy generation from waste gases, leachate management, odour control and the winning of extractive material to generate a void for disposal of waste or to cover waste after its disposal.*
>
> *waste or resource management facility means a waste or resource transfer station, a resource recovery facility or a waste disposal facility.'*

Under clause 121, development for the purpose of waste or resource management facilities may be carried out by any person with consent on land in a prescribed zone. The prescribed zones include SP1 Special Activities, which is considered to be equivalent to the special uses zone that applies to most of the site. It also includes the RU1 and RU2 zones which are equivalent to the Rural 1(a) and 1(b2) zones under Tweed LEP 2000. As a result, according to the Infrastructure SEPP, the quarries and landfills would be permissible with consent.

Under Clause 123 the Consent Authority must consider whether there is a suitable level of recovery of waste being achieved before it reaches the landfill; whether the proposal is best practice in design and operation; whether it addresses greenhouse gas issues; whether the site is already a degraded site; whether its location avoids land use conflicts; whether it's consistent with regional strategies or State guidelines; and whether transport links are optimised to reduce impacts of waste transport. An outline of these issues and a more detailed description of the justifiable demand for landfilling are provided in Section 6.

Changes to Infrastructure SEPP July 2010

On 12 July 2010, the Department of Planning issued a Planning Circular (PS 10-016) *Changes to Infrastructure SEPP – Determination of Landfill Applications.* The Circular makes amendments to Clause 123 of the SEPP to shift the emphasis for landfill applications from justifiable demand towards increased waste recovery (such as using alternative waste technologies or composting) and other environmental outcomes. However this Environmental Assessment has been based upon the DGRs issued in August 2008 which make reference to the justification of the landfill operations and maximising resource recovery from the waste stream to reduce landfill disposal.

In relation to the changes to the SEPP, Council made a submission to the Minister for Planning on 23 July 2010, seeking advice on what impact the changes will have on this existing Part 3A application. At the time of writing, a response had not yet been received.

It is noted however that the waste management components of the Project Application and Concept Plan, together with Domestic Solid Waste Management strategy which has driven recent resource recovery initiatives and will continue to guide future activities are consistent with the overall intent of the amended SEPP. Details of the Solid Waste Management Strategy are provided in Section 4.1 of this document. Furthermore Section 6.4 provides comments on how the Stage 1 Project Application and Concept Plan address the new requirements for determination of landfill applications.

2.5 Other Plans and Strategies

2.5.1 NSW Waste Avoidance and Resource Recovery Strategy

The *NSW Waste Avoidance and Resource Recovery Strategy (2007)* (WARR Strategy) provides the framework for maximising conservation of natural resources and minimising environmental harm from waste management and disposal of solid waste. The strategy includes targets in four key result areas:

- Preventing and avoiding waste;
- Increasing recovery and use of secondary materials;
- Reducing toxicity in products and materials; and
- Reduction litter and illegal dumping.

The WARR Strategy sets 2014 targets for increases in recycling of municipal waste from baseline 26% to 66% in 2014, from 28% to 63% for commercial & industrial waste and from 65% to 76% for construction and demolition waste.

The Concept Plan together with Council's Waste Strategy is consistent with the WARR Strategy in that it delivers improved resource recovery outcomes. Section 4 describes the improvements in resource recovery that are being delivered by Council.

2.5.2 Far North Coast Regional Strategy

The purpose of the Regional Strategy is to manage the Region's expected high growth rate in a sustainable manner. Due to its proximity to the high growth area of South East Queensland, the urban coastal areas of the Tweed Shire have demonstrated the strongest growth in the Region over the past decade.

The project aims to meet the growing demands of the shire through the establishment of a new landfill site. Subsequently, the proposal is considered to be consistent with the aims and objectives of the Far North Coast Regional Strategy.

2.5.3 Tweed Urban and Employment Land Release Strategy 2009

This strategy was adopted by Council on 17 March 2009. It sets out a blue print for planning for the Tweed over the long term and beyond the areas currently zoned for urban purposes. No area identified either for potential residential or employment lands development is within 2 km of the proposed quarry or landfill sites. The proposal is consistent with the Strategy in that it provides an essential urban service to a community undergoing strong population growth.

2.5.4 Tweed Regional Botanic Gardens Plan of Management

The Tweed Shire Regional Botanic Gardens are located on the site. In 1998, a Master Plan was prepared to develop an integrated relationship between the botanic gardens, cemetery, and proposed landfill areas (Master Plan Report, Tweed Shire Regional Botanic Gardens, Landplan, September 1998). As summarised in Gilbert and Sutherland (2007), the objective of the report was a planning concept for the overall site and to provide a strategy for optimum environmentally responsible procedures for: the existing quarry / landfill operations to continue; the cemetery to continue; the core botanic garden to be established; and appropriate adjacent land uses to be considered.

The project has been developed to maintain consistency with recommendations outlined within the Botanic Gardens Master Plan. That is, it is proposed that quarrying is to be limited to the West and North Valleys (despite suitable hard rock resources being located throughout the site) and that landfill would occur following quarrying in these locations.

2.6 The Application Process

The application, assessment and approval process is summarised below.

2.6.1 Agency Consultation and the Planning Focus Meeting

For some projects, the NSW Department of Planning convenes a planning focus meeting with relevant government authorities. The meeting provides a forum for participants to obtain information on the project, and discuss key issues and potential environmental impacts. Following the meeting, the Department seeks written comments from agencies on issues that should be addressed in the environmental assessment.

A planning focus meeting was held for the project in February 2008. The meeting was attended by the proponent and the following organisations:

- Department of Planning;
- Department of Primary Industries; and
- Department of Environment and Conservation (now OEH).

Following the issuing of the DGRs further consultation has been undertaken with these departments as well as the Roads and Traffic Authority (RTA) and Council.

Further details of the consultation process are outlined in Chapter 5.

2.6.2 Addressing the Director General's Requirements

Under clause 75F of the EP&A Act, the Director General is required to prepare and issue the proponent with requirements for the project. These requirements, known as the Director General's Requirements (DGRs) identify the key issues to be addressed and the level of assessment required in relation to the project. The DGRs were issued on the 31 July 2008. Since this date there have been changes to the project description, however the proponent was notified by electronic correspondence on 31 March 2009 that while an amended PEA was required, the project still triggered assessment under Part 3A and the existing DGRs remain current. A copy of the DGRs is included in Appendix A.

A summary of the assessment requirements outlined in the DGRs, together with the section of this document that addresses these requirements, are provided in Table 2-1.

Table 2-1 Summary of the Director General's requirements

Category	Summary of requirement	Document reference
General requirements	Executive summary	Executive Summary
	Detailed description of existing operations, approvals, environmental management and monitoring	Section 3.5
	Detailed description of the project, including: ◗ Need ◗ Alternatives and justification of the preferred ◗ Staging ◗ Plans	 Section 6 Section 6 Section 7 Section 7, Appendix B, Appendix D
	Environmental risk assessment	Section 8
	Assessment of: ◗ the existing environment ◗ potential impacts ◗ mitigation measures	 Section 3 (overview) Section 9 Section 8, Section 9 Section 9, Section 10
	Statement of commitments	Section 10
	Conclusion justifying the project	Section 11
	Signed statement from the author	Front of document
Key issues	Waste management	Section 4
	Soil and water	Summary Section 9.1 – 9.3, Appendix H
	Noise, blasting and vibration	Summary Section 9.4, Appendix I
	Air quality and odour	Summary Section 9.5, Appendix J
	Greenhouse gas	Summary Section 9.6, Appendix K
	Biodiversity	Summary Section 9.7, Appendix L
	Transport	Summary Section 9.8, Appendix M
	Heritage	Summary Section 9.9, Appendix N
	Visual	Section 9.10
	Hazards	Section 9.1
	Rehabilitation	Section 9.12
Consultation	Need to consult with nominated agencies	Section 5

2.6.3 Exhibition

This document was submitted to the Department of Planning in November 2010. An adequacy review was conducted, and a range of information requested. This document has been updated to reflect additional information sought from the Agencies during the adequacy assessment.

If the environmental assessment is considered to adequately address the Director-General's requirements, the Planning and Infrastructure (formerly Department of Planning) will place it on public exhibition for at least 30 days. During the exhibition period, submissions will be invited from relevant agencies and members of the community. The Planning and Infrastructure will provide the proponent with a copy of the submissions or a summary of the issues raised in the submissions. The proponent will be asked to respond to the issues and may modify the project and the draft statement of commitments to minimise impacts on the environment, if required.

If the project or statement of commitments are modified in response to issues raised, a preferred project report would be prepared to describe the scope of the revised project. The Director General would make this report public.

2.6.4 Assessment and Determination

Following the exhibition period, the Department of Planning would, on behalf of the Minister, review the environmental assessment, any preferred project report, and submissions received. Once the Department has completed its assessment, a draft assessment report would be prepared for the Director-General, which may include recommended conditions of approval.

The recommended conditions would refer to the statement of commitments and may modify them and/or add additional provisions.

The assessment report would then be submitted to the Minister for determination. The Minister may refuse the project, or approve it with any conditions considered appropriate.

The Minister's determination and the Director General's report would be published on the Department of Planning's web site immediately following determination.

3. The Site

3.1 Overview

This section of the EA provides a detailed description of the:

- Regional, local and environmental context of the site;
- Historical extractive industry and landfill operations on the site and at the Stotts Creek Resource Recovery Centre;
- The existing and approved extractive industry and landfill operations including any statutory approvals that apply to these operations; and
- The existing environmental management and monitoring regime for the site.

3.2 Site Context

3.2.1 Regional Setting

Eviron is located within the far North Coast region of NSW which extends from the Queensland border in the north, south along the coast to Evans Head and west to Woodenbong and Tabulam (Department of Planning, 2006).

Within the region, Tweed Shire covers an area of approximately 1300 km^2, and stretches along 37 km of coastline from Wooyung in the south to Tweed Heads and the Queensland border in the north and west to the Tweed Range. The Shire is bounded by the McPherson the Tweed and the Nightcap Ranges and is adjacent to the local government areas of the Gold Coast City, Kyogle Shire, Lismore City and Byron Shire.

The major watercourses of the region are the Tweed, Richmond, Wilson and Brunswick Rivers. The Tweed River is located approximately 2.5 km north of the site with its major tributaries being the Rous River, the Oxley River and Dunbible Creek, which join the river upstream from the site. Water is supplied to the Shire via Bray Park Weir after release from the Clarrie Hall Dam approximately 24 km southwest of the site.

3.2.2 Local Setting

The site is located along a spur along the northern ridge of the Condong Range where it meets the floodplain of the Tweed River and is approximately 6 km west of the coastline. The site is separated from the coastal plain by the northern extent of the Condong Range which extends further to the northeast of the site. Surrounding localities include Tumbulgum and Stotts Creek to the north, Duranbah to the east, Clothiers Creek, Farrants Hill and Nunderi to the south, and Condong to the west.

The primary access to the site is currently from Eviron Road, via the Quirks Quarry haul road (Lot 1 DP 34555). This is currently the primary access for all quarry vehicles (Figure 3).These access points are locked outside of the hours of operation of the quarry. The Pacific Highway extends along the eastern boundary of the site, and cuts through the Condong Range, however there is no direct access from the site to the highway.

Once the proposed haul road is established at the site, the existing haul road from Eviron Road access point will no longer be used for heavy vehicle access.

3.2.3 Zoning and Property Descriptions

Site Zoning

The site covers an area of approximately 111.5 ha consisting of Council owned land:

- Lot 1 DP 34555;
- Lot 1 DP1159352;
- Lot 602 DP 1001049 (portion west of Pacific Highway only).

As described in Chapter 2 most of the site is zoned 5(a) – Special Uses (Garbage Depot). The northern most portion of Lot 602 DP 1001049 and the eastern and north western portions of Lot 1 DP 1159352 are zoned 1(b2) Agricultural Protection (Figure 4).

It is important to note that Council are not seeking approval to conduct any waste or quarry related activities in any of the areas zoned Rural 1(a) or Rural 1(b2). Similarly no landfilling or quarrying will take place on Lot 1 DP 34555. Further detailed information on the project description is provided in Section 7.

Local Zoning

Land in the ownership of Council adjacent to the site is zoned Special Uses 5(a) (Garbage Depot and Quarry) at the existing Stotts Creek landfill (Lot 1 DP590220) and Special Uses 5(a) (Cemetery / Crematorium) (Lot 601 DP1001049). Council has also acquired Lot 25 DP 615931 (south west of the site), which is currently zoned 1(a) Rural. None of these adjacent lots are being considered as part of this assessment.

Lands immediately to the south of the site are zoned 1(a) Rural, the land to the north and west of the site is zoned 1(b) Agricultural Protection. Stotts Island, along the Tweed River to the north is zoned 8(a) National Parks and Nature Reserves.

Specific details on zoning are provided in Section 2.4.1.

1:10,000 (at A3)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Site Boundary
- Cadastre Boundary

Tweed LEP 2000 Zoning

- Rural - 1(a)
- Rural Living - 1(c)
- Agricultural Protection - 1(b1)
- Agricultural Protection - 1(b2)
- Special Uses - 5(a)

GHD

CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Zoning

Figure 4

N:\AU\Toowoomba\Projects\41\20806\GIS\Maps\4120806_006.mxd

54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Tweed LEP Zoning (2000), Cadastre boundary (2010). GHD - Site Boundary (2011).

3.2.4 Regional and Local Land Use

Regional (Shire Wide)

Land use within the Tweed Shire is predominantly agricultural, with approximately two thirds of the Shire zoned for rural purposes. Much of the existing rural farmland is used for grazing of beef and dairy cattle while sugar cane crops dominate the floodplains. Other regional agricultural pursuits include bananas, horticulture and market gardens (Tweed Shire Council, 2008).

Approximately 52% of the Tweed Shire is covered by bushland, and 16% of the Shire is contained in 22 reserves (Tweed Shire Council, 2009). Major reserves in the Shire include Border Ranges National Park, Limpinwood Nature Reserve, Numinbah Nature Reserve, Mount Warning National Park, and Nightcap National Park which are all part of the World Heritage listed Gondwana Rainforests of Australia extending along the Shires western boundary. Several other National Parks, Nature Reserves and State Conservation Areas occur in the region, including those in closer proximity to the site such as Stotts Creek Nature Reserve (3.7 km north), Mooball National Park (8.7 km south), Mount Nullum Nature Reserve (15.5 km southwest) and Cudgen Nature Reserve (3 km east/south east) (Figure 1) (Kingston *et. al.,* 2004).

As of June 2008, Tweed Shire had an estimated resident population of 86,833 and in the period from 2007-2008, the Shire had the largest and fastest population increase in the state, with an increase of 2,200 people (2.6%) (Australian Bureau of Statistics, 2009). Approximately 64% of the Shire's population reside in the main urban areas of Tweed Heads, Bilambil, Terranora, and Banora Point. A further 25% are located in the rural areas including Murwillumbah, Uki, Tyalgum and Chillingham, with the remaining 11% in the coastal villages and townships south of Kingscliff. Projected population figures estimate that by 2036 the population of the region (Tweed-Richmond) will grow by 37% (NSW Department of Planning, 2008).

Local

In the immediate vicinity of the site land uses include agriculture, rural, waste management, quarrying and rural residential. A summary of land use surrounding the site is provided in Table 3-1.

Table 3-1 Surrounding Land Use

Direction	Land Use
North	Sugar cane farming, quarry (O'Keeffes No. 2), Stotts Creek landfill
South	Sugar cane farming, rural residential
West	Sugar cane farming
South west	Rural residential
South	Eviron Road, rural residential, quarry
South east	Rural residential, Pacific Highway and Tweed Shire Cemetery
East	Pacific Highway, Tweed Shire Cemetery, agriculture

Sugar cane farming is the predominant agricultural land use locally, with cane fields extending north from the Condong Range to the Tweed River and extensively along the floodplain. As indicated previously, part of the site (Lot 602 DP 1001049) contains an area of sugar cane which is leased to a local cane grower.

The Pacific Highway extends along the eastern boundary of the site, with a small area of Lot 602 DP 1001049) having been bisected by the upgrade of the highway. The existing Lawn Cemetery and Crematorium (also in the ownership of Council), is located on the eastern side of the highway (lot 602 DP 1001049). Agricultural lands are located further along the Condong Range which continues east of the highway.

A private quarry known as O'Keeffes No. 2 adjoins the northern boundary of Lot 1 DP 1159352 and another quarry is situated to the south of Eviron Road adjacent to the Pacific Highway.

The closest dwellings to the site are located at:

- Lot 30 DP 820048, approximately 60 m to the south of the southern boundary of Lot 602 DP 1001049 (Quirks Quarry); and
- Lot 1 DP 783802 approximately 360 m south of the southern boundary of Lot 1 DP 1159352 (West Valley) and 130 m west of Lot 1 DP 34555.

Both of these dwellings are situated on rural zoned allotments, and are adjacent to Eviron Road.

Four other dwellings are located to the south of Eviron Road, along Hatton Road, however these are situated beyond the ridgeline on the southern slopes of the Condong Range.

3.4 Environmental Context

3.4.1 Topography

A northern spur of the Condong Range passes through the western and southern areas of the site and the natural ground surface within the site boundary rises relatively steeply from the floodplain from <2 m AHD up to around 40 m AHD in the north west and >60 m AHD in the south of the site (see Figure 5). Current floor elevations within Quirks Quarry are around 2 to 5 m AHD.

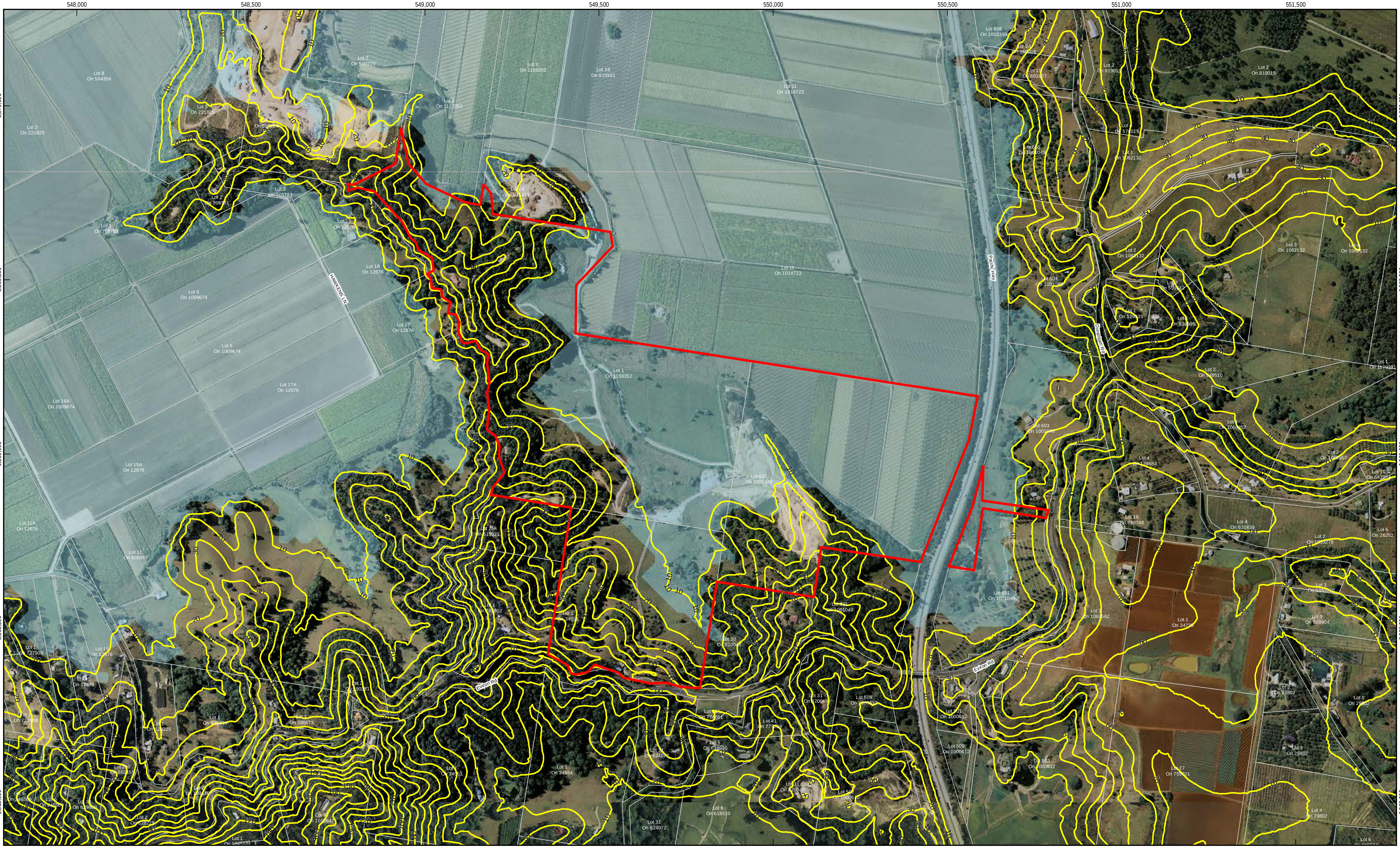
3.4.2 Hydrology and Drainage

A number of small ephemeral drainage channels flow from the site in a north/north east direction into a larger un-named channel along the northern site boundary which flows from southeast to northwest through the site. It is understood that this channel has been previously excavated to improve drainage at the site. This larger channel continues to the north close to the edge of the Tweed River floodplain and discharges to Leddays Creek, eventually discharging into the Tweed River approximately 4 km to the north of the site. Locally, several cane channels are used for water drainage associated with the low lying flood plain area. Flood mapping of the area indicates a 1 in 100 year flood level of 3.9 m AHD.

A drainage channel has also been excavated in bedrock within Quirks Quarry as part of the quarrying operations to 1 to 2 m below the quarry floor. This drainage channel skirts the eastern side of the quarry and ultimately conveys flow to the main surface water channel through the site. Some water is captured on the Quirks Quarry site in a holding dam and used in quarry operations (including for dust suppression).

The conceptual understanding from the hydrogeological and acid sulfate soils desktop study (GHD, 2010) with respect to hydrology indicated that:

- Vertical percolation of precipitation through up to approximately 30 m of unsaturated bedrock via fissures and fractures to the water table, and lateral groundwater flow, preferentially along zones of fractures and fissures, towards the north east, north and the Tweed River;
- Vertical percolation of precipitation through a relatively thin (typically <3.5 m) zone of unsaturated alluvial/marine deposits via primary porosity pathways to the water table, and lateral groundwater flow within these superficial deposits towards the north east, preferentially along more permeable layers such as those with a component of sand and, or, gravel;
- Discharge of groundwater from bedrock to the overlying alluvial deposits is considered likely to occur in the vicinity of the floodplain; and
- Shallow groundwater in the alluvial deposits is likely to discharge to the surface water channel close to the edge of the floodplain.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Site Boundary

Flood Liable Land

Cadastre Boundary

Contours - 10m Interval

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Topography and Drainage Plan

Figure 5

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54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Contours (2008), Flood Liable Land (2008), Cadastre boundary (2010). GHD - Site Boundary (2011).

3.4.3 Geology

Regional Geology

Regional scale geological mapping (1:250,000-scale map for Tweed Heads, Sheet 56-03) shows Quaternary-age deposits (river gravel, alluvium, sand and clay) outcrop along the Tweed River and other low lying areas in the vicinity of the site. Isolated outcrops of Tertiary age volcanic rock (predominantly basalt) are mapped south west and south east of the site (Figure 6). The regionally extensive Silurian-age Neranleigh–Fernvale beds (greywacke, slate, phyllite and quartzite), are mapped at ground surface in the west and south of the site and are shown to dip towards the south west at around 45° on a regional scale and may be folded, as indicated by the regional geological cross section (NSW Department of Mines 1967).

Site Specific Geology

Studies by Gilbert and Sutherland (2007 and 2008) identified two predominant geological units over the site, these being unconsolidated alluvial and marine deposits, and are broadly characterised as clay (including marine clay) and silty clay material containing limited and variable proportions of gravel and sand and occasional lenses of sandy clay; and bedrock, mapped as the Neranleigh-Fernvale Beds including weathered siltstone, quartzite, chert, greywacke and basalt This was confirmed through a drilling program undertaken as part of the planning for this assessment.

The drilling program included 15 boreholes across the North and West Valleys. Boreholes ranged between 1.8 m – 70.25 m in total depth. Note that no additional drilling or soil investigations were conducted in the existing Quirks Quarry.

Based on the drilling program there are at least three (3) geological units [and their weathered equivalents] present on the site, two of which may be sub-units of the same parent unit: the Neranleigh-Fernvale Beds. The three geological units occurring on the site are listed below:

- Tertiary to Recent Alluvial Deposits
- Neranleigh-Fernvale Beds: Siliceous
- Neranleigh-Fernvale Beds

Stratigraphic Correlation

The entire site was found to be comprised of Neranleigh-Fernvale beds (and their weathered equivalents) and Tertiary to Recent alluvium. Individual units within the Neranleigh-Fernvale were not found to be contiguous between existing drillholes. Logged units were broadly classified based on an assumed quarry product assessment:

- SO – Residual Soils. Typically clayey and sandy to silty with variable organic content. Overburden/Fill quarry product.
- AL – Alluvium. Predominantly Silty to Sandy Clays of moderate to high plasticity. Additionally marine clay including acid sulphate soils. If extracted, Overburden/Fill quarry product.
- NFW – Weathered Neranleigh-Fernvale interbedded siltstone, chert/quartzite and greywacke. Drainage aggregate, cracker dust and road base quarry products. Locally, these

beds have been silicified and when this is observed, the rocks are of moderate to high strength.

- NF – Fresh Neranleigh-Fernvale interbedded pyritic to non-pyritic greywacke and siltstone. Drainage aggregate, cracker dust and road base quarry products.

A thick section of silicified material is observed within TSCBH01 and this siliceous zone was sampled and assayed and yielded no significant results with respect to metal prospectivity. The material sampled was mostly fresh rock. Quarrying will be avoided in the vicinity of TSCBH01 where significant pyrite was intersected and is west of the proposed quarry site. The area of West Valley quarry where fresh non-pyritic interbedded greywacke and siltstone is the area being examined for quarrying purposes.

Full details and drilling results are provided in the Preliminary Quarry Study in Appendix D. Figure 6 shows the regionally mapped geology supplemented by the findings of the drilling program onsite.

3.4.4 Soils

Soil Landscapes

Soil landscape mapping of the Murwillumbah – Tweed Heads 1:100000 Sheet (Morand, 1996) indicates that three soil landscapes occur on the slopes of the site, these being the Burringbar, Billinudgel and Ophir Glen soil landscapes, while the Tweed soil landscape group extends along the floodplain (Figure 7).

The ridges of the site are predominantly comprised of an erosional landscape which is mapped as the Burringbar soil landscape. This is described as being of high rolling to steep hills with narrow to moderately broad ridges and crests which reflects the topographic character of the site. For this soil landscape group, crests and some slopes are typically comprised of grey earths, upper slopes of moderately well-drained red podsolic soils, poorly drained yellow podsolic soils with moderately well-drained red earths on lower slopes and footslopes. The soil landscape is described as being erodible, strongly acid, hardsetting and dispersive (Morand, 1996).

The Billinudgel soil landscape is also comprised of rolling hills with localised steep slopes and typically occurs downslope from the Burringbar soil landscape on the margins of the Burringbar Hills Region (which extends over much of the eastern side of the Shire). Crests of this soil landscape are comprised of red podsolic soils with yellow earths and yellow podsolic soils on slopes. This soil landscape extends over the northern end of the spur of the Condong Range upon which Stotts Creek landfill is situated.

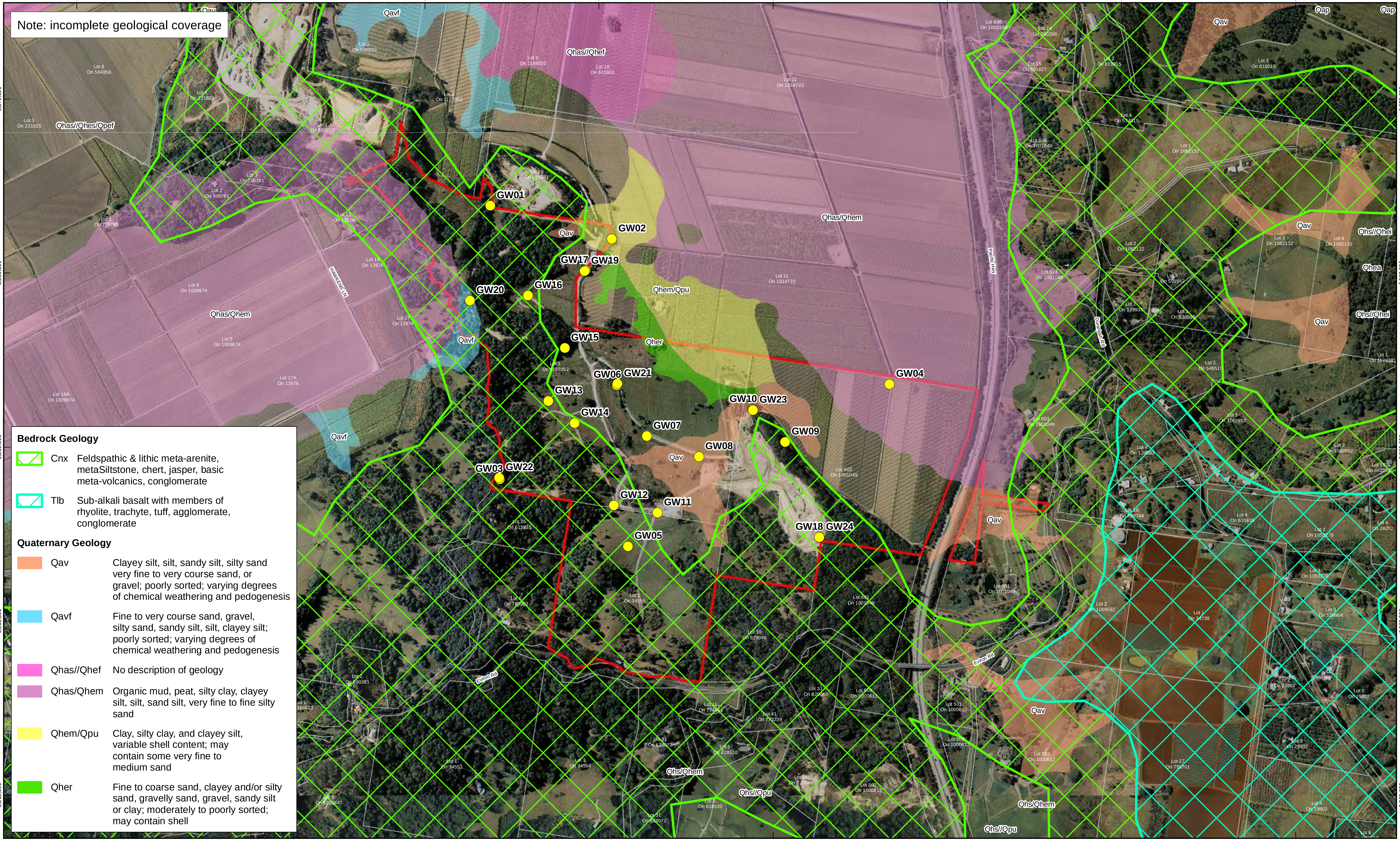
The transferral soil landscape of Ophir Glen, comprised of sheet-flood fans, alluvial fans and valley infills, is mapped predominantly on the lower slopes of Lot 1 DP 34555. The soils of this landscape are described as poorly drained yellow podsolic soils, moderately well-drained minimal prairie soils and deep poorly drained minimal brown podsolic soils occur on the lower portions of some coastal fans. Soil limitations are described in terms of waterlogging, high watertables, flood hazard, high run-on and water erosion hazard. They are strongly acidic, highly erodible and hardsetting. Small areas of this soil landscape group are mapped in similar between-slope areas throughout the region and generally have been extensively cleared (as on the site), and adjoin the Tweed soil landscape group downslope.

An estuarine/alluvial soil landscape comprised of an extensive marine plain comprised of deep Quaternary alluvium and estuarine sediments extends throughout the floodplain of the Tweed River which generally delineates the limits of the soil landscape.

Acid Sulfate Soils

Acid Sulfate Soil Risk Mapping, prepared by the (former) NSW Department of Land and Water Conservation (DLWC) for the site is shown in Figure 8. This mapping predicts the distribution of acid sulfate soils (actual acid sulfate soil [AASS] and potential acid sulfate soil [PASS]) based on an assessment of the geomorphic environment (NSW Department of Land and Conservation (1998)).

The eastern portion of both Lot 1 DP1159352 and Lot 602 DP1001049 are mapped as *high probability of occurrence* of acid sulfate soils within 1 m of ground surface whilst the remainder of the site is mapped as *no known occurrence* of acid sulfate soils. The mapping indicates an alluvial plain environment at an elevation of 1 to 2 m AHD and the environmental risk is described as 'severe environmental risk if acid sulfate soil materials are disturbed by activities such as shallow drainage, excavation or clearing'. Digital Acid Sulfate Soil Planning Mapping indicates that the area identified as having a High Probability of Occurrence is mapped as Class 2 for planning purposes (i.e. will require consent for development of works below natural ground surface and works where the water table is likely to be lowered).



1:10,000 (at A3)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Site Boundary
- Cadastre Boundary
- Groundwater Bores

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Geology & Groundwater Monitoring Bores

Figure 6

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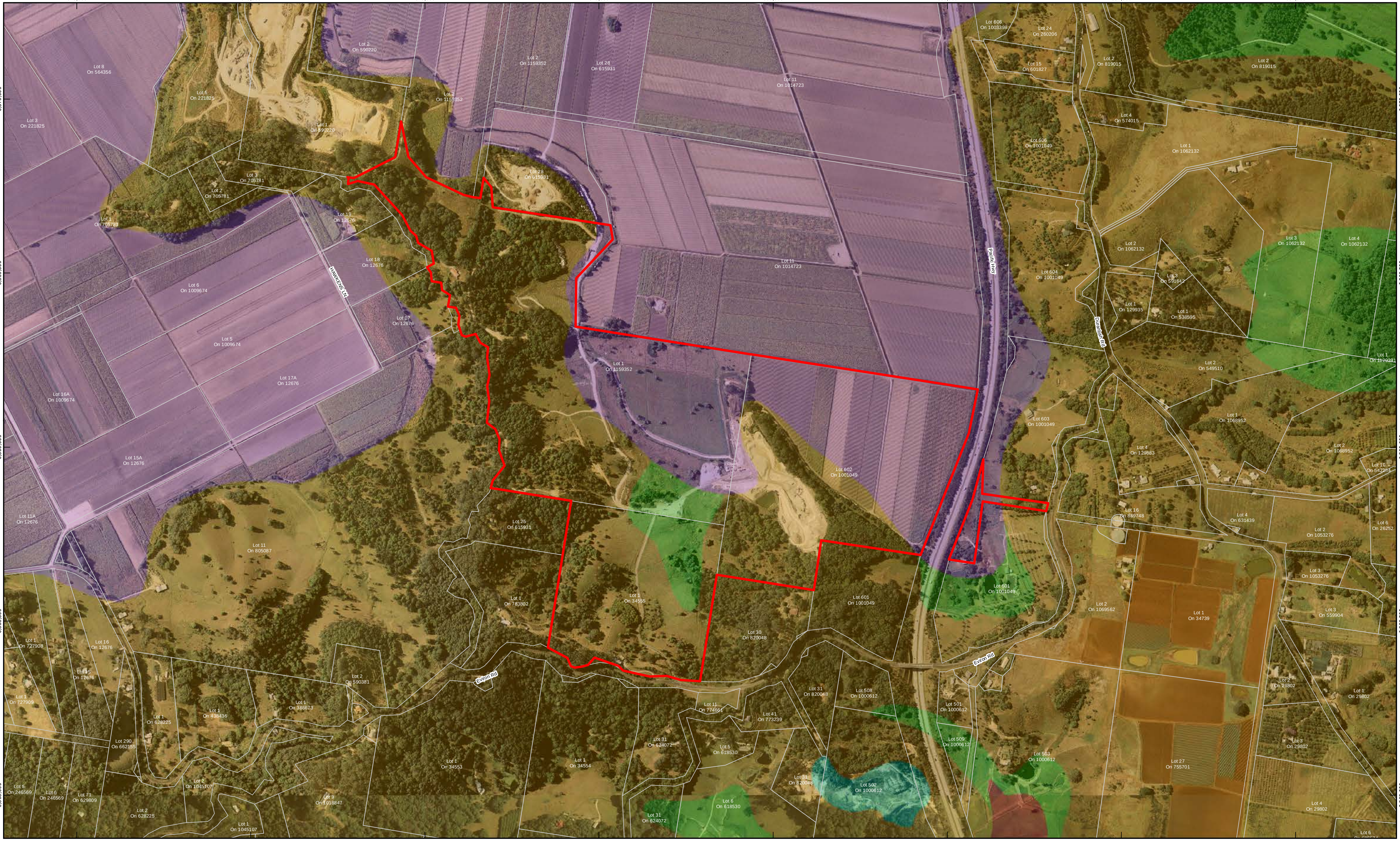
54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Bedrock Geology (2008), Quaternary Geology (2008), Cadastre boundary (2010). GHD - Site Boundary (2011).



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Site Boundary

Cadastre Boundary

Soil Landscape

Alluvial Landscapes

Distrubed Landscapes

Erosional Landscapes

Estuarine Landscapes

Transferral Landscapes

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Soil Landscapes

Figure 7

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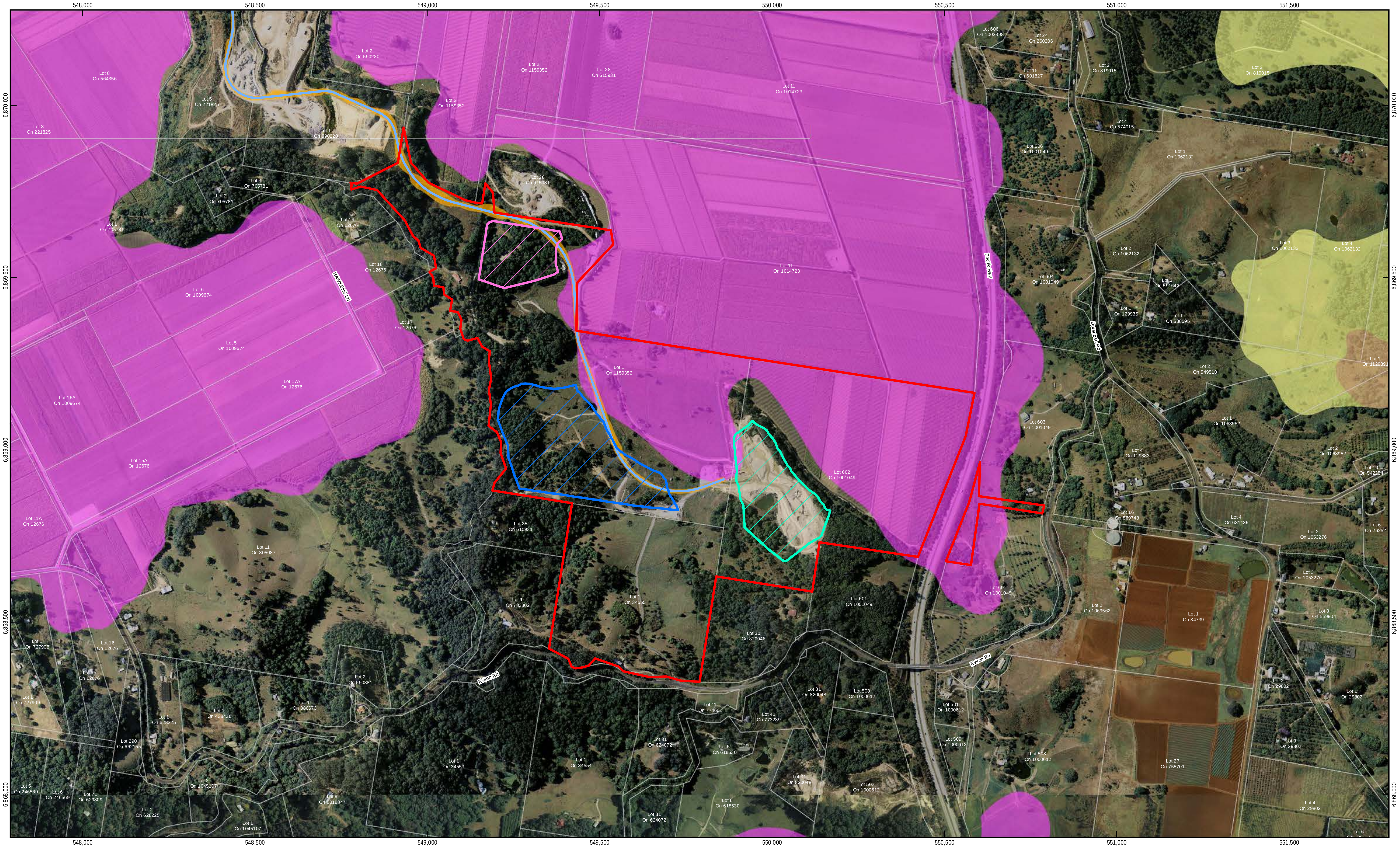
54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Soil Landscape (2008), Cadastre boundary (2010). GHD - Site Boundary (2011).



1:10,000 (at A3)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Site Boundary
- Cadastre Boundary
- Quirks Quarry
- West Valley Footprint
- North Valley Footprint
- HaulRoad
- Haul Road Batter

Acid Sulfate Soil Risk

- High - Within 1m of the ground surface
- Low - Within 1m of the ground surface
- Low - Between 1 & 3m below the ground surface

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Revision	1
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Acid Sulfate Soils Risk Map

Figure 8

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54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Acid Sulfate Soils (2008), Cadastre boundary (2010), Haul Road, Haul Road Batter (2011). GHD - Quirks Quarry (2010), West Valley Footprint (2010), North Valley Footprint (2011), Site Boundary (2011).

3.4.5 Climate

The Tweed region has a warm temperate climate and generally receives higher than average rainfalls than other areas of NSW. Summer and autumn are when higher rainfall occurs, while winter and spring are more typically dry, with average rainfall decreasing towards the west as a result of the rainshadow effect of the ranges and Mount Warning (Morand, 1996).

Climate data is not recorded at the site however the closest Bureau of Meteorology (BOM) weather station to the site is Murwillumbah (station number 058158), is located approximately 9 km south west of the site at Bray Park. Published statistics from the BOM website for this weather station give long-term averages from the period 1972 – 2008.

The annual rainfall for the Murwillumbah weather station is 1,573 mm/annum, with average rainfall being highest in February and March, and the lowest mean average rainfall occurs in September (refer Figure 9). Daily rainfall data are available for Stotts Creek landfill for the period September 2007 to August 2008 with the total rainfall in this period being 2,084.5 mm.

The mean highest maximum temperature of 29.6°C was occurs in January, while the mean lowest minimum is 8.5°C from July.

Northeasterly sea breezes are common in early spring and summer, with southerly winds predominant in late summer and autumn. Late autumn and winter winds are predominantly from the southwest. Seasonal windroses were developed for the site as part of technical studies for air quality, odour and noise and are shown in Figure 10. These utilised a regional-scale prognostic meteorological model, The Air Pollution Model (TAPM V 4), to simulate the wind climate over the subject site with consideration to DECCW *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, August 2005.

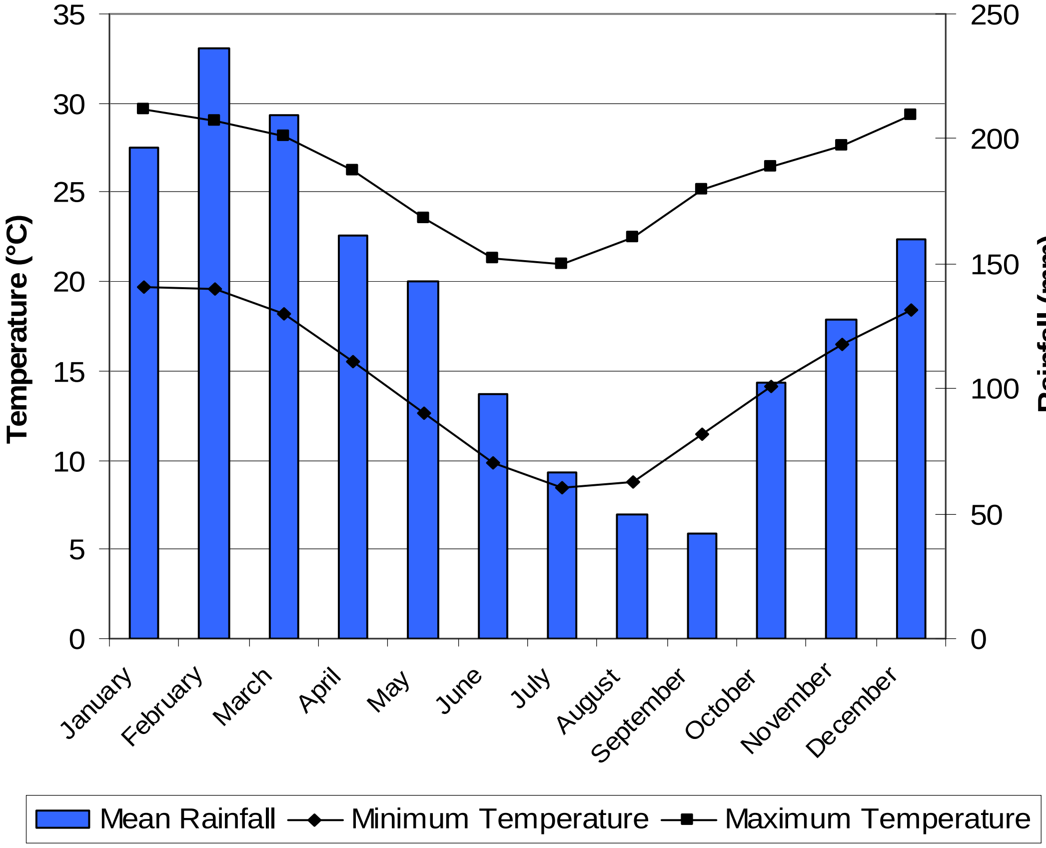


Figure 9 Monthly Average Rainfall and Temperature Murwillumbah (Bray Park) Weather Station (Source BoM)

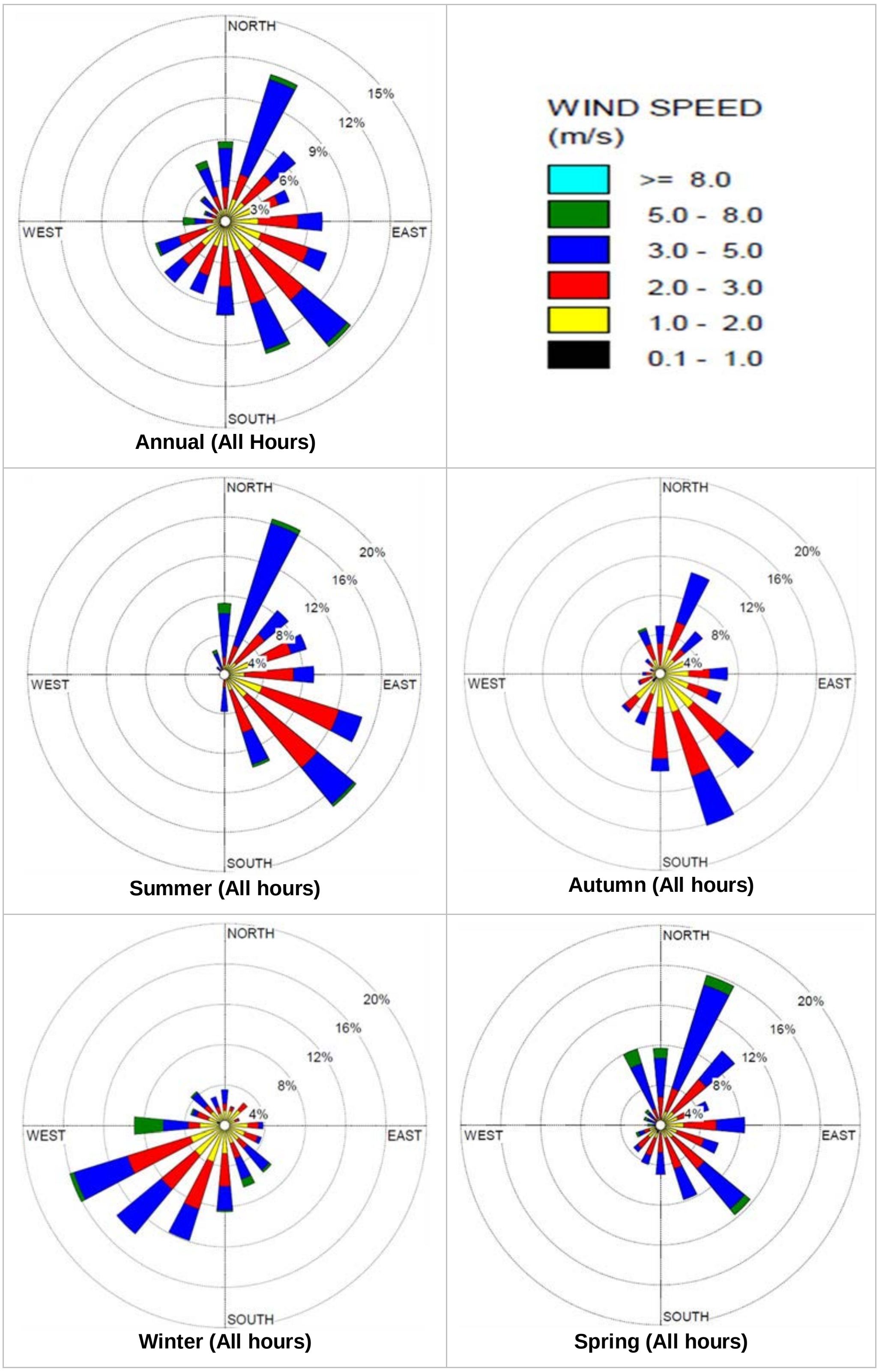


Figure 10 Wind Roses

Vegetation

Just over half of the Tweed Shire LGA is mapped as containing vegetation cover. Outside of reserve areas, over 48,000 ha (36% of the Shire) is mapped as containing bushland vegetation. Sclerophyll forest is the predominant vegetation class, while rainforest communities cover around 10,568 ha (8% of the Shire). Other smaller areas of vegetation types including heathland, sedgeland, estuarine and swamp vegetation generally occur in closer proximity to the coast (Ecograph, 2004).

Vegetation on and surrounding the site has largely been cleared historically for agricultural purposes. On the hillslopes, the site contains regrowth, closed to open forest dominated by Camphor Laurel, while vegetation in the lower elevation areas is predominantly grassland with scattered patches of trees. Very occasional patches of non-camphor laurel dominated vegetation occur within the site. In addition, small pockets of relatively degraded vegetation including broad-leaved paperbark open forest and lowland rainforest occur along modified watercourses. A small mango orchard is located along the southern quarry haul road.

3.5 Historical Operations and Activities

3.5.1 Stotts Creek Resource Recovery Centre and Bartletts Quarry

Council owns and operates the Stotts Creek Resource Recovery Centre, located at Leddays Creek Road, Eviron. This facility is located adjacent to the proposed Eviron Road Quarry and Landfill land holdings. Council has documented commitment to best practice provision of waste management infrastructure in the *2011/2021 Tweed Community Strategic Plan*. The presence of waste management strategy in the community strategic plan defines a whole of Council approach to responsible disposal of residual wastes after exhaustion of all resource recovery options. Within the Community Strategic Plan, Strategy 2.3.4 details:

> *Provision of high quality, best practice, solid waste disposal with energy recovery, and improving resource recovery practices and infrastructure which meets health and environmental requirements and projected demand.*

Section 4 of this document provides further detail on Council's community strategic plan as it relates to waste management and resource recovery.

The activities forming this overall Concept Plan include shared infrastructure and access with Stotts Creek RRC (as detailed in Section 7.2 and Quirks Quarry Landfill Concept Design Report in Appendix B and Draft Landfill Environmental Management Plan in Appendix C). However the activities at Eviron Road are separate to those at Stotts Creek. And for this reason an assessment of cumulative impacts of the two sites is not relevant.

The landfill component of Stotts Creek RRC, is a Class 1 waste facility that accepts all solid wastes including putrescible wastes and other wastes as approved by DECCW under Environmental Protection License 12181. Prior to being utilised for landfilling, the site was historically used for agricultural purposes with some quarrying operations. The quarry was located in what is now the eastern portion of the landfill and was known as Bartletts Quarry. Materials quarried included aggregates, fill, road base and cracker dust. In addition, according to the LEMP (Tweed Shire Council, 2004) contractors at the site recall the presence of a 'hail stone' quarry in the base of the landfill, however this is unconfirmed.

Prior to landfilling or quarrying activities the Stotts Creek RRC site would have comprised an elevated landform. It is inferred from its location along the range, that the slopes forming the landform were relatively steep, (grading up to 25%), with a north-south drainage divide located midway through the site, located along the remaining ridgeline that separates Lot 5 (western side) from Lot 1 (eastern side). Quarrying is understood to have taken place initially to the west of the divide (within the current solid waste landfill site), then continuing on the eastern side of the divide (current Bartlett's Quarry) following initial landfill development. The floor level of the previously quarried area within the existing landfill area was around RL 5 m (Tweed Shire Council, 2004).

The landfill was expanded in 2004 as the 'solid waste landfill expansion' which extended the solid waste landfill to Bartletts Quarry.

Licencing and Waste Management

The landfill component of the RRC is operated under two Environmental Protection Licences issued by the NSW DECCW (Table 3-2).

Table 3-2 Licences Applicable to Stotts Creek Resource Recovery Centre

Environmental Protection Licence	Lot Description	Cell	Area (ha)	Activity	Activity Threshold (t/year)	Review Date
12181	Part Lot 1 DP 590220	Cell A Cell B	2.76 22.2	Solid waste Inert landfill	55000 15000	9 December 2012
6108	Lot 5 DP 221825 Lot 1 DP 590220			Waste Processing	n/a	27 February 2011

Site Facilities

The Stotts Creek RRC hosts a materials recovery facility, green waste processing facility, transfer station (recovery of dry recyclables, paper/cardboard, metal, reusables, batteries, gas bottles, tyres, CFL's and E-Waste), DrumMuster compound, Oil Recycling Station, construction and demolition recycling pad, putrescible landfill and non-putrescible landfill. An active landfill gas extraction and energy recovery system operates on this site. Since commissioning the landfill gas infrastructure Council has flared in excess of 4,450,237m3 of methane, and combusted 4,313,931m3 of methane at the micro power station. The landfill gas system operating at Stotts Creek RRC is Council's primary emissions mitigation tool, and demonstrates a commitment to responsible environmental management of the current landfill asset.

Environmental Monitoring

Councils commitment to environmental performance of the Stotts Creek RRC is outlined in the site specific Landfill Environmental Management Plans and the environmental protection licences.

The Stotts Creek RRC hosts 24 groundwater monitoring bores to monitor the groundwater characteristics within the vicinity of the site. Groundwater monitoring bores are located upstream (background), within the operational area, and downstream of the site. The groundwater bores are monitored quarterly or annually for a range of analytes as per the environmental protection licence conditions.

Surface water is monitored at eight locations across the site to ensure compliance with environmental protection licence conditions.

Leachate is monitored at four contained locations to determine the leachate characterisation as per environmental protection licence conditions.

Methane readings are taken quarterly at all 24 groundwater monitoring bore openings, and all enclosed buildings at the site and any building within 250m, while surface methane readings are taken each quarter at waste filled areas with a final cap in place.

All sampling and laboratory analysis is undertaken by qualified persons and a registered NATA accredited laboratory.

Complaints Handling

As per environmental protection licence condition M4, Council maintains a complaints register to document any complaint received regarding the activities undertaken at the Stotts Creek RRC, or by vehicles or mobile plant associated with the site. A review of the complaints register, and cross reference with annual returns submitted to DECCW, reveal that a complaint has not been received since 2004/2005. Two complaints were received in 2004/2005 regarding environmental protection licence 12181 and one complaint was received regarding environmental protection licence 6108. No complaints have been received regarding the activities at Stotts Creek RRC or vehicles or mobile plant since 2004/2005.

Timing and Staging

The landfill component of the Stotts Creek RRC is nearing capacity, with projections estimating the current putrescible landfill cell would be full by 2012, while the inert waste cell would continue until 2016 (APC, 2007). The putrescible landfill cell operations and landfill gas recovery are intended to transfer to the Quirks Quarry Landfill in 2012 should approval for the Stage 1 Project Application be granted. The Stotts Creek inert waste cell has a minimum of 100,000 tonnes of remaining capacity. Taking an average of inert waste sent to the inert waste landfill cell over the past five years, the 100,000 tonne remaining capacity would allow inert landfilling to continue at Stotts Creek RRC until approximately 2020. At the point where the Stotts Creek inert waste cell reaches capacity (in 2020), the residual inert waste would report to either the Stage 1 Quirks Quarry or the subsequent West Valley Landfill proposed under the Concept Plan should the Quirks Quarry Landfill have also reached capacity by 2020 (subject to relevant approvals)

As development of the Stotts Creek RRC involved significant infrastructure investment by Council, all front end infrastructure and activities including the weighbridge, office, as well as recycling (recovery of dry recyclables, paper/cardboard, metal, reusables, batteries, gas bottles, tyres, CFL's and E-Waste), DrumMuster compound, Oil Recycling Station, construction and demolition recycling pad, green waste processing and the small vehicle transfer station will be retained at the Stotts Creek RRC and will continue to be managed under the Stotts Creek Landfill Facility LEMP throughout both Stage 1 and subsequent stages of the Eviron Road Concept Plan. It is anticipated the landfill gas infrastructure would also remain on the Stotts

Creek RRC site until 2032 (with a potential additional 15 years subject to the methane resource).

Rehabilitation works would commence on the Stotts Creek putrescible landfill cell once landfilling activities cease in 2012. The rehabilitation works would be conducted in accordance with the LEMP, closure plan, and incorporating components of the Landfill Revegetation Strategy that has been prepared for Bartletts Quarry (EDAW Gillespies, 2005).

Further details of the resource recovery activities at Stotts Creek RRC and current waste management statistics are provided in Section 4.

Sources of Waste/Resources

The Stotts Creek RRC is centrally located to the high density coastal/Tweed population and large rural townships. As noted previously this will remain as the entry/exit point for the landfilling activities in Stage 1 and the broader Concept Plan. The facility is located within easy reach of the main transport infrastructure of the Pacific Highway via the Tweed Valley Way.

In excess of 95% of the Tweed Shire LGA is serviced by a kerbside collection service. The Stotts Creek RRC hosts the only Class 1 putrescible waste landfill within the Shire, following its closure the landfilling component of the Eviron Road Concept Plan will also be the sole putrescible waste landfill in the Shire. Currently, there is a small rural unlicenced transfer station located at Tyalgum which services those few residents in the west of the Shire that do not have access to the kerbside collection service.

In 2009/2010 the highest contributor to the 97,865 tonnes of materials entering the Stotts Creek RRC (of which 38,496 tonnes were recycled or reprocessed) was from the Tweed Shire LGA kerbside collection of municipal solid waste (MSW) (32.86%), compared to commercial and industrial waste (C&I) (28.5%), construction and demolition waste (C&D) (14.5%), green waste (12.55%) and other (11.59%). Overall, 93.14% of these 97,865 tonnes of materials entering the Stotts Creek RRC for recycling, reprocessing and landfilling was materials generated and transported from within the Shire. The remaining 6.86% was made up of recyclables from Byron Shire LGA (4.59%) and commercial waste from South East Queensland or elsewhere (2.27%).

Council protects the landfill assets for the Tweed Shire community through a staggered gate pricing model, where waste generators from outside the Tweed Shire LGA pay a premium for materials presented for disposal at Stotts Creek RRC. This gate pricing policy was established in 2007/2008 and has had a significant effect on dispersing waste material from outside of the Tweed Shire to other licenced facilities. In 2009/2010, waste transporters presenting materials from outside of the Tweed Shire LGA paid a 12.2% premium per tonne to dispose of general waste, 15.29% premium per tonne to dispose of C&D waste, and 69.56% premium per tonne for asbestos materials. Table 3-3 provides a summary of the sources of waste and recyclable materials presented to Stotts Creek RRC (by weight) over the past three years, and the overall impact the gate pricing policy has had in protecting the landfill asset for the disposal of residual waste from the Tweed Shire LGA.

Table 3-3 Sources of Waste and Recyclables Stotts Creek RRC

Source	2007/2008 (%)	2008/2009	2009/2010
MSW	37.76	32.42	32.86
C&I	29.15	24.13	28.5
C&D	16.78	16.33	14.5
Green	10.42	8.79	12.55
Other	5.88	18.36	11.59
Waste/recyclables from inside Tweed Shire LGA	78	88.4	93.14
Waste/recyclables from outside Tweed Shire LGA	22	11.6	6.86

3.5.2 Quirks Quarry

Quirks Quarry has reportedly been operating since the 1950s. An Environmental Impact Statement (EIS) was prepared in 1996 to assess proposed extensions for the 'continued operation' of the existing quarry (as a private operation). Prior to 1996 the quarry had a threshold annual extraction rate of 50,000 tonnes (Brian J. Mackney & Associates, 1996).

Council purchased the Quarry in 1996 and at this time the quarry began operating under the current quarry management plans.

The Council Development Assessment Unit issued a deferred commencement Development Application on the 15th of December 1999 for the continuation and expansion of Quirks Quarry. The commencement was deferred with respect to obtaining an approved Plan of Management and provision of a description of an access route to the site. The Plan of Management was approved on the 16th of June 2000 (PF1960/540 Pt2).

Details of existing quarry operations are provided in Section 3.5.

3.5.3 Agricultural Use

Prior to quarry activities, the site and nearby areas were predominantly utilised for agricultural purposes including sugar cane farming on the floodplain and grazing on the slopes. A small mango orchard is also located in the southern portion of the site.

The north eastern portion of the site is still utilised for the purposes of sugar cane growing and is currently leased for this purpose. In addition, grazing has occurred in the lower lying areas of the site on agistment.

3.6 Existing and Approved Operations and Facilities at the Site

The existing and approved operations and facilities on the site include quarrying and associated activities at Quirks Quarry (e.g. blasting, crushing etc.), as well as minor agricultural use of the site. In addition, the site is the subject of the Botanic Gardens Master Plan (Landplan, 1998) which outlines intended future use of the site for the purposes of a regional botanic gardens.

3.6.1 Quirks Quarry

The current operations of Quirks Quarry are described in the 'Plan of Management Quirks Quarry V3.0'. Key features of this are outlined below.

Environmental Protection Licence

Quirks Quarry operates under EPL No, 12777 issued by DECCW which allows for extraction of between 50,000 and 100,000 tonnes per annum.

Quarry Operations

The operations involved in quarry working at Quirks Quarry are:

- Clearing of vegetation - Clearing occurs prior to working of a quarry area. No more than 40 m outside the required area is cleared. Clearing takes place immediately prior to the working of an area.
- Implementation of erosion and sediment control measures – stormwater runoff from the site is directed to the north eastern corner;
- Stripping and stockpiling of topsoil;
- Drilling and blasting of quarry face;
- Dozing of material and cartage to the crushing plant;
- Crushing, screening and stockpiling of crushed gravel;
- Loading of materials into trucks and haulage from the quarry site; and
- Site rehabilitation, including respreading of topsoils, seeding and revegetation.

Quarry Facilities

Facilities associated with Quirks Quarry include:

- A dam located on the western side of the quarry;
- Site shed and vehicle storage compound/washdown area;
- Access roads;
- Haul road (to Eviron Road); and
- Unsealed roads.

Quarry Plant and Equipment

The current quarry fleet utilised at Quirks Quarry is a combined fleet of hired and council owned Machinery and trucks (Table 3-4).

Table 3-4 Equipment Currently Used and Required at Quirks Quarry

Equipment	Detail
Council owned Equipment	1 x Fintec 542 Screening Plant 1 x Daewoo Mega 300V Wheeled Load
Hired Equipment	1 x Cat IT 62 Wheeled Loader 1 x Volvo L180 Wheeled Loader 1 x Cat D7 Dozer 1 x SEE Symons Cone Crusher 1 x Sumitomo SH 330-3 Excavator SEE Kue-Ken Jaw Crusher Fintech 640 Scalper 25m Folding Stacker Conveyor Finlay Hydra screen 683 Screening Plant.
Other Equipment Onsite	Water truck (when required) Trucks Blasting Equipment and Associated Vehicles Pneumatic hard rock drill

Current Production

The EPL for Quirks Quarry allows for the extraction of a maximum of 100,000 tonnes/annum. A range of materials is produced at the Quirks Quarry site including:

- 70-30 mm, 40 mm, 20 mm, 10 mm, 7 mm drainage aggregates;
- Cracker dust;
- “C” grading type 2.1 and “B” grading type 2.3 road base; and
- Overburden / fill.

The availability of the above materials is highly differential and dependant on the area and depths of extraction.

Approved Hours of Operation

Approved operating hours for Quirks Quarry are provided in Table 3-5.

Table 3-5 Quirks Quarry Operating Hours

Operation	Operating Days	Start Times	Finish Times
Quarrying	Monday to Friday	0700	1700
	Saturday	0700	1200
Blasting	Monday to Friday	0900	1500
	Saturday	0900	1200
Hauling	Monday to Friday	0700	1700
	Saturday	0700	1200

3.6.2 Tweed Shire Botanic Gardens

Council intends to progressively redevelop the site as a botanic gardens. A Botanic Gardens Masterplan (Landplan, 1998) and associated studies were commissioned which identify future intended uses for areas of the site. The master plan accounts for the use of the site for the purposes of landfill and quarry, and development of the Botanic Gardens will be implemented in a staged approach as the quarry and landfill sites progress and are rehabilitated. Stage One of Tweed Botanic Gardens was officially opened on 30 April 1997.

3.7 Existing Environmental Management and Monitoring Regime

3.7.1 Quirks Quarry

Management of activities at Quirks Quarry is undertaken in accordance with the Quirks Quarry Plan of Management and EPL12777. The Plan of Management specifies the requirement for quarterly reporting for the following:

- Complaints and remedial work;
- Blasting activity records;
- Ground vibration and blast over pressure monitoring undertaken;
- Water quality testing results;
- Records of any fuel spills and associated details; and
- Fauna strikes on the haul road.

3.7.2 Other Environmental Monitoring and Management

Outside of the monitoring required for compliance with EPL 12777, Council has implemented other environmental management procedures onsite:

- Ongoing weed management program to remove camphor laurel, listed as a noxious weed;

- Groundwater monitoring at a number of bores on a quarterly basis to collect baseline/reference data prior to the proposed landfill; and
- Surface water monitoring in the drainage line in the northern portion of the site on quarterly and rainfall event basis to collect baseline/reference data prior to the establishment of the proposed landfill.

4. Waste Management and Resource Recovery in the Tweed Shire

4.1 Overview

This section describes the current waste management and resource recovery activities undertaken by Council, which are underpinned by the *2011/2021 Tweed Community Strategic Plan (2011)* and *Tweed Shire Domestic Solid Waste Management Strategy* (June 2007). Council has also commissioned an analysis of alternative waste technologies (Benjas 2008), participated in an independent review of resource sharing in the Northern Rivers region (Hyder 2011), and conducted waste characterisation studies and recyclables contamination audits. Council hosts the North East Waste Forum, a voluntary regional group aimed at delivering efficiencies and cost savings for member councils and promoting innovation and excellence in waste and resource management. Each of these commitments is discussed below.

4.1.1 2011/2021 Tweed Community Strategic Plan

Council's 2011/2021 Tweed Community Strategic Plan is a whole of Council document which follows the NSW Government Integrated Planning and Reporting Framework. Council, through detailed consultation with the community, has developed a 10 year community strategic plan, 4 year delivery program and an annual operational plan. These planning instruments are supported by a 10 year financial plan and resourcing strategy. Responsible waste management and resource recovery has a strong focus in this whole of Council document. Table 4-1 below details the commitments Council has made and provides a clear insight into the direction Council is taking in the provision of best practice waste management.

It can be seen that the Strategic Plan provides whole of Council commitment to resource recovery through programs detailed under five strategic tiers. These programs assist Council in demonstrating prudency in resource recovery, and go a way to meeting requirements set out in *NSW DoP Clause 123 Infrastructure SEPP*, *NSW DECCW Reducing Waste Implementation Strategy 2011-2015*, and the *NSW Waste Avoidance and Resource Recovery Strategy 2007 (WARR Strategy).*

The programs under each tier most relating to the Eviron Road project, (Stage 1 and Concept Plan), are outlined below:

- Waste and recycling collections:
  - A commitment in year four to responsibly investigate and implement the kerbside collection of food organics, integrated into the existing green waste bin.
- Infrastructure:
  - A commitment in year four to responsibly investigating and implementing an advanced (alternative) waste treatment technology for processing of residual waste;
  - A commitment in year two and year three to develop the Quirks Quarry Landfill including an internal haul road to Stotts Creek RRC and gas capture infrastructure.
- Strategy:

- A commitment in year one and two to develop a new waste management and resource recovery strategy in line with Council's four year waste strategy planning cycle;
- A commitment in all four years of the delivery program to continue and expand on the Council's current waste and recycling education program.

- Education:
  - A commitment in all four years of the delivery program to incorporate facility tours of the landfill and resource recovery facilities into the waste and recycling education program.
- Emissions:
  - A commitment in all four years of the delivery program to monitor and report on greenhouse emissions from Council's landfill facilities.

Table 4-1 2011/2021 Tweed Community Strategic Plan – Waste Management delivery program

Strategy	Delivery Program 2011-2014 Key Actions	Annual Operating	Delivery Program Responsibility	Year(s) the key action runs 2011	2012	2013	2014
2.3.4 Provision of high quality, best practice, solid waste disposal with energy recovery, and improving resource recovery practices and infrastructure which meets health and environmental requirements and projected demand.	2.3.4.1 2.3.4.2 Provide waste and recycling collection mechanisms to improve resource recovery	2.3.4.1.1 Provide a multi bin collection service for all residential rated properties and willing non-residential (commercial) rated properties 2.3.4.1.2 Provide public place waste and recycling collection services	CWM	✓	✓	✓	✓
	2.3.4.4 Provide waste and recycling collection mechanisms to improve resource recovery	2.3.4.1.3 Provide special waste (electronic waste, fluoro tubes, batteries, oil, metal, white goods, tyres, empty farm chemical drums, gas bottles) drop off facilities at Stotts Creek Resource Recovery Centre to enable recycling	CWM	✓	✓	✓	✓
	2.3.4.5 Provide waste and recycling collection mechanisms to improve resource recovery	2.3.4.1.4 Provide bi-annual bulky waste household collection and recover metal items for recycling; and facilitate a separate metal collection year round	CWM	✓	✓	✓	✓
	2.3.4.6 Provide infrastructure to appropriately manage waste and improve resource recovery	2.3.4.1.5 Responsibly manage operational and closed waste disposal facilities and recycling assets	CWM	✓	✓	✓	✓
	2.3.4.2 2.3.4.15 Provide strategic direction to improve resource recovery	2.3.4.2.1 Continue and expand education programs to promote understanding and behavioural change in the community	CWM	✓	✓	✓	✓
	2.3.4.16 Provide strategic direction to improve resource recovery	2.3.4.2.2 Participate in regional collaboration on waste management and resource recovery initiatives	CWM	✓	✓	✓	✓
	2.3.4.3 2.3.4.1 Provide waste and recycling collection mechanisms to improve resource recovery	2.3.4.3.1 Promote green organics and dry recycling collections to non-residential (commercial) rated properties	CWM	✓	✓		
	2.3.4.4 2.3.4.10 Provide infrastructure to appropriately manage waste and improve resource recovery	2.3.4.4.1 Provide permanent drop off facility at Stotts Creek RRC for unwanted household chemical wastes (paint, herbicides, pesticides) ready for responsible disposal or recycling at an offsite purpose built licenced facility	CWM	✓	✓		
	2.3.4.5 2.3.4.13 Provide strategic direction to improve resource recovery	2.3.4.5.1 Development of Waste Management and Resource Recovery Strategy	CWM	✓	✓		
	2.3.4.6 2.3.4.8 Provide infrastructure to appropriately manage waste and improve resource recovery	2.3.4.6.1 Extension of Stotts Creek Inert Landfill	CWM		✓		
	2.3.4.7 2.3.4.14 Provide strategic direction to improve resource recovery	2.3.4.7.1 Development of Waste & Sustainability Improvement Payment (WaSIP) action plan to guide spend on resource recovery projects	CWM		✓		

Strategy	Delivery Program 2011-2014 Key Actions	Annual Operating	Delivery Program Responsibility	Year(s) the key action runs 2011	2012	2013	2014
2.3.4 *Provision of high quality, best practice, solid waste disposal with energy recovery, and improving resource recovery practices and infrastructure which meets health and environmental requirements and projected demand.*	2.3.4.8 2.3.4.7 Provide infrastructure to appropriately manage waste and improve resource recovery	2.3.4.8.1 Development of Quirks Quarry Landfill and associated infrastructure (including haul road and gas capture)	CWM		✓	✓	
	2.3.4.11 Provide infrastructure to appropriately manage waste and improve resource recovery	2.3.4.8.2 Provide additional facilities at Stotts Creek Resource Recovery Centre to recover and recycle construction and demolition waste	CWM		✓	✓	
	2.3.4.12 Provide infrastructure to appropriately manage waste and improve resource recovery	2.3.4.8.3 Develop a closure plan for Stotts Creek landfill to allow for the expansion of resource recovery facilities at the site Implement closure plan and rehabilitate site	CWM		✓	✓	
	2.3.4.9.1 2.3.4.3 Provide waste and recycling collection mechanisms to improve resource recovery	2.3.4.9.1.1 Investigation and implementation of commingled food organics and green waste collection for residential rated properties and willing non-residential (commercial) rated properties	CWM			✓	✓
	2.3.4.10 2.3.4.9 Provide infrastructure to appropriately manage waste and improve resource recovery	2.3.4.10.1 Responsible investigation and implementation of advanced (alternative) waste processing infrastructure					✓
1.1.2 Create a sustainable, socially and environmentally aware community through education	Promote education in the community	Continue and expand the environmental education program to promote understanding and behavioural change in the community		✓	✓	✓	✓
1.2.5 Effective communication between Council and community groups	Promote education in the community	Engage the community in interactive infrastructure tours of Council facilities (ie Sustainable Living Centre, wastewater treatment plants, resource recovery centre, water treatment plants, Pottsville Environment Centre)		✓	✓	✓	✓
4.4.1 Recognise and accommodate natural processes and climate change	Monitor and report on emissions profiles of Council infrastructure	Engage in the National Greenhouse and Energy Reporting Scheme for Council landfill facilities		✓	✓	✓	✓

4.1.2 Long Term Financial Plan – Waste Management

Feeding into the Tweed Community Strategic Plan 2011/2021 is a 10 year financial plan. The financial modelling for waste management services has been undertaken by Council based on a set of assumptions. The assumptions include all of Council's commitments detailed in the Strategic Plan, provisions for rehabilitation and remediation of landfill assets, investment in alternative waste infrastructure, and establishment and operational costs as a result of this Project. The 10 year financial plan provides some forecast for the domestic waste charge, Section 88 waste and environmental levy liabilities, and landfill gate pricing, as a result of Council's strategic direction in waste management which includes works to undertake this Project.

Table 4-2details the impacts on the domestic waste charge as a result of Council's strategic direction in waste management which includes works to undertake this Project. Based on this forecast, modest increases in the domestic waste charge are expected. The increases in the domestic waste charge include payments to the NSW Government for the Section 88 Waste and Environment Levy attributable to the landfilled component of municipal solid waste.

The remainder of the Section 88 Waste and Environment Levy payments will be recouped from the gate fee for C&I and C&D waste. No significant increases in landfill gate fees are anticipated as a result of this project, as Council has shown prudency in purchasing land and setting aside provisions over many years to establish the Eviron Road site for waste management activities. After 2011/2012 It is anticipated that landfill gate fees will increase by the levy plus CPI in addition to any operational variances through the 10 year forecast.

Table 4-2 10 Year Forecast Waste Charges

	Current	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016 /2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021
Domestic waste service charge	99.20	114.26	123.29	132.26	141.22	150.09	148.77	147.52	146.33	145.52	144.12
Recycling charge	60.30	60.34	60.42	60.57	60.78	61.05	62.64	64.28	65.99	67.76	69.61
Waste management charge	47.35	49.09	50.11	50.69	50.83	50.55	53.11	53.99	53.88	53.43	52.68
Garbage charge	206.85	223.69	233.83	243.52	252.83	261.69	264.52	265.79	266.19	266.71	266.42
Landfill management charge	25.00	30.00	35.00	40.00	41.20	42.44	43.71	45.02	46.37	47.76	49.19
Garbage charge + Landfill management charge	231.85	253.69	268.83	283.52	294.03	304.13	308.23	310.81	312.56	314.47	315.61
Variation in charge as percentage	7.29%	8.77%	5.79%	5.30%	3.70%	3.43%	1.44%	0.93%	0.66%	0.70%	0.45%
Greenwaste collection charge	50.00	50.40	50.84	51.16	51.52	51.86	52.19	52.51	52.81	53.11	53.39
Garbage charge + Landfill charge + Greenwaste	281.85	304.10	319.67	334.68	345.55	356.00	360.42	363.31	365.37	367.58	369.00
Variation in charge as percentage	5.25%	7.32%	4.87%	4.49%	3.15%	2.93%	1.23%	0.80%	0.56%	0.60%	0.39%

4.1.3 Domestic Solid Waste Management Strategy (2007)

This section provides a summary of the key aspects of the Tweed Shire *Domestic Solid Waste Management Strategy* (June 2007) which was prepared by APC Environmental Management as relevant to the Concept Plan. Since the publishing of the Strategy, Council have set about implementing the various recommendations made and hence some of the information in this section may not necessarily be reflective of the contents of the strategy but importantly does reflect the current waste management and resource recovery activities in Tweed Shire. A copy of the strategy is provided in Appendix E.

The Waste Strategy was endorsed by Council after community consultation which included:

- Promotion and advertising in the Tweed Link newsletter which is delivered to all residents, seeking feedback on the draft strategy;
- Preparation of a community consultation document summarising the eleven key recommendations and the Executive Summary of the draft Waste Plan which was available upon request from Council offices or web site;
- An opportunity to meet or talk with the consultants who prepared the strategy;
- Presentations to Progress Associations; and
- Briefing with the waste contractor at the time.

The final strategy identified 35 key recommended actions and strategies including education and infrastructure requirements to improve waste avoidance, minimisation and resource management, consistent with the goals of sustainability.

Council is progressively and strategically addressing the recommendations contained within the strategy, which align with the framework for action from the *NSW Waste Avoidance and Resource Recovery Strategy 2007 (WARR Strategy)* as shown in Table 4-3. It can be seen that there is a strong focus on resource recovery activities.

In addition to meeting many of the WARR targets, the Strategy has provided Council with some key resource recovery outcomes and formed the basis for new waste collection, processing, and landfill contracts.

Council works under a four year waste planning cycle, with a new waste management and resource recovery strategy due for development in 2011/2012.

Table 4-3 Summary of Waste Strategy Recommendations and WARR Key Outcome Areas

Recommended Action	WARR Strategy (2007) Framework										
	Providing Supportive Policy and regulatory framework	Reducing C&I waste	Reducing Municipal Waste	Reducing litter and illegal dumping	Supporting waste reduction in rural and regional NSW	Reducing C&D waste	Other specific waste streams	Product stewardship/EPR programs	Better knowledge and data	Education	Waste Avoidance
Council continue to monitor the activities of the South East Queensland Waste and Recycling Network Group and the NEWF.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Council request the waste contractor to have trained staff available at all times to receive and process DrumMUSTER containers.							✓			✓	
The contractor uses the service of the free DrumMUSTER training program.							✓			✓	
Council continue to support the efforts of DrumMUSTER through community education and promotion of either continuous receipt of containers or one-off collection programs.				✓			✓			✓	
Council continue to promote that asbestos should be removed, handled and stored in accordance with the Work Cover Regulation.	✓					✓	✓			✓	
All batteries received at all waste depots be correctly stored.				✓			✓				
Council include the correct disposal of gas cylinders and bottles in future community educational material and promote the drop-off of these materials at each waste disposal facility.				✓			✓			✓	
Council continue to support the operation of reuse facilities at all waste disposal facilities.			✓	✓	✓						✓
Council ensures the community is informed about household hazardous collection programs.				✓			✓			✓	
Council continue to promote the current practice of source separation and free delivery of recyclables at all waste facilities.			✓		✓		✓			✓	✓
Council should introduce a new fully commingled recycling service in a 240-litre bin collected fortnightly to all of its residents.			✓		✓						✓
Council should introduce a garden service in a 240-litre bin collected fortnightly to all single residential dwellings in townships.			✓	✓	✓						✓
Council offers an optional garden waste service to all medium-density and multiple-occupancy residential buildings.			✓	✓	✓		✓				✓
Council offer residents a 140-litre bin as the standard service with the option of a differential service rate for an 80-litre or 240-litre in the interests of social equity. The price differential for these service options will be assessed once the tender for domestic waste management services is completed.			✓		✓						
New lids in accordance with the Australian Standard 4123 Mobile Waste Container be provided to all existing and new domestic waste, recycling and garden organics bins as part of the collection contract.											
Council should continue to monitor developments by other local governments which have introduced or are proposing to introduce organic waste collection programs, in particular, Coffs Coast and Hastings Councils, to learn from their experiences. Council should also assess new and emerging technologies and processes which have applicability for the area.			✓		✓		✓		✓		
Council introduce dedicated collections for specific materials, that is, metals / whitegoods and continue with the biannual household cleanup service.			✓	✓			✓				
Should Council maintain its own MRF, then the future collection contract should specify a maximum compaction for the collection of recycling at 180 kg/m3 and in accordance with best practice.											
Council enter into discussions with third parties in relation to the acceptance of Tweed Shire Council recyclables.							✓				

Recommended Action	WARR Strategy (2007) Framework										
	Providing Supportive Policy and regulatory framework	Reducing C&I waste	Reducing Municipal Waste	Reducing litter and illegal dumping	Supporting waste reduction in rural and regional NSW	Reducing C&D waste	Other specific waste streams	Product stewardship/EPR programs	Better knowledge and data	Education	Waste Avoidance
That a two-bin system – garbage and 'containers only' or alternate litter bin system be trialled in key strategic areas.				✓	✓				✓		
That a performance review of the system be undertaken three months after the system is introduced.									✓		
Recycling stations should be provided in strategic visitor locations to reduce the incidence of visitors using private or commercial bins.					✓		✓				
Existing blue litter bins should be replaced with green bins with red lids for rubbish and yellow lids for recycling.											
Council develop a Waste Not DCP and place a notation or condition on all Development Approvals requiring the source separation and containerisation of all waste on building sites to minimise waste generation and prevent unintended pollution.	✓				✓	✓					✓
Source-separation of loads prior to delivery is desirable due to the differential pricing policy to be applied to mixed loads at Stotts Creek and Murwillumbah landfills.	✓				✓	✓					✓
Council undertakes a community education and industry information campaign to promote source-separation of all loads delivered to the Stotts Creek landfill.					✓	✓				✓	✓
Council directly approaches the significant users of its landfills on a personal basis to inform and educate them regarding the role of source-separation and of Council's intention to introduce a substantial change to the future fee structure and charges for disposal of waste.	✓	✓			✓	✓				✓	✓
Council resolves to introduce differential landfill fees for sorted and unsorted loads and offer a significant price variation to create the necessary motivation for source-separation within the community.	✓				✓						✓
Council introduces a significant differential pricing policy to encourage source – separation by waste generators of building materials.	✓				✓	✓					✓
The current education and communication program delivered by the contractor be reviewed to assess and evaluate the effectiveness and value for money prior to developing the new contract specification.					✓				✓	✓	
Given the high proportion of visitors to the area, that the use of graphic images supported by the English words must be incorporated into all communication modes				✓	✓					✓	
Council must commit sufficient and ongoing budgetary resources to continue the education of both residents and visitors.			✓	✓	✓					✓	
The waste depots should be renamed as Resource Recovery Centres.					✓						
Council ensure that the new waste education centre is a demonstration site for green building and sustainable living and be called The Sustainable Living Centre.					✓					✓	
Concurrently with developing plans for the local landfill, Council reviews other long-term disposal options for the Shire's waste as identified in the Strategy having regard to transport and disposal costs, method and number of vehicle movements to accurately assess traffic impact.	✓				✓				✓		
Total Number of Recommended Actions per Framework Area	**8**	**2**	**10**	**12**	**22**	**7**	**14**	**1**	**6**	**14**	**12**

Landfilling at Eviron Road

With regard to development of a landfill at Eviron Road, the Waste Strategy recommends:

> *Concurrently with developing plans for the local landfill, Council reviews other long-term disposal options for the Shire's waste as identified in the Strategy having regard to transport and disposal costs, method and number of vehicle movements to accurately assess traffic impact.*

One of the long term disposal options discussed in the strategy involved transporting residual waste to an existing landfill already in operation in South East Queensland. Privately operated landfills in the Ipswich region and Gold Coast City Council operated landfills were both mentioned. Council and the Tweed Shire (through community consultation on the draft strategy) have however expressed a desire to self manage wastes rather than "exporting the problem".

Disposing of waste in Queensland would involve significant transportation costs and would leave Council in a position where they have little to no influence or control over transport and disposal fees. Whilst this option increases waste diversion from landfill disposal in New South Wales would provide little incentive to achieve the WARR Strategy targets in terms of diversion of waste from landfill disposal in New South Wales. Atmospheric emissions associated with fuel consumption and transportation would also be significant. Furthermore it is noted that Queensland's Draft Waste Strategy includes a levy for waste disposed to landfill which may erode the perceived cost benefits associated with this option. It is acknowledged that municipal waste is currently excluded from the proposed levy, however the point is that there is significant uncertainty in the long term costs of exporting waste for disposal to Queensland.

Other longer term waste disposal options such as AWT are under consideration by Council. In 2008, Council commissioned a Situation Analysis of Alternate Waste and Resource Recovery Technologies which concluded at the time that there were no commercial, environmental or community best value grounds at that time to pursue AWT. At present Council keeps a watching brief on the emerging technologies which may become viable for the Tweed Shire waste stream.

Further discussion of AWT and disposal of waste to existing landfills is provided in Section 6.2.

4.2 Current Regional Participation

Council is an active participant in the North East Waste Forum (NEWF), a voluntary regional waste management group, currently comprising five councils based on the North Coast of New South Wales. NEWF is a voluntary regional body aimed at delivering efficiencies and promoting innovation and excellence in waste management and resource recovery.

In 2009, the NEWF released their *Regional Waste Strategy 2009-2012: Regional Plan for Managing Waste and Resources In the North East Waste Forum Region* which clearly placed an emphasises the importance of waste avoidance and resource recovery as a means to achieving sustainability. The plan addresses issues raised in the WARR Strategy, and also allows member Councils to make a contribution to the waste reduction targets set in the WARR Strategy. The programs included in the regional plan are listed in Table 4-4 under the expected outcome headings adopted in the WARR Strategy.

Table 4-4 NEWF Regional Plan Programs

Milestone project number	WARR 2007 Focus Area	Program	Regional resources committed $
1	All	Administration of NEWF	TOTAL $67,750
2	Reducing Commercial & Industrial Waste	Business Waste Reduction Project Support new identified businesses in implementing waste reduction initiatives Maintain business waste reduction activities for identified businesses Collate existing case studies and other tools and distribute and promote to relevant business and industry groups	TOTAL $55,500
3	Reducing Construction & Demolition Waste	C & D Waste Project Production of a revised Waste DCP Investigation into the management (acceptance and handling) of asbestos	TOTAL: $10,000
4	Support Waste Reduction in Regional and Rural NSW	RENEW NSW RENEW NSW membership and participation	TOTAL: $18,000
5	Reducing Illegal Dumping and Litter	Litter and Public Place Waste Project Investigate litter and illegal dumping resources and provide toolkit and policy for Member Councils to implement	TOTAL: $10,000
6	Reducing Municipal Waste	Residual Waste Composition Audit Project Project management of audit process on behalf of member Councils Production of summary document/media for Councils use in public arena	TOTAL: $12,500

Milestone project number	WARR 2007 Focus Area	Program	Regional resources committed $
7	Reducing Municipal Waste	Contamination Management Project Inspect domestic recycling bins and green organic bins for contamination and provide feedback on prevalence and trends of contamination Physically tag and report to Member Councils gross contamination in recycling and green organics bins Production of summary document/resources/media for Councils use in public arena	TOTAL: $41,250
8	Other Specific Waste Streams (Organics)	Organics and Emissions Project (landfill) Production of a report on the economic and emission incentives of removing organics from the landfill waste stream and impacts on frequency of collection	TOTAL: $45,000
9	Other Specific Waste Streams (Hazardous Waste)	Hazardous Waste Project Investigate feasibility of introduction of additional sub-regional hazardous waste stores Operate existing hazardous waste stores	TOTAL: $70,000
10	Other specific waste	Specific Waste Project Investigate and report on specific waste streams as those identified in WARR Strategy that may present opportunities for reuse or reprocessing	TOTAL: $5,000
11	Extended Producer Responsibility	Product Stewardship Project Produce documentation on Member Councils combined efforts in reprocessing electronic waste Deliver documentation to relevant bodies to promote Member Councils work in this area	TOTAL: $5,000
12	Better Knowledge and Data	Training and Skills Enhancement Project Provide landfill operator training for Member Councils operational staff	TOTAL: $10,000

Milestone project number	WARR 2007 Focus Area	Program	Regional resources committed $
13	Education	Waste Avoidance and Education Project Develop, administer, utilise and maintain waste avoidance resources (The Green House) Love Food Hate Waste facilitation Coordinate landfill open days Deliver education components of projects	TOTAL: $75,000
14	Better Knowledge and Data	Regional Infrastructure Mapping Project Produce a report on landfill and resource recovery infrastructure in the region	TOTAL: $2,500
15	Better Knowledge and Data	Financial Assurance Project Determine ramifications of new financial assurance policy Produce submission to Department	TOTAL: $2,500
		TOTAL	**$430,000**

4.3 Current Waste Management Activities

4.3.1 Kerbside Services

Council's Domestic Solid Waste Management Strategy recommended the introduction of a best practice multi bin system. On 1 December 2009 Council introduced a 140L red lid weekly garbage service, and a 240L yellow lid fortnightly recycling service, while the optional 240L lime lid green waste fortnightly service continues (at an additional cost). Grass clippings and garden prunings are accepted in this bin which are then mulched onsite at Council's Stotts Creek RRC and available for sale. Council currently provides the garbage and recycling multi bin system to approximately 35,000 properties. The green waste collection is available to approximately 21,000 properties, with 11,500 properties choosing to participate in the service.

Residents are able to swap to either an 80 litre (reduced charge) or 240 litre (additional charge) garbage bin if desired and order additional recycling and green organics bins at an additional charge. Council offers the same kerbside services to commercial premises as well as a bulk bin service.

The following materials are accepted in the kerbside recycling bins:

- Newsprint, magazines and cardboard;
- All plastic containers;
- Glass bottles and jars;
- Aluminium cans;
- Steel cans; and
- Liquid paperboard containers.

4.3.2 Other Services

A range of other services are provided by Council including the following:

- Household Cleanup Campaign twice a year for domestic customers to dispose of up to a maximum of 1 m^3 of excess waste, with retrieval of metal and reusables for recycling and reuse;
- Metal pick up and recycling service including collection of derelict motor vehicles, unwanted farm machinery and unwanted white goods such as old washing machines, fridges and freezers from individual properties;
- eWaste acceptance at the Stotts Creek Resource Recovery Centre. A biannual drop off day is held, however eWaste is accepted year round, this includes acceptance of compact fluorescent lamps (CFL) and fluorescent tubes;
- Transfer station accepting batteries, gas bottles, tyres, motor oil, and reusables to encourage resource recovery
- Prior to the establishment of a permanent store, an annual household chemical drop off day at Stotts Creek RRC for domestic quantities (20 litres maximum) of paint and paint-related products, pesticides, herbicides and poisons, solvents and household cleaners, pool chemicals, acids and alkalis and hobby chemicals;
- Biannual DrumMuster collection days for empty plastic and metal drums displaying the DrumMuster logo; and
- Compost bins and worm farms are offered for sale.

4.3.3 Stotts Creek Resource Recovery Centre

All domestic waste collected in the weekly and fortnightly kerbside services is transported to Council's Stotts Creek Resource Recovery Centre which is adjacent to the proposed Eviron Road Quarry and Landfill site. The centre is open Monday to Friday 7 am to 4 pm; weekends and holidays 9 am to 4 pm (closed Good Friday and Christmas Day).

The Stotts Creek RRC comprises the following, which demonstrates that resource recovery is a prominent feature of the site:

- Weighbridge and gatehouse; and
- Materials Recovery Facility.

- Transfer station for commercial and domestic self haul customers including:
  - dry recyclables, green waste, paper/cardboard, metal, reusables, batteries, gas bottles, tyres, CFL's and E-Waste;
- Oil recycling station;
- DrumMuster compound;
- Concrete recovery pad;
- Greenwaste processing facility;
- Landfill – solid waste and inert waste cells (operated under contract); and
- Active landfill gas extraction and energy recovery system.

Council also operate a transfer station at Tyalgum which accepts waste and recyclables which are then transported to Stotts Creek RRC. Commercial waste is not accepted at this facility.

Stotts Creek RRC will continue to remain in operation as the public interface for waste management in the Shire, and landfilling of residual inert waste until approximately 2020, following commencement of operations at Eviron Road. There will be no direct public access any of the landfills proposed in the Concept Plan or Stage 1 Project Application for Eviron Road. Council is committed to a continual review of service provision in terms of recycling and recovery options that can be provided to the public.

4.3.4 Waste Characterisation Studies

Council operates on a four year cycle of waste characterisation audits to provide valuable information on the content of domestic waste bins, and provide source based data to measure the effectiveness of Council's waste and recycling education program. The audits have been conducted in 2005 (APC Environmental Management 2005) and 2009 (APC Environmental Management) in accordance with the DECCW *Guidelines for Conducting Household Kerbside Residual Waste, Recycling and Garden Organics Audits in NSW Local Government Areas – June 2008***.**

A consolidated comparison between the two audits as shown in the table below, indicates a relatively consistent waste stream, however the fraction of garden organics in the 2009 data set was lower than that recorded in 2005. The reducing garden organics fraction is consistent with an increasing participation in Council's green waste collection service. A further audit is scheduled in 2013.

Table 4-5 Consolidated Waste Characterisation Data (APC Environmental Management)

Material	2005	2009
Garden Organics	18.1%	16.5%
Food Waste	26.7%	27.9%
Recyclable Paper/Cardboard	13.4%	9.0%
Recyclable Containers	9.8%	9.7%
Other Material	31.8%	36.8%
Total	100.0%	100.0%

4.3.5 Recyclables Audit (benjas)

A condition of Council's waste collection contract requires the waste contractor to conduct an audit of the domestic kerbside recyclables to determine the volume of contamination as a percentage of the load. The audit is to occur every six months to monitor contamination levels in the recyclables stream and determine the effectiveness of the Council waste and recycling education program.

The most recent recyclables audit (Benjas 2010) revealed a contamination rate of 4.66% by weight. Council, through the waste and recycling education program, is aiming for <3.5% contamination as outlined as aspirational performance measure (NSW DECCW *Getting more from our recycling systems - Good practice performance measures for kerbside recycling systems')*

4.4 Current Resource Recovery and Waste Management Statistics

Table 4-6 provides a summary of the materials handled at Stotts Creek RRC in the 2009/2010 financial year representing the overall waste generation and resource recovery for the Tweed Shire. These figures indicate an approximate overall resource recovery rate of 39.3%.

Council's gate fee pricing policy imposes a premium on waste presented for disposal from outside of the Tweed LGA. The pricing policy also encourages source separated loads to assist in recycling and reprocessing of resources. Significantly reduced gate fees are provided for materials such as concrete, timber, and garden waste which are reprocessed on-site. Clean fill (virgin excavated natural material) is also accepted at a reduced fee to assist with operational requirements of the site (daily covering of all waste fill areas). This pricing policy aims to protect the community landfill asset.

Table 4-6 2009/2010 Waste Management and Resource Recovery Summary

Waste Stream/Material	Total (Tonnes)	Landfill Disposal (Tonnes)	Recovered/ Recycled (Tonnes)	% Resource Recovery (by weight)
Domestic	30,616.84	20,848.91	9,767.93	31.9
Commercial and Industrial	28,221.49	24,997.44	3,224.05	11.4
Construction	14,220.66	6,832.10	7,388.56	52.0
Green Waste	11,512.98	0	11,512.98	100
Hazardous Waste	550.93	550.93	0	0
Hard Rubbish Clean Up	1,530.55	1,530.55	0[1]	0
Other Council	5,676.00	4,609.58	1,066.42	18.8
VENM (clean fill)	5,474.83	0	5,474.83	100
E-waste	60.68	0	60.68	100
Oil	17,200 (litres)	0	17,200 (litres)	100
Batteries	1,160 (batteries)	0	1,160 (batteries)	100
Gas bottles	106 (gas bottles)	0	106 (gas bottles)	100
DrumMuster	3,185 (drums)	0	3,185 (drums)	100
CFLs	0.594	0	0.594	100
TOTAL	**97,866[2]**	**59,370**	**38,496[2]**	**39.3%[2]**

Notes:

1. Metal and reusable items recovered from Council Hard Rubbish Pick Up are represented in Construction recycling tonnes
2. Excludes oil, batteries, gas bottles and DrumMuster recovery which are not measured by weight

Council reports that kerbside resource recovery rates have notably increased since the introduction of the new bin system, in conjunction with a consistent education program. In the first year of the multi bin system (1 December 2009 – 1 December 2010) a kerbside resource recovery rate of 44% was achieved. This represents an increase of 3924 tonnes of material recovered compared to the previous year. Table 4-7 provides a historical comparison of resource recovery rates.

Table 4-7 Kerbside Collection Resource Recovery Statistics

Waste/Resource Stream	Dec07 - Dec 08 (tonnes)	Dec08 - Dec 09 (tonnes)	Dec 09 – Dec 10 (tonnes)	Recovery or Landfill
Recyclables	7397.12	7918.74	11186.16	Recovery
Green Waste	2810.31	3575.96	4232.92	Recovery
Garbage	23717.04	22943.91	19285.50	Landfill (gas/energy recovery)
TOTAL	**33924.47**	**34438.61**	**34704.58**	

This is also presented in Figure 11 which graphically depicts the increasing resource recovery rates as a percentage of the kerbside waste/resource stream over the same period. It is expected that as residents become accustomed to the new bin provision resource recovery rates will continue to increase. However this will be periodically reviewed by monitoring both kerbside collection statistics and the landfill disposal and airspace consumption rates.

In the context of the Tweed Shire population (currently 82,995 people) the kerbside recovery tonnes (recyclables plus green waste between 1 December 2009 – 30 June 2010) represents 109.13 kg per person over the reporting period. When represented per household (35,000 services) the recovery equals 258.65 kg per household receiving a kerbside collection service.

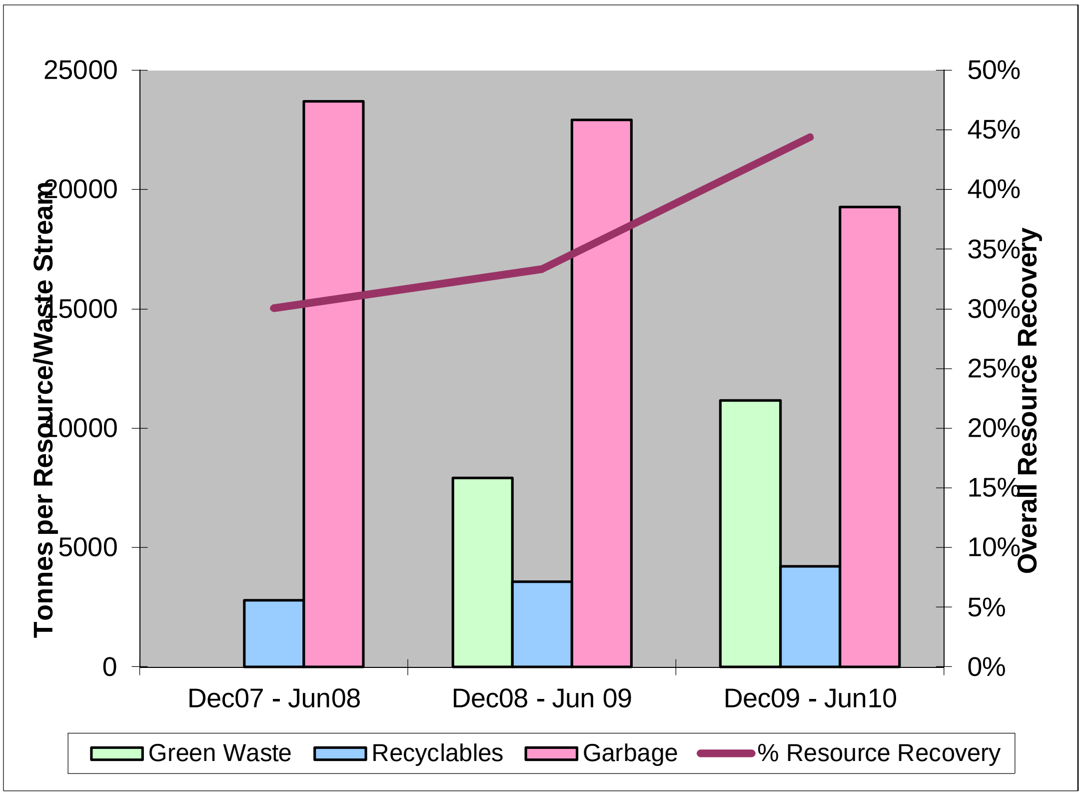


Figure 11 Resource Recovery Trends

4.5 Future Waste and Resource Recovery Position

For the purposes of the concept design of the Quirks Quarry Landfill, an initial annual input of 47,893 tonnes of residual waste was assumed on the basis of forecast waste tonnages provided by Council in April 2011. Further, the design assumed an approximate annual growth rate of 3% per annum to determine the likely operational life of the available void/air space. Section 7.1 provides further details of the staging and anticipated operational life of Quirks Quarry Landfill (Stage 1 Project Application). It is noted that the Stage 1 Project Application seeks approval for the disposal of up to 75,000 tonnes of waste per annum. The difference in the rates adopted for the design figures and that applied for in the project application makes provision for uncertainties related to the future waste disposal position of Tweed Shire, and as discussed previously the non-putrescible waste remaining at the Stotts Creek RRC inert landfill until approximately 2020. It makes adequate provision for population induced increases to waste generation, however improvements to resource recovery will continue to be driven by the implementation of Tweed Community Strategic Plan 2011/2021, Tweed's Solid Waste Management Strategy, development of the new strategy, the WARR Strategy targets along with the NSW Waste and Environment Levy for waste disposed of to landfill.

For the landfilling activities in the Concept Plan, beyond Stage 1, preliminary forecasts of waste acceptance rates have been made on the basis of:

- Population induced increased waste generation;
- Current and historical waste generation rates;
- Current and future planned resource recovery activities;

The forecast annual waste acceptance rates for the waste disposal facilities at Eviron Road after Quirks Quarry Landfill are summarised in the table below for a business as usual scenario, as well as with the adoption of an AWT option in 2017 that would divert 66% of waste previously presented for landfill disposal, likely to be commingled food organics and green waste. With this option it is clear that the landfill capacity within Stage 1 and more broadly the Concept Plan will be optimised and a greater operational life will be able to be achieved. However, for the purposes of developing the project staging the business as usual case has been adopted in this assessment.

Table 4-8 Landfill Waste Acceptance Forecast (West Valley and North Valley)

Year	Business As Usual (tonnes per annum)	With AWT (tonnes per annum)	Comments
2022	79,292	26,959	Commence West Valley Landfill (BAU)
2023	81,516	27,715	
2024	83,803	28,493	
2025	86,155	29,293	
2026	88,574	30,115	
2027	91,063	30,962	
2028	93,623	31,832	
2029	96,257	32,727	
2030	98,966	33,648	
2031	101,753	34,596	
2032	104,619	35,571	
2033	107,568	36,573	
2034	110,602	37,605	Commence North Valley Landfill (BAU)
2035	113,723	38,666	
2036	116,933	39,757	
2037	120,236	40,880	
2038	123,634	42,036	
2039	127,130	43,224	
2040	130,726	44,447	
2041	134,425	45,705	
2042	138,231	46,999	
2043	142,147	48,330	
2044	146,176	49,700	
2045	150,321	51,109	

5. Stakeholder Consultation

5.1 Objectives

The overall purpose of the Stakeholder Consultation process was to enable opportunities for nearby landowners, the Tweed community and other stakeholders to identify issues, impacts and mitigation measures and for these to be documented for consideration as part of the EA.

The key objectives of the community consultation process for the EA are to:

- Consult with landowners near the site, and the broader community to identify issues, impacts and mitigation measures for consideration in the EA;
- Engage with relevant government stakeholders to confirm issues relevant to the EA;
- Document community input for consideration in the EA and at the conclusion of the consultation process;
- Meet the requirements of the Department of Planning's Guidelines for Major Projects Community Consultation; and
- Manage emerging issues effectively and in line with Council protocols.

5.2 The Consultation Process

5.2.1 Agency Consultation

Consultation with relevant government stakeholders, including Council and state government agencies was undertaken during this EA with the following parties:

- Department of Environment and Climate Change;
- Department of Primary Industries;
- Department of Water and Energy;
- Roads and Traffic Authority;
- Tweed Shire Council;
- Community groups; and
- Affected landowners.

At the commencement of the EA process advice letters were issued to each of the agencies that contributed to the development of the DGRs. The letters advised the agency of the scope of GHD's commission and sought feedback on the adequacy of the scope. Only two responses to these letters were received, one from the RTA and one from DECCW on the scope of the ecological assessment.

5.2.2 Community Consultation

To date the following community consultation activities have been undertaken:

- Distribution of a letter and project information sheet to nearby landowners;
- Posting of project information sheet on Tweed Shire Council website;
- Establishment of 1800 freecall project information line;
- Meetings with two landowners;
- Council/Local Government Open Day;
- Tweed Shire Council sent an updated fact sheet to 22 landholders in July 2010;
- Tweed Shire Council has a static information display rotating between Civic Centres and libraries; and
- Consultation with local Aboriginal groups during the Cultural Heritage assessment (as discussed in Section 9.9 of this report).

Letter to Landowners

In March 2009, a total of 22 letters were distributed to landowners in close proximity to the site. This included properties along Eviron Road, Duranbah Road, Bartletts Road, Saunders Lane and Hawkens Lane. The letter contained a project information sheet and advice regarding the project information line.

Selected landowners (10 in total) were also extended an invitation for a one on one meeting with a Council representative and a representative of the EA team. Three landowners accepted this invitation.

A template of the letters is provided in Appendix G.

Project Information Sheet

A project information sheet outlining the Concept Plan, Stage 1 Project Application and the Environmental Assessment process was developed at the commencement of the EA. The sheet was uploaded to the Tweed Shire Council website in March 2009 and was advertised in the Tweed Link, a weekly newsletter produced and distributed by Council free to every household in the Shire.

A total of 77 downloads of the information sheet occurred via the website.

A copy of the information sheet and the Tweed Link newsletter March 24, 2009 are provided in Appendix G.

1800 Freecall Project Information Line

A free project information line was established for the EA. However the only calls received on this line were from three landowners seeking a meeting following the distribution of the letter referred to above.

Meetings with Landowners

Following contact with the three landowners, two landowners decided to attend individual meetings. The third landowner eventually declined the offer of a meeting as they advised that they had sufficient information regarding the project.

The landowner meetings occurred on April 15 2009 and provided the landowners with an opportunity to hear about the proposed landfill and quarry activities, be provided with a point of contact for any concerns and discuss any issues around the environmental assessment process.

Council/Local Government Open Day

Tweed Shire Council celebrated Local Government Day on 8 August 2010. Council hosted a manned stall comprised of factsheets, mapping, questions and answer, feedback specifically related to the Eviron Road proposal. In excess of 1500 residents were exposed to this information.

Consultation with Local Aboriginal Groups

Consultation with the Tweed Shrie Council Aboriginal Advisory Committee was conducted by heritage consultants, Converge as part of this assessment. In additional Traditional Owner representatives participated in the cultural heritage survey. Consultation was undertaken in accordanc with DECC Aboriginal Cultural Heritage Draft Community Consultation Requirements for Proponents, May 2009.

5.2.3 Public Exhibition

Details of the public exhibition feedback will be included in the final EA document.

PART B – Information on the Project

6. Project Need and Alternatives

6.1 Need for Extractive Industry

In previous regional plans, it was identified that there would be requirements for successive quarry developments for the Tweed Shire area. These plans include quarry operations which have since closed such as Stott's Quarry. Following Stott's quarrying operations, it was proposed that Quirks and Eviron quarries would continue after these operations ceased.

These council-operated quarries were located within close proximity to each other, with the intention that the entire area would be relatively isolated, to allow/ensure:

- The site to be owned by the council acquired when planning was first being developed;
- The intensive activity to be undertaken with minimal impact to the community;
- That all existing neighbours are amenable to quarry activities;
- A continuity of products produced;
- Close proximity to townships, industry and tweed development areas, in order to be economical; and
- It is proposed that once quarry resources have been exhausted in the area, the area will be land-filled and potentially used as a botanic gardens corridor.

Within the initial planning of the Stott's, Quirks and Eviron quarry sites, these areas were zoned accordingly, to ensure the proposed plan could be executed stage by stage if required.

As the Tweed Shire and surrounding areas continue to grow and develop, there will be continued demand for building aggregates and associated products in this area, as well as further afield.

According to Council as Quirks Quarry resource is close to exhaustion, the market will require the development of Eviron Quarry. It is important that the planning of the closure of Quirks and the opening of Eviron allows seamless product supply.

The local area contains two main competitors; however these are further west of the Eviron Quarry and service the Murwillumbah town and North-Tweed area, whereas the Eviron Quarry would aim to supply local council and the South-Tweed area, including Kingscliff, Bogangar, Cabarita, to Hastings Point (7 Year Plan Report and Tweed DCP 2008). These areas are all continuing to be developed and therefore are creating demand for fill and quarry products.

6.2 Need for Landfill (Justifiable Demand)

This section presents a consolidated summary of the justifiable demand for a new landfill facility as an integral part of the Concept Plan and Stage 1 Project Application. It is noted however that the changes to the *Infrastructure SEPP – Determination of Landfill Applications* announced in July 2010, shift the emphasis in the determination of landfill applications, from justifiable demand towards increased waste recovery and other improved environmental outcomes. Whilst the DGRs for this project were issued prior to these changes and this assessment was substantially progressed at the time of the changes, comments on how the Stage 1 Project Application and Concept Plan address the new requirements for determination of landfill applications are provided in Section 6.4.

6.2.1 Key Issues

Capacity of Stotts Creek landfill

Tweed Shire Council's existing putrescible landfill at the Stotts Creek RRC, is predicted to reach capacity by 2012. As such, Council is seeking to develop new waste infrastructure to provide for the waste management requirements of the Shire in the short term; and gain concept approval to develop additional waste infrastructure to meet projected medium and long term needs.

It is noted that Council intends to continue to use the existing infrastructure at Stotts Creek RRC such as the weighbridge, gatehouse, small vehicle drop off area and continue the resource recovery activities and non putrescible (inert) landfilling at Stotts Creek, following the establishment of the landfills at Eviron Road.

According to the data available since the introduction of the new kerbside collection contract Tweed Shire resource recovery activities presently divert 42% of the kerbside waste stream from landfill disposal, with an overall resource recovery rate for the 2008-2009 period of 38% realised. Despite this level of resource recovery, and plans to increase resource recovery through the actions identified in the Tweed Community Strategic Plan, Tweed Shire Waste Strategy and NEWF Regional Waste Strategy, according to Council forecasts approximately 55,000 t/yr of residual waste are likely to require landfill disposal going forward. This demonstrates the continuing requirement for landfill disposal of residual waste and the realistic diversion rate achievable via the new kerbside collection contract, which would be expected to ramp-up over the initial period of the contract.

On this basis a clear justifiable demand therefore exists for provision of new landfill capacity. The capacity/demand ratio has reached the point at which the need for new landfill capacity must be promptly addressed.

Alternative Existing Waste Disposal Landfill Sites in the LGA

The landfill at Council's Stotts Creek RRC is currently the only municipal waste disposal facility in the Tweed Shire. As discussed above there is limited remaining capacity at this site, hence the urgency to secure additional landfill space for residual waste.

Alternative Existing Waste Disposal Landfill Sites outside the LGA

As summarised in Section 4.1.1, Council's Waste strategy raised the possibility of transporting residual waste (after separate collection of organics and composting at a site in the Tweed area) or all wastes (excluding VENM) to an existing landfill already in operation in South East Queensland. This considered facilities privately operated in the Ipswich region and Gold Coast City Council operated landfills. However Council has not chosen to pursue this option for the following reasons:

- Community consultation on the Draft Waste Strategy revealed a strong sentiment that the Shire should take ownership and control over its own waste generation and disposal;
- The scale of the waste transport task itself and the required transportation distances (particularly to private landfills in Ipswich) would result would result in significant costs and greenhouse impacts that are considered avoidable by landfilling residual waste at Eviron Road;
- There is a foregone local commercial opportunity for beneficial waste processing (e.g. composting/mulching) in the Tweed, by transporting wastes outside of the Shire;
- There would be a potentially significant commercial drawback particularly for privately owned landfills, in that Council would be left open to fluctuating gate prices and waste management practices over which limited recourse is available;
- Exporting waste for disposal to South East Queensland is not in line with the intended spirit of the NSW WARR Strategy and would provide little incentive to achieve the WARR Strategy targets; and
- This option is unlikely to absolve Council of potential liabilities associated with future possible carbon taxes and waste disposal levies.
- A waste levy is to be introduced in Queensland in 2012, which would capture the landfills in South East Queensland, therefore artificially inflating the price of landfilling, and minimising any perceived economic advantage in transporting waste to this region.
- Transporting waste to alternative landfills within the Northern Rivers (NSW) does not appear to be justified. A recent independent review of resource sharing opportunities for waste management within the Northern Rivers (NSW) (Hyder 2011) revealed that

  Tweed reported a low current cost of disposal in this study and, assuming approvals for the new facility are gained, is unlikely to realise large potential savings from considering resource sharing opportunities around landfill at this stage.

This demonstrates that use of the nearest potentially available large-scale landfill (either on the Gold Coast, in Ipswich or in the Northern Rivers (NSW)) does not offer a sustainable solution. This further confirms that clear justifiable demand exists for provision of landfill capacity in the Tweed.

Alternative New Sites

Prior to purchasing the Eviron Road site over 20 years ago Council embarked upon a site selection process for future landfill sites for the Shire, based on the fact that existing landfills at that time had a limited capacity. Selection criteria for a suitable site were developed by with a view to identifying a proposed landfill site to cater for the residual waste disposal needs of the Shire for the foreseeable future. The options assessment was based on a number of selection criteria which were outlined in the PEA (2009) and are summarised below:

- The proposed site would need to be flood free;
- The proposed site would not be situated on prime agricultural land;
- The proposed site should be predominantly gently sloping;

- The proposed site should be easily accessible from major population centres;
- The proposed site should be remote from residential areas;
- The proposed site should have few adjoining landowners; and
- The existing property owners would need to be agreeable to sell the properties.

It is noted that these criteria are also consistent with the EPA Solid Waste Landfill Guidelines

Council reported that after an exhaustive search of possible sites and negotiations with affected landowners, the Eviron Road site was chosen as the most suitable site to address the chosen criteria. In addition the site has advantage of being located close to Council's existing landfill at Stotts Creek RRC, such that by constructing the proposed haul road between the two sites, costs associated with establishing front end infrastructure such as a site office, weigh bridge and transfer station can be avoided by the continued use of these facilities at Stotts Creek.

Discussions were held at the time with adjoining landowners to inform them of Council's intention to construct future landfills on the site. The longer term intent for the site to become part of the Tweed Shire regional botanical gardens following cessation of quarrying and landfilling was also discussed. The site was then subsequently zoned 5(a) Special Purpose as part of the Tweed Local Environment Plan 2000. Consultation with public authorities and other stakeholders during preparation of the draft LEP 2000 was a requirement of this process.

Bale Filling Alternative

There is some thought that improved operational outcomes (compaction) are achieved through mechanically baling waste prior to landfilling. Another local government operated landfill within the Northern Rivers (NSW) region employs a bale fill technique and provided the following comment to Council:

- Capital cost: $1.2 million
- Maintenance cost: $80,000 per annum
- Additional operational requirements: spray cover of bales
- Throughput: 30,000 tonnes of putrescible waste. The bale fill cannot be utilised for bulky waste or construction and demolition waste.
- Compaction: 1 tonne: 1m3
- Fill type: bale fill of engineered cell (not quarry void)
- This landfill had the highest cost of disposal within the Northern Rivers (NSW) region (Hyder 2011).

A bale fill technique was not implemented at Tweed Shire Council's existing landfill infrastructure, Stotts Creek RRC, as it is a quarry fill, where the waste fill is pushed up against the quarry walls with an engineered liner between the walls and each lift. Filling bales into a quarry fill would have potentially lost airspace due to the irregular quarry void. Council's Contract to manage the Stotts Creek RRC hosts an enforceable key performance indicator to ensure the contractor meets a minimum compaction of the waste fill (750kg/m^3) and provides the contractor with a bonus for exceeding the minimum compaction rate. The contractor is averaging a 1:1 (1 tonne:1 m3) compaction rate over the first 12 months of the contract.

Council's Tweed Community Strategic Plan commits Council to investigating alternative treatment options, and it may well be more prudent to distribute time and resources to treating the organic fraction of the waste stream rather than a bale fill arrangement.

Protection of the Environment

Council recognises the importance of improving environmental standards for landfill design and management. This Environmental Assessment the Tweed Community Strategic Plan and the Waste Strategy demonstrates Council's commitment to improving resource recovery and operating under a philosophy of best practice waste management. Specifically via separation and processing of organic material to reduce potential greenhouse gas generation and landfill management which seeks to prevent environmental impacts via emissions to the atmosphere, land and water via a commitment to best practice design and environmental management. Details of the environmental protection measures for Quirks Quarry Landfill (Stage 1 Project Application) are provided in the LEMP (Appendix C) and summarised in Section 7. It is intended that these measures would also apply as a minimum to any future landfills proposed as part of the overall Concept Plan.

Alignment with NSW Waste Avoidance and Resource Recovery Strategy

Council's Community Strategic Plan, Waste Strategy, the NEWF Regional Strategy and this Concept Plan are aligned with the NSW Government's direction for waste as expressed in the WARR Strategy as discussed in Section 4. Council's strategy aims for improved performance in terms of increasing resource recovery rates via the recent augmentation of kerbside waste collection services (from both municipal and C&I sectors) in order to improve the diversion of recyclables and organics from landfill, particularly via the optional provision of a third bin for green/organic waste. This diversion reduces the disposal of materials that contribute most to the formation of greenhouse gases in landfill. These organic resources will provide quality feedstock for production of valuable compost to improve the quality of local landscapes and reduce the need for chemical fertilisers.

Council's commitments to continuous improvement to waste management and resource recovery infrastructure, collections, strategy and education are documented in the Tweed Community Strategic Plan 2011/2021.

Council's Waste Strategy features improved recovery and recycling of household waste through an expanded service provision and new bin provisions.

The Strategy also makes provision for improving business sector resource recovery (both C&I and C&D) via pricing signals for landfill disposal of commingled wastes. It is acknowledged that a regional Council such as Tweed, has limited influence over the generation of C&I and C&D waste and hence differential pricing for the disposal of segregated and commingled loads reflect the greatest opportunity to make a difference in the waste stream. Differential pricing for the acceptance of C&I and C&D waste depending on the source has also been employed by Council. And Council is in the process of developing a "Waste Not" Development Control Plan (DCP) with a view to improving resource recovery from the C&D stream.

Consistency with Regional Waste Strategy

As previously outlined in Section 4, Tweed Shire Council is the Host Council and an active member of NEWF, a voluntary regional body aimed at delivering efficiencies and promoting innovation and excellence in waste management and resource recovery. Council's membership demonstrates the commitment to the programs NEWF is implementing to address the goals of the WARR Strategy.

Council has also participated in an independent review of resource sharing opportunities within the Northern Rivers (NSW) region relating to waste management. The objectives of the review, initiated by the General Managers Group of NOROC, was identifying resource and capacity sharing within the following operational areas:

- Collection;
- Resource Recovery;
- Education;
- Strategic Planning;
- Regional representation;
- New technology; and
- Governance.

The report, presented the General Managers in March 2011 for consideration, provides opportunity for Council to participate in the development of a regional waste management strategy.

6.3 Alternatives

6.3.1 Provision for Landfilling at Eviron Road in Waste Strategy

Section 13.1 of the Waste Strategy provided details available at the time of publishing in relation to the proposal landfill and quarry operation at Eviron Road. The strategy was finalised prior to the commencement of the Preliminary Environmental Assessment and this Environmental Assessment, however it did provide a summary of the recommendations made by Gilbert and Sutherland and highlighted Council's intention to establish the landfill and quarry at Eviron. Council's Tweed Community Strategic Plan documents the development of landfill infrastructure at Eviron Road as a commitment in the Delivery Program.

6.3.2 Alternatives to Landfilling

The Tweed Shire Council Domestic Solid Waste Management Strategy was finalised in 2007 after consulting widely with the community and other relevant stakeholders. The waste management strategy included information on a number of waste disposal options and included the identification of landfilling and quarry activities at the Eviron Road site and recommended "that concurrently with developing plans for the local landfill, Council reviews other long term disposal options for the Shire's waste".

Since this time a “Situation Analysis” of Alternate Waste and Resource Recovery Technologies was commissioned by Council in 2008. This study concluded that there were no commercial, environmental or community best value grounds at that time, for the pursuit of Alternative Waste Treatment technologies for the Tweed Shire. The conclusion was largely based on estimates of waste quantities generated in Tweed Shire, that were below the minimum technical feasibility level for Alternative Waste Technology (AWT) options currently in use in Australia.

However, despite the outcomes of the Situation Analysis with respect to AWT it is Council’s intention to pursue alternatives further, as documented in the Tweed Community Strategic Plan.

The Strategic Plan documents, in year four, a responsible investigation and implementation of commingled food organics and green waste collections, and investigation of advanced (alternative) waste processing infrastructure. This commitment provides an assurance that Council will endeavour to provide best practice resource recovery activities over the life of Concept Plan.

The independent review of resource sharing opportunities (Hyder 2011) concluded that to meet the NSW State Government landfill diversion targets of 66% that the use of an AWT would be required in the region. Council was an active participant in the review and will continue to participate in the development of a regional waste management strategy which will address, among other objectives, the AWT infrastructure needs of the region.

6.3.3 Alternatives to Eviron Road

As described in the discussion of Justifiable Demand for landfill Council has invested significant funds in the Eviron Road site following consideration of other sites and a site selection process over 20 years ago and since this time has appropriately rezoned the site for the intended use.

6.4 Infrastructure SEPP Changes (July 2010)

On 12 July 2010, the Department of Planning issued a Planning Circular (PS 10-016) *Changes to Infrastructure SEPP – Determination of Landfill Applications.* The Circular makes amendments to Clause 123 of the SEPP to shift the emphasis for landfill applications from justifiable demand towards increased waste recovery (such as using alternative waste technologies or composting) and other environmental outcomes.

This assessment was significantly progressed at the time of the changes and has been based upon the DGRs issued in August 2008 which make reference to the justification of the landfill operations and maximising resource recovery from the waste stream to reduce landfill disposal. It is noted however that the waste management components of the Project Application and Concept Plan, together with the commitments in the Tweed Community Strategic Plan 2011/2021, and recommendations of Council’s Waste Management Strategy which has driven recent resource recovery initiatives and will continue to guide future activities are however consistent with the overall intent of the amended Infrastructure SEPP. Comments on how the proposal addresses each of the criteria listed under Clause 123 of the SEPP are provided below:

6.4.1 Suitable Level of Recovery of Waste

Current resource recovery activities in the Tweed Shire are discussed in detail in Section 4 of this report. Kerbside services include an optional green waste bin for all ratepayers, which at present has 11,500 participants out of 21,000 eligible properties. Resource recovery activities at the Stotts Creek RRC include a greenwaste processing facility and concrete recovery pad in addition to a materials recovery facility and transfer station for commercial and domestic self haul customers. Based on figures for the 2009/2010 financial year, Tweed Shire achieved an overall resource recovery rate of 39.3%, with a 44.4% recovery rate for kerbside waste collection in the first twelve months of the new bin system.

Whilst Council is committed to pursuing viable alternative to landfilling (refer Section 6.3.2), it is considered that the approval of the Stage 1 Project Application will allow time for Tweed Shire Council to revisit and update the domestic solid waste management strategy and responsibly investigate, plan and rationalise alternative collections of food organics and emerging/alternative treatment options.

There are significant lead times required for any commercial scale AWT as well as commercial and technology investment (and risk). In addition it is also noted that any AWT proposed for the Shire will still require a licenced landfill in operation to accept the residual waste.

6.4.2 Best Practice Design and Operation

Council has committed to best practice design and operation of the landfill components of the Project Application and Concept Plan. This is demonstrated through the draft statement of commitments in this document (Section 11) as well as the Quirks Quarry Concept Design Report (GHD, 2009) and the Draft Landfill Environmental Management Plan for Quirks Quarry. A key component of this is the proposed liner system and the proposed approach to landfill gas management as discussed further in Section 6.4.3 and Section 7.2.1.

The fundamental principles outlined in commitments for the Stage 1 project application will apply as a minimum future proposed activities, which will also be subject to changes to the regulatory framework and technological advances such that the commitments would be revisited to ensure they are current at the time, reflect best practice and community expectations and are relevant to activities proposed as part of the future applications.

6.4.3 Reduction of Long Term Impacts

The reduction of long term environmental impacts is central to the design and operation of the Quirks Quarry Landfill (and any subsequent landfills). Specific design measures incorporated at the concept level are provided in Section 7.2.1 and include the following the following key initiatives:

- Containment and management of emissions (leachate and landfill gas) through engineered lines, leachate collection systems and landfill gas management systems;
- Minimisation of contaminated stormwater requiring management through diversion and separation of clean and "dirty" runoff;

- A landfill gas extraction flare with the potential for construction of an energy recovery plant depending on the gas extraction volumes realised;
- Progressive rehabilitation of the site once stages are complete; and
- Ongoing monitoring of surface water and groundwater receiving environments, as well as regular and scheduled leachate and landfill gas monitoring throughout the operation and post closure period for the landfill.

6.4.4 Use of Degraded Land

The landfill proposed as part of the Stage 1 Project Application will be situated within the existing void of Quirks Quarry which is considered to be degraded land. The landfills proposed in subsequent stages will also be located within quarrying voids such that the landfilling process itself will always be situated within degraded land.

6.4.5 Avoidance of Land Use Conflicts and Consistency with Regional Planning Strategies and Locational Principles

The land at Eviron Road was purchased by Council over 20 years ago for the purposes of securing the long term extractive and waste disposal requirements of the Shire. Most of the site is appropriately zoned Special Uses 5(a) (Garbage Depot), with the balance being Rural 1(a) and Rural 1(b2) under the Tweed LEP (2000), however not landfilling or quarrying is not permissible and will not take place in the rural zoned areas (as per the Tweed LEP 2000 and Draft Tweed LEP 2010).

As discussed in Section 2.4, the Concept Plan and Stage 1 Project Application are permissibly under both the Tweed Local Environmental Plan (2000) and the Draft Tweed Local Environmental Plan (2010), in addition, as noted in Section 2.5, 4.1.1 and 4.2 Council consider that this project is consistent with the following strategies:

- NSW Waste Avoidance and Resource Recovery Strategy;
- Far North Coast Regional Strategy;
- Tweed Urban and Employment Land Release Strategy;
- Tweed Regional Botanic Gardens Plan of Management;
- Tweed Shire Domestic Solid Waste Management Strategy;
- NEWF Regional Waste Strategy 2009-2012; and
- Tweed Shire Council Community Strategic Plan 2011-2021.

As described in Section 6.2.1 in choosing the Eviron Road site as a long term waste facility, a number of selection criteria regarding flooding and topography and proximity to residential areas and major population centres were considered. In addition the fact that the site is located adjacent to the existing Stotts Creek RRC is a major advantage to establishing waste disposal facilities at Eviron Road, such that the significant capital costs associated with establishing front end infrastructure are eliminated by using those already in place at Stotts Creek.

6.4.6 Optimisation of Transport Links

As noted in Section 6.2.1 the Eviron Road site has the advantage of being located close to Council's existing landfill at Stotts Creek RRC, such that by constructing the proposed haul road between the two sites, costs associated with establishing front end infrastructure such as a site office, weigh bridge and transfer station can be avoided by the continued use of these facilities at Stotts Creek. The Stotts Creek RRC has convenient transport access to the Tweed Valley Way for waste collection vehicles. The establishment of the haul road also means that the current quarry access to the site from Eviron Road will be closed, thereby significantly reducing the number of large vehicles traversing Eviron Road and Duranbah Road which are both single lane roads traversing hilly terrain.

7. Project Description

7.1 Overview

This section provides a detailed description of the:

- Likely staging of the project; and
- Plans of any proposed building works.

As indicated previously, the project will be undertaken in stages. The current Concept Plan outlines the intention for progressive development of landfills within quarry voids across the site:

- Stage 1 (Project Application):
  - Construction of a haul road from Stott's Creek RRC to the site;
  - Landfill within the Quirks Quarry site; and
  - Quarrying at the West Valley site.
- Future Stages:
  - Landfill within the void formed by West Valley quarry;
  - Quarrying at North Valley; and
  - Landfill within the void formed by North Valley.

It is noted that the activities forming this overall Concept Plan include shared infrastructure and access with Council's Stotts Creek RRC (as detailed in Section 7.2 and Quirks Quarry Landfill Concept Design Report in Appendix B and Draft Landfill Environmental Management Plan in Appendix C). However the activities at Eviron Road are separate to those at Stotts Creek. And for this reason an assessment of cumulative impacts of the two sites is not relevant.

Based on the Quirks Quarry Landfill concept design (Appendix B), it is anticipated that an operational period of approximately 10 years can be achieved, based on the forecast resource recovery and waste acceptance rates detailed in the design assumptions and within Section 7.2 below.

Similarly, based on projected extraction rates of 200,000 tonnes per annum for West Valley Quarry an approximate operational period of 11 years has been assumed. Taking into account the potential void created by the West Valley Quarry, and forecast waste acceptance rates provided in Section 4.5 it is possible that in the order of 12 years of landfilling may be achieved, however this will be subject to design at a later stage in the quarries' life and also take into consideration advances in waste disposal techniques and the potential maximum filling height to optimise the available space for waste disposal.

Based on preliminary estimates to date, taking into account the limited geological information, but considering topographical features and environmental constraints and an extraction rate of 200,000 tonnes per annum, the quarry in the North Valley may only operate for 3.5 years. However significantly more information is required to provide more confidence around this figure particularly in regards to localised geological features and therefore likely quarry products. Taking these initial parameters for the quarry, and the forecasted waste acceptance rates indicates that a landfill in the North Valley may operate for greater than 10 years from 2034, subject to waste acceptance at the time, advances in landfill operational procedures and the success of alternative waste technologies. For the purposes of this study, it is assumed the landfill would operate between 2034 and 2045 . Further details of the activities planned for Stage 1 are provided in Section 7.2 and subsequent stages (and limitations on the accuracy of current estimates) are described in Section 7.3.

On the basis of these parameters, Table 7-1 provides an indicative timeline of the proposed staging of activities for all activities in the current Concept Plan. It is noted that there is no overlap of landfilling activities and quarrying activities, in that it is intended that there will only ever be a single landfill and a single quarry operating at any one time.

Table 7-1 Proposed Project Staging

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Existing Facilities																										
Quirks Quarry																										
Stotts Ck Landfill																										
Stage 1 Project Application																										
Construct Haul Rd																										
Quirks Landfill																										
W Valley Quarry																										
Subsequent Stages of Concept Plan																										
W Valley Landfill																										
N Valley Quarry																										
N Valley Landfill																								To 2045 (or beyond)		

7.2 Stage 1 Project Application Detail

7.2.1 Quirks Quarry Landfill

Overview

A concept design for the proposed landfill at Quirks Quarry has been prepared along with a draft Landfill Environmental Management Plan which are provided in Appendix B and C. The landfill footprint will be limited to the footprint of operations remaining after the cessation of quarrying activities and waste will be filled within the resultant quarry void. The concept design has been developed in accordance with the (former) Environmental Protection Authority

Environmental Guidelines: Solid Waste Landfills (NSW EPA, 1996) as will be the case for subsequent detail design and operation of the landfill.

The landfill will accept Class 1 solid waste (as is currently accepted at Stotts Creek RRC). Class 1 solid waste is defined as 'non-hazardous, solid, degradable material', and include putrescible wastes, garden wastes, uncontaminated bio-solids and clinical and related waste (including contaminated waste). The waste contains a hazardous waste fraction of less than 5% by weight.

Disposal of Class 1 solid waste typically results in the generation of leachate, odours and potentially volatile gases as a result of the degradable content. The design of the landfill thus provides for the containment and management of the emissions from the waste mass through liners, leachate collection systems, and landfill gas management systems. Appropriate rehabilitation works will also be undertaken such that the waste mass can remain in a stable condition in the long term.

The proposed landfill layout is shown on Figure 12. Key features of the landfill in Quirks Quarry will include development of:

- Waste cells;
- Stormwater management controls;
- A leachate management system; and
- A landfill gas containment system.

Access to the landfill will be via a new haul road constructed between the existing Stotts Creek RRC and the Quirks Quarry Landfill.

Landfill Capacity and Staging

In April 2011, Council provided revised waste acceptance and operational data for the Stotts Creek Landfill, which has altered the calculations for the void capacity and the likely life of the Quirks Quarry Landfill.

Monthly compaction testing between December 2009 and September 2011 indicates that an average waste compaction rate of 1211 kg/m^3 has been achieved at Council's Stotts Creek Landfill (as discussed in the Concept Design Report in Appendix B). In the previous version of the concept design a waste compaction rate of 750 kg/m^3 was adopted. However based on the newly provided data, a revised compaction rate of 1000 kg/m^3 has been adopted for the concept design.

Based on the revised waste forecasts, and the void capacity estimated in the previous design, GHD have updated the estimate of the operating life for the landfill. The following assumptions were utilised in calculation of the landfill life capacity:

- Assumed 2012 yearly waste quantity = 47,893 tonnes;
- Assumed increase in yearly waste volumes for each consecutive year = 3% growth per year (average);
- Waste conversion rate: 1 m^3 = 1 tonne; and
- Estimated yearly daily cover placed = 20% of yearly waste volume.

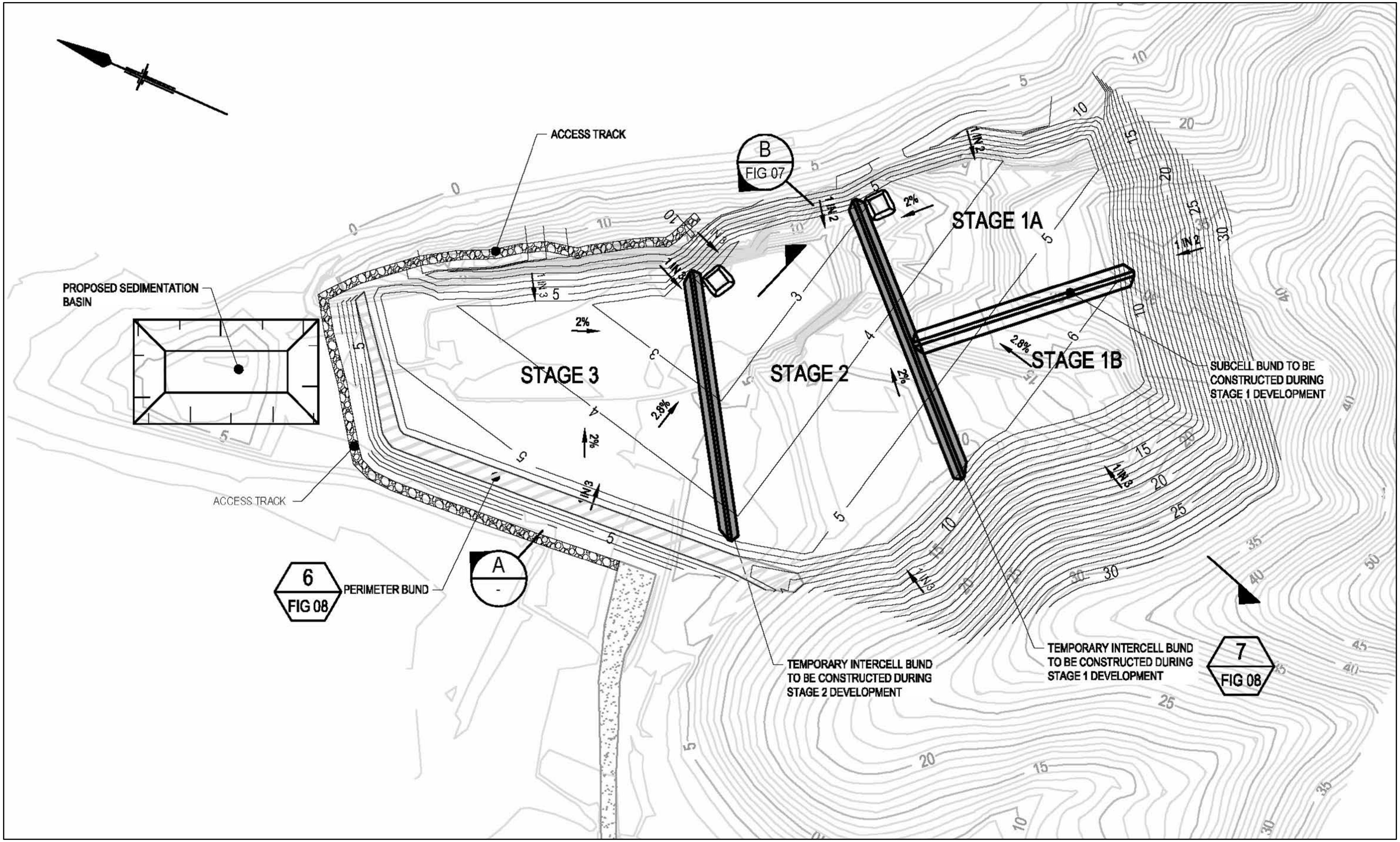
It is noted that Council has committed to establishing an AWT facility by 2016 with the aim of diverting up to 66% of the waste currently disposed to landfill. However given that planning for this is in the very early stages, this diversion and reduction of waste to landfill has not been factored into the concept design.

Construction and demolition waste will continue to be landfilled at Stotts Creek Landfill until the end of 2019, as was the case in the previous version of the concept design.

Based on the available capacity/void space it was determined that the landfill footprint would be split into stages to allow efficient management of disturbed areas and minimisation of rainfall infiltration in to landfill waste filling area and thus generation of leachate. In determining the numbers of stages/cell it was assumed that a minimum of two years of filling per stage would be required, which has resulted in three main stages as shown in Table 7-2 and on Figure 12.

Table 7-2 Life Expectancy of Each Landfill Cell

Cell /Stage	Void Capacity (m^3)	Approximate Cell Life (Months)	Comments
1	206,500	41	Intermediate Cover to RL 30
2	263,500	46	Intermediate Cover to RL 25
3	171,100	36	Final Capping
2 & 3	109,000	13	Final Capping
Total	**750,000**	**136**	Approximate Landfill Life



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CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Cell Arrangement and
Proposed Subgrade Contours

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Figure 12

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Plotted by: Nicola Hankin

Sequencing of Stages

The sequencing of the cell construction and subsequent landfilling operations in all stages will enable progressive capping to be undertaken as each stage is completed. This will allow efficient management of the disturbed areas and minimisation of rainfall infiltration into the landfill and thus generation of leachate. The initial development sequence will be as follows:

- Development of Stage 1:
  - Cells split into Stage 1A and 1B by internal bund; and
  - Lining placed to an RL 15 m.
- Landfilling of waste in Stage 1A:
  - Management of leachate in Stage 1A only, stored within cell; and
  - Rainfall on Stage 1B treated as stormwater and pumped to natural drainage.
- Landfilling of waste in Stage 1B:
  - Management of leachate in Stage 1A & 1B, stored within Stage 1 (combined);
  - Management of stormwater from cell to sediment basin once waste reaches RL 15 m; and
  - Development of leachate disposal infrastructure, treatment plant and irrigation area, based on collection of leachate quality and quantity data.
- Development of Stage 2 with landfilling of waste continuing in Stage 1 (1A and 1B) to a level of approximately RL 30 m:
  - Leachate disposed by treatment and irrigation stored within Stage 1.
- Intermediate capping of Stage 1 (1A and 1B) and establishment of temporary vegetation to a level of approximately RL 30 m;
- Landfilling of waste in Stage 2:
  - Management of leachate in Stage 1 and 2 and disposal by treatment and irrigation; and
  - Excess leachate stored within Stage 1 and 2.
- Development of Stage 3 with landfilling of waste continuing in Stage 2 to a level of approximately RL 25 m;
- Intermediate capping of Stage 2 and establishment of adequate ground cover to a level of approximately RL 25 m;
- Landfilling of waste in Stage 3:
  - Management of leachate in Stages 1 to 3, and disposal by treatment and irrigation; and
  - Excess leachate stored within Stage 1 and 2.
- Final capping of Stage 3 and establishment of adequate ground cover to a final design level of approximately RL 20;
- Landfilling of waste in Stage 2 and Stage 3 to final design levels and management of leachate in Stages 1 to 3;
- Final capping of Stage 2 and 3 and establishment of adequate ground cover to a final design levels; and

- Continue management of leachate in Stages 1 to 3 based on recommendations of closure plan (closure plan to be developed a minimum 6 months prior to final placement of waste).

Stormwater Management

The current stormwater drainage system at Quirks Quarry comprises a dam, sediment basins and perimeter stormwater drains. These will be retained where possible throughout the development stages of the proposed landfill. These will collect stormwater runoff from the current vegetated ground cover areas not associated with the proposed landfill area.

A new stormwater drainage system will be designed for the new landfill (refer Figure 13). This will comprise:

- Bund construction around the landfill;
- Construction of new stormwater management measures;
- Construction of new erosion and sediment control measures;
- Construction of a new stormwater sediment pond;
- Erosion and sediment control works across the site; and
- Progressive capping and revegetation of the site.

All drainage works will be designed and constructed in accordance with the requirements of the (former) NSW EPA, including the requirements specified in the NSW Department of Housing – Managing Urban Stormwater – Soils and Construction Guidebook (1998) and its recent "Waste Landfills" update (2008), otherwise known as the "Blue Book". All stormwater diversion and collection drains shall be sized to convey run-off from the 1 in 10 year ARI rainfall event. Where necessary the drains will be armoured or lined to prevent erosion.

Landfill Cell Liner and Subgrade

The cell liner will be designed in accordance with the NSW, EPA guidelines as follows (refer Figure 12):

- 0.9 m thick compacted clay liner placed vertical to the base and perpendicular to internal batters;
- The liner will need to achieve a permeability of less than 1×10^{-9} m/s;
- 1.5 mm thick high density polyethylene (HDPE) liner to the base of the landfill only, to an approximate RL 7 m;
- 0.3 m leachate drainage aggregate layer over the base of the liner to achieve a permeability of greater than 1×10^{-3} m/s and associated leachate collection pipework;
- Excavated internal batter slopes will were possible be ≤ 1:3 for constructability of the liner; and
- For slopes > 1:3, the liner will need to be placed in lifts.

Leachate Management System

A leachate collection system will be designed and installed in accordance with the quality requirements of an approved Construction Quality Assurance Program. Due to the inherent uncertainty regarding the quantity and quality of leachate that will be generated at the site and to avoid oversizing a leachate storage pond or treatment plant, a staged approach to leachate management is proposed in the concept design. In terms of collection this will comprise a herringbone arrangement of leachate collection points which discharge to a leachate sump located at the lowest point of each cell. The leachate will be conveyed from the sump by use of pumps via a leachate riser pipe which will then ultimately be gravity fed (where ever possible) to the leachate treatment plant for disposal by irrigation. However the following interim steps will be undertaken:

- Monitor leachate generation (quantity and quality) for a suitable period of time e.g. 1 – 2 years;
- Irrigate leachate on the active landfilling area to control leachate levels in the interim period until a leachate treatment plant and irrigation area is established;
- Review and verifying leach ate generation at the site e.g. during median and 10% AEP rainfall years; and
- Review and confirm a preferred leachate management strategy.

After this point it has been recommended that a suitable leachate treatment plant be designed and constructed based on the outputs of the monitoring be prepared. This would include a performance based specification for a leachate treatment plant that would produce an effluent suitable for the selected leachate disposal option i.e. irrigation. The treatment plant would require monitoring and optimisation of performance throughout its operational life.

During the initial 1-2 years of the landfills life, it is intended the monitoring of leachate quantity and quality will be conducted at a frequency sufficient to identify the need for a contingency in terms of leachate storage and irrigation should this be required. This issue would be handled at the licence application stage, as identified by DECCW during the adequacy assessment. Furthermore it would be an issue closely reviewed during the detail design for the landfill.

Landfill Gas

Landfill gas can move through the ground either to the surface or towards the perimeter of the landfill. The main potential hazard associated with off-site migration of landfill gas is the possibility of flammable gas entering structures and being ignited, or an asphyxiation risk due to gas entering confined spaces through cracks in foundations or via utility services.

The requirement for installation of a landfill gas active extraction system will be dependent upon the type and quantity of waste landfilled, and the requirements of the landfill license. Based upon previous assessments carried out by GHD it is expected that at a minimum, gas extraction wells and a flare will be required, which will be comprised of:

- LFG extraction wells spaced at approximately 50 m centres;
- Gas manifold pipework systems from each of the staged area;
- A gas ring main located along the landfill perimeter;

- Condensate traps located along the gas ring main to collect condensate produced as the gas moves through the pipework; and
- Possible gas extraction flare (initial installation), with the potential for construction of an energy recovery plant depending upon the gas extraction volumes.

Council has a commitment to sustainable landfill gas management and has identified a potential alternative to onsite landfill gas infrastructure at this site. Further investigation of the costs, benefits and logistics of tapping into or expanding (replicating) the existing infrastructure at the Stotts Creek RRC Facility will be undertaken to identify whether this is a more advantageous solution to the provision of a flare at the future Quirks Quarry landfill.

Landfill Capping

Throughout the waste filling process Council will progressively cover the waste using the following techniques:

- Daily Cover:
  - 150 mm minimum of soil material over exposed waste at the end of each working day.
- Intermediate Cover:
  - 300 mm minimum of well compacted soil material to achieve a suitable permeability as final waste landform profiles are achieved.
- Final Capping:
  - Linear low density polyethylene (LLDPE) liner to achieve a permeability of less than 1×10^{-8} m/s;
  - 500 mm revegetation layer which will be suitable for plant growth; and
  - 100 mm of mulch or topsoil.

The final capping option exceeds the requirements and environmental goals of the NSW EPA Guidelines. Once landfilling has commenced and Council have collected actual leachate generation figures and actual landfill gas production figures, the final capping system will be reassessed and detail designed.

Final Landform

The final landform of the landfill was designed to ensure that the landfill was restored to a similar profile to that of the surrounding landscape (refer Figure 14). The external batters were designed to be constructed at a maximum grade of 25% (1 in 4) with a minimum top surface grade of 5% (1 in 20). The minimum grade of 5% should be maintained to ensure that rain falling on the site is able to drain away freely, thus minimising infiltration into the waste.

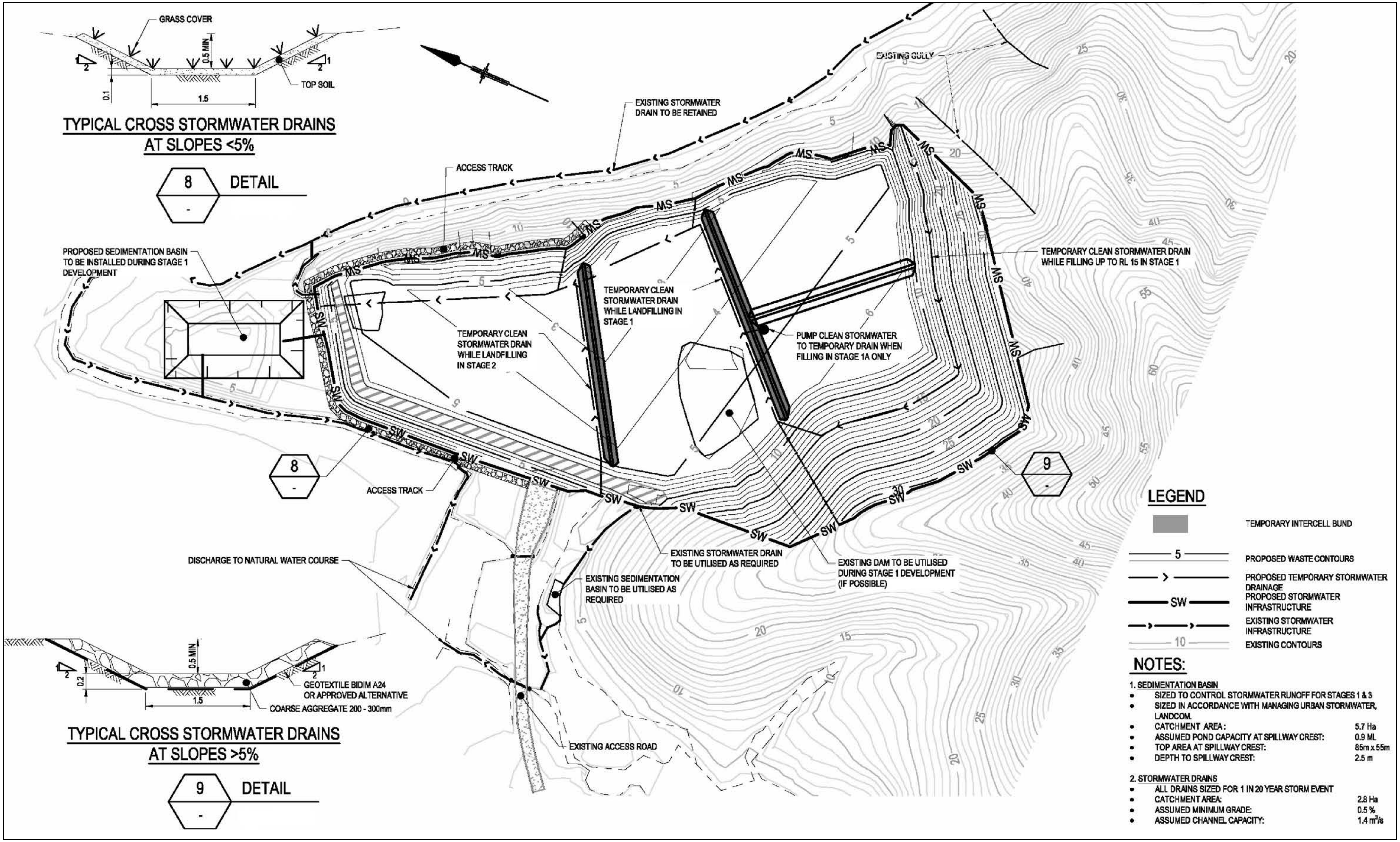
Hours of Operation

The hours of operations for the landfill will be daily between 7:00 am and 4:00 pm Monday to Friday and between 9:00am and 4:00pm Saturday and Sunday. The site will be closed (except to kerbside collection vehicles) on Christmas Day and Good Friday.

Environmental Management

As indicated above, in order to demonstrate how Council will manage the landfill to meet environmental requirements, a draft Landfill Environmental Management Plan has been prepared (GHD, 2009a). This identifies key management actions many of which have been discussed above, but also operational management issues including:

- How the landfilling operations will be staged;
- Requirements and timing of covering and capping of the landfill area; and
- Environmental management for:
  - Water quality – stormwater and leachate;
  - Air quality– landfill gas, odour and dust;
  - Litter;
  - Vermin; and
  - Noise.



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Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Stormwater Arrangement
and Details

Job Number	41-20806
Revision	0
Date	27 MAY 2011

Figure 13

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NOTES

1. VOLUMES CALCULATED FROM DATA SUPPLIED BY TWEED SHIRE COUNCIL IN FEBRUARY 2009
2. PROGRESSIVE QUARRYING WITHIN EXISTING QUARRY AREA WILL VARY CUT & FILL VOLUME

VOLUME CALCULATIONS

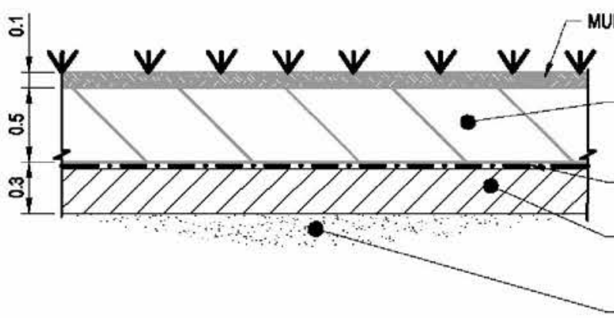
VOLUME CALCULATIONS FOR WASTE / DAILY COVER VOID CAPACITYTO SUBGRADE PROFILE

STAGE 1	
PLAN AREA	26,100 m²
VOID CAPACITY	273,000 m³
STAGE 2	
PLAN AREA	17,000 m²
VOID CAPACITY	306,000 m³
STAGE 3	
PLAN AREA	14,400 m²
VOID CAPACITY	171,000 m³
TOTAL	
PLAN AREA	57,500 m²
VOID CAPACITY	750,000 m³

LEGEND

10 — EXISTING CONTOURS

5 — PROPOSED WASTE CONTOURS



TYPICAL FINAL CAPPING LAYER PROFILE

1 - DETAIL

SCALE 1 : 50

Not to Scale
Indicative Only

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Tweed Shire Council

Eviron Road Quarry and Landfill Environmental Assessment

Final Waste Fill Contours and Cap Details

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Figure 14

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Plotted by: Nicola Hankin

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7.2.2 Quarry – West Valley

Configuration

A preliminary quarry pit design and extraction plan has been developed for the proposed West Valley quarry. The quarry footprint covers an approximate area of 11 ha (Figure 15). A minimum pit base level of reduced level (RL) 4.0 m corresponding to an estimated 100 year flood level event was adopted as the limit of extraction and general alignment for the connecting haul road between existing and proposed extraction areas. The first stage of quarry operations will commence in the south western portion of Lot 1 DP1159352.

Full details of the preliminary design are available in the Preliminary Quarry Study for the proposed West Valley Quarry (GHD, 2011) (Appendix D). Figure 15 sourced from the Preliminary Quarry Study shows the pit shell and bench configuration.

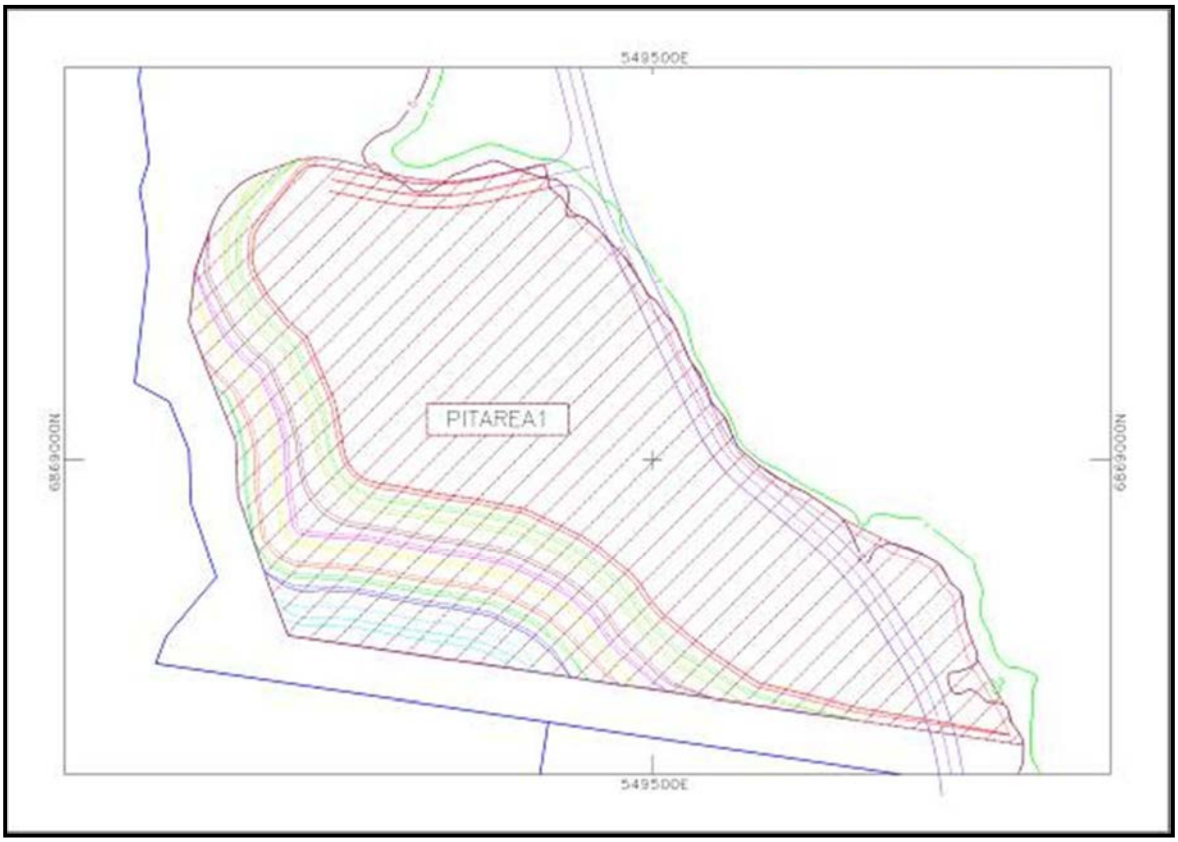


Figure 15 West Valley Quarry Pit Shell and Configuration

Quarry Schedule and Level of Production

An 11 year life-of-quarry production schedule, based on a 200,000 tonnes total material moved per year, was developed for the West Valley Quarry and is included within the Preliminary Quarry Plan (GHD, 2010). However this will be further determined by the amount of material available for extraction and what is outlined in the approvals process as appropriate for the site.

The level of production for the quarry is not to meet a demand in terms of an agreement or contract pertaining to a development in the area such as highway construction; it is to be determined by the total time allocated for these operations determined by TSC and the resource available.

Proposed Operating Methodology

Quarry production and operation is divided into a number of elements:

- Site planning and development;
- Removal and management of overburden;
- Extraction:
  - Drill and blast - to provide fragmented rock for crushing; however the density of the rock may lend itself to being easily dug up using an excavator or front end loader;
  - Load and haul - to move the rock from the quarry to the crushing plant.
- Processing:
  - Crush and screen - to process the rock to the required product size and specification product;
  - Product storage - to move the rock from the plant to the final product stockpiles;
  - Dispatch - to move the final product from the stockpiles to the customer via the weighbridge.

Quarry operations consist of a “top-down” approach to material removal with movement from higher bench levels such that completion of upper benches precludes any further material removal and/or access to the higher levels of the quarry.

Key Activities

The main activities regarding the quarry operations are summarised below, however other activities may also be undertaken on site pertaining to quality control of extracted material, dewatering as well as environmental monitoring and control measures.

- Drilling will be required for blasting operations, and allows for downhole placement of explosives so deeper rock can become available for use. Drilling and blasting activities are closely linked and both are typically undertaken on a needs basis;
- Blasting seeks to fragment the quarrying product and is a necessary quarry activity. The specific type of blasting activities undertaken will be dependent on the drill-hole patterns and initiation sequence to obtain the required material size;
- Extraction begins when rock is suitable for removal by a front end loader or excavator, usually after drill and blasting operations have been undertaken (especially when excavating hard rock);

Material blasted will be collected from the bench below using either a front end loader or excavator depending on appropriateness. The excavator will either load a series of mobile crushing/screening equipment directly or load haul trucks to take material to screens and crushers for processing, this will predominantly be determined onsite by space available in the 'working pit'; and

- Crushing and screening is required following extraction and where possible will be undertaken as close as possible to the point of extraction to reduce the overall footprint required. All crushing and screening processes will take place when conditions are favourable to minimise dust and reduce water requirements. Processing has a range of environmental aspects which need to be addressed from water use, and dust suppression, machine noise and stockpiling requirements.

Quarry Products

Based on the drilling program and preliminary quarry study, the expected quarry products available at the West Valley Quarry will include:

- 70-30 mm, 40 mm, 20 mm, 10 mm, 7 mm Drainage Aggregates;
- Cracker Dust;
- "C" Grading Type 2.1 and "B" Grading Type 2.3 Road base;
- Overburden/Fill;
- Screened topsoil (Rescreened from imported spoil); and
- Screened Sand (Rescreened from imported spoil).

However it is noted that the actual products will be dependent on the rock available. Further testing is to be undertaken on the exact products to be available from this site; however the products listed above are currently available from the Quirks Quarry site and due to their close proximity should reflect that available at West Valley.

Quarry Haulage

The existing quarry haul road from Quirks Quarry to Eviron Road will be decommissioned and all quarry traffic will utilise the new haul road through the Stotts Creek RRC exiting the site via Leddays Creek Road.

Hours of Operation

The intended hours of operation are the same as those currently approved for Quirks Quarry, as outlined in Table 7.3, to ensure minimal additional disturbance to the local area.

Table 7-3 Proposed Quarry Services Operating Hours

Operation	Operating Days	Start Times	Finish Times
Quarrying	Monday to Friday	7 00	1700
	Saturday	7 00	1200
Blasting	Monday to Friday	9 00	1500
	Saturday	9 00	1200
Hauling	Monday to Friday	7 00	1700
	Saturday	7 00	1200

Environmental Management

Environmental management requirements and considerations will be addressed in detail in a Quarry Plan of Management. However, the preliminary quarry study identified a number of key management requirements and actions including the following:

- Reduction of noise and vibration during blasting through reduced Maximum Instantaneous Charge and amendments to the type and performance of explosive charges;
- Use 'Rock On Ground' contractors such that explosives are not permanently stored on site;
- Conduct activities during licensed operating hours only and favourable weather conditions to limit dust and noise nuisance;
- Spray water to limit dust generation during crushing and screening activities;
- Manage water supplies so that water is available for dust control as needed;
- Manage stockpile to minimise that dust generation and impacts to water quality;
- Control dust on roads by:
  - Grading of roads on a regular basis;
  - Structural maintenance work along the primary haul road, when required, including scarifying and re-compacting and/or resurfacing; and
  - Regular water spraying.
- Reduce fire risk on site by implementing the following:
  - Provide adequate fire protection works, including the availability of trained personnel, water tankers and fire fighting equipment and annual hazard reduction measures with particular attention to boundaries of adjoining landholdings;
  - Make water carts and trucks available to Emergency Services in cases of bushfire incidents on the quarry or adjoining sites; and

- Take all practical steps to prevent the occurrence of bushfires and to minimise the danger of the spread of bushfires from Council land.
- Prepare a detailed spill management plan which includes an evacuation map and the locations of spill kits and cleaning devices;
- Ensure management and staff are aware of, and trained in, spill procedures;
- Bund high-medium risk areas to reduce potential for environmental impacts in the event of a chemical or fuel spill; and
- Keep a chemicals and fuel register and Material Safety Data Sheets on site and easily accessible with a copy kept at the emergency muster point.

7.2.3 Proposed Ancillary Structures

Haul Road

A haul road will be constructed from Stotts Creek RRC to the new landfill at Quirks Quarry for the purposes of heavy vehicle access for both quarry and landfill vehicles. Council's concept design for the haul road is shown in Figure 16. The concept design for the haul road was revisited in April 2011 based upon a suggestion in the adequacy review by DECCW that the haul road be relocated to the north of Brush Box open forest vegetation which has been designated a moderate to high ecological significance. The haul road now extends from the existing Stotts Creek RRC across the north of the site and rather than joining the existing unsealed road south of vegetation type 7, traverses a cleared area to the north of this.

The haul road will have a maximum width of 10 m, and the batters will be of variable width up to approximately 13 m (depending on topography), meaning that the haul road footprint is up to 35 m width in some sections. The concept design for the road (within the site boundary) has a footprint of approximately 2.583 ha, of which 2.262 ha is located within currently cleared land.

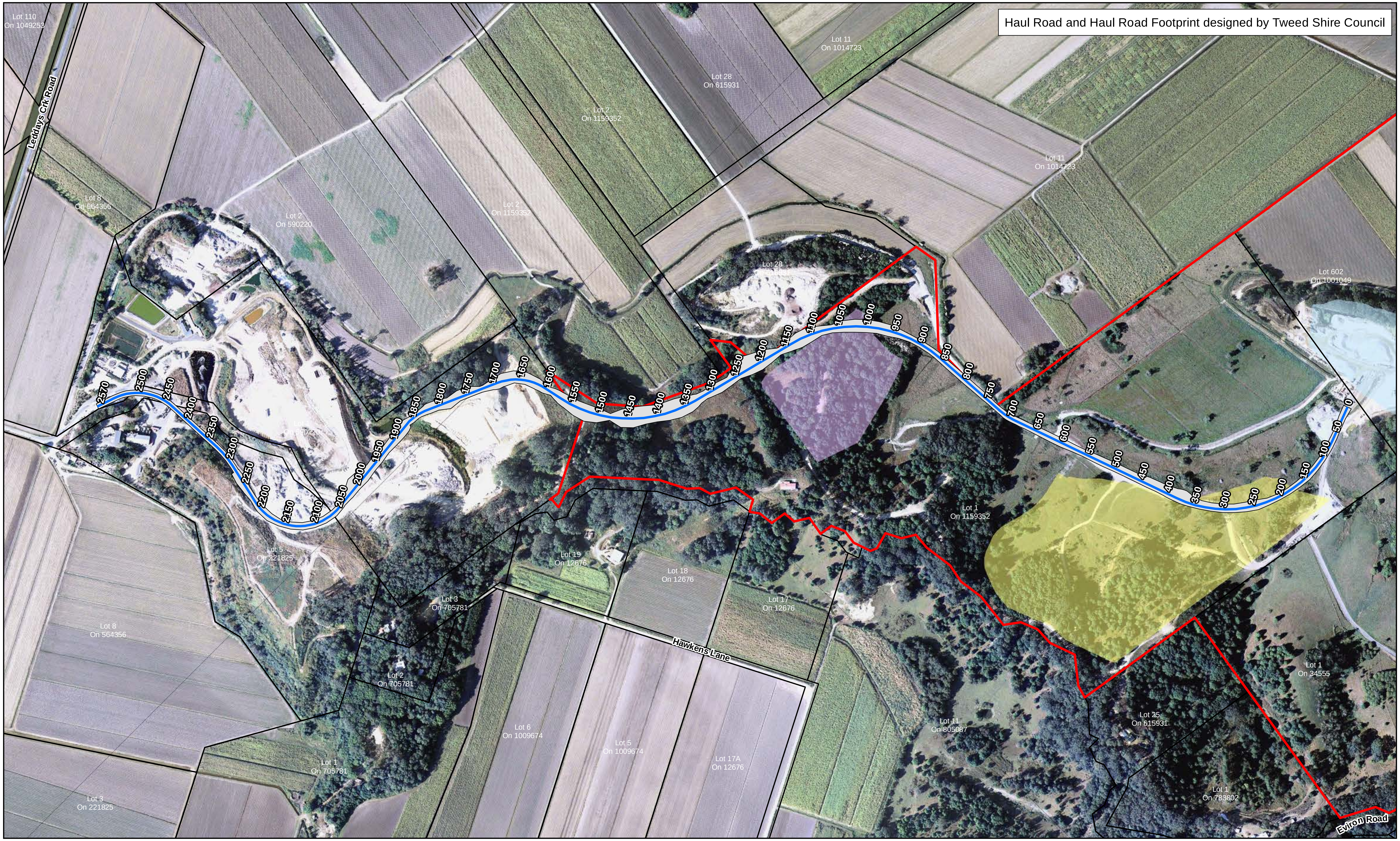
It is intended that this haul road will become the primary access to the site (rather than the existing haul road off Eviron Road). The new haul road will provide a direct link from the existing infrastructure at Stotts Creek RRC to the new landfill, and will also maintain existing landfill traffic routes.

Buildings

The existing demountable/temporary site office and amenities currently based at Quirks Quarry will be utilised for both the new landfill and Quarry site office. If necessary the contractor operating the landfill may also provide their own basic amenities.

Other Waste Infrastructure

Existing waste infrastructure currently located at Stotts Creek RRC will continue to be utilised and it is not intended to develop any further ancillary waste infrastructure within the site. In particular the existing green waste facility at Stotts Creek will be utilised and green waste will not be disposed of at the new landfill.



1:6,000 (at A3)

0 75 150 225 300

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- Cadastre boundary
- Quirks Quarry Footprint
- West Valley Footprint
- North Valley Footprint
- Haul Road Centreline
- Haul Road Footprint

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Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Concept Haulage Road Alignment

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Figure 16

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Data source: Tweed Shire Council - Haul Road Design (2011), Aerial Photography (2008), Cadastre boundary (2010). GHD - North Valley footprint (2011), Site Boundary (2011), Quirks Quarry (2010), West Valley footprint (2010).

7.3 Subsequent Stages of Concept Plan

The quarry and landfill developments associated with the future stages are expected to be of a similar scale and nature to those investigated in Stage 1. Preliminary estimates of the potential operational life of the Concept Plan activities beyond Stage 1 have been made with a view to establishing an environmental envelope for the whole of the Project.

As for Stage 1, development would occur progressively; with the projected timeframe extending to at least 2045 (refer to Table 7-1). This timeframe is dependent upon a number of key factors including but not limited to:

- Further definition of quarry resources in the West and North Valleys;
- Achieved quarry extraction rates;
- Design parameters for landfill staging and cells;
- Actual waste quantities accepted at the landfills, which will be influenced by Council's Strategic Community Plan which includes investigation of landfill diversion options through the implementation of alternative waste technology specifically focussed on the organic waste stream;
- Waste compaction rates achieved during landfilling.

On the basis of forecast waste acceptance rates, it is likely that landfilling within the West Valley will commence in 2022 and continue for at least 12 years depending on waste acceptance rates and onsite operational factors and broader strategic factors in relation to waste management in the Tweed Shire (such as the diversion of organics material from landfill disposal through the establishment of an AWT facility). This estimate has adopted the same basic landfill design assumptions used in the Quirks Quarry Landfill concept design in terms of internal and external batters slope, minimum floor level of cells and the maximum height of finished cells being sympathetic with the predevelopment topography (West Valley maximum RL of 65m AHD and North Valley maximum RL of 40 m AHD.

It has been estimated on the limited planning to date that the quarry resource in the North Valley is likely to be in the order of 700,000 tonnes of hard rock. Assuming a 200,000 tonne per annum extraction rate would result in an operational period of between 3-4 years, likely between 2022 and 2026. Based on forecast waste acceptance rates it is unlikely however that the quarry void would be utilised for landfilling until at least 2034, and could continue until approximately 2045.

As a minimum, future landfill and quarry developments at the site would employ the standards adopted for the landfill and quarry design for the Stage 1 project application and any other regulatory or industry accepted requirements and practices at the time of their planning, design and operation. It is likely that through the investigation and implementation of AWT identified in Council's Community Strategic Plan that the waste disposal facilities in all stages of the Concept Plan will operate for a longer period of time due to increased diversion of wastes. In addition the materials disposed of will potentially lower the greenhouse gas emissions associated with the project.

PART C – Environmental Assessment

8. Environmental Risk Assessment

The key environmental issues that have been identified within the DGRs as specific to this project are:

- Soil and water;
- Noise, blasting and vibration;
- Air Quality and odour;
- Greenhouse gas;
- Biodiversity;
- Transport;
- Heritage;
- Visual;
- Hazards; and
- Rehabilitation.

Table 8-1 provides a general environmental risk analysis relating to these issues relevant to the project. Section 9 of this environmental assessment is dedicated to detailed assessment of the risks associated with each issue.

8.1 Risk Assessment

Table 8-1 General Environmental Risk Analysis

Issue	Potential impacts	Relevance to Stage 1	Relevance to the Concept Plan	Comments	Reference to EA Section
Soil and water	Sedimentation and erosion resulting in decline in water quality within ephemeral watercourses downstream of the site	Could result from construction and operation of quarries .	As for Stage 1.	Soil and water have been identified in the DGRs as a key issue.	Surface Water Section 9.1 Groundwater Section 9.2
	Impacts upon surface water and groundwater quality from leachate generated by decomposing wastes within the landfill.	New landfill will be situated within the existing Quirks Quarry.	New landfills may be located in the quarry voids created in the West and North Valley.		
	Exposition of potential acid sulfate soils.			During detail design, a detailed acid sulfate soil investigation will be undertaken such that management measure	Acid Sulfate Soil Section 9.3

Issue	Potential impacts	Relevance to Stage 1	Relevance to the Concept Plan	Comments	Reference to EA Section
Noise, blasting and vibration	Noise nuisance impacts upon nearby sensitive receivers.	Some construction noise may impact upon one dwelling for the haul road (although this will be situated adjoining the existing landfill and has been acquired by Council). Heavy vehicle movements during operations of Quirks Quarry Landfill and West Valley Quarry may have noise and vibration impacts. Operational noise in Quirks Quarry will change to that of a landfill (and likely reduce). While noise from operations in the new quarry (West Valley) will be in closer proximity to two residential properties.	Similar to Stage 1, operational noise from the quarry activities will progressively change to that of a landfill (and likely reduce). Such impacts to adjacent landowners will persist throughout the length of the project.	Noise, blasting and vibration has been identified in the DGRs as a key issue. Existing noise levels have been investigated through undertaking baseline noise monitoring onsite and have been used to develop a model of potential noise impacts. The overall principles for blasting and vibration for the West Valley Quarry (and any future quarries) have been addressed in the West Valley Preliminary Quarry Study. Recommended management measures to minimise noise, blasting and vibration impacts span work ethics, choice of suitable machinery, and consideration of local weather conditions. Additional attended noise monitoring has been recommended upon commissioning of the activities associated with the Stage 1 Project Application.	Section 9.4 Appendix I – NBV report Appendix C – draft LEMP Quirks Quarry Landfill
	Property damage as a result of vibration impacts	Quarrying activities will include blasting which can be associated with vibration impacts. Vibration impacts from landfilling are likely to be limited, but waste compaction may impact.	As for Stage 1, at future quarrying sites blasting would be required at various stages.		

Issue	Potential impacts	Relevance to Stage 1	Relevance to the Concept Plan	Comments	Reference to EA Section
Air quality and odour	The landfill component has potential to result in localised reduction in air quality from dust from active areas of the landfill. The landfill component of the project is a potential source of odour if not managed effectively	The Quirks Quarry Landfill will potentially have odour impacts upon one dwelling located to the immediate south of the site, and is less likely to impact residents to the southwest of the site.	As for Stage 1	Air quality and odour have been identified in the DGRs as a key issue. Impact upon local air quality will depend on waste stream, equipment and local weather conditions. The design and intended operation of the quarry and landfill activities includes a number of measures to minimise odour and air quality impacts. Vigilant operational controls are required to minimise potential impacts from dust and odour including consideration of localised weather conditions, provision of sufficient onsite water for dust suppression, minimising landfill working areas to reduce potential odour impacts and planning ahead for the receival of particularly odorous wastes.	Section 9.5 Appendix J – Air Quality Technical Report Appendix C - Draft LEMP for Quirks Quarry Landfill Appendix D – West Valley Quarry Preliminary Study
	The quarry has potential to result in localised reduced air quality from dust and emissions.	Quarry operations may result in some localised dust impacts and emissions.	As per Stage 1.		

Issue	Potential impacts	Relevance to Stage 1	Relevance to the Concept Plan	Comments	Reference to EA Section
Greenhouse gas	Greenhouse gas will be produced during construction and operation of all quarry and landfills.	Operation of the landfill and quarry will generate greenhouse gas emissions from: ◗ Degradation of landfilled wastes ◗ Mobile plant and equipment ◗ Site electricity consumption ◗ Transport of residuals to the adjacent landfill	As per Stage 1.	Identified in the DGRs as a key issue. The detailed design of the project would be undertaken to best practice with energy efficiency in mind.	Section 9.6 Appendix C – Draft LEMP

Issue	Potential impacts	Relevance to Stage 1	Relevance to the Concept Plan	Comments	Reference to EA Section
Biodiversity	**Quarry Impacts** Vegetation clearing ◗ Habitat loss ◗ Habitat fragmentation ◗ Loss of biodiversity ◗ Fauna mortality or injury Movement of heavy vehicles ◗ Mortality or injury to fauna ◗ Habitat degradation Drilling, blasting, and processing ◗ Habitat degradation Stockpiling Adverse impacts to vegetation	Potential impacts related to Stage 1 are relevant to the development and operation of West Valley Quarry.	These potential impacts area also relevant to development and operation of a quarry at North Valley in future stages.	Identified in the DGRs as a key issue.	Section 9.7 Ecological Assessment, Appendix L.
	Landfill Impacts Landfilling Habitat Degradation	Potential impacts related to Stage 1 from development and operation of a landfill at Quirks Quarry.	Potential impacts related to future development and operation of a landfill in West Valley and North Valley.		

Issue	Potential impacts	Relevance to Stage 1	Relevance to the Concept Plan	Comments	Reference to EA Section
	Haul Road Vegetation clearing ◗ Habitat loss ◗ Habitat fragmentation ◗ Loss of biodiversity Fauna mortality or injury	Development and operation of haul road during Stage 1.	Operation of haul road during stage 2.		
Transport	Alterations to traffic movement as a result of situating an internal haul road.	Closure of site access to Eviron Road and additional traffic utilising Leddays Creek Road.	As per Stage 1	Identified in the DGRs as a key issue.	Section 9.8
Heritage	Disturbance to items of cultural heritage significance caused by the construction of the haul road and excavation of quarry voids.	Five springboard trees have been identified at the site between Quirks Quarry and the West Valley.	As per Stage 1	Identified in the DGRs as a key issue. The cultural heritage assessment did not identify any items of indigenous cultural heritage, however recommended that a management plan be established which will include provisions for onsite monitoring during clearing, procedures for unexpected finds, requirements for site inductions and training of personnel. Measures to preserve the springboard trees have been recommended.	Section 9.9 Appendix N

Issue	Potential impacts	Relevance to Stage 1	Relevance to the Concept Plan	Comments	Reference to EA Section
Visual	Reduction in amenity as a result of clearing and locating quarry and landfill operations.	The landfill to be situated within Quirks Quarry will be able to utilise existing screening to maintain amenity in the area. West Valley quarry will result in clearing of vegetated hillside visible from the Pacific Highway, Tweed Valley Way and a small number of residences located upon ridges in the local area.	Future landfill and clearing on the site will also result in some amenity reduction.	Identified in the DGRs as a key issue. This is a medium term impact as it is intended that the site be rehabilitated to become a Botanical Gardens.	Section 9.10

9. Key Issue Assessment Requirements

The section provides a discussion of the key environmental issues for the Concept Plan and Stage 1 Project Application. In general for each key issue the following format has been followed, however it is noted that this has necessarily been altered in some cases to suit either the issue or the project application.

Methodology

A summary of the methodology adopted for the assessment and identification of impacts associated with the key environmental issue.

Existing Environment

A description of the existing environment as relevant to the key issue. The information typically includes identification of sensitive receivers and background or baseline information.

Impact Assessment

This section describes and assesses potential impacts of all stages of the project with respect to relevant guidelines, policies, plans and statutory provisions. Wherever possible and relevant this has been split into:

- Stage 1 Project Application
  - Quirks Quarry Landfill; and
  - West Valley Quarry.
- Concept Plan
  - A higher level assessment of broad constraints and opportunities and identified of whether further investigations required).

Mitigation Measures

This section describes measures that would be implemented to avoid, minimise, mitigate, rehabilitate/remediate, monitor and/or offset the potential impacts of the project, including detailed contingency plans for managing any potentially significant risks to the environment.

Measures have also been split into Stage One and Concept Plan if possible, noting that Mitigation Measures for elements of the Concept Plan, will need revisiting, refinement at a later stage and probably will more be recommendations for additional investigation/modelling etc. This is also the case for some aspects of the Stage 1 Project Application.

9.1 Surface Water

This section assesses the potential impacts on surface water quality and flows associated with the Concept Plan and Stage 1 Project application. The information presented in this chapter is based on the findings of Stormwater Assessment and Sediment Management Report, the Quirks Quarry Landfill Concept Design Report and the West Valley Quarry Preliminary Study along with the findings of the baseline surface water quality monitoring. The Stormwater Assessment and Sediment Management Report is included in Appendix H, the Landfill Concept Design Report is included in Appendix B and the Preliminary Quarry Study is included in Appendix D.

9.1.1 Methodology

Hydrology and Drainage

The assessment of hydrological and drainage issues for the Concept Plan and Stage 1 Project Application included the following:

- Catchment Delineation and Site Hydrology Review:
  - Delineation of external and internal catchments;
  - A review of flood levels;
  - Assessment of site hydrology utilising XP Storm for the pre and post development case (XP-Storm is a runoff routing link-node model that performs hydrology and hydraulics of stormwater drainage systems, it generates flow hydrographs, flood levels, pollutant loads or concentrations and analyses water quality control devices and is capable of modelling and comparing multiple storm events); and
  - Provide preliminary sizing requirements for culverts beneath the haul road.
- Development of a Conceptual Erosion and Sediment Control Plan including:
  - Topography, staging for works, erosion risk mapping and drainage, proposed treatment train and concept design of sediment basins.
- Development of a Conceptual Stormwater Management Plan
  - Conduct MUSIC modelling for the pre and post development scenarios;
  - Assess the water sensitive urban design requirements for the proposed activities with a view to minimising environmental impacts from stormwater discharges;
  - Provide a site layout with approximate locations of water sensitive urban design features; and
  - Overview of maintenance requirements for the water quality control features and devices.

Elements of hydrology and drainage for the Stage 1 Project Application have been addressed in the Quirks Quarry Landfill Concept Design Report, Draft Landfill Environmental Management Plan and to a lesser extent in the West Valley Quarry Preliminary Study and these documents should be referred to.

Surface Water Quality

A review of potential impacts on surface water in the vicinity of site was undertaken via a surface water baseline study for the ephemeral drainage network surrounding the site including:

- A review of existing and proposed monitoring locations with TSC personnel onsite;
- A review of parameters monitored in relation to the proposed activities to ensure an adequate baseline is established;
- Development of a monitoring program; and
- Review of water quality data to provide a picture of the surface water quality on and off site.

9.1.2 Existing Environment

Site Hydrology

As discussed in Section 3.3.2 a number of small ephemeral drainage channels flow from the site in a north/north east direction into a larger un-named channel along the northern site boundary which flows from southeast to northwest through the site. It is understood that this channel has been previously excavated to improve drainage at the site. This larger channel continues to the north close to the edge of the Tweed River floodplain and discharges to Leddays Creek, eventually discharging into the Tweed River approximately 4 km to the north of the site. Locally, several cane channels are used for water drainage associated with the low lying flood plain area. There is no stream flow data available for these drainage channels or Leddays Creek.

Flood Levels

Flood mapping of the area indicates a 1 in 100 year flood level of 3.9 m AHD. Based upon Flood Map 2 for Mid Tweed, part of the Quirks Quarry Landfill footprint and part of the West and North Valley are in an area predicted to be inundated in an ARI 100 year flood (as shown on Figure 5).

Catchment Delineation

Quirks Quarry

The existing Quirks Quarry is located on a natural ridgeline which combined with a diversion drain upgradient of the quarry operations limits the catchment to quarry footprint itself. The existing diversion drain directs upstream runoff to a small detention basin to the west of the quarry. Runoff generated on the quarry itself is directed by a series of drains a dam and a sediment basin. A site water balance for the proposed landfill in this location was undertaken as part of the concept design of stormwater infrastructure and this indicated that total size of the Quirks Quarry catchment area is 5.7 hectares.

West and North Valley

There are four key catchments within the West and North Valley which were divided according to each nominated Legal Point of Discharge within Lot 1 DP1159352. The North Valley site consists of 3 drainage flow paths that convey surface water to a drainage channel just outside the north-eastern boundary of the Lot. The West Valley includes two drainage flow paths that convey surface water to the same drainage channel as the North Valley where flow continues to

Stott's Channel and eventually the Tweed River. The catchment delineation is shown on Figure 17.

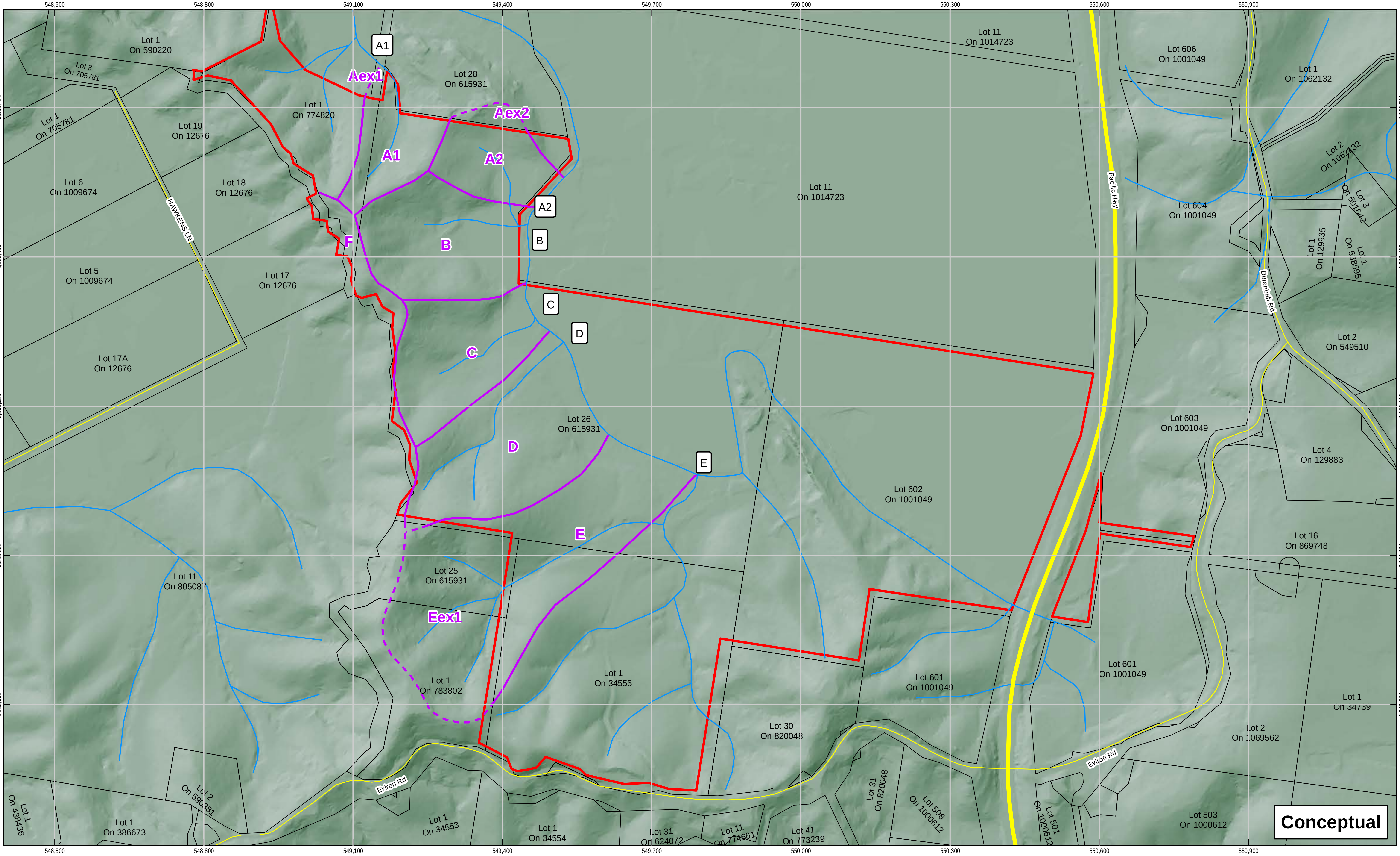
External catchments to the west and south of the North and West Valley also exist. Contributions from internal and external catchments have been taken into account in calculating stormwater volumes for the pre, post and ultimate development conditions which are described as follows.

- Pre development: refers to existing conditions (no quarry, no landfill);
- Post development: refers to conditions, post quarrying but prior to landfill; and
- Ultimate: refers to conditions after the completion of landfilling.

The Post development catchment delineation varies due to the reshaping of the site according to the landfill. Furthermore it is noted that the post development catchment for the West Valley will be further refined during detail design and that the North Valley post development and ultimate scenarios have been assessed based on a possible footprint for the quarry and landfill which is yet to be subjected to any level of formal engineering design and is therefore indicative only. The external catchment properties are the same for the Pre and Post development conditions and are diverted around the site to the existing drainage channel that traverses the site. These scenarios are summarised in Table 9-1 below and shown on Figures 17 and 18.

Table 9-1 West Valley and North Valley Key Catchment Description

	Catchment Description	Catchment Area
Stage 1 – West Valley		
Catchment D	The site sub-catchment contributes to the drainage flow path that traverses the West Valley to the northeast until converging with the drainage channel that travels toward Stott's Channel.	8.58 hectares
Catchment C	The site sub-catchment contributes to the drainage flow path that traverses the West Valley to the northeast until converging with the drainage channel that flows toward Stott's Channel.	6.06 hectares This Legal Point of Discharge is also located in the West Valley site in the middle portion of Lot 26.
Future Stages – North Valley		
Catchment A 1	A small external catchment contributes to the drainage flow path that traverses North Valley in a north west direction until converging with another tributary that travels north toward Tweed River.	2.31 hectares (internal) 0.61 hectares (external)
Catchment A2	A small external catchment contributes to the drainage flow path that traverses North Valley in a south east direction until converging with the drainage channel that flows toward Stott's Channel.	3.13 hectares (internal) 0.9 hectares (external)
Catchment B	The site sub-catchment contributes to the drainage flow path that traverses North Valley to the east until converging with the drainage channel that drains toward Stott's Channel	6.09 hectares



0 100 200 300

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Site Boundary
- Existing Drainage Lines
- External Catchment Boundaries
- Quarry Catchment Boundaries
- B Legal Point of Discharge

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Tweed Shire Council
Eviron Quarry & Landfill Site

Job Number	41-20806
Revision	2
Date	31 OCT 2011

Stormwater Catchment
Delineation (Pre Development)

Figure 17

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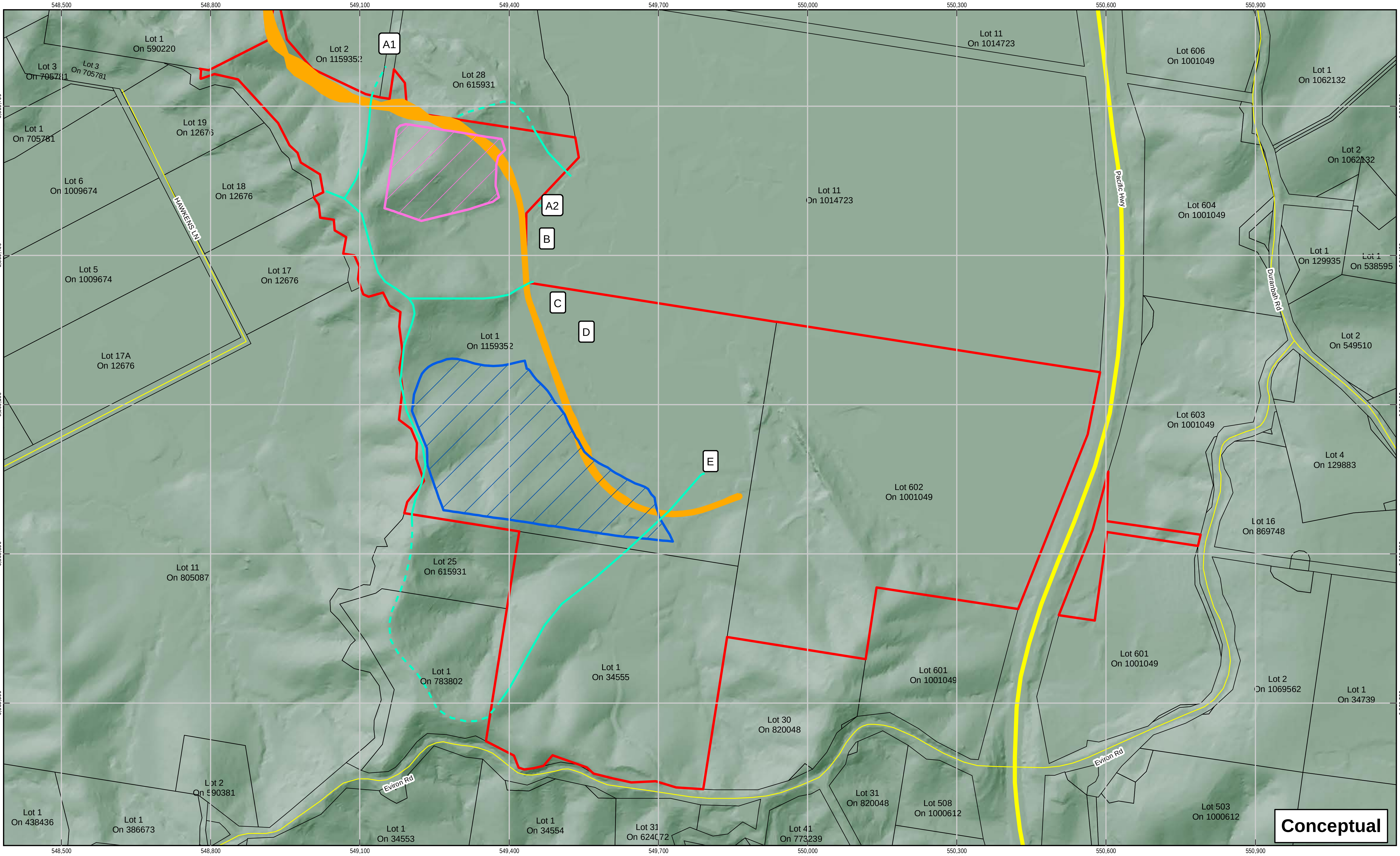
54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Cadastre boundary (2010). GHD (2010) - Site Boundary (2011), Roads, Existing Drainage Lines, Catchment Boundaries, Legal Point of Discharge, Hillshade (Derived from Tweed Shire Council ALS data).



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Site Boundary
- North Valley
- West Valley
- Existing Drainage Lines
- External Catchment Boundaries
- Quarry Catchment Boundaries
- Haul Road
- B Legal Point of Discharge

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Eviron Quarry & Landfill Site

Job Number 41-20806
Revision 2
Date 31 OCT 2011

Post Development
Catchment Delineation Plan

Figure 18

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Data source: Tweed Shire Council - Haul Road, Haul Road Footprint (2011), Cadastre boundary (2010). GHD (2010) - Site Boundary (2011), Roads, Existing Drainage Lines, Catchment Boundaries, Legal Point of Discharge, Hillshade (Derived from Tweed Shire Council ALS data), West Valley, North Valley (2011).

Existing Stormwater Infrastructure – Quirks Quarry

The current stormwater drainage system, consisting of a dam, sediment basins and perimeter stormwater drains, will be retained where possible throughout the development stages of the proposed landfill. These systems have not been sized as part of the concept design and may require further design analysis during the construction phases of the landfill.

The current perimeter drain and stormwater culverts located along the boundary of the eastern and southern edge of the site will be retained to collect stormwater runoff from the current vegetated ground cover areas not associated with the proposed landfill area.

The sediment basin and culverts located at the western edge of the existing access track will be retained to collect stormwater runoff from current vegetated ground cover areas not associated with the proposed landfill area. Refer to Figure 13 (Section 10) for locations of the current stormwater infrastructure within Quirks Quarry that will be retained for the proposed landfill.

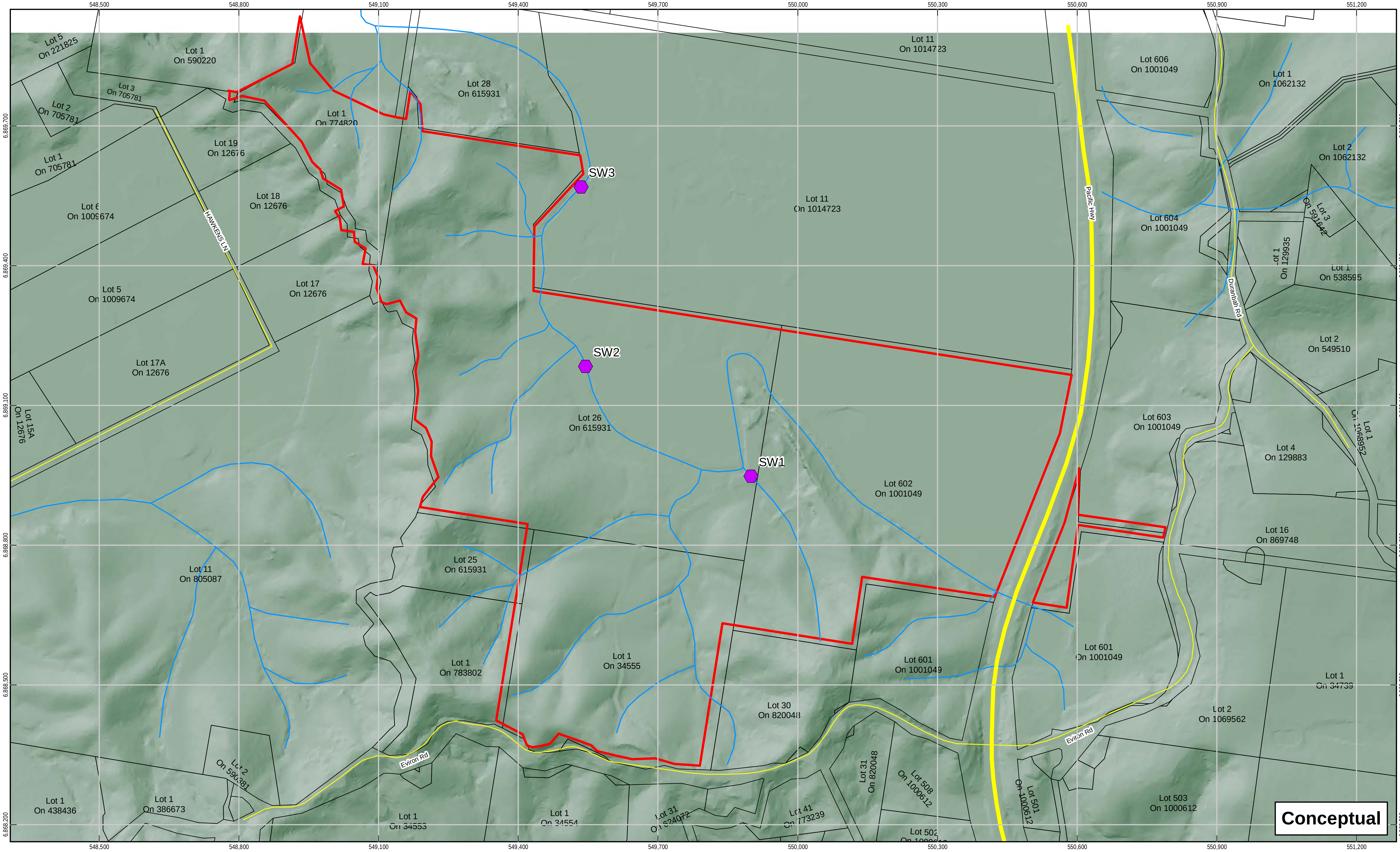
Surface Water Quality

According to the Tweed Shire State of the Environment Report (2009) water quality in all of the Shires waterways is impacted by runoff from adjacent landuses, and in some sections of the Tweed River, the discharge of treated sewage effluent.

Further, the Tweed Shire Urban Stormwater Management Policy indicates that water quality varies within the Tweed River estuarine system. The lower estuary is well flushed and has good water quality. Times of poor water quality have been directly related to rainfall events. The main arm of the river is periodically subjected to severe impacts due to the presence of actual Acid Sulfate Soils within the catchment. Water quality in the upper estuary declines from Chinderah to Murwillumbah due to the reduction in tidal flushing and is heavily impacted by upstream sources and discharges from various drains.

Council implemented a baseline surface water monitoring program in the main channel on the northern boundary of the site and adjacent to Quirks Quarry in 2008 as described below and as shown on Figure 19 below:

- SW1 – in dam/pond at western extent of Quirks Quarry collecting clean runoff;
- SW2 – unnamed channel on eastern portion of Lot 1 DP1159352 downstream of future West Valley operations and Quirks Quarry, upstream of North Valley; and
- SW3 – further north west of SW2 in unnamed channel on far north eastern boundary of Lot 1DP1159352 upstream (south east) of O'Keeffe's Quarry and Stotts Creek RRC, downstream of North and West Valley and Quirks Quarry.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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LEGEND

- Site Boundary
- Existing Drainage Lines
- Surface Water Monitoring Locations

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Tweed Shire Council
Eviron Quarry & Landfill Site

Job Number	41-20806
Revision	2
Date	31 OCT 2011

Surface Water
Monitoring Locations

Figure 9

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Data source: Tweed Shire Council - Cadastre boundary (2010). GHD (2010) - Site Boundary (2011), Roads, Existing Drainage Lines, Surface Water Monitoring Locations, Hillshade (Derived from Tweed Shire Council ALS data).

These monitoring locations were considered sufficient for the purposes of gathering baseline data. However the frequency of monitoring was increased to monthly for a period of 8 months in 2009 to increase the data available for this assessment and where possible samples were also collected during rainfall events when the drains were flowing. Monitoring was conducted at three locations (SW1, SW2 and SW3) downstream of the future landfill and quarry operations:

Collected samples have been analysed for a range or physicochemical, organic and inorganic parameters considered appropriate to develop baseline data set for landfill and quarry operations. The chosen parameters were generally in accordance with the requirements of the *Environmental Guidelines: Solid Waste Landfills* (EPA 1996).

The results to date have been reviewed and collated to document key statistics and to make an assessment of the water quality in comparison to the following trigger values from the ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*:

- Table 8.2.2.1 Trigger Values for NSW Lowland Rivers (lower bound of ranges where appropriate):
  - Total Nitrogen, Total Phosphorus, pH, conductivity, dissolved oxygen, suspended solids.
- Table 3.4.1 Trigger Values for Freshwater – 95% Level of Protection:
  - Metals and metalloids, phenols.
- Table 8.3.7 Freshwater Trigger Values as Total Ammonia-N at different pH
  - Ammonia as N at pH 6.3 (refer to mean pH as per Table 9-2).

It is intended that as more baseline data becomes available site specific trigger values will be established, however the ANZECC/ARMCANZ guidelines have been adopted as a point of reference at this point in time. The baseline data will feed into the development of the operational trigger values for the quarrying and landfill activities which will be documented in the Quarry Plan of Management and Landfill Environmental Management Plan during the licencing of the activities.

Table 9-2 to Table 9-4 below summarise the 20th and 80th percentile concentrations for key water quality parameters along with the mean concentration recorded in the monitoring events to date. The statistics are based on between 27 and 42 data points for each parameter between January 2008 and January 2010, representing a total 14 monitoring events (including five rain events) at the three sampling locations.

The monitoring undertaken to date has indicated that water quality at the three locations is similar with no consistent differences recorded between the monitoring locations. The data indicates that water is generally fresh, slightly acidic and with marginally depressed oxygen levels, however the biochemical oxygen demand (BOD) is also considered to be relatively low with a mean concentration of 3.2 mg/L. The lower dissolved oxygen levels are likely to be an indicator of slow or low flow conditions outside of rain events, however it is also noted that the concentrations during rain events were not significantly higher. Suspended solids levels also appeared to have varied according to rainfall conditions as would be expected and the range of results recorded exceed the ANZECC/ARMCANZ trigger value.

Whilst total nitrogen and phosphorus compounds have typically exceeded the trigger values, it is considered that the concentrations recorded are relatively low for a rural catchment. Furthermore it is noted that organic nitrogen has typically been the dominant form of nitrogen present (on the basis of TKN and ammonia results).

Current copper, cadmium, lead and zinc concentrations exceed the ANZECC/ARMCANZ values, whilst manganese, arsenic and nickel results are below.

Data will continue to be collected during both rain events and on a regularly quarterly basis where flow conditions and sample quantities permit collection, in order to establish site specific water quality trigger values for the landfill and quarry operations prior to site establishment.

Table 9-2 Physicochemical Parameters and Major Cations/Anions

	pH (pH units)	Conductivity (µScm-1)	Dissolved Oxygen mg/L	Suspended Solids mg/L	BOD mg/L	Alkalinity as CaCO3	Chloride mg/L	Sulphur mg/L	Calcium (Total) mg/L	Potassium (Total) mg/L	Magnesium (Total) mg/L	Sodium (Total) mg/L
Mean	6.2	218.2	5.3	32.8	3.2	25.8	36.7	14.2	7.2	4.2	4.0	21.5
80% ile	6.4	251.2	6.9	60.8	3.5	32.6	42.0	18.0	10.6	5.0	5.0	25.0
20% ile	5.8	153.4	3.7	9.8	1.0	14.0	23.4	4.1	2.0	2.0	1.5	12.2
Trigger Value	**6.5-9**	**200**		**6**	**20**							

Table 9-3 Nutrients and Organic Parameters

	Total Phosphorus - P mg/L	Ortho Phosphorus - P mg/L	Total-N mg/L	TKN mg/L	Ammonia as N mg/L	Nitrate as N mg/L	Nitrite mg/L	TOC mg/L	Phenols mg/L
Mean	0.1	0.1	0.7	0.7	0.1	0.1	0.1	5.6	0.8
80% ile	0.1	0.1	0.9	0.8	0.1	0.1	0.1	9.2	0.8
20% ile	0.1	0.1	0.4	0.4	0.1	0.1	0.1	2.2	0.8
Trigger Value	**0.025**		**0.35**		**2.54**	**0.5**	**0.5**		**0.32**

Table 9-4 Metallic Elements

	Copper (Total) mg/L	Manganese (Total) mg/L	Arsenic (Total) µg/L	Cadmium (Total) mg/L	Chromium (Total) mg/L	Nickel (Total) mg/L	Lead (Total) mg/L	Zinc (Total) mg/L
Mean	0.013	0.436	4.815	0.0090	0.010	0.010	0.0100	0.012
80% ile	0.020	0.682	5.000	0.0100	0.010	0.010	0.0100	0.010
20% ile	0.010	0.110	5.000	0.0100	0.010	0.010	0.0100	0.010
Trigger Value	**0.0014**	**1.9**	**13**	**0.0002**		**0.011**	**0.0034**	**0.008**

9.1.3 Impact Assessment

Quirks Quarry Landfill

Water Balance

As part of the concept design for the landfill, a water balance model was developed comprising two key components:

- Model for leachate quantity; and
- Model to design stormwater infrastructure.

The model provided an estimate of the quantity of leachate generated during operation and post closure of the landfill. The modelled leachate generation rates were developed using the USEPA's Hydrological Evaluation of Landfill Performance (HELP). It should be noted that the HELP model is generally conservative in nature (over estimates leachate generation) but all modelling will be verified based on actual data collected during operation.

The results of the water balance modelling are summarised in Table 9-5. Copies of the model outputs are provided in the Landfill Concept Design Report (Appendix B).

Table 9-5 Summary of Leachate Generation Modelling Results

Scenario	Estimated Leachate Generation for 10% AEP Rainfall year			Estimated Leachate Generation for 50% AEP Rainfall year		
	Average Monthly (kL/month)	Peak Month (kL/month)	Total for Year (kL)	Average Monthly (kL/month)	Peak Month (kL/month)	Total for Year (kL)
Stage 1A	460	1,200	5,500	280	1,200	3,300
Stage 1B	1,010	2,700	12,100	630	2,500	7,500
Stage 2	1,600	4,200	18,800	990	3,900	11,870
Stage 3	2,200	5,800	26,000	1,400	5,300	16,500
Final Landform	220	290	2,600	200	300	2,400

The results in Table 9-5 demonstrate that leachate generation will vary significantly over the life of the landfilling operation and during different climatic conditions.

Taking the conservative approach of the HELP model, the maximum peak monthly leachate generation will occur during Stage 3 of the landfilling operation with approximately 5,300 kL of leachate generated during a 50% AEP rainfall year and approximately 5,800 kL during the a 10% AEP rainfall year. By contrast, the highest average leachate generation during a median (50% AEP) rainfall year will be approximately 1,400 kL/month (or ~40 kL/day), which will also occur in Stage 3. During a 10% AEP rainfall year, the average monthly leachate generation in Stage 3 will rise to approximately 2,200 kL.

Leachate Management

Based on the modelling performed and previous experience the following will be implemented:

- Storage of leachate within the cells; and
- Leachate disposal that is a combination of:
  - Stage 1A and 1B: Irrigation onto active landfilling area, to control leachate levels in the interim period until a leachate treatment plant and irrigation area is established; and
  - Stage 2 and 3: Treatment of leachate followed by irrigation to a dedicated and contained irrigation area.

Further, due to the high rainfall and low comparative evaporation at the site the construction of an external leachate pond would lead to excessive amounts of leachate generation due to rainfall on the cell. It is therefore proposed that leachate be stored within the landfill cell, however the following additional measures will also be implemented to ensure leachate does not leach from the basal lining system:

- A HDPE liner above the proposed compacted clay liner;
- Monitoring of landfill leachate levels; and
- Monitoring of leachate quantity and quality.

Monitoring of leachate levels, quantity and quality will be critical to effective landfill operations, however moreso in Stages 1A and 1B prior to the establishment of a leachate treatment plant. As discussed in Section 7.2, data collected during Stage 1A and 1B will be used to design and size an appropriate treatment facility. However the information will also be used to ensure that the leachate storage capacity of the waste cell is not exceeded, and if necessary leachate will be pumped out.

Further information on the rationale and concept design of the leachate management system is provided in the Landfill Concept Design Report in Appendix B and will be further refined during the detail design phase.

Sediment Basin

A sediment basin will be required to intercept and retain sediment laden stormwater runoff from disturbed areas of the site following a rainfall event. The sediment basin has been sized in accordance with 'Managing Urban Stormwater: Soils and Construction' Volume 1, NSW Landcom, March 2004.

The following assumptions have been made to size the pond:

- As Quirks Quarry Landfill will consist of an open rock pit, with large levels of rock dust and rubble, it has been assumed that the total area for Stages 1-3 will be disturbed at commencement of landfilling in Stage 1. A total disturbed catchment area of 5.7 ha has therefore been used for sizing the sediment basin;
- Filled cells will be progressively capped as the final landform is achieved. Therefore clean stormwater from these areas will be diverted away from the sediment basin;
- A type D / F sediment basin has been classified in this design;
- The settling zone has been designed to contain all runoff expected from the 90^{th} percentile, 5 day rainfall depth;
- The storage zone has been designed as 50% of the capacity of the settling zone; and
- As a result of the nature of the rock material a soil hydrology of Group D, and thereby a runoff coefficient (Cv) of 0.9 has been assumed.

Based upon the assumptions listed above, the sediment basin has been sized to contain a maximum volume of 9,000 m^3 before overflow via a spillway. The final sizing of the sediment basin has assumed the following:

- Freeboard – 0.5 m from top of storage zone to spillway outlet;
- Embankment Height – 0.3 m from spillway outlet to top of embankment;
- Internal slope at 1 vertical to 3 horizontal; and
- Length to width of pond: 2 to 1 approximately.

The total surface area of the sediment basin (assuming top of embankment area) using the above assumptions will be as follows:

- Length: 85 m;
- Width: 55 m;

- Depth: 2.8 m; and
- Vol Capacity to spillway outlet only: 9,000 m^3.

Initial concept design of this sediment basin indicates that it can be located outside of the landfill area and can control stormwater runoff for the catchment area of 5.7 ha.

Stormwater Drains

Stormwater drains will be required to intercept sediment laden stormwater runoff from disturbed areas of the Quirks Quarry Landfill and convey it into the sediment basin prior to release from the site (as required).

A perimeter landfill drain or diversion drain will be required around the perimeter of the landfill area as each Stage of the landfill is developed. This drain will be required to:

- Reduce the volume of stormwater runoff from disturbed areas (inside and outside of the landfill footprint) entering the current landfill waste filling area (and thereby increasing the leachate generation volume);
- Intercept stormwater runoff from the current landfill waste filling area, where waste batters have been intermediately covered or where the final cap has been installed but inadequate ground cover has not yet established; and
- Intercept stormwater runoff from perimeter access tracks.

Temporary stormwater drains will be required along the boundary of each of the temporary intercell bunds. These drains will be removed as development of each cell / stage occurs. This drain will be required to:

- Intercept stormwater runoff from the perimeter drain installed during each Stage development to ensure this runoff is discharged into the sediment basin;
- Intercept stormwater runoff from disturbed undeveloped areas within the landfill footprint, (staged areas where waste has not been landfilled);
- Intercept runoff from stockpiled material used for daily cover, intermediate cover and final cap which have not been vegetated; and
- Intercept stormwater runoff from the current landfill waste filling area, where waste batters have been intermediately covered or where the final cap has been installed but inadequate ground cover has not yet established.

A temporary stormwater drain will be required within Stage 1, excavated into the south and west batters, at a level of RL 15 m to reduce leachate generation. This drain will intercept stormwater runoff from the batter areas over the RL 15 m. This stormwater runoff will be diverted to the perimeter landfill drain or to the temporary drains located along the intercell bund. Further, a subcell bund will be constructed between Stage 1A and Stage 1B to reduce leachate generation in Stage 1A. This bund will ensure that stormwater collected in Stage 1B (prior to filling) remains uncontaminated. Stormwater will collect at the lowest point of Stage 1B and then be pumped into the nearest temporary stormwater drain.

As each landfill cell / stage has the final cap installed and adequate ground cover has established, the stormwater runoff from these areas can be diverted away from the landfill perimeter drain and discharge over the revegetated surface.

The stormwater drains has been sized in accordance with ‘Managing Urban Stormwater: Soils and Construction’ Volume 1, NSW Landcom, March 2004.

The following assumptions have been made to size the drains:

- As Quirks Quarry will consist of an open rock pit, with large levels of rock dust and rubble, it has been assumed that the total area for Stages 1-3 will be disturbed at commencement of landfilling in Stage 1. The total disturbed catchment area required for each perimeter landfill drain located along the eastern and western edges of the landfill is 2.8 Ha;
- The landfill drains have been sized to contain a 1 in 20 year storm event without overflowing; and
- As a result of the nature of the rock material a soil hydrology of Group D, and thereby a runoff coefficient (Cv) of 0.9 has been assumed.

Based upon the assumptions listed above the landfill stormwater drains have been sized accordingly:

- Bed Width: 1.5 m;
- Depth: 0.5 m;
- Bank Slopes: 1:2 m; and
- Flow Capacity: 1.4 m^3/s.

Hydrology and Drainage – West and North Valley

Hydrologic assessment of the West Valley and North Valley was undertaken to identify peak flow rates for the catchments under Pre, Post and Ultimate development conditions as described in Section 9.1.2. Due to the Concept Plan comprising stage development in each of the valleys (ie quarrying and landfill) the devices proposed for mitigation will have different roles; however the sizes will remain the same. Prior to quarrying commencing sediment basins will be built to control sediment dispersion and increase in surface flows running off the cleared catchment. Upon completion of landfilling, the sediment basins will be converted into wetlands. Due to the site almost replicating pre development conditions in the Ultimate scenario, requirements for detention will be minimal, however, the size of the wetland systems have been determined by the Water Quality Objectives and environmental values of the site (such as prevention of oxidation of Potential Acid Sulfate Soils).

XP-Storm modelling was used to determine peak flows for the 1 year ARI up to and including the 100 year ARI of all catchments contributing to each point of discharge. The model results were compared to the rational method results as a cross check to determine whether the parameters adopted within the Runoff Routing model are reasonable. While the rational method is only an estimation of the peak flow rate exiting a catchment, the runoff routing results should be in the same range as the magnitude of the XP-Storm hydrographs for each catchment. This comparison indicated that the flow rates predicted by XP-Storm were greater than those derived using the rational method. It was therefore concluded that the XP-Storm model produces more conservative results to an acceptable level of accuracy for the purposes of this assessment. It is noted that in all cases the ultimate development condition resulted in lower peak flows in comparison to the pre development scenario. The peak flows for each of the catchments and points of discharge as determined by XP- Storm as well as the percentage decrease in peak flow for each catchment is summarised in Table 9-6 below.

Table 9-6 Total Peak Flows (m^3/s) at Points of Discharge for Pre and Ultimate Development Conditions

Discharge Point	1 year ARI			2 year ARI			10 year ARI			20 year ARI			50 year ARI			100 year ARI		
	Pre	Ult	Diff %	Pre	Ult	Diff %	Pre	Ult	Diff %	Pre	Ult	Diff %	Pre	Ult	Diff	Pre	Ult	Diff %
A1	0.59	0.21	-63	0.83	0.29	-64	1.30	0.45	-65	1.55	0.54	-65	1.68	0.58	-65	1.90	0.65	-65
A2	0.76	0.61	-19	1.09	0.88	-19	1.72	1.38	-19	2.06	1.66	-19	2.24	1.80	-19	2.54	2.04	-19
B	0.68	0.42	-38	0.97	0.71	-27	1.60	1.23	-23	1.93	1.64	-14	2.26	2.06	-8	2.62	2.53	-3
C&D	1.64	0.52	-68	2.34	0.76	-67	3.86	1.96	-49	4.67	2.64	-43	5.48	3.36	-38	6.35	4.15	-34

Required stormwater detention areas were modelled to address runoff from the quarrying and landfill processes within the North and West Valley, noting that the North Valley detention areas are based on a preliminary indicative footprint of quarrying operations only. Stormwater quantity and quality objectives were taken into account with the modelling. The modelling has indicated that one sediment basin for the West Valley and one for the North Valley will sufficient address the stormwater quantity and quality objectives and that discharge points B (North Valley), C and D (West Valley) will be utilised to mitigate stormwater runoff from the four catchments. The resultant sediment basins have been sized to achieve a 100 year ARI regional flood immunity and would be fenced to prevent access due to the likely depth of standing water. Further details of these stormwater detention areas are provided in Section 9.1.4.

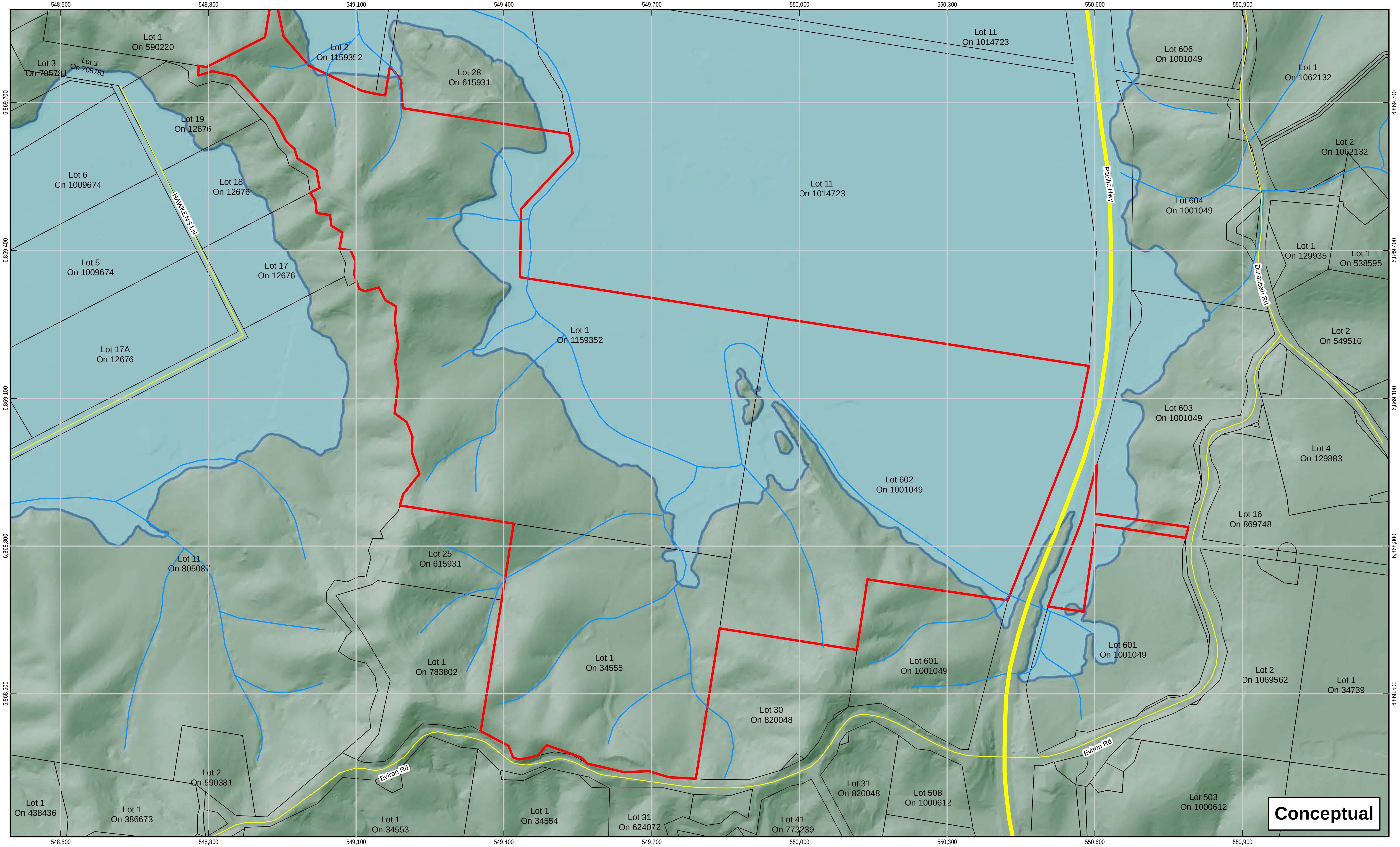
Review of Flood Levels (Hydraulic Assessment)

A hydraulic assessment has been undertaken to identify the effects of peak flood levels and the extent of flooding inundation at the West and North Valley under Pre, Post and Ultimate development conditions. Flood levels for Quirks Quarry landfill have been incorporated into the concept design and are discussed further in the next section. The hydraulic assessment was undertaken for the 100 year local ARI flood events during the Tweed Shire recorded regional peak flood level of 3.9m AHD.

While the haul road has been designed to act as a levee bank preventing back water from the Tweed River from entering the quarry sites, the outlets of the sediment basins / wetlands will be affected by the tail water level of the regional flood. These basins will be checked through modelling to determine whether the system is adequately sized to prevent flooding of the quarry sites from the contributing local catchments and can still drain accordingly.

A full investigation of the regional flood inundation affects are not part of the scope of this report and will be assessed during detail design, however regional flood levels have been shown in Figures 20 and 21 and backwater conditions at the discharge points have been assessed through hydraulic modelling for drainage adequacy. Weir levels of the detention areas have been set 300mm above the regional flood level and therefore can drain adequately and are unaffected by the regional flood event tail water effects.

A flood area balance is required due to the haul road encroaching and reducing the flood storage area of Lot 26. It is proposed to provide cut volumes to the east of the proposed haul road to balance the difference; however, flood modelling has not been performed to verify the effects of the haul road. This modelling will be undertaken during the detailed design of the haul road.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- Existing Local Flood Lines
- Existing Regional Flood Area (100 Year ARI)

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Pre Development Flood Inundation Area

Figure 20

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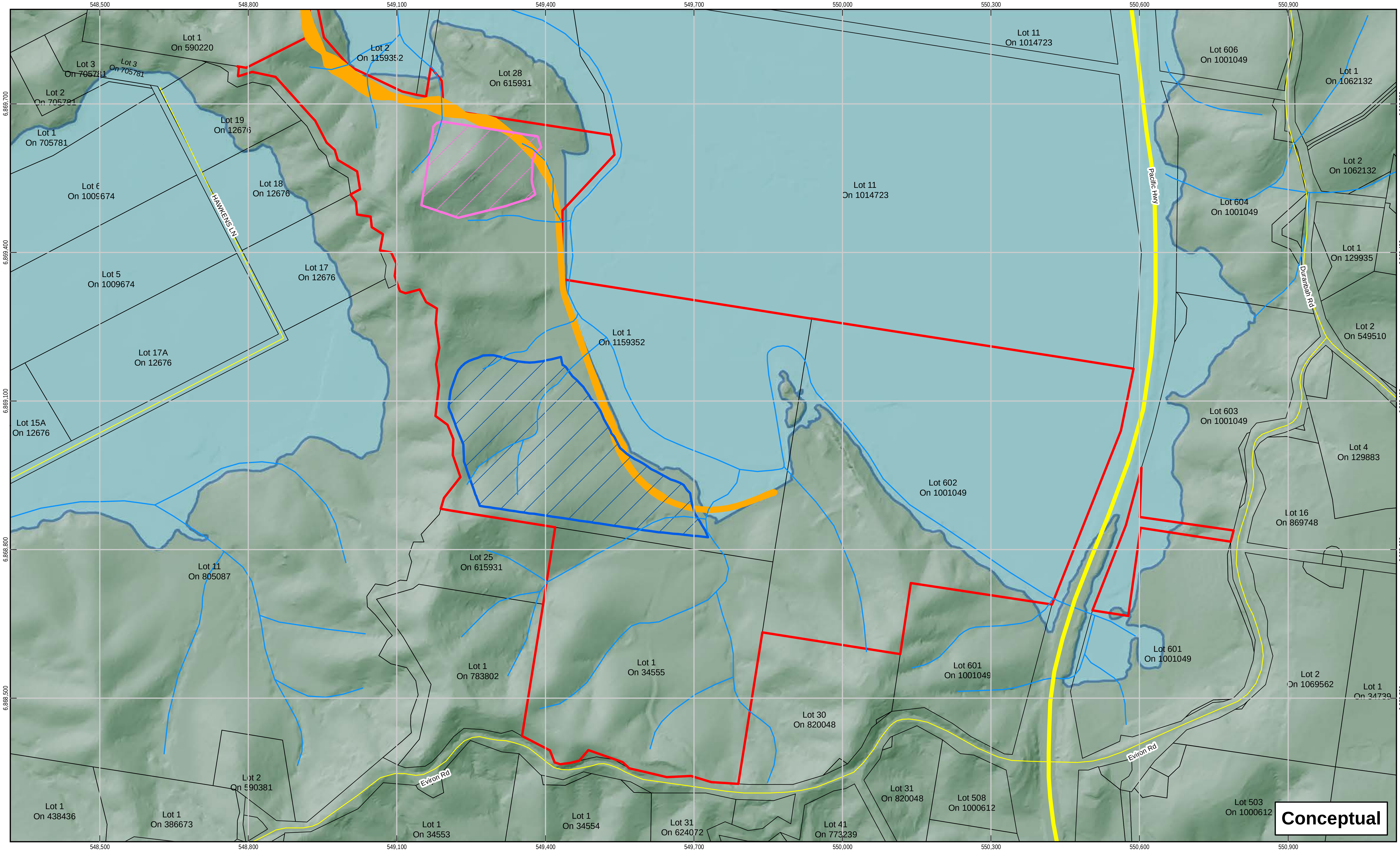
Data source: Tweed Shire Council - Cadastre boundary (2010). GHD - Site Boundary (2011), Roads, Existing Drainage Lines, Hillshade (Derived from Tweed Shire Council ALS data), Flood Area (2011).



0	100	200	300

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- Haul Road
- North Valley
- Developed Local Flood Line
- West Valley
- Developed Regional Flood Area (100 Year ARI)

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Post Development Flood Inundation Area

Figure 21

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Data source: Tweed Shire Council (2011) - Haul Road, Haul Road Footprint, Cadastre boundary (2010). GHD (2010) - Site Boundary (2011), Roads, Existing Drainage Lines, Hillshade (Derived from Tweed Shire Council ALS data), Flood Area, West Valley, North Valley (2011).

Surface Water Quality

The operations for Stage 1 Project Application will generate different types and quality of waters, including:

- Runoff from undisturbed areas of Quirks Quarry Landfill and West Valley Quarry (clean stormwater runoff);
- Runoff from rehabilitated (revegetated) areas of Quirks Quarry landfill (clean stormwater runoff);
- Runoff from disturbed areas of the landfill or quarry (potentially turbid/sediment laden stormwater runoff);
- Runoff from within the active landfilling area (potentially leachate); and
- Leachate from within the landfill.

All sources of water if not managed appropriately have the potential to impact local water quality in the channel on the northern site boundary which flows to Leddays Creek and eventually the Tweed River. Furthermore spills of stored chemicals and fuels also have the potential to impact surface water quality.

9.1.4 Mitigation Measures

Quirks Quarry Landfill

General

Council will take all practical steps to avoid contaminated waters flowing into the nearby creeks and cane drains and subsequently to the Tweed River. A range of measures will be implemented to minimise, contain, collect and dispose of leachate, which will primarily involve implementing practical measures to minimise the volume of leachate generated such as:

- Diverting upstream clean stormwater runoff, where possible;
- Minimising exposed areas at the active landfilling area by regular covering of the landfilled waste (at least daily);
- Grading filled areas to direct surface water runoff away from the active waste disposal area;
- Progressive capping and rehabilitation of landfilled areas;
- Establishment of a compacted clay and HDPE landfill basal liner which will include a leachate drainage layer; and
- Following initial storage of leachate within Stage 1 of the landfill, a leachate treatment plant will be established as part of Stage 1B to treat leachate prior to irrigation on the site.

Stormwater

The proposed stormwater drainage system will comprise:

- Bund construction around the landfill;
- Construction of new stormwater management measures;

- Construction of new erosion and sediment control measures;
- Construction of a new stormwater sediment pond;
- Erosion and sediment control works across the site; and
- Progressive capping and revegetation of the site.

To address potential flooding issues a perimeter bund will be constructed along the northern and western edges of the proposed landfill area at an average level of 6.5 m RL. The current low lying areas of the landfill footprint (Stage 3) will be raised above current surface levels along the northern and western edges of the perimeter bund by between approximately 1 m to 3 m. The base of the landfill will then fall towards the eastern edge of the proposed landfill area. This should reduce stormwater from the surrounding site overflowing the perimeter bund and entering the landfill area.

The landfill surface shall be bunded and contoured to prevent the run-on or run-off of surface waters onto / from areas where waste has been deposited. Landfill areas not being actively landfilled will be covered with intermediate cover and the runoff directed to suitable stormwater drainage systems. Following the closure of an area, intermediate covering and temporary revegetation will ensure minimisation of stormwater volumes and improved water quality.

A series of temporary stormwater diversion drains will be established during landfilling operations to prevent clean stormwater runoff from entering the active waste disposal area. Details of stormwater management measures are shown on Figure 13 Stormwater Arrangements and Details and Figure 14 Stormwater and Sediment Control Details taken from the draft LEMP.

Where the area drained is undisturbed, these drains will directly drain from the site. Where the area drained is likely to contribute sediment to the stormwater, the drains will either flow to a sediment pond, or will be constructed to spread turbid water over vegetated areas of the site in order to enable the settlement of sediments from the water. If this is not possible, sediment fencing will be installed and maintained at the site perimeter as a temporary measure.

It is proposed to install silt fencing as required around the site and to finally restore areas of the site as soon as reasonably practicable. Once final capping and revegetation has occurred at the site, stormwater management will become a less significant issue. Revegetation of the site's surface by this time will considerably reduce the rate of erosion of the site and will help to trap sediment entrained in stormwater runoff.

Leachate

All leachate collected by the leachate containment and collection systems shall be managed to prevent adverse impacts on local surface waters and local groundwater. All leachate collected shall be stored, treated and disposed of in accordance with the LEMP and the EPL.

There will be no storage of leachate in a pond onsite, the leachate collected in the active waste disposal area and leachate sumps will be stored for the first 2 years within Stage 1 of the landfill. Following assessment of actual leachate generation rates, the leachate will be pumped to a leachate treatment plant prior to being irrigated onsite.

Maintenance

All stormwater drainage and leachate management works will be maintained in proper functioning order so as to minimise flooding of the landfill area and prevent contamination of local groundwater and surface water. Maintenance will include:

- Regular cleaning of drains/pipes/pits and removal of accumulated sediments and litter;
- Removal of flow concentrations from disturbed areas; and
- Stabilisation of eroded drains.

Monitoring

Council will undertake monitoring of surface water, groundwater and leachate, in accordance with EPL requirements to ensure the landfill operations do not cause a detrimental environmental impact. In addition, every 12 months the operation of the landfill and all monitoring programs will be reviewed for adequacy and compliance with regulatory requirements.

Surface Water Quality Monitoring Program

The existing surface water monitoring locations are considered sufficient for the purposes of gathering baseline data and should continue to be monitored on a quarterly basis and analysed for the suite of parameters detailed in Table 9-7 below. These parameters are generally in accordance with the requirements of the *Environmental Guidelines: Solid Waste Landfills* (EPA 1996).

Once operations have commenced, the water quality monitoring program will be specified in the Environmental Protection Licence. The analytical suite should be revised on the basis of the additional baseline data, however the three monitoring locations are considered appropriate.

Should monitoring indicate that contamination of any local surface water ways has occurred, the affected sampling locations will be re-sampled as soon as possible after identification of the possible contamination. If the contamination is confirmed by the re-sampling, Council will notify DECCW in writing within 14 days.

Table 9-7 Surface Water Quality Monitoring Analytical Suite

Description	Analyte/Parameter
Physico-chemical parameters	pH, dissolved oxygen, redox potential, electrical conductivity – field measured total suspended solids – laboratory measured Qualitative (and/or photographic) records of flow and weather conditions at the time of sampling.
Major ions	Calcium, magnesium, sodium, potassium, chloride, sulfate, alkalinity as $CaCO_3$
Nutrients	Ammonia as N, nitrate as N, nitrite, total N, TKN, total phosphorus as P, phosphate
Dissolved Metals*	Copper, manganese, arsenic, cadmium, chromium, nickel, lead, zinc
Organic Indicators	BOD, TOC, OC Pesticides, total phenolics

Monitoring of sediment basins will also be required during site operations, both for the reuse of stormwater onsite and also in the event of release or discharge. Regular monitoring shall also be conducted on a quarterly basis in conjunction with receiving environment monitoring. In the event of a release/discharge from the basin caused by a significant rainfall event monitoring of the discharge and downstream receiving environment shall also be required. Monitoring of pH and total suspended solids shall be undertaken on a weekly basis for as long as the basin is discharging at the release point and in the downstream receiving environment.

The surface water quality monitoring program will be reviewed on an annual basis.

West and North Valley

Sediment Basins/Wetlands

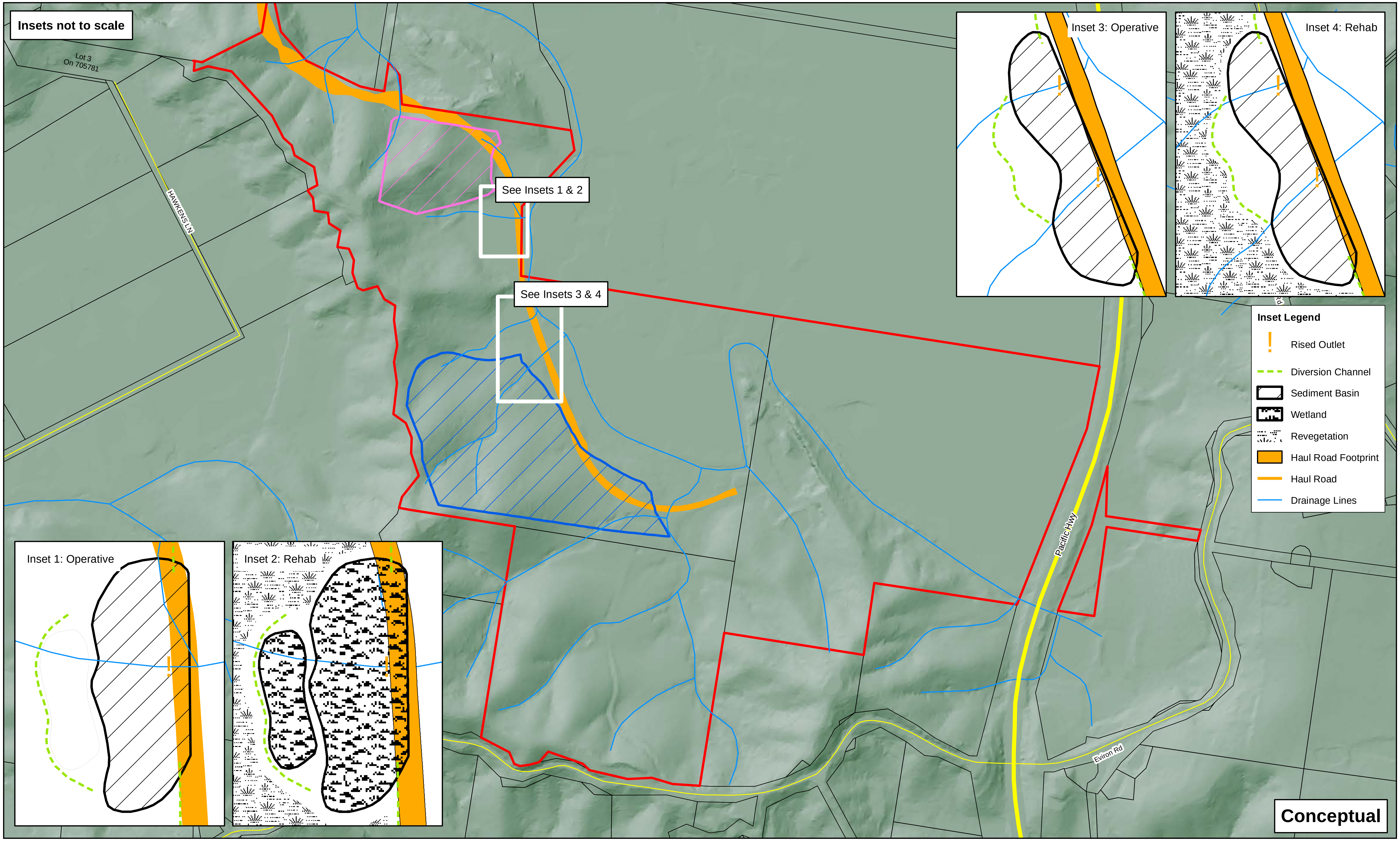
On the basis of the stormwater quantity and quality modelling one sediment basin for the West Valley and one for the North Valley will be utilised to manage stormwater runoff. The resultant sediment basins have been sized to achieve a 100 year ARI regional flood immunity and would be fenced to prevent access due to the likely depth of standing water. The key characteristics (model outputs) of the proposed sediment basins are summarised in Table 9-8 below.

Proposed sediment basin locations are indicated in Figure 22. Cross section details are provided within the technical report in Appendix H. Further details of sediment basin setup for each valley are provided in the table below.

Table 9-8 West and North Valley Stormwater Treatment Device Characteristics

Point of Discharge	Minimum Area (m^2)	Treatment Depth (m)	Storage Depth (m)	Total Volume (m^3)	WL* (m) 20yr	WL* (m) 100yr
C & D – West Valley	9,500	0.25	0.80	7,310	0.63	0.69
B - North Valley	6,835	0.25	0.80	5,040	0.61	0.70

* WL: water level as depth above permanent standing water level of the sediment basin (or wetland in ultimate scenario) in 20 year and 100 yr ARI regional event.



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- North Valley
- West Valley
- Haul Road
- Drainage Lines

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Tweed Shire Council
Eviron Quarry & Landfill Site

Job Number	41-20806
Revision	2
Date	27 MAY 2011

Quarry Stormwater Treatment Device Locations

Figure 22

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54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council (2011) - Haul Road, Haul Road Footprint, Cadastre boundary (2010). GHD (2010) - Site Boundary, Roads, Drainage Lines, Hillshade (Derived from Tweed Shire Council ALS data), Rised Outlet, Diversion Channel, Leachate Pond, Sediment Basin, Revegetation, Wetland, Irrigation Pond, West Valley, North Valley (2011).

West Valley

In the pre development scenario, flows from catchments C and D in the West Valley travel north east along the existing drainage flow paths to LPD C and D in the western portion of the council owned lot, and catchments Eex1 and E flow north east toward LPD E as depicted in Figure 18.

In the Post Development and Ultimate scenarios catchments C & D are combined in area and includes part of catchment E and the remaining portion of catchment F. Mitigation is required in the form of a detention area as per catchment B of which consists of two functions. During quarrying and subsequent landfilling in the West Valley the detention area will act as a sediment basin to collect all sediment that flows off the cleared land during quarrying and land filling. Upon completion of the landfill and site revegetation and rehabilitation of the area is complete, the sediment basins can be converted into wetlands. Based on the concept design, the size of the system will remain the same and has been determined by sediment volume requirements. The outlet of this detention system could disperse into the existing channels through 2 x 2 x 375mm culverts at a 100 year ARI flow of 0.475m3/s and velocity of 2.2m/s per pair. The remaining flows would pass over the haul road which will be designed as a spillway at the basin weir location. All outlets would need to be protected for scouring up to a distance of 4 x diameter of the outlet pipe. It is noted that this reflects conceptual planning for this system and during detail quarry design and planning this concept will be refined.

North Valley

In the Post Developed and Ultimate scenarios catchment B is increased in area by including parts of Catchment A1, A2 and F. Mitigation of stormwater flows is likely to be required in the form of a detention area of which consists of two functions as per the concept outlined for the West Valley.

Noting that all proposed infrastructure for the North Valley is based on an indicative development footprint only, it is anticipated that the outlet of this detention system will disperse into the existing channel through 4 x 375mm culverts at a 100 year ARI flow of 0.9m3/s and velocity of 2m/s. The remaining flows would pass over the road which will be designed as a spillway at the basin weir location.

Erosion and Sediment Control Concepts

The following represent the desired outcomes and principles of effective erosion and sediment control to be employed at the site:

- Minimise the extent and duration of soil disturbance;
- Control the location and velocity of drainage flow;
- Minimise soil erosion initiated by wind, rain or concentrated flow;
- Minimise sediment flow from the site;
- Promptly revegetate/stabilise all exposed and/or unstable soil surfaces; and
- Appropriately install, operate and maintain all erosion and sediment control measures.

The Stormwater Assessment and Sediment Management Report provides details of erosion and sediment control options and as the design of the quarry footprint and activities in the West Valley progress, erosion and sediment control devices will be sized and position accordingly, however the following represents some key concepts that will be incorporated in the eventual management plan:

- Erosion Controls - to minimise movement and loss of sediments at the source:
  - Minimise soil and stockpile erosion caused by wind and rain;
  - Minimise turbidity levels in stormwater runoff by minimising the exposure of soil to rain and stormwater flow; and
  - Revegetation on exposed soil surfaces that have the potential to erode and cause sediment movement into the surrounding environment during rain events. Revegetation is an effective long term ESC measure. Ideally, plants should be native to the area, have good soil binding capability and compete successfully with weed species. Temporary sediment fences should be incorporated at the downstream edge of revegetation until establishment and stabilisation have been achieved.
- Drainage Controls – to divert 'clean' water around active or disturbed areas and contain and transport potentially contaminated stormwater through disturbed areas to treatment measure(s), minimising contact with erodible soils:
  - Diversion channels placed above batters, borrow pits, exposed and disturbed surfaces to protect them from upstream runoff. They can also be incorporated at the base of cut and fill slopes and disturbed/exposed areas (sediment fences are often appropriate to install between the slope and channel) to direct sediment laden flows to treatment measures; and
  - Rock-lined channels to convey concentrated flows on grades of up to 10% and in critical sections of other types of channels (grassed, earth) such as bends and stormwater outlets where localised high velocities are likely to occur. The increased channel roughness provided by the rock lining slows flow velocities providing sediments opportunity to settle out.
- Sediment Controls – to trap and retain sediments, removing sediment from the stormwater flow. Where practical, sediment should be trapped close to its source, reducing breakdown of soil particles and the release of dispersive clays (if present) with final sediment removal/control prior to release/discharge or reuse:
  - Sediment/silt fences to provide physical filtration of sheet flow as it passes through the filter material, and allows settling of suspended sediments by the ponding of water behind the fence; and
  - Sediment basins an effective sediment containment system to trap and retain a wide range of sediment particle sizes down to 0.045 mm depending on its hydraulic characteristics (retention time and flow distribution).

Haul Road Preliminary Culvert Sizing

Council has prepared a concept design for the haul road from Stotts Creek RRC to the Eviron Road site. A number of road culverts have been proposed to pass under the proposed haul road from the quarry areas and into the existing drainage channel. These include:

- 4 x 600mm RCPs at the tributary crossing between the Stott's Creek RRC and proposed North Valley Site (approx. 5ha catchment);

- 4 x 375mm RCPs at LPD B;
- 2 x 375mm RCPs at LPD C;
- 2 x 375mm RCPs at LPD D; and
- 4 x 600mm RCPs at LPD E.

The first 4 x 600mm RCPs are not included in the hydraulic modelling. Upon design finalisation of the proposed haul road, peak flow rates will be determined and culvert sizing will be performed for this catchment, however due to it being outside the proposed quarrying / landfill site, detailed calculations have not been performed and will be required during detail design.

Concept Plan

The fundamental approach to stormwater management for the broader concept plan including all proposed landfill and quarry activities is aimed at eliminating impacts to surface water receiving environment by undertaking the following:

- Maintain undisturbed and rehabilitated / revegetated area as filters for sediment from disturbance above;
- Stage operations with a view to minimise disturbed/active areas onsite at any given time and hence minimise the volume of runoff to be managed by minimising the contributing catchment area that is active at any particular time;
- Maintain all stormwater runoff from disturbed areas as diffuse as possible to minimise sediment loads and maximise the opportunities for vegetation to strip sediment from the runoff;
- Keep sources of different quality water separate from each other, namely:
  - 'leachate' drainage from the base of the landfill and the active landfill area;
  - 'dirty' runoff containing sediment from quarrying and landfill active areas; and
  - 'clean' runoff from vegetated areas with no waste or quarry related activities.
- Providing adequate stormwater detention volume and ensure that sufficient water is available for operational requirements;
- Re-use or dispose of water on site:
  - ensure zero discharge of leachate to local streams;
  - re-use of 'dirty' runoff for dust suppression; and
  - divert 'clean' runoff into dams for supplementary water supply or overflow off site.
- Erosion control (re-vegetation, silt fencing etc.) shall be established on disturbed areas as soon as practicable and maintained;
- Employ strategic placement of bunds in the quarry and landfill working areas to ensure that water falling in the active areas does not leave the site; and
- Adopting effective spill management planning and emergency management procedures.

9.2 Groundwater

9.2.1 Methodology

Potential impacts on local and regional groundwater environment were assessed by the following:

- A review of relevant existing information including existing data, monitoring networks, published geological and acid sulfate soil maps, land classification maps, regional monitoring network databases and reports to help characterise the geology, soils and hydrogeology of the site;
- Review the draft acid sulfate soils management plan referred to in the Stage 1 Concept Plan (Tweed Shire Council 2008);
- Review stakeholder comments; and
- Identify any data gaps and provision of recommendations.

9.2.2 Existing Environment

Groundwater conditions at the site were assessed via a review of water quality in a series of existing groundwater monitoring bores and newly installed bores following recommendations after an initial desktop review in 2009.

Thirty nine locations were drilled prior to this assessment to investigate a combination of soil, stratigraphy and groundwater on the site (see Table 9-9 and Figure 23). Eleven of these locations appear to be located within the North Valley development area (BH12 to BH18 inclusive, GW1, GW2, GW16 and GW17) and seven are located in the vicinity of Quirks Quarry (BH5, BH6, BH7, GW4, GW8, GW9 and GW10). And are summarised as follows:

- Fifteen locations up to 0.7 m below natural ground surface (BH1 to BH15) to assess soil properties;
- Fourteen locations to between 1.5 and 5 m below natural ground surface completed as shallow groundwater monitoring bores (GW2, GW4, GW6, GW7 and GW8 (2007) and GW9 to GW17 (2008); and
- Ten locations to 12 m below natural ground surface. Seven of which were to prove bedrock geology (BH16 to BH22) and three of which were installed as groundwater monitoring bores (GW1, GW3 and GW5).

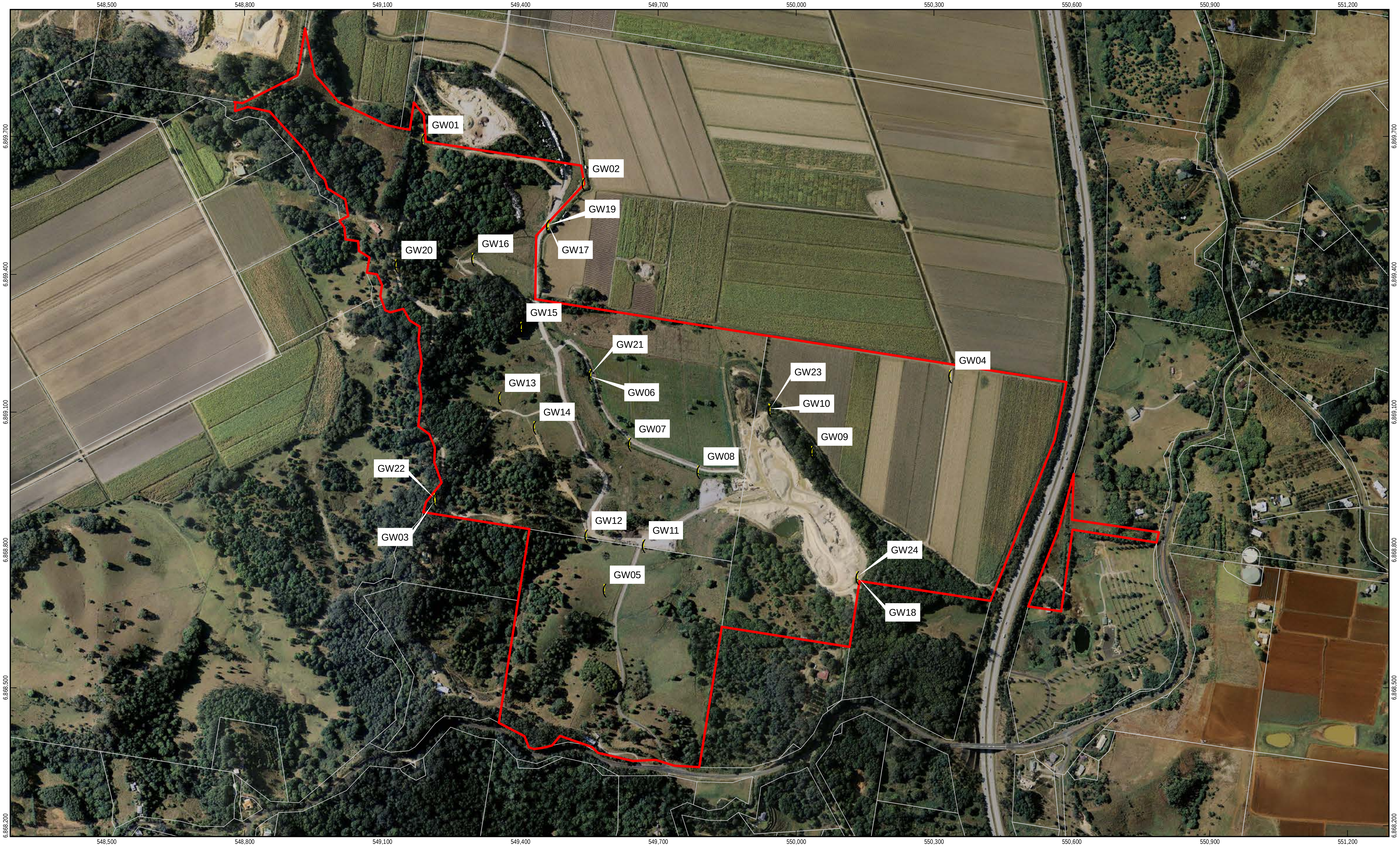
During this assessment a further 15 boreholes were drilled for the combined purposes of preliminary estimates of the quarry resource in the North and West Valley and also assisted with understanding the onsite geological and hydrogeological conditions. This included the following:

- Quirks Quarry: one borehole (TSCBH04);
- West Valley (TSCBH01, TSCBH02A, TSCBH05, TSCBH07-TSCBH13); and
- North Valley (TSCBH02B, TSCBH03A, TSCBH03B).

Following an initial desktop review of hydrogeological information, an additional six groundwater monitoring bores were installed across the site, three upgradient and three downgradient of the proposed quarry/landfill activities. The three down-gradient bores were located adjacent to existing shallow groundwater bores to help understand connectivity between the shallow water bearing alluvial deposits and water in the underlying bedrock.

- Quirks Quarry: GW23 (downgradient, adjacent to GW10) and GW24 (upgradient);
- West Valley: GW21 (downgradient, adjacent to GW6)and GW22 (upgradient); and
- North Valley GW19 (downgradient, between GW16 and GW17) and GW20 (upgradient).

GW20, GW22 and GW24 were all located on the ridgeline above the proposed quarry and landfill operations, while GW19, GW21 and GW23 are positioned in lower lying areas.



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

(Quirks Quarry Boreholes

Site Boundary

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Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Groundwater Monitoring Bores and Geology

Figure 23

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54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Cadastre boundary (2010), Licensed Groundwater Bores (2010). GHD - Site Boundary (2011).

Geology Overview

As discussed in Section 3.3, regional scale geological mapping (1:250,000-scale map for Tweed Heads, Sheet 56-03) shows Quaternary-age deposits outcrop along the River Tweed and other low lying areas in the vicinity of the site. Isolated outcrops of Tertiary age volcanic rock (predominantly basalt) are mapped south west and south east of the site. The regionally extensive Silurian-age Neranleigh–Fernvale beds (greywacke, slate, phyllite and quartzite), are mapped at ground surface in the west and south of the site are shown to dip towards the south west at around 45° on a regional scale and may be folded, as indicated by the regional geological cross section (NSW Department of Mines 1967).

Unconsolidated marine alluvial deposits present at the site are for the most part consistent with the regional mapping. The alluvial and marine deposits, which are at least 5 m thick in the vicinity of the North Valley (GW2) and at least 5.5 m thick (GW10) in the vicinity of Quirks Quarry can be broadly characterised as clay (including marine clay) and silty clay material containing limited and variable proportions of gravel and sand and occasional lenses of sandy clay. Where clay overburden was identified (for examples at locations GW1, GW5, GW11 and GW12) it is considered that this is likely to be weathered bedrock.

One or more marine clay layers, at least 3.5 m thick overly and lie within the alluvial material. The marine clay is likely to extend beneath parts of North Valley however the lateral extent of the clay is difficult to determine given the limited depth (<1 m) of investigation at a number of locations in this area. The marine clay layer may not be extensive at the site given that the marine clay was not identified in geological logs for bores drilled in West Valley or in the vicinity of Quirks Quarry.

Bedrock is mapped as the Neranleigh-Fernvale Beds (1:250,000 scale, sheet 56-03 for Tweed, Department of Mines and Energy 1967) and occurs at outcrop in the west and south of the site and continues under the alluvial deposits to the north and east although the depth to bedrock has not been proven. Bedrock encountered at the site includes weathered siltstone, quartzite, chert, greywacke and basalt.

Siltstone (bedrock) at the nearby Stotts Creek RRC has been described as highly fractured (Allan Watson Associates 2004(b)) with tight joints and it is likely bedrock at the Eviron Road site, including North and West Valley and Quirks Quarry, is also fractured and jointed. The drilling program undertaken as part of this assessment supported this. The boreholes drilled ranged between 1.8 m – 70.25 m in total depth and bore logs indicate dark grey, brown and orange colouration which could be indicative of iron staining along joints/fractures.

New South Wales Licensed Groundwater Bores

Interrogation of the online NSW Natural Resources Atlas groundwater bore data (NSW Government, data obtained November 2008) showed 13 groundwater bores within approximately 2 km of the site licensed for purposes other than groundwater monitoring (see Figure 24). Selected information for these boreholes is summarised in Table 9-9. The bores are located south and west of the site and the licensed uses include domestic supply, stock and irrigation. Records for these bores suggest groundwater is predominantly obtained from fractured bedrock including shale, diorite, greywacke and basalt encountered from 13 to 54 m below ground surface.

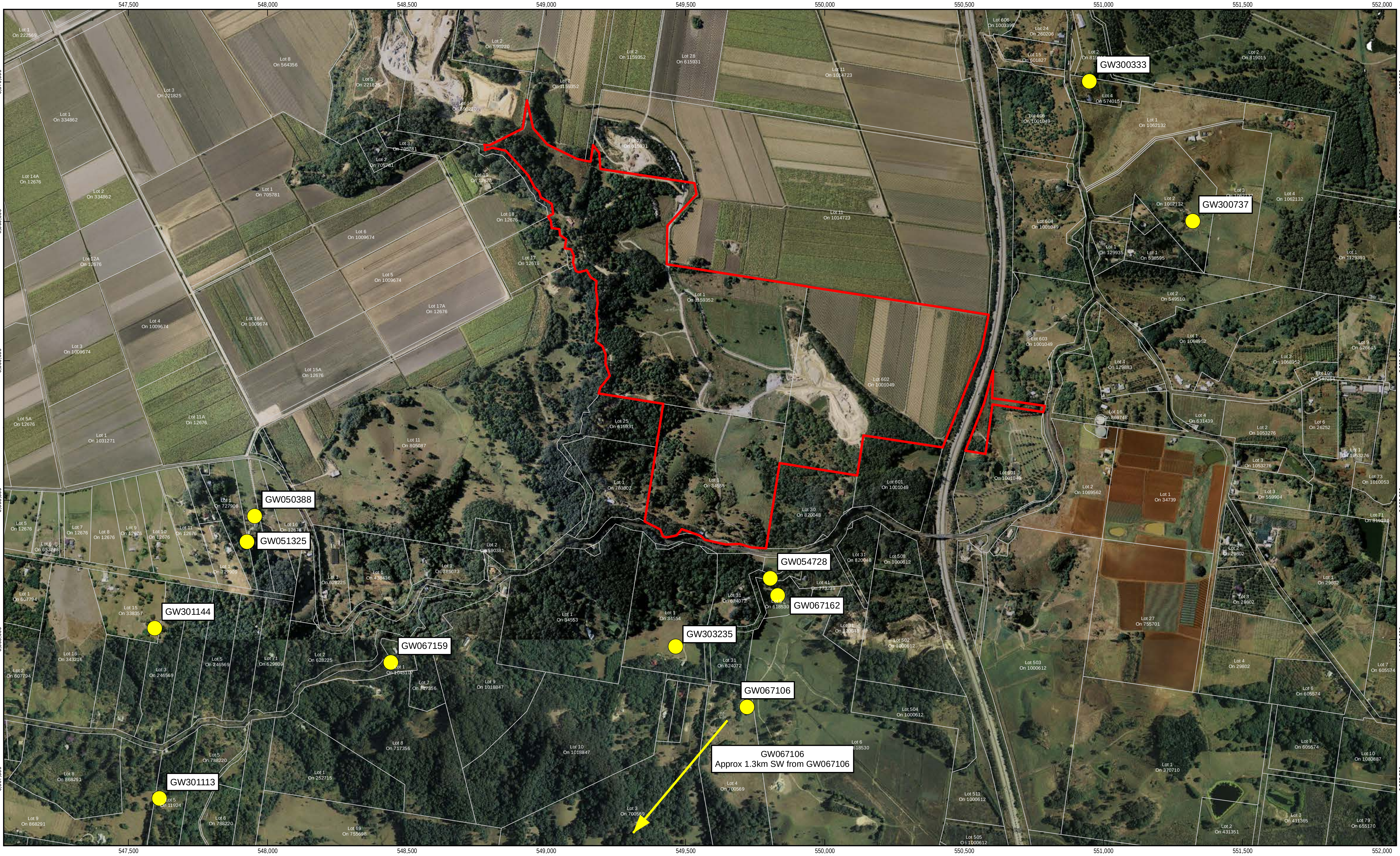
The closest groundwater bore to the site is station number GW054728, located approximately 750 m south of Quirks Quarry.

Table 9-9 Licensed Groundwater Bore Summary[1]

Registered Bore Number	Easting	Northing	Water source[2]	Bore Depth (m)	Use	Yield (L/s)
GW301144	547594	6868041	Bedrock - blue metal	25	Domestic stock	2.0
GW051325	547926	6868351	Bedrock - fractured shale	13	Domestic	1.26
GW050388	547953	6868443	Diorite	14.5	Domestic	-
GW067159	548442	6867918	Bedrock - fractured	42	Domestic	0.13
GW067162	549831	6868159	Bedrock - fractured	30	Domestic stock	0.35
GW054728	549804	6868220	No information	17.7	Not known	-
GW300333	550950	6870004	Bedrock - hard grey rock	16.8	Domestic	0.3
GW300737	551321	6869502	Bedrock - interbedded shale and basalt	28	Domestic	0.24
GW305202	551163	6870695	Bedrock - basalt	20	Farming irrigation	1.0
GW067106	549721	6867759	Fractured (bedrock)	23.5	Domestic	0.7
GW067161	549063	6866623	Fractured (bedrock)	39	Domestic stock	12.6
GW301113	547611	6867430	Basalt	39	Domestic	0.71
GW303235	549465	6867976	Fracture basalt over Greywacke	54	Domestic irrigation	0.75

[1] Data obtained from the on-line NSW Natural Resources Atlas in November 2008 (NSW Government) and excludes groundwater monitoring bores

[2]. Water source as indicated on the registered bore geological log



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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NSW Boreholes

Site Boundary

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Tweed Shire Council
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Job Number	41-20806
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Licensed Groundwater Bores

Figure 24

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Data source: Tweed Shire Council - Aerial Photography (2008), Cadastre Boundary (2010), Licensed Groundwater Bores (2010). GHD - Site Boundary (2011).

Groundwater Monitoring

Site groundwater monitoring data was provided by the Tweed Shire Council NATA accredited Tweed Laboratory. Each of the existing 17 groundwater monitoring bores shown in Table 9-10 are monitored for groundwater levels and groundwater quality on a quarterly basis. Upon installation of the additional six monitoring bores, all were monitored on a monthly basis for six months between April and September 2009. Since this time monitoring frequency has reverted back to a quarterly basis.

Groundwater monitoring data are summarised in Table 9-10 and a summary of the groundwater quality parameters analysed to November 2008 are listed in Table 9-11. Bore construction details for the original 17 locations were not available, however the geological logs suggest monitoring bores GW1, GW3 and GW5 penetrate into and monitor the bedrock (predominantly siltstone) and bores GW2, GW4, GW6 through GW12 and GW17 monitor the alluvial deposits. The locations of bores GW13, GW14, GW15 and GW16 in conjunction with the geological descriptions suggest that they probably penetrate and monitor residual soils/extremely weathered bedrock. Of the new monitoring bores GW20, GW22 and GW24 have penetrated into and monitor the siltstone bedrock, whilst GW19, GW21 and GW23 monitor the alluvial deposits.

Council has previously identified trigger values for selected parameters (pH, EC, nitrate, nitrite, ammonia, biological oxygen demand (BOD), chloride, fluoride, iron, potassium, sulfate, sodium, manganese, total N and copper). The majority of the values appear to be based on the ANZECC/ARMCANZ (2000) freshwater guideline (95% level of protection) or on the ANZECC/ARMCANZ (2000) guideline for short term irrigation.

Falling head permeability tests have been carried out at GW5, GW6 and GW8 (Gilbert and Sutherland 2007). Interpretation of the bore logs, by GHD, suggest that the permeability of alluvial deposits was tested at GW6 and GW8 and that alluvial deposits and bedrock may have been tested at GW5

Table 9-10 Summary of Water Level and Water Quality Monitoring Data

Bore ID	RL (mAHD)	Total Bore Depth (m)	Aquifer/ Water Bearing Horizon Monitored[1]	SWL[2] - Monitoring Start	SWL - Frequency	SWL – No. Monitoring Records	WQ - Monitoring Start	WQ - Frequency	WQ – No. Sampling Rounds	Comments
GW1	8.38	12	Siltstone	Sept 2007	~ monthly since Feb 2008	7	Jan 2008	~ quarterly	8	
GW2	1.501	5	Silty clay & marine clay	Sept 2007	~ monthly since Feb 2008	11	Jan 2008	~ quarterly	9	
GW3	51.04	12	Siltstone	Sept 2007	~ monthly since Feb 2008	10	Jan 2008	~ quarterly	1	Dry in all other events
GW4	1.205	5	Marine clay	Sept 2007	~ monthly since Feb 2008	12	Jan 2008	~ quarterly	9	
GW5	21.06	12	Basalt and siltstone	Sept 2007	~ monthly since Feb 2008	12	Jan 2008	~ quarterly	8	
GW6	1.975	4	Clay with gravel	Sept 2007	~ monthly since Feb 2008	11	Jan 2008	~ quarterly	9	
GW7	2.181	4	Clay with gravel	Sept 2007	~ monthly since Feb 2008	11	Jan 2008	~ quarterly	9	
GW8	2.035	4	Clay with gravel	Sept 2007	~ monthly since Feb 2008	11	Jan 2008	~ quarterly	9	
GW9	1.94	4	Silty clay over gravelly sandy clay	Aug 2008	~ monthly	4	Aug 2008	~ quarterly	6	

Bore ID	RL (mAHD)	Total Bore Depth (m)	Aquifer/ Water Bearing Horizon Monitored[1]	SWL[2] - Monitoring Start	SWL - Frequency	SWL – No. Monitoring Records	WQ - Monitoring Start	WQ - Frequency	WQ – No. Sampling Rounds	Comments
GW10	3.13	5.5	Clayey sandy gravel over silty clay	Aug 2008	~ monthly	4	Aug 2008	~ quarterly	7	
GW11	8.47	4	Silty clay	Aug 2008	~ monthly	4	Aug 2008	~ quarterly	6	Limited groundwater for sampling due to depth of bore
GW12	15.79	3	Clayey sand	Aug 2008	~ monthly	2	Aug 2008	~ monthly	0	Bore dry
GW13	13.05	4.5	Sandy clay (residual soil/extremely weathered bedrock)	Aug 2008	~ monthly	4	Aug 2008	~ quarterly	6	
GW14	9.74	1.5	Sandy clay (residual soil/ extremely weathered bedrock)	Aug 2008	~ monthly	3	Aug 2008	~ monthly	0	Bore dry
GW15	1.55	4.5	Silty clay over siltstone	Aug 2008	~ monthly	3	Aug 2008	~ quarterly	6	

Bore ID	RL (mAHD)	Total Bore Depth (m)	Aquifer/ Water Bearing Horizon Monitored[1]	SWL[2] - Monitoring Start	SWL - Frequency	SWL – No. Monitoring Records	WQ - Monitoring Start	WQ - Frequency	WQ – No. Sampling Rounds	Comments
GW16	4.38	4.5	Sandy clay (residual soil/ extremely weathered bedrock)	Aug 2008	~ monthly	3	Aug 2008	~ quarterly	6	
GW17	1.63	4.5	Sandy clay	Aug 2008	~ monthly	3	Aug 2008	~ quarterly	6	
GW19	2.4	14	Sandy gravel with silt (residual soil/extremely weathered bedrock)				Apr 2009	~ monthly	6	Quarterly monitoring after Sep 09
GW20	52.65	50	Siltstone				Apr 2009	~ monthly	6	
GW21	1.91	17	Silty clay over clayey sand (extremely weathered bedrock)				Apr 2009	~ monthly	6	
GW22	50.18	56	Siltstone				Apr 2009	~ monthly	6	
GW23	3.66	14	Silty clay				Apr 2009	~ monthly	6	
GW24	36.49	50	Siltstone				Apr 2009	~ monthly	6	

1 Monitored horizon estimated for borelogs

2 Static/standing water level

Table 9-11 Groundwater Quality Parameters

Description	Analyte/Parameter
Since January 2008	
Physico-chemical parameters	pH, dissolved oxygen, redox potential, electrical conductivity
Metals	Copper, manganese, iron
Major ions	Calcium, potassium, magnesium, sodium, chloride, sulfate
Nutrients	Ammonia as N, nitrate as N, nitrite, total N, TKN
Other	BOD, TOC, fluoride, total phenols, alkalinity as $CaCO_3$
Additional parameters Since April 2009	
Physico-chemical parameters	Temperature
Metals	Aluminium, arsenic, cadmium, chromium (speciated), nickel, lead and zinc
Major ions	Bicarbonate, carbonate
Nutrients	Total phosphorus as P
Other	Organochlorine pesticides, organophosphorus pesticides, total petroleum hydrocarbons, monocyclic aromatic hydrocarbons (BTEX)

Water Bearing Horizons and Groundwater Flow

Geological information, including bore logs and site monitoring data and hydrographs, suggest that the main water bearing horizons beneath the site are:

- Shallow alluvial and marine deposits; and
- Fractured bedrock (Neranleigh-Fernvale beds).

Alluvial Deposits

The shallow alluvial deposits will be recharged directly from rainfall and also potentially by up-flow from the underlying bedrock, however data to support this second recharge mechanism are not yet available. Shallow groundwater within the alluvial deposits is likely to move laterally via primary porosity pathways preferentially along more permeable layers towards the east-north-east, sympathetic with topography and is likely to discharge to the channel located along the edge of the floodplain or to other water courses including the Tweed River. At Stotts Creek Landfill Facility groundwater flow in the shallow water bearing horizon is reported to be towards the west and east on either side of the north-south trending topographic divide (Watson Associates 2004(b)). .

Depth to water ranges from around 1 to 3.5 m below ground surface. Static water levels for alluvial deposits (September 2007 to November 2008) typically range between around -1 and 1 m AHD in the vicinity of the flood plain increasing up to around 3.5 mAHD further west. Seasonal variations in static water levels are between around 0.2 and 1 m in the vicinity of the floodplain, close to the channel, see Figure 25, which suggests some connectivity between shallow groundwater and surface water, given the limited range in groundwater levels. No surface water level data are currently available to support this.

Bedrock

Recharge to bedrock is likely to be concentrated along the Condong Range i.e. in areas west and south of the site where the bedrock is present at outcrop. Groundwater within the bedrock is expected to flow predominantly via fractures and joints (secondary porosity), towards the north-east sympathetic with the fall in topography. The existing data suggest static water levels in bedrock range between around 5 m AHD (GW11, GW14) and 40 m AHD (GW5) with seasonal variations of up to around 2 m (see Figure 26).

A component of groundwater flow within the bedrock is likely to discharge to the drainage channel excavated in bedrock at Quirks Quarry. However, groundwater discharge (baseflow) to the ephemeral drainage channels is not anticipated along the majority of their lengths, based on a comparison of topographic contours and measured groundwater levels and given that the channels observed were not flowing at the time of the site visit by GHD (in dry weather).

The majority of groundwater flow within the bedrock in the area is considered likely to discharge to the overlying alluvial deposits in the Tweed Valley floodplain. However, no information on groundwater levels within the bedrock beneath the alluvial deposits is available and hence up-flow from the bedrock to the overlying alluvium cannot currently be confirmed.

North west of the site at the Stotts Creek RRC, groundwater flow in the bedrock is reported to be to the north towards the Tweed River.

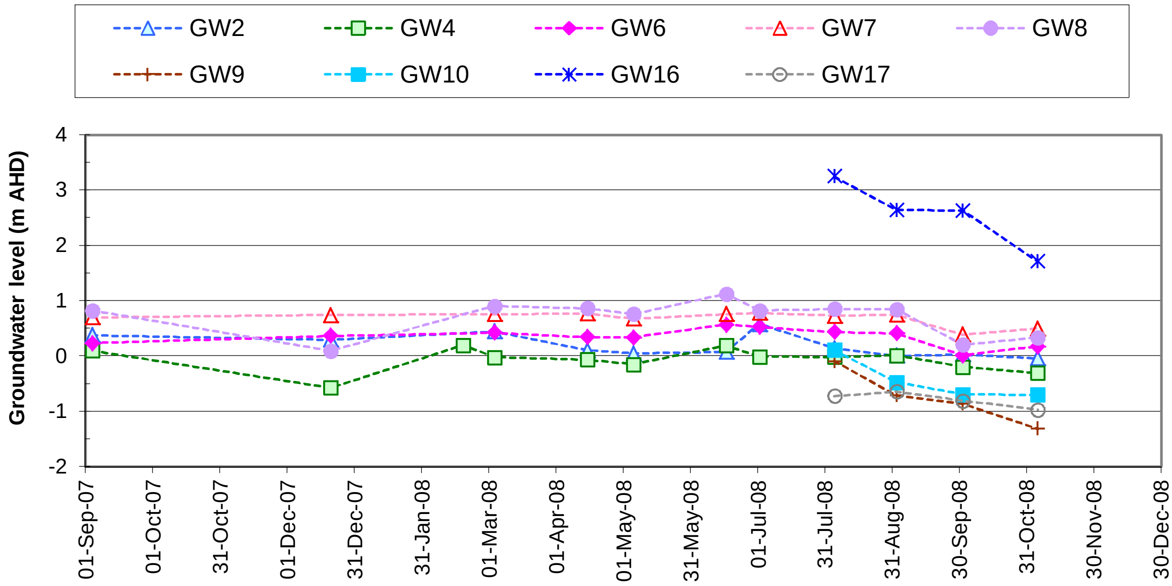


Figure 25 Static Water Levels in Alluvial Deposits

Note that the monitored water bearing horizon is estimated from the geological bore logs.

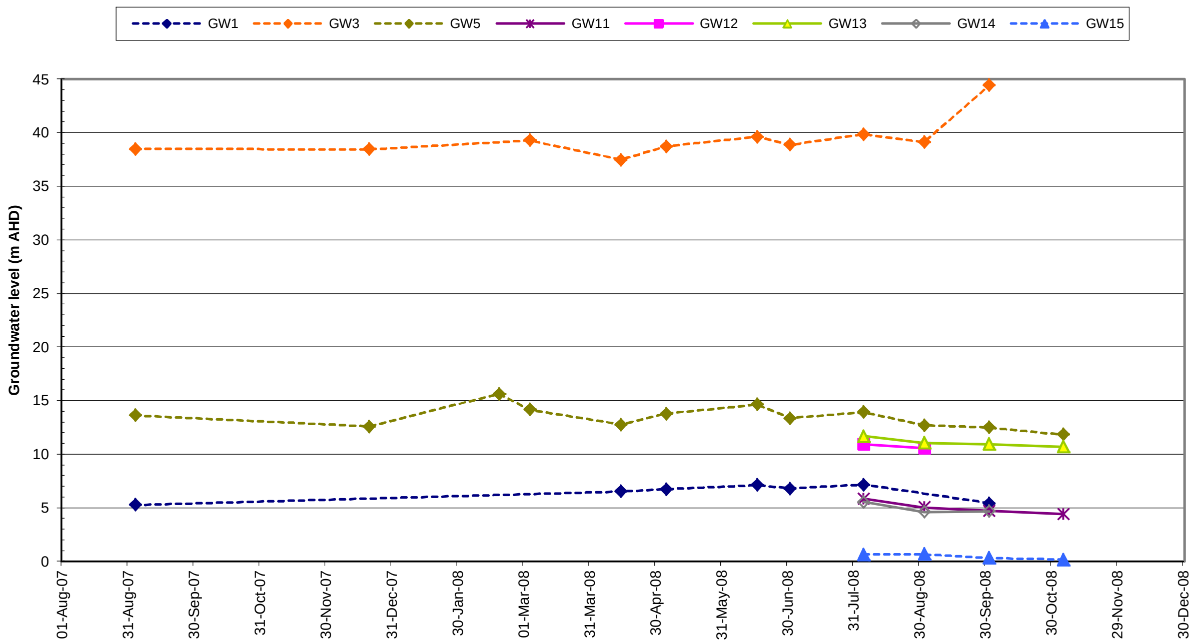


Figure 26 Static Water Levels in Bedrock

Note the monitored water bearing horizon is estimated from bore logs. GW15 appears to penetrate alluvial deposits and bedrock

Hydraulic Properties

The hydraulic conductivity of the shallow alluvial deposits at the site has been calculated to be in the range 0.2 to 0.5 m/d (Gilbert and Sutherland 2007). These values lie at the upper end of hydraulic conductivity range considered typical for a silt or loess, 0.001 to 1.7 m/d (Domenico and Schwartz 1990) rather than towards the lower end as might be expected of a silty clay (the predominant material in the bores tested). At GW6 and GW8 the relatively high reported hydraulic conductivity values may be a reflection of the relatively high gravel component (30%), identified in the base of the bores.

Based on the results of permeability testing at the nearby Stotts Creek RRC and assuming similar bedrock lithology the hydraulic conductivity of the bedrock in the vicinity of the Eviron site could be in the range 10^{-5} to 10^{-8} m/s (0.86 to 0.00086 m/d) with the higher end of the range described as being more typical of the quarried areas (Allan Watson Associates 2004(b)). However further permeability testing will be required during detail design to confirm these estimates.

Groundwater Quality

Baseline groundwater quality is summarised for the shallow bores assumed to penetrate the alluvial and marine deposits and for the deeper bores assumed to penetrate bedrock, based on the data obtained from the site monitoring bores since January 2008. As discussed in Section 9.2.2, groundwater quality has been monitored for a limited suite of parameters on up to nine separate occasions depending on the individual monitoring bore.

Alluvial Deposits

Based on these data baseline groundwater quality in the alluvial and marine deposits at the site is characterised by:

- Predominantly fresh shallow groundwater across the site with a general electrical conductivity (EC) range of 180 to 1000 µS/cm, apart from GW6 (1328 µS/cm), GW2 (up to 4,510 µS/cm) and GW4 (up to 7,000 µS/cm), GW17 (1388 µs/cm) and GW23 (1,994 µS/cm);
- Shallow groundwater is typically acidic (i.e. <7 pH) in the majority of bores and ranges from 4.3 (GW6 and GW7) to 7.6 (GW4). The pH is typically around pH 7 (neutral) at GW2 and GW4 which is also where the highest EC values were recorded;
- Detectable (i.e. above the laboratory detection limit) nutrients (predominantly nitrate and ammonia) are reported for a number of bores but concentrations are generally not significantly elevated. Ammonia as N is less than the ANZECC/ARMCANZ (2000) guideline for freshwater (95% protection) of 0.9 mg/L except at GW9 where up to 2.06 mg/L was reported in August 2008, however it is noted that since December 2008 ammonia as N concentrations at this location have been 0.05 mg/L. Elevated nitrate as N was detected immediately north of Quirks Quarry, up to 3.8 mg/L (GW10);
- With the exception of GW4 located in the canefields north east of Quirks Quarry, detectable total phosphorus as P concentrations ranged between 0.1 mg/L and 0.79 mg/L which exceed the ANZECC/ARMCANZ (2000) irrigation guideline of 0.05 mg/L and the freshwater trigger value of 0.025 mg/L. GW4 recorded notably higher concentrations up to 5.1 mg/L on the three occasions phosphorus as P has been analysed for;

- Elevated concentrations of manganese above the ANZECC/ARMCANZ (2000) freshwater guideline (95%) value of 1.9 mg/L are reported in areas of low elevation (<2 m AHD), in the northern part of North Valley (GW2), northeast of Quirks Quarry (GW4) and in the vicinity of Quirks Quarry (GW6, GW9 and GW23). Concentrations of between 2.06 and 6.88 mg/L have been recorded at these locations;
- Concentrations of iron appear to vary by around one order of magnitude at some locations, based on the current data set. Concentrations above the laboratory detection limit range from 0.01 mg/L to >200 mg/L have been recorded. The highest results have come from bores GW6 and GW7, with the majority of the remainder of results from the bores monitoring the alluvial deposits being less than 5 mg/L (GW6) has several results greater than 200 mg/L however results at the nearby GW21 are notably lower with a maximum concentration of 5.29 mg/L). Most results exceed the ANZECC/ARMCANZ (2000) guideline for short term irrigation of 0.2 mg/L. There is no freshwater ANZECC/ARMCANZ (2000) guideline for iron;
- Concentrations of aluminium are typically higher than the ANZECC/ARMCANZ (2000) freshwater trigger value (0.055 mg/L) and also exceeded the short term trigger value for irrigation (5 mg/L) in one or more monitoring events at all monitoring bores except GW19, GW21 and GW23. A peak value of 357 mg/L was recorded at GW8 in February 2010; and
- Concentrations of copper are reported as <0.01 mg/L for the majority of samples (i.e. below the laboratory detection limit) and up to 025 mg/L in GW17. The reported concentrations are all above the ANZECC/ARMCANZ (2000) guideline for freshwater (95%) of 0.001 mg/L.

Groundwater quality, except for concentrations of iron, appears to be relatively consistent in lower lying areas of the site and no trends are apparent in the data, although this interpretation is only based on a limited data set. The iron concentrations coupled with pH, conductivity and other metals would suggest a localised acid sulfate soils issue in the vicinity of GW6, GW7 and GW8 to the north east of the proposed West Valley Quarry footprint.

Bedrock

Based on the limited available data the baseline groundwater quality in the bedrock at the site is characterised by:

- The groundwater is fresh in the vicinity of North Valley (GW1), West Valley (GW3, GW5) and is characterised by EC values ranging from 88 to 683 µS/cm, slightly higher conductivity was however recorded within the siltstone in GW22 up to 1575 µs/cm (West Valley) and near Quirks Quarry (GW 24) up to 1330 µS/cm;
- Groundwater is typically acidic and ranges between 3.7 and 7.3 pH. This is consistent with bedrock water quality reported for the nearby Stotts Creek RRC (Allan Watson Associates 2004(b)). It is noted that GW24 (south of Quirks Quarry) has consistently recorded higher pH values than all other monitoring locations with a range of 6.3-9.7 between April and September 2009;
- Nutrients (predominantly nitrate and ammonia) have been detected but are generally at low concentrations, ranging from <0.05 to 0.42 mg/L (GW5) nitrate as N and <0.5 to 0.38 mg/L (GW5 on September 2008 only) ammonia as N. Ammonia concentrations were not detected above the ANZECC/ARMCANZ (2000) guideline for freshwater (95%) of 0.9 mg/L;

- Total phosphorus as P concentrations were relatively consistent across the North and West Valley and Quirks Quarry. However it is noted that the range recorded 0.05 mg/L to 0.3 mg/L did exceed the ANZECC/ARMCANZ (2000) irrigation guideline of 0.05 mg/L and the freshwater trigger value of 0.025 mg/L; and
- Metals concentrations (aluminium, manganese, copper and iron) are typically lower than in the alluvial deposits. Manganese concentrations are below the ANZECC/ARMCANZ (2000) guideline for freshwater (95%) of 1.9 mg/L (ranging from 0.05 to 0.69 mg/L) but above the ANZECC/ARMCANZ (2000) guideline for long term irrigation of 0.2 mg/L. The concentration of iron ranges from 0.02 to 69 mg/L, with the higher concentrations generally being recorded in GW1 (North Valley) GW5, GW11 and GW15 (West Valley and adjacent) since February 2009. As for the alluvial bores, copper concentrations are reported as <0.01 mg/L for all samples however the ANZECC/ARMCANZ (2000) guideline for copper in freshwater (95%) is 0.001 mg/L. Aluminium concentrations also exceeded the ANZECC/ARMCANZ values as was the case with the alluvial bores, maximum concentrations were however notably less than the alluvial results.

Overall water quality appears to be relatively consistent in North Valley (GW1) with no apparent significant rising or falling trends. However data for GW5 suggests that groundwater at this location has become more acidic since the start of monitoring (7.3 pH to 4.4 pH) but also shows decreasing EC with time (683 to 88 mg/L).

Groundwater Resources

The Neranleigh-Fernvale beds are not considered an aquifer of regional importance, although they do appear to supply a number of local, low yielding bores for domestic, stock and irrigation use in the vicinity of the site (NSW Water Resources Atlas data 2008), see Figure 24. Yields recorded for the registered bores within approximately 2 km of the site typically range between 0.13 (GW067159) and 2.0 L/s (GW301144), equivalent to 11.2 to 172 m^3/d, although a maximum yield of 12.6 L/s (1,089 m^3/d) has been achieved at GW067161, (see Table 9-9). None of these bores are thought to be located down hydraulic gradient of the site. Bore GW067161 is located approximately 2 km south of the site in the adjacent valley.

Preliminary Conceptual Understanding

Based on the review of the available information the following preliminary hydrogeological conceptual understanding is presented:

- Vertical percolation of precipitation through up to around 30 m of unsaturated bedrock via fissures and fractures to the water table and lateral groundwater flow, preferentially along zones of fractures and fissures, towards the north east, north and the Tweed River;
- Vertical percolation of precipitation through a relatively thin (typically <3.5 m) zone of unsaturated alluvial/marine deposits via primary porosity pathways to the water table and lateral groundwater flow within these superficial deposits towards the north east, preferentially along more permeable layers such as those with a component of sand and, or, gravel;
- Discharge of groundwater from bedrock to the overlying alluvial deposits is considered likely to occur in the vicinity of the floodplain. However the lack of groundwater level data for the

bedrock and the overlying alluvial deposits at the same location means that this cannot currently be confirmed; and

- Shallow groundwater in the alluvial deposits is likely to discharge to the surface water channel close to the edge of the floodplain.

9.2.3 Impact Assessment

The impact of the proposed development on groundwater have been identified based on the information available from the limited monitoring data set available at this point in time. It is intended that the information be supplemented by further monitoring data during detail design to further confirm the potential impacts associated with the Concept Plan and Stage 1 Project Application.

In assessing the potential impacts of the overall Concept Plan has been assumed that development of the quarry site will involve dewatering of the bedrock to enable safe and efficient quarrying of the material. In practice the need for dewatering will depend on current groundwater levels in the bedrock in the proposed quarry and landfill areas. Unfortunately there are currently insufficient data to confirm bedrock groundwater levels at the site to assess whether this assumption is appropriate.

The impacts described below have been divided into those associated with landfilling and quarrying in general and apply to both the Stage 1 Project Application and the Concept Plan as a whole.

Landfilling

- Potential for a reduction in groundwater quality (within both bedrock and shallow alluvial deposits) and surface water quality down hydraulic gradient of the landfill and down stream of the site as a result of seepage of leachate through the landfill liner; and
- If the base of the landfill is below the natural groundwater table or if there are significant seepages from the rock walls of the landfill, for example through fractures or fissures, then there is potential for compromising the integrity of the landfill liner during construction.

Quarrying

- Potential for an increase in the hydraulic conductivity of the shallow bedrock beneath and in vicinity of quarried areas as a result of induced fracturing that may occur following overburden/rock removal and blasting operations;
- The Neranleigh-Fernvale beds can contain pyritic materials, which when exposed to the atmosphere, for example through dewatering, have the potential to generate acid leachate and hence there is potential for a reduction in the quality of groundwater during and after quarrying operations;
- Potential for a reduction in flow rate in the surface water channel which flows towards the north west through the site as a result of quarry dewatering;
- Potential for lowering of groundwater levels in the shallow alluvial deposits. Dewatering of bedrock up hydraulic gradient of the floodplain deposits is likely to reduce the rate of groundwater flow to the alluvial deposits, however the extent of the impact will depend on the

degree of connectivity between groundwater in bedrock and in the overlying alluvial deposits which is currently unknown; and

- Potential for degradation of ground water quality if the permanent water table is lowered. Infiltration of rainfall through dewatered, oxidised ASS material could lead to the generation of acid leachate, increased groundwater and surface water acidity and mobilisation of metals.

9.2.4 Mitigation Measures

Stage One Project Application - Quirks Quarry Landfill

A range of management measures aimed at addressing potential hydrogeological and groundwater impacts have been outlined in both the Concept Design Report and the Draft Landfill Environmental Management Plan for Quirks Quarry Landfill. These are principally aimed avoiding and minimising impacts and most are also aimed at mitigating potential impacts to surface water quality (as discussed in Section 9.1). Importantly, as described in Section 9.1 one of the key goals of the landfill operation will be to minimise the amount of leachate generated by onsite and upstream activities.

Base of Cell Relative to Water Table

On the basis of a review of available information the landfill concept design has used a minimum level of RL 2 (located at the lowest point of the landfill area, Stage 2) for design of the subgrade base levels. A preliminary analysis of data regarding standing water levels for groundwater monitoring wells in the vicinity of the future landfill confirms that the water table is at an approximate RL of 0.5 m to 1 m. Therefore the concept design clay liner level of RL 2.9 m (located at the lowest point of the landfill area, Stage 2) will allow a minimum attenuation layer of approximately 1.9 m above the groundwater table. In accordance with the data provided by Council, it is presently assumed that a ground water attenuation system will not be required within the concept design.

However, it is recommended that prior to detailed design or at the construction phase, further analysis of the future groundwater level data should be undertaken and if required geotechnical and hydrogeological investigations should be carried out within the proposed landfill area to gain more accurate groundwater level information.

Landfill Liner Concept

As discussed in Section 7.2.1 the landfill liner will be designed in accordance with the NSW EPA guidelines for Solid Waste landfills such that a permeability of less than 1×10^{-9}m/s is achieved. This will include a compacted clay liner placed vertical to the base and perpendicular to internal batter with a thickness of 0.9 m, which will be overlain on the base by a 1.5 mm thick HDPE liner for additional protection to groundwater due to the storage of leachate within the waste cells. A leachate drainage layer of 0.3 m will also be incorporate with the leachate collection pipework. Installation of the liner will be subject to a Construction Quality Assurance Program of inspections and testing.

Leachate Management and Monitoring

Leachate is initially proposed to be stored within the waste cell, whilst information on actual leachate quality and quantity is gathered and a treatment option. Details of this management method are provided in Section 7.2.1. Further, as noted in Section 9.2 vigilant monitoring of leachate levels is required particularly during Stage 1 of the landfill prior to the establishment of the leachate treatment plant. Monthly measurement of depth (and volume) of leachate levels will be undertaken. In addition, the following analysis will be undertaken on a quarterly basis:

- Field measurements – temperature, electrical conductivity, salinity, pH, dissolved oxygen (DO), and redox potential; and
- Sampling and analysis for the parameters in the EPL plus Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and heavy metals (Cd, Cr, Hg, Pb).

If leachate levels are likely to exceed the storage capacity of the waste, leachate will be pumped out and disposed of appropriately such that the integrity of the landfill liner is not compromised. Disposal of the leachate may be either to an existing treatment facility at a sewage treatment plant, or via Stotts Creek RRC.

Following the establishment of a leachate treatment plant, it is proposed that irrigation of treated leachate will occur under controlled conditions and only in designated areas of the site. A general treatment process for landfill leachate would normally include preliminary treatment, carbonaceous biological oxygen demand and nutrient reduction, polishing and residuals management.

Groundwater Monitoring

The baseline groundwater monitoring program will continue on a quarterly basis such that site specific trigger values can be adopted upon commissioning of the landfill.

A draft groundwater monitoring program for the operational phase of the landfill has been provided in the draft LEMP, which will be reviewed for adequacy at least once every two years. While the required analytical suite will be nominated in the site's EPL, it is recommended that at least the following be included:

- Standing water levels (metres AHD);
- Physico chemical parameters (measured insitu): pH, conductivity, redox potential, dissolved oxygen;
- Physico chemical parameters (laboratory measured);
- Metals: Aluminium, iron, manganese, copper, arsenic, cadmium, chromium, nickel, lead and zinc;
- Major ions: Calcium, potassium, magnesium, sodium, chloride, sulfate, bicarbonate and carbonate;
- Nutrients: Ammonia as N, nitrate as N, nitrite, total N, TKN, total phosphorus as P; and
- Other parameters: Total organic carbon, total phenols, organochlorine pesticides, organophosphorus pesticides, total petroleum hydrocarbons, monocyclic aromatic hydrocarbons (BTEX).

Groundwater monitoring will continue after closure of the landfill to ensure that there are no legacy impacts to groundwater associated with the landfill operations. At such a time the monitoring program will be reviewed to ensure the appropriateness of the post closure analytical suite.

Design Issues

The following will also be undertaken during the detail design phase to address current gaps in information with a view to refining the design concepts currently proposed:

- Permeability testing of the new monitoring bores (GW24) installed into the bedrock upgradient of the proposed landfill footprint; and
- Installation of a groundwater level logger to automatically record groundwater levels to record groundwater levels upgradient of the landfill. This will help to quantify the range of short term fluctuations in groundwater levels. It is recommended that the level loggers be left in place for a minimum period of six months to record groundwater levels at hourly intervals.

Stage 1 Project Application – West Valley Quarry

Groundwater quality data to date indicates that shallow groundwater is typically on the acidic side of neutral. This is likely to be due to the presence of acid sulfate soils in the lower elevations of the West Valley (refer to Section 9.3), however it is also a typical characteristic of the Neranleigh Fernvale beds (the majority of the bedrock at the site). Therefore unless the current water table is lowered (ie. through dewatering) and rock/soils which are currently below the watertable become exposed to the atmosphere then the acid generated through leaching of rock/soil is probably unlikely to change significantly from existing conditions.

If dewatering of the Neranleigh-Fernvale beds is to be carried out as part of the development, laboratory testing and analysis will be carried out on samples obtained from rock likely to be dewatered, to assess the potential for acid generation and hence potential for impact from acid mine drainage.

To address potential impacts associated with increased hydraulic conductivity, permeability testing at GW22, which is installed in bedrock will be undertaken during detail design. A logger to automatically record groundwater levels and air pressure in the bedrock and the overlying alluvial deposits should also be installed (at GW22 and at downgradient bore GW21 installed in the alluvial deposits) to help quantify the range of short term fluctuations in groundwater levels including response to rainfall and the potential for connectivity between bedrock, alluvial deposits and surface water. It is recommended that the level loggers be left in place for a minimum period of six months to record groundwater levels at hourly intervals. The preliminary conceptual understanding will be reviewed and updated based on the interpretation of the additional data collected and on quarry design parameters.

During the quarry operations a groundwater monitoring and management plan will be required. This will serve a dual purpose in that it will gather baseline groundwater quality information that will be relevant for future planned landfilling activities in the West Valley. It is anticipated that existing groundwater monitoring bores will remain functional for various lengths of time during the extraction of the quarry resource. In particular it is important that Upgradient bore GW22 remain functional along with, GW21, GW7, GW8 and if possible GW6 which are each installed down hydraulic gradient of the proposed quarry footprint within the alluvial deposits and have displayed indicators of acid sulfate soil presence. Monitoring bore GW15 located close to the northern edge of the quarry footprint should also maintained for as long as possible as it has displayed in the monitoring to date characteristics of both the alluvial deposits and bedrock.

Groundwater monitoring should be conducted on a quarterly basis leading up to commissioning of the quarry and during operations. Whilst the site's EPL will dictate the required analytical suite, the following is recommended both for monitoring potential impacts of the quarrying activities and gathering appropriate baseline data for future landfilling;

- Standing water levels (metres AHD);
- Physico chemical parameters (measured insitu): pH, conductivity, redox potential, dissolved oxygen;
- Physico chemical parameters (laboratory measured);
- Metals: Aluminium, iron, manganese, copper, arsenic, cadmium, chromium, nickel, lead and zinc;
- Major ions: Calcium, potassium, magnesium, sodium, chloride, sulfate, bicarbonate and carbonate;
- Nutrients: Ammonia as N, nitrate as N, nitrite, total N, TKN, total phosphorus as P; and
- Other parameters: Total organic carbon, total phenols, organochlorine pesticides, organophosphorus pesticides, total petroleum hydrocarbons, monocyclic aromatic hydrocarbons (BTEX).

Concept Plan

The mitigation measures outlined for Quirks Quarry Landfill and the West Valley Quarry will apply as minimum requirements for any future landfills and quarries associated with the broader Concept Plan, however further investigations will be required and a review of best practice design and operation would be undertaken to ensure that any potential groundwater impacts are appropriately dealt with during the design phase.

9.3 Acid Sulfate Soils

9.3.1 Methodology

Potential acid sulfate soil impacts were assessed by the following:

- A review of relevant existing information including existing investigation data, published geological and acid sulfate soil maps, land classification maps and reports to help characterise the geology, soils and hydrogeology of the site;
- Review the draft acid sulfate soils management plan referred to in the Preliminary Environmental Assessment;
- Review stakeholder comments; and
- Identify any data gaps and provision of recommendations.

9.3.2 Existing Environment (Concept Plan and Stage 1 Project Application)

Acid Sulfate Soil Mapping

As described in Section 3.3.4, Acid Sulfate Soil Risk Mapping, prepared by the Department of Land and Water Conservation (DLWC) and Tweed Shire Council for the site is shown in Figure 8. This mapping predicts the distribution of acid sulfate soils (actual acid sulfate soil and potential acid sulfate soil) based on an assessment of the geomorphic environment (NSW Department of Land and Conservation (1998)).

The eastern portion of both Lot 1 DP1159352 and Lot 602 DP1001049, are mapped as High Probability of Occurrence of acid sulfate soils within 1 m of ground surface whilst the remainder of the site is mapped as No Known Occurrence of acid sulfate soils. The mapping indicates an alluvial plain environment at an elevation of 1 to 2 m and the environmental risk is described as 'severe environmental risk if acid sulfate soil materials are disturbed by activities such as shallow drainage, excavation or clearing'. Digital Acid Sulfate Soil Planning Mapping indicates that the area identified as having a High Probability of Occurrence is mapped as Class 2 for planning purposes (i.e. will require consent for development of works below natural ground surface and works where the water table is likely to be lowered).

The mapped high risk area predominantly covers the low lying portions of the site which are unsuitable for quarrying and waste disposal activities and are predominantly on the northern and eastern side of the proposed haul road. The proposed West Valley and North Valley footprints are outside the mapped area. However approximately 500 m of the haul road fall within the high risk area.

Site Specific Information

Preliminary investigations by Gilbert and Sutherland (2007) assessed three locations for acid sulfate soils at the site, reported as BHC, BHE and BHF on the laboratory results certificate. These locations are not identified on the location plans provided by Gilbert and Sutherland (2007), however two of the investigation locations are referred to as GW6 and GW8 in the report text. In the investigation a total of 27 samples were obtained from the three locations at approximately 0.5 m intervals for screening and fourteen of the samples were subject to Chromium Reducible Sulfur (CrS) and Titrateable Actual Acidity (TAA) analysis.

The main points from the discussion in Gilbert and Sutherland (2007) are summarised below:

- pH_F (field pH) and pH_{FOX} (oxidised field pH) screening indicates actual acid sulfate soil (AASS) and potential acid sulfate soil (PASS) materials in all three boreholes;
- PASS material is indicated at GW6 predominantly between 1.5 and 4.0 m below surface based on CrS results;
- PASS material is indicated at GW8 at 2.0 m below ground surface based on CrS results;
- Widespread existing acidity is indicated by TAA results;
- Where PASS materials were encountered the acidity may be attributed to past oxidation of iron sulfide;
- The acidity in soils from BHE and parts of BHF is most likely an organic acidity or inherent in the soil; and
- The samples analysed had no acid neutralising capacity (ANC) and therefore insufficient capacity to neutralise potential acid generation.

In addition to Gilbert and Sutherland (2007), soils analyses have been carried out on two samples as part of an assessment of the topsoil in the vicinity of Quirks Quarry (TSC 2006). Both samples were reported to be acidic with soil pH values of 4.17 and 4.28 pH units and would require treatment with lime before use as rehabilitation material. The report does not however state whether recognised SPOCAS or Chromium Suite laboratory analysis methods were used as a basis for the proposed treatment option

Note that under ASSMAC (1998) guidelines a soil with a pH of <5.5 is classed as acidic soil and soil with a pH of <4.0 pH is classed as Actual Acid Sulfate Soil (AASS).

Pyritic Material

The preliminary quarry study for the West Valley (GHD, 2010) identified areas of pyritic, graphitic shales, indicating that there are likely to be areas of potential acid forming (PAF) material. Given the limits of the current geological data, the extent of the PAF material has not been delineated at this stage. Council will however investigate this further during detail design, such that wherever possible the material is avoided and not disturbed or quarried. It is noted that apart from the potential environmental risks form sulfidic material, the material also has potential to cause rapid degradation of structures and pavement. Consequently, even if there were no environmental constraints, the quarry operator will have a strong financial incentive to avoid disturbing sulfidic material, which could otherwise result in significant financial liabilities.

Groundwater ASS Indicators

A review of the groundwater quality for those monitoring bores installed within alluvial deposits at the sites indicates that a number of characteristics typically associated with ASS are present. This is particularly the case for the bores located down hydraulic gradient of the West Valley (ie bores GW6, BW6, GW8 and GW21, this includes:

- Mild to moderate acidity;

- Elevated iron, sulfate, aluminium and manganese concentrations;
- Elevated conductivity; and
- Groundwater chemistry dominated by sulfate compounds.

Bores installed in alluvial depots within the vicinity of Quirks Quarry (GW9, GW10 and GW23) displayed some of these characteristics however not to the same degree as those mentioned downgradient of the West Valley.

9.3.3 Impact Assessment

Stage 1 Project Application - Preliminary Characterisation

The preliminary characterisation of acid sulfate soils impacts is based on the regional scale mapping and the limited investigation data.

- The limited laboratory analysis to date supports the regional-scale Acid Sulfate Soil Risk Mapping (DLWC) and suggests that ASS materials (AASS and PASS) are likely to be present in lower lying parts of the site, including down gradient of the West Valley and North Valley quarry footprints, the far north western extent of the Quirks Quarry landfill and for an approximate 500m section of the proposed haul road in Lot 26;
- ASS materials are likely to be present up to at least 4 m below ground surface and have been identified in clays and clay with gravel at investigation locations;
- Sources of potential acidity at the site include a combination of organic and inorganic sulfides; and
- The ASS materials are unlikely to have sufficient self neutralising capacity and could require liming rates of between 2.1 and 100.4 kg/t (Gilbert and Sutherland 2007).

Baseline acid sulfate soil conditions and the potential impacts of the proposed quarrying and landfilling activities on the site have been assessed as far as possible using information currently available for the site. Samples from three locations have been tested in accordance with ASSMAC guidelines (Gilbert and Sutherland 2007) however the sampling density is less than that required by the ASSMAC (1998) guidelines. Further investigations are therefore required during detail design of the haul road as discussed further below.

The minimum sampling densities recommended by the ASSMAC guidelines for linear works (ie haul road) provide for one borehole per 50-100m and for non-linear works the minimum sampling density is summarised in Table 9-12 below.

Table 9-12 Minimum Number of Sampling Holes

Site Area	Number of Holes
Up to 1 ha	4 holes
1 to 2 ha	6 holes
2 to 3 ha	8 holes
3 to 4 ha	10 holes
> 4 ha	2 holes/ ha

Quirks Quarry Landfill

Based on the landfill concept design a small area at the north western extent (Stage 3) of the landfill footprint is present within an acid sulfate soil risk area. It is noted however that there will be a perimeter bund established in this area where existing levels will be raised by between 1 and 3m for flood mitigation and the base of the landfill cell will also be raised and graded to allow leachate to flow by gravity to a sump in Stage 2 of the landfill (refer Figure 12). Therefore disturbance to acid sulfate soils via earthworks will not occur in this area.

If alluvial deposits are proposed to be used in landfill construction then there is potential for the generation of acid from excavated potential acid sulfate soil material if the material is not properly managed and treated before use, in accordance with ASSMAC guidelines, noting that soil properties can change following treatment with lime. The use of alluvial deposits for landfill liners will not be permitted to eliminate this potential issue. Clay overburden from the upper slopes of the West Valley Quarry footprint may however be used, subject to geotechnical testing. However based on the estimates of clay volumes from the West Valley Quarry preliminary study and the material balance calculations undertaken for the Quirks Quarry Landfill Concept Design, additional clay may be required to be sourced offsite for Stage 1 of the landfill.

West Valley Quarry

There is potential for generation of acid as a result of the disturbance (excavation and/or lowering of the water table) of acid sulfate soil material as part of quarrying operations. If not properly managed and treated, disturbance of acid sulfate soils could potentially lower the existing pH of groundwater (which is currently typically acidic) and/or surface water and result in an increase in the concentrations of metals in groundwater and surface water.

A minimum bench level (ie the lowest elevation at which extraction will take place) of 4 m AHD has been adopted in the West Valley Quarry preliminary study with a view to minimising the impacts associated with disturbance of acid sulfate soils, noting that the mapped acid sulfate soil risk area is generally below 2m AHD. The quarry footprint presented in the preliminary study does not extend into alluvial deposits or to the high risk acid sulfate soils areas. The drilling program to date has indicated that at elevations of 4m AHD significant siltstone resources are likely to be present in the southern and western extents of the West Valley footprint and hence activities at this bench level may be limited to these areas rather than extending towards the alluvial deposits even though the preliminary study shows the quarry footprint extending to the east of a portion of the haul road in the southern section of Lot 26, (see Figure 8) This issue will be investigated further during detail design of the quarry, at which point further definition of the extractive resource may prove that is not economically feasible to quarry to this eastward extent.

Haul Road

A 500 m section of the haul road between CH600 and CH1100 which is predominantly below 2m AHD elevation falls within the high risk acid sulfate soils area. Whilst the road will be built up to a level to provide flood immunity in an ARI 100 year event, this section will require further investigation during detail design to ensure that acid sulfate soil management requirements for construction of the road and any associated culvert are adequately identified and planned for.

Concept Plan

The mapping and investigations to date suggest that alluvial deposits in lower lying areas at the eastern end of the North Valley may display similar acid sulfate soil conditions to that in the lower lying areas to the east of the West Valley Quarry footprint. Whilst the assumed development footprint for the North Valley does not fall within a mapped acid sulfate soil risk area, this area will form a constraint to future design of the quarry footprint (ie there will be no quarrying within mapped acid sulfate soils risk areas). Taking into account the preliminary nature of investigations for the North Valley component of the Concept Plan to date, further investigation of acid sulfate soil potential would be required during the design of the North Valley Quarry and landfill footprint.

For the future landfill proposed in the West Valley, the design concepts adopted for the Quirks Quarry Landfill will apply as minimum requirements subject to future regulatory conditions and best practice design and operation.

9.3.4 Mitigation Measures

Additional Investigations – Stage 1 Project Application

The Environmental Management Plan (EMP) in Gilbert and Sutherland (2007) is intended to provide "a framework to ensure that the potential impacts of the proposed quarrying and landfilling activities at Councils land at Eviron, NSW, are managed, monitored, reported and if necessary mitigated". It is also acknowledged by Gilbert and Sutherland (2007) that it is not necessarily within the scope of the document to detail the full extent of each issue. The management plans presented (acid sulfate soil identification and acid sulfate soil treatment) are based on the limited preliminary acid sulfate soils investigation data for the site. It is considered that as detail design progresses for the Stage 1 Project Application that further investigation is required to revise the management plan given that:

- The management plans have been developed based on investigation of only three locations, which may not be within areas of proposed disturbance;
- The existing management plan for treatment (neutralisation) of the soils does not consider leachate management, treatment or disposal control measures; and
- The management plan does not include estimates of the volumes of material to be treated and level of treatment required.

To minimise delays during the site establishment the required ASS investigations will be carried out prior to development of the area although this is not stipulated in the ASSMAC guidelines. Therefore the investigations will be undertaken as part of the detailed design for the Stage 1 Project Application. These investigations would help to better constrain the level of treatment required to neutralise ASS material at the site, may identify areas of lower and higher potential for ASS and may reduce the amount of material requiring treatment.

Quirks Quarry Landfill

No further soil or rock excavation below the finished quarry floor levels will be undertaken for the preparation of the site in the mapped acid sulfate soil risk area. Base levels of the landfill cells range between 6m AHD (Stage 1B) and 2m AHD (lowest level of Stage 2 to allow for gravity feeding of a leachate sump). Therefore further investigation of acid sulfate soils are not warranted for this area. However ongoing groundwater monitoring will continue in the monitoring bores up and downgradient of the activity footprint.

West Valley Quarry and Haul Road

Based on the conceptual quarry footprint and current preliminary acid sulfate soil characterisation further investigations should include:

- 5 boreholes to a minimum elevation of 3m AHD between CH600 and CH1100 of the haul road. The number of boreholes nominated takes into account the minimum sampling density recommended by the ASSMAC guidelines for linear development and also the fact that levels will be raise as opposed to lowered (ie excavation of AASS or PASS)
- Geological logging of all investigation locations;
- Sample selection for rapid pH screening and for laboratory analysis suites; and
- Analysis of the investigation results and preparation of a report which will feed into the Acid Sulfate Soil Management Plan.

Given that the quarry footprint is located outside of the mapped acid sulfate soil risk area and quarry activities will not be undertaken below 4m AHD no further investigation within the quarry footprint itself are recommended.

If required the design of a PAF management system for the site will follow detailed drilling, testing and delineation of the PAF material which will be conducted as part of the detailed design for the quarry. In addition to avoiding disturbance or drainage of PAF, typical management options would be based on:

- Maintaining saturated conditions to exclude oxygen and prevent oxidisation;
- Excluding air to prevent oxidisation;
- Capping to exclude water, to prevent leachate generation, by separate cell construction or storage in or beneath post-quarry landfill;
- Carbonate-rich capping, to develop alkaline infiltration to neutralise leachate and coat sulfide grains to reduce oxidisation (passivation);
- Direct neutralisation of potential acidity of excavated PAF material; or
- A combination of the above.

Additional soil and rock testing for net acid generation (NAG) and net acid potential (NAPP) and metallic elements will be undertaken during detail design together with geotechnical investigations.

Additional hydrogeological assessment will also be performed, based on water level data from all existing monitoring bores and core holes, to assess the final post-operation water table, to determine if significant quantities of PAF will be drained in-situ, leading to additional risk of AMD generation.

Stage 1 ASS Management Plan

Based on the findings of the additional investigations an Acid Sulfate Soil Management Plan will be prepared for the activities comprising the Stage 1 Project Application. The ASSMP will be prepared during detail design and will be based on adequate information to develop mitigation strategies to manage the ASS with certainty (i.e. should include sufficient investigation data and consider the development of the design for the proposed activities)

The method put forward in the existing management plan for identification of acid sulfate soils (all soils excavated from below RL 5 mAHD will be sampled at each colour or texture change with a minimum of 1 sample per 1000 m^3) is not in accordance with ASSMAC (1998) guidelines. This issue will be addressed in the new management plan such that it is in accordance with the guidelines.

The method proposed in the current management plan for the treatment of acid sulfate soils includes a (lime) treated soil verification testing sampling density of 1 sample per 1000 m^3. This validation sampling density will be reviewed following the additional investigations during detail design given that the validation sampling density depends on the level of treatment required to neutralise the soils and also on the soil type.

Stage 1 Design Concepts and Issues

As discussed within the impact assessment and additional investigation sections above the Quirks Quarry Landfill Concept Design and West Valley Quarry Preliminary Study have incorporated a number of design concepts to address acid sulfate soil impacts which will be further refined during detail design on the basis of the additional investigations and monitoring:

Quirks Quarry Landfill

- No extraction of soil or rock below the finished quarry floor levels will be undertaken in the mapped acid sulfate soil risk area to minimise disturbance to alluvial deposits which may be present at the northern end of the landfill footprint;
- Based on the fact that the adopted base levels are consistent with the quarry floor and that dewatering operations are not currently required for Quirks Quarry, it is unlikely that further dewatering will be required that would result in localised lowering of the water table and oxidation of potential or actual acid sulfate soils;
- Clay required for the landfill liner will not be sourced from alluvial deposits, however clay from the upper benches of the West Valley may be suitable subject to geotechnical testing (including permeability). It is also likely that additional offsite clay resources may be required for the landfill liner; and

- A groundwater monitoring program which includes acid sulfate soil indicators will continue through design and operation of the landfill.

West Valley Quarry

- At the current concept planning level, quarry extraction has been limited to a minimum elevation of 4m AHD in the West Valley. However refinement of the quarry footprint and quarry resource during detail design together with additional acid sulfate soil investigations is likely to limit the eastern extent of quarrying to reduce the proximity to areas of alluvial/marine deposits which contain lower economic value resources and have the potential to exacerbate environmental impacts associated with the quarry operation; and
- A groundwater monitoring program which includes acid sulfate soil indicators has been proposed will continue through design and operation of the quarry.

Groundwater Monitoring

As discussed in Section 9.2 a groundwater monitoring program has been recommended for the site for the purposes of collecting baseline data for both hydrogeological and groundwater quality purposes which includes parameters which are considered indicators of acid sulfate conditions.

Concept Plan

Acid sulfate soil mitigation measures for activities associated with the broader Concept Plan will be developed as part of concept and detail design of the potential future landfill in the West Valley and quarry and landfill in the North Valley. Investigation of acid sulfate soil conditions in the lower lying alluvial deposits in the North Valley will be required, however the current conceptual quarry footprint is not within a mapped acid sulfate soil risk area. As a minimum the design concepts, mitigation, management and monitoring requirements outlined for the Stage 1 Project Application will apply to the Concept Plan subject to future regulatory conditions, technological advances and best practice requirements.

9.4 Noise, Blasting and Vibration

The information presented in this chapter is based on the findings of the noise and vibration assessment undertaken by GHD. The noise and vibration assessment report is included in Appendix I of this environmental assessment.

The DGR's identified that noise from excavation works, blasting operations, landfilling activity and heavy vehicle movements is the primary concern for noise and vibration impacts. Overall the outcome sought by Council is that the design, construction and operation of the facilities cause no adverse noise or vibration related impacts to sensitive receptors and that the noise emitted from the operations assessed shall be in accordance with the NSW Governments Industrial Noise Policy (INP).

9.4.1 Methodology and Approach

Modelling of Existing Noise Environment

Attended and unattended noise monitoring was conducted by GHD at a number of identified noise sensitive receptors. The purpose of noise monitoring was to determine the existing noise levels in the area, which will assist in setting operational noise goals for the project. 7 Day unattended noise monitoring was undertaken at two residential properties in close proximity to the site. These locations were chosen as appropriate locations to represent the ambient noise environment of the area and also to provide a secure location to noise monitoring equipment. Short-term attended noise monitoring was also undertaken at the same locations.

Unattended noise monitoring was undertaken using two Acoustic Research Laboratories (ARL) EL 215 environmental noise loggers.

Predictive Noise Model Configuration

The attended and unattended noise monitoring results were used to develop an acoustic model for the project. Acoustic modelling was undertaken using Computer Aided Noise Abatement (Cadna-A) to predict the noise levels generated from the proposed Quarry and Landfill. Cadna-A is a computer program for the calculation, assessment and prognosis of noise propagation. Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

Detailed topography data was supplied for use in the noise model for the existing Quarry site as well as surrounding residential areas. The vertical resolution of the topographic contours varied between 0.25 and 10 metres. Where required, ground topography data was manipulated to provide a reasonable representation of future quarry or landfill sites. All sensitive receivers were modelled 1.5 m above ground level.

Noise modelling was undertaken for each of the site configurations likely throughout the operational life of activities outlined in each Stage of the proposed Concept Plan. Based on the proposed project time line, only one quarry and one landfill would operate at any given time. Therefore, three site configurations were modelled:

- Configuration 1: Quirks Landfill and West Valley Quarry. Stage 1 of the proposed Concept Plan (2012 – 2021).

- Configuration 2: West Valley Landfill and North Valley Quarry. Stage 2 of the proposed Concept Plan (2022 – 2033).
- Configuration 3: North Valley Landfill only (2034 – 2045). Stage 3 (or subsequent).

Blasting and Vibration

Council provided GHD with a blast monitoring report from vibration monitoring of blasts from the nearby Quirks Quarry undertaken in July 2008. Estimations for ground vibration and airblast overpressure during blasting were made with consideration to Australian Standard AS2187.2–2006.

Meteorological Conditions

A regional-scale prognostic meteorological model, The Air Pollution Model (TAPM V 4), was utilised to simulate the wind climate over the site with consideration to DECCW *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, August 2005. TAPM was used to produce representative hourly surface and upper air meteorological data as part of the air quality assessment and the resulting data was used for input in the noise assessment. Further information on the use of TAPM can be found in the Air Quality Technical report in Appendix J.

Weather data was obtained from the Bureau of Meteorology automated weather station located at the Coolangatta Airport, which is situated approximately 10 km north-east of the subject site. This data was considered to be adequate for the purpose of filtering high wind events and rainfall from the noise data set in the absence of site-specific data.

Road Traffic Noise Assessment

In order to gain an understanding of the existing levels of traffic noise along these roadways, traffic noise modelling was undertaken. Road traffic noise modelling was undertaken with consideration to the Calculation of Road Traffic Noise (CoRTN) algorithm, developed by the United Kingdom Department of Transport (1998).

Limitations

It is not the intention of the assessment to cover every element of the acoustical environment, but rather to conduct the assessment with consideration to the prescribed work scope. It is the nature of environmental monitoring that not all variations in environmental conditions can be assessed and all uncertainty concerning the conditions of the ambient noise environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

9.4.2 Existing Environment

Sensitive Receivers

Sensitive receivers for the purpose of the noise and vibration assessment were defined as residential premises. A number of rural residential properties are located along Eviron Road to the south-east and west of the proposed quarry. An aerial photograph showing the location of the proposed activities in Stage 1 and the broader Concept Plan, the existing landfill and quarry and nearby sensitive receptors is shown in Figure 27. Details of the nominated sensitive receivers are also shown in Table 9-13. It is noted that Lot 25 on DP 615931 was not considered a sensitive receiver as this property was acquired by Council.

Table 9-13 Noise and Vibration Sensitive Receivers

Sensitive Receivers	Address Details	Property Details
Receiver 1	751 Eviron Rd, Eviron	Lot 30 on DP 820048
Receiver 2	157 Hawkens Ln, Eviron	Lot 2 on DP 705781
Receiver 3	656 Eviron Rd, Eviron	Lot 25 on DP 615931
Receiver 4	657 Eviron Rd, Eviron	Lot 1 on DP 783802
Receiver 5	726 Eviron Rd, Eviron	Lot 30 on DP 706846
Receiver 6	10 Donalyn Crt, Duranbah	Lot 501 on DP 1000612
Receiver 7	Eviron Rd, Duranbah	Lot 603 on DP 1001049

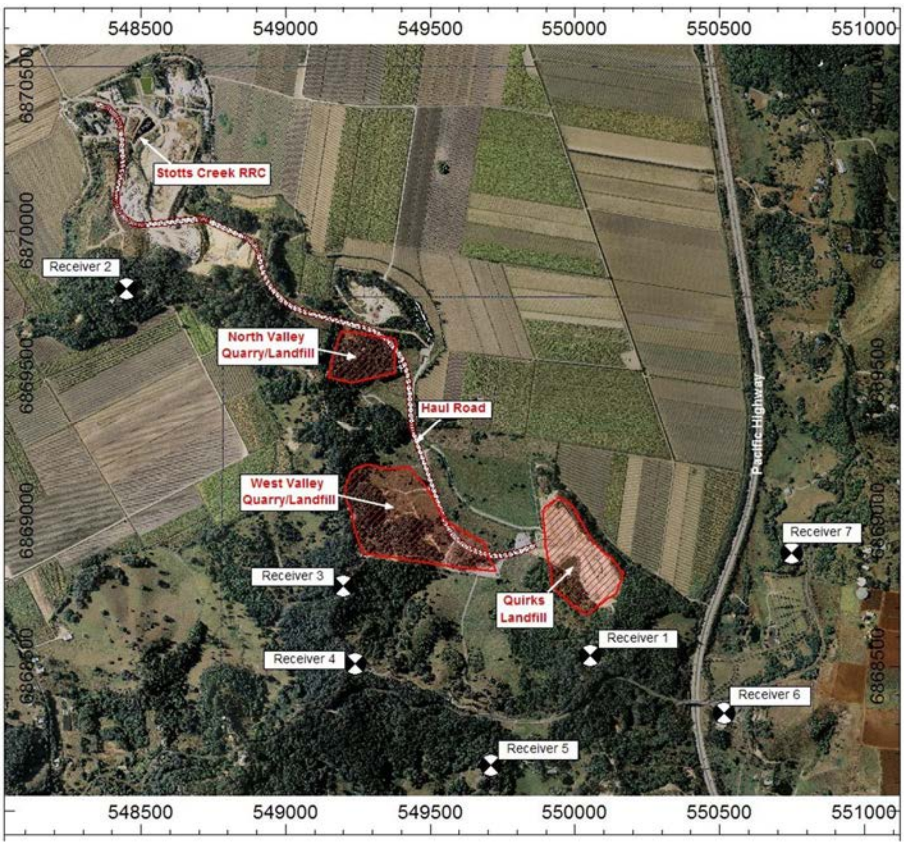


Figure 27 Noise Sensitive Receivers

Unattended Noise Monitoring Results

Unattended noise monitoring was undertaken using two Rion NL-22 environmental noise loggers. These loggers are capable of measuring continuous sound pressure levels and are able to record L_{A90}, L_{A10}, L_{Aeq} and L_{Amax} noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period from March 4 to March 13 2011.

Table 9-14 presents a summary of the long-term noise monitoring data in terms of the "Rating Background Level" for the two monitoring locations. This represents the overall single figure background noise level for day, evening and night for the entire monitoring period. Further details are provided in Appendix I.

Table 9-14 Summary of Unattended Noise Monitoring Results

Location	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Lot 19 Hawkens Lane	42	43	42	49	53	48
656 Eviron Road (Receiver 3)	42	42	38	53	53	47

Attended Noise Monitoring Results

Attended observations of noise levels were recorded at the two monitoring locations (on a minimum of two occasions each). The monitoring noted that existing levels of industrial noise in the area are not a significant contributor to the existing ambient noise level in the vicinity of the development. The results of attended monitoring together with specific comments on the various contributions within existing noise environment (eg road traffic, quarrying, landfilling, local animals and insects) are shown in Table 9-15.

Table 9-15 15-Minute Attended Noise Monitoring Results

Monitoring Location and Description	Start time	$L_{Aeq, 15 minute}$	$L_{A90, 15 minute}$	Weather Conditions	Comments on Noise Environment
Lot 19 Hawkens Lane	09:30 04/03/11	43	41	◗ Temp 24 °C, ◗ Wind - calm ◗ Cloud cover 8/8	◗ Rural environment with local animals and nearby insects audible at times. ◗ Distant traffic noise on Pacific Highway audible during measurements (approx. 40 – 43 dB(A)). ◗ Quirks Quarry not audible during measurements. ◗ Landfill operations were barely audible but were audible on occasions for short bursts i.e. less than one minute (approx. 43 – 48 dB(A)).
	13:30 22/03/11	52	40	◗ Temp 33 °C, ◗ Wind NW <1 m/s ◗ Cloud cover 4/8.	◗ Quirks Quarry occasionally audible but generally not measurable above background (approx. 40 dB(A)). ◗ Local insect/bird noise approx. 45 – 55 dB(A). ◗ Distant traffic noise on Pacific Highway was audible during measurements (approx. 39 – 43 dB(A)).
656 Eviron Road (Receiver 3)	12:15 04/03/11	53	44	◗ Temp 26 °C, ◗ Wind - calm ◗ Cloud cover 8/8	◗ Local animals and nearby insects were audible. ◗ Distant traffic noise on Pacific Highway was audible during measurements (approx. 41 – 43 dB(A)). ◗ Quirks Quarry trucks and loader reverse alarm audible but generally not measurable above background noise level (approx. 43 – 45 dB(A)). ◗ Landfill operations not audible.
	13:00 04/03/11	52	42		

Monitoring Location and Description	Start time	$L_{Aeq,}$ 15 minute	$L_{A90,}$ 15 minute	Weather Conditions	Comments on Noise Environment
	14:00 22/03/11	49	41	◗ Temp 34 °C, ◗ Wind - calm to NW <1 m/s ◗ Cloud cover 4/8.	◗ Distant traffic noise on Pacific Highway was audible during measurements (approx. 39 – 43 dB(A)). ◗ Quirks Quarry trucks and loader reverse alarm audible but generally not measurable above background noise level (approx. 40 – 45 dB(A)). ◗ Local insect/bird noise approx. 45 – 55 dB(A). ◗ Landfill operations not audible.

Meteorological Conditions

Analysis of wind data indicated that that source-to-receiver wind of 3 m/s or below does not typically occur for greater than 30% of the time in any period (day, evening, night) in any season. Therefore, with consideration to the requirements of the Industrial Noise Policy (INP), wind was not included in the noise-prediction calculation. Daytime (7 am to 6 pm) seasonal wind roses for the study area were provided Figure 10 Section 3.3.

Noise Emissions - Existing Equipment

Measurements of noise emissions associated with quarry and landfill equipment were conducted at the time of the background noise monitoring fieldwork in 2009 and again in March 2011. Emissions for landfill equipment were measured at the Stotts Creek RRC. It is understood that similar equipment currently in use at these facilities would be used at the proposed facilities at Eviron Road.

Sound power levels (L_W) for all identified noise sources are based on field measurements or, where measurement data were not available, typical noise levels produced by equipment anticipated to be used on site were sourced from BS 5228-1:2009 *Code of Practice for Noise and Vibration on Construction and Open Sites Part 1: Noise.* This standard provides sound measurement data based on measurements of individual plant and equipment at quarry sites. This standard is also referenced in DECCW's Interim Construction Noise Guideline (July 2009).

Road Traffic Noise

With only a few residential houses within the Leddays Creek road catchment area background traffic is limited with the majority of traffic being from the existing Stotts Creek RRC. According to traffic data provided by Council peak traffic along Tweed Valley Way occurs at 8:00 – 9:00 AM and 3:00 – 4:00 PM.

Key statistics for the following locations are summarised in Table 9-15 (over page) :

- Entrance to Stotts Creek RRC (Leddays Creek Road).
- Eviron Road (off Duranbah Road).
- Tweed Valley Way (north of the southern entrance to Tumbulgum).

Therefore, in order to gain an understanding of the existing levels of traffic noise along these roadways, traffic noise modelling was undertaken. Road traffic noise modelling was undertaken with consideration to the Calculation of Road Traffic Noise (CoRTN) algorithm, developed by the United Kingdom Department of Transport (1998).

There is only one identified receiver in the vicinity of Leddays Creek Road, which is located close to the entrance to the Stotts Creek RRC. It is understood this property is owned by Tweed Shire Council but is used for residential purposes.

Table 9-16 Existing Two-Way Traffic Conditions

Time Period	Entrance to Stotts Creek RRC (Leddays Creek Road)	Eviron Road	Tweed Valley Way
ADT – Weekday	625	345	10698
ADT – Weekend	425	390	10449
ADT – 7 days	568	358	10321
% Heavy Vehicles	31%	12%	6%
AM Peak	75	38	893
PM Peak	79	43	1001

9.4.3 Noise and Vibration Assessment Criteria

Operational Noise Criteria

Operational noise criteria, applicable to site noise sources, were determined with consideration to the INP, which provides guidance on the assessment of operational noise impacts. The guidelines include both Intrusive and Amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver. Intrusive noise limits set by the INP control the relative audibility of operational noise compared to the background level. The amenity criteria limit the total level of extraneous noise.

Attended observations noted that existing levels of industrial noise in the area are not a significant contributor to the existing ambient noise level. Site observations indicated that the existing Quirks Quarry was audible, at times, during operations. However, noise levels from the above sources would typically be intermittent, resulting in no applicable noise penalty over the daytime period. This intermittency of noise is highly unlikely to effect the RBL's measured by the noise loggers, which showed no difference in daytime L_{A90} levels between Sunday (quarry not operating) and Weekdays (quarry operating normally). As the RBL's were unaffected and with the planned closure of the existing quarry, no INP Table 2.2 adjustments were made in determining noise goals.

On the basis of the noise monitoring, modelling and provision of the INP the adopted project specific noise goal at all sensitive receivers is 47 dB(A) $L_{Aeq(15\ min)}$.

Road Traffic Noise Criteria

All changes in traffic flows on public roads must be assessed with consideration to the DECCW's Environmental Criteria for Road Traffic Noise (ECRTN). The quarry activities associated with the project has the potential to increase traffic on Leddays Creek Road and Tweed Valley Way since the existing site access from Eviron Road will be replaced with access directly to and from Leddays Creek Road. These roads could be considered both local roads (Leddays Creek Road) and freeway/arterial roads (Tweed Valley Way and Pacific Highway).

Therefore, the specific project falls under more than one of the ECRTN development types. Table 9-17 lists the "base" target road traffic noise criteria, as per Table 1 of the ECRTN.

Table 9-17 Road Traffic Noise Criteria

Type of Development	Criteria		
	Day (7am–10pm)	Night (10pm–7am)	Where Criteria are Already Exceeded
7. Land use developments with potential to create additional traffic on existing freeways/arterials.	$L_{Aeq(15hr)}$ 60 dB(A)	$L_{Aeq(9hr)}$ 55 dB(A)	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria. Possible applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments.
13. Land use developments with potential to create additional traffic on local roads	$L_{Aeq(1hr)}$ 55 dB(A)	$L_{Aeq(1hr)}$ 50 dB(A)	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments.

Blasting and Vibration Criteria

Vibration from General Activities

Guidance of limiting vibration values for general quarry activities has been taken from the following standards and guidelines:

- DEC(NSW) *Assessing Vibration: A Technical Guideline.*
- British Standard BS 7385.2 – 1993 *Evaluation and Measurement for Vibration in Buildings, Part 2 - Guide to damage levels from ground borne vibration*; and
- British Standard BS 6472 – 1992 *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*.

The BS 6472 human comfort peak vibration limits are shown in Table 9-18 for the frequency range of 1 Hz to 80 Hz, which is applicable to quarry activities. These values are limits that may cause loss of amenity to the occupant of a building.

Table 9-18 BS 6472 Human Comfort Vibration Limits from 1 Hz to 80 Hz (mm/s PPV[1])

Receiver type	Period[2]	Continuous Vibration		Intermittent and Impulsive Vibration	
		Preferred	Maximum	Preferred	Maximum
Residential	Day	0.28	0.56	8.6	17
	Night	0.2	0.4	2.8	5.6

[1] Based on sinusoidal vibration sources.

[2] Day is between 7 am and 10 pm and night is between 10 pm and 7 am.

Under typical operating conditions within the quarry and landfill together with the minimum separation distance of at least 50 m to the nearest receivers, vibration impacts from general operations should be negligible. Vibration impacts from blasting are discussed further below.

Blasting Vibration and Overpressure

The ANZECC *Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* has been adopted for assessment of blasting noise and vibration impacts in this report. This guideline specifies recommended human comfort criteria for blasting activities.

The ANZECC recommended maximum level for airblast overpressure is 115 dB(L) peak. This level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the airblast overpressure must not exceed 120 dB(L) peak for any blast.

Ground-borne vibration level should not exceed 5 mm/sec Peak Particle Velocity (PPV). The recommended PPV level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 10 mm/sec at any time.

ANZECC guideline recommends that blasting should only be permitted during the following hours:

- Monday to Saturday, 9am to 5pm.
- No blasting on Sundays or Public Holidays.

The frequency of blasting should not take place more than once per day. This requirement does not apply to minor blasts.

The abovementioned restrictions on times and frequency of blasting do not apply to premises where the effects of the blasting are not perceived at noise sensitive sites.

9.4.4 Impact Assessment – Stage 1

Noise Modelling Scenarios and Assumptions

The noise model was configured based on the following assumptions:

- Layout of fixed processing plant (e.g. crushers, screens and conveyors) at each of the proposed quarries was based on the layout at the existing Quirks Quarry.
- Landfill and quarry plant and equipment were modelled as operating a various percentages of time based on current 'worst-case' operations.

- A maximum of two mobile plant items at each landfill would operate simultaneously and continuously over a 15-minute assessment period. Based on existing landfill operations at Stotts Creek RRC, only one of the following pairs of equipment would operate at any time:
  - Dozer and dump truck.
  - Excavator and dump truck.
  - Dozer and compactor.

  As a conservative measure, the worst-case pair of one dozer and one dump-truck was modelled.
- Heavy vehicles on the internal haul road between Stotts Creek RRC and Quirks Landfill would be within the site boundaries and have been considered as part of site noise and been included in the assessment against the INP. Due to the low vehicle numbers, vehicles along the haul road were modelled as a series of point sources, rather than a roadway. A maximum of up to 15 heavy vehicles per hour was modelled along the haul road. A more detailed description of traffic generation is discussed in the Noise Impact Assessment Report in Appendix I.

Noise Model Validation

In order to validate the noise model and assumptions made, model sound pressure level predictions were compared against attended measurement data taken near the Quirks Quarry site office during operations of the existing quarry. Although this assessment is focused on noise from future activities on this site (Quirks Quarry Landfill) and quarry/landfill activities on different sites (West Valley and North Valley) validating the noise model under the current and existing conditions has provided confidence in predicting future noise levels from the site.

The noise model was configured to represent the operations during measurements based on the recorded sound power data for the various pieces of equipment. A comparison of the measured and predicted noise levels under the same site operations show a close correlation (less than 1 dB difference). Therefore, the noise model is shown to have an acceptable degree of accuracy and predictions can be made of future operations with confidence.

Predicted Operational Noise Impacts

Modelled overall sound power levels for the quarry and landfill are summarised in the technical report in Appendix I. Table 9-19 summarises the predicted noise levels at each identified sensitive receiver under neutral weather conditions for the combined activities of the Stage 1 Project Application.

Noise levels have been predicted with and without the use of the hard rock drill. Noise levels for normal operations (without hard rock drill) have also been predicted at the end of Stage 1 where the quarry pit will be at its lowest point and the landfill would be at full capacity. This has provided a guide as to the change in noise levels as the landscape of the quarry and landfill evolve and noise sources become more or less exposed to sensitive receivers.

The adopted project specific noise goal at all receivers is 47 dB(A) L_{Aeq}.

Table 9-19 Predicted Operational Noise Levels Stage 1 – dB(A)

Model Configuration	Scenario [1, 2]	Receiver						
		R1	R2	R3	R4	R5	R6	R7
West Valley Quarry and Quirks Landfill	Without drill at open	44	40	**49**	39	27	34	43
	With drill at open	44	41	**50**	40	27	34	43
	Without drill at close	46	37	45	37	26	40	46

[1] Open scenario refers to the equipment height at quarry and landfill opening. i.e. Quarry is at existing ground level and landfill is at previous quarry pit level.

[2] Close scenario refers to the equipment height at quarry and landfill close. i.e. Quarry is at lowest pit level and landfill is at maximum capacity (assumed to be approximately natural ground height).

The predicted noise contours “without drill at open” scenario which represents the most typical daily operations is presented in Figure 28.

Figure 28 Stage 1 Noise Modelling Results

The separate contribution of the Stage 1 quarry and landfill at each of the sensitive receivers has also been analysed. A comparison of contribution levels show that, upon opening, the quarry is generally the controlling noise source when compared to the landfill. However, as the landscape of the quarry and landfill change into the future, the noise contributions are shown to reverse, with the landfill becoming the controlling noise source at most sensitive receivers. This change is purely due to the level of exposure of equipment as they are increasingly or decreasingly shielded by local topographical features, such as the active quarry face.

It should also be borne in mind that mobile machinery would likely move about, variously altering the directivity of the noise source with respect to individual receivers. During any given period the machinery items to be used on site would operate at maximum sound power levels for only brief stages. At other times the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all equipment would be operating at their maximum sound power levels at any one time. Therefore, the model results are considered to be conservative. Furthermore, the final layout of fixed plant at the West Valley Quarry will be determined during subsequent phases of design and will take into account the results of the modelling.

Overall the noise model results for the Stage 1 activities indicate the following:

- Noise levels from normal operations of the West Valley Quarry and Quirks Landfill are expected to meet the daytime criteria at all identified residential receivers, except for at Receiver 3 (656 Eviron Road) where a potential 2 dB exceedance is predicted. Analysis of the noise contribution data shows the quarry processing plant to be the dominant source of noise at this receiver.
- The operation of the hard rock drill has potential to increase noise levels by up to 1 dB(A), causing a further exceedance at Receiver 3. Noise levels at all other receivers are predicted to remain below the adopted criteria.
- As the landscape of the quarry and landfill change, the contributions of individual sources are also changed. As the quarry pit deepens and the quarry processing plant becomes more shielded by the active wall, noise levels at all receivers are predicted to reduce and comply with the adopted goals.

Road Traffic Noise

Traffic generation and traffic impacts are discussed in detail in Section 9.8 and Appendix M. Overall it is noted that the traffic generation has been assumed based on information on expected maximum quarry outputs and expected maximum landfill intake. All facilities as part of the Concept Plan will use the same access and route to Tweed Valley Way, via the Stotts Creek RRC and Leddays Creek Road.

The expected traffic generated by landfill activities has been assumed to be directly proportional to the maximum landfill waste acceptance rates. During Stage 1, a peak of seven heavy vehicles and 48 light vehicles per hour are expected. The traffic levels associated with the landfill component are currently already accounted for within the existing road network (i.e. due to the presence and use of the existing Stotts Creek RRC). The expected growth rate would be consistent with traffic on any road network.

Whilst the quarry haulage regime will be highly variable and dependent of the availability and demand for quarry resource an average traffic generation of 26 vehicles a day has been adopted. This has been derived from the expected tonnages and average capacity of a truck and dog trailer. A daily traffic generation of 26 trucks would equate to 3 vehicles during peak hour. Traffic associated with site employees would contribute ten vehicles during peak hour.

Table 9-20 shows the existing and expected increase in road traffic during AM and PM peak hour periods at project opening.

Table 9-20 Predicted Increases in Road Traffic Noise at Project Opening

Roadway	Peak	Existing		Generated [1]		% Increase in Total Traffic[2]	Increase in Noise Emission Level (dB)
		HV	LV	HV	LV		
Leddays Creek Road	AM	23	52	3	10	17%	0.7
	PM	25	54	3	10	16%	0.7
Tweed Valley Way	AM	54	839	3	10	1%	0.1
	PM	60	941	3	10	1%	0.1

[1] Generated traffic was derived from Quarry operations only since Landfill traffic is part of existing vehicles. HV denotes Heavy vehicles and LV denotes Light Vehicles.

[2] Generated traffic during peak hour is expected to comprise of the same proportion of heavy vehicles as currently exist (approximately 30% on Leddays Creek Road).

Long term road traffic noise monitoring was not undertaken in the areas surrounding the site. Therefore, in order to gain an understanding of the existing levels of traffic noise along these roadways, traffic noise modelling was undertaken. Road traffic noise modelling was undertaken with consideration to the Calculation of Road Traffic Noise (CoRTN) algorithm, developed by the United Kingdom Department of Transport (1998).

There is only one identified receiver in the vicinity of Leddays Creek Road, which is located close to the entrance to the Stotts Creek RRC. It is understood this property is owned by Tweed Shire Council but is used for residential purposes.

Predictive modelling (including a 2.5 dB façade correction factor) indicated an existing daytime traffic noise level of 53 dB $L_{Aeq(1\ hour)}$, which is below the 55 dB $L_{Aeq(1\ hour)}$ traffic noise goal for local roads. Allowing for the expected increase in road traffic noise due to quarry vehicles entering and exiting via Leddays Creek Road results in a daytime road traffic noise level of approximately 54 dB $L_{Aeq(1\ hour)}$. Therefore, road traffic noise is expected to comply with the NSW ECRTN criteria for local roads and is expected to increase by less than 1 dB under Stage 1 of the Concept Plan.

Blasting and Vibration Impacts

GHD have adopted the results of the provided blast monitoring reports provided by Council for Quirks Quarry to use in predictions of the ground vibration and airblast over varying distances on the assumption that the blast parameters at Quirks Quarry would be representative of the conditions at the West Valley Quarry. GHD has adopted this information assuming that the blast procedure and vibration monitoring were undertaken with consideration to the relevant publications and standards.

Based on the assumptions provided in the Noise and Vibration Technical Report (See Appendix I), estimated ground vibration and airblast levels from blasting suggest that the recommended limits of 5 mm/sec and 115 dB(L) would be achieved at a minimum distance of approximately 230 m and 260 m respectively from the blast location.

It is noted however that adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods, therefore should not affect blasting during the recommended standard hours. Prevailing winds are generally from the southeast and southwest, which are generally away from the residential premises except for R2 and R3. To assist in the reduction of airblast overpressure propagation, blasting should not be conducted when the prevailing winds are blowing towards residential receivers.

It is therefore concluded that the vibration monitoring reports and subsequent predictions of airblast overpressure and ground vibration levels from blasting at West Valley Quarry indicate that the ANZECC blasting criteria should be achievable at the nearest sensitive receivers if recommended management measures are implemented.

On the basis of blast design and site parameters provided, the vibration criteria are met at the monitoring location for both ground vibration and airblast overpressure.

9.4.5 Impact Assessment - Concept Plan

The impacts associated with noise and vibration during subsequent stages of the project will be similar to those described above for Stage 1. Modelling of potential noise impacts has been undertaken for two possible site configurations associated with Concept Plan activities beyond Stage 1 has been undertaken, together with an assessment of potential road traffic noise. Further refinement of this modelling and additional background monitoring would be required once design and operational parameters are determined for Concept Plan activities.

Operational Noise Impacts

Table 9-21 summarises the predicted noise levels at each identified sensitive receiver under neutral weather conditions as was the case for Stage 1 modelling. Noise levels have been predicted with and without the use of the hard rock drill. Noise levels for normal operations (without hard rock drill) have also been predicted at the end of each Stage of the project (i.e. quarry pit at lowest point and landfill at full capacity). This has provided a guide as to the change in noise levels at the landscape of the quarry and landfill change and noise sources become more or less exposed to sensitive receivers.

The adopted project specific noise goal at all receivers is 47 dB(A) L_{Aeq}.

Table 9-21 Predicted Operational Noise Levels Concept Plan – dB(A)

Model Configuration	Scenario (1, 2)	Receiver						
		R1	R2	R3	R4	R5	R6	R7
West Valley Landfill and North Valley Quarry operating	Without drill at open	40	36	46	39	26	35	40
	With drill at open	41	41	**48**	41	27	36	41
	Without drill at close	39	34	**47**	38	22	33	39
North Valley Landfill only	Open	32	27	38	32	16	28	34
	Close	32	36	38	34	21	28	35

[1] Open scenario refers to the equipment height at quarry and landfill opening. i.e. Quarry is at existing ground level and landfill is at previous quarry pit level.

[2] Close scenario refers to the equipment height at quarry and landfill close. i.e. Quarry is at lowest pit level and landfill is at maximum capacity (assumed to be approximately natural ground height).

The predicted noise contours for each of these configurations is shown in Figure 29 and 30.

On the basis of the modelling, the following key points are noted:

- Noise levels from normal operations from the North Valley Quarry and West Valley Landfill are expected to meet adopted criteria at all identified residential receivers.
- The operation of the hard rock drill at North Valley Quarry has potential to increase noise levels by up to 5 dB(A), causing a 1 dB exceedance at Receiver 3 (656 Eviron Road). Noise levels at all other receivers are predicted to remain below the adopted criteria.
- As the landscape of the quarry and landfill change, the contributions of individual sources are also changed. As the quarry pit deepens and the quarry processing plant becomes more shielded by the active wall, noise levels at all receivers are generally predicted to reduce and comply with the adopted goals.
- At the time when North Valley landfill remains as the only activity onsite, operational noise levels are expected to readily comply with the adopted criteria at all identified residential receivers.
- As the landscape of the landfill changes, noise levels at receivers are predicted to increase slightly, but remain under the adopted noise goals.

Figure 29 Potential Noise Impacts Stage 2

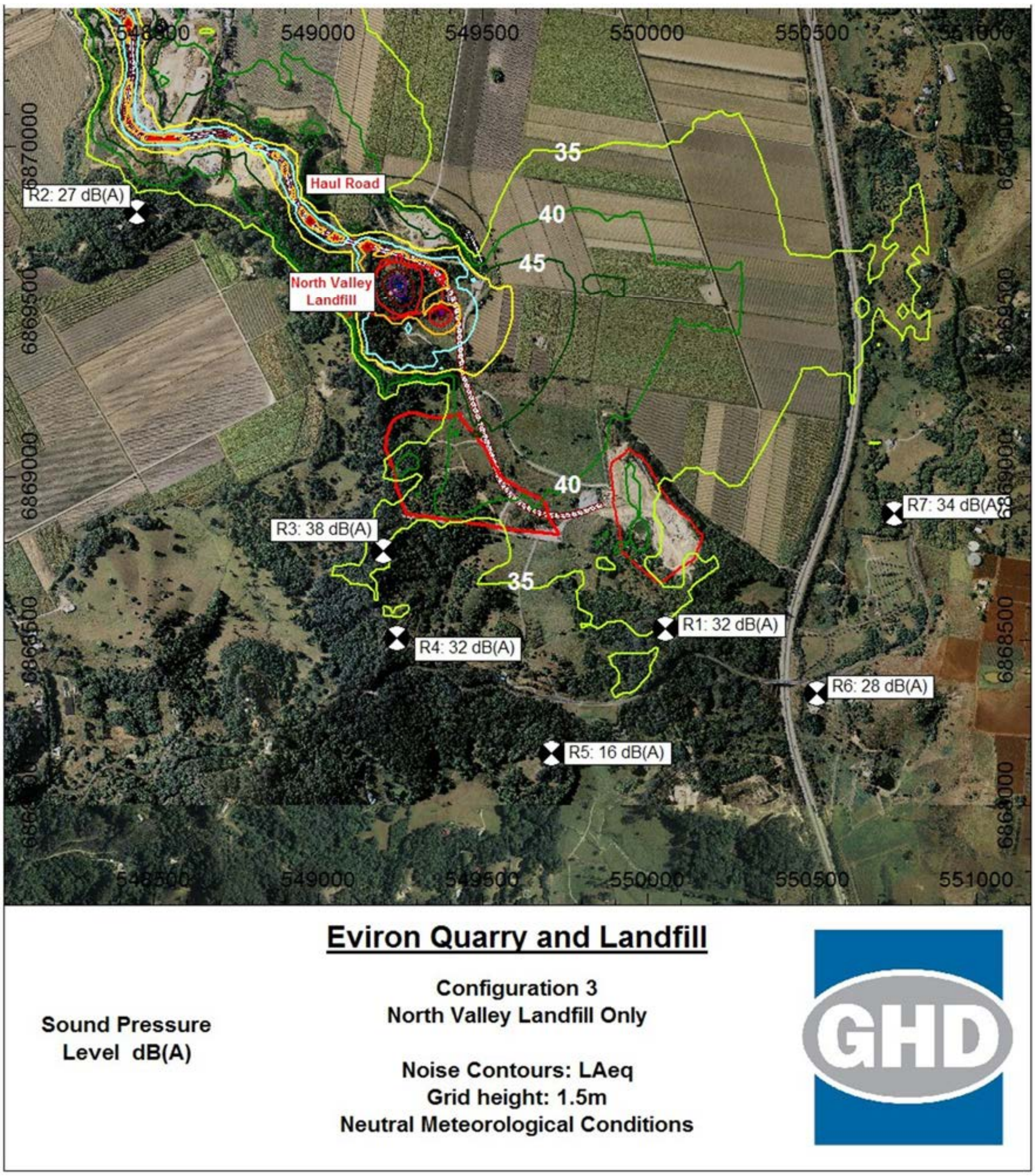


Figure 30 Potential Noise Impacts North Valley Landfill

For all stages of the Concept Plan, it should be borne in mind that mobile machinery would likely move about, variously altering the directivity of the noise source with respect to individual receivers. During any given period the machinery items to be used on site would operate at maximum sound power levels for only brief stages. At other times the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all equipment would be operating at their maximum sound power levels at any one time. Therefore, the model results are considered to be conservative (i.e. potential to overestimate noise impacts). Furthermore, the final layout of fixed plant at each quarry will be determined during detail design, therefore the modelled results should only be used as a guide for comparative purposes at this point in time. The model will be revised with future stages of development.

This Concept Plan study is based on the processes and technologies used in quarry and landfill activities at the time of this assessment. The assessment does not take into consideration emerging technologies in heavy vehicle machinery, resource recovery, alternatives to land filling and increased regulation of waste minimisation and landfill diversion targets. As the Concept Plan has an expected life of approximately 30 years, it is highly likely that improvements in technology will see a reduction in site noise emissions associated with the proposed activities.

Road Traffic Noise Impacts

The NSW ECRTN requires that road traffic noise levels be assessed at a period of 10 years after project opening. At this point it is expected that the Concept Plan would be progressed to Stage 2 with the West Valley Landfill and the North Valley Quarry both operating. The expected traffic noise increase for the 10 year predicted levels are shown in Table. The predicted increase in road traffic noise is expected to be less than 2 dB and total traffic noise levels should remain below the NSW ECRTN criteria for local roads.

Table 9-22 Predicted 10-Year Increase in Road Traffic Noise

Roadway	Peak Hour	Existing (1)		Generated (2)		% Increase in Total Traffic(3)	Increase in Noise Emission Level (dB)
		HV	LV	HV	LV		
Leddays Creek Road	AM	23	52	6	31	49%	1.7
	PM	25	54	6	31	47%	1.7
Tweed Valley Way	AM	54	839	6	31	4%	0.6
	PM	60	941	6	31	4%	0.6

[1] Existing traffic volumes were assumed to be equal to existing since the Concept Plan would generate the majority of traffic on Leddays Creek Road. This is conservative foe Tweed Valley Way as it does not account for annual traffic growth.

[2] Generated traffic was derived from West Valley Landfill and North Valley Quarry operations. The existing Stotts Creek Landfill traffic volumes were subtracted from the expected North Valley Landfill traffic to derive the growth in traffic from existing conditions. HV denotes Heavy vehicles and LV denotes Light Vehicles.

[3] Generated traffic during peak hour is expected to comprise of the same proportion of heavy vehicles as currently exist (approximately 30% on Leddays Creek Road).

With an increase in traffic volumes of approximately 1% on Tweed Valley Way, additional traffic generated as part of the Concept Plan is expected to have negligible impact on traffic noise levels.

9.4.6 Mitigation Measures – Stage One

The proposed quarry and landfill operations for Stage 1 are currently in the concept design phase only and uncertainty regarding the final choice and layout of equipment remains at this juncture, which has necessitated the assumptions made in the noise and vibration assessment. Additional attended noise monitoring be undertaken at Receivers 1 and 2, upon opening and commissioning of the quarry and landfill in Stage 1 to verify the findings of this assessment. Results of attended noise measurements will also assist in determination of requirements for any noise control measures, should they be required.

In addition to the specific noise mitigation measures mentioned throughout this report, to further ameliorate potential noise impact, the following noise mitigation measures will also be implemented:

Work Ethics

All activities on site should be confined between the hours of 7:00 am to 5:00 pm from Monday to Friday and 7:00am to 12:00pm on Saturday. In addition it is noted that quarry blasting activities will be limited to 9:00am to 3:00pm Monday to Friday and 9:00am to 12:00pm Saturday. In addition haul trucks will not arrive on site (or depart it) before 7:00 am.

Site Machinery

- Review available fixed and mobile equipment fleet and prefer more recent and silenced equipment whenever possible. In any case, all equipment used on site should be in good condition and good working order;
- Plan to use equipment, which is appropriate for the required tasks in terms of power requirements;
- All engine covers should be kept closed while equipment is operating;
- As far as possible, materials dropping heights into or out of trucks should be minimised;
- All combustion engine plant should be checked to verify they produce minimal noise with particular attention to residential grade exhaust silencers;
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable;
- Where practical, machines should be operated at low speed or power and should be switched off when not being used rather than left idling for prolonged periods;
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made;
- Although the model assumptions were deemed conservative, it is recommended that equipment noise levels be monitored once the Quarry and Landfill are operating to verify noise emissions are in line with the model assumptions; and

- It is also recommended that attended noise measurements be undertaken under a variety of weather conditions at identified noise receivers upon commission of the Eviron Landfill and Quarry Site. Attended noise measurements will allow for the validation of predicted noise levels. This, in turn will more accurately represent the site noise levels and confirm whether or not specific noise control measures are required.

Specific Noise Control Measures

- The hard rock drill has been identified as a significant noise source within the quarry equipment list. Although its operation is expected to be limited, it has potential to cause short-term noise impacts at the nearest receivers. Therefore, the use of other quarry equipment, such as the processing plant and dozer will be limited (or ceased) during times when drilling is occurring. This will assist in minimising the cumulative noise impact on nearby receivers.
- The quarry processing plant is also identified as a significant noise source during normal operations. Therefore, specific noise mitigation measures will be implemented at West Valley Quarry to reduce the impacts of noise from the processing plant. Potential options include the following, however the feasibility will be reviewed during detail design when the quarry layout is developed, such that the most practical option can be adopted:
  - Locating the processing plant in locations on site which are naturally shielded by the existing topography will also assist in minimising noise impacts. A potential reduction of up to 5 dB is likely to be achieved through this method.
  - As a last resort, treating the building facades of affected receivers will assist in minimising internal noise. Building treatments should generally be considered only when other measures, such as noise barriers are impractical or not cost-effective. Approaches to the acoustic treatment of buildings include improved window glazing and insulation to external walls.

Blasting

Blasting can cause noise and vibration impacts; however counteractive measures such as reducing the Maximum Instantaneous Charge (MIC) can be used to reduce the impact caused without sacrificing fragmentation. Amendment to the type and performance of the explosive charge, as well as the type of initiation system and the duration of delays can also assist.

Blasting usually results in both overpressure and ground vibration. The generation of fly rocks is potentially dangerous and can impact on neighbours. Therefore blasting practices will be designed and managed in order to reduce the risk to staff and the greater community.

Although the blast noise is unlikely to cause hearing damage to anyone outside the direct work area, blasting noise is more commonly an annoyance noise or discomfort. Therefore, potentially affected receivers should be notified in advance of blasting occurring at the Quarry.

Blasting will be limited to times when condition are suitable and avoided at times, as outlined below:

- Avoid at times of adverse wind condition, as this may promote the impact of blast over pressure;
- Avoid at times of temperature inversion;

- Avoid overfilling holes with blasting agent;
- Avoid firing holes in the front row which have insufficient burden.

All blasting designs should contain considerations to minimise factors such as ground vibration and air blast. It is recommended that the drilling and blasting at the quarry is under taken by qualified contractors to reduce risks associated with these activities. The blast design should include an assessment of noise and vibration impacts based on blast specific parameters.

It should also be noted that the blast parameters provided in this report are indicative only and different charges should be tested and monitored in the planning phase to provide overpressure and vibration data specific to the effect of blasting on this site. If test blasts exceed or approach the criteria levels, then this should be taken as a benchmark, overriding charge limitations advised in this report.

Meteorological Conditions

Local meteorological conditions, such as wind and temperature inversions, may increase noise levels when favourable to noise propagation. An environmental weather station located on, or closer to, the site location would capture local weather conditions with high accuracy. The weather station was programmed to record wind speed, wind direction and rainfall on 15-minute intervals for the entire monitoring period.

9.4.7 Mitigation Measures - Concept Plan

It is likely that similar mitigation and management measures will also be required throughout subsequent stages of the Concept Plan.

As a minimum the work ethics, site machinery and blasting requirements outlined in Section 9.4.6, however based on the noise and vibration modelling to date additional specific noise controls are unlikely to be required.

Additional methods and/or equipment for managing noise and vibration will be reviewed before the design and implementation of Stage 2. This additional technology will need to be considered closer to the implementation of Stage 2.

9.5 Air Quality and Odour

The information presented in this chapter is based on the findings of the air quality assessment undertaken by GHD. The air quality assessment report is included in Appendix J of this environmental assessment.

9.5.1 Methodology and Approach

The DGR's identified that dust is the primary concern for the quarry aspects of the proposal, while dust and odour are the main issues for the landfill component of the proposal. Overall the goal sought by Council for the entire Concept Plan is to maintain existing rural air quality and protect sensitive receptors, including dwellings, from adverse impacts of dust and odour. In conducting the air quality assessment the following NSW Department of Environment, Climate Change and Water (DECCW) guidelines have been considered:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (August 2005); and
- *Technical framework – Assessment and management of odour from stationary sources in* NSW (November 2006).

A computer based dispersion model, The Air Pollution Model (TAPM), 4.0,2 developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) was used as the basis of modelling potential air quality impacts of the proposal. TAPM is a regional-scale prognostic meteorological model suitable to simulate meteorology at sites with complex geography and / or for situations when the available site representative meteorological data are not adequate (as is the case in this assessment). The nearest Automatic Weather Station (AWS) to the site is located at Coolangatta Airport (approximately 10 km to the north-northeast of the site. However, this data was considered to be unrepresentative to the transport and dispersion of emissions from the development. Furthermore the BoM weather station at Murwillumbah (Bray Park) (Site No. 058158) only records weather data twice daily, which is not sufficient for the analysis required in this assessment

TAPM accesses databases of synoptic weather analyses from the BoM. The model then provides the link between the synoptic large-scale flows and local climatology, which, in this case, includes such factors as local land use, topography, atmospheric stability and mixing height. TAPM was then used to derive the meteorological data file used to conduct the dispersion modelling. Atmospheric dispersion modelling was then conducted using Ausplume (Version 6.0) to predict the maximum ground level concentrations of dust (Total Suspended Particulates[3] (TSP) and PM_{10}) and odour resulting from emissions to air from the Quarry and Landfill. Dust deposition levels were also predicted. The predicted ground level concentrations (GLC) and dust deposition rates were then assessed against the relevant criteria.

Dispersion modelling was undertaken for the site configurations representing different stages in the Concept Plan. Based on the proposed time line of the Concept Plan, only one quarry and one landfill would operate at any given time. Therefore, three site configurations were modelled:

[3] The term total suspended particulate (TSP) matter refers to airborne particles typically less than 50 microns (μm) in aerodynamic diameter. The fraction of suspended particles that are less than 10 μm are referred to as PM_{10}.

- Configuration 1: Quirks Landfill and West Valley Quarry. Stage 1 of the proposed Concept Plan (2012 – 2021).
- Configuration 2: West Valley Landfill and North Valley Quarry. Stage 2 of the proposed Concept Plan (2022 – 2033).
- Configuration 3: North Valley Landfill only (2034 – 2045).

9.5.2 Existing Environment

Sensitive Receptors

Table 9-23 identifies the rural residential properties in the vicinity of the site which are considered to be sensitive receptors from an air quality point of view. These are also shown on Figure 27 in Section 9.4.

Table 9-23 Identified Sensitive Receptors

Sensitive Receptors	Address Details	Property Details
Receptor 1	751 Eviron Rd, Eviron	Lot 30 on DP 820048
Receptor 2	157 Hawkens Ln, Eviron	Lot 2 on DP 705781
Receptor 3	656 Eviron Rd, Eviron	Lot 25 on DP 615931
Receptor 4	657 Eviron Rd, Eviron	Lot 1 on DP 783802
Receptor 5	726 Eviron Rd, Environ	Lot 30 on DP 706846
Receptor 6	10 Donalyn Crt, Duranbah	Lot 501 on DP 1000612
Receptor 7	Eviron Rd, Duranbah	Lot 603 on DP 1001049

Local Air Quality

Site-specific ambient air quality data for TSP matter or fine particulates was not available for Eviron at the time of this assessment. Furthermore DECCW does not hold ambient air quality data for this region. The closest air quality data for the subject area is in the Lower Hunter Region and Brisbane. However these sites are subjected to additional industrial and urban sources compared to a rural location. In view of this, an ambient air quality of PM_{10} levels at 15-20 $\mu g/m^3$ has been assumed for rural coastal NSW areas away from the drier inland, industrial sources and urbanised environments. It is noted however that air quality in the Tweed Shire has historically been heavily impacted by the cane harvesting season.

Information regarding ambient odour levels in the areas surrounding the proposed site was not available at the time of this assessment. Ambient levels of odour are expected to be primarily influenced by the existing Stotts Creek Landfill cells and general agriculture in the area.

Council has reported that there have been no complaints relating to odour from the existing Stotts Creek Landfill. Therefore, it can be assumed that ambient odour levels are not offensive and would be within the DECCW recommended limits.

Local Meteorology

The transport and dispersion of the air emissions from the development will be influenced by prevailing synoptic flows and vertical temperature profiles that will alter both diurnally and with wind direction.

The annual wind climate in the area is dominated by flows from southeast and north, with less frequent flows from the southeast, southwest and to a lesser extent from the north. The average wind speed is 2.3 m/s with the highest winds occurring most frequently from the west. Figure 31 and Figure 32 contain wind roses illustrating the distributions of wind speeds and directions on an annual basis, and also just for the anticipated operational hours of the quarry and landfill activities.

It is the incidence of daytime winds that are of greatest concern in regards to the transport and dispersion of dust emissions from the site. Due to the nature of operations, the majority of dust/odour generated at quarry and landfill will be during operational hours when processing activities are occurring. The daytime distribution of wind directions is not significantly different that for the entire diurnal cycle, however the average wind speed is higher during the day (2.7 m/s). Wind erosion or dust lift-off can become significant under strong winds (greater than 5 m/s). These stronger winds occur infrequently.

The occurrence of stable air-flows is of significance as these generally provide the conditions for worst-case dispersion of emissions to air, and hence potentially the highest impact to health and amenity. Stable conditions are not likely to occur during the regular daytime operational hours of the quarry and landfill. Hence, periods of worst case dispersion during the operational periods will correspond with light wind neutral atmospheric conditions typically occurring during early morning and late afternoon, and, to a lesser extent, for more moderate wind speeds for the period late-morning to early afternoon (See Figure 33).

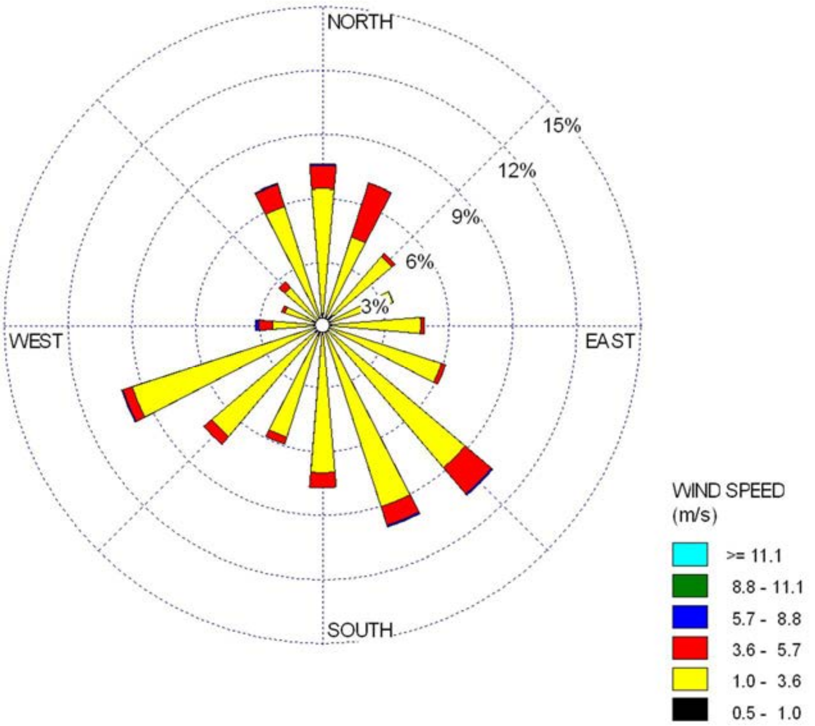


Figure 31 Annual Wind Rose, Eviron

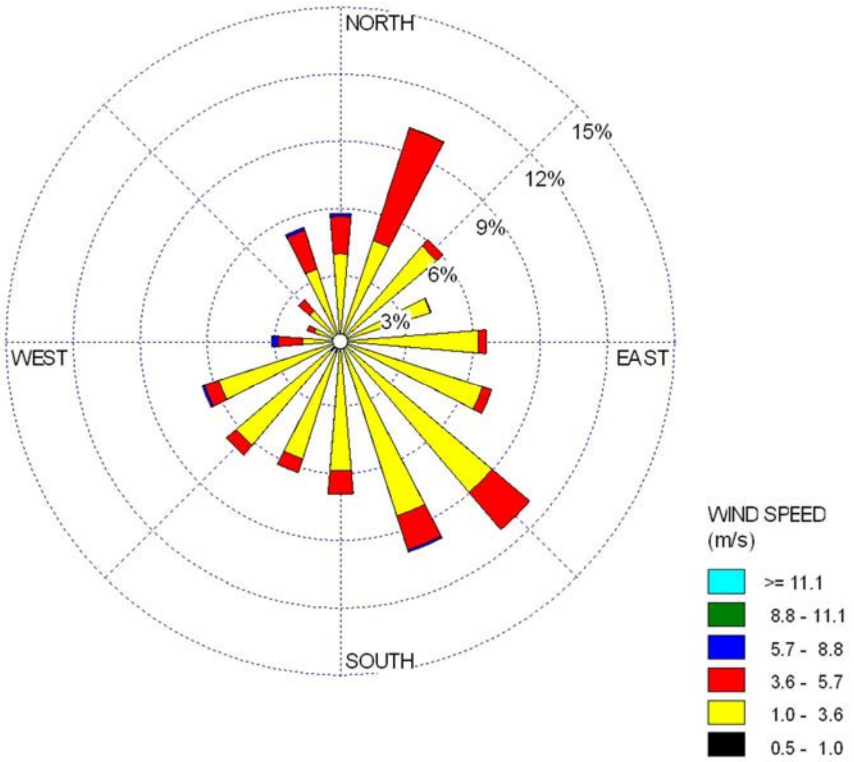


Figure 32 Operational Hours Wind Rose, Eviron

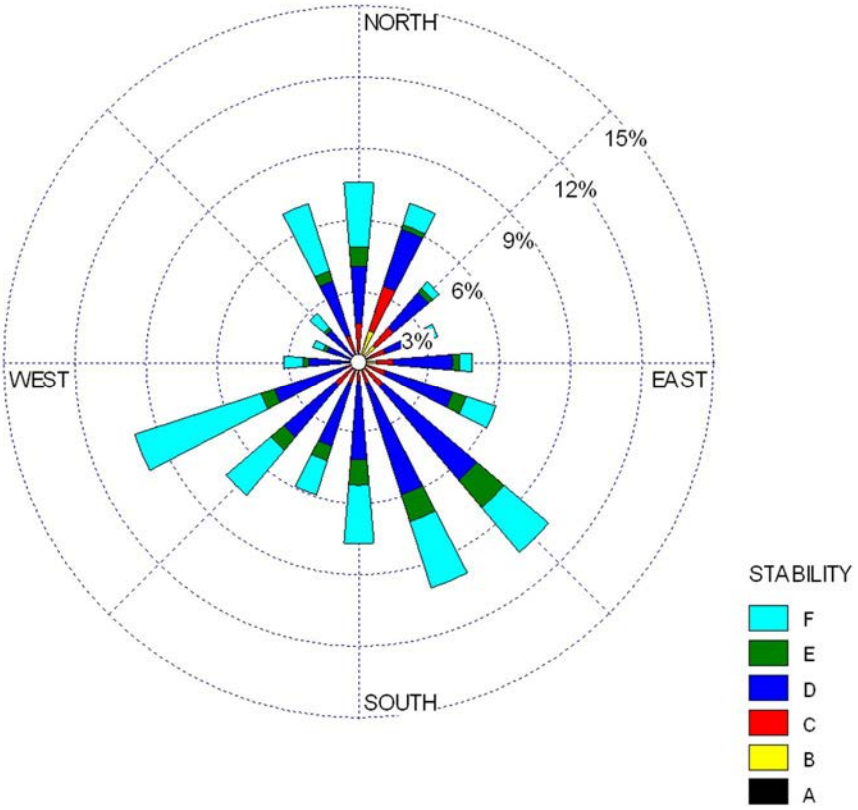


Figure 33 Annual Stability Rose, Eviron

9.5.3 Impact Assessment – Stage 1

Odour and particulate matter (dust) are generally considered to be the two primary air quality issues associated with the proposed quarry and landfill operations. Other air emissions such as combustion products (e.g. vehicle exhaust) are generally minimal.

Dust Emissions Inventory

Quarry

A dust emissions inventory for the West Valley quarry has been developed on the basis of the current operations and equipment used at the existing Quirks Quarry, the proposed processing capacity at the West Valley Quarry and emissions estimations techniques adopted from the National Pollutant Inventory (NPI).

Activities at the proposed quarry include rock extraction, screening, crushing (to secondary ~7 mm) and transport of the processed rock offsite. The individual processes that generate significant amounts of particulate matter (dust) were identified to be:

- Rock quarrying e.g. blasting, excavation and bulldozer;
- Material processing and handling e.g. crushing and loading;
- Vehicle induced dust emissions in pit area; and

- Wind erosion of exposed unstable soil surfaces and localised stockpiles.

Emission rates from naturally wind-borne dust and mechanically induced dust were characterised using Emission Factors (EF) provided in the National Pollutant Inventory (NPI) Emission Estimation Technique (EET) manual for Mining[4]. The EET used to estimate emissions from mining operations are based primarily on activity rate (e.g. tonnes per hour). The United States Environment Protection Agency Emission Factors and AP 42, *Compilation of Air Pollution Emission Factors* were also utilised, particularly for rock crushing, where they were deemed to be more applicable than the NPI emission factors, which are based on more general mining operations. The air quality impact assessment report in Appendix J provides a detailed list of the assumptions involved in calculating the emissions rates for the quarry activities.

Based on the operation of the existing Quirk's Quarry, it is understood that the operating quarry could achieve a maximum rock throughput of 400 tonnes per hour (TPH). However, under typical operating conditions the quarry would process between 500 and 1000 tonnes per day, which corresponds to crushers operating at approximately 100 tonnes per hour for 6 hours per day, 6 days per week to process approximately 200,000 tonnes of rock per year.

Although it is not expected that the quarry will operate at 400 TPH consistently, it is possible that this will occur from time to time, hence, the higher throughput of 400 TPH has been adopted in this assessment, to represent a worst-case scenario to derive emissions rates with which to assess air quality criteria with short-term averaging periods (e.g. 24-hour). The average hourly throughput of 100 TPH, which is more representative of the normal production rate, was used to derive dust emission rates with which to assess air quality criteria with long-term averaging periods.

Table 9-24 summarises the emission factors adopted and calculated emission rates for each item of equipment and activity within the quarry. This inventory has also been utilised as the basis of an inventory for the North Valley Quarry as part of the overall concept plan.

[4] National pollutant Inventory (NP)I Emission Estimation Technique Manual for Mining, Version 2.3.

Table 9-24 Quarry Process Dust Emission Rates

Equipment and Process	TSP Emission Factor	PM_{10} Emission Factor	Unit	Application	400 TPH		100 TPH [1]	
					TSP Emission Rate (kg/hr)	PM_{10} Emission Rate (kg/hr)	TSP Emission Rate (kg/hr)	PM_{10} Emission Rate (kg/hr)
Crusher – Primary [2]	0.0167	0.0061	kg/t	Operating 6 hours per day	**4.01**	**1.45**	**1.00**	**0.36**
	0.0018 (Controlled)	0.00066 (Controlled)	kg/t	Operating 6 hours per day	**0.42**	**0.16**	**0.11**	**0.04**
Crusher – Secondary [2]	0.0167	0.00605	kg/t	Operating 6 hours per day	**4.01**	**1.45**	**1.00**	**0.36**
	0.0018 (Controlled)	0.00066 (Controlled)	kg/t	Operating 6 hours per day	**0.42**	**0.16**	**0.11**	**0.04**
Loader [1] [3] [4]	0.025	0.012	kg/t	2 loaders, operating 4 hours per day each	**4.00**	**1.92**	**1.00**	**0.48**
Dozer [5]	17	4	kg/h	Operating 5 hours per day	**8.50**	**2.00**	**5.10**	**1.20**
Excavator [1]	0.025	0.012	kg/t	Operating 6 hours per day	**5.00**	**2.40**	**1.25**	**0.60**
Hard rock drill	0.59	0.31	kg/hole	1 hole per hour, 4 hours per day	**0.24**	**0.12**	**0.24**	**0.12**
Trucks [6]	3.88	0.96	kg/VKT	Each truck travels 300 metres	**2.91**	**0.72**	**1.51**	**0.37**
Unloading from stockpiles [3]	0.03	0.013	kg/t	Operating 4 hours per day	**2.40**	**1.04**	**1.20**	**0.26**

1. 100 TPH used to derive emission rate used to assess long-term (i.e. annual) PM10, TSP and dust deposition criteria.
2. Rock crushing emission rates derived from US EPA AP42 Section 11.19.2 Crushed Stone Processing and Pulverised Mineral Processing. Emission factors supplied for tertiary crushing only. Therefore emission rate was adopted for upper limit of primary and secondary crushing. Emission factors include crushing, screening and material transfer (conveyor) process. Process emission rates supplied as uncontrolled (no water sprays) and with controls (standard wet supression techniques).
3. 50% control factor applied when wet suppression used on crushers. Moisture carry over would mean that processed material in stockpiles would also have higher moisture content. Stockpiles are also regularly watered.
4. Loader processes include wheel generated dust emissions and fugitive emissions from loading of material into trucks.
5. Emission factors for PM_{10} and TSP from dozer operations are based on default values of soil moisture content and silt content of 2% and 10% respectively. Without site specific data default factors have been adopted. However, gravel quarries can have much lower silt contents than the default values. For example, if the silt content was 6% and with moisture remaining at 2%, the emissions rates would become 9 kg/h (TSP) and 2 kg/h (PM_{10}). This is approximately half of the adopted emission rates. Therefore, the default emission rates are considered highly conservative .
6. Under the maximum 400 TPH a total of 50 trucks would access the quarry per day. At 100 TPH, 26 trucks were assumed to access the quarry. Each truck to travel 300 metres on unsealed roads. 50% control factor applied for Level 1 watering (2 litres/m^2/hour). Emission rates for wheel generated dust on unpaved roads are based on 10% silt content, 2% moisture content and a gross vehicle mass of 48 tonnes. The average truck mass for the quarry is more likely to be 25 tonnes, therefore, emission factors are considered conservative.

Landfill – Stage 1

Sources of dust emissions for the Quirks Quarry landfill and any future landfills will include:

- Earthworks and waste handling within the landfill;
- Vehicle movements on unsealed roads about the site and on the landfill area; and
- Wind erosion from disturbed/unsealed areas on the site.

The emission inventory derived for the landfill is detailed in Table 9-25. As is the case for the quarry inventory, this inventory can be considered as the basis of an inventory for any future landfills proposed as part of the Concept Plan.

Table 9-25 Dust Emission Inventory – Landfill

Equipment	Default TSP Emission Factor	Default PM_{10} Emission Factor	Unit	Application	TSP Emission Rate (kg/hr) Over 9-hr Day	PM_{10} Emission Rate (kg/hr) Over 10-hr Day
Stomper	No data	No data				
Dozer	17	4	kg/h	Active 3 hours over 9 hour day	5.7	1.3
Excavator	0.026	0.012	kg/t	Shifting half of waste acceptance per day.	0.6 (1)	0.28 (1)
Trucks	3.88	0.96	kg/VKT	Total operating 2 hours per day at average 20 km/hr equals 40 km. 50% control for watering	**8.6**	**2.1**

Odour Emissions Inventory

The most significant potential source of odour will be emissions from mixed putrescible waste placed at the tipping face of the active landfill cell. Odour is not expected to be a significant issue for any quarrying operations. Closed landfill cells may continue to contribute as minor odour source via landfill gas release from the restored landfill surface. Planned active gas management measures will however likely reduce its odour potential. Landfill gas is therefore not considered to be significant odour source, and odorous emissions from the closed (i.e. capped) landfill cells are not included in the initial assessment of off-site odour impact.

A literature review was performed to ascertain the likely odour emission rates from the identified sources. Odour emission rates from a similar facility have been sourced from '*Odour Audit: Eastern Creek Stage 2: Holmes Air Sciences, December 2003*'. The Eastern Creek Landfill also accepts putrescible waste (but on a much larger scale) and implements a leachate collection and treatment system, whereby leachate is collected by a series of pipes and biologically treated on site before being either deposited back into the active landfill or safely discharged into the sewer. These adopted odour emission rates are therefore considered representative for the purposes of this assessment.

Table 9-26 shows that the derived odour emission rates from the landfill. It indicates that although the odour emission rates from the intermediate cover area is low, the surface area is high, and it is significant odour source. However, in reality it is unlikely that this source would be a major contributor to off-site odour impact because the character and hedonic tone of odour emitted from this source will be less offensive than the emissions from the active tipping face.

It should also be noted that this assessment is inherently conservative because the total waste received per day has been assumed to be 100% putrescible waste and to occupy the entire active face area over the entire duration of operating hours. In reality, there would be a progressive build-up of waste in the active cell over the course of the day. Further details of the assumptions and calculations used to derive the rates are provided in Appendix J.

Table 9-26 Estimated Odour Emission Rates – Quirks Quarry Landfill

Years of Operation	SOER (OU m/s) [1,2]		
	Tipping face	Daily cover [3]	Intermediate cover [4]
2012 – 2019	7	0.35	0.07

(1) Specific odour emission rate as reported in *Odour Audit: Eastern Creek Stage 2, Holmes Air Sciences, December 2003*. Peak-to-Mean ratios of 2.3 and 1.9 were applied over wind speed/stability times as per Approved methods.

(2) The SOER data referenced to Eastern Creek were measured using Isolation flux Chambers (IFCs). Additional odour emission rate data from a Landfill accepting putrescible waste has been compiled by GHD through indirect measurements by downwind profiling and back-calculation using Ausplume in *SITA Australia Pty Ltd Proposed SAWT Facility at Hallam Road Landfill, Odour and Dust Impact Assessment, February 2006*. Testing was undertaken at SITA's Lyndhurst Landfill. Results showed morning SOER's of ~ 4 OUm/s, and afternoon SOERs of ~ 40 OUm/s. Simulations using these alternative OERs returned off-site odour concentrations almost identical to the reported results.

(3) Odour emission rate equal to 5% of the active face odour emission rate was applied to the landfill source in the dispersion modelling outside normal operating hours to account for the application of daily cover over the active face.

(4) A specific odour emission rate equal to ~1% of the active face odour emission rate was used to account for emissions from intermediate cover area. This 99% reduction in odour emission rate is based on the relationship between odour emissions from an active face and intermediate cover as reported in *Odour Audit: Eastern Creek Stage 2, Holmes Air Sciences, December 2003*.

Atmospheric Dispersion Model

Atmospheric dispersion modelling was conducted using Ausplume, to predict the maximum ground level concentrations of dust (TSP and PM_{10}) and odour resulting from emissions to air from the Stage 1 activities (ie West Valley Quarry and Quirks Quarry Landfill). Dust deposition levels were also predicted. The predicted ground level concentrations (GLC) and dust deposition rates were then assessed against the relevant criteria.

Processing equipment, such as the crushers (with associated screens and conveyors etc), loaders (2 of) and excavator have been grouped into a processing area and have been modelled as an integrated area source with an emission rate (in kilograms per square metre per hour) calculated from the source emission rates and the assumed dimensions of the processing area (~750 m^2).

Mobile equipment and other equipment not assigned to the 'processing area' (e.g. loader (1 of), drill rig and dozer) have been modelled as individual 'volume' sources using the corresponding emission rates. Volume sources are often used to model well mixed fugitive emissions downwind of buildings and stationary plant.

Assessment Criteria

The *Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005) was used as the principal source for the development of the criteria to assess the dust and odour impacts of the Concept Plan and Stage 1 project application.

Dust

Air quality impact assessment criteria are prescribed within the DEC Approved Methods. To ensure the environmental outcomes are achieved, emissions from a premise must be assessed against the assessment criteria given in Table 9-27. The listed criteria are provided as cumulative (incremental plus background) concentration levels. As there is no background dust level emissions data available for the Eviron area, a background concentration level of 20 µg/m^3 for PM_{10} was assumed. A background concentration of TSP was assumed to be 40 µg/m^3.

Table 9-27 Adopted Dust Assessment Criteria

Pollutant	Averaging Time	Criteria
PM_{10}	24 hours	50 µg/m^3
	Annual	30 µg/m^3
TSP	Annual	90 µg/m^3
Dust Deposition	Month	2 g/m^2/month*
		** Maximum Increment. Maximum cumulative impact of 4 g/m^2/month.*

Odour

The impact assessment criterion for complex mixtures of odorous air pollutants, prescribed by the DEC Approved Methods adopts a sliding scale (2 to 7 OU, 99 percentile, 1 second average) – dependent on the size of the affected population.

The proposed site is located in a primarily rural environment and it is assumed that the existing population that may potentially be effected by odorous emissions is in the order of 10 – 30 people, hence an odour impact assessment criterion of 5 OU would apply. However, parts of the area surrounding the proposed Concept Plan are zoned residential so there is potential for the potentially impacted population to grow throughout the Concept Plan lifetime. Therefore, to account for future development, an odour assessment criterion of 2 OU has been adopted.

Note that these criteria are required to be met at the nearest off site sensitive receptors at the 99 percentile and at a 1 second peak averaging time.

Predicted Dust Impact

A summary of the results of the dispersion modelling assessment are presented in Table 9-28 for the cumulative impact of the operation of Quirks Quarry Landfill and the West Valley Quarry (ie Stage 1 Project Application) at the most exposed sensitive receptor (Receptor 3), located to the northwest of the site. Maximum predicted ground level concentrations and deposition rates at the most exposed receptor have been added to the adopted background levels to assess the cumulative impact, which can then be compared against the assessment criteria. The result indicated that all constituents assessed over the relevant averaging periods were below the respective assessment criteria at the nearest sensitive receptors for the modelled emission rate characteristics, with the exception of PM_{10} (24-hour). However it is noted that the PM_{10} (24-hour) maximum predicted concentrations have been based on a worst-case maximum quarry throughput of 400 TPH without a water spray system on processing equipment, which clearly does not represent typical operating conditions.

Further detail on the model results are provided in the following sub-sections.

Table 9-28 Maximum Predicted Dust Impact at the Most Exposed Sensitive Receptor (West Valley Quarry and Quirks Quarry Landfill)

Pollutant	Averaging Period	Units	Maximum predicted incremental impact [1]	Adopted Back-ground Level	Cumulative Impact	Criteria
Most Exposed Receptor: Receptor 3						
PM_{10}	24-hour	$\mu g/m^3$	**95**	20	**115**	50
PM_{10}	Annual	$\mu g/m^3$	4	20	24	30
TSP	Annual	$\mu g/m^3$	10	40	50	90
Dust deposition -	Annual	g/m^2/month	0.4	2[2]	2.4	4

(1) 24-hour concentration predicted using the maximum quarry throughput of 400 TPH. Annual concentrations predicted using average quarry throughput of 100 TPH.

(2) Conservative background dust deposition level of 2 g/m^2/month adopted.

PM_{10}

Table 9-29 shows that the maximum predicted total (i.e. 20 $\mu g/m^3$ background + 95 increment = 115 $\mu g/m^3$ total impact) impact for PM_{10} has the potential to exceed the 24-hour average criterion during the Stage 1 activities. Note that this is the maximum predicted impact is based on a 400 TPH production rate and worst case meteorological conditions. The table also shows the sensitivity of the model and the resultant reduction in dust emission rates associated with a lower quarry production rate of 100 TPH. Figures 34 and 35 graphically display the contour concentrations for both production scenarios.

Table 9-29 PM_{10} 24-hour Concentrations – 400 TPH vs. 100 TPH

Receptor	400 TPH Quarry Throughput		100 TPH Quarry Throughput	
	Incremental Impact (µg/m^3)	Cumulative Impact (µg/m^3)	Incremental Impact (µg/m^3)	Cumulative Impact (µg/m^3)
1	43	**63**	22	42
2	20	40	8	28
3	95	**115**	30	**50** [1]
4	45	**65**	15	35
5	16	36	6	26
6	26	46	16	36
7	18	38	10	30

(1) The DECCW Approved Methods allows for the PM10 24 hour criterion to be exceeded up to 5 times per year. The second highest prediction at Receptor 3 would result in a cumulative impact under 50 µg/m3.

Note: Cumulative impact levels based on adopted background concentration of 20 µg/m^3. PM_{10} criterion is 50 µg/m^3.

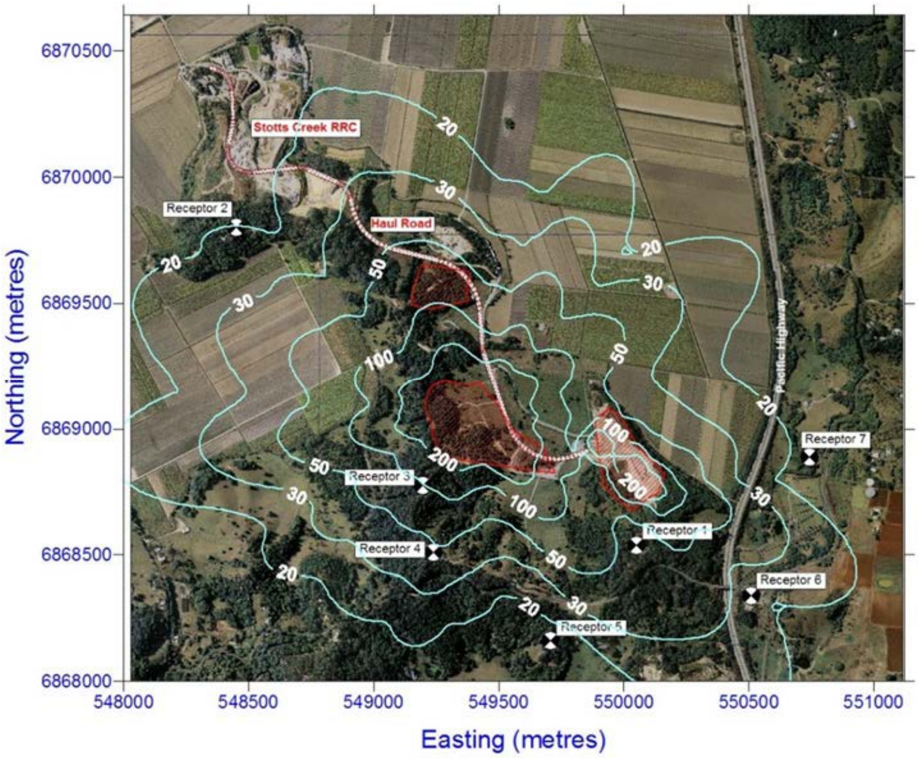


Figure 34 Stage 1 PM_{10} 24 hour Concentration Contours (400 TPH)

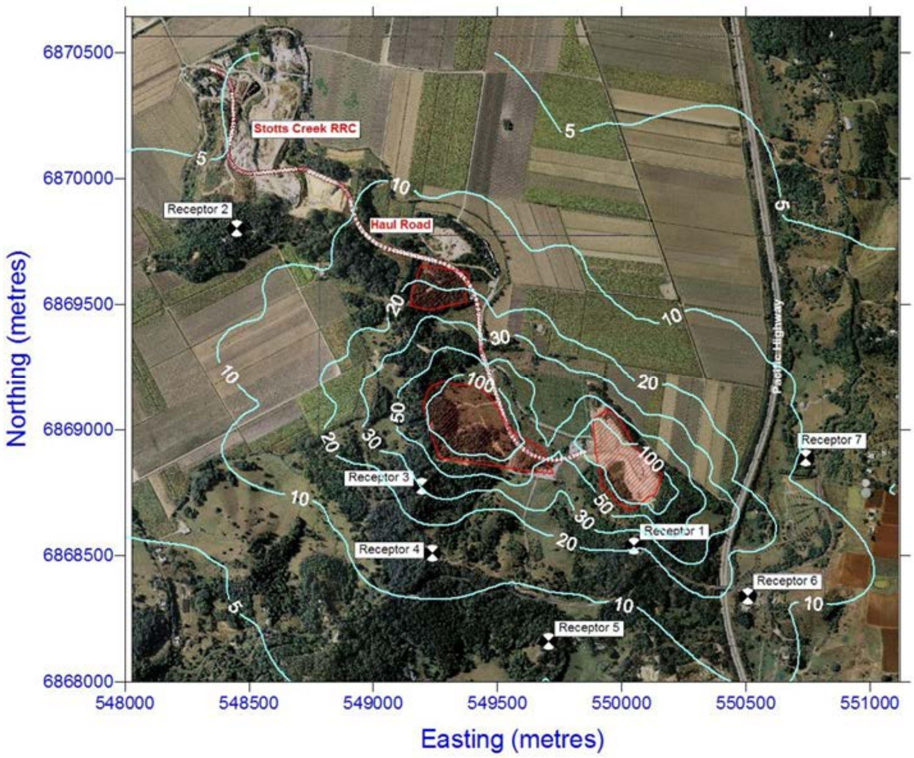


Figure 35 Stage 1 PM_{10}-24 hour Contour Concentrations (100 TPH)

The modelling indicates that when the more typical production rate of 100 TPH is adopted the predicted PM_{10} 24-hour concentrations are shown to comply with the criterion of 50 µg/m^3. The maximum predicted incremental impact was found to be roughly 60% of the criterion at the most affected receptor.

Further analysis of the model results for the 400 TPH scenario also revealed that the frequency at which the PM_{10} levels are predicted to exceed 30 µg/m^3 (i.e. the threshold at which the addition of the adopted background level would exceed the criterion) is less than approximately 30 days per year at the most exposed receptor. The frequency that the predicted incremental PM_{10} (24-hour) concentration exceeds 50 µg/m^3 is less than three times per year. Therefore, it is likely that impact of PM_{10} emissions from the Stage 1 operations on a day-to-day basis would comply with the PM_{10} criterion. The quarry would only operate at 400 TPH infrequently, and when it does operate at 400 TPH, it is unlikely that this event would be coupled with the adverse meteorological conditions required to cause maximum impact.

Blasting Impacts

Dust plumes generated from a blast event can be significant, however, they are generally well dispersed within a short time period (in the order of seconds to minutes). Therefore, the contribution to off-site dust levels on a 24-hour averaging period would be negligible. There is no criterion set in NSW for exposure to short-term PM_{10} or TSP over this duration.

The Ausplume dispersion model has a minimum emission rate input of 1-hour blocks. Therefore, an accurate representation of a blast event over a period of approximately 1 minute cannot be made. A hypothetical example of potential dust impacts off site from a blast event is included in the Air Quality Impact Assessment in Appendix J, which indicated that the maximum impact at the nearest receptor occurred under neutral atmospheric conditions and wind of approximately 3 m/sec. Conservatively assuming this plume does not immediately disperse, it would pass over a receptor on the site boundary in approximately 7 seconds. During this time the receptor would experience high concentration levels of PM_{10}, while for the remainder of the 24-hour period it would receive no impact from the quarry. Therefore, the 24-hour average PM_{10} concentration from a blast event becomes 1.29 µg/m^3, representing approximately 3% of the PM_{10} 24-hour criterion.

Therefore, due to the short-term duration of blasting and the cessation of other quarry activities during the blast it is highly unlikely that blast dust emissions would have a significant effect on day-to-day dust impacts off site.

Predicted Odour Impact

The predicted 1-second peak (nose response time) ground level odour concentrations for the proposed landfills under normal operating conditions for the Stage 1 activities at all identified receptions were less than 1 OU. This indicates that the 2 OU criterion would be readily achieved at all sensitive receptors during the operation of Quirks Quarry Landfill and West Valley Quarry. It is noteworthy that the 1 OU (equivalent to the odour detection threshold) contour is generally confined within approximately 200 metres from the landfill site boundary as shown on the Figure below.

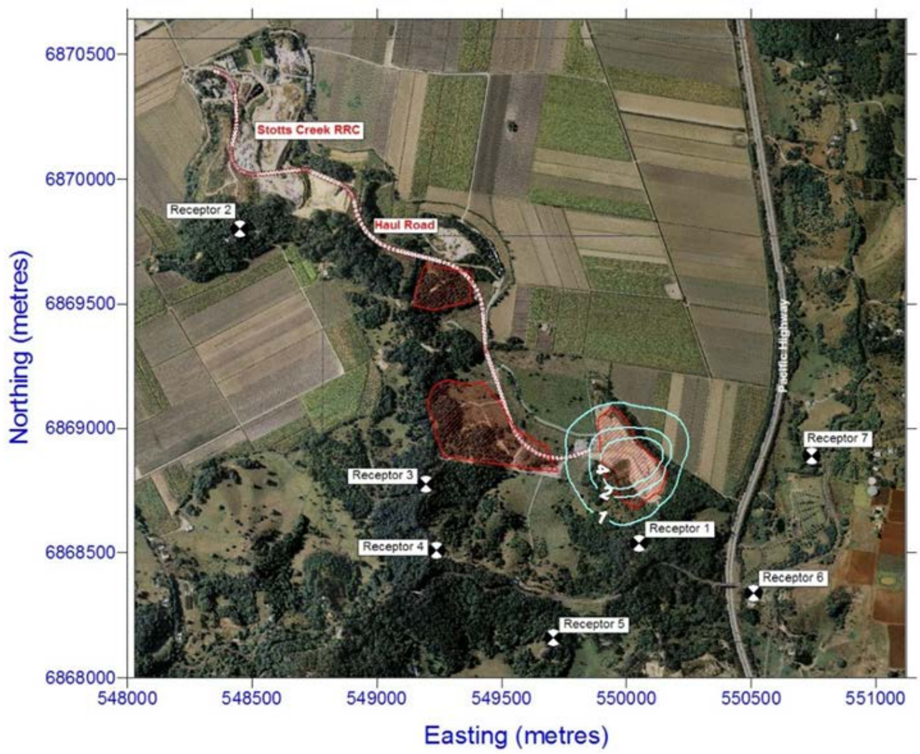


Figure 36 Stage 1 Predicted Ground Level Odour Concentrations (OU)

9.5.4 Impact Assessment - Concept Plan

It is likely that impacts associated with air quality during subsequent stages of the Concept Plan will be similar to those described above for Stage 1. However preliminary modelling of impacts has been undertaken.

As the concept plan is further developed and finalised over time technological advancements will likely provide improved equipment, methods and management which can reduce the impacts on the surrounding air quality. To accurately estimate the impacts of the Concept Plan activities beyond Stage 1, this modelling will require refinement during subsequent design phases.

Dispersion modelling was undertaken for each of the possible site configurations as outlined in the Concept Plan project description. Based on the proposed time line of the Concept Plan, only one quarry and one landfill would operate at any given time. Therefore, the following two site configurations were modelled:

- Configuration 2: West Valley Landfill and North Valley Quarry. Stage 2 of the proposed Concept Plan (2022 – 2033).
- Configuration 3: North Valley Landfill only (2034 – 2045).

Dust and Odour Emissions Inventory

The dust emissions inventory developed for the West Valley quarry has also been adopted for the North Valley Quarry. The inventory was provided in Table 9-24. Similarly, for the West

Valley and North Valley landfill, the key sources of dust emissions will be largely identical to that defined for the Quirks Quarry Landfill, and will include:

- Earthworks and waste handling within the landfill;
- Vehicle movements on unsealed roads about the site and on the landfill area; and
- Wind erosion from disturbed/unsealed areas on the site.

In terms of odour emission rates for the West Valley and North Valley landfills, the same assumptions that were used to derive emission rates for Quirks Quarry landfill have been adopted. On this basis, Table 9-30 provides the adopted emission rates.

Table 9-30 Estimated Odour Emission Rates – Landfill

Landfill	Years of Operation	SOER (OU m/s) [1,2]		
		Tipping face	Daily cover [3]	Intermediate cover [4]
West Valley	2019 – 2029	7	0.35	0.07
North Valley	2030 – 2043	7	0.35	0.07

Assessment Criteria

The air quality assessment criteria adopted for Stage 1, have been applied equally to the two additional site configurations modelled for subsequent stages of the Concept Plan.

Predicted Dust Impact

A summary of the results of the dispersion modelling for the two site configurations are presented in Table 9-31 and 9-32 for all receptors. This has shown that the most exposed sensitive receptor is Receptor 3, located to the northwest of the site.

The results indicate that under the two additional site configurations assessed for the Concept Plan, all constituents assessed over the relevant averaging periods were below their respective assessment criteria at the most affected sensitive receptor.

Table 9-31 Concept Plan, Configuration 2 Predicted Dust Impact at All Receptors

Receptor	Configuration 2		Criteria
	Increment	Cumulative	
PM10 24 hour (400 TPH[1]) µg/m^3 [adopted background level 20 µg/m^3]			
1	26	46	50
2	32	52	50
3	32	52[2]	50
4	16	36	50
5	10	30	50
6	12	32	50
7	13	33	50
PM10 Annual µg/m^3 m^3 [adopted background level 20 µg/m^3]			
1	<1	20	30
2	1	21	30
3	3	23	30
4	1	21	30
5	<1	20	30
6	<1	20	30
7	<1	20	30
TSP Annual µg/m^3 [adopted background level 40 µg/m^3]			
1	3	43	90
2	4	44	90
3	10	50	90
4	3	43	90
5	2	42	90
6	1	41	90
7	1	41	90
Dust Deposition g/m^2/month [adopted background level 2 g/m^2/month]			
1	<0.1	2.0	4
2	0.1	2.1	4
3	0.4	2.4	4
4	0.2	2.2	4
5	<0.1	2.0	4
6	<0.1	2.0	4
7	<0.1	2.0	4

(1) 24-hour concentration predicted using the maximum quarry throughput of 400 TPH. Annual concentrations predicted using average quarry throughput of 100 TPH.

(2) The OEH Approved Methods allows for the PM_{10} 24 hour criterion to be exceeded up to 5 times per year. The second highest prediction at Receptor 3 would result in a cumulative impact under 50 µg/m3.

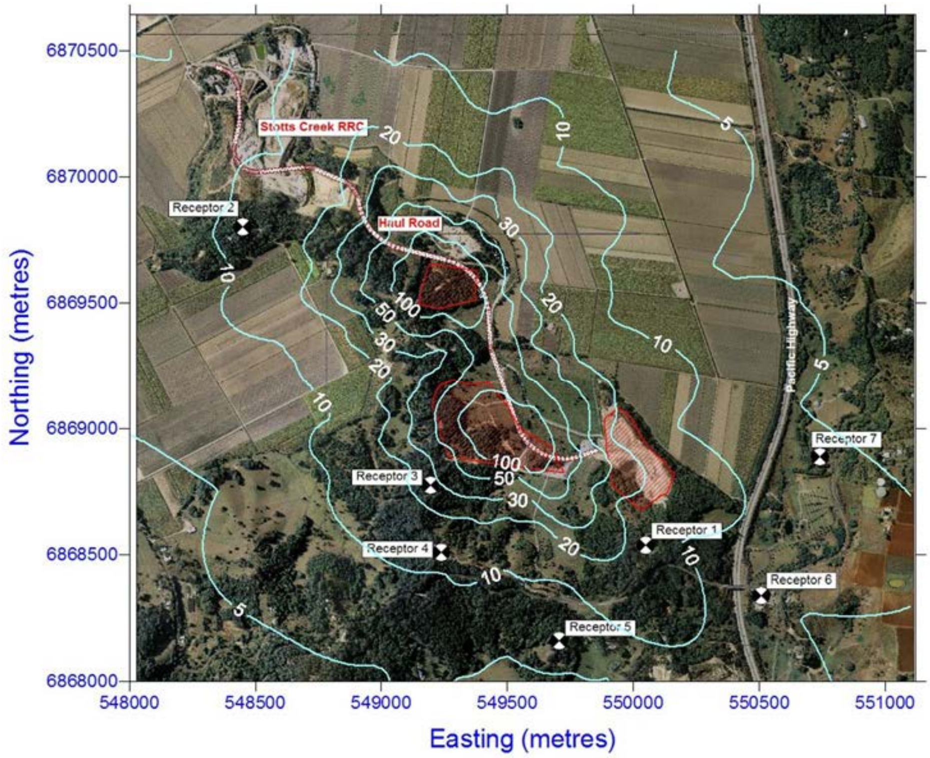


Figure 37 Configuration 2 PM_{10} 24 hour Contour Concentrations (400 TPH)

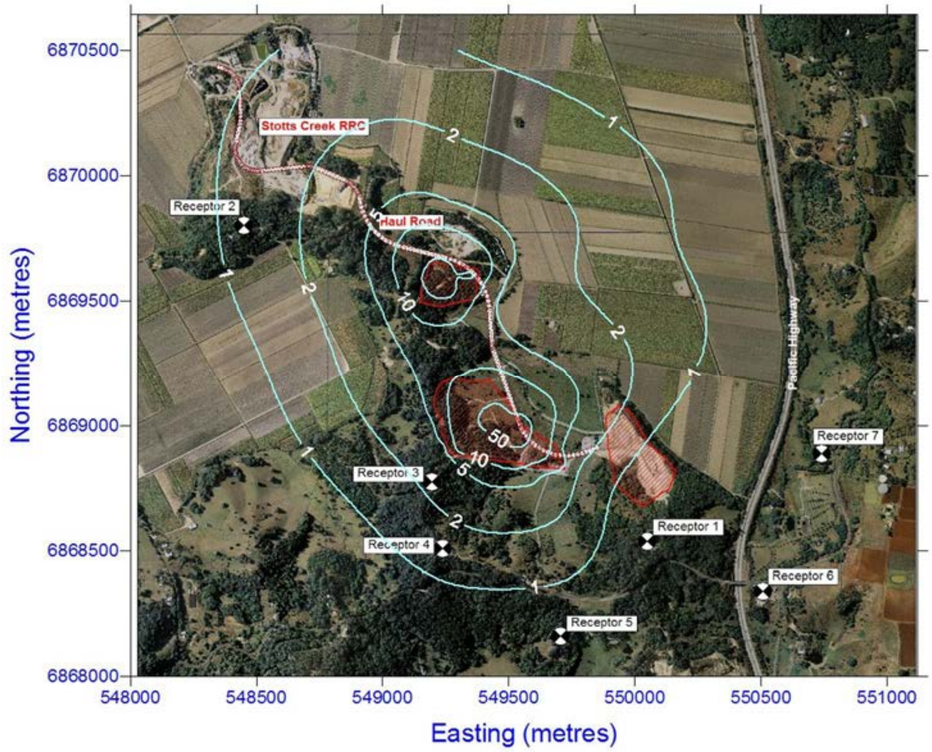


Figure 38 Configuration 2 PM_{10} Annual Average Concentration Contours

Table 9-32 Concept Plan Configuration 3 Predicted Dust Impact at All Receptors

Receptor	Configuration 3		Criteria
	Increment	Cumulative	
PM10 24 hour (400 TPH[1]) µg/m^3 [adopted background level 20 µg/m^3]			
1	5	25	50
2	9	29	50
3	5	25	50
4	3	23	50
5	2	22	50
6	3	23	50
7	3	23	50
PM10 Annual µg/m^3 m^3 [adopted background level 20 µg/m^3]			
1	<1	20	30
2	<1	20	30
3	<1	20	30
4	<1	20	30
5	<1	20	30
6	<1	20	30
7	<1	20	30
TSP Annual µg/m^3 [adopted background level 40 µg/m^3]			
1	<1	40	90
2	3	43	90
3	2	42	90
4	1	41	90
5	<1	40	90
6	<1	40	90
7	<1	40	90
Dust Deposition g/m^2/month [adopted background level 2 g/m^2/month]			
1	<0.1	2.0	4
2	<0.1	2.0	4
3	<0.1	2.0	4
4	<0.1	2.0	4
5	<0.1	2.0	4
6	<0.1	2.0	4
7	<0.1	2.0	4

(1) 24-hour concentration predicted using the maximum quarry throughput of 400 TPH. Annual concentrations predicted using average quarry throughput of 100 TPH.

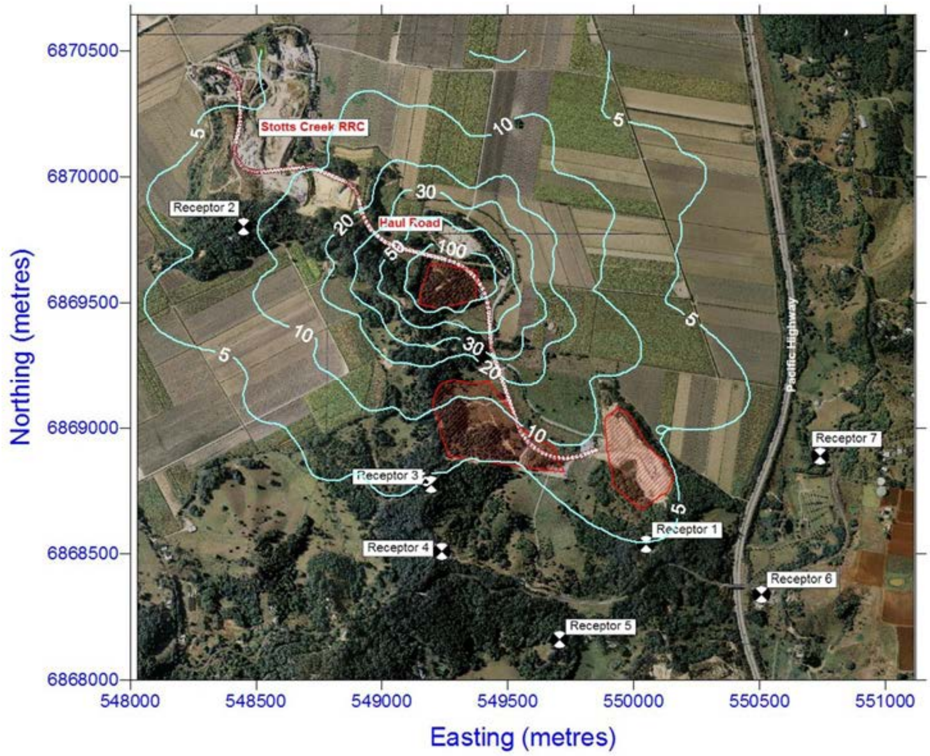


Figure 39 North Valley Landfill PM_{10} 24 hour Contour Concentrations

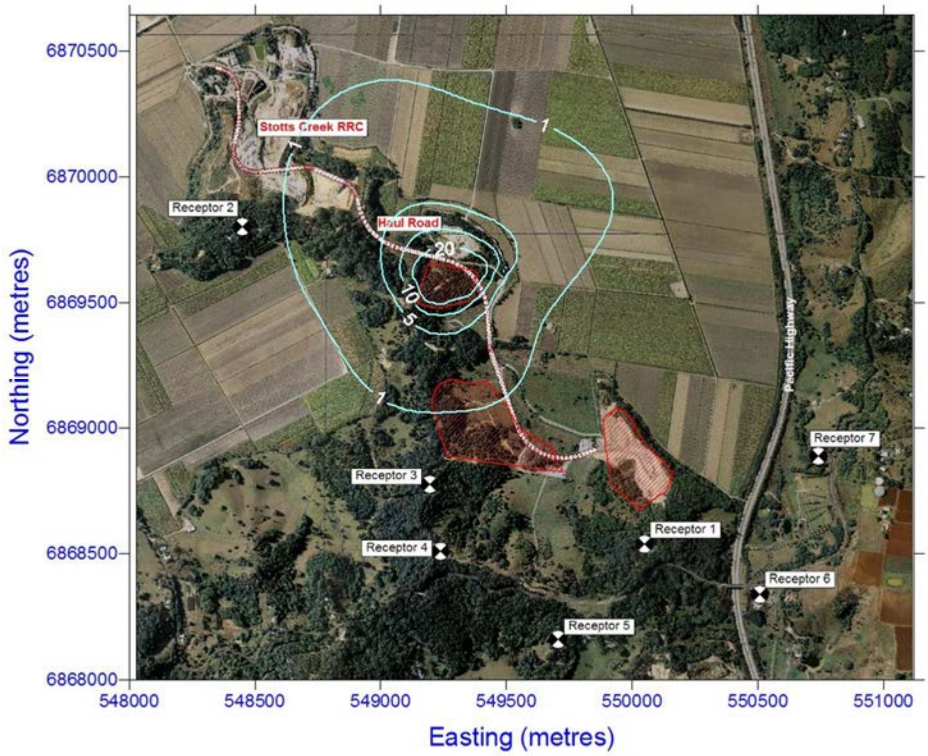


Figure 40 North Valley Landfill PM_{10} Annual Average Concentrations

As discussed within the Impact Assessment for Stage 1, dust plumes generated by blast event can be significant but are generally well dispersed in a short time period. The calculations undertaken for Stage 1, which would equally apply for the North Valley Quarry indicated that blasting may contribute approximately 3% of the PM_{10} 24-hour criterion. In this case therefore, it is highly unlikely that blast dust emissions would have a significant effect on day-to-day dust impacts off site for subsequent stages of the Eviron Road Concept Plan.

Predicted Odour Impact

The predicted 1-second peak (nose response time) ground level odour concentrations for the two configurations modelled were less than 1 OU at all sensitive receptors, indicating that the 2 OU criterion would be readily achieved. Figures 41 and 42 provide a graphic of the modelled odour contours.

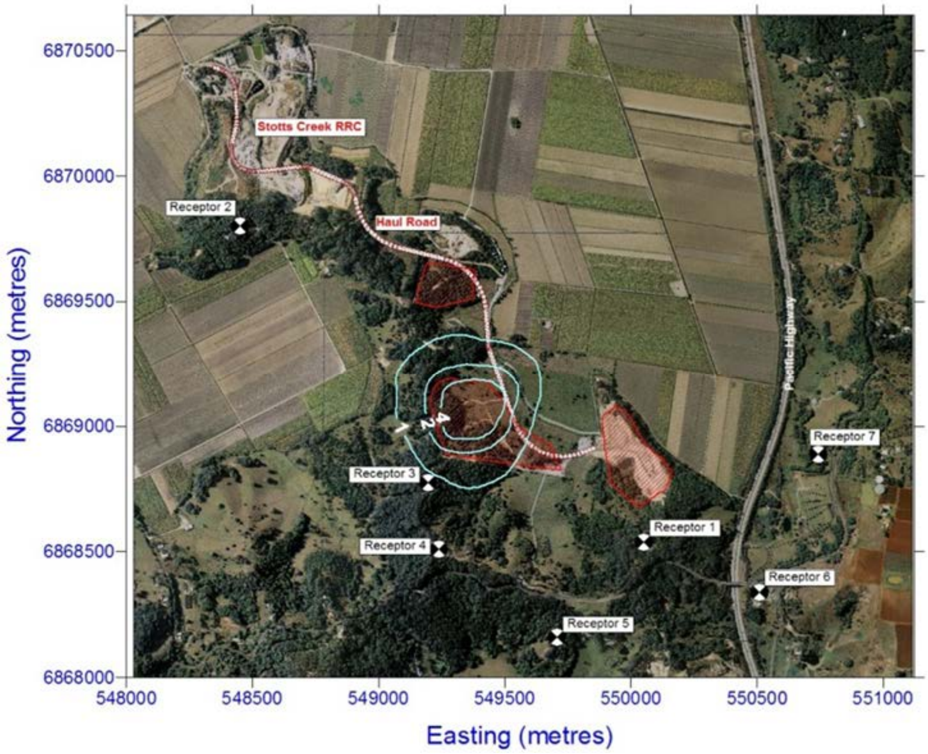


Figure 41 Stage 2 Odour Concentration Contours (OU)

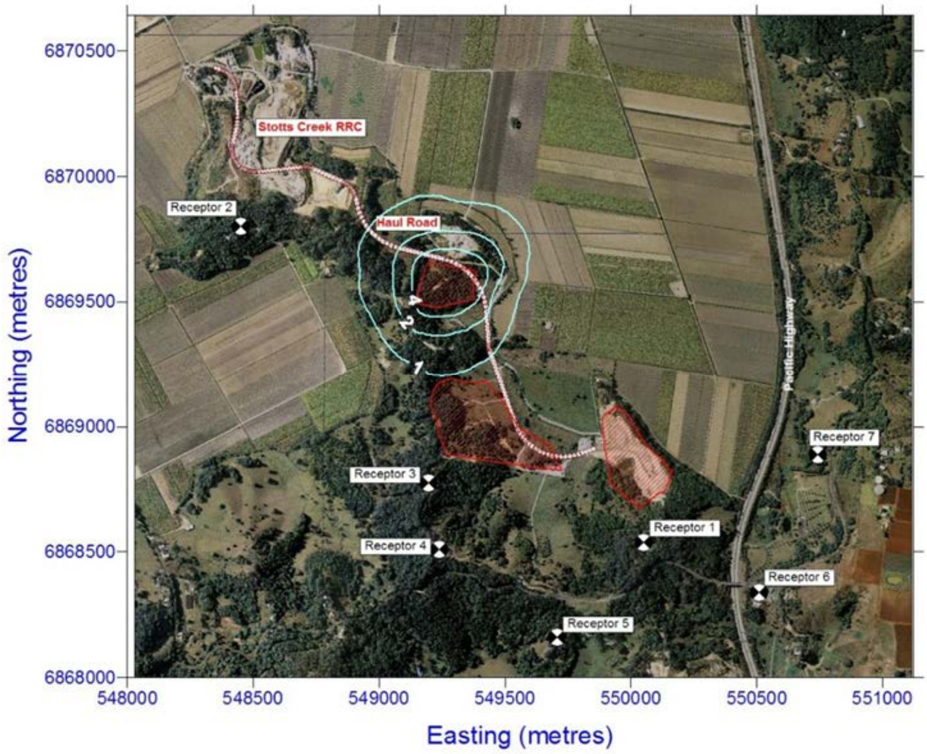


Figure 42 North Valley Landfill Odour Concentration Contours (OU)

9.5.5 Mitigation Measures – Stage 1 and Concept Plan

Specific Dust Control Measures

Effective management of dust and odour emissions is critical to the successful operations of each quarry and landfill throughout Stage 1 and the Concept Plan. As indicated in the dispersion modelling assessment, dust emissions, in particular fine particulates (PM_{10}) pose the greatest potential for off-site impact during the operations of the Concept Plan. The following sections address some options for further dust control measures with the aim of minimising emissions to achieve compliance with the DECCW criteria.

Analysis of the emissions inventory indicates that the major source of dust emissions from the quarry under the maximum throughput of 400 TPH were from activities associated with the processing plant (i.e. crushers, loaders, dozer and excavator). Figure 43 shows that contributions from these operations were as high as 79% of total PM_{10} emissions. Therefore, dust control measures as part of these operations will have the biggest impact in reducing overall site emissions.

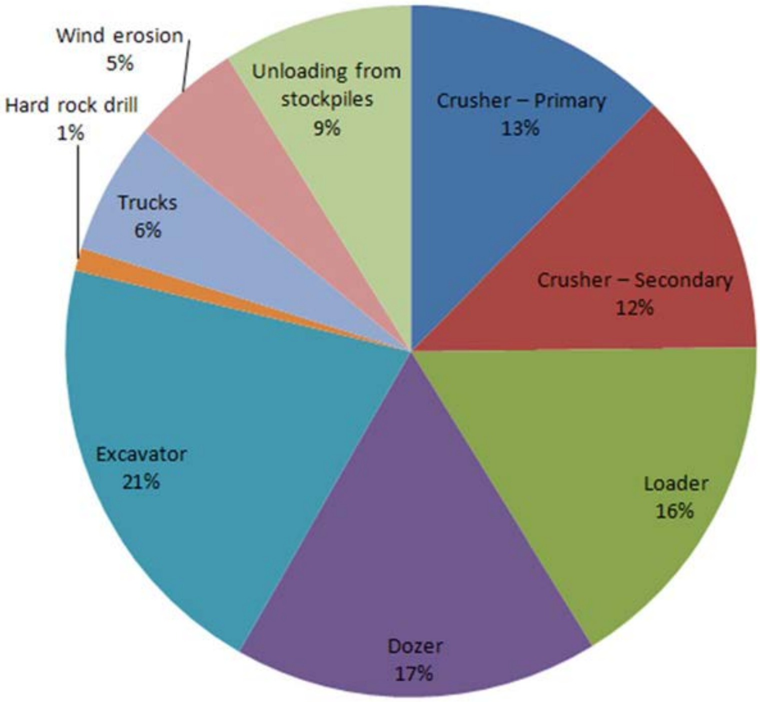


Figure 43 Quarry PM_{10} Emissions by Equipment – 400 TPH Operations

The moisture content of the material processed can have a substantial effect on emissions. Water sprays are generally the most simple and effective form of dust suppression on processing activities.

While water sprays would be impractical to use with the dozer or excavator, they can be effectively used in crushing and screening plant. Carry-over of moisture would mean that processed material in stockpiles would also have higher moisture content. In addition, stockpiles are also regularly watered, allowing for a controlled emission factor to be applied to loader and loading operations.

The potential reduction in dust emission rates as a result of the implementation of a water spray system on the crushers is shown in Table 9-33.

Table 9-33 PM_{10} 24-Hour Predicted Incremental Concentrations – With and Without Water Sprays on Crushers

Receptor	400 TPH Quarry Throughput – Uncontrolled	400 TPH – Water Spray on Crushers	100 TPH Quarry Throughput – Uncontrolled	100 TPH – Water Spray on Crushers
1	43	28	22	22
2	20	12	8	7
3	95	55	30	23
4	45	25	15	13
5	16	10	6	6
6	26	20	16	16
7	18	12	10	9

Predicted results show that processing high moisture content material could reduce predicted incremental PM_{10} concentrations at the nearest receptors by up to 40%. On this basis, Figure 44 shows the revised contributions from each quarry operation based on a higher moisture content material through the processing plant. The split of contribution indicates that the excavator and dozer become the most significant sources of PM_{10} when dust suppression is implemented in the processing operations.

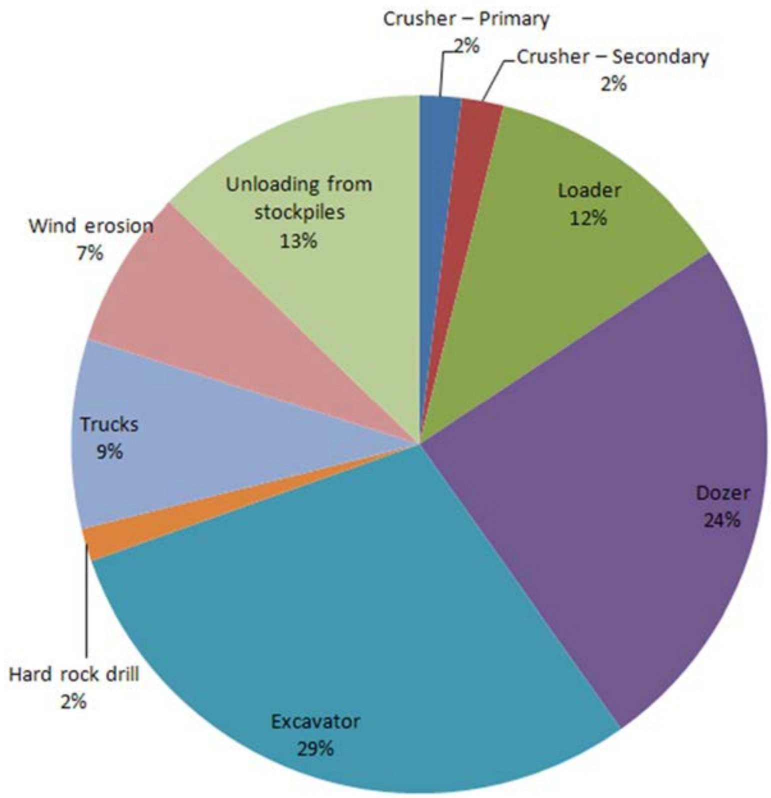


Figure 44 Quarry PM_{10} Emissions by Equipment – 400 TPH Operations – with Water Sprays on Crushers

Table 9-33 indicates that even with the use of dust suppression techniques on processing plant, there is still potential for short-term PM_{10} impacts at the nearest receptors under the maximum production rate of 400 TPH. Therefore, improvements to best practice dust management measures should focus on this short-term impact.

Examples of additional management measures include:

- To cease or reduce operations when prevailing winds are in the direction of sensitive receptors, particularly to the south and south-west of the quarry (northerly or north-easterly winds).
- The use of a real-time reactive dust monitoring at locations representative of the nearest sensitive receptors to alert the quarry manager when dust levels exceed the nominated criteria. The quarry manager could then take appropriate actions to ensure dust levels off site are reduced, such as reducing the production rate or excavation and dozer operations until weather conditions are more favourable.

Wind erosion is expected to contribute to approximately 7% of total site emissions. Therefore, in general, over a 24-hour period, wind erosion is not considered to be a significant issue. However, the sudden onset of weather systems that involve sharp increases in wind speed can have the effect of quickly stripping the fine surface silt content from exposed non-vegetated or non-rehabilitated surfaces. If not dealt with pro-actively, this can cause short- term (in the order of minutes) peaks in inhalable dust concentrations. Therefore the quarry plan of management and the landfill environmental management plan will contain a condition that the quarry and landfill managers be provided with daily weather updates that will contain warnings of the sudden onset of strong winds. In the event of such warning, the quarry and landfill managers will then take steps to ensure that exposed areas that could reasonably be subjected to wind erosion are consolidated by the timely application of water sprays.

General Dust Control Measures

General measures that will be implemented as part of the dust control management plan include:

- Rehabilitated areas will be revegetated as early as possible after completion.
- Newly stripped topsoil stockpiles will be immediately watered and revegetated with a grass cover.
- Access routes to and from the stockpiles will be watered as required, particularly during peak periods of vehicle movements.

Additional dust management measures are provided below in Table 9-34.

Table 9-34 General Management of Air Emissions

Emission Source	Proposed Management
Dust generated from transport activities on-site and off-site	Use of water sprays/trucks and sprays to wet down access roads. Clean sealed roads at access and egress points regularly to minimise the re-suspension of dust on sealed roads
Dust generated from loading, unloading and storage/stockpiling of material on-site	Use water sprays to minimise truck dust emissions. Ensure materials are appropriately stored and contained to prevent releases to the atmosphere (e.g. wind fences, water sprays)
Dust from movement of fill during operation	Where material is removed from the site or fill brought to the site, trucks will be covered whenever conditions are such that dust nuisance is occurring. This might include windy conditions or when materials being transported have a high level of fine particles.
Dust from Crushing and screening operations	Install spray systems on equipment and the stabilisation of the surface silt content of working surfaces around the processing site through (i) application of water via general wheeled carting and (ii) localised, manually controlled, canon water spraying.

Odour Mitigation Measures

While adverse odour impacts are not predicted, the following measures should be considered as part of the odour management plan for landfill activities. Odours will be significantly reduced by operating the site in accordance with sanitary landfilling methods and good site management. Odours will be minimised by:

- Not depositing waste in standing water;
- Depositing wastes in thin layers to optimise compaction;

- Immediately cover waste which is potentially malodorous;
- Covering all exposed waste at the end of each working day with daily cover material; and
- Minimising disturbance of previously filled areas.

A record of complaints regarding odours will be kept by TSC in accordance with the complaint management system, and reported to the relevant regulating authority (currently OEH) as required in the Annual Return. Investigations into the source of the odour emission giving rise to the complaint and any corrective actions taken to rectify the cause of complaint would also be documented.

9.5.6 Mitigation Measures - Concept Plan

The mitigation measures outlined above will apply as a minimum to all stages of development within the Concept Plan. As noted above a range of specific and general control measures on equipment and site processes and activities will be required.

Additional methods and/or equipment for managing dust and odour will likely be developed before the design and implementation of Stage 2. Similarly, advances in equipment technology and operational methods may serve to reduce impacts and alter proposed mitigation measures. This will need to be considered during the design of infrastructure for Stage 2 and subsequent stages of the Concept Plan.

9.6 Greenhouse Gas

The information presented in this chapter is based on the findings of the greenhouse gas assessment undertaken by GHD. The greenhouse gas assessment technical report is included in Appendix K of this environmental assessment.

The purpose of the greenhouse assessment was to calculate the predicted Scope 1 and 2 emissions of greenhouse gases associated with Stage 1 and the Concept Plan.

9.6.1 Methodology and Approach

The DGR's identifies greenhouse gas impacts as a key consideration in the Environmental Assessment and development consent process and note that the production of methane and other greenhouse gases may potentially have significant greenhouse implications. The greenhouse assessment was prepared in accordance with the following general principles:

- The Greenhouse Gas Protocol (GHG Protocol), a recognised international standard;
- The *National Greenhouse Accounts (NGA) Factors – June 2009* published by the DCC (now DSEWPC);
- The DCC (now DSEWPC) *National Greenhouse and Energy Reporting System Measurement, Technical guidelines for estimation of greenhouse gas emissions by facilities in Australia – June 2009*; and
- To estimate the methane emissions arising from the deposition of the waste in the three landfill site the calculations were based on the predicted amount of waste to be received during the years of operation. Thus the inventory represents present and future emissions arising from activities in the inventory year.

Classification of Emissions

Emissions are classified into three scopes under the IPCC guidelines; these scopes, adopted by the Department of Climate Change (DCC, now OEH), are:

- **Scope 1** – Direct emissions arising from activities within the boundaries of an organisation, such as the combustion of diesel and methane emissions;
- **Scope 2** – Emissions arising from outside of the boundaries of an organisation, due to the import of energy, such as electricity imported from the grid; and
- **Scope 3** – Emissions arising from the wider economy due to an organisation's activities. This includes other life-cycle emissions, such as emissions arising from the oil extraction, processing and transportation of diesel.

Boundaries of this Assessment

The system boundaries for the greenhouse gas assessment are the Scope 1 and 2 emissions of the project as shown in Figure 45. The following sources were assessed in developing the assessment:

- Methane emissions from landfills;
- On-site equipment fuel consumption; and
- On-site plant fuel use.

The following emission sources were not included in this assessment:

- Emissions arising from the leachate were ignored as this will be managed within the waste and via a treatment plant. The Intergovernmental Panel on Climate Change (IPCC) guidelines estimates that the emissions from leachate are in the order of 1% of total emissions and recommends their exclusion.
- Scope 3 emissions such as:
  - Embodied emissions of construction materials; and
  - Transportation of waste from the source to the transfer stations.
- Emissions arising from waste transport to site; and
- Use of electricity from the grid, although they are Scope 2 emissions Council verified that the existing electrical infrastructure at Stotts Creek would be utilised for this site, therefore it is not considered that there will be additional electricity use at the site.

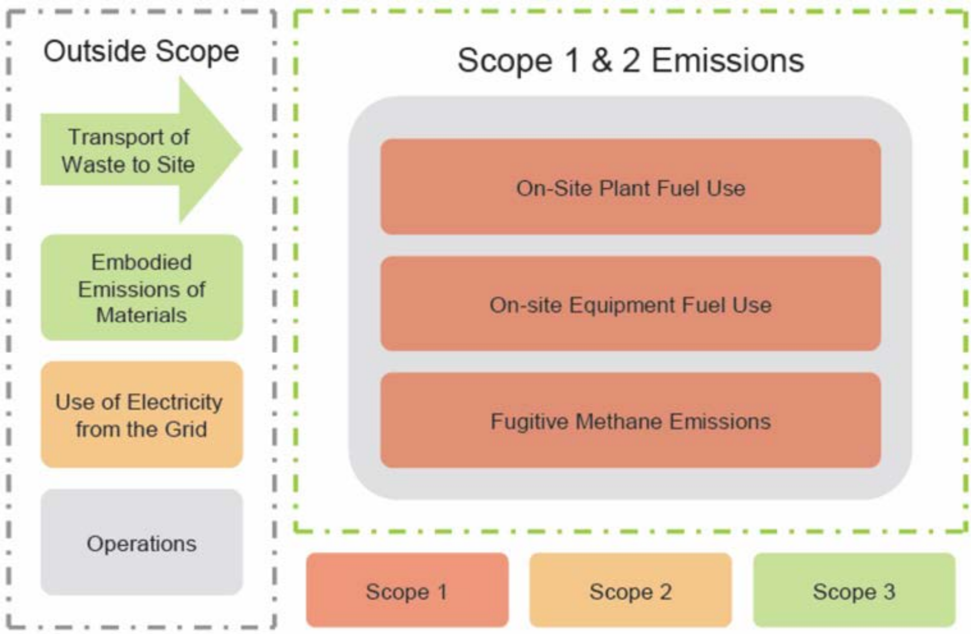


Figure 45 Greenhouse Gas Assessment Boundaries

Data Collection

Methane Emissions Released from Landfill

Methane emissions from the landfill were estimated in accordance with **Method 1**, one of the 3 methods available in the *National Greenhouse and Energy Reporting System Measurement – Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia June 2009 (Technical Guidelines)*.

- **Method 1** – Methane generation from solid waste disposal is estimated using the tonnage of solid waste materials received at the landfill and a First Order Decay (FOD) model. The FOD model provides default factors such as methane generation constants (k) and degradable organic carbon (DOC) contents of different types of waste. The Determination also provides default percentages for different waste streams (Municipal Solid Waste, Commercial and Industrial, and Construction and Demolition) for each state and territory and also provides default percentages for each type of waste (e.g. food, garden, paper, wood, inert materials) under each of the waste streams.

For the purpose of this assessment the default waste stream and waste type percentages for New South Wales as mentioned in the Technical Guidelines were considered. See Table 9-35.

Table 9-35 Default Waste Stream and Waste Type Mix for New South Wales

	Waste Streams		
	Municipal Solid Waste	Commercial & Industrial	Construction & Demolition
	31%	42%	27%
	Waste Mix Type for each waste stream above (%)		
Food	35	21.5	-
Paper and paperboard	13	15.5	3
Garden and park	16.5	4	2
Wood and wood waste	1	12.5	6
Textiles	1.5	4	-
Sludge	-	1.5	-
Nappies	4	-	-
Rubber and Leather	1	3.5	-
Concrete, metal, plastic and glass	28	37.5	89

(Source: NGER Measurement, Technical Guidelines 2009)

Fuel Use

The emission factors (EF) used for this inventory have been sourced primarily from the *National Greenhouse and Energy Reporting System Measurement Technical Guidelines* for the estimation of greenhouse gas emissions by facilities in Australia, June 2009 published by the Department of Climate Change. Fuel usage data for from Quirks Quarry and from the Stotts Creek RRC provided by Council was used as the basis for the future fuel consumption.

The total fuel (diesel) used for onsite plant and equipment at Quirks Quarry and the Stotts Creek RRC for the 2008/2009 financial year was 147,394.81 litres. It has been assumed that these figures will apply to each of the future quarries and landfills based on the same equipment fleet being adopted for all stages of the Concept Plan.

Exclusions

Some items were excluded from this assessment because their contribution to the inventory is anticipated to be neither minor, not relevant, or outside of the scope or because data was not available at the time of the assessment. A complete list of exclusions from the greenhouse gas assessment is available in the technical report in Appendix K.

9.6.2 Impact Assessment – Stage 1

Total GHG emissions of approximately 144,968 tCO_2-e for the Quirks Quarry Landfill and West Valley Quarry has been estimated. Of this total:

- 140,259 tCO_2-e arise from methane emissions associated with landfill; and
- 4,709 tCO_2-e arise from the plant and equipment fuel use.

Methane emissions from the landfill are the largest source contributing 97% of all emissions, with the remaining 3% arising from plant and equipment fuel use. A breakdown of the estimated emissions for the Stage 1 activities is shown in Figure 46 and the detailed sources of emissions are listed in Table 9-36.

Table 9-36 Summary of GHG Emissions for Stage 1 Project Application

Source	Greenhouse Gas Emissions (tCO_2-e)
Methane Emissions	140,259
On-site plant & equipment fuel use – Quirks Quarry Landfill and West Valley Quarry	4,709
Total	**144,968**

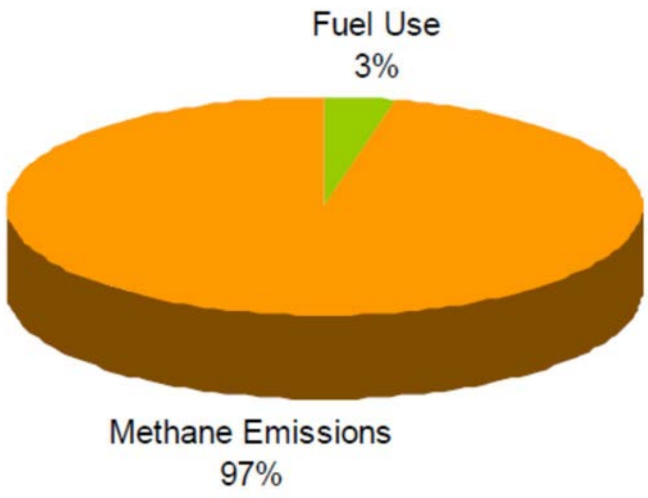


Figure 46 Stage 1 Project Application Emission Sources (%)

Methane Emissions from Landfill

The modelling results show that a total of 104,259 tCO_2-e will be generated from decaying organic matter at the Quirks Quarry landfill during its operational life (Table 9-37).

Table 9-37 Methane Emissions per Year (tCO_2-e)

Year	Emissions per Year (tCO_2-e)
2012	1,700
2013	4,842
2014	7,722
2015	10,395
2016	12,896
2017	15,252
2018	17,988
2019	20,538
2020	23,022
2021	25,904
TOTAL	140,259
2022	23,263
2023	21,017

The First Order Decay method assumes that biodegradable component in waste decays slowly throughout a few decades, during which CH_4 and CO_2 are formed. If the landfill conditions are constant the rate of methane production will depend on the amount of carbon remaining in the waste. As a result methane emissions from landfills are highest in the first few years after closure and then gradually decline as the degradable carbon in the waste is consumed by the bacteria. Therefore, emissions will continue to be emitted for a period of time after the landfill has been closed as shown in Figure 47.

The methane emissions model was run for 100 years from 2021 and the results show that 498,055 tCO_2-e will be generated from decaying organic matter at the Quirks Quarry landfill over that period after closure.

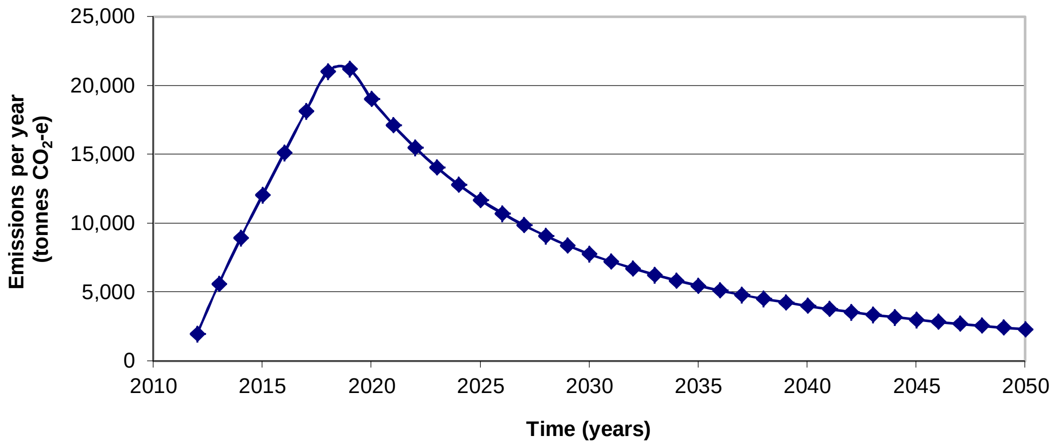


Figure 47 Estimated Methane Emissions Stage 1

On the basis of the Greenhouse Gas Assessment it is apparent that the methane emissions associated with landfilling of waste are the dominant source of greenhouse emissions. Comparatively, fuel consumption represents a minor component of the overall emission profile. Taking into consideration the potential for future advancements in technology and management of greenhouse gas emissions accurate assessments of emissions for future stages of the concept plan are unreliable at this time.

9.6.3 Impact Assessment Concept Plan

Utilising the same emissions factors, waste composition, fuel consumption as that adopted for the Stage 1 activities, a preliminary estimate of the GHG emissions associated with the West and North Valley Landfills and North Valley Quarry have been made. The operational lives of each of these facilities was based on forecast quarry extraction rates and landfill waste acceptance rates provided by Council.

It is noted that at present the GHG assessment has not factored in increased diversion of organic materials, and lower landfilling rates that will be likely following Council's implementation of AWT. The emissions forecast are based on business as usual waste acceptance rates forecast by Council. Therefore the emission rates presented herein are considered to be conservative and overestimate that likely GHG emissions from the West Valley and North Valley landfills.

As was the case with the Stage 1 activities methane emissions from landfilled waste are the largest source of GHG emissions for the remainder of the Concept Plan. Utilising the assumptions outlined above a breakdown of the source and estimated emissions for each of the activities in the Concept Plan beyond Stage 1 activities is provided in Table 9-38.

Table 9-38 Summary of GHG Emissions for Concept Plan (beyond Stage 1)

Source	Greenhouse Gas Emissions (tCO_2-e)
Landfill Methane Emissions (during operational life)	
- West Valley Landfill (12 years)	305,295
- North Valley Landfill (12 years)	417,807
On-site plant & equipment fuel use	
- West Valley Landfill	3
- North Valley Quarry	1497
- North Valley Landfill	3
Total	**724,605**

The landfill methane emissions models were run for 100 years from the closure date of the West Valley and North Valley landfills. This showed that 926,394 tCO_2-e and 1,271,284 tCO_2-e will be generated from decaying organic matter at the landfills respectively over the period after closure.. This is displayed in Figure 48 below for both landfills.

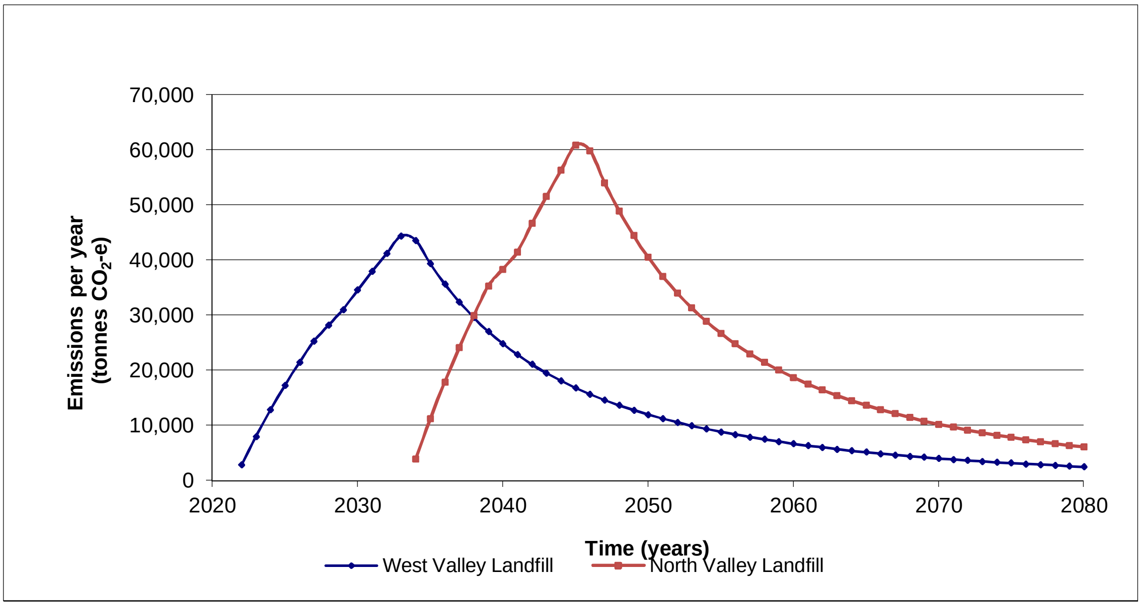


Figure 48 Estimated Landfill Methane Emissions Concept Plan (beyond Stage 1)

9.6.4 Mitigation Measures

In addition to the initiatives identified in the Landfill Environmental Management Plan, such as resource recovery activities, diversion of recyclable and reusable items from landfill and the implementation of measures to minimise the potential for environmental impacts from the future waste management operations, the following mitigation measures will be implemented:

Methane Emissions

From the results of the inventory it can be seen that the emissions are dominated by methane emissions, to minimise these emissions it is recommended that:

- The landfill shall be progressively capped as soon as possible following the deposition of the waste. The cap shall be designed, constructed and maintained to minimise the emissions of gas from the decomposing waste;
- A landfill gas management system will be installed in each landfill to capture gaseous emissions including methane. Depending on the quantity of landfill gas generated and captured infrastructure such as a flare will be installed as a minimum, and investigations into the viability and feasibility of tapping into or replicating the Stotts Creek Renewable Energy Facility will be undertaken once landfill gas flows and compositions can be verified; and
- Reducing biodegradable organic content of waste going into the landfill would also reduce the methane emissions; however the quantity of landfill gas available for electricity generation along with the amount of carbon sequestered would also be reduced. To quantify the effects on the overall carbon footprint, an assessment would be required that also considers the implications of the emissions arising from the diverted waste.

Fuel

Diesel combustion is the second main source of greenhouse emissions. The following options may reduce these emissions:

- Switching to fuels with lower carbon intensity, such as biodiesel blends or liquid natural gas;
- Switching off equipment and stationary plant when not required;
- Optimising transport routes, payloads and journey timing to minimise fuel consumption;
- Selecting higher efficiency vehicles and stationary plant when making capital purchases and ensuring their size is appropriate for the intended tasks;
- Ensuring that vehicles are well maintained and have optimal tyre pressures;
- Ensuring that the operators and drivers are trained to operate vehicles and plant efficiently; and
- Reviewing the current waste network and operational procedures to identity potential opportunities to minimise transportation requirements and double handling of waste.

Carbon Offsetting

In addition to the mitigation of greenhouse gases by on-site programs, the carbon footprint of the project could be reduced by the purchase of offsets. These offsets can be generated from a variety of sources such as renewable energy, forestry plantations and energy efficiency projects.

9.7 Biodiversity

The information presented in this chapter is based on the findings of the Ecological Assessment undertaken by GHD. The full Ecological Assessment report is included in Appendix L of this Environmental Assessment.

9.7.1 Methodology and Approach

Overview

An Ecological Assessment was prepared to address the Director General's Requirements (DGRs) with respect to biodiversity, which included:

- Vegetation clearing estimates;
- Assessment of potential impacts upon threatened species, populations, endangered ecological communities or their habitats; and
- A detailed description of the measures that would be implemented to achieve a 'maintain or improve' outcome for biodiversity values of the surrounding region in the medium to long term.

In accordance with the DGRs, survey and assessment of threatened species, populations, endangered ecological communities or their habitats was undertaken in accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005) ('Part 3A Threatened Species Guidelines') under s.75f of the EP&A Act 1979 ('the Part 3A Assessment Guidelines').

Assessment Methodology Summary

A desktop assessment was undertaken prior to field survey. Searches for existing records of threatened species contained in the DECCW Atlas of NSW Wildlife were undertaken. In addition, existing studies were reviewed for conservation significant species records in the local area (Quirks Quarry Environmental Impact Statement (B. J. Mackney and Associates, 1995) and the Pacific Highway Upgrade Yelgun to Chinderah Species Impact Statement (Woodward Clyde, & Landmark Ecological Services Pty Ltd, 1998)). Based upon the findings of the desktop assessment, the field survey methodology was developed with regard to the methods outlined in the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (working draft)* (DEC, 2004).

A survey for flora and fauna species was undertaken in January 2009 in order to identify species occupying or potentially utilising the site on occasion as well as habitat for threatened species and populations. Additional surveys were conducted on the site by Council ecologists in June and July 2010.

Flora surveys were undertaken through traverses of the site and delineation of vegetation types, while fauna surveys included a systematic trapping program, as well as nocturnal and diurnal survey and habitat assessment to detect fauna species and identify characteristic habitats.

The currency of the database searches was reviewed in 2011 and any additional species from these were considered in the Ecological Assessment report.

Potential Impact Assessment

A detailed assessment of the potential impact of the proposed activity was undertaken in relation to threatened species, populations and endangered ecological communities or their habitats listed under the *Threatened Species Conservation Act 1995* and/or the *Environment Protection and Biodiversity Conservation Act 1999* that were recorded, or considered likely to occur and be either directly or indirectly impacted as a result of the proposed activity.

The Ecological Assessment report assessed the Concept Plan as a whole, as the various components associated with the proposed activities for Stage 1 and the overall Concept Plan were considered likely to occur concurrently at least during part of operational period, and therefore it was more appropriate to assess together rather than separately.

9.7.2 Existing Environment

Vegetation

Approximately 55% of the site is vegetated. The lower slopes are predominantly cleared and contain areas of sugar cane or open grassy areas with isolated trees. The upper slopes and ridges along the western boundary are vegetated, as are the hills to the south and the area immediately adjacent to the eastern side of Quirks Quarry. Lot 1 DP 34555, the central southern lot adjoining Eviron Road, contains only scattered vegetated areas. The existing haul road to Quirks Quarry traverses this lot.

It is likely that historical clearing of vegetation for agricultural purposes has occurred on a large proportion of the site. Removal or reduction in grazing or other ongoing management practices has allowed dense establishment of camphor laurels (**Cinnamomum camphora*), with only small pockets of native vegetation evident. Occasional emergent eucalypts within the camphor open forest and woodland are most likely to have been remnant isolated paddock trees. This pattern of historical clearing and regrowth of camphor laurels is evident over the ridgelines in much of the local area.

Vegetation in surrounding areas on the western side of the Pacific Highway follows a similar pattern to that in the site, having vegetated mid to upper slopes with cleared lower slopes and floodplain, while areas on the eastern side of the Pacific Highway along Eviron Road have been more substantially cleared, although similarly contain areas of regenerating camphor laurels.

Eight vegetation types, two of which contained two sub-types, were mapped over the study area (Figure 49).

3. Camphor dominated vegetation:
   - 1a – Camphor laurel (**Cinnamomum camphora*) closed forest; and
   - 1b – Camphor laurel (**Cinnamomum camphora*) open forest to open woodland.
4. Blackbutt Open Forest:
   - 2a – Blackbutt (*Eucalyptus pilularis*) wet sclerophyll forest; and
   - 2b – Blackbutt (*Eucalyptus pilularis*) dry sclerophyll forest.
5. Camphor laurel – pink bloodwood (**Cinnamomum camphora – Corymbia intermedia*) closed forest;

6. Grassland / cleared areas;
7. Canefield;
8. Broad-leaved paperbark – camphor laurel (*Melaleuca quinquenervia – *Cinnamomum camphora*) open forest; and
9. Brush Box – Bennett's ash (*Lophostemon confertus – Flindersia bennettiana*) open forest; and
10. Orchard.

Endangered Ecological Communities

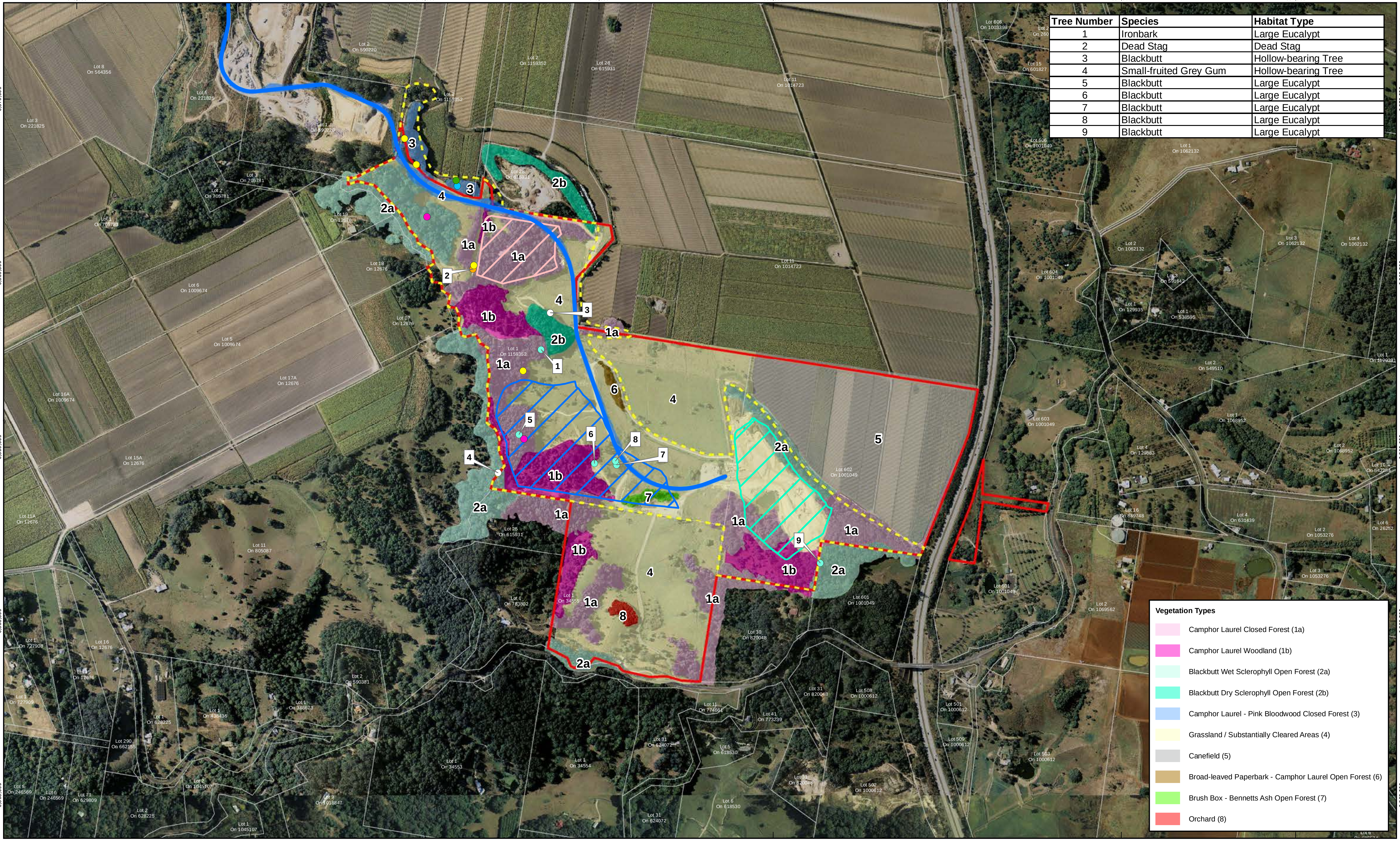
Vegetation Type 3 was considered to contain elements consistent with the endangered ecological community (EEC) lowland rainforest on floodplain. In addition, Vegetation Type 6 was floristically similar to the EEC swamp sclerophyll forest on coastal floodplain.

Flora Species

A total of 186 plant species were recorded during the surveys. This included 50 exotic species (approximately 27% of total species richness).

A stand of five white lace flower plants (*Archidendron hendersonii*), listed as vulnerable under the TSC Act was recorded at the site in the south western portion of Lot 1 DP1159352. In addition, a juvenile of this species was recorded from the vegetation to the south of the proposed Haul Road in the north western portion of the lot (Figure 49).

Three rare or threatened Australian plant (ROTAP) species were recorded at the site. The most commonly occurring ROTAP species was black walnut, which was recorded in a number of locations in the study area, two other ROTAP species, long-leaved tuckeroo *(Cupaniopsis newmanii*) and smooth scrub turpentine (*Rhodamnia maideniana*), were recorded in a small patch of vegetation to the north of the proposed haul road (see Figure 49).



Tree Number	Species	Habitat Type
1	Ironbark	Large Eucalypt
2	Dead Stag	Dead Stag
3	Blackbutt	Hollow-bearing Tree
4	Small-fruited Grey Gum	Hollow-bearing Tree
5	Blackbutt	Large Eucalypt
6	Blackbutt	Large Eucalypt
7	Blackbutt	Large Eucalypt
8	Blackbutt	Large Eucalypt
9	Blackbutt	Large Eucalypt

1:10,000 (at A3)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Quirks Quarry
North Valley Footprint
West Valley Footprint
Site Boundary
Study Area
Cadastre Boundary
Haul Road

Conservation Significant Plants
- Black Walnut
- White Lace Flower
- Long-leaved Tuckeroo
- Smooth Scrub Turpentine

Habitat Trees
- Dead Stag
- Hollow-bearing Tree
- Large Eucalypt

GHD

CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
Eviron Road Quarry and Landfill Environmental Assessment

Job Number	41-20806
Revision	1
Date	27 MAY 2011

Vegetation Map

Figure 49

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54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011), Cadastre boundary (2010). GHD - Site Boundary (2011), Vegetation Mapping (2010), Habitat Trees (2010), Quirks Quarry, West Valley (2010), North Valley (2011).

Fauna Habitats

Habitat Types

Nine distinct habitat types were identified over the study area. These were consistent with mapped vegetation communities, with higher ecological value areas in the open eucalypt forest areas, and cleared or camphor dominated areas having lower ecological value for fauna species. These included:

1. Mature eucalypt woodland;
2. Camphor laurel open to closed forest;
3. Lantana and bracken;
4. Wet sclerophyll forest with rainforest elements;
5. Tall grassland;
6. Drainage line;
7. Quarry;
8. Weeds with occasional trees; and
9. Cane fields.

Connectivity

The cleared floodplain of the Tweed River essentially surrounds the vegetated areas on the site such that habitats to the north of the study area are extensively isolated for non-flying species. In addition, the Pacific Highway, located along the eastern boundary, presents a significant movement barrier to most ground and cover dependent species. In the wider area, opportunity for terrestrial fauna movement is present in vegetation along the ridgelines to the south and southwest of the study area (i.e. along Farrants Road, Hammond Drive through Clothiers Creek and Reserve Creek) with generally only minor barriers present such as country roads and some areas of sparser vegetation. The vegetated ridgelines connect along the Burringbar Range to Mooball National Park, with further connectivity south and west to Mount Jerusalem National Park and Nightcap National Park.

Koala Habitat

The distribution of vegetation types containing koala feed trees (*Eucalyptus* sp.) was mapped (Figure 49) over the study area as blackbutt open forest (Vegetation Type 2a and 2b, Figure 40). Based upon a SEPP 44 assessment of koala habitat, however, none of the vegetation in the study area would be classified as ‘potential koala habitat’ which is defined as ‘an area of native vegetation where the trees of the types listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component’. Despite this, targeted surveys for koalas and searches for signs of recent koala activity were conducted and koalas were observed in eucalypt vegetation along the western ridgeline of the study area during surveys in both January 2009 and July 2010. There are also a number of recent records of the species in proximity to the site, suggesting that some areas could be classified as ‘core koala habitat’.

Habitat Trees

Very few hollow-bearing trees were recorded within or adjacent to the development footprints, due to the vegetation predominantly being comprised of camphor laurel regrowth. A number of hollows were observed in vegetation along the western ridgeline.

Fauna Species

A total of 99 fauna species were identified within the study area.

Six threatened fauna species listed under the *Threatened Species Conservation Act 1995* were observed or recorded on site during the survey, these being:

- Birds:
  - Collared kingfisher – (*Todiramphus chloris*) - vulnerable - (presumed to be a transient individual); and
  - Little lorikeet – (*Glossopsitta pusilla*) - vulnerable.
- Mammals:
  - Koala (*Phascolarctos cinereus*) vulnerable;
  - Grey-headed flying-fox (*Pteropus poliocephalus*) – vulnerable;
  - Eastern false pipistrelle – (*Falsistrellus tasmaniensis*) - vulnerable ('almost certain' call identification confidence); and
  - Little bentwing-bat – (*Miniopterus australis*) - vulnerable ('definite' call identification confidence).

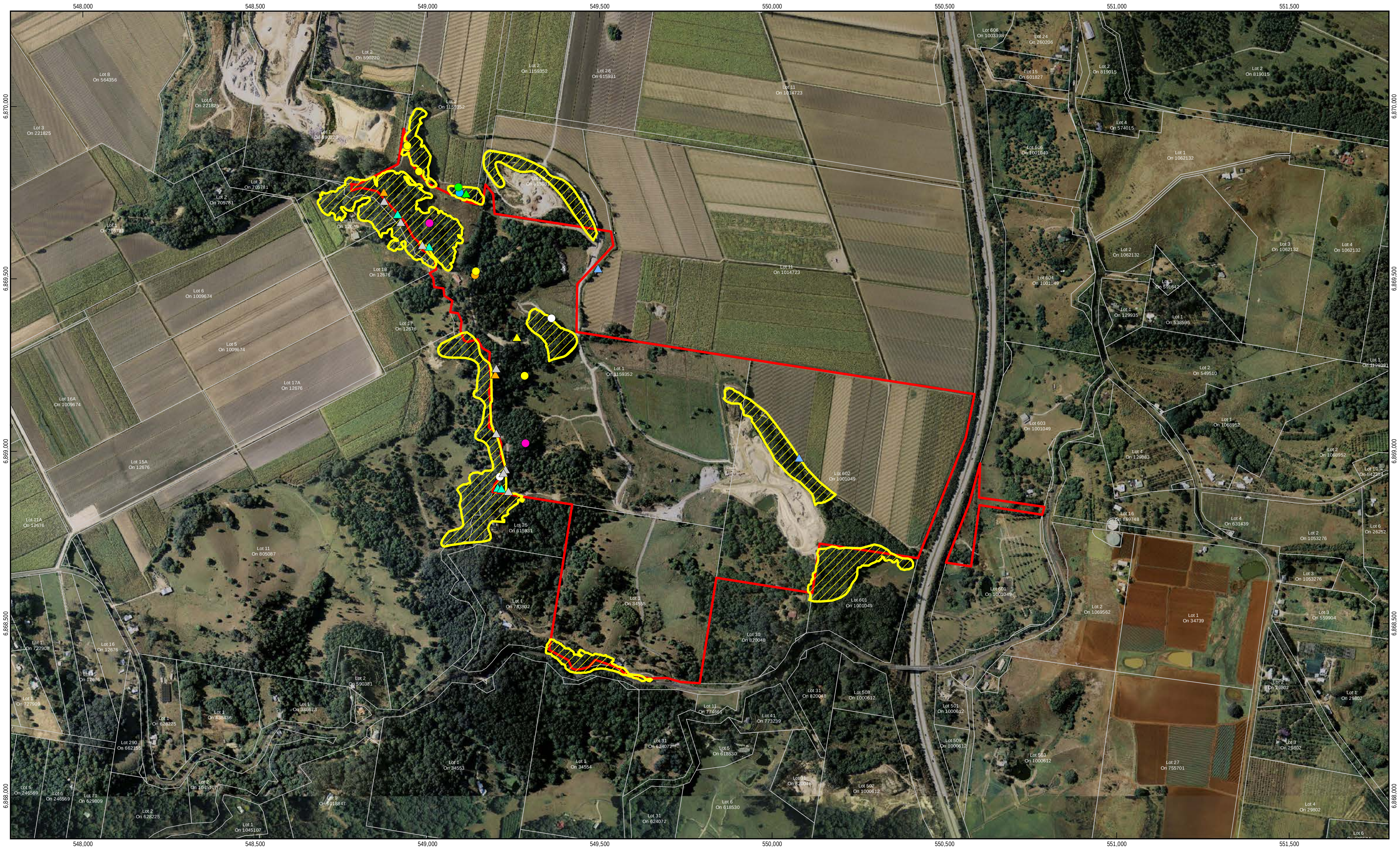
In addition the following records were tentatively recorded:

- An overflying black-cockatoo species likely to be a glossy black-cockatoo – (*Calyptorhynchus lathami*) (vulnerable) from the known population in the local area;
- A petaurid glider was observed during spotlighting that was unable to be identified to species level with a high level of confidence. Follow up targeted surveys by Council's Fauna Ecologist in July 2010 recorded sugar gliders from two locations within the blackbutt open forest; and
- A possible record of the eastern long-eared bat (*Nyctophilus bifax*) – vulnerable ('possible' call identification confidence from a poor quality call sequence).

A precautionary approach was taken to the identification of the tentatively recorded species, and all were considered as likely to at least forage in the study area on occasion.

Summary of Conservation Significance

Figure 50 provides an indication of the key ecological aspects of the site including the distribution of threatened species records and higher ecological value areas in the study area. A summary of conservation significance is provided in Table 9-38.



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0 125 250 375 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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LEGEND

Fauna Observations
- Collared Kingfisher
- Grey-headed Flying-fox
- Koala
- Little Lorikeet
- Petaurid Glider
- Rose-crowned fruit-dove

Conservation Significant Plants
- Black Walnut
- Long-leaved Tuckeroo
- Smooth Scrub Turpentine
- White Lace Flower (vulnerable)

Habitat Trees
- Dead Stag
- Hollow-bearing Tree

- Areas of Higher Ecological Value
- Site Boundary

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Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Job Number	41-20806
Revision	1
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Key Ecological Aspects

Figure 50

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54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Cadastre boundary (2010). GHD - Site Boundary (2011), Areas of Higher Ecological Value (2010), Fauna Observations (2009), Habitat Trees (2010).

Table 9-39 Study Area Conservation Significance

Attribute	Survey Finding
Threatened Flora Species	White lace flower (*Archidendron hendersonii*) recorded.
Threatened Fauna Species	Five threatened fauna species recorded, with a further four threatened species (with uncertain identifications) potentially occurring in the study area.
Migratory Species	Three migratory species recorded within or overflying the study area.
Endangered Populations	No endangered populations recorded within the subject site or study area.
Endangered Ecological Communities	Two ecological communities that have characteristics consistent with that of EECs recorded in the study area: ◗ Wet sclerophyll closed forest (Vegetation Type 3) mapped within and adjacent to the northwestern boundary of the site outside of the development footprint contained elements consistent with the lowland rainforest on floodplain EEC. ◗ Vegetation along the drainage line (Vegetation Type 6) was likely to be representative of the swamp sclerophyll forest on coastal floodplains EEC.
Habitats for Threatened Flora and Fauna	◗ Although the vegetation in the study area is camphor laurel-dominated and highly disturbed due to historical clearing and subsequent weed infestation, it contains potential habitat for rainforest species. White lace flower (*Archidendron hendersonii*) was recorded from the development footprint. ◗ Small areas of blackbutt open forest (wet and dry sclerophyll) provide feeding habitat for a resident population of koalas. Areas where this habitat occurs in the study area (outside of that approved for Quirks Quarry) will be retained. ◗ Limited numbers of hollow-bearing trees were recorded within or in close proximity to the subject site, with only two trees containing hollows and one dead stag recorded. No hollow bearing trees were recorded within areas to be cleared. ◗ Vegetation along drainage lines in the lower lying areas have predominantly been cleared and modified and generally provide only marginal habitat for threatened frog species.

9.7.3 Potential Impacts and Impact Assessment

Overview

Both of the quarries and the three landfills outlined in the Concept Plan are expected to result in similar potential ecological impacts as they are all located within close proximity and occur on similar topography and contain similar and connected vegetation types. The potential impacts associated with 'quarry' type and 'landfill' type impacts as well as the haul road are detailed separately in Table 9-40. Management measures for potential impacts are described in Section 9.7.4.

Existing and Historical Impacts

Due to existing and historical impacts in the region, the study area is presently subject to a number of impacts associated with quarry and landfill developments as well as historical clearing for agricultural purposes.

Habitat Loss and Fragmentation

The principal existing ecological impact is the historical loss and subsequent fragmentation of habitats. These impacts may have resulted in reduced home range availability, reduction in shelter and foraging resources and possible isolation of populations.

Habitat Degradation

Habitats in the study area have been and are presently subject to localised degradation from previous disturbances such as weed infestation, dust and noise impacts. These influences are likely to have reduced the diversity of fauna and flora occurring locally. Much of the vegetation is weed infested and has lower levels of biodiversity than would be found in an undisturbed area.

Habitat Alteration

Habitats over a large proportion of the study area have been substantially altered through clearing. Subsequent regrowth habitats predominantly contain a dense regrowth of camphor laurels with sparse understorey and ground level vegetation, dense shrubby weed growth (e.g. lantana), or are open cleared areas. The simplified structure of the habitats as a result of historical clearing may ultimately lead to a homogenisation of local species diversity as forest-reliant species may be replaced by opportunists that can tolerate disturbed environments.

Fragmentation and Barriers to Movement

Opportunities for movement to other habitat remnants within the surrounding regional landscape may have previously been restricted by agricultural development and roads. These would impact upon less mobile fauna species such as arboreal and ground dwelling mammals.

Impacts Associated with the Activity

Vegetation Clearing

As required by the DGRs, estimates of the clearing required for all components of the proposed activity are provided in Table 9-39. These numbers have been generated based upon calculations from overlaying the elements of the Concept Plan (Figure 3 Section 1) over the Vegetation Map (Figure 49). As such, they do not necessarily present an exact figure in relation to clearing, and in many cases the figures will over represent the area to be cleared. Areas have been rounded in hectares to three decimal places (i.e. nearest 10 m^2).

It is anticipated where relatively low areas of clearing are indicated, (e.g. the 60 m^2 of vegetation type 2b and 170 m^2 of vegetation type 3), that these would be able to be avoided or reduced during detailed design. In addition, the 3680 m^2 of vegetation type 7 that currently falls within the concept footprint for West Valley quarry is not likely to require clearing. The concept design assumed a minimum pit level of RL 4 AHD, however as this eastern section would provide little gain with regard to quarry resource and would intercept elements of Council's botanic gardens concept, Council has committed to avoidance of this area and to minimise clearing of native vegetation in general.

Table 9-40 Estimated Clearing Areas

#	Vegetation Type	Clearing Area (ha)				
		Approved	Stage 1		Future Stage	
		Quirks Quarry	West Valley	Haul Road	North Valley	Total
1a	Camphor laurel (**Cinnamomum camphora*) closed forest	(1.006)	1.689	0.217	3.170	5.076
1b	Camphor laurel (**Cinnamomum camphora*) open forest to open woodland	(0.255)	3.084	0.015	0.068	3.167
2a	Blackbutt (*Eucalyptus pilularis*) wet sclerophyll forest	(0.367)	0.000	0.066	0.000	0.066
2b	Blackbutt (*Eucalyptus pilularis*) dry sclerophyll forest	(0.000)	0.000	0.006	0.000	0.006
3	Camphor laurel – pink bloodwood (**Cinnamomum camphora – Corymbia intermedia*) closed forest	(0.000)	0.000	0.017	0.000	0.017
4	Grassland / cleared areas	(4.770)	5.831	2.269	0.313	8.413
5	Canefield	(0.000)	0.000	0.000	0.000	0.000
6	Broad-leaved paperbark – camphor laurel (*Melaleuca quinquenervia – *Cinnamomum camphora*) open forest	(0.000)	0.000	0.000	0.000	0.000
7	Brush Box – Bennett's ash (*Lophostemon confertus – Flindersia bennettiana*) open forest	(0.000)	0.368	0.000	0.000	0.368
8	Orchard	(0.000)	0.000	0.000	0.000	0.000

Concept Plan Impact Summary

A summary of the potential impacts resulting from the Concept Plan are Provided in Table 9-41.

Table 9-41 Activities and Potential Impacts

Impact Type	Activity	Potential Impact
Quarry Impacts	**Vegetation Clearing** Clearing will be required for the development of the quarries. This will involve the progressive stripping of vegetation from the work area during the lifespan of each of the quarries.	- Habitat loss - Habitat fragmentation - Loss of biodiversity - Fauna mortality or injury
	Movement of Heavy Vehicles The proposal will result in the movement of heavy vehicles along the haul road and within the quarry area. It is anticipated that roads within the site will be speed limited to below 40 km an hour within the site.	- Mortality or injury to fauna - Habitat degradation - Noise and Vibration - Air quality
	Drilling, blasting, and processing The quarry works will require drilling and blasting as well as processing (screening and crushing).	- Habitat degradation - Noise and Vibration - Air Quality - Water Quality
	Stockpiling Stockpiling of quarry resource may be required.	- Adverse impacts to vegetation
Landfill Impacts	**Landfilling** Landfilling will involve receipt of waste materials and disposal to a landfill constructed in the void left by the quarries.	- Habitat Degradation - Vermin Attraction and Altered Species Dynamics - Decreased Water Quality - Litter - Spread of Exotic Species - Noise Impacts upon Fauna Species - Reduction in Air Quality
Haul Road Impacts	**Vegetation Clearing** The concept design haul road has been located as far as possible within existing cleared areas or along existing tracks such that a reduced amount of clearing is required.	- Habitat loss - Habitat fragmentation - Loss of biodiversity - Fauna mortality or injury

Part 3A Impact Assessment

In accordance with the DGRs a detailed assessment of the potential impacts of the project on any threatened species, populations, endangered ecological communities or their habitats was undertaken in accordance with the Part 3A Threatened Species Guidelines (DEC and DPI, 2005). These indicate that impacts are 'more significant' if the following apply:

- Areas of high conservation values are affected;
- Individual animals and/or plants and/or subpopulations that are likely to be affected by the proposal play an important role in maintaining the long term viability of the species, population or ecological community;
- Habitat features that are likely to be affected by the proposal play an important role in maintaining the long-term viability of the species, population or ecological community;
- The duration of the impacts are long-term; and
- The impacts are permanent and irreversible.

An evaluation was made in relation to each of the activities associated with the Concept Plan with respect to the above impact evaluation factors. A summary is provided in Table 9-41.

Table 9-42 Impact Evaluation Factors

Significance	Proposed Activity and Impact
Areas of high conservation values are affected.	Specific activities that have potential to impact upon areas of high conservation values areas are: ◗ Clearing of vegetation for quarry establishment; ◗ Clearing of vegetation for haul road establishment; and ◗ Operational activities that may result in degradation of habitat. Areas considered to have higher ecological values in the study area include: ◗ Eucalypt open forest including wet sclerophyll forest with lowland rainforest elements; and ◗ Swamp sclerophyll forest. The proposed activity has been configured such that the maximum areas of these habitats are maintained in the study area, and where relevant, their existing connectivity to other areas of higher conservation value are retained.
Individual animals and/or plants and/or subpopulations that are likely to be affected by the proposal play an important role in maintaining the long term viability of the species, population or ecological community.	Although it is not expected that the proposed activity will affect the long term viability of any species, population or ecological community, specific activities that could have a direct impact upon individual flora and fauna species are: ◗ Clearing of vegetation for quarry establishment; ◗ Clearing of vegetation for haul road establishment; and ◗ Movement of heavy vehicles. Any threatened species identified in the study area are considered as likely to have an important role in maintaining the long term viability of the species population or ecological community. The proposed activity will have direct impacts upon a small stand of white lace flower (*Archidendron hendersonii*) which occur within the footprint of West Valley.

Significance	Proposed Activity and Impact
Habitat features that are likely to be affected by the proposal play an important role in maintaining the long-term viability of the species, population or ecological community;	Specific activities that may have impacts upon habitat features are: ◗ Clearing of vegetation for quarry establishment; and ◗ Clearing of vegetation for haul road establishment. No hollow-bearing trees will be cleared for the activity. Scattered eucalypts from within camphor laurel dominated vegetation will be removed where they occur within the development footprint. These would provide feeding resources for koalas and other fauna species.
The duration of the impacts are long-term.	Specific activities that will result in long term impacts: ◗ Removal of quarry materials; and ◗ Landfilling. It is anticipated that the proposed activity will take place over a period of 40 years. During this time some of the components of the activity will be rehabilitated for the purposes of the Tweed Regional Botanic Gardens.
The impacts are permanent and irreversible.	It is anticipated that the development footprints of all the quarry and landfill developments will be rehabilitated to become the future Tweed Shire Botanic Gardens. The final landform will depend upon the requirements for this. The impacts of clearing are not considered to be irreversible, however the footprint will not be returned to that existing. Future development of the botanic gardens has potential to provide beneficial impacts that will result in habitats in the study area that are improved for a variety of fauna species. In addition, due to the study area containing suitable conditions for a variety of rainforest species, areas outside of the footprints could be restored or rehabilitated to reflect the original communities occurring on the site. Management and rehabilitation of habitats in the study area is achievable and with respect to this the impacts are not considered to be permanent or irreversible.

Appendix H of the Ecological Assessment report provides details of the Part 3A Adverse Impact Assessments undertaken in accordance with Appendix 3 of the Part 3A Assessment Guidelines.

The key findings of the Part 3A Adverse Impact Assessments were that the proposed activity was not likely to have an adverse impact on any species, populations or ecological communities or their habitats that occur or could occur in the study area such that they are placed at risk of extinction.

EPBC Act Assessments of Significance

Appendix H of the Ecological Assessment report provides details of the EPBC Act Assessments of Significance that were undertaken. It was determined from these assessments that the proposed activity is not likely to have a significant impact upon any threatened species, populations or ecological communities, or migratory species that occur or could occur in the study area.

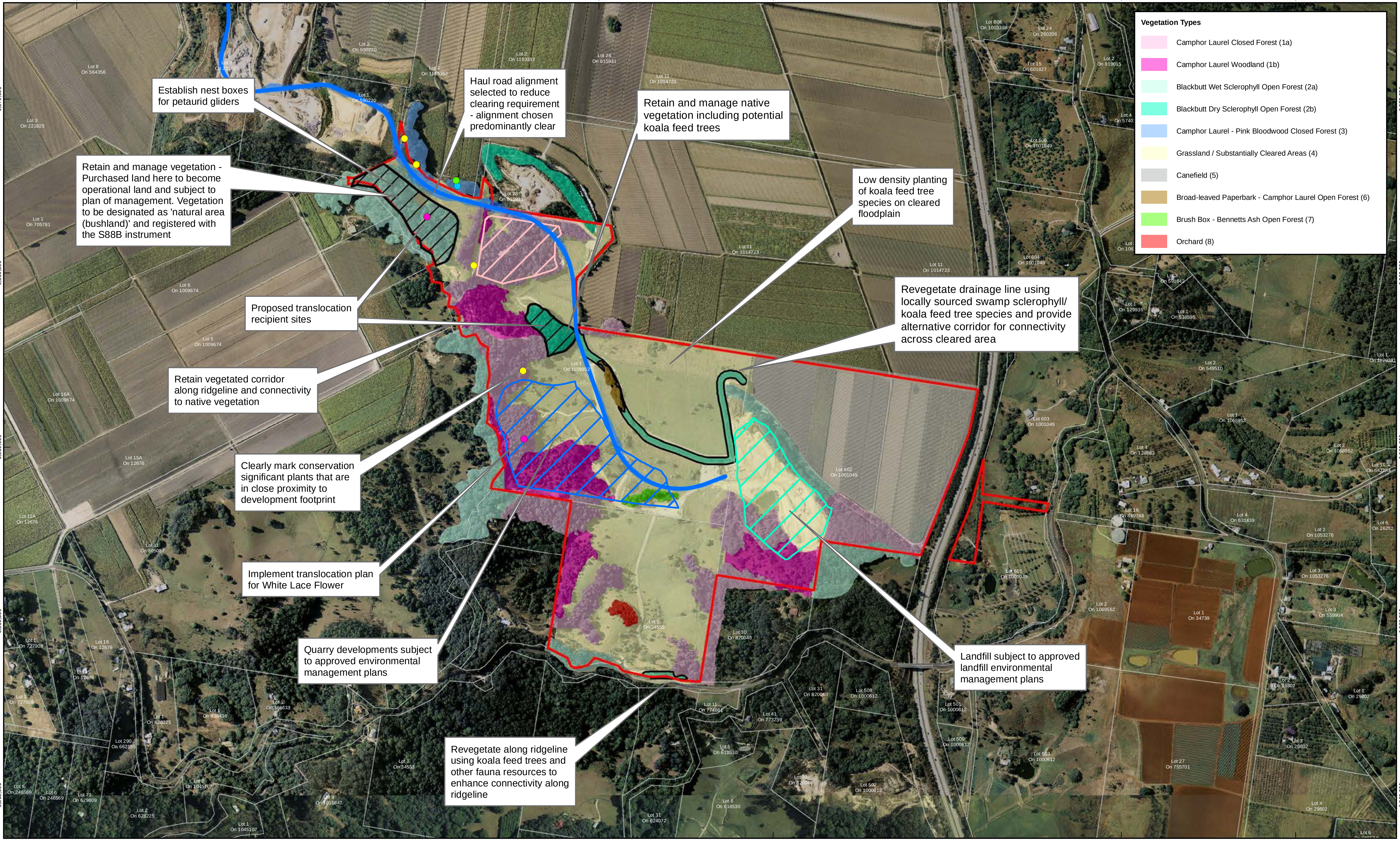
9.7.4 Mitigation Measures

Overview

The development of mitigation measures associated with the Concept Plan was undertaken according to the hierarchy of avoidance, mitigation and offsetting of impacts. Although the potential impacts have primarily been avoided or mitigated, an offset for some aspects of the loss of biodiversity values is required. These values specifically relate to:

- Loss of some koala and rose-crowned fruit-dove feed tree habitat as a result of clearing camphor laurel dominated vegetation containing occasional blackbutts and other eucalypt species;
- Loss of shelter – camphor laurel dominated vegetation provides shelter (e.g. thermal, cover), for a variety of fauna species;
- Narrowing of vegetation corridor along the ridgeline; and
- Clearing of five white lace flower (*Archidendron hendersonii*) plants from within the camphor dominated vegetation and as such, loss of potential habitat for these and other rainforest species.

An overview of the key management measures for avoidance, mitigation of potential impacts are provided below. Figure 51 shows the key management measures proposed to be implemented.



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0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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LEGEND

- Site Boundary
- Cadastre Boundary
- Management Areas
- Revegetation Areas
- Quirks Quarry
- North Valley Footprint
- West Valley Footprint
- Haul Road

Conservation Significant Plants

- Black Walnut
- Long-leaved Tuckeroo
- Smooth Scrub Turpentine
- White Lace Flower (vulnerable)

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Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Job Number	41-20806
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Management Measures

Figure 51

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54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011), Cadastre boundary (2011). GHD - Site Boundary (2011), Vegetation Mapping (2010), Habitat Trees (2010), Management Areas (2010), Revegetation Areas (2010), Quirks Quarry (2010), West Valley (2010), North Valley (2011).

Impact Avoidance

The proposed infrastructure has been configured such that areas of higher conservation significance and existing regimes are maintained. In particular, the West Valley Quarry footprint was constrained by the location of the blackbutt open forest habitat and provision of connectivity along the ridgeline. The indicative footprint for the North Valley Quarry also avoids areas of higher ecological value, however this will be subject to future concept design, which would take higher ecological value areas into consideration as constraints.

The landfill development within Quirks Quarry will be limited to existing disturbed areas and as such avoids further clearing or disturbance to higher ecological value areas.

In order to reduce impacts upon areas that provide potential habitat for threatened rainforest species, the Haul Road concept plan was realigned to reduce the clearing requirement in the higher ecological value vegetation type. . The haul road concept was realigned in April 2011 to avoid vegetation type 7, as suggested by DECCW.

Impact Mitigation

Environmental Management Plans

All landfill and quarry developments will be subject to compliance with guidelines and an approved environmental management plan (EMP). This would include management of the construction of the haul road.

The EMPs will include sub-plans detailing how a range of elements, including the following will be managed:

- Vegetation management including clear delineation of clearing footprints and identification of conservation significant trees;
- Fauna management;
- Pest species management;
- Surface water management; and
- Soil management.

Landfill Environmental Management Plan

A draft LEMP (Appendix C) was developed for facilitation of safe and efficient operation of the proposed landfill and to safeguard the environment and surrounding community from pollution and off-site effects, and will form part of the application for an Environmental Protection Licence for the landfill operations.

The draft LEMP contains details of environmental goals and control measures with respect to:

- Water pollution, including landfill leachate;
- Air pollution, including gas emissions;
- Wastes, including quality and quantity;
- Noise pollution; and
- Remediation.

The draft LEMP provides an outline of quarterly and annual monitoring of groundwater and surface water; leachate; and stormwater pond; as well as quarterly monitoring of landfill gas.

Quarry Plan of Management

As for the LEMP, a Quarry Plan of Management is required as part of the application for an Environmental Protection Licence for each of the proposed quarries. Works and activities for the quarries must be carried out in accordance with the site-specific Quarry Plan of Management.

Vegetation Management

In order to protect and maintain vegetation outside of the development footprints, the following would be included in the management plan for vegetation:

- Vegetation protection areas will be identified and established prior to construction.
- Vegetation (and, if necessary individual trees) identified to be retained in close proximity to development areas shall be clearly marked and a 'protection zone' established.
- All site personnel will be made aware of retained vegetation areas and requirements for the protection of these areas.
- If stockpiling of vegetative material is required, this is to be covered and stored at least 50 m away from any watercourse and outside the drip zone of any retained trees.

Activities Prohibited within the Protection Zone

Activities that would be prohibited in the protection zones include:

- Use of or parking of vehicles and equipment (unless associated with a permitted activity);
- Placement of construction materials, refuse, excavated spoils and stockpiling;
- Dumping of poisonous materials that may be harmful to plant health;
- Use of tree trunks as a winch support, anchorage, temporary power pole, signpost or other similar function;.

Activities Permitted within the Protection Zone

The following activities permitted in the protection zones include:

- Weed management;
- Activities as described in the Habitat Management Plan (to be developed); and
- Restoration and translocation activities.

Target Survey and Translocation of Threatened Plant Species

Target surveys for threatened plant species will be undertaken once the final development footprint has been confirmed.

A 'Preliminary Translocation Plan for Threatened Plants' has been prepared by Council in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Appended to the Ecological Assessment report, Appendix L). The plan provides details of the proposed translocation of the white lace flower plants recorded in the study area via ameliorative enhancement, with the goal to establish a viable self-sustaining population at the site. Replacement ratios of 1:50 for tubestock (seed propagation), and 1:100 for cuttings have been included in the plan.

In the event that further threatened species are located in the development footprint, the Translocation Plan would be revised to incorporate additional individuals or species.

Offset of Residual Impacts

Restriction on Title

In 2010 Council negotiated the purchase of an area of about 6.5 ha of land which constitutes the north western portion of Lot 1 DP1159352 at Eviron to secure land for long term quarry and landfill operations. The purpose of the acquisition was for the creation of a corridor between the existing Stott's Creek RRC and Council's proposed Quarry and Landfill site at Eviron . A linking road would traverse this area thereby connecting the Eviron Road quarry and landfill proposal with existing infrastructure located at Stott's Creek RRC.

Part of this parcel of land in the north western portionwill be classified as operational land. This area is also recognised as having a number of biodiversity values including threatened fauna and flora species habitat and corridor values associated with the vegetated areas on the upper slopes and ridgeline. In order to manage these habitat values in perpetuity, it is proposed that a positive covenant be registered on the title imposing a legal obligation in perpetuity to abide by the management actions of a Habitat Management Plan.

A plan showing the habitat areas would form part of the Habitat Management Plan. To create the legal obligations in perpetuity, a positive covenant is to be registered on the title where the Habitat Management Plan will be a memorandum attached to the positive covenant. The positive covenant will create the legal obligation to manage the land in accordance with the Habitat Management Plan

The Habitat Management Plan would describe:

- The habitat areas being the blackbutt mapped forest upslope on the proposed haul road; and
- Management actions to maintain and improve this habitat in perpetuity.

The restriction on the title forms part of Council's statement of commitments (Section 10).

Corridor Planting and Habitat Enhancement

Although it is recognised that planting and corridor enhancement measures may not be considered to be a direct 'offset', effective provision of these are predicted to provide longer term connectivity and habitat benefits to fauna species such as the koala that are thought to have a resident population in the study area.

Council have prepared a Preliminary Restoration Plan that outlines the intended works to establish the corridors described below. This is appended to the Ecological Assessment report in Appendix L. The objectives of the plan include the:

- Reconstruction of bushland habitat to facilitate wildlife movement throughout the site and wider locality;
- Provision of a fauna refuge across the site to minimise the risk of fauna injuries and mortalities from quarry and landfill operations and natural disturbance events;

- Reconstruction of native vegetation communities consistent with that likely to have occurred prior to clearing, or, where the existing environment is highly modified, reconstruct a suitable alternative native vegetation community (Tweed Shire Council, 2011b).

The Preliminary Restoration Plan identifies that local provenance stock would be sourced where the vegetation community and constituent species are well represented in the local area (e.g. Blackbutt forest). Composite provenancing would be employed for species that are poorly represented in the locality, (such as Swamp Mahogany and associated species). In this case, the seed stock would be sourced from local, intermediate and long distances from the revegetation site i.e. ~60% sourced from local stock (on or adjoining the site), ~30% from an intermediate source and ~10% from a more removed site (Tweed Shire Council, 2011b).

The Preliminary Restoration Plan includes a five year schedule of works for maintenance and monitoring (including reporting). An evaluation report would be prepared at the end of the five year period, that would provide recommendations for the future management of the restoration areas (Tweed Shire Council, 2011b).

To provide future potential habitat and an alternate route for connectivity across the site, planting of suitable riparian / floodplain vegetation will be undertaken adjacent to the watercourse in Lot 1 DP1159352. The Preliminary Restoration Plan identifies strategies for this area, referred to as the 'Northern Riparian Corridor', for planting and assisted natural regeneration. Species characteristic of Swamp Sclerophyll Forest would be planted along the alignment using techniques of cluster planting along with a revegetation screen. This will create a vegetated corridor that connects the lowland areas to the ridgeline and effectively connect vegetation adjacent to the eastern side of Quirks Quarry to retained eucalypt open forest in the central western area of the site and link to the ridgeline.

The vegetation along the southern boundary of the site along Eviron Road (Lot 1 DP 34555) in the immediate vicinity of the current haul road access is currently predominantly cleared of native vegetation. This location along the ridgeline provides an opportunity to enhance connectivity from the vegetation to the south of Quirks Quarry in the east, to adjacent habitats along the Condong Range west and southwest of the site. Planting would be undertaken in this area to reflect existing remnant vegetation along the ridgeline and focus on providing fauna habitat and feeding resources. Suggested planting in this area would include small-fruited grey-gum (*Eucalyptus propinqua*), tallowwood (*E. microcorys*) (for koalas and other arboreal mammals) and forest oak (*Allocasuarina torulosa*) (for glossy black-cockatoos). The Preliminary Restoration Plan identifies a strategy for this 'Southern Ridgeline Corridor', will involve planting out with tubestock characteristic of Blackbutt wet sclerophyll forest.

Supplementary Nest Boxes

Although no hollow-bearing trees will be cleared, some mature eucalypts with the potential to form hollows will be lost. Consequently, in recognition of this, a nest box plan for petaurid gliders will be developed, with boxes to be established within the parcel of land set aside for habitat management on Lot 1 DP1159352.

9.8 Traffic Impacts

9.8.1 Methodology

The assessment of traffic impacts involved the following main tasks:

- Assessment of Road Network Traffic Conditions;
  - A site visit to review the proposed routing and access arrangements to/from the site. The characteristics of the route are considered in light of the type of vehicles using the route; tonnage; average trips per week; timing; and hours of operation. The road layout has been reviewed to ensure the accessibility for all vehicles are adequately catered for and in compliance with Austroads Guidelines;
  - Review of background traffic data (tube counts) provided by Council for.
- Review trip generation of the proposed activities;
- Intersection Analysis;
  - Analysis of intersections to access site and other impacted intersections using the intersection modelling software Sidra Intersection 4.0 (SIDRA);
- Performance of Road Network;
  - Following estimation of traffic generation, the performance of the road network was assessed to determine the construction and operational impact of the proposed Quarry and Landfill facility.
- Access - the site access was assessed to review operation and sight distance issues.

9.8.2 Existing Environment

Existing Road Network

The existing road network is shown in Figure 52. The site currently has access onto Eviron Road. However for the proposed activities all vehicles will access the site via the existing access to Stotts Creek RRC from Leddays Creek Road. Therefore site access to and from Eviron Road was not assessed as this access will be removed as part of the Concept Plan and the key intersections assessed were:

- Tweed Valley Way and Leddays Creek Road; and
- Facility access / Leddays Creek Road and Bartletts Road.

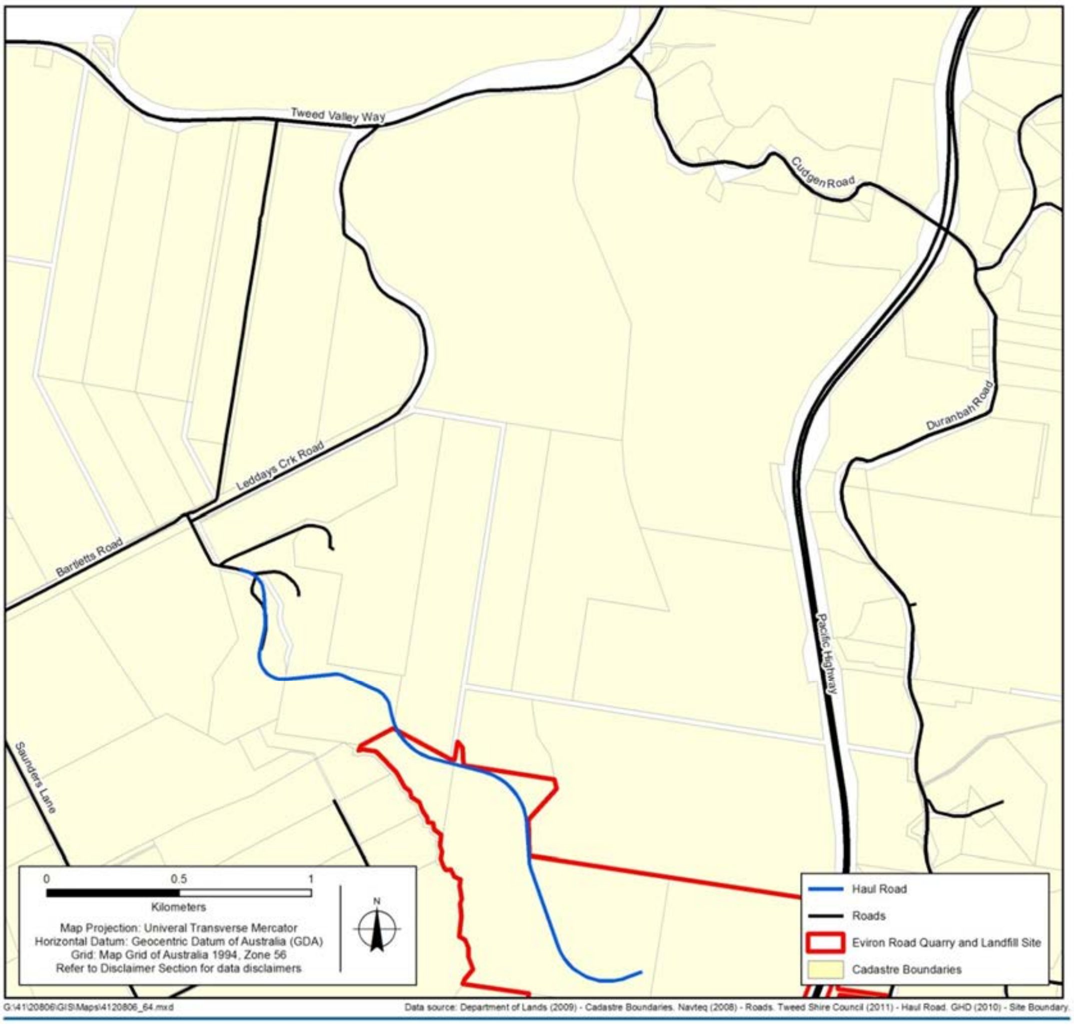


Figure 52 Surrounding Road Network

Road Network Details

Figure 53 shows the condition of Leddays Creek Road from the intersection of Bartletts Road looking north. It is a sealed two lane rural road (one lane each direction) that starts at the site access and joins on to Tweed Valley Way to the north.

Figure 53 Leddays Creek Road Looking North from Bartletts Road Intersection

Figure 54 shows the intersection of Tweed Valley Way (eastbound) and Leddays Creek Road. Tweed Valley Way is a two lane (one lane each direction) 100km/hr arterial road which follows the Tweed River and eventually loops back on to the Pacific Highway which is directly to the east of Quirks Quarry.

Figure 54 Tweed Valley Way from Leddays Creek Road Intersection

Background Traffic and Volumes

With only a few residential houses within the Leddays Creek Road catchment area background traffic is limited with the majority of traffic being from the landfill and quarry. There are no publicly listed bus routes that pass the Leddays Creek Road intersection.

Traffic data was provided by Council for the following locations:

- Entrance to Stotts Creek RRC (Leddays Creek Road)
- Eviron Road (off Duranbah Road); and
- Tweed Valley Way (north of the southern entrance to Tumbulgum).

Key statistics for these three locations including the average daily traffic (ADT), morning and afternoon peak hour traffic volumes and the percentage of heavy vehicles[5] is provided in the following table.

[5] Defined as Class 3 and above in accordance with Austroads Vehicle Classification System

Table 9-43 Traffic Count Key Statistics

	Entrance to Stotts Creek RRC (Leddays Creek Road)	Eviron Road	Tweed Valley Way
ADT – Weekday	625	345	10698
ADT – Weekend	425	390	10449
ADT – 7 days	568	358	10321
% heavy vehicles (Class 3 and above)	31%	12%	6%
AM Peak	75	38	893
PM Peak	79	43	1001

Note: all data provided by Tweed Shire Council

Based upon traffic count data provided by Council peak traffic along Tweed Valley Way generally occurs at 8:00-9:00 AM and 3:00-4:00 PM.

9.8.3 Impact Assessment

Site Access and Operating Hours

The existing access point for Quirks Quarry onto Eviron Road will be discontinued and access will no longer be permitted. For this reason the access on to Eviron Road has not been included in this assessment. The access point for all activities associated with the Concept Plan (including the Stage 1 Project Application) will be the existing access onto Leddays Creek Road from the Stotts Creek RRC as shown in Figure 55 below.

Waste collection vehicles will proceed through the Stotts Creek facility and along the proposed haul road to Quirks Quarry Landfill. Whilst small vehicular traffic (ie domestic and small commercial customers) will not enter the Eviron Road site and will continue to utilised the transfer station facility at the Stotts Creek RRC. Therefore this traffic is not considered further in the assessment as it is considered to be a continuation of the existing operations and not part of the Concept Plan.

As described in Section 7.2, the expected hours of operation of Quirks Quarry landfill are 7am to 4pm Monday to Friday and 9am to 4pm Saturday and Sunday, whilst quarrying activities will operate between 7am and 5pm Monday to Friday and 7am to 12pm Saturday.

Figure 55 Site Access from Leddays Creek Road

Traffic Generation

On the basis of the traffic data provided by Council for the existing quarry and landfill operations and the traffic counts for the identified intersection, a number of assumptions regarding the traffic generation, distribution and directional splits were made as part of this assessment to derive the turning movement traffic volumes. Overall it is noted that the traffic generation has been assumed based on information on expected maximum outputs from the Quarry and expected maximum intake at the landfill. Both facilities will use the same access and route to Tweed Valley Way.

It is recommended that during detail design, classified traffic counts should be undertaken at the Bartletts Road / Leddays Creek Rd intersection and Tweed Valley Way / Leddays Creek Rd intersection to confirm that assumptions summarised below:

- 5% traffic growth rate applied to tube counts provided by Council;
- Assumed directional split for counts on Tweed Valley Way in the AM 60% heading east, 40% heading west and reverse in the PM;
- Generated traffic in peak hours coming to / from the quarry/landfill. AM - 40% out, 60% in and reverse in PM;
- Turning movements from Leddays Creek Road for both traffic counts and generated traffic, 50% east (right), 50% west(left).

- There will be no net increase in traffic from the site during the establishment of the Quirks Quarry landfill.
- It is assumed that traffic growth is at 5% in accordance with other recent traffic data counts in the area.
- As the activities for the Stage 1 Project Application are in essence a continuation of existing Council activities in this area, from a traffic impact point of view it is considered that there is no construction phase as such with all heavy vehicles, soil and building relocations already either existing on site or utilising the site and will not add additional traffic to the surrounding road network. Staff/employee movements to site will still remain as per existing activities.

Quirks Quarry Landfill

To provide for the worst case scenario/maximum traffic generation, a waste acceptance rate of 75,000 tonnes per annum has been adopted, but it is acknowledged that this will gradually increase from 55,000 tonnes per annum from the start of operations. Heavy vehicles (ie kerbside waste collection vehicles) constitute 13% of the vehicles entering the Stotts Creek RRC (as is currently the case).

Based on the expected waste tonnages and traffic counts from Stotts Creek, in the order of 550 vehicles per day would be expected at the site initially, with approximately 10% of these vehicles being present at the peak time, equating to the following:

- 7 heavy vehicles; and
- 48 light vehicles.

Traffic associated with site employees would contribute six vehicles in peak hour.

This traffic would travel onto Leddays Creek Road and it is assumed that at the intersection with Tweed Valley Way, a 50/50 split of vehicles would occur for a left and right turn.

Since the traffic levels associated with the landfill component are currently already accounted for within the existing road network (ie due to the presence and use of the existing Stotts Creek RRC) there is no net impact (other than the anticipated growth in vehicular traffic that would have been experienced in any case) on traffic volumes on Leddays Creek Road and Tweed Valley Way associated with this activity. Traffic associated with waste disposal facilities both at Stotts Creek and Quirks Quarry Landfill will remain the dominant source of traffic on Leddays Creek Road.

West Valley Quarry

It is expected that 200,000 tonnes will be extracted and removed from the site each year. It has been assumed that haulage vehicles are truck and dog trailers with an average 25 tonnes per load capacity.

Whilst the quarry haulage regime will be highly variable and dependent of the availability and demand for quarry resource an average traffic generation of 26 vehicles a day has been adopted. This has been derived from the expected tonnages and average capacity of a truck and dog trailer. Based on the traffic count provided by Council for Eviron road, the number of Class 4 heavy vehicles generated by the proposed quarry is consistent with the existing traffic counts. During peak periods this would equate to three vehicles per hour. Traffic associated with site employees would contribute ten vehicles in peak hour

The proposed haulage route from the quarry will be through the internal haul road to Stotts Creek RRC, then right onto Leddays Creek Road and on to Tweed Valley Way.

Product haulage from the quarry will be by heavy vehicles on an as required basis. The level of activity at the quarry will be variable depending on local construction and maintenance requirements. The haulage route will also vary depend on the location of construction activity. However it is anticipated

All haulage will occur during daylight hours between the hours of 7:00am - 5:00pm Monday to Friday. Combinations of trucks will be used but it is expected that truck and dog trailers setups will mainly be used. These trucks have a payload of between 20 – 30 tonnes per load and will reduce the number of truck trips and resulting potential impacts.

Heavy vehicle traffic on Eviron Road associated with quarrying activities will be eliminated upon establishment of the proposed haul road and closure of the current Quirks Quarry site access. However this traffic will be diverted to Leddays Creek Road and the intersection with Tweed Valley Way. The split of traffic travelling east or west on Tweed Valley Way will be dependent on the required destination of quarry materials, however it is assumed that this is a 50/50 split. The addition of on average 26 heavy vehicles a day associated with the quarry, will impact upon Leddays Creek Road increasing heavy vehicles by approximately 13%, indicating that the landfill activities will still largely be responsible for the bulk of the traffic generation. In terms of the impact on overall traffic volumes on Tweed Valley Way the impact is minimal.

Intersection Analysis

The intersection analysis reviewed two locations, these being the site access on to Leddays Creek Road and the intersections of Leddays Creek Road with Tweed Valley Way.

Tweed Valley Way / Leddays Creek Road

Figure 56 shows the layout of the intersection of Tweed Valley Way and Leddays Creek Road. Traffic can access the site by a right or left turn lanes from the Tweed Valley Way and can also turn either way when exiting from Leddays Creek Road. An added lane is present for vehicles performing a left turn out of Leddays Creek Road onto Tweed Valley Way, however for the right turn, only a painted island refuge is provided. During detail design it is recommended that a safety audit be conducted on this intersection to ensure that the additional heavy vehicle traffic associated with the quarry does not present a safety hazard and that there are adequate sight distances both for traffic travelling on and accessing Tweed Valley Way.

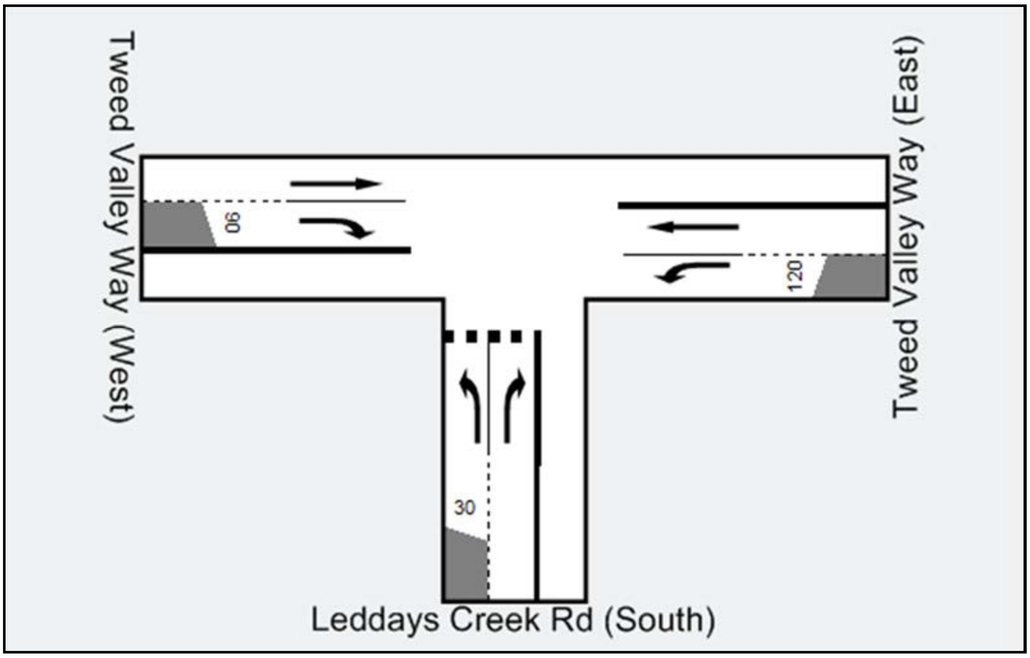


Figure 56   Intersection Layout

Site Access / Leddays Creek Road

Figure 57 below shows the intersection layout for the Bartletts Road and Leddays Creek Road (ie the site access road). Bartletts Rd is a minor unsealed (dirt) road that does appear to experience much traffic. For the traffic generation estimates it was assumed that all traffic associated with the proposed activities travels via Leddays Creek Road. As shown in Figure 58 below, there is no signage leading up to the intersection from either approach on Leddays Creek Road (ie from the north and from the site access). Traffic on Bartletts Road is signed to give way to traffic on Leddays Creek Road, include the access road to the landfill such that traffic to and from the site access flows freely through this intersection. However with the following will require further consideration in the detail design:

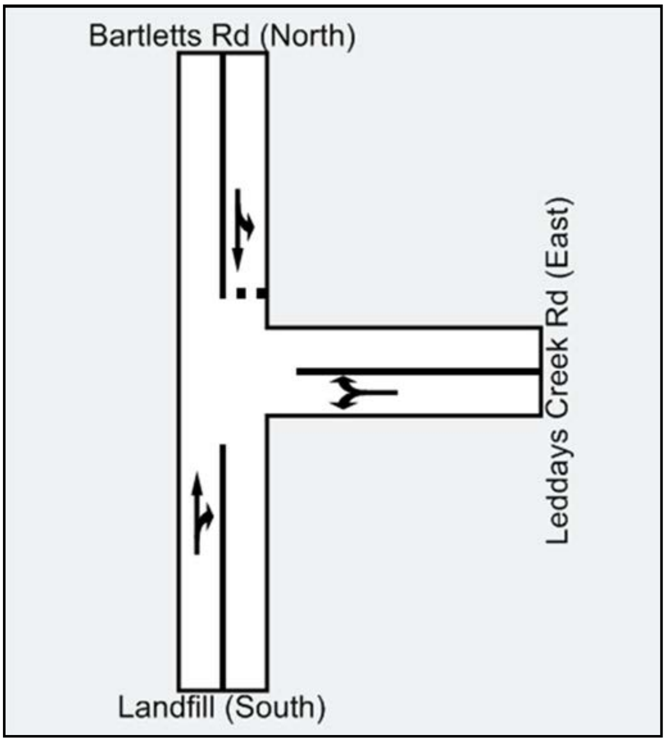
- Safe access for local traffic from Bartletts Road
- Potential for increased maintenance of the pavement due to impact from heavy vehicles.
- 

Figure 57 Intersection Layout

Figure 58 Intersection Leddays Creek Road (Site Access Road) and Bartletts Road

Access to Transport Routes

Part of the criteria in selecting Eviron Road for long term extractive and waste disposal activities was the proximity of the site to existing transportation routes.

The access to the Tweed Valley Way (major arterial) is approximately two kilometres from the site entrance, with access to the Pacific Highway (north and south bound) a further four kilometres north east. Currently quarry access via Eviron Road results in heavy vehicles travelling approximately 5km north along Duranbah Road which is a two lane rural road (one lane each direction) with a 60-80km/hour speed limit, passing through rural residential areas and tourist attractions (Tropical Fruit World). The closure of this access will remove this traffic from Duranbah Road and provide improved access to the Tweed Valley Way and Pacific Highway for quarry traffic.

For traffic accessing the waste disposal facilities proposed, access to major transport routes will remain unchanged.

9.8.4 Mitigation/Management Measures Stage 1 and Concept Plan

During detail design a road safety audit will be undertaken to identify whether additional measures are required for the safe access/egress of heavy vehicles onto Tweed Valley Way is required. Further a review of safe access for the low volume of local traffic entering Leddays Creek Road from Bartletts Road should also be undertaken.

The planned maintenance program for Leddays Creek Road shall be reviewed during the detail design to ascertain whether the addition of heavy vehicles associated with the quarrying activities will necessitate maintenance being brought forward.

Detail design of the proposed haul road will be in accordance with good practice for heavy vehicles and the following guidelines:

- *Road width* - (as defined) of the road to be at least 3.5 times the width of the largest vehicle regularly using the road;
- *Road grade* - generally the grade should be less than 3% (1:30) with a maximum of 10%;
- *Road profile* - the pavement shall be shaped so as to readily drain water and to provide a safe surface to travel. The road shall be crowned in the centre with a 2-3% cross-fall to each edge;
- *Curvature of bends* - In general, bend radii should be 100 metres or greater for main sections of road if a road speed of 25 km/hr is to be adopted;
- *Intersections* - all new intersections should be “T intersections” (angle of approach of at least 70 degrees). Where this is not possible, a risk assessment shall be conducted on the alternative design to ensure that persons can use the intersection with safety;
- *Safety berms or barriers* shall be installed at any point where the ‘drop off’ at the side of the road is greater than half a metre (0.5 m). This drop off situation should be avoided wherever possible by allowing a run-off slope at the side of the road battered at an angle no steeper than 1:4.
- *Guideposts* are to be of such size, shape, robustness and visibility (reflectors added) so as to adequately define the road boundaries in all conditions. The spacing of the guideposts shall be a nominal 100 metres on the haul road. Culverts unprotected by barriers or berms should be marked with pairs of guideposts;
- *Signage* - traffic control and direction signage shall be installed where necessary. The signs shall comply with AS 1742: *Manual of uniform traffic control devices;* and
- *Surface material* – the haul road should be sheeted with sufficient competent material to provide an adequate degree of traction when wet, and to enable the surface condition to be restored through normal road maintenance.

A traffic management plan will be prepared for the operation of the site that covers procedures and controls for traffic using both the Stotts Creek RRC and the facilities associated with the Stage 1 Project Application and Concept Plan.

9.9 Heritage

9.9.1 Methodology

A cultural heritage assessment was undertaken by Converge Heritage Consultants in 2009. The assessment report is provided in Appendix N. The assessment included consultation with the community and the Tweed Shire Council Aboriginal Advisory Committee (AAC), an assessment of the bio-geographical context of the area, a review of scientific assessments of cultural evidence, historical backgrounds, register searches, and traditional knowledge and literature available from various sources. The assessment was conducted in accordance with the then DECC *Interim Guidelines for Community Consultation* and the then newly released *May 2009, Draft Community Consultation Requirement for Proponents.*

The cultural heritage assessment was undertaken in the form of a field survey conducted over three days (18 and 19 March 2009 and 30 July 2009). The survey was aimed at identifying the presence of and/or the potential for Indigenous and non-Indigenous cultural heritage. An AHIMS search was undertaken which did not identify any registered sites or items within the project site.

The study area was traversed on foot via the use of both established vehicle tracks and walking paths and exploration of more vegetated areas. Traditional Owner representatives participated in the survey and consultation was in accordance with DECC Aboriginal Cultural Heritage Draft Community Consultation Requirements for Proponents, May 2009.

Areas of interest were photographed and locations were recorded using a GPS. Ground Surface Integrity (GI) and Ground Surface Visibility (GSV) were recorded across the project area to provide insight into the levels to which the landscape had been modified and how much the ground surface could be seen during the survey. This was determined using a percentage range between 0-100%.

As a result of the adequacy assessment review, DECCW sought clarification on the extent of Aboriginal community consultation and noted that the cultural heritage report lacked formal evidence from all six registered Aboriginal stakeholders of their views on the report. Specific information sought of the Aboriginal community by DECCW included their views on:

1. The Cultural significance of the area;
2. The adequacy of the proposed management measures detailed in the cultural heritage report; and in particular,
3. The proposed monitoring program and Cultural Heritage Management Plan (CHMP).

Converge undertook further consultation in order to address this, and documentation associated with this is provided in Appendix N.

In summary, Converge met with the Tweed Shire Council AAC on 4 March 2011. The AAC confirmed that it agreed that appropriate consultation had been undertaken to support the original assessment. Committee members in attendance maintained their support of the original findings and recommendations of the report.

Three letters were received, and a verbal endorsement was given by Garth Lena. One registered individual originally consulted has declined to be further involved with the Tweed Shire Council AAC consultation process.

9.9.2 Existing Environment/Impact Assessment

No areas or objects of Indigenous cultural heritage significance were identified within the study area. This may have been partially due to the low GI and poor GSV levels that predominated over the majority of the study area and the recent ground disturbance of ridgelines; which were considered to have a higher possibility of identifying Indigenous cultural heritage.

No areas or objects of non-Indigenous cultural heritage significance were identified within the project area, most probably due to activities from the recent historic past including grazing, dairying and other more general farming activity, until more recent quarrying. There were five springboard trees identified during the field survey, which have historic interest, as they may be illustrative of the past activities of loggers and timber getters.

The survey results and the register searches indicate that there is only a low probability that further, undetected cultural heritage material may remain in the study area, either within areas of low visibility or as subsurface remains.

9.9.3 Mitigation Measures

Although no items of cultural heritage significance were located during the assessment the Converge report outlined the following will be undertaken to assist in protecting and managing the cultural heritage values of the project area.

- On-going consultation with the local Aboriginal community to ensure cultural considerations are incorporated into future development activities and an appropriate Cultural Heritage Management Plan for the site is developed. Council will investigate the negotiation of a Council-wide Memorandum of Understanding (MoU) with the local Aboriginal community for the management and conservation of cultural heritage which acknowledges that cultural heritage assessments should take place before any land surface disturbance for areas identified as potentially containing cultural heritage;
- A program of site monitoring by representatives of the Aboriginal Party during activities causing ground disturbance should be developed as a management option for the recognised areas with a higher potential for the presence of unidentified cultural heritage. Within the project area this would be the ridgelines bounding the site and especially the north-south running ridgelines in the southeast quadrant of the project area;
- Development and implementation of procedures for managing unexpected finds. Much of the project area had poor ground surface visibility which limited the potential for identification of cultural objects and raises the possibility that further, undetected cultural heritage still exists within the study area;
- Implement cultural heritage inductions so that work crews are aware of specific obligations to look for cultural heritage material aiming at informing workers what archaeological materials may look like and give them clear instructions on procedures for inadvertent discoveries; and

- There were five sites (springboard trees) of historic interest that may be illustrative of the past activities of loggers and timber getters and should be retained *in situ* wherever possible and relocated to an appropriate location where they can be preserved and displayed along with appropriate interpretation if they cannot be retained in situ.
- A procedure to maintain continuous consultation process with the community for the life of the project will be included in the CHMP, in regards to all Aboriginal cultural heritage matters associated with the project area. This will include procedures for recording evidence of such consultation, such that in the final iteration of the CHMP the evidence can be presented.
- The following will included in the CHMP as a minimum:
  – Procedures for ongoing Aboriginal consultation and involvement;
  – Management of any recorded sites of higher archaeological potential within project footprint;
  – Responsibilities of all stakeholders;
  – Details of proposed mitigation and management strategies of all sites;
  – Procedures for the identification and management of previous unrecorded sites (excluding human remains);
  – Details of an Aboriginal cultural heritage education program for contractors and personnel associated with construction activities;
  – Corrective procedures in the unlikely event that a non compliance with the CHMP is identified.

9.10 Visual Impact

9.10.1 Methodology

An assessment of the potential visual impact of the proposed activities for Stage 1 and the Concept Plan was undertaken, as the development will be partially visible from a number of vantage points on the ridges lines to the north, east and south of the site (Figure 59 over page).

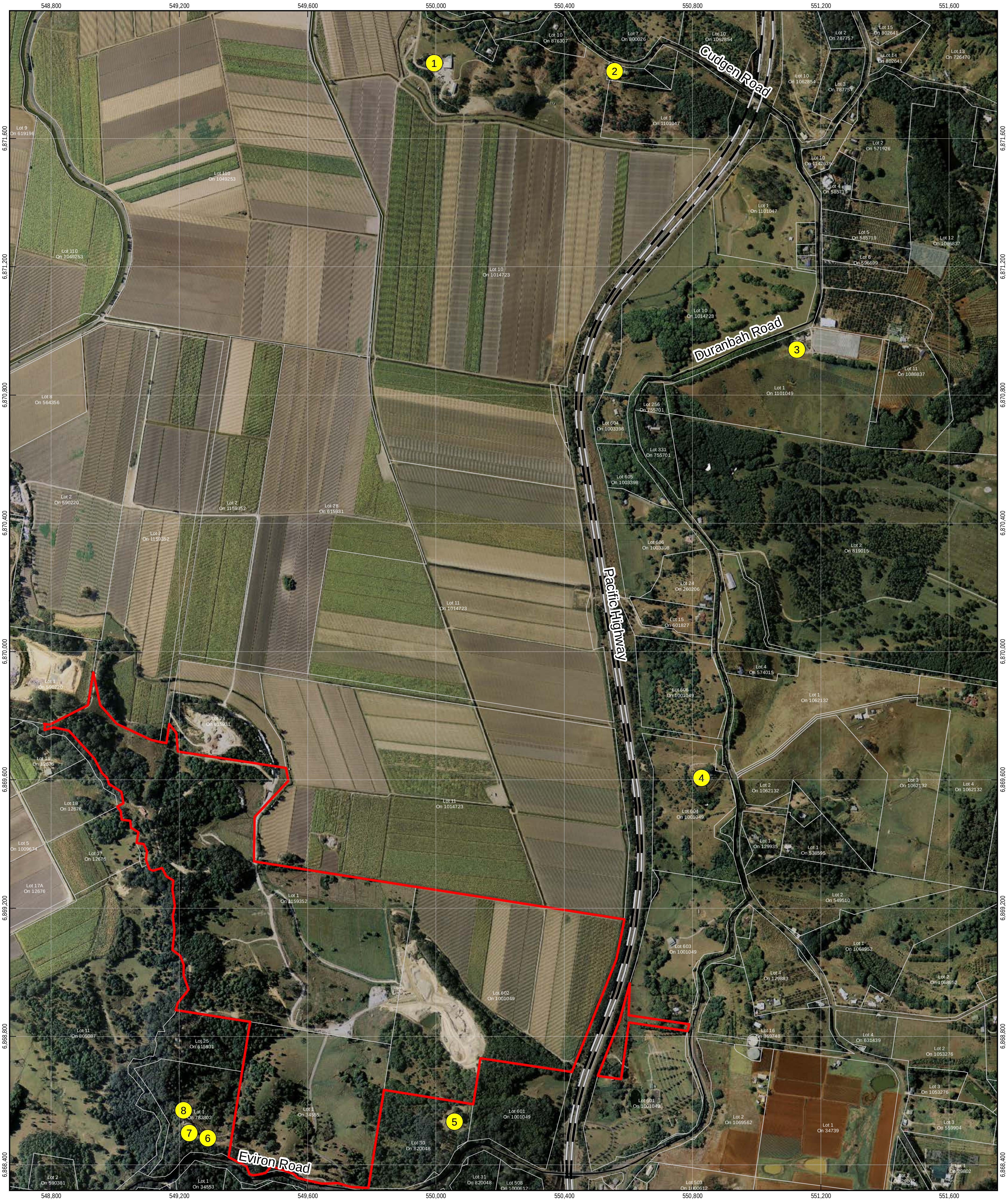
This assessment has considered the effect of existing topography, future topography (end of quarry life and landfill cap) and vegetation coverage in identifying the visual impact of the works at the proposed Quirks Landfill, West Valley Quarry and North Valley Quarry.

Note that specific details related to the development footprints of Quirks Quarry Landfill, West Valley Quarry are contained within the concept design report (Appendix B) and Preliminary West Valley Quarry Study (Appendix D) respectively.

The components of the Concept Plan beyond Stage 1 (i.e. West Valley landfill, North Valley quarry and then landfill) have not yet been subject to concept design. The anticipated development footprint and impacts associated with these components have been considered based upon the scale of development proposed for Stage 1 (i.e. it is assumed that the future quarry and landfills associated with future stages of the current Concept Plan would require a development footprint of a similar magnitude and result in similar impacts to that of Stage 1) as well as the type of development (i.e. 'quarry' type or 'landfill' type) for which there are expected to be equivalent impacts to the quarry and landfill type developments from Stage 1.

The visual assessment was developed based upon the following:

- Identification via a site visit, of residences with potential views of the West Valley Quarry and the final capping height of Quirks Quarry Landfill (noting that the current quarry footprint limits the landfill footprint, but that the resultant landform will be a maximum of 45 metres above the base level of the quarry). This approach facilitates a worst case scenario for the visual analysis;
- GIS viewshed analysis to identify which houses can see the final capping height of Quirks Quarry Landfill, West Valley Quarry (at end of quarry life) and North Valley Quarry (at end of quarry life) using existing vegetation cover; and
- GIS viewshed analysis to identify which houses can see the final capping height of Quirks Quarry Landfill, West Valley Quarry (at end of quarry life) and North Valley Quarry (at end of quarry life) using both existing vegetation coverage and mitigation measures (see Figure 8 in the Ecological Assessment, Appendix L to the EA) for the location of the mitigation measures (revegetation)).



LEGEND

1 Observation Points

Site Boundary

Highway

Local Road

Cadastre boundary

1:11,000 (at A3)

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
Eviron Road Quarry and
Landfill Environmental Assessment

Job Number	41-20806
Revision	2
Date	27 MAY 2011

Vantage Points

Figure 59

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54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: NavTeq - Highways, Local Roads (2008). Tweed Shire Council - Aerial Photography (2008), Cadastre boundary (2010). GHD - Site Boundary (2011), Vantage Points (2010), Vegetation Height (2010).

GIS software ArcView was used to undertake the viewshed analysis to determine which dwellings would be able to see the final height of Quirks Quarry Landfill, and West Valley Quarry. This was prepared using the following approach:

- A digital elevation model (DEM) was derived from a combination of:
  - 0.5 m contours for the site boundary;
  - 10 m contours for areas to the north of the site boundary;
  - 1 m cap contours for Quirks Landfill at the end of its operational life; and
  - 5 m contours for West Valley Quarry at the end of its operational life.
- Vegetation from within the site as well as vegetation from outside the site were given a height value of between 4 and 20 metres (based on an estimated height assessed during the site visit), and added to the DEM to take into account potential vegetation screening. ;
- The proposed screening vegetation was given a height value of either 15 or 25 metres and was incorporated with the existing vegetation to create a second DEM to take into account potential impact of the proposed mitigation measures; and
- Running a viewshed model with the approximate standing height of an observer set at 1.8 m above ground level.

Intended plantings associated with the project along an existing drainage line within the site boundary will help shield parts of Quirks Quarry Landfill, West Valley Quarry and North Valley Quarry from all vantage points. A viewshed analysis was undertaken including this vegetation in order to identify the potential mitigation associated with the plantings.

Assumptions

The visual analysis is subject to the following assumptions:

- All observation points are 1.8 metres AGL;
- Vegetation patches are of uniform height with vegetation height being represented in Figure 59;
- Vegetation shown in aerial photography provided by Tweed Shire Council has not been cleared;
- All elevation data (contours and cut and fill designs) provided by Tweed Shire Council are accurate; and
- All vegetation with the West and North Valley footprints will be cleared.

It is also noted that the nature of visibility analysis is subjective and dependent on a number of factors which can include:

- The relationship of the viewer to the surrounding environment (i.e. whether the person is a permanent resident, traveller, worker);
- Exposure to the view (i.e. whether it is a brief glimpse or an outlook from a house);
- Distance from a particular vantage point;
- The sensitivity of the view;
- The degree of human modification;

- Consistency with surrounding landscape;
- The number of viewers
- Vegetation cover;
- Topography; and
- Orientation of views (i.e. from houses or open space)

To reduce the reliance on subjective criteria, this assessment has utilised objective methodology where appropriate. Regardless of the approaches used, a significant subjective element is required to undertake the assessment, whether in the methodologies used, selection of the assessment criteria or by assigning values to each criteria. Consequently, the assessment process has been clearly documented to allow the reader to understand the process undertaken and the justification for the decisions reached.

Topographic screening was addressed by utilising contour data for the region as well as cut and fill designs for Quirks Quarry Landfill, West Valley Quarry and North Valley Quarry derived from the Conceptual Landfill Design and Preliminary Quarry Plan. Screening vegetation has been modelled according to vegetation patches and heights provided by Tweed Shire Council within the site boundary as well as between housing to the north and east of Quirks Quarry Landfill, West Valley Quarry and North Valley Quarry. Screening impacts from scattered or landscaped vegetation have not been included due to the complexity of such assessments. As such the analysis may underestimate the level of screening in many areas.

9.10.2 Existing Environment

The key visual characteristics of the site and surrounding areas are:

- Lowlands (<10 metres AHD):
  - Predominantly cleared; and
  - Used for agriculture (mainly sugar cane).
- Uplands (>10 metres AHD):
  - Densely wooded to the south (Condong Range), north (Cudgen Road) and to the east (Duranbah Road); and
  - Steep slopes.
- Pacific Highway to east;
- Border Ranges and Mount Warning to the west;
- Stotts Creek Resource Recovery Centre to the north-west;
- Quirks Quarry; and
- O'Keeffes Quarry.

Vegetation of significance to the visual assessment in the vicinity of the site is predominantly confined to the hills to the north, east and west of the site. The lowland areas surrounding the site are mostly cleared of vegetation and are currently used for agriculture (sugar cane). For more detailed descriptions of vegetation within the site refer to the Ecological Assessment (Appendix J to the EA).

9.10.3 Impact Assessment – Stage 1 and Concept Plan

The viewshed analysis identified the extent to which each of the eight (8) vantage points (see Figure 59) could see the final height of Quirks Quarry Landfill, West Valley Quarry/Landfill footprint and the North Valley Quarry/Landfill footprint. These vantage points represent residential dwellings to the north, east and south of Quirks Quarry Landfill, West Valley Quarry and North Valley Quarry. An additional two vantage points were undertaken on Lot 1 DP 783802 in outdoor positions where the property owners have established social/recreational areas. Each vantage point was shielded from a complete view of all aspects of the proposed activity by a combination of topography and existing vegetation. Most of the vantage points received increased visual shielding from Quirks Quarry Landfill and West Valley Quarry as a result of implementation of mitigation measures (i.e. planting of vegetation) however all of the vantage points apart from those located to the south will be able to see the upper benches of the West Valley Quarry.

Figure 60-67 show the viewshed analysis for each of the vantage points, and a comparative analysis displaying the results of the proposed mitigation planting.

Vantage Point 1

The viewshed analysis results for Vantage Point 1 are provided in Figure 60. Vantage Point 1 is located at a dwelling on the western edge of the northern ridgeline and is 18.85 m above sea level (ASL) and 1.8 metres above ground level (AGL).

Vantage Point 1 is shielded from views of Quirks Landfill and North Valley due to a combination of landform and vegetation, however it will be able to see the lower eastern sections as well as the upper benches of the southern wall of West Valley Quarry. The mitigation measures are likely to provide an effective screen of the West Valley site.

Vantage Point 2

The viewshed analysis results for Vantage Point 2 are provided in Figure 61. Vantage Point 2 is located at a dwelling close to the top of the middle of the northern ridgeline and is 56.8 metres ASL and 1.8 metres AGL.

Vantage Point 2 has views of the upper sections of the Quirks Quarry Landfill and will be able to see the upper benches as well as the lower eastern corner of West Valley Quarry. The mitigation measures are unlikely to reduce the views of Quirks Quarry Landfill however they are likely to lead to a reduction in the visibility of the West Valley site so that only the upper benches of the quarry are visible.

Vantage Point 3

The viewshed analysis results for Vantage Point 3 are provided in Figure 62. Vantage Point 3 is located at a dwelling close to the top of the eastern ridgeline and is 60.82 metres ASL and 1.8 metres AGL.

Vantage Point 3 has views of the upper sections of Quirks Landfill and will be able to see lower eastern corner and upper benches of West Valley Quarry. The mitigation measures are unlikely to reduce the views of Quirks Landfill however they are likely to offer increased screening of the lower eastern corner of West Valley.

Vantage Point 4

The viewshed analysis results for Vantage Point 4 are provided in Figure 63. Vantage Point 4 is located at a dwelling close to the top of the eastern ridgeline and is 57.28 metres ASL and 1.8 metres AGL.

Vantage Point 4 will have views of the upper sections Quirks Quarry Landfill and will be able to see the lower eastern corner and upper benches of West Valley Quarry as well as some sections of North Valley The mitigation measures are unlikely to reduce the views of Quirks Landfill however they are likely to offer increased screening of North Valley and the lower eastern corner of the West Valley footprint.

Vantage Point 5

The viewshed analysis results for Vantage Point 5 are provided in Figure 64. Vantage Point 5 is located at a dwelling on top of the hill directly to the south of Quirks Quarry and is 81.3 metres ASL and 1.8 metres AGL.

Vantage Point 5 is likely to have views of West Valley and North Valley activities due to its position on top of a hill. The mitigation measures are unlikely to offer any additional screening of site activities.

Vantage Point 6, 7 and 8

The viewshed analysis results for Vantage Point 6, 7 and 8 are provided in Figure 65 to Figure 67. These three Vantage Point are all located on the one property (Lot 1 DP 783802, 657 Eviron Rd) which is close to the top of the ride to the south west of Quirks Quarry. All three vantage points have been modelled at 1.8 metres AGL and are located as follows:

- Vantage Point 6 is located on a deck to the east of the dwelling (98.3 metres ASL);
- Vantage Point 7 is located at the dwelling (92.63 metres ASL); and
- Vantage Point 8 is located in a second outdoor area to the north west of the dwelling (96.73 metres ASL).

Vantage Point 6 has views of the Quirks Quarry Landfill and is likely to have very limited views of North Valley and the non-extractive sections of West Valley Quarry. The mitigation measures are likely to provide minimal additional shielding of West Valley or North Valley however they are likely to offer increased screening of the northern sections of Quirks Quarry Landfill.

Vantage Point 7 is likely to have views of Quirks Landfill. However it is unlikely to have views of West Valley Quarry and North Valley Quarry. The mitigation measures are likely to provide increased screening of the northern sections of Quirks Landfill.

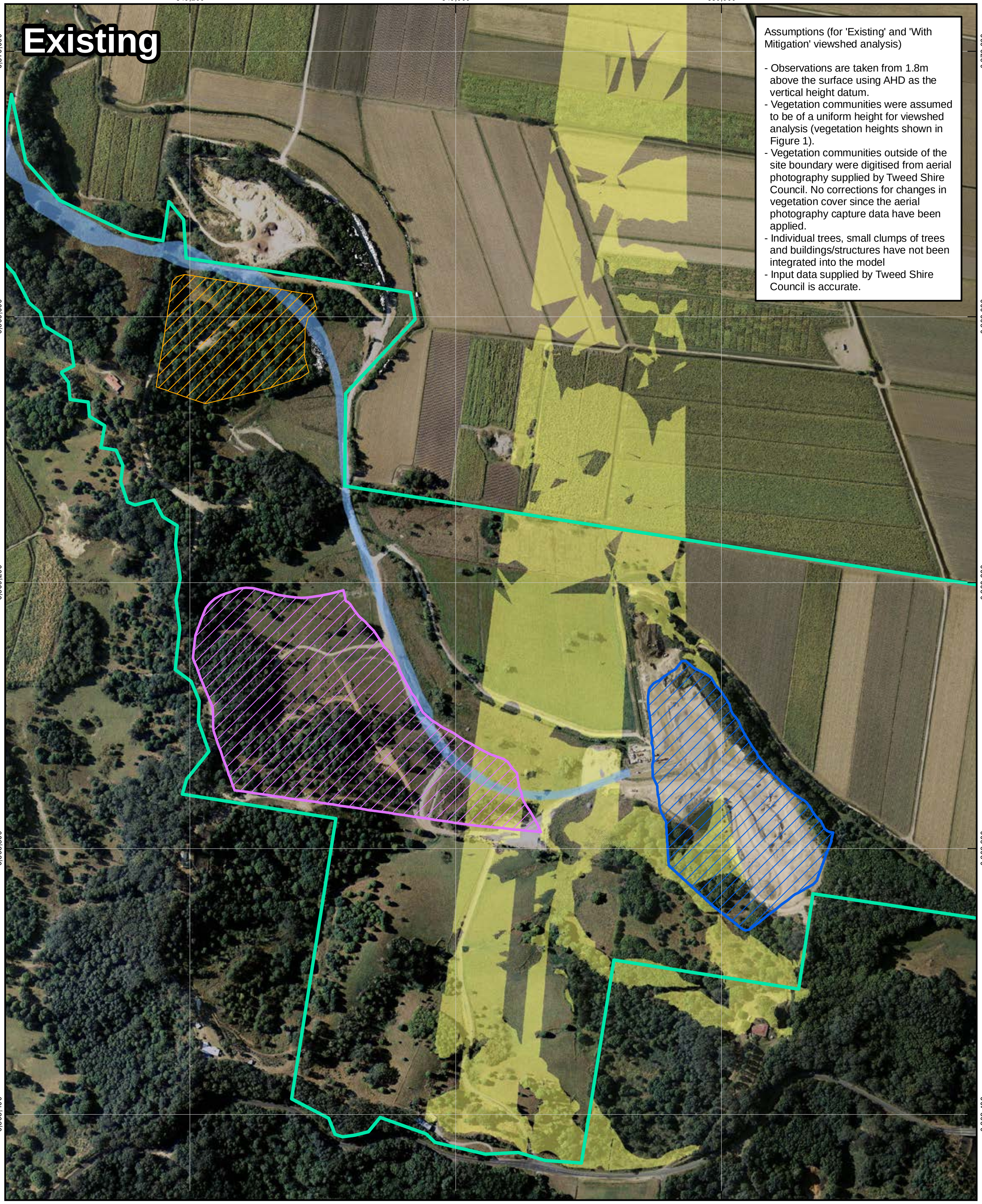
Vantage Point 8 is likely to have views of Quirks Quarry Landfill as well as minimal views of the lower sections of West Valley Quarry. The mitigation measures will offer a reduction in the visibility of the northern sections of Quirks Quarry as well as a minimal reduction in the visibility of the lower section of the West Valley Quarry.

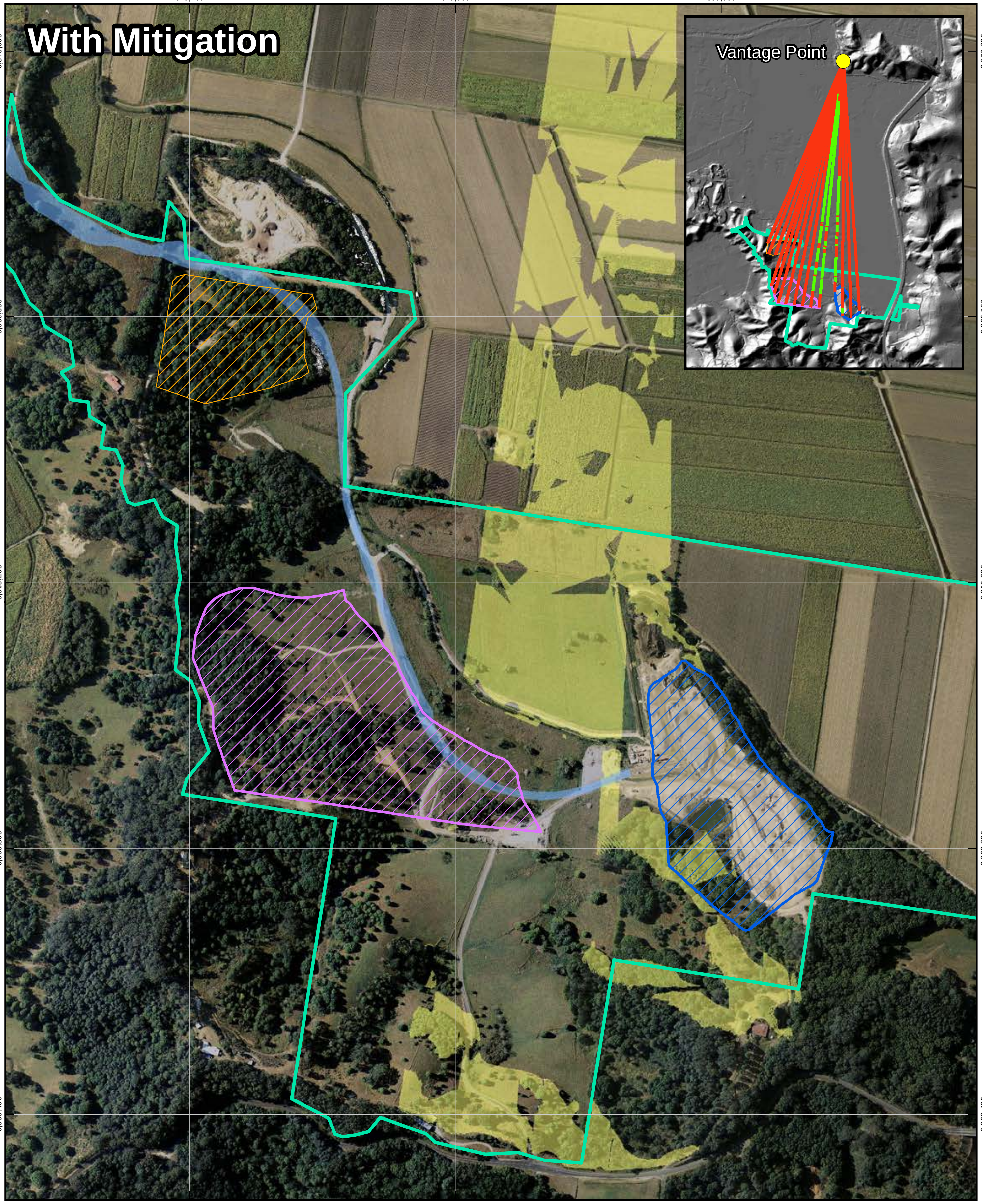
9.10.4 Mitigation Measures

The viewshed analysis performed at the eight observation points north, east and south of the site identified the potential visual impact of Quirks Quarry Landfill and West and North Valley

Quarry and Landfills. Each observation point had a different level of visual exposure to each site as a result of its relative position within the landscape and the screening features between the observer and the site however none of the observation points had a complete unscreened view of any of the activities. Mitigation measures such as the planting of additional trees along a drainage line between Quirks Landfill and West Valley Quarry will provide additional screening to observation points to the north however due to the location of the observation points as well as the situation of development footprints within the surrounding terrain it is unlikely that either site will be able to be completely screened

Regarding the overall concept plan depending on the ultimate size and orientation of the North Valley Quarry, some vantage points predominantly to the east of the site, will have views of the quarry operations. Mitigation measures such as further targeted plantings may assist in reducing impacts. Landfilling within the West Valley Quarry will also create visual impacts during its operational life. The extent of impacts unable to be mitigated during operation by the plantings discussed previous cannot be assessed until a concept design and final height of the landfill is determined. In all cases the landfills onsite will be progressively revegetated to reduce the long term visual impact of the activities.





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0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Site Boundary
Haul Road
Quirks Quarry Footprint
West Valley Footprint
North Valley Footprint

Visibility - Line of Sight
Visible from Vantage Point
Not Visible from Vantage Point

Visibility - Viewshed
Visible from Vantage Point

CLIENTS | PEOPLE | PERFORMANCE

Tweed Shire Council
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Vantage Point 1

Figure 60

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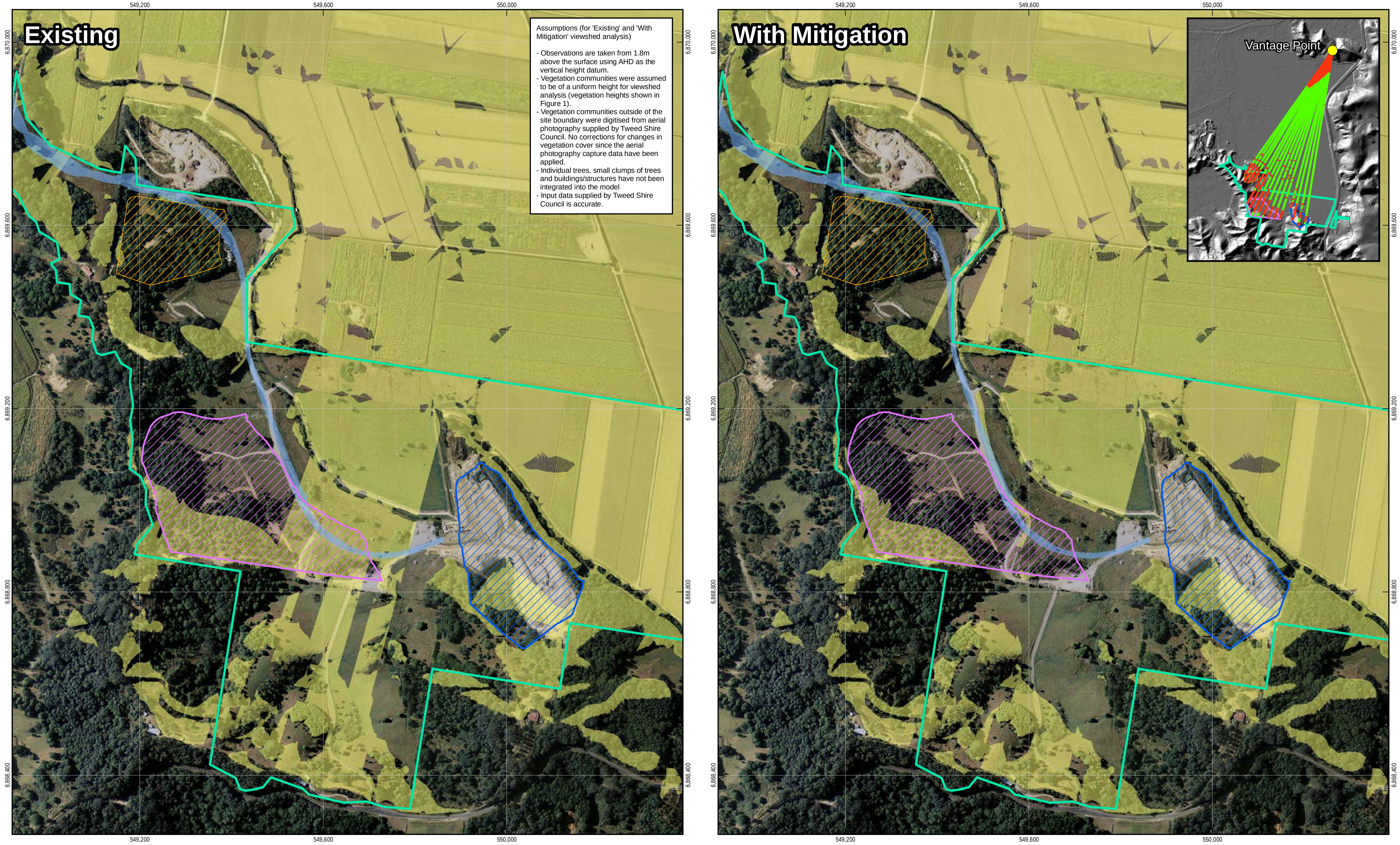
54-58 Nerang Street Nerang QLD 4211 Australia T 61 7 5557 1000 F 61 7 5557 1000 E goldcoastmail@ghd.com.au W www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM



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0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Site Boundary
- Haul Road
- Quirks Quarry Footprint
- West Valley Footprint
- North Valley Footprint

Visibility - Line of Sight

- Visible from Vantage Point
- Not Visible from Vantage Point

Visibility - Viewshed

- Visible from Vantage Point

CLIENTS | PEOPLE | PERFORMANCE

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Vantage Point 2

Figure 61

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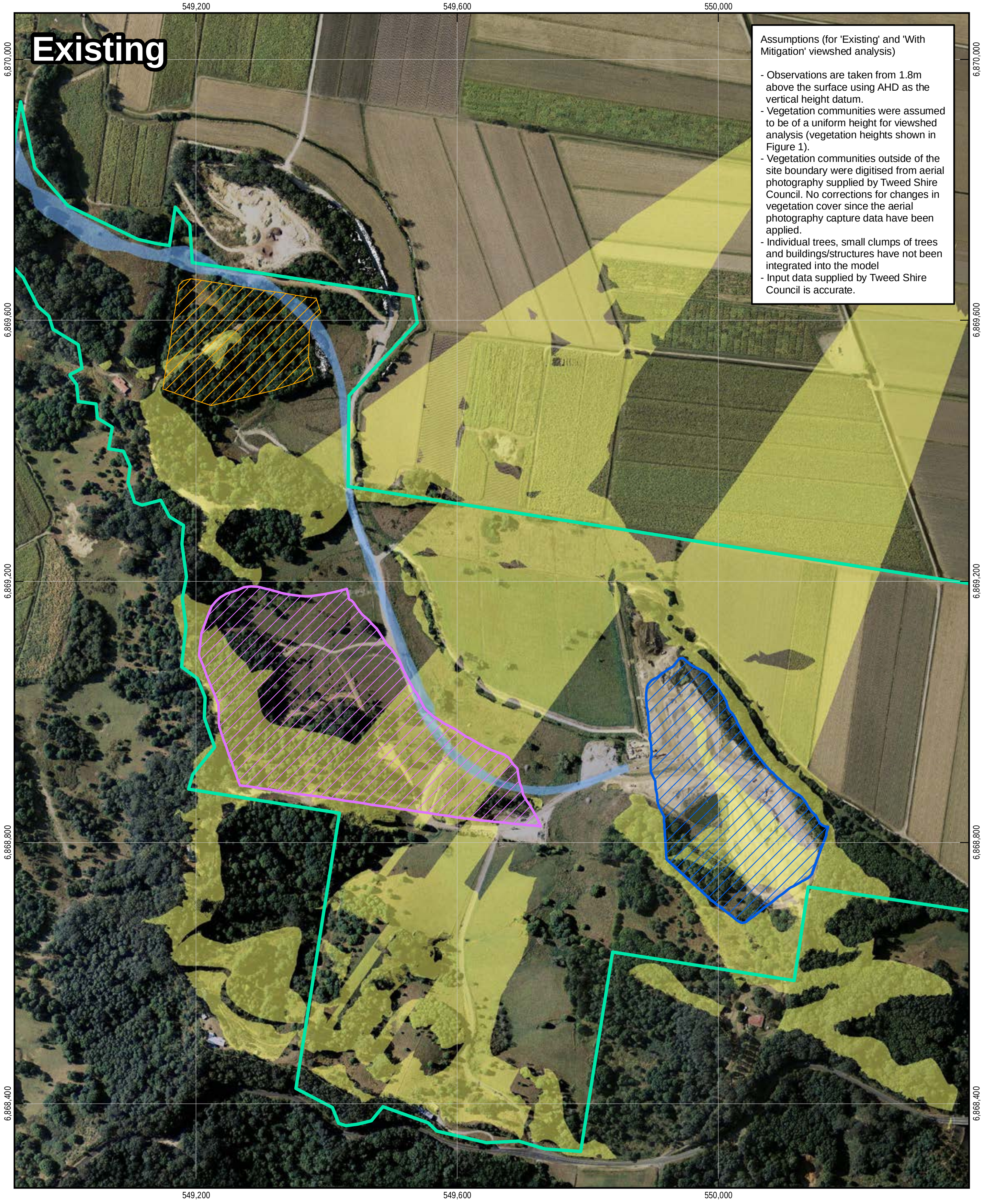
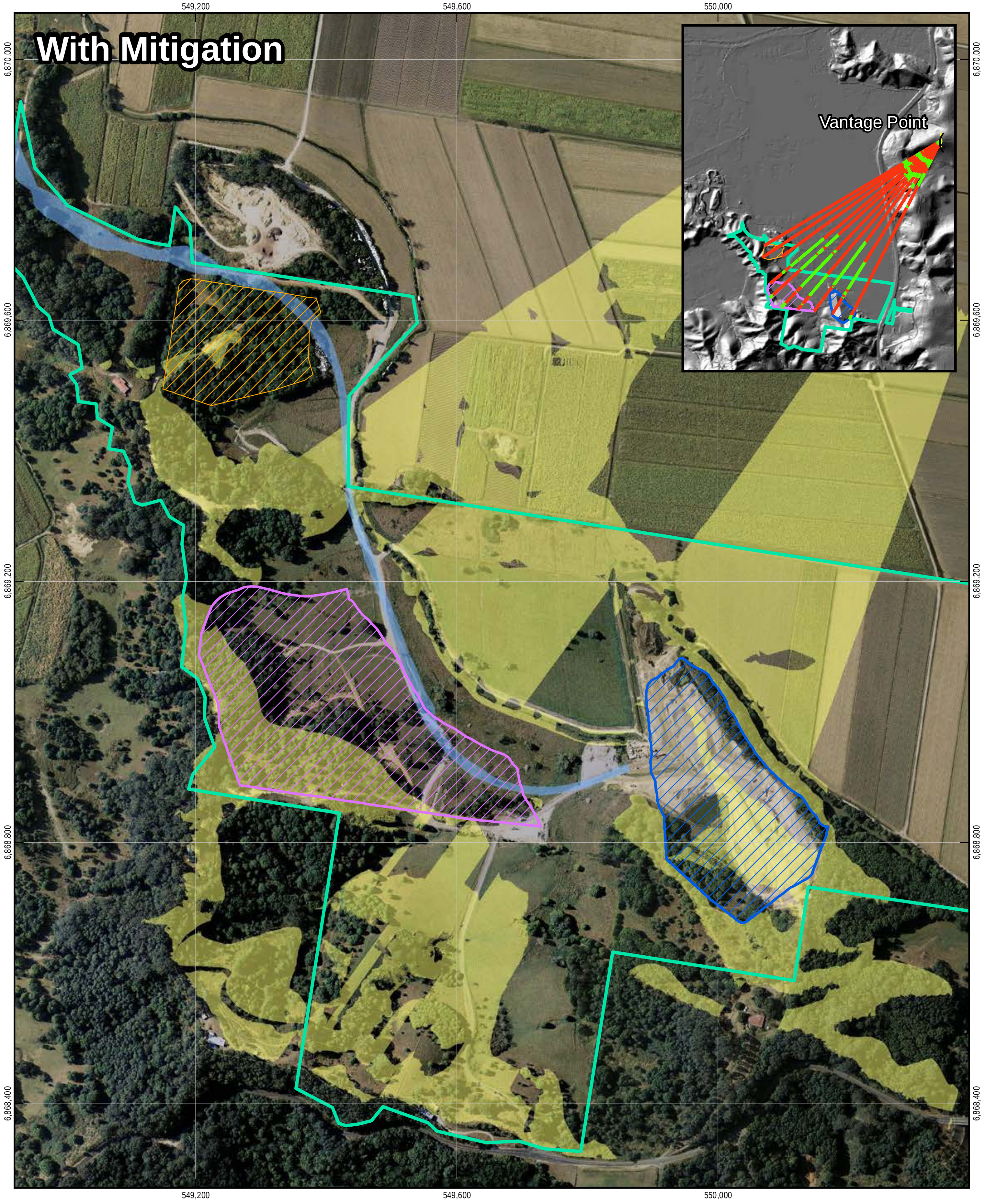
Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM





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0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- Haul Road
- Quirks Quarry Footprint
- West Valley Footprint
- North Valley Footprint

Visibility - Line of Sight

- Visible from Vantage Point
- Not Visible from Vantage Point

Visibility - Viewshed

- Visible from Vantage Point

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CLIENTS | PEOPLE | PERFORMANCE

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Vantage Point 3

Figure 62

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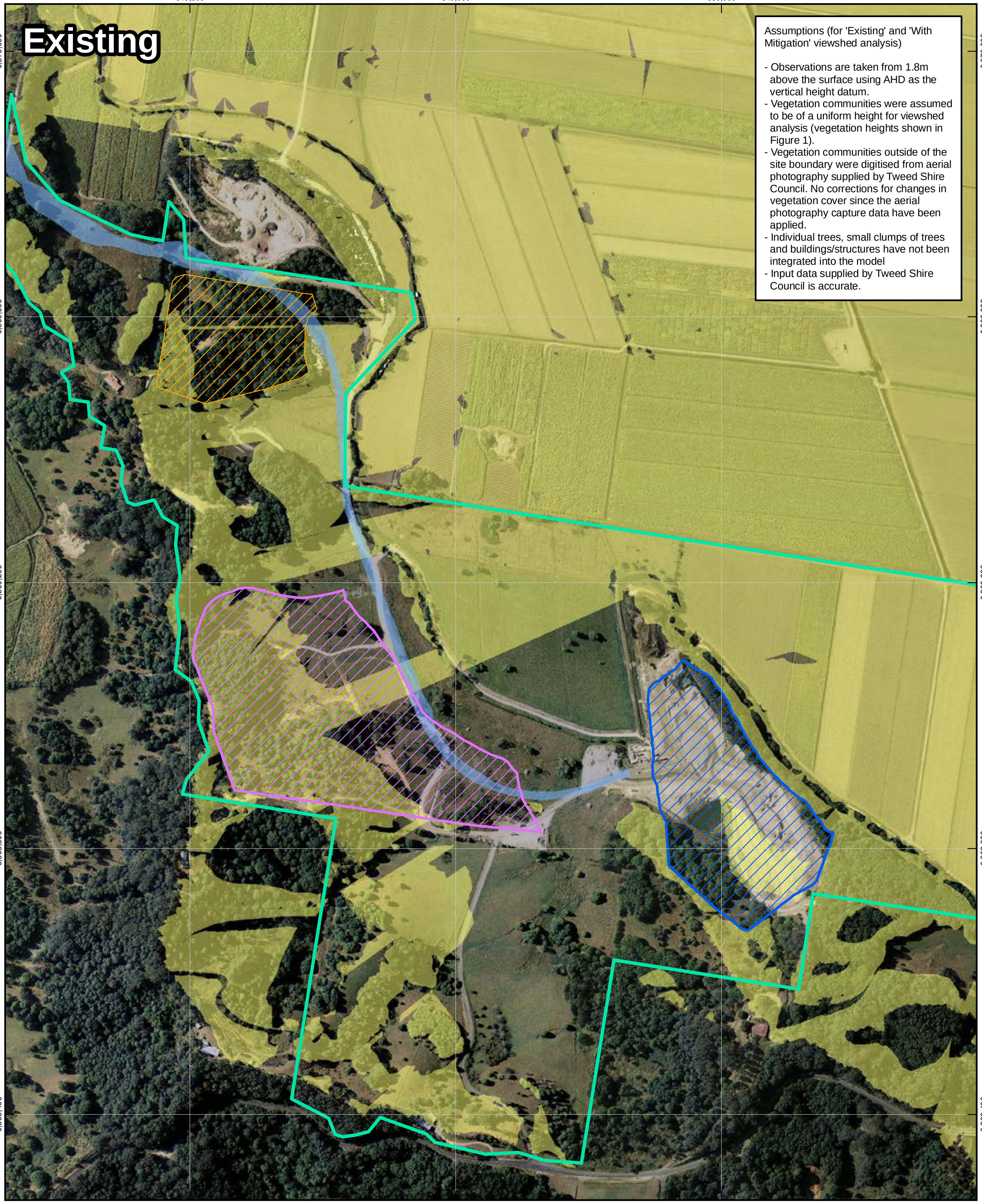
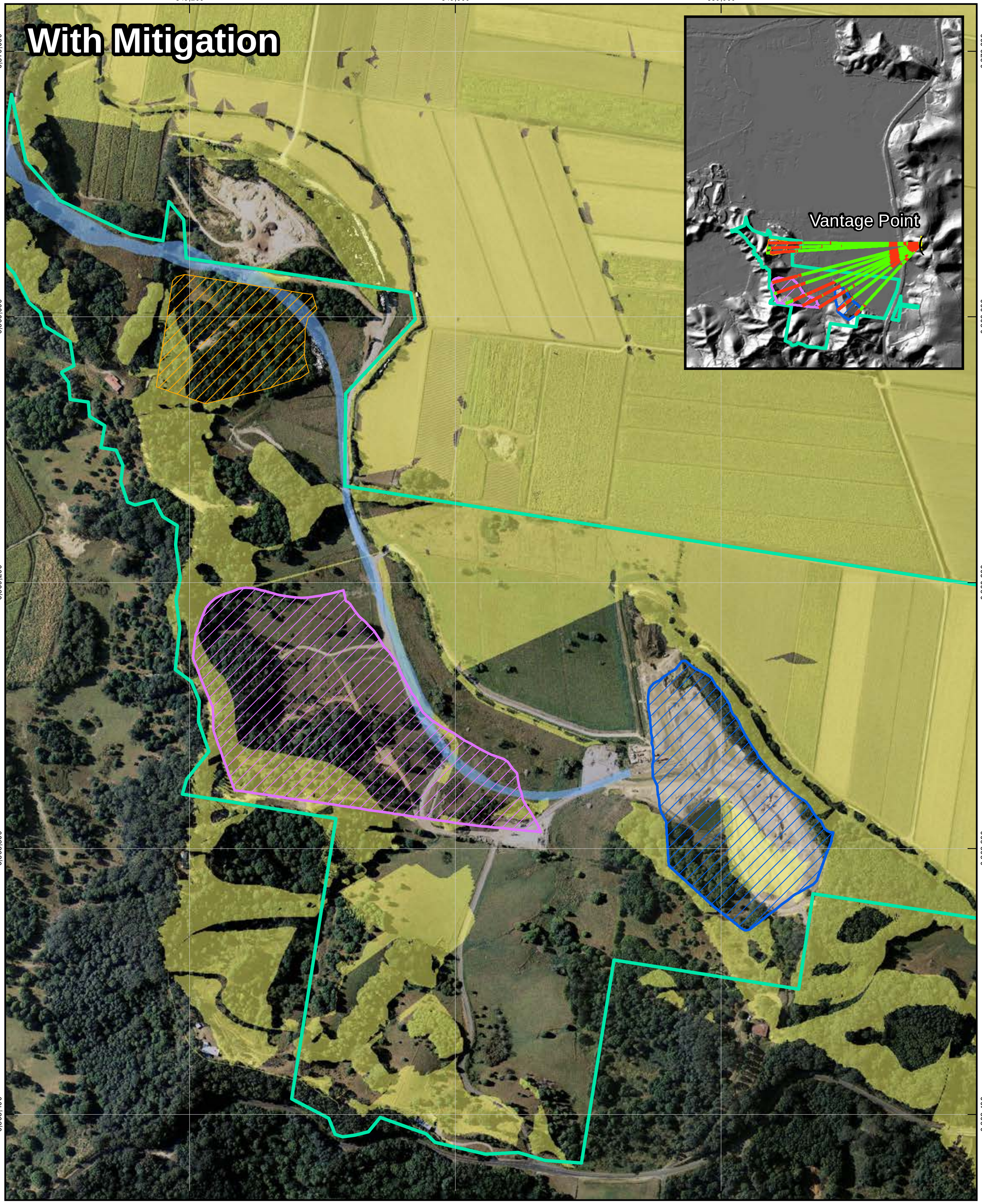
Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM





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0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- Haul Road
- Quirks Quarry Footprint
- West Valley Footprint
- North Valley Footprint

Visibility - Line of Sight

- Visible from Vantage Point
- Not Visible from Vantage Point

Visibility - Viewshed

- Visible from Vantage Point

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Vantage Point 4

Figure 63

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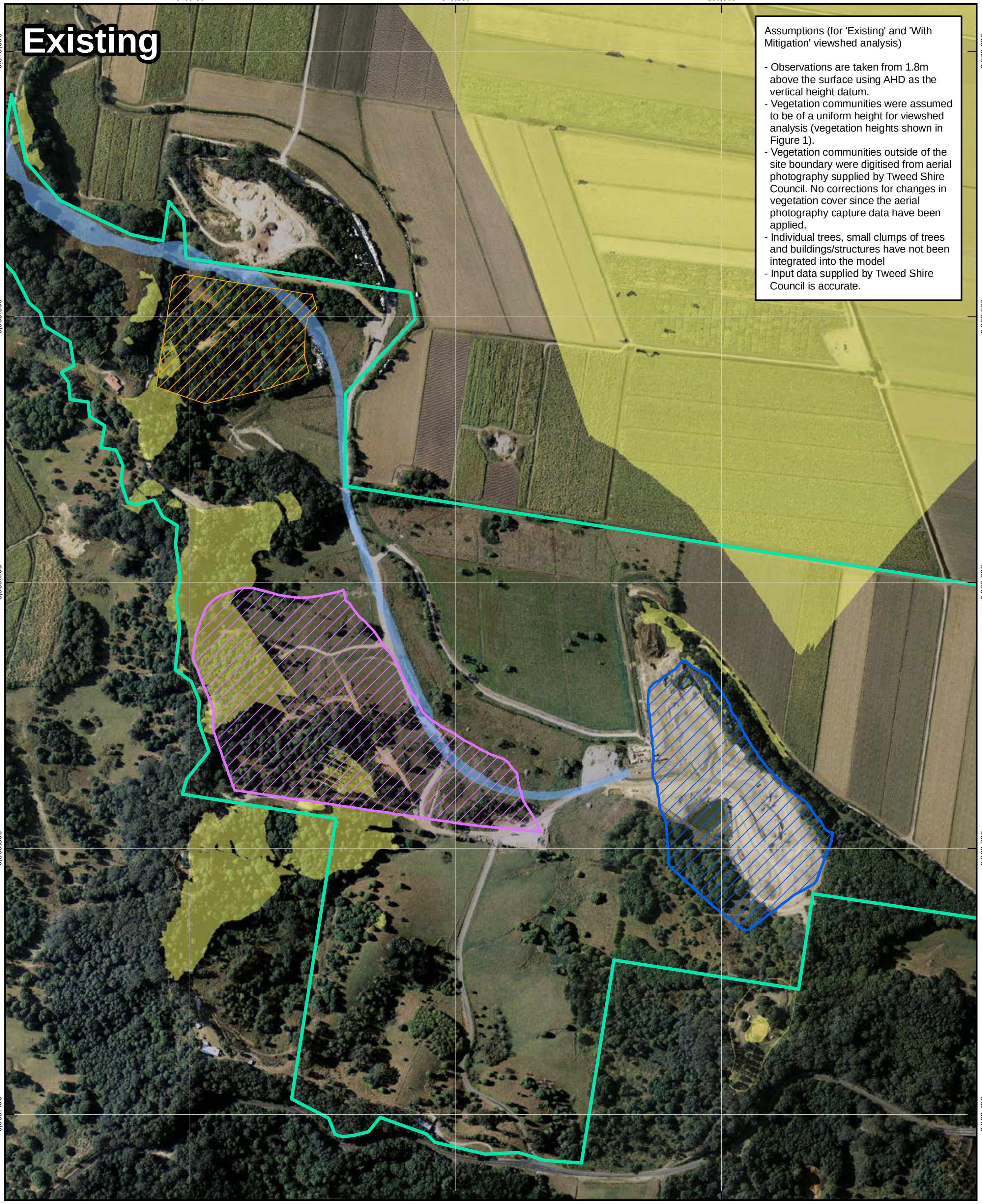
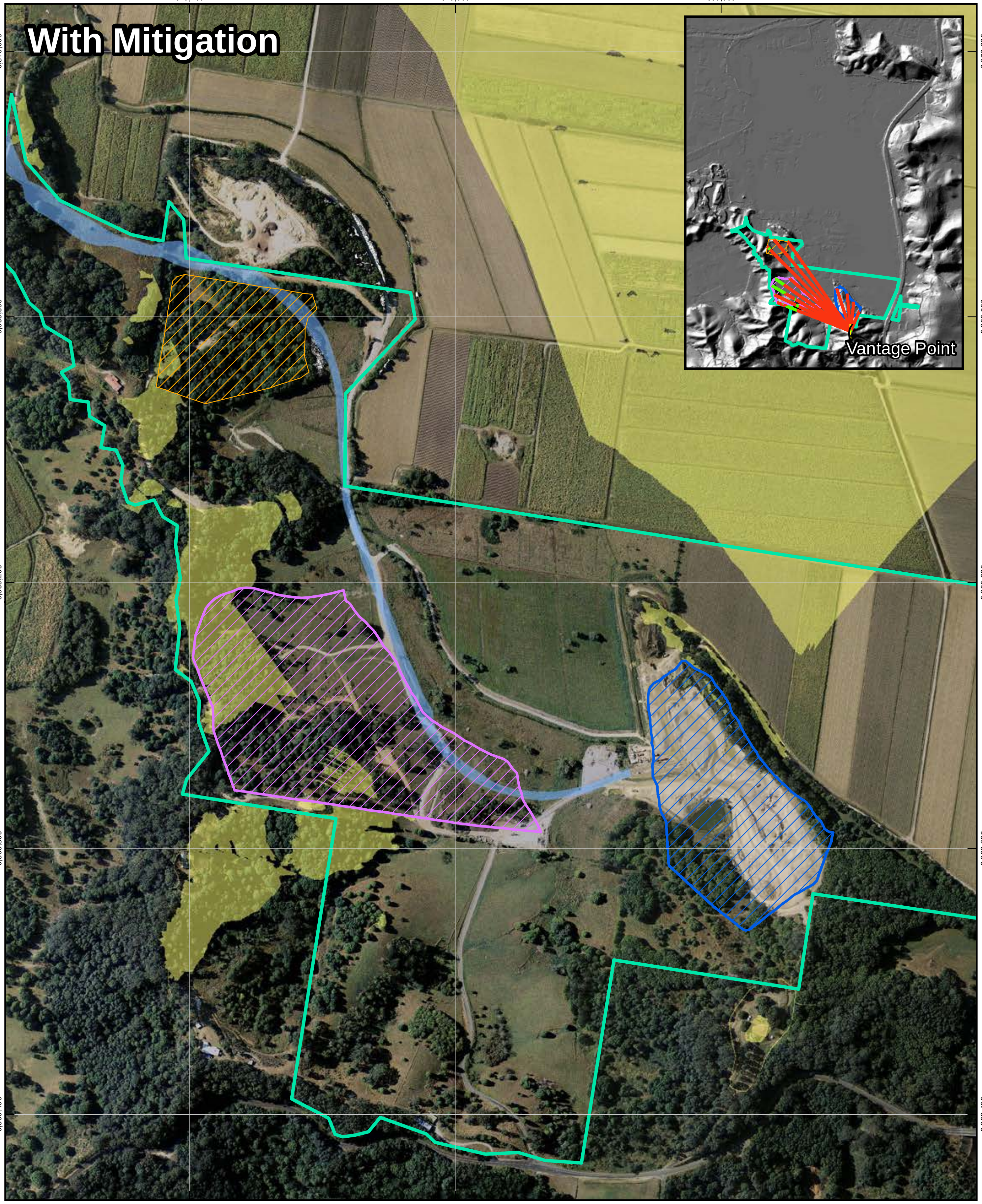
Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM





1:7,500 (at A3)

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

Site Boundary
Haul Road
Quirks Quarry Footprint
West Valley Footprint
North Valley Footprint

Visibility - Line of Sight
Visible from Vantage Point
Not Visible from Vantage Point

Visibility - Viewshed
Visible from Vantage Point

CLIENTS | PEOPLE | PERFORMANCE

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Vantage Point 5

Figure 64

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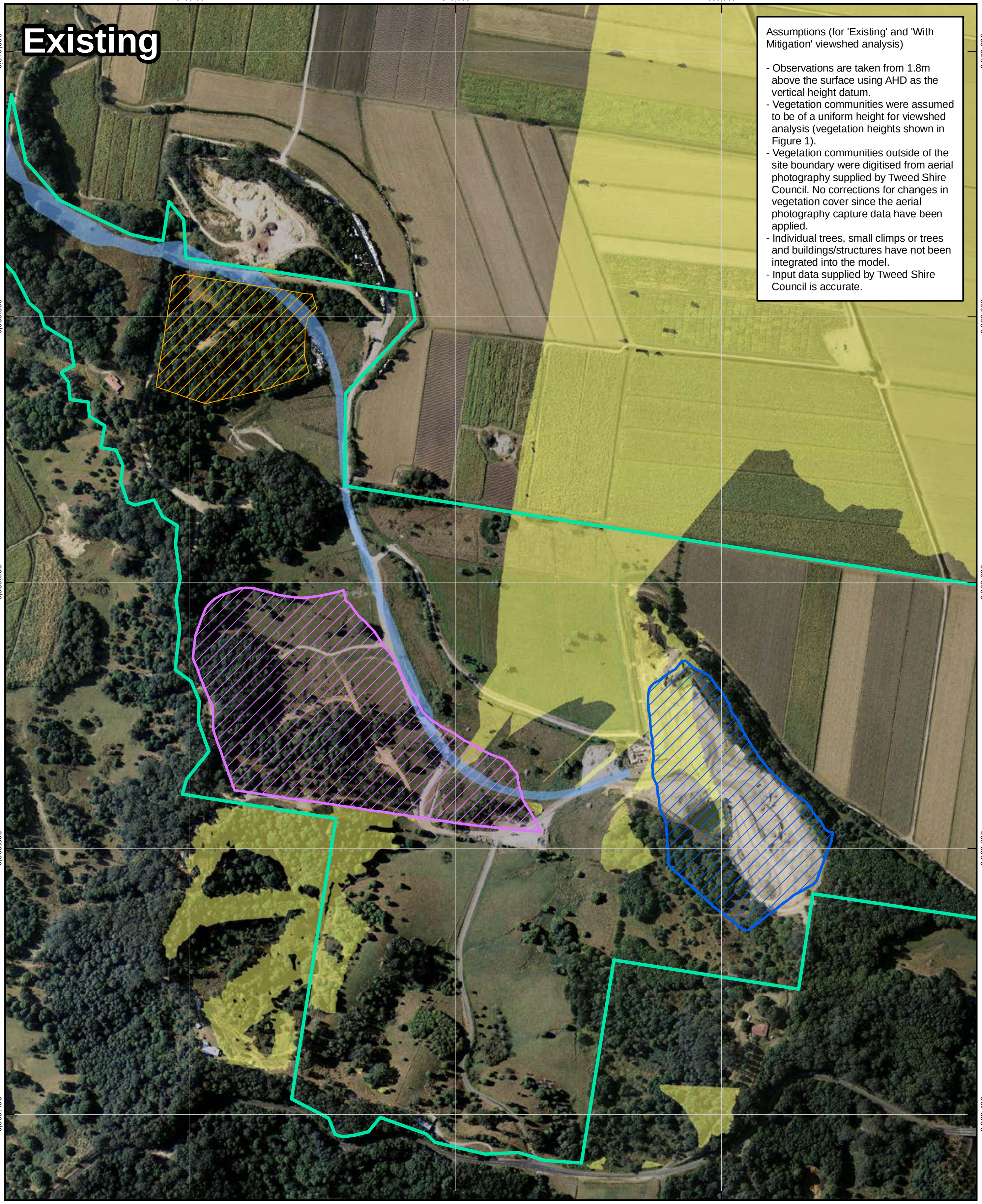
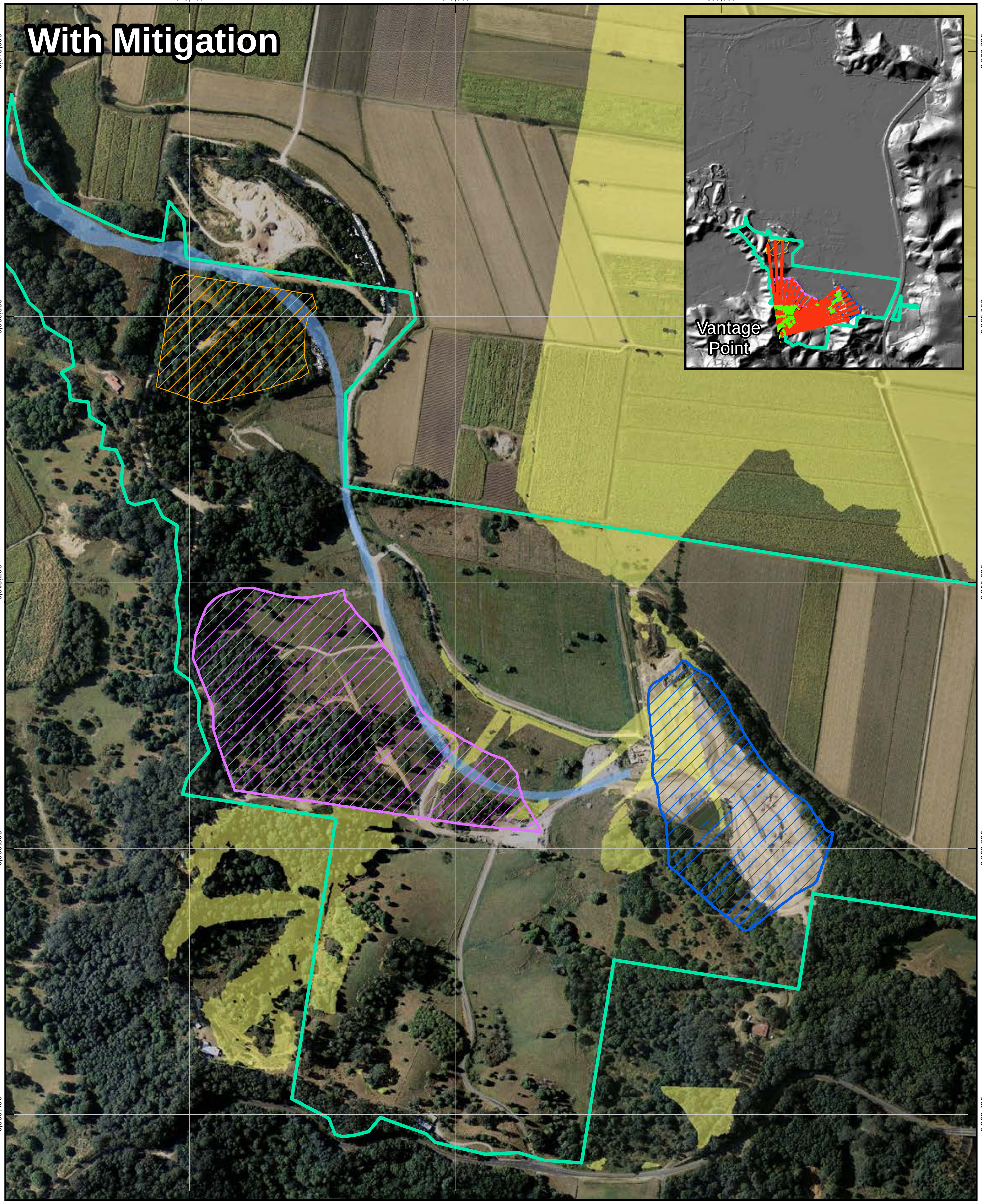
Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM





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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- Haul Road
- Quirks Quarry Footprint
- West Valley Footprint
- North Valley Footprint

Visibility - Line of Sight
- Visible from Vantage Point
- Not Visible from Vantage Point

Visibility - Viewshed
- Visible from Vantage Point

CLIENTS | PEOPLE | PERFORMANCE

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Vantage Point 6

Figure 65

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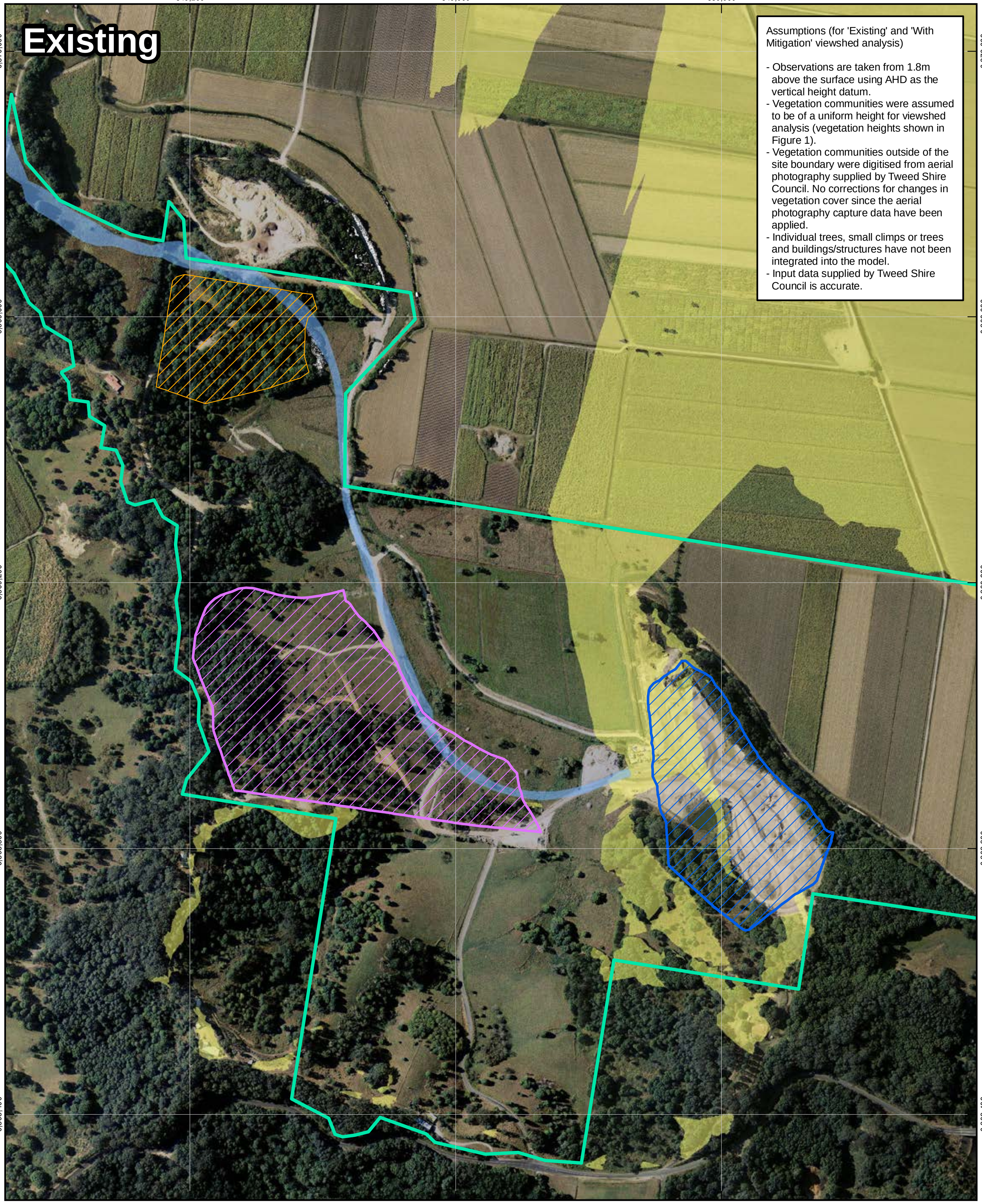
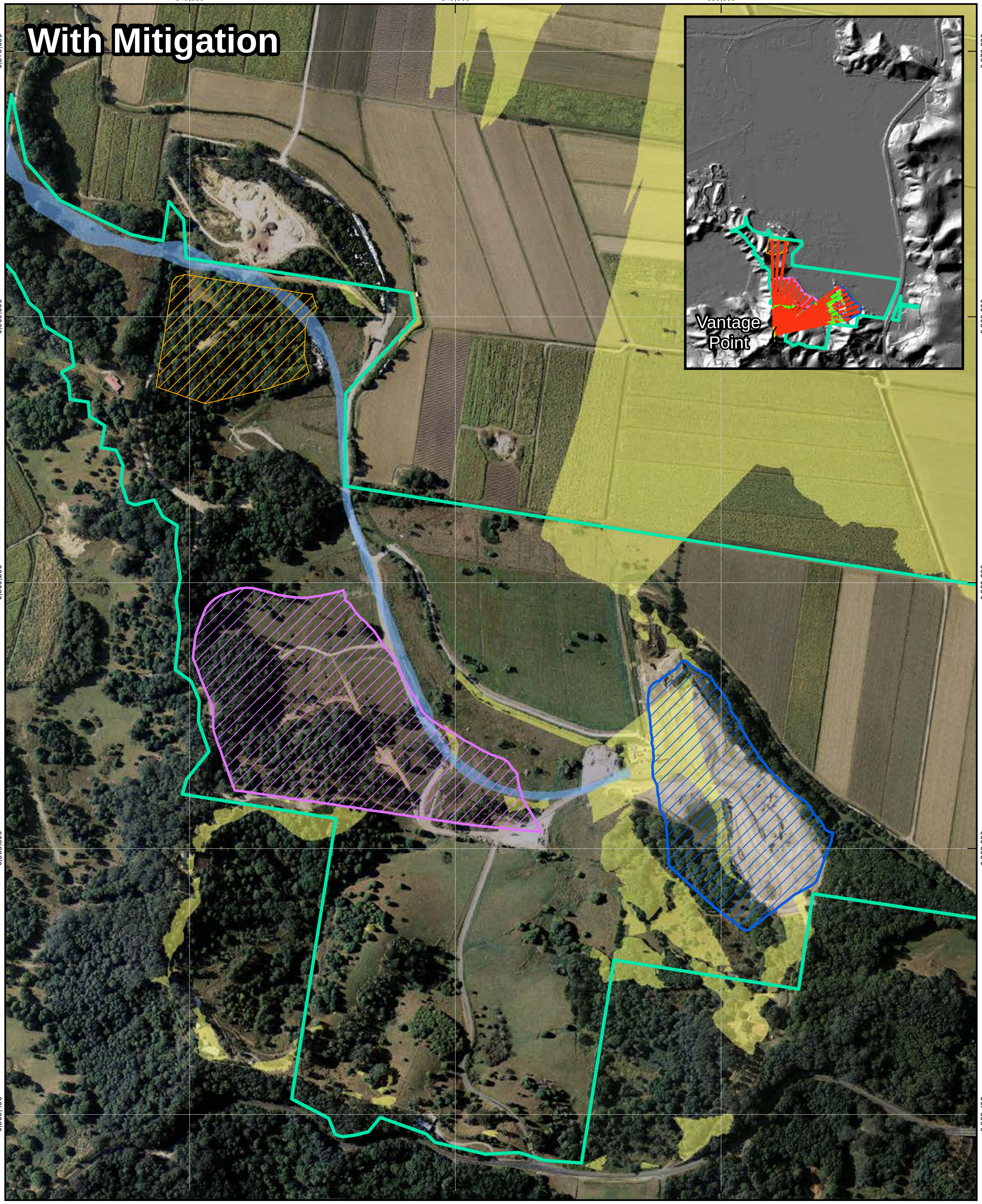
Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM





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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- Site Boundary
- Haul Road
- Quirks Quarry Footprint
- West Valley Footprint
- North Valley Footprint

Visibility - Line of Sight

- Visible from Vantage Point
- Not Visible from Vantage Point

Visibility - Viewshed

- Visible from Vantage Point

CLIENTS | PEOPLE | PERFORMANCE

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Vantage Point 7

Figure 66

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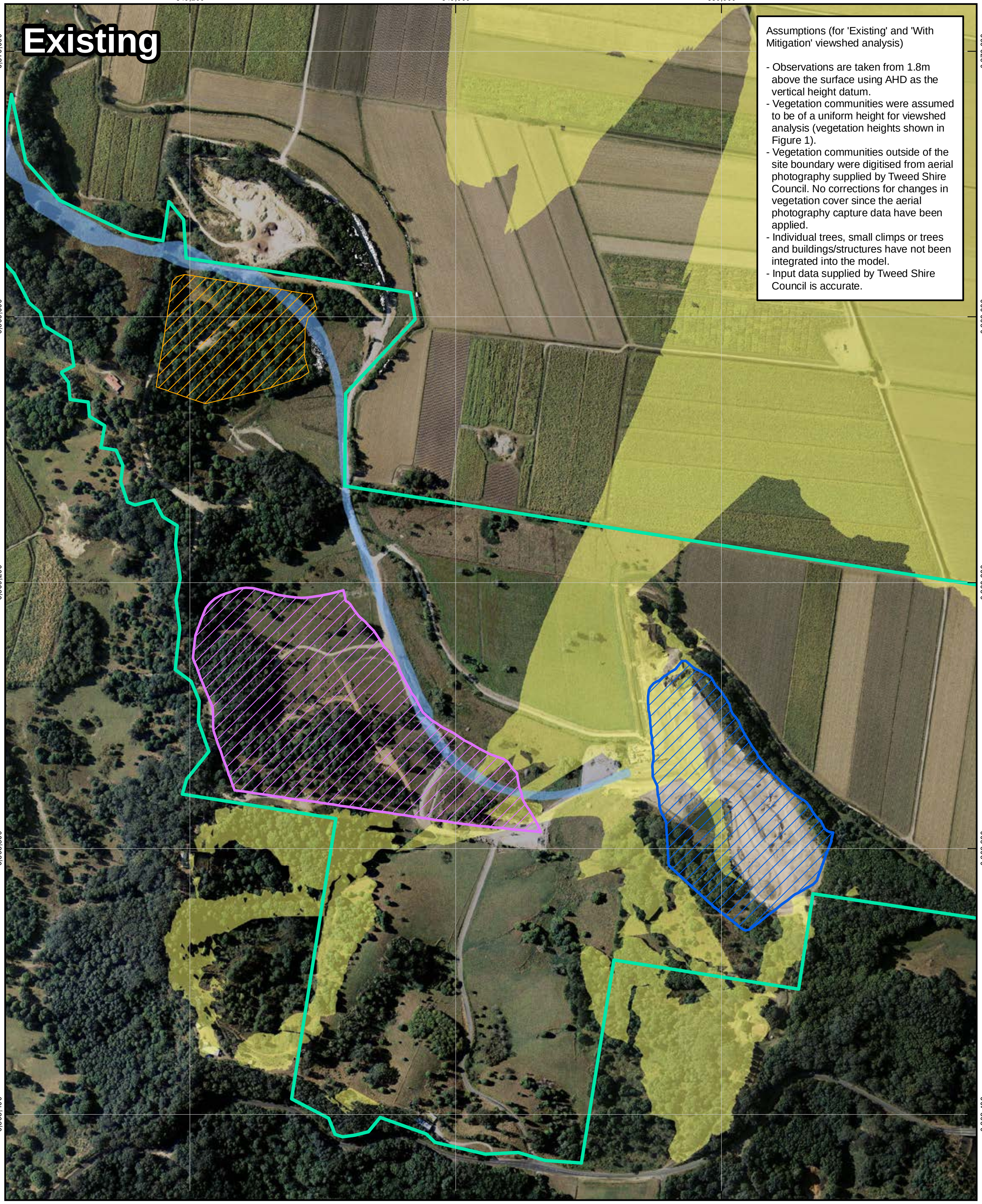
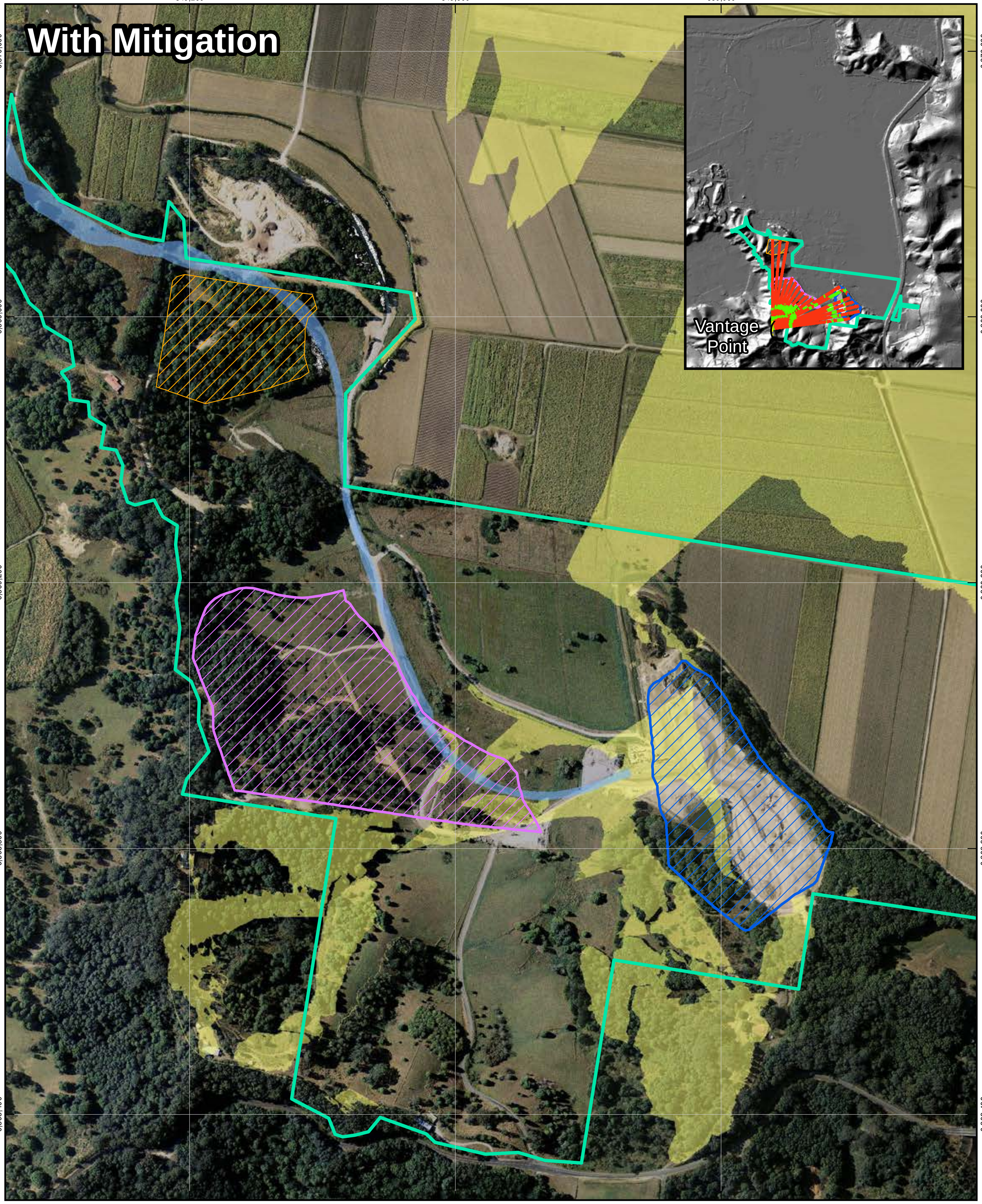
54-58 Nerang Street Nerang QLD 4211 Australia **T** 61 7 5557 1000 **F** 61 7 5557 1000 **E** goldcoastmail@ghd.com.au **W** www.ghd.com.au

Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM





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0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

Site Boundary
Haul Road
Quirks Quarry Footprint
West Valley Footprint
North Valley Footprint

Visibility - Line of Sight

Visible from Vantage Point
Not Visible from Vantage Point

Visibility - Viewshed

Visible from Vantage Point

CLIENTS | PEOPLE | PERFORMANCE

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Vantage Point 8

Figure 67

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Data source: Tweed Shire Council - Aerial Photography (2008), Haul Road (2011). GHD - Site Boundary (2011), Quirks Quarry Footprint (2010), West Valley Footprint (2010), North Valley Footprint (2010), Line of Sight (2011), Viewshed (2011), Vantage Point, Hillshade. Created by: CM

9.11 Hazards

9.11.1 SEPP 33 overview and risk framework

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development aims to ensure that appropriate measures are employed to minimise the impacts of developments that are deemed to be either 'hazardous' or 'offensive'. As discussed in Section 2.5 under SEPP 33, the Project may be considered to be potentially offensive because waste related activities could potentially impact on the surrounding localities, even after measures are taken to reduce or minimise the potential impacts.

However, the Project is not considered hazardous, as environmental controls proposed for the Project would limit the potential health risk to workers and nearby residents and risk to the biophysical environment. Mitigation measures for these risks are outlined in the various sections of this Environmental Assessment.

9.11.2 Hazard identification

A hazard is defined as a source of potential harm or a situation with a potential loss. Hazards can relate to situations with potential for human injury, damage to property, damage to the environment, or a combination of these factors.

Waste Management Facility (Landfill)

Hazards typically associated with waste management facilities include:

- Health (biological) hazards;
- Occupational Health and Safety (OH&S) hazards; and
- Hazards during excavation and filling works.

Quarry

- Occupational Health and Safety (OH&S) hazards;
- Operational hazards during extraction, crushing, screening; and
- Operational hazards drawing product loading and haulage from the site.

9.11.3 Impact assessment and Mitigation

Construction

Construction type activities would occur initially to establish the new haul road. Safety hazards from haul road construction would include those associated with the operation of heavy equipment such as earth moving equipment. A safety management plan including traffic management and detailing of occupational health and safety procedures will be required for the construction of the haul road.

When internal haul roads or access roads are required within the approved quarry and landfill footprints this would involve a lower level of construction activity than the initial construction works, and would be classified as normal operations on a typical landfill or quarry site.

Operations

Neither the landfill or quarry activities associated with the Stage 1 Project Application and the Concept Plan would be considered as hazardous. Normal levels of hazard and risk associated with industrial sites and many construction sites would exist for site workers. These would be managed through development and implementation of a site operations plan both for the landfill and quarry activities.

Respirable Crystalline Silica (Quarry)

Emissions of respirable crystalline silica (RCS) can be generated by activities such as crushing, in particular tertiary level crushing, which can produce very fine particulate matter. The siltstone present at the site is likely to contain silica. Accordingly, there could be a fraction of crystalline silica contained in the fine fraction of the rock dust released during crushing operations. Site-specific data on the mineral composition of the rock resource and the particle size distribution of the rock dust released during crushing operations should be collected and analysed such that that an assessment of potential RCS exposure can be conducted once the required data is available.

Fires

Potential sources of fire or ignition include:

- Migration and/or emissions of potentially explosive landfill gas;
- Ignition from equipment (metal grinding or welding) or unguarded exhausts of vehicles/equipment parked or travelling over dry pasture;
- Lightning may cause ignition of vegetation, particularly at higher elevations such as along ridgelines;
- As there are multiple neighbours to the site it is possible that fires started due to other operations or places may carry over to the Site; and
- Other accidental causes of ignition exist which are usually to related human activity.
  - Actions of employees, trespassers or neighbours;
  - Vehicles accidents or fires on malfunctioning equipment and motors;
  - Deliberately lit fire; and
  - Fuel reduction fires.

Methane will be produced by the degradation of organic wastes in the landfills. However, the landfills will be lined, which would prevent off-site migration of this gas, and a gas management system will be specified in the detailed design phase which would potentially include active gas extraction and either flaring or energy recovery that would be designed to prevent methane from being discharged to the atmosphere from closed areas of the landfill.

Fire risks can be assessed and limited to reduce the risks to human life, infrastructure and operations, in a number of ways. A systematic fire response plans can be developed to minimise the risks associated with fire. A response plan can provide guidance within quarry operations to deal with potential fires; using a series of strategies and practical measures.

A preliminary assessment of the hazard to building infrastructure and other assets within the lands under the care and control of the TSC should be undertaken as a priority when the initial activities on site begin as potential sources of ignition may become evident or will be reduced in some areas.

As part of risk reduction measures to be undertaken on site Council will:

- Provide adequate fire protection works on site, including the availability of trained personnel, water tankers and fire fighting equipment and annual hazard reduction measures with particular attention to boundaries of adjoining landholdings;
- Make available to the Emergency Services when required, water carts and trucks in cases of bushfire incidents on the site or adjoining sites; and
- To take all practical steps to prevent the occurrence of bushfires on their land, and to minimise the danger of the spread of bushfires on or from, their land.

Fire management planning will be a critical component of the site operations plan. The West Valley Quarry Preliminary Study (Section 13) provides a detailed description of fire management planning including risk reduction measures, objectives, mitigation measures, equipment and training requirements which will be used as the basis for future fire management plans.

Noise

Earth moving equipment and other noisy equipment used during various operational activities could exceed noise levels for operators. Occupational health and safety procedures such as the use of personal protective equipment such as earmuffs where noise exposure is unavoidable, would be followed during use of this equipment.

Dangerous goods

No dangerous goods would be stored on site, apart from small quantities of paints and solvents, used for equipment maintenance, and herbicides used for controlling weeds on site. However, all such chemicals would be stored within a building in accordance with standard dangerous goods storage practices. Material safety data sheets will be held onsite for all chemicals stored.

Diesel fuel for on-site machinery will not be stored onsite.

General safety hazards

Safety hazards would exist from landfilling, cell preparation works, resource extraction, heavy machinery movements and truck movements to the quarry and landfill. These would mainly be from the use of heavy equipment, and from specialised quarry and landfill equipment (such as crushers, compactors etc). Occupational health and safety procedures would be followed during use of this equipment.

Hazards to the Public

Public access will not be permitted to any of the landfills or quarries at Eviron Road. This therefore eliminates the risks associated with having small vehicles and infrequent visitors to the site mixing with trucks, earthmoving equipment and other large machinery.

9.12 Rehabilitation

9.12.1 Introduction

Following completion of the quarrying activities, it is intended that each void will be transformed into a lined landfill. Therefore this section addresses the rehabilitation of the project footprint following completion of landfill, however progressive site restoration and rehabilitation will be conducted throughout the operational life of the facilities, this is also summarised herein. It is noted that the site is earmarked to form part of the future botanical gardens as detailed in the Tweed Shire Botanic Gardens Master Plan, however there are a range of minimum requirements for the closure and post closure care of landfill sites that Council is committed to regardless of the longer term botanic gardens plan which will ultimately deliver a significant benefit and asset to the community.

9.12.2 Progressive Site Rehabilitation and Restoration

Council is committed to the implementation of a range of measures to progressively rehabilitate the site to achieve a 'maintain or improve' outcome for biodiversity values at the site as discussed in Section 9.7. These include:

- Designation of part of the site as Operational Land as per the *Local Government Act 1993* by the acquisition of land in the north western portion of Lot 1 DP 1159352. This land has been primarily acquired for the purposes of establishing the haul road to Stotts Creek RRC. However vegetated areas outside of the haul road footprint in this area contain blackbutt open forest (approximately 3 ha). It is intended that the vegetated area would be designated as a 'natural area' as part of the Operational Land designation and be preserved and managed in order to conserve and habitat for fauna species including the koala as well as maintaining and enhancing potential habitat for threatened rainforest plants;
- Two areas within the site have been identified for creation of connectivity and reconstruction of habitat including staged removal of camphor laurel and other weed species. These areas are along a drainage line across Lot 1 DP1159352, which would in the longer term allow for sheltered movement of species such as koalas across the presently cleared lowland area of the site, and planting along the ridgeline along the southern boundary of the site on Lot 1 DP 34555 which is presently cleared, which would enhance connectivity directly along the Condong Range for species such as the koala; and
- Supplementary nest box installation – although no hollow-bearing trees will be removed some mature eucalypts with the potential to provide hollows will be lost. Consequently, in recognition of this, a nest box plan for petaurid gliders is proposed.

In addition to these measures Council will progressively rehabilitate the landfills (and individual landfill stages) as filling is completed. This will involve placing an engineered cover layer over each tipping area as it is completed, and revegetating the final cover. The average slope angle shall not exceed 1:4 (V:H), and level parts of the landfill will be domed or graded to a minimum 5% (1:20).

9.12.3 Landfill Closure and Post Closure

Council will prepare and submit a Landfill Closure Plan to DECCW at least three months prior to the last load of waste being landfilled at each of the planned waste disposal facilities. The Closure Plan will address the following in detail:

- Final landform selected, land use and landscaping / revegetation;
- Final capping;
- Post closure management and maintenance;
- Post closure environmental management e.g. of groundwater, green waste runoff, leachate, stormwater, landfill gas;
- Post closure environmental monitoring and reporting;
- Certificate of completion; and
- Implementation program.

Management and Monitoring

Ongoing environmental management of the site would be undertaken by Council following closure of the site for landfilling. This would consist primarily of management and maintenance of stormwater infrastructure and drainage, leachate management system, landfill gas management system and vegetation (including revegetation and landscaping).

Council will ensure that all leachate collection, landfill gas management, stormwater controls and reporting practices are maintained at the same level employed during the operational life of the landfill. These environmental management measures will continue until Council can demonstrate that the landfill does not pose a threat to the environment.

Council will maintain an environmental monitoring program for leachate, groundwater, stormwater and landfill gas as used throughout the operation of the site. Monitoring will continue until TSC is able to demonstrate that the landfilled waste no longer have the direct potential to impact on the environment.

Council will engage with neighbouring residents as required to such that appropriate lines of communication are established in the event that residents need to discuss any problematic issues following site closure. Any complaints that are received will be recorded in a complaints register.

Maintenance

Council will undertake regular maintenance of the final landform selected and landscaping as required to maintain its integrity. This will include the following:

- Maintaining surface water drains and structures, and undertaking repairs where necessary;
- Monitoring of landfill gas emissions, and undertaking repairs to gas management system where necessary;
- Filling of any cracks that may occur in the final cover layer;
- Filling of depressions created by settling of the landfilled waste (to ensure shedding of surface water runoff);

- Replacement of vegetation affected by landfill gas or erosion if necessary, to maintain the density of the vegetation cover;
- Design and construction of any remedial works if significant areas of vegetation are impacted from landfill gas, leachate or landslips;
- Repairing erosion scours; and
- Ensuring that all monitoring boreholes and locations are maintained and operational as required.

PART D – Conclusion

10. Draft Statement of Commitments

The Director General's requirements indicated that in accordance with Section 75E(6) of the EP&A Act, the Proponent is required to prepare a Statement of Commitments with respect to environmental management and mitigation measures for the project . In accordance with this requirement, this section provides an outline of the commitments that Council commits to for the entire Concept Plan and specifically the Stage 1 Project Application.

Whilst, the fundamental principles outlined in these commitments will carry over to future applications associated with the Concept Plan for Eviron Road however it is noted that with changes to the regulatory framework and technological advances these commitments will be revisited to ensure they are current at the time, reflect best practice and community expectations and are relevant to activities proposed as part of the future applications.

Issue	Commitment
Environmental Management Plans	Environmental management plans would be prepared and implemented to guide environmental management and monitoring activities during establishment and operation of all landfills and quarries. This will take the form of an LEMP for Quirks Quarry Landfill and a Plan of Management for West Valley Quarry. Council is committed to best practice environmental management for both the quarry and landfill activities. It is noted that a draft LEMP has already been prepared for the Quirks Quarry Landfill which outlines environmental management requirements for the waste disposal activities. The NOW will be consulted in the development of the LEMP in regarding to the monitoring and management of stormwater and leachate. The quarry plan of management will include the following sub-plans: ◗ Stormwater management plans – The plan would include the measures to retain and re-use the maximum amount of water on-site and ensure the surface run-off water is maintained at acceptable levels. The plan would also include erosion and sediment mitigation measures. ◗ Air quality management plan – The plan would include mitigation measures for control of odours, dust and particles and monitoring undertaken. ◗ Noise management plan – The noise management plan will include noise control measures, monitoring. ◗ Traffic management plan – The plan will include parking and access requirements, safety signage and training of personnel in traffic management. ◗ Fire management plan – The plan would include details of sources of water for firefighting, the need for fire extinguishers on all mobile equipment and suitable training for site-based personnel.

Issue	Commitment
Surface Water	Specific measures to maintain the quality of onsite and downstream surface water quality for the Stage 1 Project Application have been outlined in the Quirks Quarry Landfill Concept Design Report and draft Landfill Environmental Management Plan and general concepts for the West Valley Quarry have been provided in the Preliminary Quarry Study and include the following: ◗ Clean stormwater runoff from undisturbed or areas upstream of the quarry and landfill activities will be diverted around the activities to minimise the quantity of stormwater required to be stored (and potentially treated) onsite. ◗ Stormwater runoff generated from active areas of the quarry and landfill will be captured in sediment basins and reused onsite wherever possible (for example for dust suppression). Concept designs for sediment basins associated with the Stage 1 Project Application have been developed and devices have been sized to minimise the opportunity for uncontrolled discharge from the site. Sizing and location of the stormwater management devices will be further refined during detail design. ◗ A perimeter bund will be established around the northern end of the Quirks Quarry Landfill to a minimum RL of 6.5m AHD to address flooding in an 100 yr ARI regional flood event. In addition, the base of the landfill in Stage 3 will be raised by between 1m and 3m (based on the finished quarrying levels) such that the base of the landfill will fall towards the eastern end of the cell to reduce the impacts of potential overflowing of the perimeter bund. ◗ The haul road from Stotts Creek has been designed to provide flood immunity to activities in the North and West Valley areas in 100 yr ARI regional flood event. ◗ Any works within 40 m of a watercourse will be undertaken in a manner consistent with the NOW (2008) *Guidelines for Controlled Activity Approvals.* ◗ Leachate generated by the landfill activities and any stormwater which comes into contact with waste will initially be stored within the waste cell and once characteristics such as quantity, quality and generation rates are determined a leachate treatment process will be established. Prior to the establishment of a leachate treatment process leachate levels within the landfill will be closely monitored to ensure that the storage capacity of the waste is not exceeded and if necessary leachate can be pumped out and appropriately disposed of to avoid impacts on surface water quality. ◗ Should any of the sediment basins proposed, classify as dams under SEPP 52 *Farm Dams,* they will be constructed and operated in accordance with this policy and with any Harvestable Right Order published under section 54 of the *Water Management Act 2000.*

Issue	Commitment
Surface Water (continued)	◗ The baseline surface water monitoring program will continue in the lead up to the establishment of the landfill and quarry such that site specific water quality objectives/trigger values can be established. During quarry and landfill operations surface water monitoring will be conducted in accordance with the conditions of the Environmental Protection Licence (including specified frequencies and analytical suite). ◗ Following completion of landfilling, sediment basins used for stormwater detention will be converted to wetlands.
Groundwater	Minimisation of potential impacts to groundwater resources will be ensured by the following commitments: ◗ Further geotechnical and hydrogeological investigations will be undertaken during detail design of the landfills and quarries to address potential issues associated groundwater management such as dewatering during quarrying and hydraulic conductivity and connectivity between alluvial deposits and bedrock. ◗ No further excavation below the final quarry floor levels will be undertaken for the establishment of the waste cells for Quirks Quarry (and future North and West Valley) landfills. ◗ Council will ensure the proper compaction of the floor of each landfill cell to achieve a uniform low permeability equivalent to less than 1×10^{-9} m/s for a depth of at least 0.9 m. The in situ permeability of compacted material would be tested by sampling and laboratory testing to ensure the required permeability level has been achieved. In addition a high density polyethylene liner will be installed across the base of the landfill to further prevent migration of leachate to the local groundwater environment. ◗ The base of the Stage 3 cell of the Quirks Quarry Landfill will also be raised by between 1m and 3m (based on the finished quarrying levels) to further reduce potential impacts to the local groundwater environment. ◗ Council would continue to undertake a groundwater monitoring program including groundwater level and quality monitoring both for continued baseline data collection prior to commissioning of site activities and will continue the program in accordance with the eventual EPL's for the proposed activities. ◗ In the event that any onsite infrastructure intercepts the water table, or if dewatering is required consultation will be undertaken with NOW officers during detail design to determine licencing issues. ◗ Any required groundwater licenses will be obtained and associated works appropriately authorised prior to works commencing. ◗ A groundwater monitoring and management plan will be prepared for the proposed development and submitted to NOW for approval.

Issue	Commitment
Acid Sulfate Soils and Pyritic Materials	Council makes the following commitments to manage acid sulfate soils and pyritic materials: ◗ Additional acid sulfate soils investigations along the haul road during detail design to better characterise potential issues and identify management requirements for construction of the road; ◗ Development of a revised Acid Sulfate Soils Management Plan following completion of additional investigations; ◗ Ongoing groundwater monitoring as described in the groundwater commitments to monitoring acid sulfate soil indicators; and ◗ Vigilant monitoring of any clay imported from offsite sources for the construction of landfill liners. ◗ If required the design of a management system for pyritic materials site will follow detailed drilling, testing and delineation of PAF material to be conducted as part of the detailed design for the quarry. The key management measure for pyritic materials will be to avoid disturbance or drainage of PAF. Where this is not feasible, typical management options will be based on: – Maintaining saturated conditions to exclude oxygen and prevent oxidisation; – Excluding air to prevent oxidisation; – Capping to exclude water, to prevent leachate generation, by separate cell construction or storage in or beneath post-quarry landfill; – Carbonate-rich capping, to develop alkaline infiltration to neutralise leachate and coat sulfide grains to reduce oxidisation (passivation); – Direct neutralisation of potential acidity of excavated PAF material; or – A combination of the above. ◗ Additional soil and rock testing for net acid generation (NAG) and net acid potential (NAPP) and metallic elements will be undertaken during detail design together with geotechnical investigations. ◗ Additional hydrogeological assessment will also be performed, based on water level data from all existing monitoring bores and core holes, to assess the final post-operation water table, to determine if significant quantities of PAF will be drained in-situ, leading to additional risk of AMD generation.

Issue	Commitment
Soils and Land Capability	Council would implement the following measures: ◗ Topsoil removed for quarrying would be stockpiled and used later for revegetation and rehabilitation of the final landfill cover. ◗ Care would be taken to ensure that topsoils and subsoils are not stripped when they are too moist. ◗ Topsoil stockpiles would be up to 1 m high and subsoil/overburden stockpiles would not exceed 3 m in height. ◗ Subsoil and topsoil stockpiles would be located within the footprint of the landfill, quarry or on the upper surface of completed landfill stages. ◗ Stabilisation measures would be used until vegetation is established on the stockpiled soil.
Biodiversity	Council makes the following commitments in terms of maintenance and protection of the biodiversity values of the site: **Substantially avoid clearing of areas of higher ecological significance.** ◗ The quarry footprint and haul road have been designed such that they minimise clearing of native vegetation and predominantly avoid areas of higher ecological value vegetation. ◗ Council has realigned the haul road concept to avoid clearing of vegetation type 7, and commits to the avoidance of clearing of an area of this vegetation type that falls within the eastern section of the quarry footprint currently shown. The quarry footprint would be revised to reflect this during detailed design. ◗ Retain and Manage Higher Ecological Value Areas – Council commits to a restriction on use on a portion of Lot 1 DP 1159532 registered on the title imposing a legal obligation in perpetuity to abide by the management actions of a Habitat Management Plan (to be developed by Council). A plan showing the habitat areas on the lot would be registered with the s88B instrument to identify the area burdened by the restriction. ◗ Areas of higher ecological value will be clearly marked by fencing with high visibility fauna permeable fencing or similar. Include these areas as 'vegetation protection areas' in an approved Environmental Management Plan.

Issue	Commitment
Biodiversity (continued)	**Maintain and enhance or restore habitat connectivity.** ◗ Retain a vegetated corridor along the ridgeline - the quarry footprints have been designed such that they retain a vegetated corridor along the western ridgeline. ◗ Develop an east-west movement corridor - To provide future potential habitat and an alternate route for connectivity across the site, planting of suitable riparian / floodplain vegetation will be undertaken adjacent to the watercourse in Lot 1 DP1159352. This will create a vegetated corridor that connects the lowland areas to the ridgeline and effectively connect vegetation adjacent to the eastern side of Quirks Quarry to retained eucalypt open forest in the central western area of the site and link to the ridgeline. ◗ Restore connectivity along the southern boundary – a vegetated corridor would be developed along the southern boundary of Lot 1 DP 34555 along Eviron Road that would contain species consistent with existing remnant vegetation along the ridgeline. ◗ Undertake works as per a finalised Restoration Plan. A Preliminary Restoration Plan (refer Appendix L) has been prepared by Council to guide works in the abovementioned corridors. **Minimise impact to conservation significant fauna species.** ◗ Manage Clearing - all clearing of vegetation will be undertaken in the presence of an experienced fauna spotter-catcher. ◗ Contractor awareness – all contractors (construction and operation) to be made aware of the potential presence of fauna species. ◗ Heavy vehicle movements - restricted speed limits to be implemented near to vegetated areas. ◗ Environmental Management Plans - management plans will include actions for management of potential direct and indirect impacts to fauna species. ◗ **Locate and translocate threatened plant species.** ◗ Target surveys for threatened plant species will be undertaken once the final development footprint has been confirmed. ◗ A ‘Preliminary Translocation Plan for Threatened Plants’ has been prepared by Council in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Appendix L). ◗ In the event that any additional threatened species are located in the development footprint, the Preliminary Translocation Plan would be revised to incorporate additional individuals or species.

Issue	Commitment
Biodiversity (continued)	**Maintain habitat values.** ◗ Environmental Management - implement measures detailed in the approved EMP and undertake site works in general accordance with AS 4970-2009. ◗ Maintain habitat - nest boxes will be installed in vegetation to be retained and managed on Lot 1 DP 1159532 in order to offset a reduction in hollow recruitment. In relation to vegetation protection: ◗ Establish vegetation protection areas prior to construction. ◗ Activities permitted in the vegetation protection area would include weed management, Habitat Management, and restoration / translocation activities. ◗ Activities prohibited in the vegetation protection areas would include: use of or parking of vehicles and equipment (unless associated with a permitted activity), placement of construction materials, refuse, excavated spoils and stockpiling, use of tree trunks as a winch support.
Cultural Heritage	Council commits to the following actions regarding the management of cultural heritage at the site: ◗ On-going consultation with the local Aboriginal community to develop a Cultural Heritage Management Plan for the site; ◗ The Management Plan will include as a minimum: – Procedures for ongoing Aboriginal consultation and involvement. – Management of any recorded sites of higher archaeological potential within project footprint. – Responsibilities of all stakeholders. – Details of proposed mitigation and management strategies of all sites. – Procedures for the identification and management of previous unrecorded sites (excluding human remains). – Details of an Aboriginal cultural heritage education program for contractors and personnel associated with construction activities. – Corrective procedures in the unlikely event that a non compliance with the CHMP is identified. ◗ A program of site monitoring by representatives of the Aboriginal Party during activities causing ground disturbance for the recognised areas with a higher potential for the presence of unidentified cultural heritage. ◗ The five springboard trees will be retained *in situ* wherever possible and relocated to an appropriate location where they can be preserved and displayed along with appropriate interpretation where they cannot be retained *in situ*.

Issue	Commitment
Cultural Heritage (continued)	◗ Cultural heritage inductions will be undertaken so that work crews are aware of specific obligations to look for cultural heritage material aiming at informing workers what archaeological materials may look like and give them clear instructions on procedures for inadvertent discoveries
Noise and Vibration	Council will design and operate the facilities to ensure that there are no adverse noise and vibration impacts at sensitive receivers. Follow up noise monitoring will be undertaken at the commencement of the Stage 1 activities. **Specific Control Measures** ◗ Hard rock drill: Although its operation is expected to be limited, it has potential to cause short-term noise impacts at the nearest receivers. Therefore, the use of other quarry equipment, such as the processing plant and dozer will be limited (or ceased) during times when drilling is occurring. ◗ Quarry processing plant: Specific noise mitigation measures will be implemented at West Valley Quarry to reduce the impacts of noise from the processing plant. Potential options include the following, however the feasibility will be reviewed during detail design when the quarry layout is developed, such that the most practical option can be adopted: – Locating the processing plant in locations on site which are naturally shielded by the existing topography will also assist in minimising noise impacts. – As a last resort, treating the building facades of affected receivers will assist in minimising internal noise. Building treatments should generally be considered only when other measures, such as noise barriers are impractical or not cost-effective. Approaches to the acoustic treatment of buildings include improved window glazing and insulation to external walls.

Issue	Commitment
Noise and Vibration (continued)	**Blasting Controls** Blasting will be limited to times when condition are suitable and avoided at times, as outlined below: ◗ Avoid at times of adverse wind condition, as this may promote the impact of blast over pressure. ◗ Avoid at times of temperature inversion. ◗ Avoid overfilling holes with blasting agent. ◗ Avoid firing holes in the front row which have insufficient burden. All blasting designs should contain considerations to minimise factors such as ground vibration and air blast. The blast design should include an assessment of noise and vibration impacts based on blast specific parameters. **General Management Controls** General noise management controls that would be implemented during operation of the quarries and landfills are as follows. ◗ All activities would be undertaken during the approved operating hours only: Monday to Friday 7am – 5pm, Saturday 7am to 12pm noting that blasting can only occur Monday to Friday 9am – 3pm and Saturday 9am – 12pm. ◗ Review available fixed and mobile equipment fleet and prefer more recent and silenced equipment whenever possible. ◗ All equipment, particularly the quarry fleet and waste delivery trucks, will be maintained to a high standard to ensure there are no unnecessary noise emissions. ◗ All vehicles accessing the site will used the designated haul routes and approved access points only. ◗ Neighbouring properties shall be notified of the date and time of blasting activities in advance.
Air Quality and Odour	Council will design and operate the facilities to maintain the existing rural air quality. The following will be implemented: ◗ High dust-generating activities would be avoided during adverse wind conditions when blowing directly towards the nearest residences. ◗ Cease or reduce operations when prevailing winds are in the direction of sensitive receptors, particularly to the south and south-west of the quarry (northerly or north-easterly winds). ◗ The use of a real-time reactive dust monitoring at locations representative of the nearest sensitive receptors to alert the quarry manager when dust levels exceed the nominated criteria. ◗ Specific dust control measures to increase the moisture content of quarried material.

Issue	Commitment
Air Quality and Odour (continued)	◗ Use of water sprays/trucks and sprays to wet down access and haul roads. Clean sealed roads at access and egress points regularly to minimise the re-suspension of dust on sealed roads. ◗ Ensure materials are appropriately stored and contained to prevent windborne releases to the atmosphere. ◗ Where material is removed from the site or fill brought to the site, trucks will be covered whenever conditions are such that dust nuisance is occurring. ◗ To address dust generated by crushing and screening, Install spray systems on equipment and stabilise working surfaces around the work area. ◗ Exposed surfaces, including stockpiles unless revegetated or have a stable surface, would be watered. ◗ Completed areas of the landfill would be progressively rehabilitated and revegetated to minimise dust emissions. ◗ Odour emissions from the landfill will be minimised by limiting the working face of disposal areas, covering all exposed waste at the end of each day, limiting the disposal of malodorous wastes, planning for receival of malodourous waste to minimise the time such wastes would be exposed and minimising the disturbance of previously filled areas. ◗ Records of any complaints would be kept with respect to odour and dust and correlating with weather conditions and deliveries of particularly odorous wastes.
Traffic and Transport	Council will commit to the following measures: ◗ Cessation of access to the site via Eviron Road; ◗ Design of the haul road in accordance with good practice for heavy vehicle traffic. ◗ Safety audit for the Tweed Valley Way and Leddays Creek Road intersection to ensure safe access to and from the major arterial, especially for heavy quarry traffic. ◗ Maintenance of the Leddays Creek Road access intersection and provision of maintenance for the duration of the operation of the quarry and landfill activities. ◗ Preparation of traffic management plans (as part of the environmental management plans) to ensure safe movement of vehicles into and around each the site. ◗ Requirement that each driver would sign a Code of Conduct (during their first visit to the operational site).

Issue	Commitment
Visual	◗ Council will undertake strategic tree planting for screening purposes, including along a drainage line across Lot 1 DP1159352, which will in the longer term facilitate sheltered movement of species such as koalas across the presently cleared lowland area of the site; ◗ Progressive rehabilitation and revegetation of all landfill sites would be undertaken to visually blend the landfill capping with the surrounding landscape; and ◗ The site would be kept clean and tidy at all times as per the LEMP and Quarry Plan of Management (or other site operations plans as relevant).
Greenhouse Gas	◗ Greenhouse gas emissions from landfilling activities will be minimised through active landfill gas management (as per the LEMP). Depending on the quantity of landfill gas generated and captured infrastructure such as a flare will be installed as a minimum, and investigations into the viability and feasibility of tapping into or replicating the Stotts Creek Renewable Energy Facility. ◗ As and when appropriate Council will consider alternative fuels for the onsite plant and equipment as well as more fuel efficient equipment (where cost competitive).
Hazards	Council will implement the following measures to address potential hazards: ◗ Hazard and risk associated with the proposed activities would be managed through development and implementation of a site operations plan which will address safety hazards and develop occupational health and safety procedures and emergency management procedures. ◗ The siltstone present at the site is likely to contain silica, which could potentially be released as respirable crystalline silica in rock dust released during crushing operations. Site-specific data on the mineral composition of the rock resource and the particle size distribution of the rock dust released during crushing operations will be analysed during detail design to facilitate an assessment of potential RCS exposure. ◗ A preliminary assessment of the hazard to building infrastructure and other assets within the lands under the care and control of Council will be undertaken as a priority when the initial activities on site begin as potential sources of ignition may become evident or will be reduced in some areas. ◗ A fire management plan will be included in the site management plans for fires caused by onsite and offsite activities. As part of the management plan, Council will identify risk reduction measures. ◗ Occupational health and safety procedures and appropriate personal protective equipment would be followed during use of plant and equipment as relevant to the particular activity. ◗ Residents would not be permitted to deliver waste to or access any of the landfills. All public access to waste management facilities will be conducted at Stotts Creek RRC.

Issue	Commitment
Hazards (continued)	◗ All landfills will be lined to prevent off-site migration of landfill gas, and a gas management system would be designed in the detailed design phase to prevent methane from being discharged to the atmosphere from closed areas of the landfill. ◗ No dangerous goods would be stored on site, apart from small quantities primarily used for equipment maintenance, and herbicides used for controlling weeds on site. ◗ All chemicals would be stored within a building in accordance with standard dangerous goods storage practices.
Revegetation, rehabilitation and post closure management	Council commits to the following: ◗ Undertake a program of progressive revegetation in those areas disturbed by the operations taking account of the intended future Botanic Gardens. ◗ Conversion of stormwater detention areas to wetlands following cessation of landfilling activities. ◗ Continue to manage the site following closure of the landfill facility, in accordance with the commitments and procedures to be documented within the Site Closure plan. This includes long term monitoring of groundwater, leachate, surface water, landfill gas, revegetation success and capping integrity
Community	◗ Council will undertake consultation with relevant community stakeholders including during the site establishment period and will proactively engage with the community during operations. This will as a minimum include residents whose properties directly adjoining Council's landholding. ◗ The waste education facility at Kingscliff Wastewater Treatment Plant – adjacent to the Stotts Creek RRC will continue to be utilized. ◗ Areas not required for project-related activities will be maintained in a manner that enhances their ecological values as described in the Biodiversity and rehabilitation section. ◗ The site will ultimately be returned as a community asset in the form of the Tweed Shire Botanic Gardens in accordance with the existing Master Plan.

11. Project Justification and Conclusions

11.1 Justification of the Project Application and Concept Plan

This justification of the Concept Plan and Stage 1 Project Application contained within this Environmental Assessment is based on the following factors which are summarised within this section:

- The waste management components of the Concept Plan and Project Application are consistent with Tweed Shire Council's Domestic Solid Waste Strategy;
- The proposed project is consistent with the Tweed Shire Council Community Strategic Plan 2011-2021;
- The waste management components of the Concept Plan and Project Application together with other resource recovery initiatives being implemented by Council are consistent with the strategic direction for waste management in New South Wales;
- There is a justifiable demand for waste disposal facilities in Tweed Shire and the proposal is consistent with recent changes to the Infrastructure SEPP;
- The site at Eviron Road was identified as the most suitable location based upon Council's criteria and there are limited alternative landfilling sites. In addition, landfilling is presently the most viable option for residual waste management in Tweed Shire;
- There is sufficient demand for the quarry products;
- The site is appropriately zoned and is considered to be suitable for the proposed activities; and
- The site is such that potential environmental impacts can be managed in a manner that maintains or improves the environmental values of the site and surrounding areas.

11.1.1 Consistency with Council's Strategic Direction

Council Solid Waste Strategy identified 35 key recommended actions and strategies including education and infrastructure requirements to improve waste avoidance, minimisation and resource management, consistent with the goals of sustainability.

Council is progressively and strategically addressing the recommendations contained within the strategy, which align with the framework for action from the *NSW Waste Avoidance and Resource Recovery Strategy 2007 (WARR Strategy)*

With regard to the development of a waste management facility at Eviron Road, the Waste Strategy recommends:

> *Concurrently with developing plans for the local landfill, Council reviews other long-term disposal options for the Shire's waste as identified in the Strategy having regard to transport and disposal costs, method and number of vehicle movements to accurately assess traffic impact.*

Other long term disposal options considered by Council include transporting residual waste to an existing landfill already in operation in South East Queensland as well as investigating the feasibility of alternative waste technologies. Council and the community have expressed a desire to self manage wastes rather than "exporting the problem", outside of the Shire including interstate to Queensland. Furthermore this type of option provides no incentive to minimise waste generated and leaves Council in a position where it has no control over the costs of waste disposal nor the method in which the waste is ultimately managed.

Alternative waste treatment technologies are under consideration by Council. In 2008, Council commissioned a Situation Analysis of Alternate Waste and Resource Recovery Technologies which concluded at the time that there were no commercial, environmental or community best value grounds at that time to pursue AWT. At present Council keeps a watching brief on the emerging waste technologies that may during the course of the project become viable for the Tweed Shire waste stream.

The recommendations of the waste strategy have guided the delivery of improved kerbside waste services to residential and commercial customers in the Tweed Shire. In December 2009 Council introduced a 140L red lid weekly garbage service, and a 240L yellow lid fortnightly recycling service, while the optional 240L lime lid green waste fortnightly service continues. Since the introduction of this service kerbside resource recovery rates have increased to 42%, representing an increase of almost 2350 tonnes recovered from the residual waste stream compared to the same period in the previous year. It is expected with ongoing education regarding the new services the resource recovery rates will continue to increase towards the WARR Strategy targets.

11.1.2 Strategic Direction for Waste Management in NSW

The waste management components of the Concept Plan and Project Application together with ongoing resource recovery initiatives described in Council's Waste Strategy and within this assessment would deliver outcomes consistent with state legislation and strategies for sustainable waste management. These include the *Waste Avoidance and Resource Recovery Act 2001*, the Waste Avoidance and Resource Recovery Strategy 2007, and the North East Waste Forum Regional Waste Strategy 2009-2012.

11.1.3 Justifiable Demand for Landfill and Infrastructure SEPP

As Tweed Shire Council's existing landfill is predicted to reach capacity by 2012, new waste infrastructure is required to provide for the waste management requirements of the Shire in the short term; as well as broader approval for projected medium and long term needs. Council intends to continue to use the existing infrastructure (such as the weighbridge, gatehouse, small vehicle drop off area) and continue the resource recovery activities at Stotts Creek, following the establishment of the landfills at Eviron Road.

According to forecasts between approximately 50,000 t/yr and 75,000 t/yr of residual waste are likely to require disposal going forward. This demonstrates the continuing requirement for landfill disposal of residual waste and the realistic diversion rate achievable via the new kerbside collection contract, which would be expected to ramp-up over the initial period of the contract.

On this basis a clear justifiable demand therefore exists for provision of new landfill capacity. The capacity/demand ratio has reached the point at which the need for new landfill capacity must be promptly addressed.

On 12 July 2010, the Department of Planning issued a Planning Circular (PS 10-016) *Changes to Infrastructure SEPP – Determination of Landfill Applications.* The Circular makes amendments to Clause 123 of the SEPP to shift the emphasis for landfill applications from justifiable demand towards increased waste recovery (such as using alternative waste technologies or composting) and other environmental outcomes.

This Environmental Assessment was significantly progressed at the time of the changes and has been based upon the DGRs issued in August 2008 which make reference to the justification of the landfill operations and maximising resource recovery from the waste stream to reduce landfill disposal. It is noted however that the waste management components of the Project Application and Concept Plan, together with the recommendations of Council's Waste Management Strategy which has driven recent resource recovery initiatives and will continue to guide future activities are consistent with the overall intent of the amended Infrastructure SEPP as discussed in detail in Section 6.4. Overall it is considered that the approval of the landfill component of the Stage 1 Project application will allow Council time to revisit and update its domestic solid waste management strategy as well as investigate and plan for alternative collection and treatment options, acknowledging that a licensed landfill facility will still be required with any AWT to receive residual waste. This approach also takes account the significant commercial and technological risks involved in moving towards AWT.

11.1.4 Lack of Suitable Waste Disposal Alternatives

Over the course of the past 20 years Council has explored alternatives to waste disposal at Eviron Road and alternatives to landfilling as a waste disposal option, which continues to remain a priority.

The Eviron Road was chosen after an exhaustive site selection process approximately 20 years ago. It was chosen for a number of reasons including:

- Proximity to existing waste disposal and resource recovery facilities at the Stotts Creek Resource Recovery Centre. The use of the existing customer interface at Stotts Creek (weighbridge, gate house and transfer station including recycling areas) delivers significant cost savings in relocating or purchasing this infrastructure; and
- Community consultation undertaken during the development of the waste strategy identified a strong sentiment that the Shire should take ownership and control over its own waste generation and disposal as opposed to transporting waste outside of the Shire to Queensland or other sites in New South Wales.

As discussed above, Council continues to seek alternative options for the management and disposal of residual waste remaining after resource recovery activities from the municipal waste stream. At this point in time landfilling utilising best practice design and environmental management principles represents the most suitable medium term option for the Tweed Shire.

11.1.5 Demand for Quarry Resources

It has been previously identified that there would be requirements for quarry developments for the Tweed Shire area following the progressive closure of other Council quarries such as Bartletts Quarry and on closure of Quirks Quarry. Council has a customer base of 55 companies external to council to which it sells the resource.

The Eviron Road site was selected as a potential quarry site as it is located within close proximity to existing quarries and is relatively isolated. In addition, benefits of quarrying at the site included that:

- It was owned by the council acquired when planning was first being developed;
- Quarrying activities would be able to be undertaken with minimal impact to the community;
- Existing neighbours would be accustomed to quarry activities;
- There would be continuity of products produced;
- The site is economical in that it is proximal to transport, townships, industry and development areas; and
- The site is zoned appropriately for quarrying.

With the planning and delivery of major civil infrastructure projects in the region (including major road upgrade projects) it is expected that demand for roadbase from quarries such as Eviron Road will remain high.

11.1.6 Environmental Protection

Council recognises the importance of improving environmental standards for quarry and landfill design and management. This Environmental Assessment and the Waste Strategy both demonstrate Council's commitment to improving resource recovery via separation and processing of organic material to reduce potential greenhouse gas generation and a landfill management philosophy which seeks to prevent environmental impacts via emissions to the atmosphere, land and water via a commitment to best practice design and environmental management. Quarry operations will be guided by a plan of management which will outline required environmental management measures.

It is acknowledged that further investigations during detail design for the landfill and quarry are required to address some geotechnical, hydrogeological and acid sulfate soil issues and that a pre clearing survey targeting threatened flora species is required for the West and North Valley. However the design concepts presented as part of this assessment for the Stage 1 Project Application have addressed key environmental issues including flooding and stormwater management, noise, blasting and vibration, air quality, biodiversity issues, traffic impacts, surface water quality management, landfill leachate and gas management, hazards and rehabilitation. Commitments that Council has made regarding these issues have been provided in this document as well as being contained within a Draft Landfill Environmental Management Plan for Quirks Quarry Landfill and the West Valley Quarry Preliminary Study.

11.2 Consequences of Not Proceeding

It has been documented within this assessment that Council's only existing landfill is likely to reach capacity in 2012. It is therefore critical that, coupled with Council's commitment to continuous improvement in resource recovery that an adequate waste disposal facility for the Shire be established to replace the existing one.

Without this project, the most logical alternative for waste disposal is transporting waste out of the Shire and most likely out of the state. This assessment and Council's Waste Management Strategy have documented the reasons why this is not a desirable outcome, which include: a lack of control of the capital and ongoing costs, significant greenhouse gas impacts from the transport of waste to Queensland, lack of control over the management and liability associated with wastes once landfilled. In addition, this sort of option whilst achieving diversion of waste from landfill within New South Wales is inconsistent with the intent of state waste management legislation around this issue.

Should the project not proceed, the rehabilitation of Quirks Quarry will need to be addressed in a manner that is consistent with the Botanic Gardens Master Plan. Council would have to determine alternative resources for such rehabilitation which has not been considered at this point in time; and

If the quarry aspects do not proceed there will be reduced competition in the market for quarry products which is likely to contribute to higher infrastructure delivery costs. In addition the existing Council workforce at the quarry will need to be redeployed.

11.3 Conclusion

This Environmental Assessment has considered the potential impacts of the Stage 1 Project Application and the Concept Plan. It has been prepared in accordance with the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979* and the requirements of the Director-General of the NSW Department of Planning. The Environmental Assessment has documented the potential environmental impacts associated with the Project, considering both potential positive and negative impacts of the Project, and recommending management and mitigation measures to protect the environment where required.

Environmental investigations were undertaken during the preparation of the Environmental Assessment to assess the potential environmental impacts. These included specialist assessment on issues involving noise, blasting and vibration, air quality, greenhouse gas emissions, traffic, biodiversity, and heritage.

Overall the Stage 1 Project Application would:

- Provide short to medium term waste disposal requirements for the Shire which is consistent with Shire's Waste Management Strategy;
- Provide extractive materials for which there is an increased market demand;
- Manage the facilities such that negative environmental and community impacts are minimised through the implementation of the mitigation and management measures outlined in this assessment;

- Provide protection and management of an area of vegetation containing higher ecological values on Lot 1 DP 1159352;
- Ensure continued employment for the existing quarry workforce; and
- Ensure the principles of the revised *Infrastructure SEPP – Determination of Landfill Applications* are met while allowing Council to responsibly investigate and plan for alternatives to landfilling.

Approval of the Concept Plan would deliver surety that the site can be utilised for extractive industries for which there is ongoing demand and that there is provision for the medium to longer term waste disposal requirements of the Shire. In addition the Concept Plan identifies broad environmental and geophysical constraints and limits the maximum footprint for activities proposed for future stages of development. Specific staged applications would be made in the future based upon the regulatory framework and best practice waste management technologies applicable to the Tweed Shire.

The Environmental Assessment has identified that a number of key issues require further attention during detail design however the main potential impacts associated with the proposed activities can be effectively managed through project design features. To manage these issues, and in some cases eliminate them completely, a number of mitigation and management measures (commitments) that would be undertaken are outlined throughout Section 9 and summarised in a Draft Statement of Commitments in Section 10.

Commitments made by Council include undertaking detailed geotechnical, hydrogeological and acid sulfate soils investigations and the preparation of environmental management and operational management plans to ensure that the mitigation and management measures are developed, implemented and monitored. These plans would also ensure compliance with relevant legislation and any conditions of approval.

The construction and operation of the proposed activities would be undertaken in accordance with all relevant legislative guidelines. It is recommended that the Concept Plan and Stage 1 Project Application be approved subject to the implementation of the mitigation measures and commitments identified in this Environmental Assessment.

12. References

APC Environmental Management Pty Ltd (June 2007). *Domestic Solid Waste Management Strategy* Tweed Shire Council, Murwillumbah

APC Environmental Management Pty Ltd (2009) *Regional Municipal Domestic Waste Data Collection* prepared for North East Waste Forum (NEWF)

Australian and New Zealand Environment Conservation Council (ANZECC) (1990). *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*

Australian and New Zealand Environment Conservation Council, Agriculture and Resource Management council of Australia and New Zealand (ANZECC/ARMCANZ) (2000) *National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality*

Australian Bureau of Meteorology (2010). Weather Station Data for Coolangatta, from www.bom.gov.au/climate/data/weather-data.shtml

Australian Bureau of Statistics (2009). 3218.0 Regional Population Growth Australia 2007-08.

Australian Koala Foundation (1996). Tweed Coast Koala Habitat Atlas Habitat Classes Map. 1:50,000. Australian Koala Foundation, Brisbane.

Australian Standard (2006). Explosives – Storage, transport and use. Part 2: Use of explosives. (AS 2187.2 – 2006)

Benjas Pty Ltd (November 2008). *Alternate Waste and Resource Recovery Technologies Situation Analysis for Tweed Shire Council*

Benjas Pty Ltd (2010) *Solo Resource Recovery Recyclables Delivery Audit*, prepared for Solo Resource Recovery

Bishop, T. (2000). *Field Guide to the Orchids of New South Wales and Victoria* (Second ed.). University of New South Wales Press, Sydney

BMT, & WBM. (2008). *Draft Tweed Botanic Gardens Water Modelling Report*. Murwillumbah: Tweed Shire Council, Murwillumbah

Brian J. Mackney & Associates (1995). *Quirks Quarry Environmental Impact Statement*. Bangalow.

Briggs, J. D., & Leigh, J. H. (1996). *Rare or threatened Australian plants* (Rev. ed.). CSIRO Publishing, Collingwood

British Standard Institution (2009). *Code of Practice for Noise and Vibration on Construction and Open Sites* Part 1: Noise (BS 5228-1:2009)

British Standard Institution (1993). *Evaluation and Measurement for Vibration in Buildings*, Part 2 - Guide to damage levels from ground borne vibration (BS 7385.2 – 1993)

British Standard Institution (1992). *Guide to Evaluation of Human Exposure to Vibration in Buildings* (1 Hz to 80 Hz) (BS 6472 – 1992)

Brooker, M. I. H. (1999). *Field guide to eucalypts. South eastern Australia.* (Second ed. Vol. 1). Bloomings Books, Hawthorn

Cogger, H.G. (2000). *Reptiles and Amphibians of Australia.* Reed New Holland Publishing, Frenchs Forest

Cropper, S. (1993). *Management of Endangered Plants.* CSIRO Publications, East Melbourne

Davey, S.M. (1984). Habitat preferences of arboreal marsupials within a coastal forest in southern New South Wales. Pp 509-516 *Possums and Gliders* edited by A.P. Smith and I.D. Hume, Australian Mammal Society, Sydney

Department of Climate Change (2009). National Greenhouse and Energy Reporting System Measurement - *Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia*. Department of Climate Change, Canberra

Department of Climate Change and Energy Efficiency (2010). *National Greenhouse Accounts* (NGA) Factors, Canberra

Department of Environment and Climate Change (2007). *New South Wales Waste Avoidance and Resource Recovery Strategy 2007*, Department of Environment and Climate Change NSW, Sydney

Department of Environment and Climate Change, (2007). *Threatened species assessment guidelines The assessment of significance*. Department of Environment and Climate Change, Sydney

Department of Environment, Climate Change and Water (2009). *Interim Construction Noise Guideline*. Department of Environment, Climate Change and Water, Sydney

Department of Environment, Climate Change and Water (2009). *Aboriginal Cultural Heritage Draft Consultation Requirements for Proponents*; Part 6 of the *National Parks and Wildlife Act, 1974*. Department of Environment, Climate Change and Water, Sydney

Department of Environment, Climate Change and Water (2008). Detailed data: Definitions of vegetation types for CMA areas. Excel database. Retrieved online at http://www.environment.nsw.gov.au/resources/nature/BioMetric_Vegetation_Type_CMA.xls

Department of Environment, Climate Change and Water (2008) *Guidelines for Conducting Household Kerbside Residual Waste, Recycling and Garden Organics Audits in NSW Local Government Areas,* Department of Environment, Climate Change and Water, Sydney

Department of Environment, Climate Change and Water (2006). *Assessing Vibration: A technical Guideline*, Department of Environment, Climate Change and Water, Sydney

Department of Environment, Climate Change and Water (2005). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, Department of Environment, Climate Change and Water, Sydney

Department of Environment, Climate Change and Water (2000). *Industrial Noise Policy*, Department of Environment, Climate Change and Water, Sydney

Department of Environment and Conservation (date unknown) *Getting more from our recycling systems - Good practice performance measures for kerbside recycling systems* http://www.environment.nsw.gov.au/resources/warr/2005147_gov_kerbrecyperf.pdf

Department of Environment and Conservation (2006). *Technical framework – Assessment and management of odour from stationary sources in New South Wales*, Department of Environment and Conservation (NSW), Sydney

Department of Environment and Conservation and Department of Infrastructure and Planning (2005). *Draft Guidelines for Threatened Species Assessment.* NSW Department of Environment and Conservation and NSW Department of Primary Industries

Department of Environment and Heritage (2006). *Significant Impact Guidelines 1.1: Matters of National Environmental Significance.* Department of Environment and Heritage, Canberra

Department of Land and Water Conservation (DLWC) (1998). Acid Sulfate Soil Risk Map for Cudgen (hard copy map)

Department of Land and Water Conservation (DLWC). Acid Sulfate Soil Risk Mapping (digital format provided by TSC)

Department of Mines and Energy (1967). 1:250,000 scale geological map for Tweed, sheet 56-03.

Department of Planning (NSW) (2006*). Far North Coast Regional Strategy*. Department of Planning (NSW), Grafton

Department of Planning (NSW) (2008). *New South Wales State and Regional Population Projections*, 2006-2036, 2008 Release, Department of Planning (NSW), Sydney

Department of Planning (NSW) (2010). *New South Wales Statistical Local Area Population Projections*, 2006-2036, Department of Planning (NSW), Sydney

Department of Planning and Infrastructure (2011) Part 3A of the EP&A Act and residential, commercial, retail and coastal subdivision development. Planning Circular 11-014, 13 May 2011.

EDAW Gillespies (2005). *Bartletts Quarry landfill revegetation strategy. Draft Report*. Unpublished report for Tweed Shire Council, Murwillumbah

Environmental Protection Authority (1999). *Environmental criteria for road traffic noise*. Environmental Protection Authority, Sydney

Environmental Protection Authority (1996). *Environmental Guidelines: Solid Waste Landfills. Guideline* prepared by the Waste Management Branch of the Environment Protection Authority

Forestry Commission of NSW (1989). *Forest Types in NSW, Research Note No. 17*

Full Circle Environmental Solutions (2005) *Regional Municipal Waste Characterisation Study,* prepared for North East Waste Forum (NEWF)

Gilbert and Sutherland (2006). *Proposed Management Measures in relation to Council Land at Eviron*. Tweed Shire Council, Murwillumbah

GHD (2006) *SITA Australia Pty Ltd Proposed SAWT Facility at Hallam Road Landfill, Odour and Dust Impact Assessment*, February 2006

GHD (2009a). *Draft Landfill Environmental Management Plan for Quirks Quarry Landfill.* Unpublished report prepared for Tweed Shire Council

GHD (2011). *Conceptual Landfill Design Report for Quirks Quarry Landfill*. Unpublished report prepared for Tweed Shire Council

GHD (2010). *Hydrogeological and acid sulfate soils desktop study. Eviron Road Quarry and Landfill Environmental Assessment*. Unpublished report prepared for Tweed Shire Council

GHD (2011). *Preliminary Quarry Study for the proposed West Valley Quarry*. Unpublished report prepared for Tweed Shire Council

Gibbons, P. and Lindenmayer, D. (2002). *Tree hollows and wildlife conservation in Australia.* CSIRO Publishing, Collingwood

Gilbert and Sutherland Pty Ltd (2007). *Site Investigation Addressing Soils, Stratigraphy and Proposed Management Measures in Relation to Council Land at Eviron, NSW*

Gilbert and Sutherland Pty Ltd (2008). Geological bore logs (GW9 to GW17)

Hannah, D. (2008). *Eviron Road Quarry and Landfill Proposal Concept Plan*, *Stage 1 Application and Preliminary Environmental Assessment*. *Design Unit, Engineering and operations*, Tweed Shire Council, Murwillumbah

Harden, G. (1990-2002). *The Flora of New South Wales Volumes 1 to 4*

Harden, G., McDonald, B., & Williams, J. (2007). *Rainforest climbing plants. A field guide to their identification*. Gwen Harden Publishing, Nambucca Heads

Higgins, P.J. (1999). *Handbook of Australian, New Zealand and Antarctic Birds Volume 4 Parrots to Dollarbirds.*

Higgins, P.J., Marchant, S., Peter, J.M., Davies, S.J.J.F, Steele, W.K. and Cowling, S.J. (1990-2006). *Handbook of Australian, New Zealand and Antarctic Birds (HANZAB)* Book Series. Oxford University Press, Melbourne

Holmes Air Sciences (2003*) Odour Audit: Eastern Creek Stage 2*

Hurley, P. *The Air Pollution Model (TAPM) Version 4. CSIRO Atmospheric Research Paper No. 55*

Hyder Consulting Pty Ltd (2011) *Review of Resource Sharing Opportunities: Waste Management* prepared for Northern Rivers Regional Organisation of Councils (NOROC)

International Organisation for Standardization (1996). *Acoustics – Attenuation of sound during propagation outdoors - Part 2: General Method of Calculation, First Edition* (ISO 9613-2)

Keith, D. A. (2004). *Ocean Shores to Desert Dunes. The native vegetation of New South Wales and the ACT.* Department of Environment and Conservation, Hurstville

Kingston, M.B., Turnbull, J.W. & Hall, P. W. (2004). *Tweed Vegetation Strategy Volumes 1-3*. Tweed Shire Council, Murwillumbah

Kingston, M.B., Turnbull, J.W., and Hall, P.W. (2004). Tweed Vegetation Management Strategy Volumes 1-3. Document prepared by Ecograph for Tweed Shire Council

Landplan Landscape Architects (September 1998) *Tweed Shire Regional Botanic Gardens Master Plan Report*

Menkhorst, P. and Knight, F. (2004). *Field Guide to Mammals of Australia*. Oxford University Press, Melbourne

Morand, D. T. (1996). *Soil Landscapes of the Murwillumbah - Tweed Heads 1:100000 Sheet Report*. Department of Land and Water Conservation, Sydney

National Parks and Wildlife Service, (undated). Key Habitats and Corridors in North East NSW. Retrieved online at http://maps.nationalparks.nsw.gov.au/keyhabs/default.htm.

National Pollutant Inventory (2001). *Emission Estimation Technique Manual for Mining*, *Version 2.3*

New South Wales Minerals Council (2000). *Technical Paper: Particulate Matter and Mining Interim Report,* New South Wales Minerals Council, Sydney

New South Wales Office of Water (2008) *Guidelines for Controlled Activity Approvals*

Nicholson, H., & Nicholson, N. (2003). *Australian Rainforest Plants IV* (Second ed.). Terania Rainforest Publishing

Nicholson, N., & Nicholson, H. (2000). *Australian Rainforest Plants V*. Terania Rainforest Publishing, The Channon

North East Waste Forum (2009). *Regional Waste Strategy 2009/2012 A Regional Plan for Managing Waste and Resources In the North East Waste Forum for the Years 2009-2012*

Phillips, S. & Hopkins, M. (2009). *Ecological status and viability of koala populations in the Tweed LGA*. Biolink Ecological Consultants. Retrieved online at: http://www.tweed.nsw.gov.au/councilmeetings

Phillips, S., & Callaghan, J. (1996). *Koala Habitat Atlas Project Number 4: Tweed Coast. Draft.* Australian Koala Foundation, Brisbane

Phillips, S., & Callaghan, J. (1995). The *Spot Assessment Technique*: determining the importance of habitat utilisation by Koalas (*Phascolarctos cinereus*). Prepared for the Australian Koala Foundation.

Quin, D. (1995). Population ecology of the squirrel glider (*Petaurus norfolcensis*) and the sugar glider (*P. breviceps*) (Marsupialia: Petauridae) at Limeburger's Creek on the central north coast of New South Wales. *Wildlife Research* 22: 471-505.

Robinson, M. (2000). *A Field Guide to Frogs of Australia.* Reed New Holland Publishing, Frenchs Forest

Rowston C. & Catterall C.P. (2004). Habitat segregation, competition and selective deforestation: effects on the conservation status of two similar Petaurus gliders. Pp. 741-747 in *the Conservation of Australia's Forest* Fauna (second edition) 2004 edited by Daniel Lunney. Royal Zoological Society of New South Wales, Mosman

Standards Association of Australia (2006). *Australian Standard: Explosives – Storage, transport and use. Part 2: Use of explosives*. (AS 2187.2 – 2006), Standards Australia, North Sydney

Strahan, R. (Ed.). (2004). *The Mammals of Australia* (Second ed.). Reed New Holland Publishing, Sydney

Tweed Shire Council (2004). *State of the Environment Report. Tweed Shire Council*, Murwillumbah

Tweed Shire Council (2004) *Stotts Creek Landfill Facility Landfill Environmental Management Plan for Solid Waste Expansion*, Murwillumbah

Tweed Shire Council (2006). *Plan of Management Quirks Quarry, Eviron Road Eviron. V 3.0*. Tweed Shire Council, Murwillumbah

Tweed Shire Council (2008). *Tweed Shire State of the Environment 2008*. Tweed Shire Council, Murwillumbah

Tweed Shire Council (2008) *Tweed Shire Development Control Plan 2008*. Tweed Shire Council, Murwilumbah

Tweed Shire Council (2009) *Tweed Shire Council Draft Management Plan 2009 – 2012*. Tweed Shire Council, Murwillumbah

Tweed Shire Council (April 2009) *Eviron Road Quarry and Landfill Proposal Concept Plan,* *Stage 1 Project Application and Preliminary Environmental Assessment*. Tweed Shire Council, Murwillumbah

Tweed Shire Council () *Tweed Urban Stormwater Quality Management Plan*. Tweed Shire Council, Murwillumbah

Tweed Shire Council (November 2006) *Plan of Management Quirks Quarry V3.0 Eviron Road Eviron.* Tweed Shire Council, Murwillumbah

Walker, J., & Hopkins, M. S. (1998). Vegetation. In R. C. McDonald, R. F. Isbell, J. G. Speight, J. Walker & M. S. Hopkins (Eds.), *Australian Soil and Land Survey Field Handbook* (2nd ed.). Australian Collaborative Land Evaluation Program, Canberra

Watsford, P. (2006). *Plants of the forest floor: a guide to small native plants of subtropical eastern Australia*. (1st ed.). Nullum Publications, Murwillumbah

Woodward Clyde & Landmark Ecological Services Pty Ltd (1998). *Pacific Highway Upgrade Yelgun to Chinderah. Species Impact Statement*. *Milton.*

Woodward Clyde, & Landmark Ecological Services Pty Ltd (1998). *Flora and Fauna Assessment Working Paper No. 7 for the Upgrade of the Pacific Highway Yelgun to Chinderah*.

World Resources Institute. & World Business Council for Sustainable Development (2001). *The greenhouse gas protocol : a corporate accounting and reporting standard* World Business Council for Sustainable Development ; World Resources Institute, Geneva, Switzerland and Washington, D.C.

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- Were limited to those specifically detailed in GHD's Proposal dated 17 September 2008 (Ref 41/09094/08/3988).
- Did not include preliminary or detailed design of any of the proposed activities or presence onsite during all geological investigations.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report ("Assumptions"), including (but not limited to):

- Assumptions listed in each of the technical reports provided in Appendix B through N.
- Climate change is an emerging emission for coastal communities in Australia, it has been assumed that the flood height provided by Council and the consequent minimum pit/cell floor level is appropriate for the subject site.
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