

Armidale Regional Landfill

Planning Assessment Commission Response



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Prepared for

Armidale Dumaresq Council

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Executive Summary

Armidale Dumaresq Council (Council) proposes to develop the Armidale Regional Solid Waste (Putrescible) Landfill Facility off Waterfall Way in Armidale, NSW. The existing landfill at the Armidale Waste Management Facility on Long Swamp Road is fast approaching its final capacity.

The purpose of this report is to address issues raised during meetings convened by the Planning Assessment Commission (PAC) on 24 and 25 May 2012. This report has been prepared to provide additional information to the PAC to assist in its determination of the project in relation to:

- Potential for groundwater contamination by leachate
- Potential for surface water flows into Gara River
- A Regional Landfill Facility from a regional context
- Strategic Waste Limit – two versus five cell approval
- Site selection process
- Biodiversity and Amenity Issues (Visual, odour, noise, litter and vermin)

The above concerns raised during the PAC meeting have been addressed as follows:

- **Potential for groundwater contamination by leachate** - the proposed leachate management system has been designed using a precautionary approach, has been designed to meet the worst case of “poor hydrological conditions” and exceeds the requirements for design of a leachate barrier stipulated in the *NSW Environmental Guidelines: Solid Waste Landfills 1996* Guidelines (Benchmark Technique No.1). The composite liner proposed is considered best practice and is adopted by regulatory authorities worldwide. Council proposes to install the barrier system in accordance with this benchmark technique and with a carefully monitored QA/QC procedure.
- **Potential for surface water flows into Gara River** – surface water will be managed at the Site using a stormwater diversion system, a sedimentation basin and dry basin in addition to the leachate pond. In the unlikely event of emergency overflow from the leachate pond, all overflows will be fully contained in the downstream sedimentation basin, and then ultimately in the dry basin. The diversion system has been designed for the 1 in 100 year ARI peak flow event from the upslope catchments to divert ‘clean’ stormwater away from the Site. The sedimentation basin has been designed to fully contain the 5-day, 95th percentile rainfall depth for the Armidale area. Ultimately, the dry basin has been designed to contain the 1 in 100 year ARI 3 day duration rainfall event. The 100 year ARI, 3 day rainfall event is an extreme rainfall event and the potential risk of any off-site discharge would be extremely unlikely during the landfill operation. The proposed water management system is designed to a higher level than that accepted by the EPA during the EA process, where it is proposed to design and size the dry basin for a 1 in 100 ARI, 1 day duration rainfall event.
- **A Regional Landfill Facility** - The Armidale Dumaresq Council area generates by far the largest waste quantity within the immediately surrounding areas including Guyra, Walcha and Uralla Councils. Whilst these Councils have not either confirmed or denied their participation in disposal of their waste at a regional facility, they have provided the commitment letters during the consultation process. Guyra Council has been depositing waste at the Armidale landfill since late 2002. Anticipated Council reforms over the next few years or decades, may in fact amalgamate regional and rural Councils. It would therefore seem logical, that if such amalgamation were to happen, Armidale would serve as a Regional facility and that smaller and less cost effective facilities are closed down.
- **Strategic waste limit – two cell versus five cell approval** - the Director General’s Environmental Assessment Report recommended that approval be granted to construct and operate two of the proposed five cells. It was noted that it is ‘*not intended as an environmental limit, but a strategic waste limit that will ensure the Council continue to update its waste recovery planning in line with the NSW waste recovery targets*’. Council do not agree with the Director General’s Environmental Assessment Report’s comment that if a five cell development was permitted, that there will be no driver to update its’ waste recovery planning. The current landfill is operating to best Regional/Rural landfill practices, which was acknowledged in the Director General’s Environmental Assessment report which stated that “Council’s Recovery performance is better than the State Average”. Councils waste diversion practices are already getting close

to achieving the 2014 WARR targets. Council has further increased their waste diversion activities since the submission of the EA and the inspection of their existing activities by the DoP's independent waste advisor, including the commencement of the domestic organics (garden and food wastes) service. This demonstrates Council's full commitment to maximising waste diversion and to meeting their intent of essentially operating the new landfill as a non-putrescible landfill.

Furthermore, a number of proposed conditions of consent require Council to design the landfill and ancillary infrastructure to accommodate outputs from five cells but with approval to only operate two cells subject to Council satisfactorily addressing Clause 123(1)(a) of State Environmental Planning Policy (Infrastructure) 2007.

The water and leachate management infrastructure supporting the two cells for the base case scenario would be built to final design size (i.e. sufficient capacity to accommodate containment and storage requirements for five landfill cells) in Year 1. The proposed staged approval of the landfill cells would mean that water and leachate management infrastructure to support two cells only would be constructed in Year 1, with further construction required in future years to augment/upgrade the infrastructure to support additional landfill cells as they are approved (two cell scenario).

Option 1 (i.e. the Proposal as submitted) has lower costs and a lower risk profile. This approach would be preferred to reduce the financial risk of future landfill cells not being approved, and hence the burden on rate payers and the uncertainty of a longer term waste solution for Council.

- **Site selection process** - Council has maintained records of the site selection process including reports, correspondence with real estate agents, newspaper advertisements and minutes and resolutions of Council Meetings, which demonstrate that the site selection process was comprehensive and rigorous. It involved consideration by multiple consultants, state government departments, Council's advisory committees and by the elected Councillors. It is noted that the site selection work undertaken by Brian Mackney and Associates was "peer reviewed" by the NSW Department of Public Works (which subsequently changed its' name to NSW Department of Commerce during the review period).
- **Biodiversity and amenity issues** - the proposal includes a biodiversity offset of approximately 61 hectares of land to account for approximately 20 hectares of vegetation being cleared due to the proposed landfill facility. The biodiversity area will be contained entirely within the Site extent to enable direct and intensive management of the offset and to minimise the disturbance and relocation distance for some older and hollow-bearing trees and associated habitats. The Biodiversity Offset Management Plan for the Site has been prepared in accordance with the recommendations of the DECCW (now EPA) principles for biodiversity offsetting.

Amenity impacts such as noise, odour and vermin will be managed through mitigation measures as outlined in the EA and appropriate management plans for construction and operation phases including the LEMP. Visual impacts will be mitigated through progressive landscaping and revegetation, with no visual impacts for the life of the operation.

Further summarising water management controls adopted for this proposal we confirm the following:

	Benchmark Technique (Environmental Guidelines: Solid Waste Landfills)	Proposed in Environmental Assessment	Revised Proposal for this Submission
Leachate Dam	Benchmark Technique No. 2 - 25 year, 1 day storm event	100 year 1 day storm event (13.9ML)	100 year 3 day storm event (14.6ML)
Sedimentation Dam	Benchmark Technique No. 3 - 90 th Percentile 5-day rainfall	90 th Percentile 5-day rainfall (2.85ML)	95 th Percentile 5-day rainfall (5.25ML)
Dry Basin	Benchmark Technique No. 2 - 110% capacity bund of leachate dam capacity (110% x 13.9ML = 15.3ML)	19ML (minimum capacity in lieu of bund)	30ML (minimum capacity in lieu of bund)

The proposed landfill would operate under a strict management regime to ensure impacts to the environment are minimised.

1.0 Introduction

1.1 Background

Armidale Dumaresq Council (Council) proposes to develop the Armidale Regional Solid Waste (Putrescible) Landfill Facility off Waterfall Way in Armidale, NSW. The existing landfill at the Armidale Waste Management Centre on Long Swamp Road is fast approaching its final capacity. No further options are available to extend or otherwise prolong the life of the landfill, mainly due to the lack of further available land area, suitable for landfilling at that site. Land has recently been acquired adjacent to the existing waste management facility at Long Swamp Road, however this was purchased to provide additional space for the expansion of the Resource Recovery Centre (second-hand shop), waste processing activities and stockpile areas. It has never been considered as land available for landfill extension. It is also noted that a significant landfill extension on the existing Long Swamp Road site has not been considered viable by Council owing to a range of significant constraints, which would preclude it from being a landfill under current site location guidelines. In addition it would not comply with the National Airports Safeguarding Framework, which specifies distance restrictions to manage risk of collisions between wildlife and aircraft at or near airports where that risk may be increased by the presence of wildlife attracting land uses, such as a landfill. As such, the need exists to provide a long-term waste disposal solution for the region.

The purpose of this report is to address issues raised during meetings convened by the Planning Assessment Commission (PAC) on 24 and 25 May 2012. This report has been prepared to provide additional information to the PAC to assist in its determination of the project.

1.2 Environmental Guidelines: Solid Waste Landfills (NSW Environment Protection Authority, 1996)

1.2.1 Benchmark Techniques

The *Environmental Guidelines: Solid Waste Landfills* NSW Environment Protection Authority (EPA) 1996 (Landfill Guidelines) provides a framework for a consistent and environmentally responsible approach to managing landfills in NSW. The Landfill Guidelines set out benchmark techniques for the design, operation, monitoring and management for a landfill as well as specified Environmental Goals. These guidelines note that 'there is no impediment to rejecting some techniques in relation to a given facility. The occupier should select those techniques that are applicable to meeting the goals, identify those that are not, and justify the omissions or alternatives put forward'.

These guidelines have been used as the targets to meet in the design of the proposed Armidale Regional proposed Landfill, as they were specified in the Director-General's Requirements (DGRs) issued by the Director General of the then Department of Planning on the 20th November 2008. These DGRs were issued specifically after consultation with other regulatory authorities during the planning focus meeting held to discuss the proposal and other consultation. During the Regulatory consultation period in which the DGRs were determined, the Commonwealth Department of Environment and Heritage was consulted for input as a result of the sites' proximity to the Gara River and Wild Oxley Rivers National Park. No further design guidelines were specified or recommended.

The benchmark techniques have been considered throughout the design of the proposed Armidale Regional Landfill. The draft Landfill Environmental Management Plan (LEMP) (AECOM, 2010) sets out the benchmark techniques and how the proposed design complies with, or exceeds the recommended benchmarks. The EPA has used these benchmark techniques as a point of reference when assessing Council's proposal for the Armidale Regional Landfill, which is reflected in the draft conditions of approval recommended by the EPA and the Department of Planning and Infrastructure (DP&I).

1.2.2 Environmental Goals for Water Pollution

Leachate is the liquid that percolates through landfills as a result of infiltration of rainwater and/or decomposition of the wastes. If not adequately controlled, ground and surface waters can be put at risk if contaminated by untreated leachate from landfill sites. Due to the location of the proposed landfill in proximity to the Gara River and in the catchment of the Oxley Wild Rivers National Park and World Heritage Area, the engineering design, monitoring programmes and management measures proposed for the Armidale Regional Landfill reflect the Environmental Goals set out in the Landfill Guidelines relating to water pollution including:

- **Preventing pollution of water by leachate** - Leachate must be controlled within the landfill site, ensuring that neither groundwater nor surface water is polluted.
- **Detecting water pollution** - Effective mechanisms must be developed for early detection of groundwater and surface water pollution; and
- **Remediating water pollution** - Any detected groundwater or surface water pollution needs to be speedily remediated.

1.3 Planning and Environmental Assessment Process

1.3.1 Planning Assessment Framework

The proposed Armidale Regional Landfill is defined as a 'waste facility' under Schedule 1 of the *State Environmental Planning Policy (Major Development) 2005* (SEPP 2005) as it would have the capacity to receive greater than 650,000 tonnes of putrescible waste over the life of the landfill. The project was therefore declared to be a development to which Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) applies and requires the approval of the Minister for Planning and Infrastructure.

An Environmental Assessment (EA) was prepared in accordance with the provisions of Part 3A of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), together with the DGRs issued by the Director General of the then Department of Planning on the 20th November 2008.

In October 2011, Part 3A of the EP&A Act was repealed, however under clause 2 of Schedule 6A of the EP&A Act, the project is a 'transitional Part 3A project' and therefore continues to be assessed under Part 3A of the Act.

1.3.2 Public Exhibition of the Environmental Assessment

Under Section 75H (3) of EP&A Act, the EA was required to be exhibited for a period of '*at least 30 days*'. Given the size of the EA and previous comments from the public suggesting the exhibition period be extended, the EA was placed on exhibition for a period of 60 days, from 3 June to 6 August 2010. During the exhibition period, the then Department of Planning website experienced technical difficulties with the electronic collection of submissions. In light of this issue, submissions were accepted by the Department for a further 30 days after the exhibition period closed. This gave a total consultation period of 90 days, well in excess of the standard 30 days required under the EP&A Act.

Comments raised by the public during the exhibition period were considered by Armidale Dumaresq Council and responses provided in a Submissions Report (dated 12 April 2011). Consultation with key stakeholders continued through and in some cases beyond the exhibition period. This included ongoing discussions with the then Department of Environment, Climate Change and Water (DECCW), Roads and Traffic Authority (RTA) as well as meetings with specific residents and community groups.

1.3.3 Determination Process

Following lodgement of the Submissions Report, the Director General of the DP&I prepared an Environmental Assessment Report which assessed the merits of the project with regard to the EP&A Act and the principles of ecologically sustainable development.

The Director General's assessment report concluded that the project was in the public interest and recommended that the Armidale Landfill Project be approved subject to conditions. Draft Conditions of Consent were prepared and were provided as Appendix A of the Director General's assessment report.

Under the EP&A Act the Minister for Planning and Infrastructure is the approval authority for Part 3A projects. However, as more than 25 submissions were received during the exhibition, the project is to be determined by the NSW PAC, to which the Minister has delegated the final assessment role. On 11 April 2012, the DP&I referred the Armidale Landfill Project application to the PAC for determination. The Commissioners presiding over the PAC for this project include Dr Neil Shepherd and Mr Gary West.

On 24 May 2012, the PAC convened a public meeting in Armidale and invited representations from the public. Nine parties addressed the PAC including:

- Mr Christian Quaife
- Mr Geoffrey Fox - (President of the Gara Valley Environment Preservation Association)
- Mr Hans Hietbrink - Mayor, Guyra Shire Council

- Mr Ron Piddington
- Mr Peter Metcalfe - President of the Armidale Branch of the National Parks Association of NSW
- Mr David Laird
- Mr Peter Lloyd
- Mr Gorm Kirsch
- Mr Damien Coffey

On 25 May 2012 the PAC convened a meeting with Council to discuss the issues raised at the public meeting. The Commissioners also conducted an inspection of the proposed landfill site, accompanied by representatives from Council and its Consultant. Issues raised by the PAC, and responses to each, are presented in Section 2.0 of this report.

2.0 Issues

2.1 Summary of Issues

Issues were primarily those received during the exhibition period for the EA. In summary, the issues discussed during the PAC meeting on 25 May 2012 with Council included:

- Potential for groundwater contamination by leachate (Section 2.2)
- Potential for surface water flows into Gara River (Sections 2.2.4 and 2.2.5)
- A Regional Landfill Facility from a regional context (Section 2.3)
- Strategic Waste Limit – two versus five cell approval (Section 2.4)
- Site selection process (Section 2.5)
- Biodiversity and Amenity Issues (Visual, odour, noise, litter and vermin) (Section 2.6)

2.2 Potential for Groundwater Contamination by Leachate

Concerns regarding leachate and water management raised during the submissions to the PAC are discussed below under the following headings.

1. The proposed leachate barrier system
 - The barrier system's compliance and exceedance of the EPA's benchmark standards
 - The barrier system's specification in relation to current practice and world standards
 - Construction of the barrier system using a carefully regulated QA/QC system
2. The nature of the leachate
 - The barrier system specification is based upon general municipal solid waste leachate
 - Current practice of removing organics and green waste from the waste stream
 - Nature of leachate currently produced
3. The mechanics of the leachate management system
 - Base grade of landfill (i.e. sloping topography)
 - Drainage layer
 - Leachate collection pipes
 - Leachate sump
 - Leachate pond
4. Management of stormwater on Site
 - Diversion system
 - Stormwater dam
 - Dry basin
5. Flood Levels of the creek discharging to the Gara River
6. Mitigation and management In the event of failure
 - Overflow of dams
 - Failure of leachate barrier system

2.2.1 Proposed Leachate Barrier System

Proposed Design – Compliance / Exceedance of Benchmark Standards

The leachate barrier system (liner) proposed for the Armidale Regional Landfill is a composite barrier system comprising of 900mm thick re-compacted clay with a permeability of 1×10^{-9} m/sec, overlaid by a flexible membrane liner (FML) of High Density Poly Ethylene (HDPE) construction, of a minimum 1.5mm thickness and with a permeability of 1×10^{-14} m/sec. A 300mm layer of gravel sandwiched geotextile will then be placed over the

HDPE layer, to facilitate the movement of leachate across the liner and prevent ponding of leachate against the liner.

The design proposed for the Armidale Regional Landfill has adopted a precautionary approach and has been designed to meet the worst case of “poor hydrological conditions”.

The *NSW Environmental Guidelines: Solid Waste Landfills 1996 (Guidelines, 1996)* contains the benchmark technique for leachate barrier design (Benchmark Technique No.1) which has a primary environmental goal of “preventing pollution of water by leachate”. It does this by first advising that if the natural underlying geology of the site is suitable, a liner may not even be required. In the event that a liner is required it specifies:

- *“A re-compacted clay or modified soil liner at least 90 centimetres thick with an in situ co-efficient of permeability of less than 10^{-9} ms^{-1} . Successive layers should be of compatible material and each underlying layer should be scoured to prevent excessive permeability due to laminations. The sides should generally have a slope not exceeding a gradient of one vertical to three horizontal in order to allow suitable compaction of the barrier and to facilitate subsequent testing.*
- *If the landfill is located in an area of poor hydrological conditions or otherwise poses a significant potential threat to groundwaters or surface waters, the clay or modified soil liner should be overlaid with a flexible membrane liner (FML) of minimum co-efficient of permeability of 10^{-14} ms^{-1} . The FML should have material properties that will ensure that it maintains this permeability for a period at least equivalent to the reactive life of the waste contained by the FML. The FML should have a minimum thickness of 1.5 millimetres, and be laid following procedures in an approved construction quality assurance program. All joins and repairs should be fully tested to ensure liner integrity is not breached at these locations, and the FML should be protected by an overlay of soil with low abrasive properties or synthetic non-woven geotextile of sufficient depth to protect the FML against load-induced damage.”*

The approved Construction Quality Assurance Program forms part of the EPA approvals process, and the Guidelines (1996) state that:

“All design, construction and operation activities must be carried out in accordance with a quality system acceptable to the EPA.”

World Standards

Drawing on information from across its network of offices with waste management specialists in the United States, Canada and the European Union, AECOM has undertaken a current investigation of internationally adopted techniques. This investigation, performed after the PAC meeting of 25 May, confirmed that for the disposal of municipal solid waste, (without organics removal or pre-treatment) typically accepted design includes a composite liner system which is comprised of a low permeability barrier layer (clay of a given thickness and established minimum permeability) overlain by a FML. This style of composite liner is stipulated by regulatory authorities worldwide and is considered to be internationally adopted practice.

In the European Union, the standards adopted for “Non-Hazardous” landfills i.e. those taking municipal, commercial and industrial waste, but excluding hazardous waste, is that specified in the EU Directive (Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste) namely is a geological barrier, typically compacted clay, of up to 1,000mm thickness with a permeability $< 1 \times 10^{-9}$. Where the geological barrier does not naturally meet the above conditions, it can be completed artificially and reinforced by other means giving equivalent protection. The EU directive states that an artificially established geological barrier should be no less than 500mm thick and the typical reinforcement is FML or geomembrane such as HPDE.

In the United Kingdom, the reinforcement is a HDPE secondary liner laid across a geological barrier. Putrescible landfills proposed and built since 2002 in the UK have been built to this minimum standard, but there are also site-specific issues to consider such as aquifer classification and proximity to potable water supplies. The standard of the landfill liner design and construction is usually determined by undertaking a site specific hydrogeological and stability risk assessment.

In France, non-hazardous waste landfills are regulated by the ministerial decree dated 9 September 1997 (arrête ministeriel du 9 September 1997), modified by the ministerial decree dated 18 July 2007 (arrête ministeriel du 18 July 1997) to include just two additional requirements from the directive 1999/31/EC dated 26 April 1999.

However, the French regulation enforces stricter requirements regarding the permeability of the underlying site geology beneath the cells than the EU directive specifies. This regulation requires, from the top to bottom:

- 1,000mm thickness of material with permeability $< 1 \times 10^{-9}$ m/s; or
- 5,000mm thickness with material with permeability $< 1 \times 10^{-6}$ m/s; and
- Cells batters must have 1,000mm thickness of material with permeability $< 1 \times 10^{-9}$ m/s.

When the natural ground (sub-base) does not comply with these requirements, the sub-grade can be completed and reinforced by artificial material that will present the same equivalent required permeability. This reinforced sub-base must have a thickness of at least 1 m at the bottom of the cell, and at least 500mm along the cell batters up to 2,000mm above the cell bottom. A study must demonstrate that the permeability of the proposed sub-base presents equivalent permeability as the requirements mentioned above. . Generally, the design proposed for Armidale would comply with this regulation, as whilst the clay is thinner at 900mm, it is overlaid by HDPE.

In the United States and Canada, for the disposal of municipal solid waste (MSW) landfill best management practice requires a composite liner system which is comprised of a low permeability barrier layer (clay of a given thickness of generally up to 900mm and established minimum permeability) overlain by a FML.

The Resource Conservation and Recovery Act (1976): subtitle D requires 600mm of 1×10^{-9} m/sec compacted clay soil topped by a minimum 0.75mm FML. Different states within America have implemented 300mm to 900mm of clay plus a 1.5mm FML. Depending upon the availability of adequate clay material, a portion of the clay layer may be substituted with a geosynthetic clay layer (GCL) provided that the overall thickness/permeability of the clay barrier exceeds the requirements of the regulatory agency. The thickness of the clay varies from 600mm to one meter depending upon regional regulations.

The use of HDPE has become the standard material used for a FML. The thickness and surface texture of the HDPE are dependent upon factors related to slope stability, depth of waste mass, angle of side slopes, anticipated foundation settlement, projected settlement of waste mass, and so on. The key to the successful licensing of the final disposal cell is the ability of the certifying engineer to provide adequate QA/QC documentation that the liner system was installed in accordance with the design and meets the intent of the agency regulations.

Construction of Barrier System

In reviewing the NSW EPA's benchmark techniques, and the international requirements, it can be seen that the proposed liner design is conservative in its approach. It exceeds the NSW typical requirements and meets or exceeds internationally adopted practices. It is acknowledged there are potential issues associated with landfills of this design through liner failure due to operational and construction QA/QC challenges. With careful construction in accordance with an approved construction quality plan and awareness of operational issues, the liner will provide the best barrier available to protect soil and groundwater outside of the landfill's footprint.

Rowe (2009) considered the different factors impacting the long-term performance of leachate collection systems and geomembrane HPDE Liners for waste landfills. The paper identified that HDPE liners can have a potentially short service life, or potentially long service life with a number of key factors playing an influential role: type of geomembrane, configuration of liner systems and temperature history of the liner. In considering factors, the proposed design:

- Specifies the gravel drainage layer and separation layer recommended
- Minimises the potential for a saturated drainage zone by actively recirculating the leachate through the landfill
- Specifies the use of a minimum 1.5mm HDPE as the FML/geomembrane. The actual HDPE (thickness, texture and properties) are to be determined during the detailed design

Criticism of this style of landfill design have generally focused on a "dry tomb" style landfill, where the landfill waste is kept dry and isolated from water, with the intent of minimising the generation of leachate. This approach requires the minimisation of surface water and rainfall entering the landfill cell during operation, and the minimisation of infiltration when the landfill has been closed. There is a developing viewpoint that dry tomb landfills are not an ideal approach to landfill operation and management, because the majority of contaminants and leachate are effectively held in stasis. Lee states that "... keeping the waste dry would lead to a situation where no waste decomposition would occur, and therefore the wastes would be a threat to generate leachate, effectively forever ..." (Lee & Associates, 2011).

The Armidale Landfill would not be operated as a dry tomb landfill. While it will have the required infrastructure, and will be operated to minimise infiltration of surface water and rainfall in order to minimise the generation of

leachate, leachate will be recirculated on an as needs basis throughout the waste mass. It should also be noted that the Armidale landfill will not be operated as a bioreactor. However leachate will be re-injected into the waste to assist with management of leachate across the site.

Leachate Pumping Systems (2004) stated that "Recirculation in Subtitle D landfills has become an increasingly accepted way of dealing with leachate". The company conducted a case study with the primary objective of contrasting the cost of trucking leachate offsite for treatment, and establishing an onsite recirculation system. In addition the company identified that "wetting of the biological material has a composting effect", and "leachate dispersal into the landfill biomass accelerates stabilisation of trash (sic) and will result in additional airspace recovery over time as the biological material decomposes". It was noted that "Recirculation also improves leachate quality ... and post-closure time to stabilisation is also decreased significantly".

Calabro *et al* (2010) found "...the first 30 months of monitoring of concentrated leachate recirculation show that leachate production did not increase significantly and that only a few quality parameters (i.e. COD, Nickel and Zinc) presented a moderate increase".

Potential impacts to underlying groundwaters may arise from leachate infiltration through a landfill's liner material, primarily where the liner has not been installed appropriately, or has since become compromised in some manner. Council proposes to install the barrier system in accordance with the benchmark technique and with a carefully monitored QA/QC procedure comprising:

- For the clay liner, moisture control, compaction and permeability testing of multiple thinner layers of clay, keying each of these thinner layers together; and
- For the HDPE liner, temperature monitored laying, welding, inspection, patching, pressure testing of welds.

This QA procedure has previously been used and approved by the EPA (and its proceeding authorities, for example DECCW) in both landfill design and remediation of old landfills, and is the current internationally adopted practice.

2.2.2 The Nature of the Leachate

Both local and worldwide practice and current landfill design techniques are based upon leachate derived from municipal solid waste landfills, which are generally acknowledged to accept unsorted household wastes, putrescible untreated wastes and often small amounts of potentially hazardous wastes. The liner materials used in contemporary landfills have been specified to withstand chemical degradation by the potentially hazardous substances found in the concentrations and quantities typical of municipal solid waste. There have been studies performed over the past decade that show potential degradation of lining materials, where large volumes and concentrations of hazardous materials such as BTEX (Benzene, Toluene, Xylene and Ethylbenzenes) and other volatile hydrocarbons have been disposed of into landfills, usually in industrial quantities. These compounds are found in everyday products such as glues, cleaning products, floor polish, paint, degreasers etc., but in very small quantities relative to the general residual waste stream.

Armidale Dumaresq Council is acknowledged to be following best if not leading practices in the collection and management of a rural city waste stream. Practices currently employed by Council include:

- Operation of an all year round chemical waste collection for containers holding hazardous household chemicals (rather than once or twice per year employed by other Councils). ADC is the only Council in the NIRW group (that includes Tamworth, Gunnedah, Narrabri, Moree and Inverell Councils) that operates a chemical waste collection service all year round. Chemicals collected by this Council for the year 2009/10 amounted to 50% of the NIRW Group collection contract
- Operation of an on-site 'tip shop' which removes reusable/resalable items from the general waste stream
- Operation of an e-waste separation facility, which facilitates manual separation of hazardous components of televisions, computer monitors and other electronic goods
- Operation of a penalty charge for unsorted waste for over 10 years. Council have found this to be a very effective tool in the encouragement of sorting at source and also provides Council with the necessary funds to operate a clean materials recycling facility to sort clean mixed waste on the disposers behalf
- Operation of a fortnightly service since 1 February 2012 for the collection of domestic organic waste (food and garden waste) via a 240L mobile garbage bin (mgb) (an additional 240L mgb available at a nominal charge for residents requiring a larger service). The continuation of the weekly garbage service reduces the likelihood of contamination of the other recycling collection services

- Investigations and negotiations are currently taking place so that a food waste collection service can be provided to commercial and industrial premises by Council's contractor Cleanaway

These combined practices greatly reduce the quantity of waste (and hence leachate) produced as well as remove potentially hazardous and non-hazardous contaminant and concentrations. This also re-enforces Council's stated objective to operate the landfill as a non-putrescible Solid Waste Landfill. Pre-treatment of the organic component also contributes to the benign nature of the leachate.

Current and historical leachate monitoring results for Council's existing Long Swamp Road Landfill show that the leachate generated from the Long Swamp road landfill is relatively benign and contains very low concentration or no hazardous substances that pose a threat to degradation of the liner materials. This reflects the nature of waste received with little or no industrial waste owing to the lack of a heavy manufacturing/ industrial sector in Armidale, with primarily light industry, agriculture, retail, hospitality and maintenance operations being performed.

Concentrated leachate from the base of the unlined section of the Long Swamp Road landfill (i.e. prior to being collected in the leachate dam) was sampled four times in 2000 (CodyHart Environmental Consultants). Slight traces of BTEX compounds were detected, however BTEX did not exceed the Australian 95th percentile protection limit for Australian freshwater aquatic ecosystems (ANZECC & ARMCANZ, 2000). Four heavy metals were detected at greater than the guideline 95th percentile protection limit. The predominant leachate constituents were total nitrogen and total phosphorus, which are compounds derived from plant and vegetable matter. This concentrated leachate moves slowly to a leachate dam, where it is diluted by rainwater. Samples taken from the leachate dam showed no BTEX compounds were detected as they had been volatilised and biologically removed. Heavy metals were below the 95th percentile protection guidelines for freshwater aquatic ecosystems, and total nitrogen and total phosphorus levels were also reduced.

Leachate monitoring is currently being performed in leachate dams and in leachate discharge pipes leading to the dams. The May 2012 Environmental monitoring event for the Long Swamp road landfill (Appendix A), shows that the leachate at this facility in all monitoring locations, contains extremely low concentrations of Iron, Magnesium and Zinc, which pose no chemical threat to either HDPE or clay. Likewise, the leachate at all locations exhibits levels of Nitrates, typical of putrescible waste leachate, which are also of little to no chemical threat to the barrier system. Historical leachate testing from 2000 at monitoring location LL1 (leachate discharging in a drain from the centre of the southern side of the old landfill towards the LS3 dam) shows Volatile Organic Compounds detected in consistently very low levels, sufficient to allow the DECCW to approve a reduction in monitoring parameters to just BTEX.

Monitoring for BTEX from 2001 onwards shows that none of these compounds have been detected in the leachate generated. BTEX have also been tested for but have not been detected at leachate monitoring point LL2 (the leachate dam for the more recent extension to the landfill). It is noted that these leachate monitoring results were taken from what is now considered an old landfill which over its lifespan accepted wastes before Council started adopting its current waste segregation and diversion practices.

As the new proposed landfill will be operating from commissioning under the Council's current (and constantly updated and improved waste diversion and treatment regime, it is envisaged that the leachate quality will be of lower contaminant concentrations than that of the existing landfill. The leachate dam for the more recent landfill extension (LL2) would contain leachate more typical of current waste collection, segregation and landfilling practices. The benign nature of this leachate both diminishes any potential for leachate to degrade the liner materials and in the event of any leakage to the environment, poses little risk of harm.

2.2.3 Mechanics of the Leachate Management System

Whilst the NSW Environmental Guidelines: Solid Waste Landfills specifies the benchmark techniques for design of the leachate collection and conveyance systems (LCCS), the mechanism to achieve this is not explained in great detail. Benchmark Technique No. 2 has the primary environmental goal of "preventing pollution of water by leachate". It does this by specifying the basic techniques for collection and containment of leachate.

Leakage from landfill liners in general, occurs where there is build-up of leachate against the wall or base liner and the leachate exerts head or pressure on the liner, trying to force a path through it. If a minor puncture has occurred, the leachate may flow through the puncture under pressure.

The benchmark technique discusses the use of a 300mm drainage layer of gravel of a certain specification to allow free drainage of leachate from beneath the mass of waste to stop perched pockets of leachate forming adjacent to the leachate barrier system. If perched pockets of leachate form, this could potentially lead to an increased pressure head of leachate (i.e. pressure of leachate) against the liner, trying to force its way through.

As the cells in the proposed landfill are proposed to be built on a slope rather than flat ground, with a typical 1% minimum base slope (specified by the Guidelines) leachate would drain by gravity above the leachate barrier system with no surface ponding. As an additional measure, the gravel contains a herringbone pattern of slotted leachate collection and conveyance pipes, which affords better flow of leachate down the hillside and towards the leachate collection sumps. The slotted pipes are specified so as to not collapse under the weight of a full height of waste in the landfill and the gravel layer also acts as a barrier between the waste and the HDPE liner to prevent waste 'punching' through the liner. A 300mm layer of gravel, overlying a geotextile layer, on top of the HDPE inner liner, provides robust puncture protection. Typical details on the flow of leachate and a schematic of the LCCS are shown in Appendix B.

The leachate sump has been designed to collect this leachate as it flows away from the waste through the LCCS. The leachate surface level within this sump is monitored and the leachate is pumped out into the leachate pond when the leachate reaches 300mm above the liner level in the lowest part of the cell. This system is designed therefore to prevent pressure of leachate against the liner and effectively drain the landfill, such that there should be no available leachate to penetrate the liner (under pressure) throughout the landfill cells.

Leachate Pond

The leachate pond presented in the EA has been designed to fully contain the predicted leachate generated from the landfill during its operational life with no spill occurring. A daily water balance model was generated using recorded climatic data including evaporation and rainfall records for Armidale township. The model incorporated varied rainfall conditions due to potential climatic change effects. Based on results of the modelling, a predicted pond storage capacity of 12ML is required to manage the potential excess leachate that would be generated during operation of the landfill with no spill occurring.

Benchmark Technique No. 2 requires *"If the leachate dam or tanks are open at the top, they should generally be capable of accepting a 1 in 25 year, one day-duration storm event without overflowing"*. The leachate for this site is proposed to be stored in an open dam, with a fairly large surface area to promote evaporation during dry periods. Rather than being capable of withstanding a 1 in 25 year Average Recurrence Interval (ARI) 1 day (24 hour) duration rainfall event without overflowing (as per the Solid Waste Landfill Guidelines), taking a conservative approach, Council proposes that the dam be designed to contain a 1 in 100 ARI, 1 day duration rainfall event (equivalent to 150mm total rainfall over a 1 day period). The design allows for the leachate pond to accept a 1 in 100 year, 1 day duration storm event on top of the full operational level of the pond without spilling. This design, which is more conservative than the benchmark technique, is proposed in recognition of the Site being located close to the Gara River and within the catchment of the Oxley Wild Rivers National Park and World Heritage Area. This approach has been accepted by the EPA and reflected in the draft conditions of consent for the landfill (DP&I, 2012). Following the PAC meeting in Armidale in May 2012, Council commissioned AECOM to undertake further conceptual design for the dam to accommodate an even more conservative approach of a design rainfall event for a longer duration of 3 to 5 days. The 1 in 100 year ARI, 3 day total rainfall depth is equivalent to 225mm over the 3 day period.

A review of the current BOM rainfall records for Armidale (1858 to present) was undertaken to assess actual daily recorded rainfall for the area. The highest recorded 3 day and 5 day event rainfall totals were 270mm and 274mm respectively which occurred in between the 25th to 29th August 1949. The next highest 3 day total rainfall event of 172mm was recorded in January 1964. For comparison purposes, the recent Armidale floods in November 2011 recorded 170mm between 24th to 27th November. Based on this assessment the 100 year ARI, 3 day rainfall event (equivalent to 225mm total rainfall) is a design flood event that has been exceeded only once in the 155 years of the Armidale rainfall record. Therefore the 100 year ARI, 3 day rainfall event is deemed appropriate as the design flood storage event for the leachate pond. This would cater for the pond at the maximum storage level of leachate (12ML capacity) plus an additional flood storage to contain this design rainfall event without spill occurring.

This design criteria is considered very conservative and addresses public concerns regarding the capacity of the pond and the potential for it to overflow in extreme rainfall events. Council is committed to ensuring that environmental risks are minimised, and has reconsidered the leachate pond design.

The leachate pond capacity (as presented in the EA) with a freeboard of 300mm to contain the 1 in 100 ARI, 1 day duration rainfall event gave a total storage capacity of 13.9ML. The pond will now have an increased freeboard of 400mm to contain the 100 year ARI, 3 day rainfall event producing a total storage capacity of 14.6ML.

In the unlikely event of overflow from the leachate pond, all overflows would be fully contained in the downstream sedimentation basin, and then ultimately in the dry basin (itself an additional control over and above the requirements of the Solid Waste Landfill Guidelines (1996)), and therefore minimise potential risk of leachate release to the downstream environment. For consistency, the design of the dry basin has also now been updated and has been designed to fully contain the 1 in 100 year ARI, 3 day duration storm event from the upslope disturbed landfill area.

2.2.4 Management of Stormwater on Site

The stormwater management system on Site is comprised of the following main components:

- Diversion system
- Sedimentation basin
- Dry basin

Diversion System

The proposed landfill Site is located within the upper reaches of an existing valley with a total catchment area of approximately 275 hectares. Surface runoff from this catchment flows to the north (down-gradient) towards an existing ephemeral creek. It is noted that surface runoff from this catchment only occurs during rainfall events but would need to be diverted around the proposed landfill site. As a result, the landfill has been specifically sited in the upper reaches of this catchment to minimise diversion works. In this case, the landfill cells being on a hillside and as high in the runoff catchment as possible, assists with minimising the on flow of water which could potentially become contaminated by landfilling activities.

Diversion drains will be constructed around the perimeter of the Site to divert “clean” surface runoff water around the Site and will drain to the north and discharge into the downstream creek system. These diversion drains will be designed to convey the 1 in 100 year ARI peak flow event from the upslope catchments. The adopted 100 year ARI event is recommended in Australian Rainfall and Runoff (ARR) to divert or convey waterways associated with environmentally sensitive sites.

The diversion drains will incorporate erosion and sediment control works along the drain and at the outlet to the existing creek in accordance with Managing Urban Stormwater Soils and Construction – The Blue Book (Landcom, 2004).

Sedimentation Basin

A sedimentation basin is to be located downstream of the landfill to capture all water runoff (excluding any leachate and leachate contaminated water) from all disturbed areas of soil during operation, but not areas where water has run over or infiltrated waste. Collected water within the basin may contain potential contaminants such as sediment, oils, greases and litter from earthworks and maintenance activities. The stored stormwater will be treated to an approved level and subsequently released to the downstream waterway system in accordance with the proposed Water and Leachate Management Plan and the site Environmental Protection Licence.

The sedimentation basin, as presented in the EA, was designed with a capacity of 2,850m³ to contain dirty water runoff from the disturbed catchment from the 90th percentile 5-day rainfall event for the Armidale region in accordance with the Managing Urban Stormwater Soils and Construction (Blue Book) guidelines. In response to the PAC's request that Council further consider the adequacy of basin sizing in larger rainfall events, Council commissioned further assessment of the performance of the sedimentation basin to fully contain the 95th percentile 5-day rainfall. This adopted design criteria is recommended in the Blue Book guideline for environmental sensitive sites. The sedimentation basin (as presented in the EA) had a minimum capacity of 2,850m³, with the basin now having a total minimum capacity of 5,250m³ (based on the Blue Book requirements) which includes an additional one year sediment storage volume from the upslope disturbed areas.

In the unlikely event of a spill from the sedimentation basin, all overflows would be fully contained in the downstream dry basin therefore minimising potential risk of untreated stormwater release to the downstream environment.

Dry Basin

The dry basin is to be located in the north-eastern corner (at the most downstream area) of the Site. The objective of the dry basin is to collect and fully contain any potential overflows from the upslope sedimentation basin, including any (unlikely) emergency overflows from the upslope leachate pond. The inclusion of the dry basin

provides an extra and conservative protection measure to capture any overflows during high rainfall events and reduces the risk of any uncontrolled off-site releases during operation.

The dry basin, as presented in the EA, was designed with the capacity to contain all overflows up to the 1 in 100 year ARI, 1 day (24 hour) duration rainfall event from the sedimentation basin and leachate pond upslope catchments. This adopted design criteria, accepted by the EPA, was recommended to minimise potential risk of leachate or untreated stormwater release to the downstream environment. In response to the PAC's request that Council further consider the adequacy of the pond sizing in larger storm events, Council commissioned further assessment of the performance of the dry basin under more extreme storm events. As specified for the leachate pond, a design flood freeboard for a 1 in 100 year ARI 3 day duration rainfall event was also adopted for the dry basin. This conservative design criteria has been considered by Council to address public concerns regarding the capacity of the basin and the potential for it to overflow.

To contain the runoff from the upslope disturbed catchment from this design rainfall event, a minimum flood storage capacity of 30ML is required (compared to 19ML originally proposed for a 1 in 100 year 1 day event). The basin would be actively and effectively managed to ensure this storage volume is maintained during the landfill operation so that in the unlikely event there are overflows from the sedimentation basin or in the unlikely emergency scenario from the leachate pond, flows can be completely contained within the dry basin with no release of diluted leachate to the environment. The design of the dry basin also conservatively assumes that no pump-out is undertaken during the 3-day rainfall period.

2.2.5 Flood Levels of the Unnamed Creek Which Flows to the Gara River

The proposed landfill Site is located within the upper reaches of the catchment and is sited between the Gara River to the east and Commissioners Waters River to the west. Surface runoff from the Site flows to the north towards an ephemeral creek, which flows east and ultimately discharges into the Gara River, approximately 1km downstream of the Site.

The flood assessment undertaken for the project was carried out in accordance with the procedures outlined in ARR (2007) which is used as the guideline for the analysis and prediction of flood events in Australia for design purposes. ARR was used to predict the 1 in 100 year ARI storm event from the existing creek catchment at a point opposite the Site. The 1 in 100 year ARI peak flow of approximately 40m³/s was predicted for the creek adjacent to the north-eastern boundary of the Site.

The flood assessment results concluded that the predicted 1 in 100 year ARI creek flood level would extend to approximately 6 to 7m below the north-eastern boundary of the Site. As a result the landfill and the associated water management infrastructure (i.e. leachate pond, sedimentation basin and dry basin) are located well outside the extent of the predicted 1 in 100 year ARI creek floodplain. The creek flood waters also pose no risk of overflowing into the proposed leachate or stormwater storage systems.

It is noted that the Site access road would need to cross the creek floodplain and may therefore be affected by flooding during high rainfall events. Road creek crossings will incorporate suitably designed pipe culverts to allow flows up to the 1 in 100 year ARI to pass through and/or overtop the roadway in a safe manner. During flood events, waste transport to the Site could be postponed until such time that the flooding recedes and safe access to the Site is possible. Postponement of waste delivery is possible as waste could be held at the Long Swamp Road Waste Transfer Station where there is adequate capacity and safeguards to temporarily store the waste.

2.2.6 Mitigation and Management in the Event of Failure

Overflow of Dams

The leachate pond has been designed to accommodate the maximum storage level of leachate (12ML capacity) with a flood freeboard of 400mm to fully contain the 100 year ARI, 3 day rainfall without overflowing.

In the unlikely event of emergency overflow from the leachate pond, all overflows will be fully contained in the downstream sedimentation basin, and then ultimately in the dry basin. The inclusion of the dry basin, in lieu of DoPs draft approval consent of a bund of 110% capacity of the leachate dam, provides an extra protection measure to capture any overflows during high rainfall events and reduces the risk of uncontrolled off-site releases to the downstream environment during landfill operation. The dry basin has been sized to allow for containment of a breach of the leachate dam in a similar manner to the DOP draft approval bund would and therefore replace the bund, which is not a practical solution for a leachate dam. The dry basin has been designed to contain the 1 in 100 year ARI, 3 day duration storm event from the maximum upslope disturbed landfill area without spill occurring. The dry basin would be effectively managed to ensure this storage volume is maintained during the

landfill operation in the infrequent scenario event when an overflow is occurring from either the sedimentation basin or the leachate pond.

The system of capturing runoff from all disturbed areas of the landfill and the proposed contingency measures are considered very conservative and have been modelled to address public concerns regarding the capacity of the pond and the potential for it to overflow.

In the event of the leachate pond overtopping during a 1 in 100 year ARI, 3 day duration storm event, diluted leachate would discharge into the dry basin. If the dry basin is also at maximum capacity storing stormwater drained from the catchment surrounding the landfill, in extreme rainfall events, further stormwater containing diluted leachate may ultimately be discharged from the dry basin. Discharged stormwater may travel to the unnamed creek and ultimately into the Gara River system. As discussed previously the current levels of total nitrogen recorded in the leachate at the Long swamp Rd landfill range between 41.8 mg/L and 162.0 mg/L. Should the leachate pond overflow, leachate would enter stormwater contained within the dry basin. Should the dry basin overflow the concentrations of total nitrogen in any overflow, after dilution with stormwater from the dry basin, would not exceed the 95 percent species protection level as specified in Table 3.4.1 of the ANZECC Guidelines (2000) for freshwater aquatic species.

Failure of Leachate Barrier System

Groundwater Monitoring

The number of groundwater monitoring bores chosen to assess a potential source of groundwater impact is selected using a number of factors, the predominant one being the level of 'risk' to the potentially receiving environment. In this instance a number of factors combine to reduce the risk to low levels. The landfill has been designed using a multiple barrier system approach including water management, leachate management/collection and treatment and also clay and HDPE liners. Should, upon failure of all of these controls, leachate migrate into the receiving environment, then the geology on which the Site sits is complex and not conducive to rapid or sustained contaminant migration. There is a potentially considerable depth of unsaturated zone beneath the landfill and the presence of the landfill, acting as an impermeable cap over the ground, effectively reduces rainfall infiltration and reduces the 'flushing' effect that might wash leachate downwards to the water table. Once leachate reaches the water table, the very low measured permeability of the rock means that contaminant migration would be extremely slow. Reduced existing groundwater quality is not unusual in areas where groundwater has a very high residence time and in agricultural areas where animal excreta can lead to ammoniacal and bacteriological contamination and agro-chemicals lead to nutrient and pesticide type contamination.

Therefore, the groundwater in this area could be considered to have a low sensitivity and limited capacity for contaminant migration. As a result Council considers that a low number of groundwater monitoring wells would be warranted in this instance. Once monitoring wells are installed baseline conditions will be established for existing groundwater quality prior to construction of the landfill and to enable effective monitoring following commissioning.

Remediation Options if in the Unlikely Event if Contamination is Detected During Monitoring

Ammonia contamination of groundwater is difficult to remediate and very difficult to remediate at great depth *in-situ*. In the first instance should significant impacts be detected in groundwater then the following actions may apply:

- 1) Install further monitoring wells in the area where the impact was detected, to establish the extent of the issue, and down gradient of the impact to determine whether the contamination is migrating.
- 2) Once the impacts are known and if found to be significant in concentration and migration potential then there are a number of potential options groundwater and discharge to the landfills leachate treatment system. It is likely that groundwater volumes would be low and that this would not over-burden the system. Other in-situ technologies such as enhanced bioremediation could be trialled whilst the groundwater 'pump and treat' system was underway.

Statutory Obligations and Reporting Requirements with Respect to Contaminated Land

Should contamination of the groundwater occur there are a number of requirements to report contamination of the environment to the local authority and or the EPA.

Section 60 of the Contaminated Land Management Act 1997 (CLM) requires a 'person whose activities have contaminated land or a landowner whose land has been contaminated is required to notify the EPA when they become aware of the contamination. The requirements for reporting groundwater contamination comprise:

"For the purposes of s. 60 (3) of the CLM Act, notification of actual or foreseeable contamination of groundwater is required if:

- *the contaminant has entered, or will foreseeably enter, groundwater*

AND

- *the concentration of the contaminant in the groundwater is, or will foreseeably be, above the concentration specified for that contaminant in Column 1 of Appendix A*

AND

- *the concentration of the contaminant in the groundwater is will foreseeably continue to remain above the specified concentration (EPA, 2009).*

Should the above conditions be met, the Site would require reporting to the EPA and the EPA becomes responsible for regulating the site under the CLM Act, if necessary.

The Protection of the Environment Operations Act 1997 also compels a polluter to report 'pollution incidents' although this legislation is more tailored toward releases/spillages.

2.3 Regional Landfill Facility

This section of the response addresses the role of the proposed landfill being considered in a regional context.

The Armidale Dumaresq Council area generates by far the largest waste quantity within the immediately surrounding areas including Guyra, Walcha and Uralla Councils. Whilst these Councils have not either confirmed or denied their participation in disposal of waste at a regional facility, they have provided commitment letters during the consultation process, as provided in Appendix C.

Guyra Council has been depositing waste at the Armidale landfill since late 2002, without a formal contract but with an agreement to take Guyra Council's waste as required. Recently however Guyra Council have chosen to dispose of waste at a small rural landfill at Tingha. Council believes this to be a short term cost saving exercise and that in the long term, waste from Guyra Council will again be disposed of at the Armidale facility. This waste stream has typically been mixed municipal solid waste, not suitable for sorting and is disposed of directly to landfill.

Annual tonnages from 2005 received from Guyra Council, and more recently from Guyra Tomato Farm, are shown in Table 1.

Table 1 Municipal solid waste volumes from Guyra Council and Guyra Tomato Farm

Period	Guyra Council (tonne/annum)	Guyra Tomato Farm (tonne/annum)
2005/06	457.9	-
2006/07	465.9	-
2007/08	489.3	-
2008/09	486.3	-
2009/10	480.5	-
2010/11	511.2	677.2
2011/2012	279.4^	359.9*

^ July 2011 to January 2012 inclusive

* July 2011 to May 2012 inclusive

Anticipated Council reforms over the next few years or decades, may lead to the amalgamation of regional and rural Councils. In this instance, the proposed landfill would be ideally suited, if capacity is available, as the Region's facility.

2.4 Strategic Waste Limit – Two Cell Approval

2.4.1 Environmental Approval

The Director General's Environmental Assessment Report recommended that approval be granted to construct and operate two of the proposed five cells. In making the recommendation, it was noted that it is *'not intended as an environmental limit, but a strategic waste limit that will ensure the Council continue to update its waste recovery planning in line with the NSW waste recovery targets'* (Director General's Environmental Assessment Report 2012, page 3).

However, a number of proposed conditions of consent require Council to design the landfill and ancillary infrastructure to accommodate outputs from five cells, but with approval to only operate two cells subject to Council satisfactorily addressing Clause 123(1)(a) of *SEPP (Infrastructure) 2007* which states:

"In determining a development application for development for the purpose of the construction, operation or maintenance of a landfill for the disposal of waste, including putrescible waste, the consent authority must take the following matters into consideration:

(a) whether there is a suitable level of recovery of waste, such as by using alternative waste treatment or the composting of food and garden waste, so that the amount of waste is minimised before it is placed in the landfill"

The design of the ancillary infrastructure to accommodate five cells but with approval for only two cells presents a significant cost impost to Council, particularly in the context of the elements of uncertainty that this imposes on Council, relating to applications for further modifications for landfill cells in the future and under future planning regimes.

2.4.2 Council's Resource Recovery Performance

The reasoning that the NSW Department of Planning has provided for the two cell proposed approval rather than 5 cells, lies mainly around the assumption that Council will have little initiative to improve its resource recovery performance, should a long term landfill solution be approved.

Council has demonstrated its commitment to resource recovery and the application of new technologies to direct waste away from landfill including:

- targets and timeframes for recovery of waste using alternative waste treatment (AWT)
- composting of food and garden waste to minimise waste to landfill.

Council do not agree with the Director General's Environmental Assessment Report comment that if a five cell development was permitted, that there will be no driver to update its waste recovery planning. The current landfill is operating to best Regional/Rural landfill practices, which was acknowledged in the Director General's Environmental Assessment report which stated that "Council's Recovery performance is better than the State Average". Council's waste diversion practices are already getting close to achieving the 2014 WARR targets. Council has further increased their waste diversion activities since the submission of the EA and the inspection of their existing activities by the DoP's independent waste advisor, including the commencement of the domestic organics (garden and food wastes) service. Examples of the practices Council are using are included within the section of this response dealing with minimisation of leachate quantity and contaminant concentration (Section 2.2.2). This demonstrates Council's full commitment to maximising waste diversion and to meeting their intent of essentially operating the new landfill as a non-putrescible landfill.

The new regional landfill would be operated to the same, if not better, standards to achieve the best outcome for the community and the environment.

2.4.3 Economic Analysis of Approval Scenarios

The design and associated costing presented in the EA and submissions report (base case) proposes that the first two landfill cells, water and leachate management infrastructure (i.e. barrier system, diversion drains, leachate and sedimentation ponds and dry basin) and ancillary works (access road, fencing, amenities etc.) are constructed at the commencement of the project. The water and leachate management infrastructure supporting

the two cells would be built to final design size (i.e. sufficient capacity to accommodate containment and storage requirements for five landfill cells) in Year 1. The proposed staged approval of the landfill cells would mean that water and leachate management infrastructure to support two cells only would be constructed in Year 1, with further construction required in future years to augment/upgrade the infrastructure to support additional landfill cells as they are approved (two cell scenario).

An economic analysis was undertaken to compare the present values of the costs of the options over a 60 year period. In summary of the above, the options were:

- Option 1: base case scenario where all infrastructure required for a five cell landfill is constructed in 2013 and construction of five cells undertaken progressively over a 60 year period
- Option 2: two cell scenario where infrastructure for two cells only is constructed in 2013 along with construction of two cells over a 20 year period. Further construction (such as expanded ponds, pumps and drains), would be subject to a new development application, associated EA and design. If this approval was approved, then construction of the expanded infrastructure is undertaken in 2033. An allowance for obtaining new approvals, based upon Council expenditure to date, appropriately indexed over time, has been included in the cost estimate in Table 2

The key inputs to the analysis were:

- Schedules of capital cost, shown in Table 2 below, which assumes cells are built every 10 years with the first cell being built in 2013 for both options
- The cost of future environmental approvals in the case of Option 2 is assumed to be \$2 million, and is included in the 2033 cost figures in Table 2
- Assumptions regarding inflation for capital works, operating costs and consumer prices, in order to express costs in real terms
- Assumptions with regard to the discount rate be used to discount all future costs to 2012

As shown in Table 2, the undiscounted costs show that Option 2 costs \$2.147 million more than Option 1. However, investment appraisal practice recognises that a cost of (say) \$1 million in (say) 30 years' time is less than the same cost now, because only \$184,250 would need to be invested now to be worth \$1 million in 25 years' time. Put another way, the present value of \$1 million that will be spent in 25 years' time is \$184,250. In the analysis that follows, all future costs are discounted to a base year. The present value of a cost that will occur in year 20 is given by the following formula:

$$\text{Present value of cost occurring in year 20} = \text{cost} / (1 + \text{discount})^{20}$$

This approach is standard in appraisal and has been applied consistently to all future streams of costs. The effect of discounting is to reduce the present value of the difference in cost between Option 1 and Option 2, because Option 2 incurs some of its costs further in the future, and which are therefore discounted more heavily than costs arising closer to the present time.

A further sensitivity test involved changing the assumption of a simple 15% contingency sum at all points in the project life. It is likely that costs in 20 years' time are subject to more uncertainty and therefore arguably this should be allowed for in the appraisal. One approach used in appraisal is to allow for optimism bias (OB) with respect to future costs with costs in the near term subject to a lower level of OB than costs at a later date. This approach has been adopted here as a sensitivity test by increasing the contingency factor over time. It is noted that this is a less sophisticated analysis than a quantitative risk assessment (QRA) type approach. However, a full QRA is arguably not required here because, as is shown below, there is no reasonable probability of cost outcomes which would alter the rankings of the options.

Table 2 Schedule of capital costs

	Option 1	Option 2
2013	\$9,571,746	\$8,684,153
2023	\$2,811,350	\$2,811,350
2033	\$2,811,350	\$5,845,618
2043	\$2,811,350	\$2,811,350
2053	\$2,811,350	\$2,811,350
Total (undiscounted)	\$20,817,146	\$22,963,821

The core assumptions for the analysis were as shown in Table 3.

Table 3 Assumptions for present value analysis

Factor	Assumption	Notes
Project life	60 years	This is longer than the normal 30 year project life: however, as the costs are known for the whole period this is preferable to the alternative of estimating a residual value at year 30
Discount rate	7% in real terms	This is a standard rate used in appraisals: a sensitivity test was undertaken using a 4% rate
Capital (capex) cost inflation	1 % over CPI inflation	Based on other current capital project cost analysis: a higher rate will favour immediate investment
Operating cost inflation	0.5% below CPI inflation	This was included for completeness but has no impact on the ranking of the options
CPI inflation	2.5 %	The actual rate is immaterial, as it is the relationship to capital cost inflation that affects option ranking

The outputs of the present value analysis and three sensitivity tests are shown in Table 4. This assumes a simple 15% contingency allowance in each year.

Table 4 Present value analysis – simple contingency analysis

Assumptions	Option 1	Option 2
Core assumptions	\$25,426,662	\$25,496,729
4% discount rate	\$35,124,335	\$36,010,864
Capex inflation 2.5% over CPI	\$26,751,062	\$27,171,709
4% discount rate and capex inflation 2.5% over CPI	\$37,796,692	\$39,331,234

This reveals that the present value of the costs of Option 1 is always slightly less expensive. Based on the assumptions used for the analysis the cost margin is very small, at most \$1.534 million, this being the difference between \$39.331 million and \$37.797 million in Table 4. As discussed above, the effect of discounting is to narrow the cost gap between Option 1 and Option 2 because Option 2 incurs some of its costs further into the future.

Table 5 shows the outcome of the additional sensitivity test, where allowance is made for additional OB in future costs, that is allowing for the likelihood that future costs will be under-estimated to a greater degree than costs in the immediate future. The sensitivity test uses an OB factor of 15% in 2013, with this factor increasing by 5% every 10 years.

Table 5 Present value analysis - increasing contingency optimum bias analysis

Assumptions	Option 1	Option 2
Core assumptions	\$25,696,096	\$25,852,048
4% discount rate (sensitivity text)	\$35,695,785	\$36,738,367
Capex inflation 2.5% over CPI	\$27,140,679	\$27,677,508
4% discount rate and capex inflation 2.5% over CPI	\$38,662,275	\$40,407,924

The analysis summarised in both Table 4 and Table 5 show that Option 1 is superior to Option 2 on cost grounds for all of the assumptions made and for all of the sensitivity tests shown.

The above analysis shows that the rankings are most sensitive to the discount rate. Accordingly further analysis was undertaken to identify whether the rankings change at higher discount rates. This identified that Option 2 is marginally superior if the appraisal discount rate is increased to 8% and all other core assumptions hold. However, a higher rate of inflation of capital expenditure (capex) offsets the effect of a higher discount rate. Table 6 shows the values of capex inflation at which the present values of the cost streams are equal when using alternative discount rates. These are referred to as switch points: for any given discount rate, a lower capex inflation rate would make Option 2 the lower cost option, while a higher capex inflation rate would make Option 1 the lower cost option. It should be noted that the capex inflation rates shown here are the actual rates, not the differential between capex and CPI inflation rates. For the analysis the CPI rate is maintained at 2.5% per annum. It should also be noted that here the contingency allowance is retained at 15% at all times. An increasing contingency rate would reduce the switch value of capex inflation. For example, in the case of an 8% discount rate, the switch rate for the capex inflation rate would reduce from 4.10% to 3.69%.

Table 6 Switch points for discount rate and capex inflation

Discount rate	Annual rate of inflation of capex, below which Option 2 is the lower cost option
8%	4.10%
9%	5.07%
10%	6.03%
11%	6.99%

Work for government on other major projects has indicated that capex inflation at a rate of 1% over the CPI inflation rate is reasonable, and consistent with discount rates in the range between 4% and 7%. Higher rates of capex inflation are possible, but in reality these are likely to move in line with CPI, taking a long term view of rate movements. Higher rates of CPI would tend to be associated with higher discount rates, but a combination of a high discount rate above 7.37% and a differential between capex and CPI inflation of 1% would make Option 2 the lower cost option.

It emerges therefore that the core assumptions describe a situation that is relatively close to a point at which one option would be preferred over the other. However, the future outcomes on capital costs are uncertain as is the possibility that permission for an additional three cells might not be forthcoming in 2033. The choice of options should therefore depend not only on the estimates of the present values of costs but on the degree of uncertainty associated with each option. When looked at in this way, Option 1 can be seen to represent the superior alternative as:

- Option 1 avoids cost escalation risks on the additional works required in 2033, which were analysed using an adjusted contingency (OB) factor
- Option 1 avoids the uncertainty surrounding future permissions for the remaining 3 cells, which is a potential risk under option 2.

Therefore, under reasonable assumptions Option 1 has lower costs but importantly offers a lower risk profile. Further, even if Option 1 were more expensive than Option 2 in the core appraisal, the fact that Option 1 buys the option of developing the additional three cells in the future would increase its true value. This real option value has not been calculated here because Option 1 is less expensive on the basis of reasonable assumptions.

2.4.4 Alternative Long Term Solution

It has been noted in the Public PAC submissions that Council has an alternative available, which is to long-haul waste to Tamworth for disposal at its existing landfill facility. It must be emphasised, that this is not a long term waste management alternative for Council, Council only has this agreement in place as a contingency for there being no other viable options established by the time that the Long Swamp facility is full. This agreement with Tamworth Council specifies a maximum of 2 years' disposal (30,000 tonnes). As such it does not replace Councils' proposed strategy of a long term five cell landfill.

2.5 Site Selection

2.5.1 Introduction

Various submissions to the PAC addressed the site selection process for the proposed Armidale Regional Landfill, as land on which the proposed landfill will be sited is currently owned by a former Councillor and one of the real estate agents commissioned by Council during the site selection process. Council has maintained records of the site selection process including reports, correspondence with real estate agents, newspaper advertisements and minutes and resolutions of Council Meetings, which demonstrate that the site selection process was comprehensive, rigorous and involved consideration by multiple consultants, state government departments, Council's advisory committees and by the elected Councillors. Council also has maintained records and minutes of meetings whereby the former Councillor had removed himself from proceedings, if and when the future landfill facility was discussed.

This section presents a summary of the key steps in the site selection process as well as the extensive consultation and investigation that was undertaken to identify the proposed Site on Waterfall Way.

2.5.2 Preliminary Investigations

The site selection process commenced in the mid-1990s and during initial investigations over 50 alternative sites were considered for the proposed landfill facility, including sites within and surrounding the Armidale-Dumaresq Local Government Area.

In 1996, a Preliminary Regional Landfill Siting Study prepared by Brian J Mackney & Associates Pty Ltd Further considered the proposed sites and eliminated a number from consideration. The report also identified key selection criteria to be applied to enable focus to be placed on areas of maximum potential.

Between 1996 and 1998, real estate agents were invited to identify appropriate sites that were available for purchase (refer to Appendix D). Advertisements were also placed in local and national newspapers calling for the public to identify suitable land for the regional landfill (refer to Appendix E). At least three real estate agents proposed several sites, which were considered as part of the site selection process, however other site options were also assessed in addition to those identified by the real estate agents. Seven sites were identified as being consistent with the recommended geological criteria and hence were noted as potentially suitable landfill sites.

In 2002, a Landfill Siting Study by the NSW Department of Public Works identified two additional sites. Based on the study, a property called "Ballantrae" (site 9) was recommended as the preferred site.

It is noted that the site selection work undertaken by Brian Mackney and Associates was "peer reviewed" by the NSW Department of Public Works (which subsequently changed its' name to NSW Department of Commerce during the review period).

2.5.3 Advisory Committees

In 1998, a Joint Councils Regional Landfill Advisory Committee was formed between (the former) Armidale City and Dumaresq Shire Councils, with support from Uralla Shire Council. The Committee considered and eventually decided against a number of landfill site options, based on the preliminary assessment studies conducted up to 1998.

The amalgamation of Armidale City and Dumaresq Shire Councils in 2001 resulted in the formation of Armidale Dumaresq Council and the disbanding of the Joint Councils Regional Landfill Advisory Committee.

In 2003, following objections and debate on the selection of Ballantrae as the preferred site, Council endorsed the formation of the Armidale Dumaresq Landfill Community Consultative Committee (ADLCCC). The Committee was formed to consider the issues relevant to the siting of a landfill as well as other waste issues. The Committee contributed to the development of selection criteria and weightings for the site evaluation process that were then used within a subsequent report titled *Regional Landfill Siting Study* prepared by Maunsell Australia in 2004 (refer to Section 2.7.5 of the report).

Membership of the ADLCCC comprised:

- 3 Council representatives
- 6 representatives (2 per site) from the 3 short listed landfill sites under investigation: sites 7, 8 and 9
- 1 independent chair
- 5 members of the public

Two site owners were nominated as representatives for short listed landfill sites: Mr Derry Crisp was appointed as a representative for site 7 (the current proposed site), however the other site owner (site 9) nominated for membership was not appointed to the committee due to inadequate awareness of waste management issues. Representatives for sites 8 and 9 were close neighbours of those sites.

Several members of the Gara Valley Environment Preservation Association (GVEPA) were members of the ADLCCC including:

- Mr David Laird representing site 7
- Mr Les Davis and Mr John Holthouse representing site 9
- Mr Dan Calvert (Mining Vale Road) which is the access road to site 9
- Ms J Grainger

All these persons were involved in the ADLCCC's activities including adopting of selection criteria, weightings and the final selection of the preferred site.

The potential conflict of interest or pecuniary interest associated with the appointment of Mr Crisp to the ADLCCC was raised by Mr Les Davis, President of the GVEPA, in a letter to Council's General Manager dated 28 April 2003. To quote from the General Manager's reply dated 30 April 2003: *"The issue of Mr Crisp's appointment and the question of conflict or pecuniary interest also concerned myself. However, upon enquiry with both ICAC and the Department of Local Government for advice, it would appear that he has the right to sit on a Community Advisory Committee, as it is only formulating recommendations for Council's decision. It was advised that Mr Crisp should declare his interest at the start of the meetings and he will be encouraged to do this."* Mr Crisp's interest as an owner of part of the land involved in site 7 was declared and understood from the start of the process, similar to all others on the committee that had interest as owners or close neighbours of a site under consideration. Note that Mr Les Davis President of the GVEPA and a member of ADLCCC representing site 9, was a recent past owner of the proposed site 9 land and owned land in its immediate vicinity.

2.5.4 Selection of a Preferred Site

Site evaluation included consideration of environmental impacts, proximity to sensitive receivers and the likely magnitude of impacts at each site. The principles outlined in the document *Landfilling – EIS Guidelines* (DUAP, 1996) were used to develop appropriate criteria and weightings for the assessment of the potential landfill sites identified from the preliminary investigations.

The NSW EPA Environmental Guidelines: Solid Waste Landfills (1996) adopts criteria outlined in the *Landfilling – EIS Guidelines*, for locating landfill facilities within appropriate areas. Areas of high environmental value to be avoided include:

- Areas reserved or dedicated in the National Parks and Wildlife Act 1974 (NP&W Act), such as:
 - National Parks
 - Nature reserves
 - Historic sites
 - Areas covered by a Conservation Agreement

- Other areas protected under this Act
- World Heritage Areas
- Wilderness Areas identified or declared under the Wilderness Act 1987
- Items included on the Register of National Estate
- Marine Reserves, Aquatic Reserves, Marine National Parks or Nature Reserves
- Sites within 250 m of any of the above areas

This guideline, which specifically notes World Heritage Areas and National Parks was referred to during the site selection process and the proposed site was not ruled out as it was located outside of these areas.

As part of the *Regional Landfill Siting Study* undertaken by (Maunsell (now AECOM) in 2004, Maunsell drafted a weighting system based on professional judgement, technical knowledge and extensive landfill experience. Maunsell presented the draft weightings to the ADLCCC to get local stakeholder input to the weighting process. The weightings were adjusted based on comments from the ADLCCC and the final weightings were agreed with Council and ADLCCC. The final weightings allowed for a more robust evaluation of the sites.

Based on the review of the process up to 2004, application of the selection criteria and weightings and a comparison to other sites evaluated, site 7 (Sherraloy, the proposed site) replaced the first preferred site, Ballantrae (site 9), as the preferred site. Site 7 was recommended to be the most suitable site for a future landfill due to the following advantages:

- The site was not included in any areas deemed sensitive or unsuitable by Environmental Guidelines
- The site was located within a preferable geological area
- Underlying metasediments should provide an adequate barrier to groundwater movement through the site
- Site topography and local geology appears to lend itself well to long term control and monitoring of leachate
- Views are generally protected from surrounding land towards the west, south and east by existing vegetation, with partially inhibited views towards the north
- Use as a landfill should not impact on surrounding land use provided the landfill is managed correctly and an adequate buffer distances are maintained
- Relatively low bush fire hazard exists as the area is largely clear of vegetation
- Haulage costs were amongst the lowest of the sites evaluated due to shorter distances to areas serviced (taking into account average haulage levels) and good quality road access

In 2004, Council and ADLCCC adopted a recommendation of site 7 as the preferred site for the proposed landfill. The ADLCCC was then disbanded, as its primary purpose was to conduct and conclude the site selection process. Site 7 was the subject site for the EA prepared by AECOM.

2.6 Biodiversity and Amenity

2.6.1 Biodiversity

The proposal includes a biodiversity offset of approximately 61 hectares of land to account for approximately 20 hectares of vegetation being cleared for the proposal. The biodiversity area will be contained entirely within the Site extent to enable direct and intensive management of the offset and to minimise the disturbance and relocation distance for some older and hollow-bearing trees and associated habitats. The offset is to comprise 40 hectares of stringybark woodland and 21 hectares of grassland covered under the Biodiversity Offset Management Plan for the Site, prepared in accordance with the recommendations of the DECCW (now EPA) principles for biodiversity offsetting.

The proposed compensatory offset area would surround the proposed landfill footprint and connect to the Travelling Stock Route. The development of a vegetation buffer along this corridor would improve the condition of vegetation at the Site through increased connectivity to the Gara Remnant Subregional Corridor. Rehabilitation of the site would also provide connectivity between remnant woodlands within the development footprint.

The implementation of these stringent controls, the potential eradication of introduced species from the site and the inclusion of approximately 61 hectares of offset compensatory habitat would provide adequate mitigation to

ensure there would be no net loss of biodiversity. With the proposed mitigation measures and Biodiversity Offset Management Plan, it is concluded that the proposal would have no long term significant impacts on biodiversity.

To mitigate ongoing impacts to biodiversity during operation of the landfill, a LEMP will include the following management sub plans:

- Native Fauna Management Plan
- Fire Management Plan
- Pest Management Plan
- Disease Monitoring Protocol

2.6.2 Visual

Visual impacts associated with operation of the proposed landfill facility would result from construction of the landfill, landfilling activities and rehabilitation of the Site. The final landform will sit naturally between two ridges minimising visual impacts to surrounding receivers. In addition, the proposed landfill is not visible from any neighbouring residences, with limited visibility from traffic passing along Waterfall Way for a length of approximately 500m. Progressive landscaping and revegetation of each completed landfill cell would mitigate visual impacts during operation.

2.6.3 Noise

Modelling was completed as part of the EA to establish noise impacts during both construction and operation of the landfill facility. An assessment based on the 'worst-case scenario' concluded that with the implementation of proposed mitigation measures, noise levels generated by the proposed landfill facility would generally comply with environmental criteria. Traffic generated by the development would increase traffic noise levels by less than 2dB (A) and would comply with road traffic noise criteria. A Construction Noise Management Plan would be implemented during the construction phase and would include a noise monitoring program, reasonable and feasible noise mitigation measures and a complaint management strategy. Appropriate noise mitigation measures as outlined in the EA such as equipment noise attenuation would be applied during operation of the landfill.

2.6.4 Other Amenity Issues

Other amenity issues associated with landfill facilities such as litter, odour and vermin will be managed in accordance with mitigations measures outlined in the EA and the LEMP. Based on current landfill operations these impacts are limited. Control measures to be applied at the proposed landfill would provide a high level of management with minimal residual impact.

3.0 Conclusion

Concerns raised during the PAC meeting on 25 May 2012 with Council have been addressed as follows:

- **Potential for groundwater contamination by leachate** - the proposed leachate management system has been designed using a precautionary approach, has been designed to meet the worst case of "poor hydrological conditions" and exceeds the requirements for design of a leachate barrier stipulated in the *NSW Environmental Guidelines: Solid Waste Landfills 1996 Guidelines* (Benchmark Technique No.1). The composite liner proposed is considered best practice and is adopted by regulatory authorities worldwide. Council proposes to install the barrier system in accordance with this benchmark technique and with a carefully monitored QA/QC procedure.
- **Potential for surface water flows into Gara River** – surface water will be managed at the Site using a stormwater diversion system, a sedimentation basin and dry basin in addition to the leachate pond. In the unlikely event of emergency overflow from the leachate pond, all overflows will be fully contained in the downstream sedimentation basin, and then ultimately in the dry basin. The diversion system has been designed for the 1 in 100 year ARI peak flow event from the upslope catchments to divert 'clean' stormwater away from the Site. The sedimentation basin has been designed to fully contain the 5-day, 95th percentile rainfall depth for the Armidale area. Ultimately, the dry basin has been designed to contain the 1 in 100 year ARI 3 day duration rainfall event. The 100 year ARI, 3 day rainfall event is an extreme rainfall event and the potential risk of any off-site discharge would be extremely unlikely during the landfill operation. The proposed

water management system is designed to a higher level than that accepted by the EPA during the EA process when it was proposed to design and size the dry basin for a 1 in 100 ARI, 1 day duration rainfall event.

- **A Regional Landfill Facility** - The Armidale Dumaresq Council area generates by far the largest waste quantity within the immediately surrounding areas including Guyra, Walcha and Uralla Councils. Whilst these Councils have not either confirmed or denied their participation in disposal of their waste at a regional facility, they have provided the commitment letters during the consultation process. Guyra Council has been depositing waste at the Armidale landfill since late 2002. Anticipated Council reforms over the next few years or decades, may in fact amalgamate regional and rural Councils. It would therefore seem logical, that if such amalgamation were to happen, Armidale would serve as a Regional facility and that smaller and less cost effective facilities are closed down.
- **Strategic waste limit – two cell versus five cell approval** - the Director General's Environmental Assessment Report recommended that approval be granted to construct and operate two of the proposed five cells. It was noted that it is *'not intended as an environmental limit, but a strategic waste limit that will ensure the Council continue to update its waste recovery planning in line with the NSW waste recovery targets'*. Council do not agree with the Director General's Environmental Assessment Report's comment that if a five cell development was permitted, that there will be no driver to update its' waste recovery planning. The current landfill is operating to best Regional/Rural landfill practices, which was acknowledged in the Director General's Environmental Assessment report which stated that "Council's Recovery performance is better than the State Average". Councils waste diversion practices are already getting close to achieving the 2014 WARR targets. Council has further increased their waste diversion activities since the submission of the EA and the inspection of their existing activities by the DoP's independent waste advisor, including the commencement of the domestic organics (garden and food wastes) service. This demonstrates Council's full commitment to maximising waste diversion and to meeting their intent of essentially operating the new landfill as a non-putrescible landfill.

Furthermore, a number of proposed conditions of consent require Council to design the landfill and ancillary infrastructure to accommodate outputs from five cells but with approval to only operate two cells subject to Council satisfactorily addressing Clause 123(1)(a) of State Environmental Planning Policy (Infrastructure) 2007.

The water and leachate management infrastructure supporting the two cells for the base case scenario would be built to final design size (i.e. sufficient capacity to accommodate containment and storage requirements for five landfill cells) in Year 1. The proposed staged approval of the landfill cells would mean that water and leachate management infrastructure to support two cells only would be constructed in Year 1, with further construction required in future years to augment/upgrade the infrastructure to support additional landfill cells as they are approved (two cell scenario).

Option 1 (i.e. the Proposal as submitted) has lower costs and a lower risk profile. This approach would be preferred to reduce the financial risk of future landfill cells not being approved, and hence the burden on rate payers and the uncertainty of a longer term waste solution for Council.

- **Site selection process** - Council has maintained records of the site selection process including reports, correspondence with real estate agents, newspaper advertisements and minutes and resolutions of Council Meetings, which demonstrate that the site selection process was comprehensive and rigorous. It involved consideration by multiple consultants, state government departments, Council's advisory committees and by the elected Councillors. It is noted that the site selection work undertaken by Brian Mackney and Associates was "peer reviewed" by the NSW Department of Public Works (which subsequently changed its' name to NSW Department of Commerce during the review period).
- **Biodiversity and amenity issues** - the proposal includes a biodiversity offset of approximately 61 hectares of land to account for approximately 20 hectares of vegetation being cleared due to the proposed landfill facility. The biodiversity area will be contained entirely within the Site extent to enable direct and intensive management of the offset and to minimise the disturbance and relocation distance for some older and hollow-bearing trees and associated habitats. The Biodiversity Offset Management Plan for the Site has been prepared in accordance with the recommendations of the DECCW (now EPA) principles for biodiversity offsetting.

Amenity impacts such as noise, odour and vermin will be managed through mitigation measures as outlined in the EA and appropriate management plans for construction and operation phases including the LEMP.

Visual impacts will be mitigated through progressive landscaping and revegetation, with no visual impacts for the life of the operation.

Further summarising water management controls adopted for this proposal we confirm the following:

	Benchmark Technique (Environmental Guidelines: Solid Waste Landfills)	Proposed in Environmental Assessment	Revised Proposal for this Submission
Leachate Dam	Benchmark Technique No. 2 - 25 year, 1 day storm event	100 year 1 day storm event (13.9ML)	100 year 3 day storm event (14.6ML)
Sedimentation Dam	Benchmark Technique No. 3 - 90 th Percentile 5-day rainfall	90 th Percentile 5-day rainfall (2.85ML)	95 th Percentile 5-day rainfall (5.25ML)
Dry Basin	Benchmark Technique No. 2 – 110% capacity bund of leachate dam capacity (110% x 13.9ML = 15.3ML)	19ML (minimum capacity in lieu of bund)	30ML(minimum capacity in lieu of bund)

The proposed landfill would operate under a strict management regime to ensure impacts to the environment are minimised.

Appendix A

Long Swamp Road Landfill Environmental Monitoring Report May 2012

Appendix A Long Swamp Road Landfill Historical Leachate Monitoring Results



Helping You Protect Your Environment

ENVIRONMENTAL MONITORING REPORT

LONG SWAMP ROAD LANDFILL

May 2012

for Armidale Dumaresq Council

CodyHart Consulting Pty Ltd ACN: 076 662 989 ABN: 23 809 060 895
Trading as CodyHart Environmental
Groundwater and Landfill Environmental Monitoring Specialists

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APPENDICES

Appendix A - Field Parameter Forms
Appendix B - Chain of Custody Forms
Appendix C - Laboratory Reports

Presented by: Barbara Hart
Hydrogeologist & Environmental Scientist

Date: 9 June 2012
Report: CodyHart 12.2043.2

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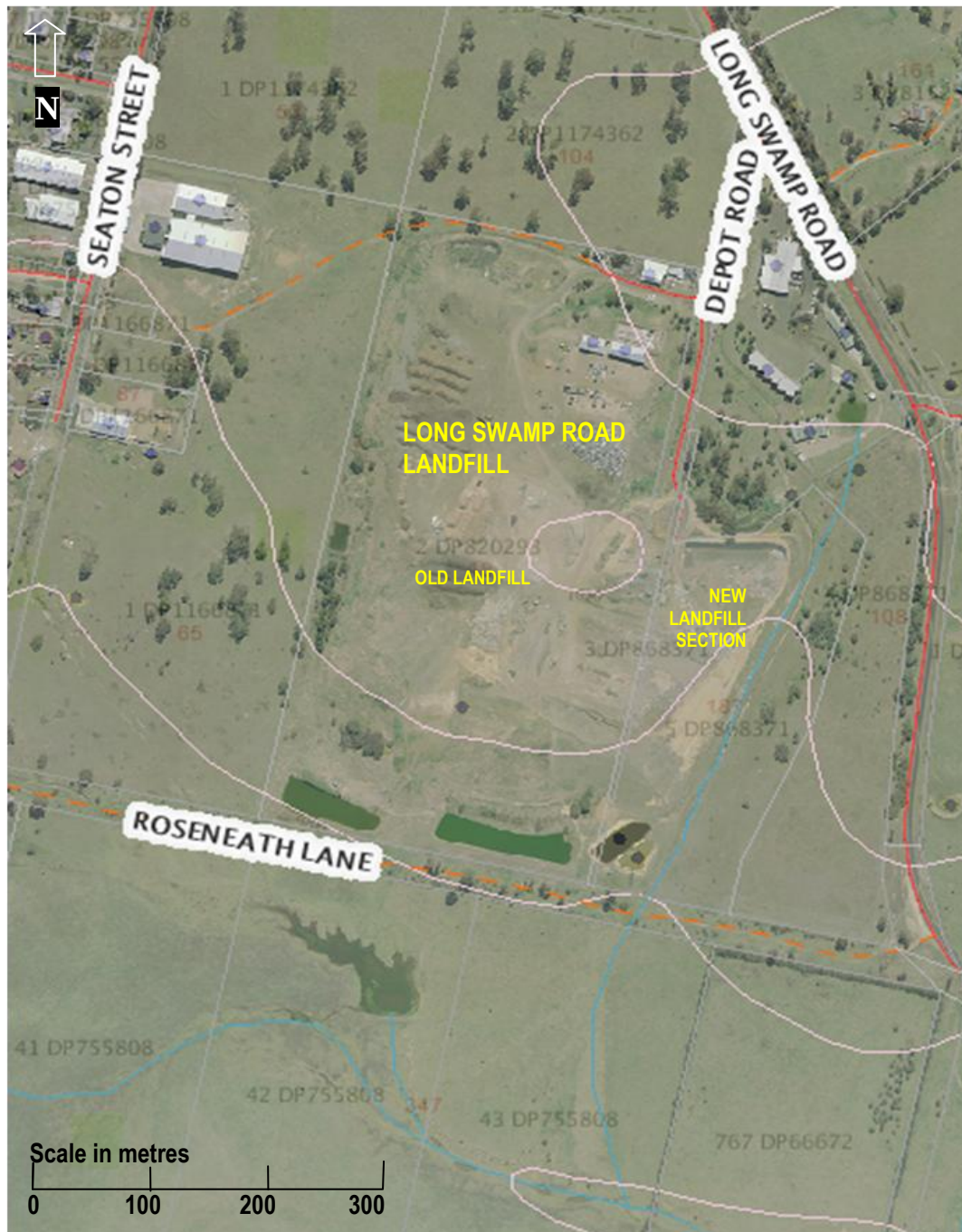
1. INTRODUCTION

This report concerns the May 2012 round of environmental monitoring conducted at the Long Swamp Road Landfill for methane, groundwater (wells LW1-LW3, and wells GWEX-01 to GWEX-03), and leachate LS2-LS4, and surface water LS5 and SWEX-01, even though there was no flow at the SWEX-01 diversion drain.

2. LANDFILL LOCATION

The Long Swamp Road Landfill is to the southeast of Armidale's town centre. A satellite image of the site is shown on Figure 1.

Figure 1: Location of Long Swamp Road Landfill

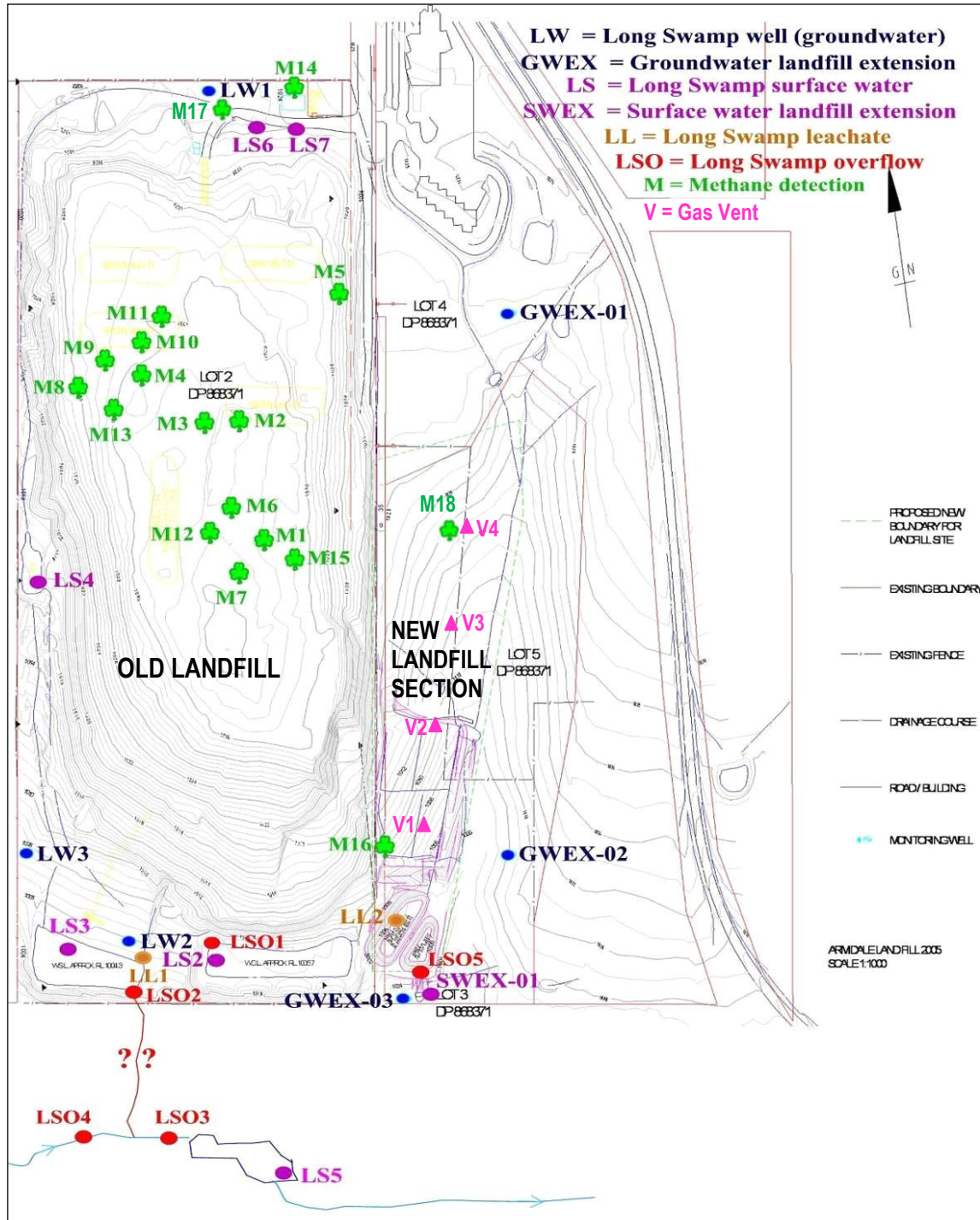


Base map SIX NSW Land & Property Information 2012

3. SAMPLING LOCATIONS

Figure 2 shows the sampling locations for methane, groundwater, surface water and leachate.

Figure 2: Sampling locations



4. AIM OF MONITORING

The environmental assessment monitoring program aims to assess present environmental health risks due to methane emissions from surface areas and within buildings, and landfill leachate contamination of surface water and groundwater.

5. METHANE MONITORING

Quarterly surface monitoring and building monitoring for methane is being conducted at the Long Swamp Road Landfill as a precautionary measure against the environmental and occupational health and safety problems that may occur at landfills due to the methane component of landfill gas. Methane is a colourless, odourless gas that is flammable and explosive.

Benchmark Technique No. 17 for *Surface Gas Emission Monitoring* and Benchmark Technique No. 18 for *Gas Accumulation Monitoring* found in the NSW EPA (1996, p. 30) *Environmental Guidelines: Solid Waste Landfills* are followed. The surface methane monitoring is undertaken to demonstrate that the cover material is controlling the emission of landfill gas. Methane accumulation monitoring is undertaken in all recycling sheds, the gatehouse, the skip shed, and the transfer station bays to assure health and safety against asphyxiation and explosion.

CodyHart uses a Year 2010 model RKI Eagle™ portable gas meter. Its methane recalibration date is shown on the display screen and CodyHart conducts the gas recalibration when required. The methane channel is zero calibrated in fresh air by CodyHart before the start of sampling at each site.

5.1 Surface methane monitoring results

Methane sampling was conducted on 9 May 2012. The maximum wind gust over five minutes measured at the landfill at that time was 1.50 m/s (5.4 km/hr), which is less than the 10 km/hr recommended by NSW EPA (1996). A protector was attached over the head of the gas inlet to protect the inlet from wind. Nil gas was detected except for that from the landfill extension passive extraction vents. Their internal emissions ranged from 0 ppm to +50,000 ppm, the lower explosive limit. Methane was 10,875 ppm on the ground outside Vent 4, the most upgradient vent. Council people were advised to place soil cover over this area to convert the methane to carbon dioxide. Historical results are provided in Table 1 and detection points are shown on Figure 2.

Table 1: Surface methane detections to date – Long Swamp Road Landfill

Date	Sampling location detects	ppm by vol in air	% CH ₄ by volume in air	% LEL (Lower Explosive Limit)
	Note:	500ppm CH ₄ by vol in air	= 0.05% CH ₄ by vol in air	= 1% LEL
10/02/00	no detects at any sampling location			
10/05/00	no detects at any sampling location			
15/08/00	M1 – metal dump pit	max 520; generally 5 to 310	0.052%	1.04%
18/09/01	M2 metal dump pit – in depression (1m x 1m area)	10,200	1.02%	20.4%
06/12/01	M2 metal dump pit	10,190	1.019%	20.38%

Table 1 continued:

Date	Sampling location detects	ppm by vol in air	% CH ₄ by volume in air	% LEL (Lower Explosive Limit)
	Note:	500ppm CH ₄ by vol in air	= 0.05% CH ₄ by vol in air	= 1% LEL
06/12/01	M3 face below compactor parking spot	4,950	0.495%	9.9%
06/12/01	M4 near fill area	3,250	0.325%	6.5%
06/12/01	M5 a few landfill fire fissures – no smoke	max 4,950	0.495%	9.9%
07/03/02	M6 metal dump pit	2,350	0.235%	4.7%
07/03/02	M7 metal dump pit	1,045	0.105%	2.1%
07/03/02	M8 upper western slope	4,750	0.475%	9.5%
07/03/02	M9 upper western slope	10,000	1.0%	20.0%
07/03/02	M10 upper western slope	3,780	0.378%	7.56%
07/03/02	M11 upper western slope	468	0.047%	0.94%
24/05/02	M12 metal dump pit	2,800	0.28%	5.6%
24/05/02	M7 metal dump pit	11,000	1.1%	22.0%
04/09/02	M9 upper western slope	2,050	0.205%	4.10%
04/09/02	M7 metal dump pit	9,850	0.985%	19.70%
08/12/02	M13 upper western slope	max 2,720	0.27%	5.44%
08/03/03	M1 (11,900ppm); M6 (10,750ppm) metal dump pit	max 11,900	1.19%	23.8%
08/03/03	M14 footings of equipment shed extension	max 7,650	0.765%	15.3%
12/06/03	M7 metal dump pit	5350	0.535%	10.7%
12/06/03	M12 metal dump pit	4485	0.448%	8.96%
06/09/03	Nil methane detected at sampling locations			
20/01/04	M15 covered section of old metal dump pit	8850	0.885%	17.7%
05/03/04	Nil methane detected at sampling locations			
28/05/04	M6 old metal dump pit area	2910	0.291%	5.82%
16/09/04	Nil methane detected at sampling locations			
28/11/04	Nil methane detected at sampling locations			
07/03/05	Nil methane detected at sampling locations			
17/06/05	M16, fissure southeast corner landfill outside fence	1750	0.175%	3.5%
16/09/05	Nil methane detected at sampling locations			
18/01/06	Nil methane detected at sampling locations			
20/03/06	Nil methane detected at sampling locations			
21/07/06	Nil methane detected at sampling locations			
15/09/06	Nil methane detected at sampling locations			
18/01/07	Nil methane detected at sampling locations			
18/04/07	Nil methane detected at sampling locations			
27/07/07	Between points M4 & M13 methane detected	2570	0.257%	5.14%
14/10/07	Nil methane detected at sampling locations			
21/01/08	Nil methane detected at sampling locations			
12/04/08	Nil methane detected at sampling locations			
22/06/08	Nil methane detected at sampling locations			
16/09/08	Nil methane detected at sampling locations			
31/01/09	Nil methane detected at sampling locations			
16/04/09	Nil methane detected at sampling locations			
05/07/09	M10 behind mulch piles on old landfill.	Max 10,750	1.075%	21.5%
22/10/09	Nil methane detected at sampling locations			
07/03/10	Nil methane detected at sampling locations			
02/05/10	Nil methane detected at sampling locations			
18/07/10	Nil methane detected at sampling locations			
14/10/10	Nil methane detected at sampling locations			
21/02/11	M17 base of bent post, northern side of road west of 2 nd hand shop	2,875	0.2875%	5.75%
26/06/11	Nil methane detected at sampling locations			
17/08/11	Nil methane detected at sampling locations			

Date	Sampling location detects	ppm by vol in air	% CH ₄ by volume in air	% LEL (Lower Explosive Limit)
	Note:	500ppm CH ₄ by vol in air	= 0.05% CH ₄ by vol in air	= 1% LEL
12/10/11	Nil methane detected at sampling locations. OHS note: 0 to +50,000 ppm at passive landfill gas vents.			
22/01/12	Nil methane detected at sampling locations. OHS note: 0 to +50,000 ppm at passive landfill gas vents.			
09/05/12	M18 around Vent 4 upper section landfill extension. OHS note: 0 to +50,000 ppm at passive landfill gas vents.	10,875	1.088%	21.75%

Notes:

1. 100% LEL for methane (CH₄) = 5% CH₄ by volume in air (50,000 ppm by volume in air). Methane may explode in confined spaces or ignite in open spaces if ignited when CH₄ is 5% to 15% by volume in air. Oxygen levels should never fall below 18% by volume in air (180,000 ppm by volume in air) and carbon dioxide levels should not exceed 0.5% by volume in air (5000 ppm by volume in air) for an 8 hour working day (Gendebien *et al.*, 1992:282-284).
2. NSW EPA (1996) surface methane monitoring threshold value = 0.05% CH₄ by volume in air = 500 ppm by volume in air = 1% LEL.
3. NSW EPA (1996) methane accumulation threshold value in buildings = 1.25% CH₄ by volume in air = 12,500 ppm by volume in air = 25% LEL.
4. EPA NSW (1996:31) notification level for surface, subsurface and building methane monitoring is 1.25% methane by volume in air, that is, 12,500 ppm.

5.2 Building methane monitoring results

High and low level sections of all recycling sheds, the gatehouse, skip shed, and the transfer station bays were tested. Testing was also conducted around the outside of these buildings. All methane readings were zero (Table 2).

Low sections of the buildings were tested because traces of methane may be trapped amongst high proportions of carbon dioxide that is denser than air and therefore heavier. High sections of the buildings were tested because methane is less dense and therefore lighter than air. Enclosed areas under equipment and in cupboards, and external ducting areas such as water pipe inlets were also tested.

Table 2: Building methane detections to date – Long Swamp Road Landfill

Date	Sampling location	ppm by vol in air	% CH ₄ by volume in air	% LEL (Lower Explosive Limit)
	Note:	12,500ppm CH ₄ by vol in air	= 1.25% CH ₄ by vol in air	= 25% LEL
10/02/00	Nil methane detected in both sheds.			
10/05/00	Nil methane detected in both sheds.			
10/08/00	Nil methane detected in both sheds.			
18/09/01	Nil methane detected in both sheds.			
06/12/01	Nil methane detected in both sheds.			
07/03/02	Nil methane detected in both sheds.			
24/05/02	Nil methane detected in both sheds.			
04/09/02	Nil methane detected in both sheds.			
08/12/02	Nil methane detected in both sheds.			
08/03/03	Nil methane detected in both sheds – but methane detected in footings of extension to equipment shed (Table 1).			
12/06/03	Nil methane detected in both sheds.			
06/09/03	Nil methane detected in both sheds.			
20/01/04	Nil methane detected in both sheds and gatehouse.			
05/03/04	Nil methane detected in both sheds and gatehouse.			
28/05/04	Nil methane detected in both sheds and gatehouse.			

Table 2 continued

Date	Sampling location	ppm by vol in air	% CH ₄ by volume in air	% LEL (Lower Explosive Limit)
	Note:	12,500ppm CH ₄ by vol in air	= 1.25% CH ₄ by vol in air	= 25% LEL
16/09/04	Nil methane detected in both sheds and gatehouse.			
28/11/04	Nil methane detected in both sheds and gatehouse.			
07/03/05	Nil methane detected in both sheds and gatehouse.			
17/06/05	Nil methane detected in both sheds and gatehouse.			
16/09/05	Nil methane detected in both sheds and gatehouse.			
18/01/06	Nil methane detected in both sheds and gatehouse.			
20/03/06	Nil methane detected in both sheds and gatehouse.			
21/07/06	Nil methane detected in both sheds and gatehouse.			
15/09/06	Nil Methane detected in both sheds and gatehouse.			
18/01/07	Nil Methane detected in both sheds and gatehouse.			
18/04/07	Nil Methane detected in both sheds and gatehouse.			
27/07/07	Nil Methane detected in both sheds and gatehouse.			
14/10/07	Nil Methane detected in both sheds and gatehouse.			
21/01/08	Nil Methane detected in both sheds and gatehouse.			
12/04/08	Nil Methane detected in both sheds and gatehouse.			
22/06/08	Nil Methane detected in both sheds and gatehouse			
16/09/08	Nil methane detected – sheds, gatehouse, recycling facility			
31/01/09	Nil methane detected – sheds, gatehouse, recycling facility			
16/04/09	Nil methane detected – sheds, gatehouse, recycling facility			
05/07/09	Nil methane detected – sheds, gatehouse, recycling facility			
22/10/09	Nil methane detected – sheds, gatehouse, recycling facility			
07/03/10	Nil methane detected – sheds, gatehouse, recycling facility			
02/05/10	Nil methane detected – sheds, gatehouse, recycling facility			
18/07/10	Nil methane detected – sheds, gatehouse, recycling facility			
14/10/10	Nil methane detected – sheds, gatehouse, recycling facility			
21/02/11	Nil methane detected – sheds, gatehouse, recycling facility			
26/06/11	Nil methane detected – sheds, gatehouse, recycling facility			
17/08/11	Nil methane detected – sheds, gatehouse, recycling facility			
12/10/11	Nil methane detected – sheds, gatehouse, recycling facility			
22/01/12	Nil methane detected – sheds, gatehouse, recycling facility			
09/05/12	Nil methane detected – sheds, gatehouse, recycling facility			

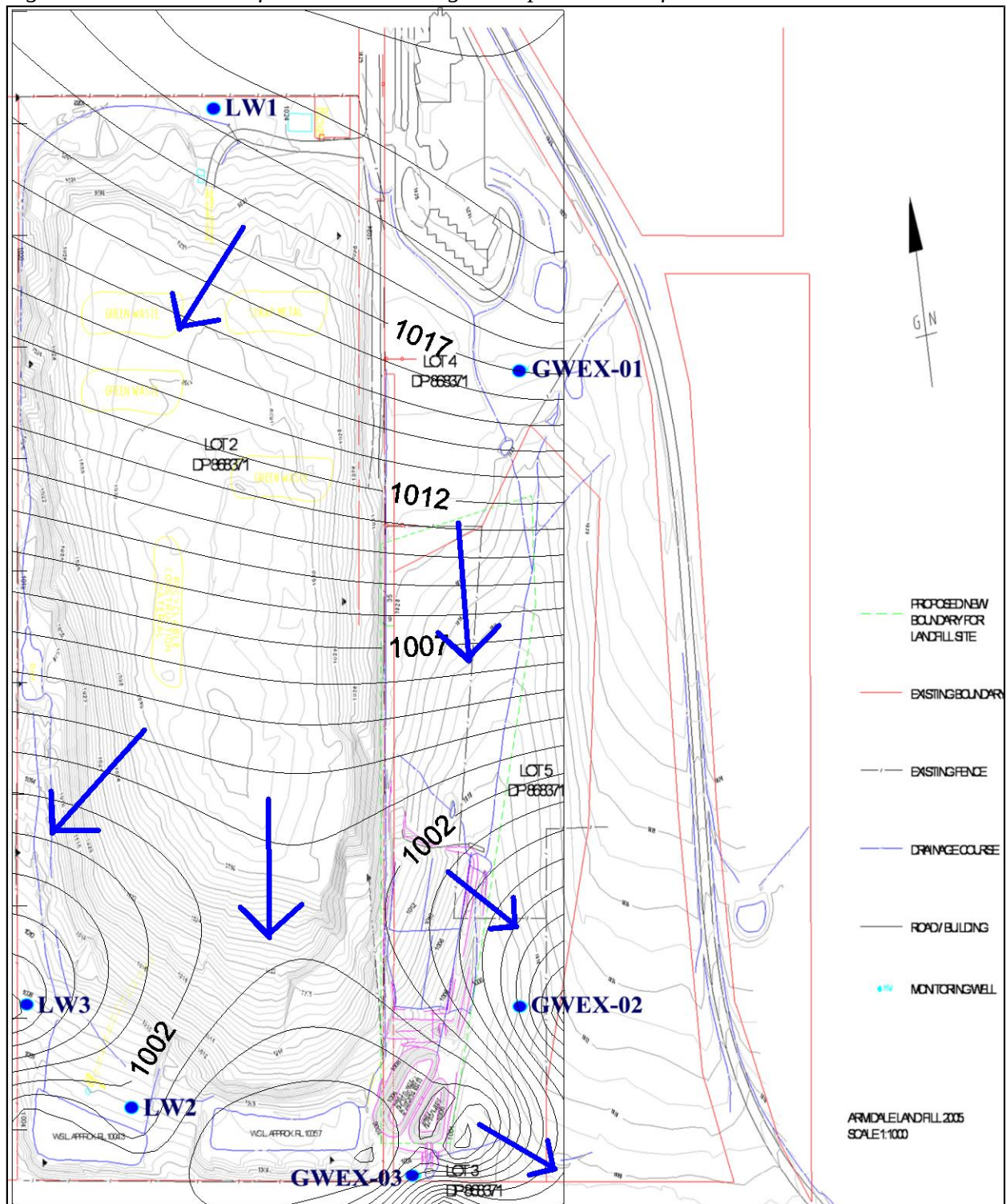
Note: EPA NSW (1996:31) notification level for surface, subsurface and building methane monitoring is 1.25% methane by volume in air, that is, 12,500 ppm.

6. GROUNDWATER FLOW DIRECTION & VELOCITIES

Groundwater flow direction was estimated from water levels (WL) taken on the 29th August 2005 measured from the top of the PVC casings in wells on the old landfill site (LW1, LW2, LW3) and the landfill extension (GWEX-01, GWEX-02, GWEX-03). The water levels (WL) were converted to Reduced Levels (RL) relative to mean sea level.

The arrows on Figure 3 show that the general groundwater flow direction is southwards in sympathy with the topography, fanning out at the base of the landfill and the landfill extension. Note that the WRLs for the dams are higher than the groundwater and as surface water and groundwater have some connectivity, the dam water affects the groundwater flow direction.

Figure 3: Groundwater flow direction Long Swamp Road Landfill



(CodyHart 2005)

Groundwater velocities were estimated in Year 2000 for the groundwater regimes adjacent to wells in the old section of the landfill:

- LW1 - 0.156827292 metres /day or 57.242 m/year
- LW2 - 0.025393044 metres /day or 9.268 m/year
- LW3 - 0.035550444 metres /day or 12.976 m/year

(CodyHart 2000)

7. WATER SAMPLING FIELD WORK

Sampling was conducted on 8 to 13 May 2012 at the following sampling points:

- Groundwater quality monitoring at LW1 to LW3, GWEX-01 to GWEX-03;
- Diluted leachate in dams LS2-LS4; and
- Surface water in the diversion drain (SWEX-01) and the farmer's dam LS5..

Sampling points are displayed on Figure 2.

The TPS field lab used by CodyHart Environmental to take field temperature, pH, electrical conductivity (EC), redox potential (Eh) and dissolved oxygen (DO) readings is calibrated daily so that sampling is conducted within 24 hours of field lab calibration.

For diluted leachate at LS2, LS3 and LS4 and surface water at LS5, the samples were collected with a beaker on the end of a two-metre extension pole from the dam edges. The sample at SWEX-01 was taken by kneeling down alongside the sampling point. Two field analyte samples were taken, and the values noted on each field parameter form (Appendix A). Sample bottles were filled in order from the most volatile analyte being sampled to the least volatile.

For groundwater sampling, the water level was measured at each well using an electronic dip meter and noted on the field parameter form (Appendix A). At each well, a decontaminated, stainless steel, bladder pump attached to ¼ inch OD LDPE tubing for compressed air and ¼ inch OD LDPE tubing for water, was used to pump groundwater to the surface. A set pump position, discharge/refill rate and psi, and purge volume are used each sampling round to suit each well's hydraulic characteristics. The aim is to minimise water level drawdown in a method called 'low-flow' groundwater sampling. Minimal drawdown means that the groundwater is less disturbed and samples are more likely to be representative of true groundwater quality. A flow-through cell is used to house field probes for measuring field analytes (EC/Temp, pH, Eh and DO) values (Appendix A). When purging was complete, sample containers were filled generally from the most volatile analyte to be sampled to the least. Total organic carbon (TOC) and metal samples were not filtered if the samples were clear (Appendix A).

After collection, the samples were immediately put on ice in a chilled esky. The samples were transported in an iced esky to reach the ALS laboratory well within holding times.

An anemometer, thermometer and compass were used to determine air temperature, wind speed and wind direction and their values were noted on each field parameter form (Appendix A).

8. WATER MONITORING QUALITY ASSURANCE

A number of techniques are used in an endeavour to assure a high quality of sampling and analyses.

- Sampling procedures documented by CodyHart Environmental were followed. These included tests of deionised water and field blanks to assure proper decontamination of equipment.
- Relative percentage differences (RPDs) of field analytes were reviewed. Dissolved Oxygen (DO) and redox potential (Eh) have the potential to vary more than other field

analytes when water is extracted from its normal environment. However, no exceedances occurred.

- Calibration of the field lab was documented. A certificate is provided in Appendix B.
- Chain of custody forms were completed to document the lack of tampering with sample containers and for the ALS laboratory to advise of sample receipt. (Appendix B)
- Australian Laboratory Services (ALS), Stafford, Brisbane, conducted the majority of laboratory analyses. They are a global, Australian company who analyses a broad range of analytes and provides good service. In addition to the certificate of analysis and analytical results, ALS provide quality control reports for laboratory duplicates, method blank and laboratory control samples, matrix spikes, and an interpretive quality control report that summarises the quality assurance findings (Appendix C). There were no untoward quality control issues.
- CodyHart conducted laboratory analyses (yellow sheet, Appendix C) that are best conducted on fresh samples – using an APHA (1998) titration method for alkalinity and free CO₂.
- The CodyHart sampling team took duplicate samples (LWD) as replicate samples (one after the other) at well LW1 which were analysed for chloride, some metals, nitrogen compounds and total organic carbon (TOC). The values were within the ALS quality control duplicate criteria.

9. WATER QUALITY RESULTS TO DATE

All results to date are tabled on portrait tables which allow a quick comparison of each analyte's historical results by looking down each column. Appendix C has a copy of the detailed laboratory results for this monitoring round, which include the laboratory QC reports. The CodyHart laboratory results follow the QC reports.

Table 3: Field analytes, water level, nutrients, carbon – Monitoring well LW1

LW1	Field analytes					Water levels		Nutrients								Carbon					
	DO	EC	pH	Eh	Temp	D	RL	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC	
Measure	mg/L	µS/cm	1-14	Mv	°C	m	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01	1	1	1	1	1	1	1
09/02/00	0.72	3600	4.49	+343	17.1	2.10	1021.69	400	NT	NT	739.0	NT	1140	NT		<1			9		
10/05/00	0.13	3300	4.24	+184	16.4	2.17	1021.62	312	<0.01	312	4.0	0.06	316	<0.01		<1			9		
14/08/00	0.42	3403	4.27	+404	13.3	2.39	1021.40	331	0.80	330	0.2	0.22	331	<0.01		<1			2		
14/11/00	0.47	3520	4.71	+357	14.8	2.48	1021.31	336	0.002	336	0.7	0.04	337	0.09		<1			<1		
15/06/01	0.21	3380	4.17	+361	14.5	2.28	1021.51	333	0.024	333	0.6	0.61	334	NC		<1			6		
19/09/01	0.46	3543	4.09	+403	18.8	2.49	1021.30	381	<0.001	381	0.6	0.04	382			<1			4		
06/12/01	0.14	3580	4.17	+356	15.7	2.35	1021.44	397	0.006	396	6.6	3.53	404			<1			2		
07/03/02	0.25	3613	4.04	+404	20.2	2.39	1021.40	333	0.009	333	<0.1	0.04	333			<1			25		
24/05/02	0.18	3620	4.16	+319	17.2	2.59	1021.20	339	0.011	339	<0.1	0.03	339			<1			6		
05/09/02	0.56	3668	4.09	+381	17.1	2.93	1020.86	387	0.014	387	<0.1	0.07	387			<1			2		
08/12/02	0.25	3850	4.11	+389	20.3	2.91	1020.88	268	0.027	268	<0.1	<0.01	268		205	<1	56		5		
09/03/03	0.14	3683	4.06	+349	19.4	2.95	1020.84	440	0.016	440	<0.1	0.03	440		238	<1	65	26	13	39	
12/06/03	0.31	4068	4.01	+306	18.2	2.99	1020.80	379	0.017	379	<0.1	0.09	379		240	<1	65	27	2	29	
05/09/03	1.21	4020	4.18	+421	18.6	2.96	1020.83	386	<0.001	386	<0.1	0.04	386		205	<1	56	19	6	25	
02/12/03	0.45	4083	4.08	+388	15.6	2.79	1021.00	374	0.022	374	<0.1	0.02	374		232	<1	63	<1	8	8	
05/03/04	0.39	3878	4.12	+321	19.7	2.52	1021.27	345	NC	NC	<0.1	0.06	346		240	<1	65	<1	3	3	
28/05/04	0.10	3960	4.12	+369	15.1	2.66	1021.13	317			<0.1	<0.01	317		246	<1	67	7	5	12	
15/09/04	1.27	4090	3.91	+418	16.3	2.96	1020.83	459			<0.1	0.05	459		235	<1	46	<1	3	3	
28/11/04	0.94	3930	3.86	+368	20.5	2.78	1021.01	362			0.3	0.279	362		267	<1	53	26	<1	26	
08/03/05	0.69	3750	3.88	+373	19.8	2.66	1021.13	320			<0.1	0.089	320		220	<1	60	NC	8	NC	
17/06/05	0.41	3835	4.22	+382	13.3	2.75	1021.04	374			<0.1	0.016	374		211	<1	58		3		
29/08/05						2.98	1020.81														
14/09/05	0.58	3720	4.14	+289	15.4	2.85	1020.94	379			<0.1	<0.01	227		208	<1	57		<1		
25/11/05	0.37	3728	4.15	+255	16.9	2.71	1021.08	93.5			<0.1	0.070	93.5		213	<1	58		12		
18/03/06	0.28	3358	4.15	+308	18.8	2.55	1021.24	322			<0.1	0.072	322		221	<1	60		3		
13/09/06	0.74	3530	3.68	+408	16.7	3.08	1020.71	354			<0.1	0.054	354		211	<1	58		3		
20/04/07	0.14	3348	4.22	+330	17.8	2.80	1020.99	309			<0.1	0.113	309		233	<1	64		4		
14/10/07	0.15	3553	4.23	+375	16.7	2.99	1020.80	296			<0.1	0.041	296		208	<1	57		4		
13/04/08	0.07	3650	4.33	+295	17.2	2.65	1021.14	295			<0.1	0.050	295		220	<1	60		3		
15/09/08	0.34	3765	4.34	+304	15.8	2.90	1020.89	725			<0.1	0.050	725		220	<1	60		2		
15/04/09	0.34	3500	4.21	+232	17.8	2.77	1021.02	238			0.3	<0.01	238		227	<1	62		2		
22/10/09	0.35	3708	4.02	+258	16.0	2.98	1020.81	228			<0.1	0.08	228		249	<1	68		4		
02/05/10	0.24	3705	4.00	+327	18.0	2.83	1020.96	278			5.7	0.05	284		178	<1	49		5		
15/10/10	1.75	3540	4.04	+204	15.2	2.78	1021.01	220			<0.1	0.09	220		198	<1	54		5		
24/06/11	0.87	3698	4.08	+392	16.3	2.59	1021.20	308			<0.1	0.03	308		161	<1	44		11		
12/10/11	2.34	3530	4.09	+461	14.8	2.41	1021.38	291			0.5	0.09	292		155	<1	42		<1		
09/05/12	0.91	3745	4.04	+371	17.2	2.03	1021.76	276			0.3	0.06	276		164	<1	45		4		

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Depth to water from top of internal well PVC casing; RL = water level converted to Reduced Level relative to mean sea level (RL from top of PVC casing = 1023.79m; VOCs = Volatile Organic Compounds; NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free Carbon Dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested; NC = Not continuing; Bold = not filtered.

Table 4: Laboratory analytes – geochemical, metals, PAHs, phenols, VOCs – Monitoring well LW1

LW1	Laboratory analytes – geochemical and metals																			VOCs	
	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	PAH	Phenols		
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0001	0.002 – 0.004	0.1	Various	
09/02/00	65	99	649	3	18	405	<0.2	1.1	<0.01	0.64	0.002	0.001	<0.001	NT	<0.01	NT	0.0025	NT	NT	nil detected	
10/05/00	48	95	509	2	12	377	<0.2	1.0	0.20	0.64	0.001	0.002	0.001	0.010	<0.01	0.203	0.0005	<DL	<0.1	nil detected	
14/08/00	48	98	477	2	10	124	<0.2	1.5	0.64	0.66	0.001	0.065	<0.001	0.002	<0.01	0.177	0.0035	<DL	<0.1	nil detected	
14/11/00	55	108	483	2	11	375	<0.1	1.5	0.08	0.70	<0.001	0.003	<0.001	0.002	<0.01	0.171	0.0021	<DL	<0.1	nil detected	
15/06/01	NC	NC	NC	NC	NC	391		1.1	0.03	0.54	NC	NC	NC	NC	NC	0.179	0.0007	NC	NC	discontinued	
19/09/01						442		1.3	0.22	0.60						0.494	0.0004				
06/12/01						395		1.4	0.17	0.50						0.579	<0.0001				
07/03/02						451		1.4	0.10	0.54						0.572	0.0009				
24/05/02						414		1.3	0.25	0.53						0.637	0.0007				
05/09/02						414		1.5	0.14	0.47						0.460	0.0013				
08/12/02						445		1.4	0.11	0.53						0.340	<0.0001				
09/03/03						450		1.6	0.18	0.54						0.671	<0.0001				
12/06/03						463		1.4	0.21	0.65						0.560	0.0002				
05/09/03						440		1.4	0.09	0.62						0.187	0.0018				
02/12/03						492		1.5	0.08	0.51						0.579	0.0007				
05/03/04						404		1.0	0.08	0.56						0.191	0.00078				
28/05/04						432		1.3	0.15	0.49						0.140	0.0003				
15/09/04						482		0.6	0.09	0.55						0.184	0.0024				
28/11/04						456		1.6	0.12	0.50						0.201	<0.0001				
08/03/05						435		1.6	0.14	0.51						0.212	0.0006				
17/06/05						520		1.3	0.18	0.65						0.529	<0.0001				
14/09/05						447		1.3	0.22	0.70						0.186	0.0020				
25/11/05						405		1.1	0.11	0.73						0.173	0.0004				
18/03/06						383		1.3	0.17	0.68						0.155	<0.0001				
13/09/06						444		1.3	0.18	0.78						0.138	0.0022				
20/04/07						419		1.3	0.25	0.74						0.130	0.0011				
14/10/07						398			0.13	0.72						0.130	0.0010				
13/04/08						413			0.17	0.71						0.136	<0.0001				
15/09/08						490			0.24	0.76						0.218	0.0044				
15/04/09						420			0.28	0.68						0.230	0.0019				
22/10/09						416			0.27	0.789						0.213	0.0019				
02/05/10						460			0.31	0.453						0.239	0.0015				
15/10/10						458			0.20	0.511						0.293	0.0014				
24/06/11						436			0.18	0.269						0.072	0.0098				
12/10/11					13	431			0.10	0.303						0.074	0.0015				
09/05/12						425			0.15	0.331						0.215	0.0011				

Abbreviations: Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; PAHs = Polynuclear Aromatic Hydrocarbons; NT = Not tested; VOCs = Volatile Organic Compounds; <DL = less than detection limit; Bold = not filtered.

Table 5: Field analytes, water level, nutrients, carbon – Monitoring well LW2

LW2	Field analytes					Water levels		Nutrients								Carbon					
	DO	EC	pH	Eh	Temp	D	RL	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC	
Measure	mg/L	µS/cm	1-14	Mv	°C	m	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01	1	1	1	1	1	1	
09/02/00	0.77	976	6.47	+74	19.7	4.16	1002.90	0.03	NT	NT	0.5	NT	0.5	NT		177			6		
09/05/00	0.40	1045	6.70	+52	12.6	4.35	1002.71	<0.01	NT	NT	0.5	NT	0.5	0.03		180			6		
14/08/00	0.40	1127	6.65	+67	12.9	4.62	1002.44	0.14	NT	NT	0.4	NT	0.5	0.01		169			3		
15/11/00	0.51	1311	6.32	+71	15.0	4.73	1002.33	<0.01	NT	NT	0.9	NT	0.9	0.19		181			<1		
18/09/01	0.32	999	6.31	+79	19.5	4.28	1002.78	<0.01	<0.001	<0.01	0.65	0.65	0.65	NC		181			2		
08/03/02	0.30	948	6.30	+54	21.4	4.48	1002.58	0.04	0.008	0.03	0.4	0.34	0.4			173			41		
04/09/02	0.56	722	6.47	+60	14.2	4.72	1002.34	0.06	<0.001	0.06	0.8	0.41	0.9			183			1		
08/03/03	0.60	754	6.50	+67	18.3	4.98	1002.08	0.07	<0.001	0.07	0.4	0.37	0.5		129	173	69	54	10	64	
05/09/03	0.78	738	6.35	+58	14.6	4.58	1002.48	0.02	<0.001	0.02	0.9	0.33	0.9		100	183	63	27	4	31	
04/03/04	0.47	734	6.52	+51	18.2	4.46	1002.60	0.07	NC	NC	1.5	0.28	1.6		120	244	81	44	5	49	
15/09/04	0.66	732	6.47	+28	18.2	4.79	1002.27	0.05			<0.1	0.31	<0.1		128	213	77	62	4	66	
08/03/05	0.38	700	6.42	+32	17.8	4.67	1002.39	0.013			0.9	0.484	0.9		120	171	66	NC	3	NC	
29/08/05						5.07	1001.99														
14/09/05	0.42	644	6.58	+50	15.3	4.98	1002.08	<0.01			2.1	0.431	2.1		106	211	70		<1		
19/03/06	0.61	741	7.11	+20	17.5	4.80	1002.26	<0.01			<0.1	0.172	<0.1		73	229	65		<1		
12/09/06	2.14	686	6.44	+108	14.6	5.02	1002.04	0.435			0.3	0.204	0.7		88	283	80		1		
19/04/07	1.70	654	6.61	+15	17.7	5.06	1002.00	0.056			0.3	0.242	0.3		94	187	62		3		
14/10/07	0.95	643	6.57	+143	17.6	4.92	1002.14	0.126			0.4	0.236	0.5		60	192	54		1		
12/04/07	0.54	641	6.79	-181	16.9	3.67	1002.54	0.016			0.9	0.574	0.9		79	200	61		3		
14/09/08	0.52	633	6.66	-108	16.8	3.67	1002.54	0.090			1.1	0.520	1.2		88	193	62		2		
16/04/09	0.46	609	6.65	-114	18.2	3.96	1003.10	0.020			0.4	0.370	0.5		103	190	65		5		
22/10/09	2.56	623	6.71	+130	19.7	3.87	1003.19	0.060			0.3	0.130	0.3		88	190	61		3		
01/05/10	0.78	629	6.67	+22	16.9	4.71	1002.35	0.040			0.2	0.20	0.2		80	212	64		7		
14/10/10	0.72	606	6.74	+81	16.0	4.28	1002.78	0.120			<0.1	0.04	0.1		63	174	51		10		
24/06/11	0.74	633	7.05	-8	16.5	4.26	1002.80	0.030			0.2	0.21	0.2		85	177	58		12		
11/10/11	0.71	591	6.70	+94	17.5	4.57	1002.49	0.050			<0.1	0.02	<0.1		91	143	53		<1		
13/05/12	0.40	600	6.68	+28	12.2	5.04	1002.02	0.020			0.3	0.16	0.3		88	233	70		<1		

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Depth to water from top of internal well PVC casing; RL = water level converted to Reduced Level relative to mean sea level (RL from top of PVC casing = 1007.06m); NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free carbon dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested; NC = Not continuing; Bold = not filtered.

Table 6: Laboratory analytes – geochemical, metals, VOCs – Monitoring well LW2

LW2	Laboratory analyte – geochemical and metals																	VOCs
	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	various
09/02/00	51	31	111	27	182	127	<0.2	0.5	0.81	0.61	0.001	<0.001	<0.001	NT	<0.01	NT	<0.0005	nil detected
09/05/00	60	34	100	29	245	106	<0.2	0.4	1.25	0.58	0.002	0.001	<0.001	<0.001	<0.01	0.069	<0.0001	NT in error
14/08/00	56	31	91	37	270	38	<0.2	0.5	2.21	0.63	0.002	0.007	<0.001	<0.001	<0.01	0.089	<0.0005	nil detected
15/11/00	86	42	127	8	395	81	<0.1	0.4	3.66	0.87	0.003	<0.001	<0.001	0.001	<0.01	0.164	<0.0001	nil detected
18/09/01	NC	NC	NC	NC	NC	76		0.3	3.24	0.57	NC	NC	NC	NC	NC	0.487	NC	discontinued
08/03/02						65		0.3	3.99	0.52						0.203		
04/09/02						61		0.3	3.59	0.50						0.532		
08/03/03						58		0.3	2.68	0.43						0.884		
05/09/03						61		0.2	3.14	0.37						0.055		
04/03/04						54		0.2	3.43	0.40						0.056		
15/09/04						66		0.2	2.45	0.38						0.041		
08/03/05						59		0.3	2.50	0.32						0.053		
14/09/05						19		<0.1	2.26	0.68						0.042		
19/03/06						62		0.3	0.92	0.36						0.042		
12/09/06						66		0.3	1.68	0.06						0.034		
19/04/07						68		0.3	3.08	0.35						0.026		
14/10/07						61			2.50	0.21						0.028		
12/04/08						64			4.28	0.24						0.007		
14/09/08						58			3.57	0.22						0.007		
16/04/09						61			4.05	0.23						0.036		
22/10/09						58			<0.05	0.197						0.073		
01/05/10						56			1.37	0.298						0.067		
14/10/10						57			<0.05	0.096						0.095		
24/06/11						61			<0.05	0.003						0.006		
11/10/11						60			<0.05	0.017						0.092		
13/05/12						53			0.58	0.258						0.052		

Abbreviations: Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; VOCs = Volatile Organic Compounds; NT = Not tested; Bold = not filtered.

Table 7: Field analytes, water level, nutrients, carbon – Monitoring well LW3

LW3	Field analytes					Water levels		Nutrients								Carbon					
	DO	EC	pH	Eh	Temp	D	RL	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC	
Measure	mg/L	S/cm	1-14	Mv	°C	m	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01	1	1	1	1	1	1	
09/02/00	0.37	1107	5.88	+98	22.0	12.88	996.53	0.02	NT	NT	1.5	NT	1.5	NT		158			15		
09/05/00	0.61	965	5.94	+83	17.7	12.74	996.67	<0.01	NT	NT	1.3	NT	1.3	0.65		133			5		
14/08/00	0.44	1006	6.31	+91	11.6	12.69	996.72	<0.01	NT	NT	1.0	NT	1.0	0.59		157			1		
15/11/00	0.28	969	6.24	+52	14.5	12.65	996.76	<0.01	NT	NT	1.0	NT	1.0	0.65		174			1		
18/09/01	0.26	693	6.17	+57	18.7	12.69	996.72	<0.01	<0.001	<0.01	0.75	0.75	0.75	NC		193			3		
07/03/02	5.82	641	6.33	+78	20.2	12.69	996.72	<0.01	0.008	<0.01	2.0	0.41	2.0			197			53		
05/09/02	1.22	441	6.21	+276	17.8	12.82	996.59	0.09	<0.001	0.09	2.6	0.42	2.7			202			4		
08/03/03	0.36	489	6.44	+91	19.8	13.06	996.35	0.03	0.001	0.03	1.5	0.42	1.5		213	113	80	66	23	89	
05/09/03	0.15	480	6.49	+50	17.0	13.17	996.24	<0.01	<0.001	<0.01	1.8	0.39	1.8		169	250	95	26	7	33	
04/03/04	1.48	474	6.36	+222	20.7	13.16	996.25	0.08	NC	NC	2.2	0.37	2.3		199	288	111	55	51	106	
16/09/04	0.50	456	6.20	+111	21.0	13.02	996.39	0.02			2.3	0.30	2.3		208	249	106	75	6	81	
08/03/05	0.47	440	6.15	+27	22.9	13.00	996.41	0.014			2.9	0.761	2.9		182	227	94	NC	6	NC	
29/08/05						12.93	996.48														
14/09/05	0.26	439	6.41	+33	18.1	12.83	996.58	0.018			0.6	0.344	0.7		188	261	103		<1		
19/03/06	0.93	436	6.24	+165	20.4	12.83	996.58	0.013			1.2	0.436	1.2		194	221	96		4		
12/09/06	0.68	444	5.99	+24	16.6	12.79	996.62	0.336			1.9	0.452	2.3		205	349	125		2		
19/04/07	1.27	454	6.67	+18	15.3	12.78	996.63	0.014			0.8	0.447	0.8		169	215	88		5		
14/10/07	0.92	474	6.44	+19	16.7	12.79	996.62	0.023			0.6	0.483	0.7		170	211	88		2		
12/04/08	0.50	413	6.28	-29	20.6	12.68	996.73	0.012			1.0	0.420	1.0		167	216	88		2		
14/09/08	0.25	467	6.33	-8	16.7	12.57	996.84	0.020			0.8	0.400	0.8		169	207	87		<1		
16/04/09	0.23	464	6.35	-25	20.5	12.48	996.93	0.020			0.4	0.400	0.5		205	207	97		5		
22/10/09	0.41	540	6.45	+8	17.6	12.42	996.99	<0.01			0.8	0.400	0.8		161	203	84		2		
01/05/10	6.84	469	6.43	+56	18.6	12.34	997.07	0.12			0.5	0.47	0.6		147	200	79		9		
14/10/10	0.64	481	6.40	+31	18.6	12.21	997.20	0.02			0.7	0.34	0.7		161	242	92		8		
26/06/11	0.38	469	6.23	-8	18.8	12.04	997.37	<0.01			0.6	0.41	0.6		185	210	92		15		
11/10/11	0.28	471	6.36	+41	19.2	11.82	997.59	0.01			0.9	0.42	0.9		169	197	85		<1		
09/05/12	0.32	485	6.28	-5	19.0	11.56	997.85	<0.01			0.7	0.42	0.7		164	200	84		<1		

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Depth to water from top of internal well PVC casing; RL = water level converted to Reduced Level relative to mean sea level (RL from top of PVC casing = 1009.41m); NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free carbon dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested; NC = Not continuing; Bold = unfiltered.

Table 8: Laboratory analytes – geochemical, metals, VOCs – Monitoring well LW3

LW3 Measure Reporting Limit	Laboratory analytes – geochemical and metals																	VOCs
	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	SO ₄ mg/L	Cl mg/L	B mg/L	Br mg/L	Fe mg/L	Mn mg/L	As mg/L	Cd mg/L	Cr mg/L	Pb mg/L	Se mg/L	Zn mg/L	Hg mg/L	mg/L various
	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	
09/02/00	49	29	132	43	314	78	<0.2	0.4	0.36	1.20	0.002	<0.001	<0.001	NT	<0.01	NT	<0.0005	nil detected
09/05/00	54	30	106	16	328	42	<0.2	0.2	2.72	1.54	<0.001	0.017	<0.001	0.001	<0.01	0.082	<0.0001	NT in error
14/08/00	59	32	113	17	307	41	<0.2	0.2	4.86	1.76	0.002	0.010	<0.001	<0.001	<0.01	0.095	<0.0005	nil detected
15/11/00	56	29	105	12	289	206	<0.1	0.2	5.43	1.47	0.002	0.001	<0.001	<0.001	0.01	0.074	<0.0001	nil detected
18/09/01	NC	NC	NC	NC	NC	18	NC	<0.1	5.38	1.04	NC	NC	NC	NC	NC	0.195	NC	discontinued
07/03/02						16		0.1	2.23	0.95						0.099		
05/09/02						16		0.1	7.78	0.92						0.161		
08/03/03						24		<0.1	4.98	0.79						0.523		
05/09/03						16		0.1	2.68	0.75						0.057		
04/03/04						15		<0.1	4.69	0.75						0.050		
16/09/04						15		<0.1	2.99	0.70						0.069		
08/03/05						23		<0.1	5.20	0.64						0.076		
14/09/05						64		0.3	1.62	0.28						0.034		
19/03/06						12		<0.1	5.35	0.66						0.028		
12/09/06						17		<0.1	10.30	0.73						0.044		
19/04/07						21		0.1	3.68	0.57						0.038		
14/10/07						15			5.68	0.60						0.041		
12/04/08						17			5.66	0.61						0.098		
14/09/08						16			2.60	0.58						0.048		
16/04/09						15			5.97	0.61						0.100		
22/10/09						17			2.96	0.583						0.015		
01/05/10						13			3.80	0.601						0.121		
14/10/10						17			1.62	0.595						0.028		
26/06/11						13			3.49	0.552						0.022		
11/10/11						18			2.48	0.591						0.046		
09/05/12						12			4.97	0.524						0.036		

Abbreviations: Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; VOCs = Volatile Organic Compounds; NT = Not tested; Bold = unfiltered.

Table 9: Field analytes, water level, nutrients, carbon – Monitoring well GWEX-01

GWEX-01	Field analytes					Water levels		Nutrients				Carbon				
	DO	EC	pH	Eh	Temp	D	RL	NO _x as N	TKN as N	NH ₃ as N	TotN	Free CO ₂	Alk	CO ₂ + Alk	TOC	PAH yearly
Measure	mg/L	µS/cm	1-14	Mv	°C	m	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.1	0.001	0.1	1	1	1	1	various
29/08/05						3.62	1020.37									
12/09/05	9.50	538	5.39	+232	12.0	3.76	1020.23	<0.01	0.2	0.060	0.2	136	8	39	<1	NT
26/11/05	7.23	543	4.96	+246	17.5	4.02	1019.97	0.104	0.3	0.065	0.4	160	8	45	6	nil detected
19/03/06	7.42	506	4.74	+334	18.8	3.86	1020.13	0.039	<0.1	0.059	<0.1	161	5	45	4	nil detected
20/07/06	5.44	515	4.85	+301	16.7	4.34	1019.65	0.285	0.2	0.057	0.5	179	3	49	4	NT
10/09/06	6.99	517	4.76	+286	15.0	4.46	1019.53	0.694	0.6	0.060	1.2	169	5	47	3	NT
18/01/07	6.68	518	4.47	+487	21.0	4.38	1019.61	0.025	0.1	0.020	0.2	197	<1	54	2	nil detected
19/04/07	8.24	500	5.14	+261	19.0	4.28	1019.71	0.321	0.4	0.035	0.7	199	3	55	5	NT
07/07/07	6.63	511	4.71	+256	14.4	4.38	1019.61	0.155	0.1	0.029	0.3	167	<1	46	3	NT
13/10/07	6.91	548	4.80	+291	15.4	4.48	1019.51	0.148	<0.1	0.027	0.1	144	4	40	3	NT
13/04/08	6.01	615	4.86	+249	17.9	3.93	1020.06	0.081	<0.1	0.065	<0.1	169	8	48	3	nil detected
15/09/08	5.02	618	4.59	+347	16.2	4.30	1019.69	0.020	0.5	0.100	0.5	183	2	50	1	NT
15/04/09	5.00	633	4.62	+230	17.2	3.98	1020.01	0.120	0.2	0.050	0.4	176	37	55	3	Phenanthrene 0.001
22/10/09	4.66	673	4.77	+245	16.0	4.17	1019.82	0.080	0.2	0.050	0.2	191	3	53	4	NT
02/05/10	3.85	619	4.64	+267	17.3	4.12	1019.87	0.080	0.2	0.030	0.3	161	1	44	4	nil detected
15/10/10	3.71	632	4.63	+218	15.0	4.12	1019.87	0.72	<0.1	0.04	0.7	197	1	54	4	NT
24/06/11	3.37	639	4.77	+488	16.3	3.96	1020.03	0.12	<0.1	0.02	0.1	153	1	42	11	nil detected
12/10/11	3.22	630	4.75	+580	14.2	3.82	1020.17	0.11	<0.1	0.05	0.1	194	3	54	< 1	NT
09/05/12	3.66	634	4.69	+300	16.6	3.38	1020.61	0.06	0.2	0.05	0.3	165	3	46	2	nil detected

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Depth to water from top of internal well PVC casing; RL = water level converted to Reduced Level relative to mean sea level (RL from top of PVC casing = 1023.99m; NO_x = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Free CO₂ = Free Carbon Dioxide; Alk = Al in an alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TOC = Total Organic Carbon; PAH = Polynuclear aromatic hydrocarbons (includes Benzo(a) pyrene); NT = not tested; Bold = unfiltered. Note: PAH only required yearly.

Table 10: Laboratory analytes – geochemical, metals, VOCs – Monitoring well GWEX-01

GWEX-01	Laboratory analytes – geochemical and metals																	VOCs
	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0001	various
12/09/05	4	5	99	3	16	150	<0.1	0.7	0.06	0.21	<0.001	0.0006	<0.001	<0.001	<0.01	0.092	0.0002	nil detected
26/11/05	4	4	91	1	11	140	<0.1	0.6	0.07	0.12	0.001	0.0009	<0.001	<0.001	<0.01	0.058	<0.0001	nil detected
19/03/06	3	4	92	1	9	132	<0.1	0.6	0.11	0.11	0.001	0.0005	0.001	0.003	<0.01	0.074	<0.0001	nil detected
20/07/06	3	5	99	<1	9	154	<0.1	0.7	0.10	0.08	<0.001	0.0002	<0.001	<0.001	<0.01	0.081	0.0005	nil detected
10/09/06						142		0.7	0.62	0.08						0.068	0.0014	discontinue
18/01/07						143			0.32	0.05						0.041	0.0012	
19/04/07						148		0.6	0.50	0.05						0.047	0.0016	
07/07/07						144			0.09	0.05						0.032	0.0014	
13/10/07						152			0.09	0.06						0.039	0.0015	
13/04/08						189		< 0.05	0.07							0.053	0.0014	
15/09/08						162			0.52	0.06						0.186	0.0035	
15/04/09						167			1.06	0.06						0.145	0.0031	
22/10/09						207			0.25	0.060						0.095	0.0030	
02/05/10						174			0.17	0.058						0.151	0.0036	
15/10/10						191			0.13	0.059						0.161	0.0022	
24/06/11						183			0.67	0.055						0.033	0.0043	
12/10/11						195			0.48	0.058						0.036	0.0039	
09/05/12						174			0.06	0.053						0.123	0.0025	

Abbreviations: Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; VOCs = Volatile Organic Compounds; Bold = unfiltered.

Table 11: Field analytes, water level, nutrients, carbon – Monitoring well GWEX-02

GWEX-02	Field analytes					Water levels		Nutrients				Carbon				
	DO	EC	pH	Eh	Temp	D	RL	NO _x as N	TKN as N	NH ₃ as N	TotN	Free CO ₂	Alk	CO ₂ + Alk	TOC	PAH yearly
Measure	mg/L	μS/cm	1-14	Mv	°C	m	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.1	0.001	0.1	1	1	1	1	various
29/08/05						14.55	992.90									
12/09/05	1.29	323	6.39	+187	15.4	14.47	992.98	0.100	<0.1	0.042	0.1	164	108	66	<1	NT
26/11/05	1.10	317	6.01	+257	17.7	14.51	992.94	0.166	0.2	0.064	0.4	164	114	67	3	nil detected
19/03/06	0.94	313	6.10	+173	17.6	14.40	993.05	0.289	<0.1	0.047	0.3	164	105	65	1	nil detected
20/07/06	0.90	320	6.02	+202	16.0	14.48	992.97	0.541	<0.1	0.057	0.5	183	103	70	< 1	NT
10/09/06	0.94	318	5.91	+194	16.8	14.49	992.96	0.063	<0.1	0.068	0.6	169	101	66	< 1	NT
18/01/07	1.64	332	5.81	+174	24.8	14.62	992.83	0.151	0.1	0.025	0.3	161	100	64	< 1	nil detected
19/04/07	0.84	323	5.91	+189	17.6	14.71	992.74	0.185	<0.1	0.034	0.2	123	100	53	3	NT
07/07/07	0.94	329	6.02	+210	13.9	14.72	992.73	0.144	<0.1	0.023	0.1	160	100	63	< 1	NT
13/10/07	1.04	328	6.19	+174	15.8	14.80	992.65	0.172	<0.1	0.021	0.2	157	104	63	< 1	NT
20/01/08	0.87	343	5.73	+110	17.6	14.51	992.94	0.156	0.8	<0.010	1.0	160	108	65	1	nil detected
13/04/08	1.09	340	6.03	+138	19.7	14.58	992.87	0.147	<0.1	0.036	0.1	155	103	63	< 1	NT
22/06/08	0.81	349	5.99	+151	16.3	14.67	992.78	0.144	<0.1	0.041	0.1	150	96	60	< 1	NT
15/09/08	0.70	341	5.94	+127	17.0	14.59	992.86	0.180	0.5	0.160	0.6	161	103	64	< 1	NT
30/01/09	0.77	362	6.03	+147	18.3	14.66	992.79	0.120	<0.1	<0.010	0.1	153	103	62	2	NT
15/04/09	0.97	344	6.02	+121	17.1	14.75	992.70	0.150	0.3	<0.010	0.4	142	100	58	3	nil detected
04/07/09	0.76	351	6.03	+161	13.7	14.69	992.76	0.170	<0.1	0.020	0.2	161	100	64	13	NT
22/10/09	0.77	358	6.03	+145	20.6	14.64	992.81	0.160	0.2	0.040	0.3	176	103	68	2	NT
07/03/10	0.83	335	6.00	+150	18.4	14.52	992.93	0.180	<0.1	<0.010	0.2	176	100	68	7	NT
02/05/10	0.85	355	6.06	+155	17.0	14.62	992.83	0.180	<0.1	0.540	0.2	161	103	64	9	nil detected
15/07/10	1.17	355	6.07	+143	16.3	14.67	992.78	0.180	<0.1	0.020	0.2	154	100	62	8	NT
14/10/10	0.89	350	6.11	+155	17.3	13.95	993.50	0.14	<0.1	0.03	0.1	161	103	64	< 1	NT
21/02/11	0.97	355	6.10	+182	21.3	13.43	994.02	0.16	<0.1	0.04	0.2	147	100	60	< 1	NT
24/06/11	1.15	355	6.36	+218	15.9	13.54	993.91	0.15	<0.1	0.02	0.2	138	103	58	21	nil detected
17/08/11	0.93	355	5.91	+216	15.4	13.29	994.16	0.08	<0.1	0.06	<0.1	155	100	62	4	NT
12/10/11	1.11	343	6.07	+423	17.2	13.02	994.43	0.10	<0.1	0.02	0.1	147	103	60	< 1	NT
22/01/12	1.04	362	6.11	+171	18.8	12.25	995.20	0.08	<0.1	0.03	<0.1	155	103	63	1	NT
09/05/12	0.66	365	5.91	+130	17.7	12.39	995.06	0.12	<0.1	0.03	0.1	161	103	64	3	nil detected

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Depth to water from top of internal well PVC casing; RL = water level converted to Reduced Level relative to mean sea level (RL from top of PVC casing = 1007.45m; NO_x = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Free CO₂ = Free Carbon Dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TOC = Total Organic Carbon; PAH = Polynuclear aromatic hydrocarbons (includes Benzo(a) pyrene); NT = not tested; Bold = not filtered. Note: PAH only required yearly.

Table 12: Laboratory analytes – geochemical, metals, VOCs – Monitoring well GWEX-02

GWEX-02	Laboratory analytes – geochemical and metals																		VOCs
	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg		
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Reporting Limit	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0001	various	
12/09/05	24	12	30	3	22	29	<0.1	0.2	<0.05	0.01	<0.001	0.0008	<0.001	<0.001	<0.01	0.022	0.0002	nil detected	
26/11/05	23	11	28	3	23	23	<0.1	0.4	<0.05	<0.01	<0.001	0.0002	<0.001	<0.001	<0.01	0.005	0.0001	nil detected	
19/03/06	24	12	29	3	22	27	<0.1	0.2	<0.05	0.01	<0.001	<0.0001	<0.001	0.001	<0.01	0.007	0.0001	nil detected	
20/07/06	22	12	30	3	22	29	<0.1	0.2	<0.05	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.01	0.011	<0.0001	nil detected	
10/09/06						28		0.2	<0.05	0.01						0.007	0.0006	discontinue	
18/01/07						28			0.06	<0.01						<0.005	<0.0001		
19/04/07						32		0.2	<0.05	0.01						0.015	0.0002		
07/07/07						28			<0.05	<0.01						0.008	<0.0001		
13/10/07						28			<0.05	<0.01						0.006	<0.0001		
20/01/08						37			<0.05	0.02						0.031	<0.0001		
13/04/08						102			<0.05	<0.01						0.099	<0.0001		
22/06/08						30			<0.05	0.02						0.117	<0.0001		
15/09/08						28			<0.05	<0.01						0.005	<0.0001		
30/01/09						27			<0.05	0.02						0.011	<0.0001		
15/04/09						28			<0.05	0.01						0.007	<0.0001		
04/07/09						22			<0.05	0.003						0.030	<0.0001		
22/10/09						24			0.06	0.008						0.049	<0.0001		
07/03/10						24			<0.05	0.004						0.130	<0.0001		
02/05/10						26			<0.05	0.004						0.077	<0.0001		
15/07/10						22			<0.05	0.003						0.078	<0.0001		
14/10/10						22			<0.05	0.005						0.100	<0.0001		
21/02/11						21			3.78	0.196						0.031	<0.0001		
24/06/11						26			<0.05	0.005						0.010	<0.0001		
17/08/11						22			<0.05	0.002						0.075	<0.0001		
12/10/11						22			<0.05	0.004						0.078	<0.0001		
22/01/12						22			<0.05	0.004						0.078	<0.0001		
09/05/12						24			<0.05	0.002						0.091	<0.0001		

Abbreviations: Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; VOCs = Volatile Organic Compounds; Bold = unfiltered.

Table 13: Field analytes, water level, nutrients, carbon – Monitoring well GWEX-03

GWEX-03	Field analytes					Water levels		Nutrients				Carbon				
	DO	EC	pH	Eh	Temp	D	RL	NO _x as N	TKN as N	NH ₃ as N	TotN	Free CO ₂	Alk	CO ₂ + Alk	TOC	PAH yearly
Measure	mg/L	µS/cm	1-14	Mv	°C	m	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.1	0.001	0.1	1	1	1	1	various
29/08/05						10.74	993.44									
13/09/05	1.04	794	6.43	+226	16.0	10.71	993.47	0.056	<0.1	0.050	<0.1	170	329	111	<1	NT
26/11/05	0.43	780	6.52	+154	16.5	10.71	993.47	0.112	0.2	0.083	0.3	182	334	115	3	nil detected
18/03/06	0.80	765	6.45	+147	18.9	10.43	993.75	0.141	<0.1	0.043	0.1	161	292	101	<1	nil detected
20/07/06	0.61	800	6.52	+181	13.6	10.47	993.71	0.306	0.1	0.052	0.4	176	273	102	2	NT
12/09/06	1.86	780	7.10	+148	14.2	10.45	993.73	0.461	0.2	0.056	0.7	182	273	103	1	NT
18/01/07	0.45	815	6.68	+164	16.2	10.65	993.53	0.080	0.2	<0.010	0.3	191	271	105	<1	nil detected
18/04/07	0.36	794	6.50	+266	16.8	10.76	993.42	0.102	<0.1	0.015	0.1	183	273	104	5	NT
08/07/07	1.19	811	6.11	+166	10.8	10.82	993.36	0.128	<0.1	0.017	0.1	173	283	103	1	NT
13/10/07	0.50	840	6.90	+162	16.6	10.88	993.30	0.172	<0.1	0.027	0.2	142	272	92	<1	NT
21/01/08	0.71	805	6.78	+70	16.7	10.49	993.69	0.098	0.4	0.017	0.5	82	367	95	<1	nil detected
13/04/08	1.01	782	7.39	+61	16.3	10.64	993.54	0.148	0.2	0.074	0.3	21	316	68	<1	NT
22/06/08	8.12	780	7.25	+112	13.6	10.61	993.57	0.132	<0.1	0.072	0.1	53	221	58	<1	NT
15/09/08	1.48	751	7.12	+78	17.2	10.52	993.66	0.170	0.5	0.160	0.6	22	267	59	<1	NT
30/01/09	2.11	785	8.91	+66	20.2	10.69	993.49	0.080	0.6	0.030	0.7	<1	367	72	6	NT
16/04/09	1.52	696	7.11	+79	16.1	10.77	993.41	0.170	0.2	0.040	0.4	65	267	70	4	nil detected
04/07/09	1.75	766	7.30	+81	12.3	10.59	993.59	0.200	<0.1	0.060	0.2	67	258	69	12	NT
22/10/09	3.25	868	6.88	+126	19.2	10.72	993.46	0.170	0.2	0.040	0.3	79	300	81	1	NT
07/03/10	0.69	818	6.53	+122	18.1	10.50	993.68	0.14	<0.1	0.020	0.1	147	281	95	3	NT
01/05/10	0.61	854	6.51	+101	17.8	10.65	993.53	0.13	<0.1	<0.010	0.1	154	290	99	13	nil detected
15/07/10	0.53	874	6.63	+141	14.0	10.76	993.42	0.14	<0.1	<0.010	0.1	170	283	102	13	NT
14/10/10	0.60	961	6.72	+76	16.9	10.13	994.05	0.23	<0.1	0.03	0.2	154	317	104	6	NT
21/02/11	0.79	912	6.64	+118	19.9	9.69	994.49	0.14	<0.1	0.04	0.2	150	301	100	<1	NT
24/06/11	1.19	733	6.86	+166	15.6	9.73	994.45	0.14	<0.1	0.01	0.1	170	243	94	22	nil detected
17/08/11	0.61	872	6.32	+214	15.4	9.53	994.65	0.06	<0.1	0.08	<0.1	167	280	101	12	NT
12/10/11	1.19	826	6.57	+363	18.0	9.40	994.78	0.10	<0.1	<0.01	0.1	120	277	87	<1	NT
22/01/12	1.26	826	6.41	+154	19.4	8.64	995.54	0.08	<0.1	0.02	<0.1	179	258	100	<1	NT
09/05/12	0.98	914	6.38	+199	17.7	8.72	995.46	0.90	0.3	0.04	1.2	176	250	97	12	nil detected

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Depth to water from top of internal well PVC casing; RL = water level converted to Reduced Level relative to mean sea level (RL from top of PVC casing = 1004.18m; NO_x = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Free CO₂ = Free Carbon Dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TOC = Total Organic Carbon; PAH = Polynuclear aromatic hydrocarbons (includes Benzo(a) pyrene); NT = not tested; Bold = not filtered. Note: PAH only required yearly.

Table 14: Laboratory analytes – geochemical, metals, VOCs – Monitoring well GWEX-03

GWEX-03	Laboratory analytes – geochemical and metals																	VOCs
	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0001	various
13/09/05	61	38	59	4	20	94	<0.1	0.8	<0.05	0.07	<0.001	0.0004	<0.001	<0.001	<0.01	0.017	0.0002	nil detected
26/11/05	56	36	54	3	19	93	<0.1	0.9	<0.05	0.03	<0.001	0.0001	<0.001	<0.001	<0.01	<0.005	<0.0001	nil detected
18/03/06	59	36	59	2	19	86	<0.1	0.9	<0.05	0.02	0.001	<0.0001	<0.001	<0.001	<0.01	0.034	<0.0001	nil detected
20/07/06	61	38	59	3	19	101	<0.1	1.0	<0.05	0.02	<0.001	<0.0001	<0.001	<0.001	<0.01	<0.005	<0.0001	nil detected
12/09/06						95		1.0	<0.05	0.01						0.007	<0.0001	discontinue
18/01/07						97			<0.05	<0.01						<0.005	<0.0001	
18/04/07						108		0.4	<0.05	0.03						0.013	<0.0001	
08/07/07						94			<0.05	0.01						0.006	<0.0001	
13/10/07						99			<0.05	0.01						0.007	<0.0001	
21/01/08						101			<0.05	0.02						0.032	<0.0001	
13/04/08						115			<0.05	<0.01						0.012	<0.0001	
22/06/08						98			<0.05	<0.01						0.016	<0.0001	
15/09/08						98			<0.05	<0.01						0.010	<0.0001	
30/01/09						93			<0.05	<0.01						<0.005	<0.0001	
16/04/09						90			<0.05	0.02						0.011	<0.0001	
04/07/09						89			<0.05	0.003						0.012	<0.0001	
22/10/09						92			0.06	0.004						0.019	<0.0001	
07/03/10						102			<0.05	0.003						0.032	<0.0001	
01/05/10						99			0.05	0.004						0.040	<0.0001	
15/07/10						105			<0.05	0.006						0.028	<0.0001	
14/10/10						98			<0.05	0.005						0.047	<0.0001	
21/02/11						99			2.20	0.117						0.019	<0.0001	
24/06/11						88			<0.05	0.003						0.006	<0.0001	
17/08/11						94			<0.05	0.002						0.006	<0.0001	
12/10/11						97			<0.05	0.004						0.034	<0.0001	
22/01/12						84			<0.05	0.004						0.064	<0.0001	
09/05/12						111			<0.05	0.005						0.033	<0.0001	

Abbreviations: Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; VOCs = Volatile Organic Compounds; Bold = not filtered.

Table 15: Field analytes, water level, nutrients, carbon – Surface water sampling point LS1

LS1	Field analytes					Water depth	Nutrients								Carbon					
	DO	EC	pH	Eh	Temp		D	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC
Measure	mg/L	µS/cm	1-14	Mv	°C	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01	1	1	1	1	1	1	1
13/02/98	NT	NT	5.97	NT	NT		NT	NT	<0.01	NT	<0.01	NT	NT		92				17	
24/02/98	NT	NT	6.25	NT	NT		NT	NT	<0.01	NT	<0.01	NT	NT		144				23	
16/03/98	NT	NT	6.22	NT	NT		NT	NT	<0.01	NT	<0.01	NT	NT		208				18	
20/04/98	NT	NT	6.91	NT	NT		NT	NT	0.04	NT	0.52	NT	NT		2				18	
18/05/98	NT	NT	5.64	NT	NT		NT	NT	0.10	NT	0.38	NT	NT		71				9	
09/02/00	8.01	307	9.01	+68	26.5	1.40	0.01	NT	NT	1.8	NT	1.8	0.05		71				17	
09/05/00	8.49	180	8.85	+92	16.9	1.02	0.01	NT	NT	0.9	NT	0.9	0.02		38				20	
15/08/00	12.64	256	8.61	+93	15.1	1.03	<0.01	NT	NT	1.5	NT	1.5	0.51		58				20	
15/11/00	8.50	136	7.15	+105	15.6	1.00	0.03	NT	NT	1.3	NT	1.3	0.19		23				14	
18/09/01	9.02	274	7.54	+216	17.3	1.00	<0.01	<0.001	<0.01	0.05	0.05	0.05	NC		20				12	
08/03/02	9.14	198	8.81	+240	24.7	0.45	<0.01	<0.001	<0.01	1.4	0.09	1.4			32				18	
04/09/02	7.11	186	7.02	+258	19.8	0.40	0.03	<0.001	0.03	4.5	2.98	4.5			32				16	
09/03/03	4.97	159	7.12	+223	21.1	0.90	0.02	0.008	0.01	1.1	0.10	1.1		6	27	7	10	27	37	
06/09/03	15.29	265	10.14	+130	17.6	0.60	<0.01	0.002	<0.01	2.0	0.11	2.0		<1	53	10	9	16	25	
04/03/04	8.92	218	9.38	+124	24.0	0.70	<0.01	NC	NC	3.2	NC	3.2		<1	59	12	10	8	18	
16/09/04	11.23	172	7.26	+149	12.3	0.45	<0.01			0.9		0.9			31		4	9	13	
No longer exists																				

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Approximate depth of water at sampling point; NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free carbon dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested.

Table 16: Laboratory analytes – suspended solids, geochemical, metals, VOCs – Surface water LS1

LS1	Laboratory analytes – geochemical and metals																			VOCs
	SS	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	Cu	
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	0.001	various
13/02/98	NT	15	NT	32	2	7	32	NT	NT	0.28	<0.01	<0.001	<0.001	NT	<0.01	NT	<0.001	<0.005	0.01	NT
24/02/98	NT	4	NT	50	3	8	40	NT	NT	0.43	<0.01	<0.001	<0.001	NT	<0.01	NT	0.010	<0.005	<0.01	NT
16/03/98	NT	4	NT	35	3	7	36	NT	NT	0.63	<0.01	<0.001	<0.001	NT	<0.01	NT	<0.001	<0.005	<0.01	NT
20/04/98	NT	4	NT	66	7	37	48	NT	NT	0.40	0.05	<0.001	<0.001	NT	0.01	NT	0.003	<0.005	<0.01	NT
18/05/98	NT	4	NT	40	1	2	26	NT	NT	0.20	<0.01	<0.001	<0.001	NT	0.01	NT	0.008	<0.005	<0.01	NT
09/02/00	6	14	7	30	6	23	34	<0.2	0.3	0.45	0.08	0.001	<0.001	<0.001	NT	<0.01	NT	<0.0005	NT	nil detected discontinued
09/05/00	6	9	4	16	4	20	NC	<0.2	0.1	0.35	0.01	NC	<0.001	NC	<0.001	NC	0.010	NC	NC	
15/08/00	17	NC	NC	NC	NC	NC		<0.2	0.2	2.07	0.19		<0.001		<0.001		0.004			
15/11/00	9							<0.1	<0.1	0.75	0.03		<0.001		0.001		0.023			
18/09/01	13								0.2	0.47	0.01						0.030			
08/03/02	15								0.1	0.56	<0.01						0.050			
04/09/02	9								<0.1	1.85	0.13						0.120			
09/03/03	4								<0.1	0.97	0.08						0.038			
06/09/03	<1								0.3	0.32	0.01						0.019			
04/03/04	8								0.2	0.44	0.02						0.002			
16/09/04	15								<0.1	0.64	0.02						0.031			
No longer exists																				

Abbreviations: SS = Suspended solids; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; Cu = Copper; VOCs = Volatile Organic Compounds; NT = Not tested.

Table 17: Field analytes, water level, nutrients, carbon – Surface water sampling point LS2

LS2	Field analytes					Water depth	Nutrients								Carbon					
	DO	EC	pH	Eh	Temp		D	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC
Measure	mg/L	S/cm	1-14	Mv	°C	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01	1	1	1	1	1	1	1
13/02/98	NT	NT	8.02	NT	NT		NT	NT	<0.01	NT	<0.01	NT	NT		1				7	
24/02/98	NT	NT	7.56	NT	NT		NT	NT	<0.01	NT	<0.01	NT	NT		73				6	
16/03/98	NT	NT	8.09	NT	NT		NT	NT	<0.01	NT	<0.01	NT	NT		129				9	
20/04/98	NT	NT	6.54	NT	NT		NT	NT	0.51	NT	<0.01	NT	NT		1194				5	
18/05/98	NT	NT	7.20	NT	NT		NT	NT	<0.01	NT	0.03	NT	NT		2				4	
09/02/00	7.94	1143	8.60	+99	23.6	1.00	<0.01	NT	NT	2.3	NT	2.3	0.02		206				13	
09/05/00	8.17	1111	8.82	+19	16.0	1.25	0.01	NT	NT	1.5	NT	1.5	0.02		205				33	
15/08/00	11.10	1218	8.62	+27	10.0	1.50	<0.01	NT	NT	2.9	NT	2.9	<0.01		242				28	
15/11/00	9.13	1268	8.94	+39	17.5	1.20	0.08	NT	NT	1.4	NT	1.5	0.08		261				25	
18/09/01	10.62	1190	8.83	+188	15.5	1.00	0.03	0.027	<0.01	0.77	0.05	0.8	NC		230				24	
08/03/02	8.26	1607	8.65	+237	23.0	1.10	<0.01	<0.001	<0.01	1.5	0.11	1.5			243				58	
05/09/02	10.03	1853	8.96	+262	18.2	0.75	<0.01	0.001	<0.01	1.9	0.05	1.9			235				29	
08/03/03	5.93	1592	8.17	+117	24.3	1.00	1.11	0.071	1.04	4.9	2.77	6.0		1	209	41	56	42	98	
12/06/03	13.20	1425	8.45	+246	12.4	0.90	0.13	0.024	0.11											
06/09/03	13.43	1593	8.82	+159	13.2	1.20	0.92	0.023	0.90	2.6	0.05	3.5		<1	300	60	45	46	91	
05/03/04	8.48	1347	8.59	+180	20.1	0.99	0.42	NC	NC	6.5	NC	6.9		<1	473	93	79	47	126	
15/09/04	11.87	1387	9.16	+101	15.2	0.60	<0.01			1.5		1.5		<1	363	71	73	32	105	
07/03/05	6.27	1417	8.66	+224	20.8	0.90	<0.01			4.5		4.5		<1	301	59	NC	34	NC	
17/06/05	10.68	1481	9.17	+113	9.5	1.00	0.02			4.1		4.1		<1	423	83		51		
13/09/05	12.24	1236	8.92	+150	11.8	1.20	0.535			3.5		4.0		<1	253	50		50		
26/11/05	12.33	1071	9.96	+111	25.7	1.40	0.052			5.2		5.2		<1	276	54		42		
18/03/06	9.84	971	8.65	+84	24.3	1.20	0.039			3.7		3.7		<1	300	59		34		
20/07/06	12.97	1009	9.11	+107	10.8	0.50	0.305			3.6		4.0		<1	249	49		42		
12/09/06	12.68	962	9.04	+109	10.8	0.75	0.860			4.2		5.1		<1	239	47		30		
18/01/07	8.22	1072	9.03	+113	25.4	1.20	<0.01			6.3		6.3		<1	231	45		46		
18/04/07	12.94	1124	8.94	+217	18.8	1.40	0.095			5.5		5.6		<1	367	72		41		
08/07/07	11.38	1070	9.06	+61	7.8	1.20	0.046			4.0		4.1		<1	338	66		40		
14/10/07	7.07	1378	8.16	+176	18.8	1.25	0.272			6.0		6.2		<1	420	84		37		
14/04/08	9.61	1393	9.03	+156	19.5	1.20	<0.01			6.8		6.8		<1	439	86		46		
14/09/08	13.71	1398	9.02	-118	14.8	0.60	0.11			5.7		5.8		<1	440	87		41		
15/04/09	10.66	1592	9.38	+100	20.0	0.70	0.01			4.8		4.8		<1	480	94		64		
21/10/09	15.35	1733	9.53	+136	25.1	0.45	0.05			7.4		7.5		<1	513	101		77		
02/05/10	10.92	2172	8.69	+56	19.7	0.50	0.02			10.3		10.3		<1	613	121		85		
14/10/10	11.44	2041	9.01	+1	14.8	0.80	0.11			10.1		10.2		<1	563	111		66		
26/06/11	14.01	2710	8.58	+92	10.6	0.75	0.23			24.4		24.6		<1	440	87		124		
11/10/11	13.05	2610	8.85	+56	17.1	0.70	0.43			19.5		19.9		<1	683	134		57		
08/05/12	10.99	2780	8.68	+55	16.8	0.45	0.22			17.0		17.2		<1	700	138		83		

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Approximate depth of water at sampling point; NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free Carbon Dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested; NC = Not continuing; Bold = unfiltered.

Table 18: Laboratory analytes – suspended solids, geochemical, metals, VOCs – Surface water LS2

LS2 Measure Reporting Limit	Laboratory analytes – geochemical and metals																			VOCs
	SS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	SO ₄ mg/L	Cl mg/L	B mg/L	Br mg/L	Fe mg/L	Mn mg/L	As mg/L	Cd mg/L	Cr mg/L	Pb mg/L	Se mg/L	Zn mg/L	Hg mg/L	Cu mg/L	mg/L
	1	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	0.001	various
13/02/98	NT	10	NT	211	3	42	184	NT	NT	0.13	<0.01	0.005	<0.001	NT	<0.01	NT	<0.001	<0.005	0.01	NT
24/02/98	NT	10	NT	345	4	37	199	NT	NT	0.01	<0.01	<0.001	<0.001	NT	<0.01	NT	0.003	<0.005	0.01	NT
16/03/98	NT	11	NT	389	5	35	199	NT	NT	<0.01	<0.01	0.005	<0.001	NT	<0.01	NT	<0.001	<0.005	0.01	NT
20/04/98	NT	10	NT	173	3	28	180	NT	NT	0.03	0.05	<0.001	<0.001	NT	<0.01	NT	0.001	<0.005	<0.01	NT
18/05/98	NT	9	NT	265	112	29	204	NT	NT	0.07	<0.01	0.003	<0.001	NT	0.01	NT	0.005	<0.005	<0.01	NT
09/02/00	15	28	35	127	40	64	199	<0.2	1.7	<0.01	0.05	0.002	<0.001	<0.001	NT	<0.01	NT	<0.0005	NC	nil detected discontinued
09/05/00	11	26	35	118	39	58	NC	<0.2	1.7	0.06	0.02	NC	0.001	NC	<0.001	NC	0.005	NC		
15/08/00	4	NC	NC	NC	NC	NC		<0.2	2.6	0.04	<0.01		<0.001		<0.001		0.009			
15/11/00	32							<0.1	2.6	0.27	0.04		<0.001		0.001		0.036			
18/09/01	7								2.3	0.04	0.03						0.010			
08/03/02	9								3.5	0.21	<0.01						0.110			
05/09/02	9								4.5	0.07	<0.01						0.014			
08/03/03	4								3.8	0.23	0.07						0.030			
06/09/03	<2								3.0	0.04	<0.01						0.013			
05/03/04	10								1.4	0.02	0.02						0.003			
15/09/04	5								1.9	0.11	0.03						0.021			
07/03/05	38								4.4	0.20	0.26						< 0.005			
17/06/05	55								2.6	1.23	0.15						< 0.005			
13/09/05	55								2.3	1.31	0.06						< 0.005			
26/11/05	43								1.6	0.67	0.07						0.012			
18/03/06	15								1.7	0.20	0.12						0.010			
20/07/06	41								1.8	0.74	0.14						0.005			
12/09/06	42								1.4	1.40	0.13						0.016			
18/01/07	92								NT	0.27	0.10						0.006			
18/04/07	32								0.6	< 0.05	< 0.01						< 0.005			
08/07/07	10									0.35	0.06						0.022			
14/10/07	8									0.45	0.14						0.010			
14/04/08	59									0.23	0.14						0.022			
14/09/08	43									0.26	0.06						0.007			
15/04/09	58									0.13	0.08						< 0.005			
21/10/09	112									0.22	0.053						< 0.005			
02/05/10	65									0.18	0.184						< 0.005			
14/10/10	64									0.09	0.092						< 0.005			
26/06/11	29									0.55	0.148						< 0.005			
11/10/11	35									0.10	0.095						< 0.005			
08/05/12	29									0.16	0.069						< 0.005			

Abbreviations: SS = Suspended solids; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; Cu = Copper; VOCs = Volatile Organic Compounds; NT = Not tested; NC = Not continuing; Bold = not filtered.

Table 19: Field analytes, water level, nutrients, carbon – Surface water sampling point LS3

LS3	Field analytes					Water depth	Nutrients							Carbon						
	DO	EC	pH	Eh	Temp		D	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk mg/L	CO ₂ + Alk mg/L	TIC mg/L	TOC mg/L	TC mg/L
Measure	mg/L	µS/cm	1-14	Mv	°C	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01	1	1	1	1	1	1	1
13/02/98	NT	NT	8.04	NT	NT		NT	NT	0.96	NT	5.56	NT	NT		835				35	
24/02/98	NT	NT	6.01	NT	NT		NT	NT	0.95	NT	13.46	NT	NT		851				39	
16/03/98	NT	NT	8.52	NT	NT		NT	NT	0.91	NT	10.70	NT	NT		5				50	
20/04/98	NT	NT	8.45	NT	NT		NT	NT	0.63	NT	8.45	NT	NT		1059				43	
18/05/98	NT	NT	5.91	NT	NT		NT	NT	0.31	NT	13.81	NT	NT		117				33	
09/02/00	10.10	2122	8.48	+103	23.7	1.50	0.81	*3.63	*<0.01	10.3	*6.52	11.1	0.06		541				20	
09/05/00	4.89	2102	8.33	+52	17.2	1.10	0.79	0.40	0.39	15.8	7.82	16.6	NT		548				67	
15/08/00	7.48	2000	8.29	+78	11.4	1.00	2.99	0.31	2.68	18.6	14.9	21.6	0.10		611				48	
14/11/00	13.36	2217	9.10	+7	17.0		1.42	0.216	1.20	15.58	5.0	17.0	0.28		630				66	
18/09/01	9.49	2672	8.29	+161	17.2	1.00	0.57	0.367	0.20	21.03	15.0	22.6			642				68	
08/03/02	13.01	2255	8.72	+211	24.4	1.00	1.43	0.554	0.88	7.5	1.07	8.9			400				96	
05/09/02	20.20	2356	9.19	+209	18.0	0.90	2.41	0.260	2.15	10.5	4.45	12.9			360				59	
08/03/03	5.25	1590	8.08	+129	26.5	1.00	0.94	0.158	0.78	9.6	6.67	10.5		12	315	65	82	53	135	
12/06/03	7.61	1749	8.36	+235	13.7	0.60														
06/09/03	11.07	2085	8.59	+147	14.8	1.00	2.21	0.076	2.13	9.9	6.14	12.1		<1	517	102	64	50	114	
05/03/04	7.60	2185	8.38	+230	18.9	0.95	1.49	NC	NC	17.3	11.4	18.8		<1	837	165	134	67	203	
15/09/04	14.19	2039	9.24	+101	16.1	0.50	3.48			9.5	2.89	13.0		<1	375	74	77	67	144	
07/03/05	8.66	1470	8.83	+161	21.8	0.85	0.393			9.6	2.48	10.0		<1	329	65	NC	41	NC	
13/09/05	13.47	1500	8.67	+176	13.2	0.75	5.89			11.6	6.97	17.5		<1	347	68		79		
18/03/06	11.91	1424	9.37	+102	22.8	0.80	0.185			12.8	0.915	12.9		<1	327	64		68		
12/09/06	16.62	1648	9.70	+70	12.8	1.00	0.695			17.1	2.04	17.8		<1	380	75		84		
18/04/07	22.88	1666	9.19	+154	21.9	0.80	0.302			19.3	7.99	19.6		<1	473	93		81		
14/10/07	19.18	1927	9.00	+71	22.3	1.25	1.030			15.0	6.03	16.0		<1	428	83		90		
14/04/08	11.62	1497	8.68	+120	19.9	0.90	0.210			9.0	3.67	9.2		<1	437	86		53		
14/09/08	13.09	1546	8.79	-56	14.8	0.50	0.800			5.8	3.97	6.6		<1	420	83		41		
15/04/09	16.62	1192	9.93	+106	20.3	1.10	0.270			4.9	0.43	5.2		<1	267	53		56		
21/10/09	14.80	1618	9.26	+166	24.4	0.55	0.460			5.2	1.32	5.6		<1	357	70		61		
02/05/10	11.24	1418	9.19	-1	19.9	0.60	0.120			6.4	1.03	6.5		<1	340	67		65		
14/10/10	14.50	1532	8.87	+95	15.0	0.50	0.220			7.4	3.27	7.6		<1	367	72		47		
26/06/11	13.68	1659	8.13	-50	10.3	1.20	1.33			11.2	6.97	12.5		15	719	146		59		
11/10/11	13.62	1561	8.81	+69	16.9	0.75	1.00			7.1	2.03	8.1		<1	377	74		28		
08/05/12	13.18	1733	9.08	+52	17.8	0.70	0.07			8.9	0.62	9.0		<1	713	140		64		

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Approximate depth of water at sampling point; NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free carbon dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested; * = Tested ~ fortnight later; NC = Not continuing; Bold = unfiltered.

Table 20: Laboratory analytes – suspended solids, geochemical and metals – Surface water LS3

LS3	Laboratory analytes – geochemical and metals																			VOCs
Measure	SS	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	Cu	mg/L
Reporting Limit	1	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	0.001	various
13/02/98	NT	35	NT	260	57	6	356	NT	NT	0.31	<0.01	0.002	<0.001	NT	<0.01	NT	<0.001	<0.005	0.02	NT
24/02/98	NT	35	NT	450	80	6	466	NT	NT	0.18	<0.01	<0.001	<0.001	NT	<0.01	NT	0.030	<0.005	0.01	NT
16/03/98	NT	43	NT	90	63	5	56	NT	NT	0.17	<0.01	<0.001	<0.001	NT	<0.01	NT	<0.001	<0.005	0.01	NT
20/04/98	NT	38	NT	693	86	3	613	NT	NT	0.62	0.01	<0.001	<0.001	NT	0.01	NT	0.008	<0.005	<0.01	NT
18/05/98	NT	35	NT	255	46	2	447	NT	NT	0.26	0.10	<0.001	<0.001	NT	0.01	NT	0.011	<0.005	0.01	NT
09/02/00	14	48	63	248	121	16	380	0.3	3.6	1.17	0.12	0.004	<0.001	0.001	NT	<0.01	NT	<0.0005	NT	nil detected discontinued
09/05/00	21	62	56	186	119	19	NT	0.3	3.6	2.25	0.11	0.004	<0.001	0.001	<0.001	<0.01	0.011	<0.0001	0.05	
15/08/00	3	NT	NT	NT	NT	NT	NT	0.2	4.3	1.80	0.14	0.003	0.003	<0.001	<0.001	0.02	0.025	<0.0005	NC	
14/11/00	43	47	66	226	121	82	NT	0.2	5.6	1.58	0.11	0.004	<0.001	0.001	0.001	<0.01	0.021	<0.0001		
18/09/01	13	NC	NC	NC	NC	NC	NC	NC	5.5	0.03	0.03	NC	NC	NC	NC	NC	0.014	NC		
08/03/02	41								5.4	0.28	0.03						0.044			
05/09/02	29								6.6	0.06	0.03						0.028			
08/03/03	9								3.2	0.99	0.20						0.033			
06/09/03	26								4.1	0.30	0.06						0.031			
05/03/04	24								2.9	0.06	0.14						0.019			
15/09/04	26								4.3	0.39	0.02						0.035			
07/03/05	42								4.9	0.69	0.13						0.016			
13/09/05	42								2.4	0.83	0.06						<0.005			
18/03/06	92								3.1	0.67	0.11						<0.005			
12/09/06	102								4.3	2.83	0.08						0.019			
18/04/07	68								1.9	0.06	<0.01						<0.005			
14/10/07	113									0.47	0.11						0.018			
14/04/08	56									0.25	0.22						0.016			
14/09/08	30									0.23	0.11						<0.005			
15/04/09	56									0.30	0.07						0.010			
21/10/09	48									0.30	0.060						<0.005			
02/05/10	56									0.34	0.205						<0.005			
14/10/10	48									0.22	0.160						0.006			
26/06/11	46									0.65	0.118						0.009			
11/10/11	37									0.33	0.089						0.009			
08/05/12	71									0.24	0.174						<0.005			

Abbreviations: SS = Suspended solids; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; Cu = Copper; VOCs = Volatile Organic Compounds; NT = Not tested; Bold = not filtered.

Table 21: Field analytes, water level, nutrients, carbon – Surface water sampling point LS4

LS4 Measure Reporting Limit	Field analytes					Water depth D m	Nutrients							Carbon					
	DO	EC	pH	Eh	Temp		NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC
	mg/L	µS/cm	1-14	Mv	°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01	1	1	1	1	1	1
13/02/98	NT	NT	7.33	NT	NT		NT	NT	1.05	NT	1.87	NT	NT		102			34	
24/02/98	NT	NT	8.39	NT	NT		NT	NT	1.46	NT	1.26	NT	NT		88			89	
16/03/98	NT	NT	8.37	NT	NT		NT	NT	0.89	NT	3.96	NT	NT		97			70	
20/04/98	NT	NT	5.86	NT	NT		NT	NT	0.81	NT	5.28	NT	NT		109			106	
18/05/98	NT	NT	5.52	NT	NT		NT	NT	1.29	NT	1.45	NT	NT		54			35	
09/02/00	12.61	2753	8.35	+111	20.0	0.45	1.29	*<0.01	*5.25	10.1	*13.1	11.4	0.18		628			59	
09/05/00	15.40	3100	8.52	+69	18.4	0.35	3.92	2.07	1.85	26.9	15.6	30.8	0.15		674			89	
15/08/00	16.36	1868	8.68	+96	14.7	0.35	5.30	0.58	4.72	15.9	12.9	21.2	0.14		452			55	
14/11/00	4.45	1298	8.34	+60	17.2	0.35	2.85	0.452	2.40	18.15	11.0	21.0	0.28		375			49	
18/09/01	15.33	2868	8.34	+167	18.2	0.40	0.68	0.375	0.30	13.62	8.0	14.3	NC		600			70	
08/03/02	9.24	1524	8.73	+187	25.2	0.10	0.01	0.013	<0.01	5.2	0.08	5.2			287			77	
05/09/02	16.03	2158	9.17	+223	19.8	0.25	1.61	0.213	1.40	6.9	0.29	8.5			327			49	
08/03/03	13.78	2027	8.30	+237	24.2	0.20	1.57	0.244	1.33	4.0	0.40	5.6		<1	384	76	106	67	173
06/09/03	13.38	2161	8.78	+188	12.7	0.15	1.88	0.022	1.86	4.0	0.04	5.9		<1	427	84	38	38	76
05/03/04	12.45	1376	9.18	+206	21.8	0.12	0.23	NC	NC	2.9	0.11	3.1		<1	431	85	70	55	125
15/09/04	14.46	1254	8.86	+115	18.2	0.30	1.13			2.6	0.49	3.8		<1	253	50	63	36	99
07/03/05	24.37	1007	9.79	+88	24.6	0.23	0.011			3.2	0.198	3.2		<1	261	51	NC	31	NC
13/09/05	19.95	1127	9.03	+171	16.4	0.20	6.93			3.8	0.673	10.7		<1	367	72		<1	
18/03/06	15.66	1024	9.86	+45	25.6	0.15	0.018			3.8	0.105	3.8		<1	265	52		42	
12/09/06	17.44	1690	8.91	+50	15.8	0.15	1.33			4.6	0.295	5.9		<1	313	62		47	
18/04/07	17.82	1828	8.76	+140	24.0	0.12	0.154			4.4	0.256	4.6		<1	415	82		63	
14/10/07	23.82	2173	9.65	-22	22.4	0.15	0.097			4.3	0.120	4.4		<1	378	74		66	
14/04/08	15.42	970	8.88	+111	20.7	0.25	0.039			2.2	0.073	2.2		<1	345	68		25	
14/09/08	16.61	1130	8.91	-44	15.5	0.20	<0.010			3.0	0.160	3.0		<1	250	49		31	
15/04/09	10.62	1085	8.58	+179	22.0	0.30	0.520			2.4	0.180	2.9		<1	277	54		30	
21/10/09	11.62	1670	8.81	+180	27.7	0.15	0.220			3.1	0.550	3.3		<1	287	46		48	
02/05/10	6.31	1364	8.23	+105	21.0	0.15	0.03			3.1	0.500	3.1		7	240	49		40	
14/10/10	13.15	1464	8.18	+8	15.2	0.30	0.50			3.0	0.15	3.5		147	367	112		48	
26/06/11	9.89	1758	7.71	+253	13.1	0.25	3.52			15.1	13.1	18.6		38	567	122		65	
11/10/11	6.56	1332	7.83	+23	17.5	0.35	2.98			4.5	1.84	7.5		29	394	85		37	
08/05/12	5.90	1764	7.29	+87	17.1	0.30	0.02			2.5	0.25	2.5		29	303	68		41	

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Approximate depth of water at sampling point; NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free carbon dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested; TBT = To Be Tested; * = Tested ~ fortnight later; NC = Not continuing; Bold = unfiltered.

Table 22: Laboratory analytes – suspended solids, geochemical, metals, VOCs – Surface water LS4

LS4	Laboratory analytes – geochemical and metals																			VOCs
	SS	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	Cu	
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	0.001	various
13/02/98	NT	38	NT	374	27	13	251	NT	NT	0.32	<0.01	<0.001	<0.001	NT	<0.01	NT	0.003	<0.005	0.01	NT
24/02/98	NT	45	NT	701	40	9	323	NT	NT	0.22	<0.01	<0.001	<0.001	NT	<0.01	NT	0.002	<0.005	0.01	NT
16/03/98	NT	43	NT	340	64	13	684	NT	NT	0.72	0.01	<0.001	<0.001	NT	<0.01	NT	0.003	<0.005	0.01	NT
20/04/98	NT	37	NT	2099	2	34	1297	NT	NT	0.86	0.04	0.001	<0.001	NT	0.01	NT	0.018	<0.005	0.01	NT
18/05/98	NT	36	NT	140	46	11	299	NT	NT	0.44	0.02	0.004	<0.001	NT	0.01	NT	0.023	<0.005	0.01	NT
09/02/00	96	58	82	312	133	9	502	0.2	4.2	0.82	0.75	0.007	<0.001	<0.001	NT	<0.01	NT	<0.0005	NC	nil detected discontinued
09/05/00	30	66	90	299	153	15	NT	0.3	5.6	0.27	0.31	0.005	0.001	0.001	<0.001	0.01	0.017	<0.0001		
15/08/00	28	NT	NT	NT	NT	NT	NT	<0.2	4.2	0.26	0.21	0.002	<0.001	<0.001	<0.001	0.02	0.023	<0.0005		
14/11/00	46	49	35	98	65	14	NT	<0.1	1.9	2.17	0.49	0.002	<0.001	0.002	0.004	<0.01	0.066	<0.0001		
18/09/01	24	NC	NC	NC	NC	NC	NC	NC	6.3	0.08	0.20	NC	NC	NC	NC	NC	0.041	NC		
08/03/02	49								2.7	0.06	0.16						0.069			
05/09/02	57								5.5	0.32	0.07						0.095			
08/03/03	14								3.4	0.05	0.04						0.019			
06/09/03	16								4.7	0.08	0.03						0.018			
05/03/04	12								2.1	0.02	0.06						0.008			
15/09/04	14								1.8	0.34	0.05						0.021			
07/03/05	7								3.9	0.27	0.11						0.017			
13/09/05	29								1.4	0.13	0.02						< 0.005			
18/03/06	17								2.0	0.44	0.22						0.007			
12/09/06	26								4.2	0.52	0.11						0.007			
18/04/07	8								3.4	0.06	< 0.01						< 0.005			
14/10/07	14									0.25	0.06						0.009			
14/04/08	9									0.50	0.27						< 0.005			
14/09/08	17									0.67	0.35						0.011			
15/04/09	5									0.29	0.14						0.011			
21/10/09	15									0.46	0.224						0.012			
02/05/10	24									1.16	0.361						0.023			
14/10/10	6									0.31	0.255						0.007			
26/06/11	8									0.32	0.178						0.015			
11/10/11	9									0.48	0.189						0.022			
08/05/12	9									0.64	0.486						0.007			

Abbreviations: SS = Suspended solids; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury; Cu = Copper; VOCs = Volatile Organic Compounds; NT = Not tested; Bold = not filtered.

Table 23: Field analytes, water level, nutrients, carbon – Surface water sampling point LS5

LS5	Field analytes					Water depth	Nutrients								Carbon					
	DO	EC	pH	Eh	Temp		D	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC
Measure	mg/L	µS/cm	1-14	Mv	°C	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01		1	1	1	1	1	1
09/02/00	5.81	574	7.93	+108	28.4	0.30	<0.01	NT	NT	2.3	NT	2.3	0.08			155			18	
09/05/00	8.42	312	8.13	+107	17.1	0.38	0.03	NT	NT	1.4	NT	1.4	0.05			96			19	
15/08/00	12.17	394	8.57	+107	11.8	0.30	<0.01	NT	NT	1.3	NT	1.3	0.08			129			22	
15/11/00	7.67	132	7.28	+97	14.9	0.60	0.03	NT	NT	1.1	NT	1.1	0.29			45			15	
18/09/01	7.85	249	7.70	+186	16.3	0.60	0.06	0.008	0.05	1.54	0.50	1.6	NC			62			17	
08/03/02	7.86	320	7.57	+255	22.3	0.25	<0.01	<0.001	<0.01	3.7	0.03	3.7				87			25	
04/09/02	9.35	230	8.07	+237	18.0	0.25	0.13	0.014	0.12	2.5	0.50	2.6				75			17	
09/03/03	6.72	344	7.47	+161	19.9	0.30	0.02	0.009	0.01	1.5	0.05	1.5		6	45	10	18	35	53	
06/09/03	13.30	398	9.35	+113	17.1	0.30	<0.01	0.001	<0.01	1.3	0.03	1.3		<1	83	16	9	19	28	
04/03/04	10.30	303	8.84	+116	20.6	0.30	<0.01	NC	NC	2.0	NC	2.0		<1	113	22	20	10	30	
16/09/04	7.58	279	7.14	+128	12.7	0.30	0.12			2.2		2.3		<1	73	14	16	1	17	
07/03/05	9.31	221	7.88	+161	25.4	0.30	<0.01			1.9		1.9		<1	63	12	NC	22	NC	
13/09/05	9.18	158	7.52	+140	13.3	0.30	0.072			2.0		2.1		3	48	10		20		
19/03/06	9.00	313	9.24	+92	20.9	0.80	0.011			2.4		2.4		<1	95	19		20		
15/09/06	21.86	694	10.01	+175	17.8	0.30	0.379			1.7		2.0		<1	149	29		32		
19/04/07	12.20	954	8.59	+146	23.6	0.40	0.042			3.6		3.7		<1	255	50		40		
14/10/07	9.85	366	8.83	+126	15.3	0.20	0.023			2.0		2.0		<1	109	21		20		
14/04/08	9.71	858	9.48	+94	19.6	0.25	0.038			2.5		2.5		<1	192	38		28		
15/09/08	6.89	347	7.21	+75	15.5	0.30	<0.01			1.6		1.6		10	67	16		19		
15/04/09	9.62	124	7.84	+180	21.8	0.30	<0.01			1.3		1.3		10	31	9		27		
21/10/09	12.78	655	10.39	+176	25.0	0.25	0.08			1.4		1.5		<1	80	16		27		
02/05/10	4.10	521	7.41	+154	14.2	0.20	0.28			1.4		1.7		9	133	29		22		
14/10/10	8.64	925	8.26	+106	14.8	0.50	0.04			1.8		1.8		6	194	40		25		
26/06/11	10.43	1081	8.02	+184	9.7	0.70	0.40			4.1		4.5		26	233	53		34		
11/10/11	9.33	486	7.48	+151	21.6	0.35	0.02			2.9		2.9		13	109	25		24		
08/05/12	10.80	716	8.23	+62	18.2	0.30	<0.01			1.9		1.9		3	156	32		24		

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Approximate depth of water at sampling point; NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; Free CO₂ = Free carbon dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; NT = Not tested; NC = Not continuing; Bold = unfiltered.

Table 24: Laboratory analytes – suspended solids, geochemical, metals, VOCs – Surface water LS5

Measure	Laboratory analytes – geochemical and metals																			VOCs
	SS	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	Cu	mg/L
Reporting Limit	1	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	0.001	various
09/02/00	26	22	18	46	21	6	72	<0.2	0.7	1.00	0.40	0.002	<0.001	<0.001	NT	<0.01	NT	<0.0005	NT	nil detected discontinued
09/05/00	29	17	16	39	22	8	NT	<0.2	0.5	1.05	0.14	0.001	<0.001	<0.001	0.001	<0.01	0.012	<0.0001	NT	
15/08/00	41	NT	NT	NT	NT	NT	NT	<0.2	0.5	0.63	0.13	<0.001	<0.001	<0.001	<0.001	<0.01	0.006	<0.0005	NT	
15/11/00	33	NT	NT	NT	NT	NT	NT	<0.1	<0.1	0.64	0.05	<0.001	<0.001	<0.001	0.002	<0.01	0.020	<0.0001	NT	
18/09/01	10	NC	NC	NC	NC	NC	NC	NC	0.2	2.06	0.07	NC	NC	NC	NC	NC	0.035	NC	NC	
08/03/02	30								0.3	0.44	0.04						0.051			
04/09/02	36								0.2	0.81	0.05						0.020			
09/03/03	25								0.5	1.21	0.13						0.045			
06/09/03	10								0.5	0.11	<0.01						0.019			
04/03/04	19								0.2	0.08	0.02						0.001			
16/09/04	28								0.3	1.20	0.15						0.035			
07/03/05	7								1.7	1.88	0.22						< 0.005			
13/09/05	31								0.2	5.89	0.15						< 0.005			
19/03/06	10								0.3	0.85	0.08						< 0.005			
15/09/06	11								1.0	1.58	0.02						< 0.005			
19/04/07	22								1.4	< 0.05	< 0.01						< 0.005			
14/10/07	32								1.78	0.14							0.006			
14/04/08	26								0.78	0.10							0.023			
15/09/08	14								3.43	0.11							0.009			
15/04/09	24								1.35	0.06							0.010			
21/10/09	20								0.85	0.056							0.008			
02/05/10	5								1.19	0.151							< 0.005			
14/10/10	15								1.47	0.226							< 0.005			
26/06/11	17								0.97	0.052							0.010			
11/10/11	53								5.53	0.106							0.028			
08/05/12	23								1.47	0.051							0.008			

Abbreviations: SS = Suspended solids; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Hg = Mercury; Zn = Zinc; Cu = Copper; VOCs = Volatile Organic Compounds; NT = Not tested; Bold = not filtered.

Table 25: Field analytes, physical, nutrients, carbon – Surface water sampling point SWEX-01

SWEX-01	Field analytes					Physical		Nutrients				Carbon				Phenols
	DO	EC	pH	Eh	Temp	D	VFR	NO _x as N	TKN as N	NH ₃ as N	TotN	Free CO ₂	Alk	CO ₂ + Alk	TOC	Total phenols
Measure	mg/L	µS/cm	1-14	Mv	°C	m	Kl/day	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01		0.01	0.1	0.01	0.1	1	1	1	1	0.05
13/09/05	11.53	278	8.06	+300	15.1	0.01	14.40	<0.01	0.5	NT	0.5	2	62	13	2	NT
26/11/05	6.72	256	8.39	+156	24.2	0.01	2.16	0.021	1.2	0.064	1.2	<1	79	16	11	0.10
18/03/06	8.64	320	8.30	+168	26.2	0.05	0.65	0.057	0.4	0.052	0.5	<1	111	22	8	<0.05
20/07/06	12.46	245	8.65	+129	11.4	0.05	10.37	0.276	0.3	0.055	0.6	<1	70	14	5	<0.05
10/09/06	10.23	234	8.55	+164	17.4	0.04	34.56	3.450	0.5	0.063	3.9	<1	86	17	6	<0.05
18/01/07	no	water														
18/04/07	16.18	328	8.66	+206	21.7	0.20	Nil	0.127	0.7	0.047	0.8	<1	127	25	14	<0.05
08/07/07	13.20	288	8.38	+120	7.6	0.06	181.40	0.020	0.2	0.044	0.2	<1	92	18	4	<0.05
13/10/07	13.66	351	7.46	+116	16.1	0.15	Nil	<0.010	0.2	0.033	0.2	9	123	27	6	<0.05
21/01/08	8.63	277	7.81	+117	27.6	0.005	0.43	<0.010	0.8	<0.010	0.8	6	100	21	1	<0.05
14/04/08	No	flow														
21/06/08	11.85	293	8.43	+134	10.1	0.15	0.09	0.016	<0.01	0.073	<0.1	<1	87	17	14	<0.05
15/09/08	9.10	253	7.78	+59	18.2	0.15	216.00	<0.010	0.7	0.060	0.7	9	80	18	6	<0.05
30/01/09	no	water														
15/04/09	7.53	597	7.31	+97	18.3	0.02	52.00	0.640	1.6	0.060	2.2	15	90	22	16	0.22
04/07/09	15.88	310	8.67	+116	9.7	0.20	1.08	0.020	0.3	0.020	0.3	<1	80	16	8	<0.05
21/10/09	no	water														
07/03/10	no	water														
02/05/10	9.18	266	6.87	+145	15.9	0.06	Nil	0.030	1.2	0.060	1.2	15	50	14	9	0.39
15/07/10	9.50	308	7.09	+145	11.6	0.05	0.33	0.070	0.5	0.030	0.6	12	57	14	4	<0.05
14/10/10	9.24	275	7.02	+95	19.1	0.03	6.48	0.230	0.4	0.15	0.6	15	97	23	10	<0.05
21/02/11	no	flow														
26/06/11	12.11	267	7.18	+192	7.8	0.05	7.2	0.25	0.3	0.04	0.6	15	54	15	9	<0.05
17/08/11	no	flow														
12/10/11	no	flow														
08/05/12	5.77	220	6.52	+45	14.5	0.05	Nil	<0.01	0.9	0.04	0.9	23	25	11	7	<0.05

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Approximate depth of water at sampling point; VFR = Volumetric Flow Rate; NO_x = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Free CO₂ = Free carbon dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TOC = Total Organic Carbon, NT = not tested; ND = nil detected.

Table 26: Laboratory analytes – suspended solids, geochemical, metals – Surface water SWEX-01

SWEX-01	Laboratory analytes – suspended solids, geochemical and metals										
	SS	Ca	Mg	Na	K	SO ₄	Cl	Br	Fe	Mn	Zn
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	1	0.1	0.01	0.01	0.001
13/09/05	14							<0.1	0.87	0.010	<0.005
26/11/05	83	18	9	18	6	11	12	0.2	1.84	0.060	0.008
18/03/06	7	28	13	19	3	38	12	<0.1	0.17	0.040	<0.005
20/07/06	11	19	9	15	2	24	17	<0.1	0.16	<0.010	<0.005
10/09/06	8	23	10	15	3	16	12	<0.01	1.70	<0.010	0.018
18/01/07	no water										
18/04/07	6	29	14	17	4	22	11	0.4	<0.05	<0.010	<0.005
08/07/07	29	25	12	17	4	26	16		0.13	<0.010	0.081
13/10/07	4	29	14	26	6	26	16		0.19	0.040	<0.005
21/01/08	37	22	9	14	7	13	24		0.38	0.030	0.045
14/04/08	No flow										
21/06/08	10	24	10	17	7	25	15		0.15	0.010	0.008
15/09/08	23	22	8	18	7	16	12		0.43	0.020	<0.005
30/01/09	no water										
15/04/09	14	48	17	32	42	74	71		0.40	0.020	0.027
04/07/09	10	23	8	15	12	20	20		0.33	0.008	0.006
21/10/09	no water										
07/03/10	no water										
02/05/10	53	16	7	12	20	40	12		0.55	0.020	0.011
15/07/10	14	24	8	13	14	36	25		0.95	0.034	0.009
14/10/10	12	25	8	13	7	5	12		1.57	0.092	<0.005
21/02/11	no flow										
26/06/11	9	21	7	13	8	25	23		0.19	0.007	0.007
17/08/11	no flow										
12/10/11	no flow										
08/05/12	90	15	5	11	7	47	11		6.07	0.480	0.015

Abbreviations: SS = Suspended solids; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; Br = Bromine; Fe = Iron; Mn = Manganese; bold = not filtered.

Table 27: Field analytes, water level, VOCs, nutrients – Leachate sampling point LL1

LL1	Field analytes					Water depth D	Volatile Organic Compounds (VOCs)	Nutrients						
	DO	EC	pH	Eh	Temp			NO _x as N mg/L	NO ₂ as N mg/L	NO ₃ as N mg/L	TKN as N mg/L	NH ₃ as N mg/L	TotN mg/L	TotP mg/L
Measure	mg/L	S/cm	1-14	Mv	°C	m	mg/L							
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.005	0.01	0.01	0.01	0.1	0.01	0.1	0.01
09/02/00	0.10	3325	6.61	-84	18.8	0.15	carbon disulphide 0.030 mg/L; 0.005 mg/L chlorobenzene.	<0.01	NT	NT	121	NT	121	34.30
09/05/00	0.15	4418	6.49	-147	22.0	0.10	methylethyl ketone (MEK) 0.170 mg/L; hexadiyne 0.005 mg/L; toluene 0.220 mg/L; ethylbenzene 0.015 mg/L; m&p-xylene 0.055 mg/L; cyclooctatetraene 0.013 mg/L; o-xylene 0.036mg/L; ethylemethyl benzene 0.020 mg/L; trimethyl benzene 0.130 mg/L; 1,2,4-trimethyl benzene 0.042 mg/L; ethyl hexanol 0.010 mg/L; butyl benzene 0.035 mg/L; eucalyptol 0.094 mg/L	0.10	<0.01	0.09	147	95.9	147	16.7
15/08/00	0.23	4048	6.85	-146	16.7	0.10	toluene 0.584 mg/L; ethylbenzene 0.027 mg/L; m&p-xylene 0.055 mg/L; cyclooctatetraene 0.051 mg/L; o-xylene 0.030mg/L; 1,2,4-trimethyl benzene 0.031 mg/L; p-isopropyltoluene 0.047 mg/L; eucalyptol 0.025 mg/L	0.01	0.01	<0.01	208	84.8	208	51.0
14/11/00	0.16	3448	7.01	-93	19.7	0.10	m,p-xylene 0.015 mg/L; 0-xylene 0.027 mg/L; ethylmethylbenzene 0.006 mg/L; 1,3,5-triethylbenzene 0.007 mg/L; 1,2,4-trimethylbenzene 0.009 mg/L; p-isopropyltoluene 0.012 mg/L; SVOCs tested for first time: 0.005 mg/L naphthalene, no other compounds including no organochlorine and organophosphorus pesticides	<0.01	<0.01	<0.01	NT	132	132	25.5
18/09/01	1.63	3405	6.83	-61	14.1	0.10	Only BTEX tested. Nil detected.	1.72	<0.001	1.72	84.0	70.7	85.7	
05/09/02	1.25	3463	7.16	-17	14.2	0.10	Only BTEX tested. Nil detected.	0.23	0.002	0.23	83.8	83.8	84.0	
06/09/03	2.24	3575	7.04	-101	14.6	0.15	Only BTEX tested. Nil detected.	0.38	<0.001	0.38	85.0	85.0	85.44	
15/09/04	1.63	3885	7.54	-49	15.3	0.02	Only BTEX tested. Nil detected.	0.06	0.001	0.06	114.0	10.1	114	
14/09/05	4.33	4023	7.38	-60	14.8	0.02	Only BTEX tested. Nil detected.	0.109	0.002	0.107	131	127	131	
12/09/06	1.02	3712	6.96	-132	10.4	0.05	Only BTEX tested. Nil detected.	1.12			260	99.7	262	
14/10/07	-0.08	3780	7.19	-124	21.3	0.02	Only BTEX tested. Nil detected.	0.199			139	93.1	140	
14/09/08	4.05	3140	8.05	+139	11.1	0.01	Only BTEX tested. Nil detected.	14.1			79.3	69.9	93.4	
21/10/09	4.60	3155	7.98	+137	18.3	fall	Only BTEX tested. Nil detected.	18.5			59.5	35.9	78.0	
14/10/10	4.63	2930	8.12	+105	15.3	fall	Only BTEX tested. Nil detected.	0.91			68.1	67.1	69.0	
11/10/11	7.84	2585	7.98	+53	20.2	fall	Only BTEX tested. Nil detected.	2.66			39.1	34.7	41.8	

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Ph = Ph; Eh = Redox Potential; Temp = Temperature; D = Approximate depth of water at sampling point; NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; NT = Not tested.

Table 28: Major ions, metals, TOC, pesticides – Leachate LL1

LL1	Laboratory analytes – geochemical and metals																		
Measure	Ca	Mg	Na	K	SO ₄	Cl	B	Br	Fe	Mn	As	Cd	Cr	Pb	Se	Zn	Hg	Cu	Organo-Pesticides
Reporting Limit	1	1	1	1	1	1	0.2	0.1	0.01	0.01	0.001	0.001	0.001	0.001	0.01	0.001	0.0005	0.001	0.0005 to 0.02
09/02/00	106	58	203	136	5	365	0.4	5.4	161	0.40	0.011	0.008	0.003	0.077	<0.01	NT	<0.0005	NT	
09/05/00	245	89	257	200	43	440	0.7	6.1	181	4.65	0.048	0.004	0.014	0.012	0.03	4.56	<0.0001	NT	
15/08/00	252	80	230	146	9	382	0.5	8.0	153	3.22	0.025	0.006	<0.001	0.009	0.04	2.09	<0.0005	NT	
14/11/00	159	68	203	136	15	420	0.6	7.4	469	14.30	0.002	<0.001	0.001	0.001	<0.01	0.360	<0.0001	NT	
18/09/01	NC	NC	NC	NC	NC	472	NC	8.6	16.0	1.17	NC	NC	NC	NC	NC	0.021	<0.0001	NC	nil detected
05/09/02						475		8.7	2.35	0.60						0.037	<0.0001		nil detected
06/09/03						474		8.3	11.0	0.60						0.033	<0.0001		nil detected
15/09/04						482		4.6	1.94	0.53						0.048	<0.0001		nil detected
14/09/05						556		5.6	23.6	0.62						0.025	<0.0001		0.0006 Endrin aldehyde
12/09/06						506		7.8	8490	7.78						0.908	<0.0001		nil detected
14/10/07						440			36.6	3.29						0.198	<0.0001		<LOR
14/09/08						390			3.16	1.55						0.030	<0.0001		<LOR
21/10/09						415			0.61	0.58						0.010	<0.0001		<LOR
14/10/10						298			1.20	1.34						0.007	<0.0001		<LOR
11/10/11						302			1.71	0.267						0.011	<0.0001		<LOR

Abbreviations: Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; SO₄ = Sulphate; Cl = Chloride; B = Boron; Br = Bromine; Fe = Iron; Mn = Manganese; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Se = Selenium; Zn = Zinc; Hg = Mercury;

Cu = Copper; NT = Not tested; bold = unfiltered.

Table 29: Carbon compounds – Leachate LL1

LL1	Carbon					
Measure	Free CO ₂	Alk	CO ₂ + Alk	TIC	TOC	TC
Reporting Limit	1	1	1	1	1	1
09/02/00			1420		54	
09/05/00			2210		743	
15/08/00			1390		129	
14/11/00			1267		94	
18/09/01			1150		101	
05/09/02			1130		75	
06/09/03	226	1161	290	104	264	368
15/09/04	169	1550	351	261	64	325
14/09/05	167	1633	367	NC	192	NC
12/09/06	337	1207	329		131	
14/10/07	161	1204	281		109	
14/09/08	59	1000	213		45	
21/10/09	59	900	193		93	
14/10/10	88	1125	245		78	
11/10/11	73	833	184		50	

Abbreviations: Free CO₂ = Free Carbon Dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TIC = Total Inorganic Carbon; TOC = Total Organic Carbon; TC = Total Carbon; Bold = unfiltered.

Table 30: Special samples re nutrient levels – LS6 10/05/00, Lmulch 17/05/00, LS7 15/08/00

	Field analytes					Nutrients						
	DO	EC	pH	Eh	Temp	NO _x as N	NO ₂ as N	NO ₃ as N	TKN as N	NH ₃ as N	TotN	TotP
Measure	mg/L	S/cm	1-14	Mv	°C	Mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	0.01	0.1	0.01	0.1	0.01
LS6	8.95	3565	7.62	+185	23.7	0.10	<0.01	0.09	10.1	0.28	10.2	0.75
Deionised water	7.96	3	6.00	+242	20.0							
Lmulch	1.76	4165	3.45	+171	20.5	0.07	0.01	0.06	196.0	110.0	196.0	143.0
LS7	4.34	408	8.20	+127	11.2	0.01	0.01	<0.01	3.3	0.74	3.3	0.90

Table 31: Field analytes, water level, BTEX, nutrients – Leachate sampling point LL2

LL2	Field analytes					Gauge depth GD	Benzene, Toluene, Ethylbenzene, Xylene compounds (BTEX) (test yearly)	Nutrients			
	DO	EC	pH	Eh	Temp			NO _x as N	TKN as N	NH ₃ as N	TotN
Measure	mg/L	S/cm	1-14	Mv	°C	m	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	various	0.01	0.1	0.01	0.1
26/11/05	0.36	2642	8.44	-42	26.4	0.45	<LOR	0.036	37.6	0.331	37.6
18/03/06	5.21	605	7.97	+113	24.0	1.50	NT	0.014	3.4	0.084	3.4
18/01/07	2.61	1271	8.00	+122	23.9	1.50	<LOR	<0.010	3.8	0.034	3.8
08/07/07	2.12	2163	8.93	+80	7.4	1.50	NT	<0.010	14.1	5.70	14.1
20/01/08	19.82	2041	8.35	+30	23.0	1.35	<LOR	0.038	24.2	8.06	24.2
21/06/08	13.08	2199	9.03	+116	10.8	1.55	<LOR	0.152	16.2	12.4	16.3
30/01/09	13.39	1907	9.04	+67	26.1	1.20	<LOR	0.510	12.2	2.49	12.7
04/07/09	8.62	3330	8.31	+52	8.3	1.30	NT	0.100	67.4	59.3	67.5
07/03/10	6.45	3445	8.30	+77	20.8	1.20	<LOR	0.100	68.5	63.5	68.6
15/07/10	15.04	2960	9.27	+86	12.5	1.30	NT	0.520	29.0	20.3	29.5
21/02/11	25.11	3780	8.49	+49	29.3	1.20	<LOR	0.13	93.4	85.2	93.5
17/08/11	23.03	4750	8.34	+127	11.7	1.00	NT	0.02	164.0	72.1	164.0
22/01/12	15.00	4575	8.05	+40	23.7	1.00	NT	<0.01	162.0	167.0	162.0

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance;

Ph = Ph; Eh = Redox Potential; Temp = Temperature; GD = Approx depth at depth gauge; BTEX (test yearly); NO_x = Nitrite + Nitrate; NO₂ = Nitrite; NO₃ = Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen + ammonia); NH₃ = Ammonia as a measure of ammonium ions; Tot N = Total Nitrogen; Tot P = Total Phosphorus; LOR = Level of reporting; NT = Not tested.

Table 32: Chloride, bromide, metals, pesticides, carbon compounds – Leachate LL2

LL2	Geochemical and metals						Pesticides Organo-pesticides (test yearly)	Carbon				
	Cl	Br	Fe	Mn	Zn	Hg		Free CO ₂	Alk	CO ₂ + Alk	TOC	PAH (test yearly)
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reporting Limit	1	0.1	0.01	0.01	0.001	0.0005	0.0005 to 0.02	1	1	1	1	various
26/11/05	163	0.6	5.26	4.79	0.069	<0.0001	<LOR	<1	995	196	746	NT
18/03/06	47	0.4	0.30	0.34	<0.005	<0.0001	<LOR	21	245	54	22	<LOR
18/01/07	72	NC	0.47	0.30	0.006	<0.0001	<LOR	29	305	68	35	<LOR
08/07/07	168		3.90	0.30	0.006	<0.0001	NT	<1	1000	197	80	NT
20/01/08	241		0.61	0.11	0.012	<0.0001	<LOR	<1	830	163	58	<LOR
21/06/08	268		0.30	0.14	0.009	<0.0001	<LOR	<1	700	138	79	<LOR
30/01/09	285		0.53	0.18	0.008	<0.0001	<LOR	<1	600	118	86	<LOR
04/07/09	368		2.52	0.456	0.014	<0.0001	NT	<1	1133	223	122	NT
07/03/10	487		0.96	0.182	<0.005	<0.0001	<LOR	<1	1000	197	98	<LOR
15/07/10	504		0.85	0.272	0.010	<0.0001	NT	<1	750	148	118	NT
21/02/11	515		0.49	0.345	0.014	<0.0001	<LOR	<1	1200	236	107	<LOR
17/08/11	538		2.68	0.247	0.026	<0.0001	NT	<1	1533	191	183	NT
22/01/12	453		1.92	0.266	<0.005	<0.0001	NT	88	1465	312	122	NT

Abbreviations: Cl = Chloride; Br = Bromine; Fe = Iron; Mn = Manganese; Zn = Zinc; Hg = Mercury; Organo-pesticides = Organochlorine and Organophosphorus pesticides (test yearly); Free CO₂ = Free Carbon Dioxide; Alk = Alkalinity measured as mg/L CaCO₃ equivalent; Unfiltered C of (CO₂ + Alk) = 12/44 CO₂ + 12/61 Alk; TOC = Total Organic Carbon; PAH = Polynuclear aromatic hydrocarbons (includes Benzo(a) pyrene) (test yearly); NT = not tested; NC = not continuing; LOR = Level of reporting; Bold = unfiltered.

10. CURRENT ENVIRONMENTAL MONITORING PROGRAM

The following table lists the Long Swamp Road Landfill current analytes required by the landfill's Environment Protection Licence No. 5860 updated by OEH Armidale, and archived 31 March 2011. Some extra analytes for additional water quality review are being tested at CodyHart recommendation, for example, free carbon dioxide.

Table 33: Licence required environmental monitoring - Long Swamp Road Landfill

Groundwater	Surface Water (LS2-LS5)	Surface Water (SWEX-01)	Leachate	Overflow events
Wells LW1-LW3, GWEX-01 (six-mthly) GWEX-02, GWEX-03 (quarterly) In situ field analytes Temperature pH Redox potential Electrical Conductivity Dissolved Oxygen Within 24 hours Alkalinity Laboratory Chloride Iron Manganese Zinc Mercury (not LW2, LW3) Ammonia Nitrate + Nitrite (NO _x) TKN TOC PAH (only GWEX-01 to GWEX-03; & only yearly.)	Points LS2 – LS5 (six-monthly) In situ field analytes Temperature pH Redox potential Electrical Conductivity Dissolved Oxygen Within 24 hours Alkalinity Laboratory Iron Manganese Zinc Ammonia (LS3, LS4 only) Nitrate + Nitrite (NO _x) TKN TOC Suspended solids	Point SWEX-01 (quarterly after stormwater discharge) In situ field analytes Temperature pH Electrical Conductivity Within 24 hours Alkalinity Laboratory Chloride, Calcium, Magnesium, Potassium, Sodium Iron Manganese Zinc Ammonia Nitrate + Nitrite (NO _x) TKN TOC Total Phenolics Suspended solids Field measurement Rough estimate of volumetric flow rate	Points LL1, LL2 LL1 annually, LL2 six-monthly) In situ field analytes Temperature pH Redox potential Electrical Conductivity Dissolved Oxygen Within 24 hours Alkalinity Laboratory Chloride Iron Manganese Zinc Mercury Ammonia Nitrate + Nitrite (NO _x) TKN TOC BTEX (Benzene, toluene, ethylbenzene, xylene) (LL2 yearly) Organochlorine and organophosphate pesticides (LL2 yearly) PAH (only LL2; only yearly.)	Overflow points at dam LS2 (LSO1), dam LS3 (LSO2), at dam LL2 (LSO5); downstream (LSO3) and upstream (LSO4) if possibly affected by leachate overflow Laboratory pH Electrical Conductivity Within 24 hours Alkalinity Chloride Iron Manganese Zinc Ammonia Nitrate + Nitrite (NO _x) TKN TOC Suspended solids BTEX (Benzene, toluene, ethylbenzene, xylene) (rough estimate of volumetric flow rate)
Methane monitoring: quarterly				

11. WATER QUALITY COMPARISONS

Table 34 is given as an aid for reviewing environmental health risks.

Table 34: Environmental health warning limits surface water - some Landfill analytes

Analyte	Reason for Inclusion	Aquatic 1	Human 2	Irrigation 3	Livestock 4
Temperature	Biodegradation of waste increases temperature. Temp + EC have successfully defined a leachate plume (Scrudato & Pagano, 1994).	>80%ile <20%ile	NR	NR	NR
pH	varies from acidic to alkaline as waste decomposition progresses (Andreottola & Cannas, 1992:72). But pH levels in groundwater are often naturally low.	6.5 to 8.0 (2000); 6.5 – 9.0 (1992)	6.5 to 8.5 (A)	>6 limits corrosion of pipes	NR
Electric Conductivity (EC)	a general indicator that summarises the general trend of major cation and anion concentrations.	≤30 - 350µS/cm (2000); ≤1500 µS/cm (1992)	≤1500µS/cm (A)	varies, e.g., ≤1,000µS/cm carrots	≥3582 µS/cm analyse for specific ions which may affect
Alkalinity	Measures acid-neutralising capacity, a solution's ability to buffer, that is stop pH changing. Often high in leachate, but some groundwaters can also have high alkalinity.	NR	NR	NR	NR
Boron	High mobility in clay. Good tracer. Found in leachate (Bagchi, 1994:52). Found in fireproofing agents, preservatives, antiseptics, glass, enamels, cosmetics, cements, carpets, soaps, powders and ointments. Some crops are intolerant to boron (ANZECC, 1992:5-13).	≤0.37 mg/L	≤0.3mg/L	≤0.5 mg/L (long term)	≤5mg/L
Bromine	Recently found to be a good leachate indicator (Baker, 1993a). Used in bleaches; dyes; pharmaceuticals; pesticides; solvents for waxes, greases and oils; additives for motor oil and fuels; and used in photograph development.	NR	NR	NR	NR
Ammonium ions	From decaying plants and animals. May be high in leachate (Hancock & Phillips, 1992:22). Toxic to fish (ANZECC, 1992:2-30).	≤0.18 mg/L as N for pH 9.0; ≤0.9 mg/L as N pH 8.0 ; ≤2.18 mg/L pH 7.0.	≤0.01 mg/L as N (1992) (A) ≤0.05 mg/L as NH ₄ (2004) (A)	Nitrogen ≤5 mg/L (long term; 25-125 mg/L (short term – up to 20 years)	NR
Iron and manganese	High iron concentrations affect plant growth and high manganese concentrations clog irrigation equipment and are toxic to plants (ANZECC, 1992:5-15,5-16).	Fe NR (2000), ≤1 mg/L (1992), Mn≤1.9mg/L	Fe 0.3 mg/L (A) Mn 0.5 mg/L	Fe & Mn 0.2 mg/L long term, 10 mg/L short term	not sufficiently toxic (2000); ≤17 mg/L for dairy cattle (1992)
Nitrate	From final stage of plant and animal decomposition or fertilisers. May be high in leachate (Canter, 1997:6). Toxic to infants and livestock (ANZECC, 1992:4-10,5-23).	NO _x ≤0.015 mg/L; TN ≤0.25 mg/L (2000); TN ≤0.1 to 0.75 mg/L (1992)	≤≤10 mg/L as N (1992) ≤11.3 mg/L as N (1996) ≤50 mg/L as NO ₃ (2004)	As for ammonia	≤ 90 mg/L as N; Nitrite ≤9 mg/L as N
Phosphorus	Csuros (1994:228-229) explains that phosphorus occurs in animal, plant and mineral kingdoms. Its discharge to streams may stimulate growth of photosynthetic organisms especially if it is the nutrient whose low values are limiting the primary productivity of the water.	Total P ≤0.02 mg/L	NR	≤0.05 mg/L (long term to prevent clogging irrig equipment; ≤0.8-12 mg/L (short term)	NR
VOCs	Good indicators of man-made pollutants found in landfill leachate (USEPA, 1991:51075). Toxic and carcinogenic to animals and humans.	varies for different compounds	varies for different compounds	NR	NR
Arsenic	Found in cattle dip soils; toxic, possibly carcinogenic (Manahan, 1990:150), toxic to livestock in high concentrations (ANZECC, 1992:5-25)	≤0.024 mg/L (III) form; ≤0.05 aquaculture	≤0.007 mg/L	≤0.1 mg/L long term; ≤2 mg/L short term	0.5 to 5 mg/L tolerated

Table 34 continued:

Analyte	Reason for Inclusion	Aquatic 1	Human 2	Irrigation 3	Livestock 4
Cadmium	Causes high blood pressure, kidney damage, destroys testicular tissue and red blood cells, toxic to aquatic biota (Manahan, 1990:150), toxic and carcinogenic to livestock (ANZECC, 1992:5-26)	≤0.0002 mg/L	≤0.002 mg/L	≤0.01 mg/L long term; ≤0.05 mg/L short term	≤0.01 mg/L
Chromium	Cr ⁺⁶ is possibly carcinogenic and is toxic to humans (anaemia, kidney disease, nervous system) (Manahan, 1990:150), reduces crop yield (ANZECC, 1992:5-14).	≤0.001 mg/L for Cr ⁺⁶	≤0.05 mg/L (Cr ⁺⁶)	≤0.1 mg/L long term; ≤1 mg/L short term	≤1 mg/L
Copper	Essential in small concentrations for plant growth and animals (ANZECC, 1992:5-15&5-27). Toxic to sensitive plants and animals and bioaccumulated.	0.0014 mg/L	<2 mg/L	≤0.2 mg/L long term; ≤5 mg/L short term	<0.4 mg/L sheep, <1 mg/L cattle; <5 mg/L pigs and poultry
Lead	Wildlife destruction (Manahan, 1990:151), reduces plant growth (ANZECC, 1992:5-16). Decreases human intelligence, growth (Csuros, 1994:210).	≤0.0034 mg/L	≤0.01 mg/L	≤2 mg/L long term; ≤5 mg/L short term	≤0.1 mg/L
Mercury	Very toxic to humans - numbness, deafness, loss of muscle control (Csuros, 1994:212); toxic to fish (ANZECC, 1992:2-38).	NR (2000); ≤0.0001 mg/L (1992)	≤0.001 mg/L	≤0.002 mg/L	≤0.002mg/L
Selenium	Toxic to cattle, fish and humans (Manahan, 1990:151) Used in electronics, glass, ceramics, pigments, rubber (Csuros, 1994:213).	≤0.005 mg/L	≤0.01 mg/L	≤0.02 mg/L long term; ≤0.05 mg/L short term	≤0.02 mg/L
Zinc	Found both naturally (weathering & erosion) and from anthropogenic sources (ANZECC, 1992:2-42). Zinc coating used to protect iron, steel and brass; used in dry batteries, construction materials, printing processes (Csuros, 1994:215). One of seven analytes with greatest percentage increase from 71 unlined landfills in North Carolina, USA (Borden and Yanoschak, 1990:269). Also found by CodyHart in landfill ponds and leachate.	≤0.008 mg/L	≤3 mg/L (A)	≤2 mg/L long term; ≤5 mg/L short term	≤20 mg/L
PAH	In old coal gasification plant coal tar waste deposited in landfill extension.	e.g., Naphthalene 0.016 mg/L	insufficient data	NR	as per human

1. from Tables 3.3.1, 3.3.2, 3.3.3 - Default trigger values for aquatic ecosystems in upland rivers of south-east Australia which are slightly-moderately disturbed and Tables 3.4.1 trigger values for toxicants 95% level of aquatic ecosystem protection in 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality', ANZECC & ARMCANZ 2000.

2. from 'Summary of Australian Drinking Water Guidelines' NHMRC & ARMCANZ 1996:26-32. (A) = aesthetic, no health guideline – same 2004 values <http://www.mincos.gov.au/nwqms_docs.htm>.

3. from Tables 4.2.5, 4.2.10, 4.2.11, 4.2.14 and 4.2.15 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality', ANZECC & ARMCANZ 2000.

4. from page 4.3-3 – 4.3-5 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality', ANZECC & ARMCANZ 2000.

NR - No recommendation

(A) aesthetic guideline rather than an environmental health guideline

(1992) refers to the 1992 edition of the 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'.

12. COMMENTS ON WATER LEVELS AND WATER QUALITY

Groundwater

Wells LW1, LW2, LW3, the old landfill wells.

Well LW1, the upgradient well. This well continues to be contaminated with nitrite + nitrate (276 mg/L) due to the nearby old night soil trenches as found on historical photographs and discussed with a former employee. The mercury concentration is still of note at 0.0011mg/L.

Well LW2, the downgradient well just north of the eastern end of leachate dam LS3. There was no indication of leachate contamination.

Well LW3, the downgradient well adjacent to the southern section of the western fence. There was no indication of leachate contamination.

Wells GWEX-01, GWEX-02, GWEX-03, the wells for the landfill extension.

These wells are not contaminated by landfill leachate. Comments of note are as follows:

- **GWEX-01**, the well upgradient of the landfill extension.
Mercury continues to be relatively high in well GWEX-01 (0.0025 mg/L). However, the mercury may not be due to anthropogenic causes. It may be derived from the surrounding soil and rock. Mercury is a compound that can be found naturally in the environment. It can be found in metal form, as mercury salts or as organic mercury compounds.
- **GWEX-02**, the downgradient well on the eastern side of the landfill extension.
The relative water level of well GWEX-02 continues to be lower (0.40 m lower) than in the topographically downgradient well, GWEX-03. The general groundwater flow direction under the new landfill extension is therefore towards GWEX-02. The water quality of this well has no contaminants of concern.
- **GWEX-03**, the downgradient well on the southern side of the landfill extension.
Bentonite intruded into the well screen increasing the pH in earlier sampling rounds. This was countered by raising the pump position, and increasing the purge volume until the pH was that of preceding rounds. The pump position was lowered to its original position in the October 2011 sampling round, and the pH continued to be normal at 6.38 after 4L of sampling. So the bentonite effect seems to have completely dissipated. No analytes were of note.

Surface water

SWEX-01 - surface water discharge point for the eastern diversion drain landfill extension

There was no flow in the diversion drain, but the flow path downstream from a pool was still very moist. Due to the shallowness of the pool, the sampling beaker needed to be pressed into the pool to collect the sample. As a result the suspended solids were relatively high at 90 mg/L. The total nitrogen was a little high at 0.9 mg/L when compared to the ≤ 0.25 mg/L guidance limit for 90% protection of Australian freshwater aquatic ecosystems. However, the ammonium compounds and nitrate were within the guideline limits. Organic nitrogen was therefore in exceedance, but was likely due to decaying animal and plant matter upstream in the diversion drain.

LS5 - the farmer's dam on the property to the south of the landfill

The water quality in this dam is not pristine. It receives surface water runoff from the landfill site, the industrial area in Acacia Park and farmland to the west. Its electrical conductivity (EC) of 716 $\mu\text{S}/\text{cm}$ and within the range of EC results from Year 2000 onwards. Its total kjeldahl nitrogen (1.9 mg/L) and metals were of low concentration for this dam. These concentrations are all acceptable for stock drinking purposes, the dam's economic use.

Leachate

LS2 - holding dam in the south-east corner of the old landfill site

This dam can now be classified as a leachate dam. Its leachate indicator analyte concentrations have been gradually increasing since the landfill extension leachate has been pumped into it. Its electrical conductivity for the May 2012 round was its greatest to date at 2780 $\mu\text{S}/\text{cm}$ which is approximately half strength the more concentrated leachate found at LL1 in Year 2000. So there is still some rainwater dilution from rain over the leachate dams. Total nitrogen was 17.2 mg/L, which is notable, but not a high concentration.

LS3 – leachate dam in south-western corner of the old landfill site

The May 2012 electrical conductivity (1733 $\mu\text{S}/\text{cm}$) was about midrange for this dam and indicates that the leachate in this dam is diluted by rainwater. Its total nitrogen concentration was 9.0 mg/L and therefore suitable for on-site irrigation over the landfill footprint. (The Australian and New Zealand total nitrogen guideline limit for long-term irrigation is 5 mg/L, and the short-term irrigation guideline is 25-125 mg/L.) Iron and manganese were at low concentrations, and zinc was not detected. The light green colour and high dissolved oxygen (13.18 mg/L) indicated that algae were improving the water quality.

LS4 – leachate dam on mid-western boundary of the old landfill site

This dam is shallow. Its metal concentrations were within the range of historical concentrations. Its nitrogen compound concentrations have returned to their lower concentrations of 2.5 mg/L.

LL1 – leachate discharging in a drain from the centre of the southern side of the old landfill towards the LS3 dam

This more concentrated leachate was not due for sampling this round. Until Year 2009, the LL1 sampling point had the most concentrated leachate sampled on the landfill site. There is more clay cover over the old section of the landfill, so there is only a trickle of leachate from a purpose built drain at the base of the old landfill. Its EC in September 2011 was 2,585 $\mu\text{S}/\text{cm}$, total nitrogen was 34.7 mg/L, and no BTEX compounds or pesticides were detected.

LL2 – leachate dam for landfill extension

This more concentrated leachate was not due for sampling this round. LL2, the primary dam for the eastern landfill extension now has the greatest leachate concentrations due to the increased age of the waste in the landfill extension. For example, in January 2012 its electrical conductivity (EC) was 4575 $\mu\text{S}/\text{cm}$ and total nitrogen was 162 mg/L. Metal concentrations were still low and not indicative of landfill leachate contamination.

13. CONCLUSION

This report has detailed the results of Long Swamp Road Landfill environmental monitoring for May 2012. All historical results are tabled in this report for easy review.

No methane was detected inside or outside buildings.

Surface methane was detected emanating from the soil surrounding the uppermost vent, Vent 1 (Figure 2) on the landfill extension at 10,875 ppm. Council people were advised to cover the area with a thick layer of soil to convert the methane to carbon dioxide.

Although not required for methane monitoring, methane emitting from the passive gas extraction vents on the landfill extension is tested. Concentrations ranged from 0 ppm to +50,000 ppm. A reading of 50,000 ppm is the lower explosive limit and therefore an occupational health and safety danger. There should be no smoking and no naked flames.

All six groundwater monitoring wells (LW1 - LW3, GWEX-01 to GWEX-03), three leachate dams (LS2 – LS4) and two surface water sampling points (SWEX-01 and LS5) required sampling under the licence this May 2012 sampling round.

Notable water qualities were as follows:

- The nitrate due to night soil trenches nearby the upgradient monitoring well LW1 continues to dissipate but is still very high at 276 mg/L. There is no contamination in the other five wells. This means that none of the nitrate detected in well LW1 has travelled to the downgradient wells due to the extensive clays that underlie the Long Swamp Road Landfill site. The clays contain and attenuate the night soil leachate.
- The three leachate dams tested have very low concentrations for leachate and can be regarded as very weak fertiliser.
- The two surface water sampling points tested were of similar qualities to previous rounds and of no concern.

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APPENDIX A - Field Parameter Forms



GROUNDWATER FIELD PARAMETER FORM (Monitoring wells)

Project: Armidale Dumaresq Council - Long Swamp Road Landfill

SAMPLE POINT ID: LW1

PURGING INFORMATION

Pump type: T1250 QED bladder Tubing: LDPE

Total well depth (from top of casing) (m) 1 2 • 8' 0"

Air controller: QED Micropurge Model 400

Depth to groundwater (m)

2.03

Position pump at: 7.25 m (from top of PVC casing)

(from top of PVC casing) (RL top of internal casing = 1023.79 m)

WATER COLUMN DEPTH (m)

10.77

Discharge/refill rate (secs): 15/20 psi: 30

(well depth minus depth to groundwater)

Purge volume: 4 L Date: 9/5/12 Start time: 12:10 (24 hr clock) Cycle vol: 100 mL Pump rate: 200 mL/min

FIELD ANALYTE VALUES

Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)	Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)
							0.5	1.23	3400	4.29	301	17.5	
							1.0	1.11	3450	4.12	322	17.4	
							1.5	1.19	3520	4.10	337	17.3	
							2.0	1.02	3680	4.05	363	17.3	
							2.5	0.97	3690	4.05	366	17.2	
							3.0	0.94	3690	4.04	360	17.2	
							3.5	0.87	3700	4.04	374	17.1	
							4.0	0.85	3700	4.04	375	17.1	
							4.5						2.07

Mean of last four values (sampling mean)

RPD

Notes:

Pump brand CodyHartFiltered ☐ Not filtered ☒Tick on metals bottle: Dissolved ☒ Total ☐EC standard 2760 µS/cm

SAMPLING INFORMATION

Pretest of deionised water 2.10 µS/cm at 25°CField blank EC 3.67 µS/cm at 25°C

Beaker material: polypropylene

Sample composited (Y/N): NStart sample: 12:30 (2400 hr clock)Weather: (5 min. max. at ground level at LW1) Rain nil, Temp 24.8°C, Cloud cover nilWind direction 200, Wind Speed 1.50 m/s Upwind Activities landfillSample appearance: Odour — Colour clear Turbidity —Non-conformances of well condition (see 'Field checks') and equipment (Y/N): N (If yes, write details and remedy or arrange remedy.)

Details:

Purging and sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Name: Barbara Hart Signature: BHart Date: 9/5/12 Time: 13:00

CodyHart Consulting Pty Ltd

Duplicate as split sample.
Nil gas in buildings Nil gas on landfill bunds
V1 (bottom well) 50,000 ppm V3 20,500 ppm V4 nil
outside 10,875 ppm



GROUNDWATER FIELD PARAMETER FORM (Monitoring wells)

Project: Armidale Dumaresq Council - Long Swamp Road Landfill

SAMPLE POINT ID: LW2

PURGING INFORMATION

Pump type: bladder pump Tubing: LDPE

Total well depth (from top of casing) (m) 38.87 Air controller: QED Micropurge Model 400

Depth to groundwater (m) $4.19 + 0.85 = 5.04$ Position pump at: 35.0 m from top of PVC casing
(from top of PVC casing) (RL top of internal casing = 1007.06 m)

WATER COLUMN DEPTH (m)

(well depth minus depth to groundwater)

38.83

Discharge/refill rate (secs): 60/60 psi: 55

30/30

Purge volume: 4 L Date: 13/4/12 Start time: 15:00 (24 hr clock) Cycle vol: 100 mL Pump rate: 100 mL/min

FIELD ANALYTE VALUES

Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)	Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)
							0.5	6.7	598	6.67	+74	12.1	
							1.0	6.10	597	6.57	+74	12.2	
							1.5	0.8	601	6.61	+74	12.3	
							2.0	0.44	600	6.64	+74	12.1	
							2.5	0.44	600	6.67	+74	12.2	
							3.0	0.40	600	6.68	+74	12.2	
							3.5	0.39	601	6.68	+74	12.2	4.62
							4.0	0.38	600	6.69	+74	12.2	+0.85
													5.47

Mean of last four values (sampling mean)

RPD

Notes:

Pump brand CodyHartFiltered ☒ Not filtered ☐Tick on metals bottle: Dissolved ☒ Total ☐EC standard 2760 µS/cm

Remember 0.85m of casing broken off

SAMPLING INFORMATION

Pretest of deionised water 3.10 µS/cm at 25°CField blank EC 3.68 µS/cm at 25°C

Beaker material: polypropylene

Sample composited (Y/N): NStart sample: 15:45 (2400 hr clock)Weather: (5 min. max. at ground level at LW2) Rain Nil, Temp 10.8 °C, Cloud cover NilWind direction 250, Wind Speed 2.04 m/s Upwind Activities beachate damSample appearance: Odour — Colour cloudy white Turbidity traceNon-conformances of well condition (see 'Field checks') and equipment (Y/N): N (if yes, write details and remedy or arrange remedy.)

Details:

Purging and sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Name Barbara Hart Signature B Hart Date 13/4/12 Time 16:30



GROUNDWATER FIELD PARAMETER FORM (Monitoring wells)

Project: Armidale Dumaresq Council - Long Swamp Road Landfill

SAMPLE POINT ID: LW3

PURGING INFORMATION

Pump type: bladder pump Tubing: LDPE

Total well depth (from top of casing) (m) 35.88

Air controller: QED Micropurge Model 400

Depth to groundwater (m)

11.56

Position pump at: 30.0 m from top of PVC casing

(from top of PVC casing) (RL top of internal casing = 1009.41 m)

WATER COLUMN DEPTH (m)

24.32

Discharge/refill rate (secs): 60/60 psi: 50.55

(well depth minus depth to groundwater)

Purge volume: 4 L Date: 9/5/12 Start time: 14:50 (24 hr clock) Cycle vol: 100 mL Pump rate: 100 mL/min

FIELD ANALYTE VALUES

Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)	Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)
							0.5	0.56	479	6.32	0	19.8	
							1.0	0.54	482	6.30	0	19.8	
							1.5	0.48	488	6.23	0	19.8	
							2.0	0.43	486	6.24	-2	19.7	
							2.5	0.39	488	6.24	-3	19.5	
							3.0	0.38	485	6.26	-5	19.2	
							3.5	0.29	484	6.30	-6	18.7	
							4.0	0.25	484	6.30	-6	18.6	
							5.0						12.87

Mean of last four values (sampling mean)

RPD

0.32 485 6.28 -5 19.0

Notes:

Pump brand Sample ProFiltered ☒ Not filtered ☐Tick on metals bottle: Dissolved ☒ Total ☐EC standard 2760 µS/cm

SAMPLING INFORMATION

Pretest of deionised water 2010 µS/cm at 25°CField blank EC 417 µS/cm at 25°C

Beaker material: polypropylene

Sample composited (Y/N): NStart sample: 15:30 (2400 hr clock)Weather: (5 min. max. at ground level at LW3) Rain Nil, Temp 20.5°C, Cloud cover 0%Wind direction 200°, Wind Speed 0.77 m/s Upwind Activities paddocksSample appearance: Odour — Colour light brown, iron bacteria specs at first Turbidity moderateNon-conformances of well condition (see 'Field checks') and equipment (Y/N): N (If yes, write details and remedy or arrange remedy.)

Details:

Purging and sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Name: Barbara Hart Signature: B Hart Date: 9/5/12 Time: 16:00



Project: Armidale Dumaresq Council - Long Swamp Road Landfill **SAMPLE POINT ID:** GWEX-01

Name: Barbara Hart Signature: B Hart Date: 9/5/12 Time: 11:30



GROUNDWATER FIELD PARAMETER FORM (Monitoring wells)

Project: Armidale Dumaresq Council - Long Swamp Road Landfill

SAMPLE POINT ID: GWEX-02

PURGING INFORMATION

Pump type: bladder Tubing: LDPE

Total well depth (from top of casing) (m) 26.66

Air controller: QED Micropurge Model 400

Depth to groundwater (m)

(from top of PVC casing) (RL top of internal casing = 1007.45 m)

Position pump at: 25.50m (from top of PVC casing)

WATER COLUMN DEPTH (m)

(well depth minus depth to groundwater)

Discharge/refill rate (secs): 15/15 psi: 40

Purge volume: 4 L Date: 8/5/12 Start time: 9:40 (24 hr clock) Cycle vol: 100 mL Pump rate: 200 mL/min

FIELD ANALYTE VALUES

Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)	Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)
							0.5						
							1.0	1.02	438	6.03	+123	17.2	
							1.5	0.89	395	6.04	+126	17.2	
							2.0	0.77	380	6.02	+129	17.3	
							2.5	0.69	368	5.96	+129	17.6	
							3.0	0.66	365	5.94	+134	17.6	
							3.5	0.64	364	5.89	+130	17.7	
							4.0	0.63	362	5.85	+131	17.8	12.39
Mean of last four values (sampling mean)							0.66	365	5.91	+130	17.7		
RPD							✓	✓	✓	✓	✓		

Notes:

Pump brand CodyHartFiltered ☐ Not filtered ☒Tick on metals bottle: Dissolved ☒ Total ☐EC standard 2760 µS/cm

SAMPLING INFORMATION

Pretest of deionised water 3.65 µS/cm at 25°CField blank EC 3.82 µS/cm at 25°CBeaker material: polypropylene Sample composited (Y/N): N Start sample: 10:00 (2400 hr clock)Weather: (5 min. max. at ground level at GWEX-02) Rain Nil, Temp 19.9°C, Cloud cover NilWind direction 200°, Wind Speed 1.07 m/s Upwind Activities leachate damSample appearance: Odour — Colour clear Turbidity traceNon-conformances of well condition (see 'Field checks') and equipment (Y/N): N (If yes, write details and remedy or arrange remedy.)

Details:

Purging and sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Name: Barbara Hart Signature: BHart Date: 8/5/12 Time: 10:30



GROUNDWATER FIELD PARAMETER FORM (Monitoring wells)

Project: Armidale Dumaresq Council - Long Swamp Road Landfill

SAMPLE POINT ID: GWEX-03

PURGING INFORMATION

Pump type: bladder Tubing: LDPE

Total well depth (from top of casing) (m) 26.68

Air controller: QED Micropurge Model 400

Depth to groundwater (m)

(from top of PVC casing) (RL top of internal casing = 1004.18 m)

Position pump at: 25.50m (from top of PVC casing)

Previously 24m, pH now OK

WATER COLUMN DEPTH (m)

(well depth minus depth to groundwater)

Discharge/refill rate (secs): 15/15 psi: 50

Purge volume: 4 L Date: 9/5/12 Start time: 13:40 (24 hr clock) Cycle vol: 100 mL Pump rate: 200 mL/min

FIELD ANALYTE VALUES

Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)	Vol (L)	DO (mg/L)	EC (µS/cm)	pH (STD)	Eh (mV)	Temp (°C)	WL (m)
							0.5	2.16	977	6.35	+223	18.0	
							1.0	1.17	978	6.32	+217	17.9	
							1.5	0.94	673	6.35	+215	17.9	
							2.0	0.98	644	6.37	+206	17.6	
							2.5	0.95	943	6.38	+204	17.8	
							3.0	0.97	925	6.38	+201	17.8	
							3.5	0.99	600	6.38	+197	17.7	
							4.0	1.01	889	6.36	+194	17.6	8.90

Mean of last four values (sampling mean)

RPD

Notes:

Pump brand CodyHartFiltered ☐ Not filtered ☒Tick on metals bottle: Dissolved ☒ Total ☐EC standard 2760 µS/cm

SAMPLING INFORMATION

Pretest of deionised water 2.10 µS/cm at 25°CField blank EC 4.17 µS/cm at 25°CBeaker material: polypropylene Sample composited (Y/N): NStart sample: 14:00 (2400 hr clock)Weather: (5 min. max. at ground level at LW3) Rain Nil, Temp 20-5°C, Cloud cover 0%Wind direction 200°, Wind Speed 0.77 m/s Upwind Activities paddocksSample appearance: Odour — Colour clear Turbidity traceNon-conformances of well condition (see 'Field checks') and equipment (Y/N): N (If yes, write details and remedy or arrange remedy.)

Details:

Purging and sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Name: Barbara Hart Signature: BHart Date: 9/5/12 Time: 14:30



SURFACE WATER & LEACHATE FIELD PARAMETER FORM

Project: Armidale Dumaresq Council

SAMPLE POINT ID: LS2

SAMPLING INFORMATION

Pretest of deionised water 3.65 $\mu\text{S}/\text{cm}$ at 25°CField blank EC 4.02 $\mu\text{S}/\text{cm}$ at 25°C

DO mg/L	EC $\mu\text{S}/\text{cm}$	pH (STD)	Eh (mV)	Temp (°C)	
<u>10.88</u>	<u>2810</u>	<u>8.62</u>	<u>+58</u>	<u>16.9</u>	Beaker material: polypropylene
<u>11.10</u>	<u>2750</u>	<u>8.73</u>	<u>+52</u>	<u>16.7</u>	Sample composited (Y/N): <u>Y</u>
<u>$\bar{x}$ 10.99</u>	<u>2780</u>	<u>8.68</u>	<u>+55</u>	<u>16.8</u>	
<u>RPD</u> ✓	✓	✓	✓	✓	

Sample date: 8.1.12 Start sample: 14:00 (2400 hr clock)Weather: (5 min. max. at ground level at LS3) Rain N'd, Temp 24.7°C, Cloud cover 1%Wind direction 190°, Wind Speed 2.82 m/s Upwind Activities leachate dam LS2 + dam wallSample appearance: Odour - Colour light green Turbidity trace

LOCATION INFORMATION

Grab sample 2m out from middle western end, south-eastern leachate pond of old landfill.

DEPTH INFORMATION

A. Estimated depth of water (m) 0.45 mNon-conformances of sampling point (see 'Field checks') and equipment (Y/N) : N (If yes, write details and remedy or arrange remedy.)
Details:

Sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Sampler's name: Barbara Hart Signature: B Hart Date: 8/5/12 Time: 14:30Filtered ☐ Not filtered ☒Tick on metals bottle: Dissolved ☐ Total ☒EC standard 2760 $\mu\text{S}/\text{cm}$



SURFACE WATER & LEACHATE FIELD PARAMETER FORM

Project: Armidale Dumaresq Council

SAMPLE POINT ID: L53

SAMPLING INFORMATION

Pretest of deionised water 3.65 $\mu\text{S/cm}$ at 25°CField blank EC 4.02 $\mu\text{S/cm}$ at 25°C

DO mg/L	EC $\mu\text{S/cm}$	pH (STD)	Eh (mV)	Temp (°C)	
<u>13.13</u>	<u>1731</u>	<u>9.02</u>	<u>+54</u>	<u>18.2</u>	Beaker material: polypropylene
<u>13.23</u>	<u>1734</u>	<u>9.14</u>	<u>+50</u>	<u>17.4</u>	Sample composited (Y/N): <u>N</u>
<u>$\bar{X}$ 13.18</u>	<u>1733</u>	<u>9.08</u>	<u>+52</u>	<u>17.8</u>	
RPD <u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	

Sample date: 8/05/12 Start sample: 13:00 (2400 hr clock)Weather: (5 min. max. at ground level at L53) Rain Nil, Temp 24.7°C, Cloud cover 1%
No 1.23 m/sWind direction 190°, Wind Speed 2.82 m/s Upwind Activities leachate dam L53Sample appearance: Odour — Colour light green Turbidity trace

LOCATION INFORMATION

Grab sample 2m from northern edge of dam, ~2m east of irrigation pump shed.

DEPTH INFORMATION

A. Estimated depth of water (m)

0.70 mNon-conformances of sampling point (see 'Field checks') and equipment (Y/N) : N (If yes, write details and remedy or arrange remedy.)

Details:

Sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Sampler's name: Barbara Hart Signature: BHart Date: 8/5/12 Time: 13:30Filtered ☐ Not filtered ☒Tick on metals bottle: Dissolved ☐ Total ☒EC standard 2760 $\mu\text{S/cm}$



SURFACE WATER & LEACHATE FIELD PARAMETER FORM

Project: Armidale Dumaresq Council

SAMPLE POINT ID: L54

SAMPLING INFORMATION

Pretest of deionised water 3.65 $\mu\text{S/cm}$ at 25°CField blank EC 4.02 $\mu\text{S/cm}$ at 25°C

DO mg/L	EC $\mu\text{S/cm}$	pH (STD)	Eh (mV)	Temp (°C)	
<u>5.98</u>	<u>1765</u>	<u>7.23</u>	<u>+92</u>	<u>17.2</u>	Beaker material: polypropylene
<u>5.81</u>	<u>1762</u>	<u>7.34</u>	<u>+81</u>	<u>17.0</u>	Sample composited (Y/N): <u>N</u>
<u>X 5.90</u>	<u>1764</u>	<u>7.29</u>	<u>+87</u>	<u>17.1</u>	
RPD ✓	✓	✓	✓	✓	

Sample date: 8/5/12 Start sample: 12:00 (2400 hr clock)Weather: (5 min. max. at ground level at L53) Rain Nil, Temp 24.7°C, Cloud cover 1%
Av 1.23 m/sWind direction 190°, Wind Speed 2.82 m/s Upwind Activities grassed edge of landfillSample appearance: Odour - Colour V. lt. tinge yellow Turbidity trace

LOCATION INFORMATION

Grab sample 2m from edge of dam, south-eastern corner

DEPTH INFORMATION

A. Estimated depth of water (m)

0.30 mNon-conformances of sampling point (see 'Field checks') and equipment (Y/N) : N (If yes, write details and remedy or arrange remedy.)

Details:

Sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Sampler's name: Barbara Hart Signature: B Hart Date: 8/5/12 Time: 12:30
metals + TOCFiltered ☐ Not filtered ☒Tick on metals bottle: Dissolved ☐ Total ☒EC standard 2760 $\mu\text{S/cm}$



SURFACE WATER & LEACHATE FIELD PARAMETER FORM

Project: Armidale Dumaresq Council

SAMPLE POINT ID: LS5

SAMPLING INFORMATION

Pretest of deionised water 3.65 $\mu\text{S/cm}$ at 25°C Field blank EC 4.02 $\mu\text{S/cm}$ at 25°C

DO mg/L	EC $\mu\text{S/cm}$	pH (STD)	Eh (mV)	Temp (°C)	
<u>10.63</u>	<u>718</u>	<u>7.99</u>	<u>+63</u>	<u>18.2</u>	Beaker material: polypropylene
<u>10.96</u>	<u>713</u>	<u>8.47</u>	<u>+60</u>	<u>18.1</u>	Sample composited (Y/N): <u>N</u>
<u>x 10.80</u>	<u>716</u>	<u>8.23</u>	<u>+62</u>	<u>✓</u>	
RPD: <u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>		

Sample date: 8/5/12 Start sample: 14:30 (2400 hr clock)Weather: (5 min. max. at ground level at LS3) Rain Nil, Temp 24.7°C, Cloud cover 1%
Av 1.23 m/sWind direction 190, Wind Speed 2.82 m/s Upwind Activities Southern paddock, area
tunge ofSample appearance: Odour — Colour v.v. lt. yellow Turbidity trace

LOCATION INFORMATION

Grab sample from SE corner of dam with 3m extension pole,
Few fresh cow dung - but no visible cattle
in paddock.

DEPTH INFORMATION

A. Estimated depth of water (m)

0 - 30 mNon-conformances of sampling point (see 'Field checks') and equipment (Y/N) : N (If yes, write details and remedy or arrange remedy.)

Details:

Sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Sampler's name: Barbara Hart Signature: BHart Date: 8/5/12 Time: 15:00Filtered ☐ Not filtered ☒Tick on metals bottle: Dissolved ☐ Total ☒EC standard 2760 $\mu\text{S/cm}$

SAMPLING INFORMATION

Pretest of deionised water 3.65 $\mu\text{S/cm}$ at 25°C Field blank EC 3.82 $\mu\text{S/cm}$ at 25°C

DO mg/L	EC $\mu\text{S/cm}$	pH (STD)	Eh (mV)	Temp (°C)	
<u>5.37</u>	<u>217</u>	<u>6.47</u>	<u>+41</u>	<u>14.7</u>	Beaker material: polypropylene
<u>6.16</u>	<u>222</u>	<u>6.56</u>	<u>+49</u>	<u>14.2</u>	Sample composited (Y/N): <u>N</u>
<u>5.77</u>	<u>220</u>	<u>6.52</u>	<u>+45</u>	<u>14.5</u>	
RPD ☒	☒	☒	☒	☒	

Sample date: 8/5/12 Start sample: 10:30 (2400 hr clock)

Weather: (5 min. max. at ground level at SWEX-02) Rain Nil, Temp 19.9°C, Cloud cover Nil

Wind direction 200, Wind Speed 1.07 m/s Upwind Activities leachate dam

Sample appearance: Odour — Colour clear — Turbidity trace
with grass seeds

LOCATION INFORMATION

Grab sample in pond recently filled by flow (pathway still very moist) upgradient (north) of LLZ dam.

DEPTH INFORMATION

A. Estimated depth of water (m)

0.05 m

Non-conformances of sampling point (see 'Field checks') and equipment (Y/N) : N (If yes, write details and remedy or arrange remedy.)

Details:

Sampling procedures were those detailed by CodyHart Consulting Pty Ltd.

Sampler's name: Barbara Hart Signature: BHart Date: 8/5/12 Time: 11:00
metals + TOC

Filtered ☐ Not filtered ☒

Tick on metals bottle: Dissolved ☐ Total ☒

EC standard 2760 $\mu\text{S/cm}$

APPENDIX B - Chain of Custody Forms and Calibration Certificate

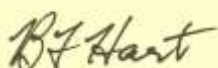
CodyHart COC to Site & Calibration Certificate

Chain of Custody for sample containers - laboratory to site

CodyHart ordered sample containers from ALS laboratory, Stafford, Brisbane. When they were received they were stored in the locked and security monitored CodyHart office at Burleigh Heads, Queensland.

CodyHart labels were adhered to appropriate containers. The containers for each sampling point were placed into self sealing plastic bags, which were then labelled with the sampling point identity. The containers for each sampling point were then placed into CodyHart eskies and transported to the Long Swamp Road Landfill by CodyHart.

It is certified that the sample bottles were received in unbroken sealed containers from ALS, and that no tampering with the sample containers occurred when in CodyHart hands.



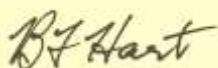
09/05/12

Calibration certificate for field lab

A TPS 90-FL Series field lab is used by CodyHart to take field temperature, pH, electrical conductivity (EC), redox potential (Eh) and dissolved oxygen (DO) readings.

A yearly maintenance service is conducted by TPS Pty Ltd, Brisbane.

It is certified that the field lab was calibrated daily at Armidale so that sampling was conducted within 24 hours of field testing. The pH was recalibrated if any probe drift was noticed. The calibration process was documented and is available on request.



13/05/12

CHAIN OF CUSTODY TO LAB

CLIENT: *CodyHart Environmental*

ADDRESS / OFFICE: 3/29 Township Drive, BURLEIGH HEADS 4220 (PO Box 1073 BURLEIGH HEADS 4220)

PROJECT MANAGER (PM): Barbara Hart

PROJECT ID: **Armidale 243**

SITE: **Long Swamp Road Landfill**

P.O. NO.:

SAMPLER: B. Hart

MOBILE: 042 777 5120

PHONE:

EMAIL REPORT TO: pelican@codyhart.com.au

EMAIL INVOICE TO: (above)



RESULTS REQUIRED (Date):

QUOTE NO.: BN-101-12 (Blanket quote)

ANALYSES REQUIRED:

FOR LABORATORY USE ONLY

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

COOLER SEAL (if applicable)

Initial: Yes No N/A

PLEASE SCAN THIS FORM **ON DAY OF ARRIVAL** AND EMAIL.

SAMPLE TEMPERATURE

CHILLED: Yes No

SAMPLE INFORMATION (note: S = Soil, W=Water)

CONTAINER INFORMATION

ALS ID	SAMPLE ID	MATRIX	DATE	Time	TYPE	No. bottles	ED040 Sulphate	ED045 Chloride	NT-1 (Major Cations)	EG020 Fe M Zn	EG020 Fe M Zn			EG020 Fe M Zn	EG020 Hg (I)	EK055 Ammonia	NT-5 Total Nitrogen	EP005 Total Organic Carbon	EP035 Phenols	EP080 BTEX	W-12 OC/OP Pesticides	EA025 Suspended Solids	EP075 PAHs			
1	GWEX-02	W	8/5/12	10:00	250mL Green; 60mL Red; 125 mL Purple; 40 mL Purple; 100 mL Orange.	5		X			X					X	X	X						X		
2	SWEX-01	W	8/5/12	10:30	1 L Green; 60mL Red; 125 mL Purple; 40 mL Purple; 250mL Purple.	5	X	X	X					X		X	X	X	X				X			
3	LS2	W	8/5/12	14:00	500 mL Green; 60mL Red; 125 mL Purple; 40 mL Purple.	4								X			X	X				X				
4	LS3	W	8/5/12	13:00	500 mL Green; 60mL Red; 125 mL Purple; 40 mL Purple.	4								X		X	X	X				X				
5	LS4	W	8/5/12	12:00	500 mL Green; 60mL Red; 125 mL Purple; 40 mL Purple.	4								X		X	X	X				X				
6	LS5	W	8/5/12	14:30	500 mL Green; 60mL Red; 125 mL Purple; 40 mL Purple.	4								X			X	X				X				

RELINQUISHED BY:

Barbara Hart

Date: 8/05/2012

RECEIVED BY:

Name:

Date:

METHOD OF SHIPMENT

Transport Co: TAMEX

CodyHart Environmental

Time: 16:00

Of: ALS Laboratory, Brisbane

Time:

Con' Note No:

Signature:

B J Hart

Signature:

4344271

Environmental Division
Brisbane

Work Order

EB1212516



Telephone : + 61-7-3243 7222

Samples were despatched in CodyHart Esky/Eskies numbered:

PLEASE HOLD ALL CODYHART ESKIES AT ALS UNTIL AN ESKY RETURN IS REQUESTED.

CodyHart Consulting Pty Ltd trading as CodyHart Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order : EB1212516

Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	Page	: 1 of 2
Order number	: ----	Quote number	: EB2012CODCON0249 (BN/101/12)
C-O-C number	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Long Swamp Road Landfill		
Sampler	: B.Hart		

Dates

Date Samples Received	: 09-MAY-2012	Issue Date	: 11-MAY-2012 12:38
Client Requested Due Date	: 18-MAY-2012	Scheduled Reporting Date	: 18-MAY-2012

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 2.8°C - Ice present
No. of coolers/boxes	: 1 MEDIUM	No. of samples received	: 6
Security Seal	: Intact.	No. of samples analysed	: 6

General Comments

- This report contains the following information:
 - Sample Container(s)/Preservation Non-Compliances
 - Summary of Sample(s) and Requested Analysis
 - Proactive Holding Time Report
 - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Please direct any queries related to sample condition / numbering / breakages to Matt Goodwin.
- Analytical work for this work order will be conducted at ALS Brisbane and ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- No sample container / preservation non-compliance exist.

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

Matrix: WATER

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER Suspended Solids	WATER Sulfate	Discrete Chloride	WATER Dissolved Solids	WATER Total Residue	WATER Dissolved Solids	WATER Ammonia	WATER Total Organic Carbon
EB1212516-001	08-MAY-2012 10:00	GWEX-02			✓	✓		✓	✓	✓
EB1212516-002	08-MAY-2012 10:30	SWEX-01	✓	✓	✓		✓		✓	✓
EB1212516-003	08-MAY-2012 14:00	LS2	✓				✓			✓
EB1212516-004	08-MAY-2012 13:00	LS3	✓				✓		✓	✓
EB1212516-005	08-MAY-2012 12:00	LS4	✓				✓		✓	✓
EB1212516-006	08-MAY-2012 14:30	LS5	✓				✓			✓

Matrix: WATER

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER Total Ph	WATER SIM - P/P	WATER Major C	WATER Total Nit
EB1212516-001	08-MAY-2012 10:00	GWEX-02		✓		✓
EB1212516-002	08-MAY-2012 10:30	SWEX-01	✓		✓	✓
EB1212516-003	08-MAY-2012 14:00	LS2				✓
EB1212516-004	08-MAY-2012 13:00	LS3				✓
EB1212516-005	08-MAY-2012 12:00	LS4				✓
EB1212516-006	08-MAY-2012 14:30	LS5				✓

Sample(s) have been received within the recommended holding times for the requested analysis.

MS BARBARA HART

- *AU Certificate of Analysis - NATA (COA)
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)
- A4 - AU Tax Invoice (INV)
- Chain of Custody (CoC) (COC)
- EDI Format - ENMRG (ENMRG)
- EDI Format - XTab (XTAB)

[illegible]

BATCH 2 of 2



SAMPLER: B. Hart

MOBILE: 042 777 5120

PHONE:

EMAIL REPORT TO: pelican@codyhart.com.au

EMAIL INVOICE TO: (above)

ANALYSES REQUIRED:

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

PLEASE SCAN THIS FORM **ON DAY OF ARRIVAL** AND EMAIL.

PLEASE SCAN THIS FORM **ON DAY OF ARRIVAL** AND EMAIL.

CHILLED: Yes No

CONTAINER INFORMATION

[illegible]

METHOD OF SHIPMENT

Transport Co: TAMEX

Con' Note No:

4344272

PLEASE HOLD ALL CODYHART ESKIES AT ALS UNTIL AN ESKY RETURN IS REQUESTED.

COC Page 1 of 1

Work Order

EB1212746



Telephone : +61-7-3243 7222

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order : **EB1212746**

Client : **CODYHART CONSULTING PTY LTD**
 Contact : **MS BARBARA HART**
 Address : **P O BOX 1073**
BURLEIGH HEADS QLD, AUSTRALIA
4220

Laboratory : Environmental Division Brisbane
 Contact : Customer Services
 Address : 32 Shand Street Stafford QLD Australia
 4053

E-mail : **pelican@codyhart.com.au**
 Telephone : **+61 55205532**
 Facsimile : **+61 07 55206531**

E-mail : **Brisbane.Enviro.Services@alsglobal.com**
 Telephone : **+61 7 3243 7222**
 Facsimile : **+61 7 3243 7218**

Project : **Armidale 243**
 Order number : **----**
 C-O-C number : **----**
 Site : **Long Swamp Road Landfill**
 Sampler : **B. Hart**

Page : **1 of 2**
 Quote number : **EB2012CODCON0249 (BN/101/12)**
 QC Level : **NEPM 1999 Schedule B(3) and ALS QCS3 requirement**

Dates

Date Samples Received : **11-MAY-2012**
 Client Requested Due Date : **22-MAY-2012**

Issue Date : **15-MAY-2012 13:10**
 Scheduled Reporting Date : **22-MAY-2012**

Delivery Details

Mode of Delivery : **Carrier**
 No. of coolers/boxes : **1 MEDIUM**
 Security Seal : **Intact.**

Temperature : **6.6°C - Ice present**
 No. of samples received : **5**
 No. of samples analysed : **5**

General Comments

- This report contains the following information:
 - Sample Container(s)/Preservation Non-Compliances
 - Summary of Sample(s) and Requested Analysis
 - Proactive Holding Time Report
 - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Please direct any queries related to sample condition / numbering / breakages to Matt Goodwin.
- Analytical work for this work order will be conducted at ALS Brisbane.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.

[illegible]

APPENDIX C - Laboratory Reports

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EB1212516	Page	: 1 of 6
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 09-MAY-2012
Sampler	: B.Hart	Issue Date	: 21-MAY-2012
Site	: Long Swamp Road Landfill		
Quote number	: BN/101/12	No. of samples received	: 6
		No. of samples analysed	: 6

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Andrew Epps	Metals Production Chemist	Brisbane Inorganics
Jonathon Angell	Inorganic Coordinator	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				GWEX-02	SWEX-01	LS2	LS3	LS4
				08-MAY-2012 10:00	08-MAY-2012 10:30	08-MAY-2012 14:00	08-MAY-2012 13:00	08-MAY-2012 12:00
Compound	CAS Number	LOR	Unit	EB1212516-001	EB1212516-002	EB1212516-003	EB1212516-004	EB1212516-005
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	----	90	29	71	9
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	----	47	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	24	11	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	----	15	----	----	----
Magnesium	7439-95-4	1	mg/L	----	5	----	----	----
Sodium	7440-23-5	1	mg/L	----	11	----	----	----
Potassium	7440-09-7	1	mg/L	----	7	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.002	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	0.091	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
EG020T: Total Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	----	0.480	0.069	0.174	0.486
Zinc	7440-66-6	0.005	mg/L	----	0.015	<0.005	<0.005	0.007
Iron	7439-89-6	0.05	mg/L	----	6.07	0.16	0.24	0.64
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.04	----	0.62	0.25
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.12	<0.01	0.22	0.07	0.02
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	0.9	17.0	8.9	2.5
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	0.1	0.9	17.2	9.0	2.5
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	3	7	83	64	41
EP035G: Total Phenol by Discrete Analyser								
Phenols (Total)	----	0.05	mg/L	----	<0.05	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				GWEX-02	SWEX-01	LS2	LS3	LS4
				08-MAY-2012 10:00	08-MAY-2012 10:30	08-MAY-2012 14:00	08-MAY-2012 13:00	08-MAY-2012 12:00
Compound	CAS Number	LOR	Unit	EB1212516-001	EB1212516-002	EB1212516-003	EB1212516-004	EB1212516-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	39.4	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	88.8	----	----	----	----
2,4,6-Tribromophenol	118-79-6	0.1	%	93.4	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	80.4	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%	105	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	113	----	----	----	----



Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

				LS5	----	----	----	----
				08-MAY-2012 14:30	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1212516-006	----	----	----	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	23	----	----	----	----
EG020T: Total Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.051	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	0.008	----	----	----	----
Iron	7439-89-6	0.05	mg/L	1.47	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.9	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	1.9	----	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	24	----	----	----	----



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	71.9
2-Chlorophenol-D4	93951-73-6	26.8	130.2
2.4.6-Tribromophenol	118-79-6	19.3	180.8
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	13.9	146.1
Anthracene-d10	1719-06-8	34.6	137.4
4-Terphenyl-d14	1718-51-0	36.2	154.2

Environmental Division

QUALITY CONTROL REPORT

Work Order	: EB1212516	Page	: 1 of 8
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Long Swamp Road Landfill	Date Samples Received	: 09-MAY-2012
C-O-C number	: ----	Issue Date	: 21-MAY-2012
Sampler	: B.Hart	No. of samples received	: 6
Order number	: ----	No. of samples analysed	: 6
Quote number	: BN/101/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Andrew Epps	Metals Production Chemist	Brisbane Inorganics
Jonathon Angell	Inorganic Coordinator	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA025: Suspended Solids (QC Lot: 2300438)									
EB1212470-001	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	7	7	0.0	No Limit
EB1212479-007	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	10	6	50.0	No Limit
EA025: Suspended Solids (QC Lot: 2300439)									
EB1212516-003	LS2	EA025H: Suspended Solids (SS)	----	5	mg/L	29	33	12.9	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2303462)									
EB1212277-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<5	<5	0.0	No Limit
EB1212389-017	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	431	437	1.4	0% - 20%
ED045G: Chloride Discrete analyser (QC Lot: 2300683)									
EB1212516-001	GWEX-02	ED045G: Chloride	16887-00-6	1	mg/L	24	24	0.0	0% - 20%
ED045G: Chloride Discrete analyser (QC Lot: 2303461)									
EB1212277-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	59	61	2.7	0% - 20%
EB1212389-017	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	13	13	0.0	0% - 50%
ED093F: Dissolved Major Cations (QC Lot: 2303460)									
EB1212277-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	16	16	0.0	0% - 50%
		ED093F: Magnesium	7439-95-4	1	mg/L	17	17	0.0	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	259	260	0.6	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	74	74	0.0	0% - 20%
EB1212389-017	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	126	126	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	42	43	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	29	29	0.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	16	16	0.0	0% - 50%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2302500)									
EB1212210-022	Anonymous	EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.338	0.338	0.0	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.016	0.015	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.36	0.32	13.4	No Limit
EB1212715-003	Anonymous	EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.06	0.10	48.7	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2302551)									
EB1212210-022	Anonymous	EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.324	0.326	0.4	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.015	0.016	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.09	0.09	0.0	No Limit
EB1212334-008	Anonymous	EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.154	0.147	4.6	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.006	0.005	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.22	0.18	20.6	No Limit

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Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG035F: Dissolved Mercury by FIMS (QC Lot: 2302499)									
EB1212210-021	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2308127)									
EB1212334-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.04	0.01	120	No Limit
EB1212334-011	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.02	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2308126)									
EB1212334-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.01	0.01	0.0	No Limit
EB1212334-011	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.02	0.02	0.0	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2307222)									
EB1212621-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.2	0.2	0.0	No Limit
ES1211430-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	6.7	7.1	5.4	0% - 20%
EP005: Total Organic Carbon (TOC) (QC Lot: 2304868)									
EB1212372-001	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	5	5	0.0	No Limit
EB1212516-001	GWEX-02	EP005: Total Organic Carbon	----	1	mg/L	3	4	0.0	No Limit
EP035G: Total Phenol by Discrete Analyser (QC Lot: 2306652)									
EB1212036-001	Anonymous	EP035G: Phenols (Total)	----	0.05	mg/L	<0.05	<0.05	0.0	No Limit
ES1211105-003	Anonymous	EP035G: Phenols (Total)	----	0.05	mg/L	2.60	2.53	3.1	0% - 20%



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result		LCS	Low	High
EA025: Suspended Solids (QCLot: 2300438)								
EA025H: Suspended Solids (SS)	----	5	mg/L	<5	1000 mg/L	92.0	82	120
EA025: Suspended Solids (QCLot: 2300439)								
EA025H: Suspended Solids (SS)	----	5	mg/L	<5	1000 mg/L	92.8	82	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2303462)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	114	70	130
ED045G: Chloride Discrete analyser (QCLot: 2300683)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	98.0	70	128
ED045G: Chloride Discrete analyser (QCLot: 2303461)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	97.5	70	128
ED093F: Dissolved Major Cations (QCLot: 2303460)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2302500)								
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.100 mg/L	115	86	118
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.200 mg/L	108	87	119
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.50 mg/L	117	84	122
EG020T: Total Metals by ICP-MS (QCLot: 2302551)								
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.100 mg/L	106	88	123
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.200 mg/L	93.4	81	123
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.500 mg/L	109	83	129
EG035F: Dissolved Mercury by FIMS (QCLot: 2302499)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.010 mg/L	88.6	84	116
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2308127)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	72.0	70	120
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2308126)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	83.2	70	124
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2307222)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10.0 mg/L	82.9	70	115
EP005: Total Organic Carbon (TOC) (QCLot: 2304868)								
EP005: Total Organic Carbon	----	1	mg/L	<1	5 mg/L	99.5	76	112



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
Method: Compound	CAS Number	LOR	Unit	Result				
EP035G: Total Phenol by Discrete Analyser (QCLot: 2306652)								
EP035G: Phenols (Total)	----	0.05	mg/L	<0.05	0.50 mg/L	82.8	62	120
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2301701)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	10 µg/L	83.2	47	120
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	10 µg/L	74.2	46	127
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	10 µg/L	81.4	50	123
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	10 µg/L	81.9	50	126
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	10 µg/L	64.3	49	115
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	10 µg/L	99.2	44	120
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	10 µg/L	93.1	46	122
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	10 µg/L	92.7	46	122
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	10 µg/L	82.8	48	125
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	10 µg/L	105	43	119
EP075(SIM): Benzo(b)fluoranthene	205-99-2	1	µg/L	<1.0	10 µg/L	72.7	43	138
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	10 µg/L	105	38	132
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	10 µg/L	88.2	39	125
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	10 µg/L	69.9	40	137
EP075(SIM): Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	10 µg/L	69.8	42	140
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	10 µg/L	65.2	37	136
EP075(SIM): Sum of polycyclic aromatic hydrocarbons	----	1	µg/L	<1.0	----	----	----	----



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number		MS	Low	High
ED045G: Chloride Discrete analyser (QCLot: 2303461)							
EB1212281-001	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	101	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2302500)							
EB1212649-055	Anonymous	EG020A-F: Manganese	7439-96-5	0.100 mg/L	104	70	130
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	100	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2302551)							
EB1212334-002	Anonymous	EG020A-T: Manganese	7439-96-5	1.000 mg/L	101	70	130
		EG020A-T: Zinc	7440-66-6	1.000 mg/L	90.7	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2302499)							
EB1212516-001	GWEX-02	EG035F: Mercury	7439-97-6	0.010 mg/L	87.0	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2308127)							
EB1212334-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	126	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2308126)							
EB1212334-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	83.0	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2307222)							
EB1212621-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	85.3	70	130
EP035G: Total Phenol by Discrete Analyser (QCLot: 2306652)							
EB1212036-001	Anonymous	EP035G: Phenols (Total)	----	0.42 mg/L	79.5	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
					MS	MSD	Low	High	Value	Control Limit
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number							
ED045G: Chloride Discrete analyser (QCLot: 2303461)										
EB1212281-001	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	101	----	70	130	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2302500)										
EB1212649-055	Anonymous	EG020A-F: Manganese	7439-96-5	0.100 mg/L	104	----	70	130	----	----
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	100	----	70	130	----	----
EG020T: Total Metals by ICP-MS (QCLot: 2302551)										
EB1212334-002	Anonymous	EG020A-T: Manganese	7439-96-5	1.000 mg/L	101	----	70	130	----	----
		EG020A-T: Zinc	7440-66-6	1.000 mg/L	90.7	----	70	130	----	----

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 Client : CODYHART CONSULTING PTY LTD
 Project : Armidale 243



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EG035F: Dissolved Mercury by FIMS (QCLot: 2302499)										
EB1212516-001	GWEX-02	EG035F: Mercury	7439-97-6	0.010 mg/L	87.0	----	70	130	----	----
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2308127)										
EB1212334-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	126	----	70	130	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2308126)										
EB1212334-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	83.0	----	70	130	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2307222)										
EB1212621-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	85.3	----	70	130	----	----
EP035G: Total Phenol by Discrete Analyser (QCLot: 2306652)										
EB1212036-001	Anonymous	EP035G: Phenols (Total)	----	0.42 mg/L	79.5	----	70	130	----	----

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EB1212516	Page	: 1 of 8
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Long Swamp Road Landfill	Date Samples Received	: 09-MAY-2012
C-O-C number	: ----	Issue Date	: 21-MAY-2012
Sampler	: B.Hart	No. of samples received	: 6
Order number	: ----	No. of samples analysed	: 6
Quote number	: BN/101/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers



Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA025: Suspended Solids								
Clear Plastic Bottle - Natural (EA025H) SWEX-01, LS3, LS5	LS2, LS4,	08-MAY-2012	----	----	----	11-MAY-2012	15-MAY-2012	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) SWEX-01		08-MAY-2012	---	05-JUN-2012	----	15-MAY-2012	05-JUN-2012	✓
ED045G: Chloride Discrete analyser								
Clear Plastic Bottle - Natural (ED045G) GWEX-02		08-MAY-2012	---	05-JUN-2012	----	14-MAY-2012	05-JUN-2012	✓
Clear Plastic Bottle - Natural (ED045G) SWEX-01		08-MAY-2012	---	05-JUN-2012	----	15-MAY-2012	05-JUN-2012	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Natural (ED093F) SWEX-01		08-MAY-2012	---	15-MAY-2012	----	15-MAY-2012	15-MAY-2012	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) GWEX-02		08-MAY-2012	---	04-NOV-2012	----	15-MAY-2012	04-NOV-2012	✓
EG020T: Total Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T) SWEX-01, LS3, LS5	LS2, LS4,	08-MAY-2012	17-MAY-2012	04-NOV-2012	✓	17-MAY-2012	04-NOV-2012	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) GWEX-02		08-MAY-2012	---	05-JUN-2012	----	15-MAY-2012	05-JUN-2012	✓
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G) GWEX-02, LS3,	SWEX-01, LS4	08-MAY-2012	---	05-JUN-2012	----	17-MAY-2012	05-JUN-2012	✓



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) GWEX-02, SWEX-01, LS2, LS3, LS4, LS5	08-MAY-2012	---	05-JUN-2012	----	17-MAY-2012	05-JUN-2012	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) GWEX-02, SWEX-01, LS2, LS3, LS4, LS5	08-MAY-2012	16-MAY-2012	05-JUN-2012	✓	16-MAY-2012	05-JUN-2012	✓
EP005: Total Organic Carbon (TOC)							
Amber TOC Vial - Sulfuric Acid (EP005) GWEX-02, SWEX-01, LS2, LS3, LS4, LS5	08-MAY-2012	----	----	----	15-MAY-2012	05-JUN-2012	✓
EP035G: Total Phenol by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EP035G) SWEX-01	08-MAY-2012	16-MAY-2012	05-JUN-2012	✓	16-MAY-2012	05-JUN-2012	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) GWEX-02	08-MAY-2012	14-MAY-2012	15-MAY-2012	✓	16-MAY-2012	23-JUN-2012	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	15	13.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	3	21	14.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	10	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	10	20.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	3	25	12.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	15	13.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phenol by Discrete Analyser	EP035G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	4	21	19.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	5	20.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	2	25	8.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phenol by Discrete Analyser	EP035G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	21	9.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	5	20.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	2	25	8.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phenol by Discrete Analyser	EP035G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Page : 5 of 8
 Work Order : EB1212516
 Client : CODYHART CONSULTING PTY LTD
 Project : Armidale 243



Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	15	6.7	5.0	✔	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	20	5.0	5.0	✔	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	10	10.0	5.0	✔	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	10	10.0	5.0	✔	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	5.3	5.0	✔	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	6.7	5.0	✔	ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.0	5.0	✔	ALS QCS3 requirement
Total Phenol by Discrete Analyser	EP035G	1	20	5.0	5.0	✔	ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Suspended Solids (High Level)	EA025H	WATER	In-House, APHA 21st ed., 2540D A gravimetric procedure employed to determine the amount of 'non-filterable' residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2) Sodium Absorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2) Total Hardness is calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Cadmium Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)



<i>Analytical Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO3-. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP005	WATER	APHA 21st ed., 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Phenol by Discrete Analyser	EP035G	WATER	APHA 21st ed., 5530 B&D Steam distillable Phenols are reacted with 4-aminoantipyrine. The resultant colour intensity is measured by Seal. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
TKN/TP Digestion	EK061/EK067	WATER	APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Digestion for Total Recoverable Metals	EN25	WATER	USEPA SW846-3005 Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Phenols After Microdistillation	EP035D	WATER	APHA 21st ed., 5530 A, B&D pH adjusted Steam distillable Phenolic compounds. The resultant colour intensity is measured by Discrete Analyser.
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.
- For all matrices, no Matrix Spike outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EB1212746	Page	: 1 of 5
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 11-MAY-2012
C-O-C number	: ----	Issue Date	: 22-MAY-2012
Sampler	: B. Hart	No. of samples received	: 5
Site	: Long Swamp Road Landfill	No. of samples analysed	: 5
Quote number	: BN/101/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Jonathon Angell	Inorganic Coordinator	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				LW1	GWEX-01	GWEX-03	LW3	LWD
				09-MAY-2012 15:00	09-MAY-2012 15:00	09-MAY-2012 15:00	09-MAY-2012 15:00	09-MAY-2012 15:00
Compound	CAS Number	LOR	Unit	EB1212746-001	EB1212746-002	EB1212746-003	EB1212746-004	EB1212746-005
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	425	174	111	12	434
EG020F: Dissolved Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.331	0.053	0.005	0.524	0.309
Zinc	7440-66-6	0.005	mg/L	0.215	0.123	0.033	0.036	0.206
Iron	7439-89-6	0.05	mg/L	0.15	0.06	<0.05	4.97	0.18
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	0.0011	0.0025	<0.0001	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.06	0.05	0.04	0.42	0.06
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	276	0.06	0.90	<0.01	288
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.3	0.2	0.3	0.7	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	276	0.3	1.2	0.7	288
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	4	2	12	<1	8
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	----	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L	----	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L	----	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L	----	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L	----	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L	----	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L	----	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L	----	<1.0	<1.0	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	----	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	----	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	----	<1.0	<1.0	----	----
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	----	<1.0	<1.0	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	----	<0.5	<0.5	----	----



Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

				LW1	GWEX-01	GWEX-03	LW3	LWD
				09-MAY-2012 15:00	09-MAY-2012 15:00	09-MAY-2012 15:00	09-MAY-2012 15:00	09-MAY-2012 15:00
Compound	CAS Number	LOR	Unit	EB1212746-001	EB1212746-002	EB1212746-003	EB1212746-004	EB1212746-005
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	----	42.0	40.5	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	----	99.9	94.8	----	----
2,4,6-Tribromophenol	118-79-6	0.1	%	----	78.7	75.8	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	----	89.8	82.2	----	----
Anthracene-d10	1719-06-8	0.1	%	----	80.1	92.0	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	----	107	101	----	----



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	71.9
2-Chlorophenol-D4	93951-73-6	26.8	130.2
2,4,6-Tribromophenol	118-79-6	19.3	180.8
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	13.9	146.1
Anthracene-d10	1719-06-8	34.6	137.4
4-Terphenyl-d14	1718-51-0	36.2	154.2

Environmental Division

QUALITY CONTROL REPORT

Work Order	: EB1212746	Page	: 1 of 7
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Long Swamp Road Landfill	Date Samples Received	: 11-MAY-2012
C-O-C number	: ----	Issue Date	: 22-MAY-2012
Sampler	: B. Hart	No. of samples received	: 5
Order number	: ----	No. of samples analysed	: 5
Quote number	: BN/101/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Jonathon Angell	Inorganic Coordinator	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Matt Frost	Senior Organic Chemist	Brisbane Organics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED045G: Chloride Discrete analyser (QC Lot: 2305475)									
EB1212657-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	301	308	2.3	0% - 20%
EB1212770-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	----	118	# Not Determined	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2310398)									
EB1212574-001	Anonymous	EG020A-F: Manganese	7439-96-5	0.001	mg/L	1.31	1.29	1.6	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.51	0.50	0.0	0% - 50%
EB1212628-001	Anonymous	EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2310668)									
EB1212617-001	Anonymous	EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.343	0.338	1.6	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.008	0.007	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.54	1.52	1.4	0% - 20%
EB1212657-001	Anonymous	EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.009	0.009	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.014	0.014	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.18	0.19	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2310667)									
EB1212617-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EB1212657-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2313266)									
EB1212558-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.22	0.23	7.1	0% - 20%
EB1212559-006	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.02	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2313265)									
EB1212558-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	47.2	44.4	6.2	0% - 20%
EB1212559-006	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.16	0.18	12.7	0% - 50%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2312932)									
EB1212735-004	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	183	189	3.2	0% - 20%
EB1212752-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.4	0.4	0.0	No Limit
EP005: Total Organic Carbon (TOC) (QC Lot: 2310446)									
EB1212617-005	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	18	19	7.7	0% - 50%
EB1212746-001	LW1	EP005: Total Organic Carbon	----	1	mg/L	4	8	75.6	No Limit



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result			LCS	Low
ED045G: Chloride Discrete analyser (QCLot: 2305475)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	92.9	70	128
EG020F: Dissolved Metals by ICP-MS (QCLot: 2310398)								
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.100 mg/L	96.0	86	118
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.200 mg/L	97.7	87	119
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.50 mg/L	96.7	84	122
EG020F: Dissolved Metals by ICP-MS (QCLot: 2310668)								
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.100 mg/L	106	86	118
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.200 mg/L	105	87	119
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.50 mg/L	104	84	122
EG035F: Dissolved Mercury by FIMS (QCLot: 2310667)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.010 mg/L	99.3	84	116
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2313266)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	97.6	70	120
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2313265)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	93.6	70	124
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2312932)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10.0 mg/L	87.4	70	115
EP005: Total Organic Carbon (TOC) (QCLot: 2310446)								
EP005: Total Organic Carbon	----	1	mg/L	<1	5 mg/L	97.3	76	112
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2305126)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	10 µg/L	81.3	47	120
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	10 µg/L	84.2	46	127
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	10 µg/L	82.5	50	123
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	10 µg/L	86.4	50	126
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	10 µg/L	87.0	49	115
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	10 µg/L	87.1	44	120
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	10 µg/L	88.7	46	122
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	10 µg/L	89.5	46	122
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	10 µg/L	92.9	48	125
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	10 µg/L	84.6	43	119
EP075(SIM): Benzo(b)fluoranthene	205-99-2	1	µg/L	<1.0	10 µg/L	106	43	138
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	10 µg/L	85.0	38	132
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	10 µg/L	91.4	39	125



Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2305126) - continued								
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	10 µg/L	96.6	40	137
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	10 µg/L	97.8	42	140
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	10 µg/L	98.7	37	136
EP075(SIM): Sum of polycyclic aromatic hydrocarbons	----	1	µg/L	<1.0	----	----	----	----



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%) MS	Recovery Limits (%) LowHigh	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number				
ED045G: Chloride Discrete analyser (QCLot: 2305475)							
EB1212770-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2310398)							
EB1212574-002	Anonymous	EG020A-F: Manganese	7439-96-5	0.5 mg/L	94.2	70	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	94.6	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2310668)							
EB1212617-003	Anonymous	EG020A-F: Manganese	7439-96-5	0.100 mg/L	99.8	70	130
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	104	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2310667)							
EB1212617-003	Anonymous	EG035F: Mercury	7439-97-6	0.010 mg/L	102	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2313266)							
EB1212558-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	# Not Determined	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2313265)							
EB1212558-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	103	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2312932)							
EB1212752-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	94.5	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number		MS	MSD	Low	High	Value	Control Limit
ED045G: Chloride Discrete analyser (QCLot: 2305475)										
EB1212770-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	----	70	130	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2310398)										
EB1212574-002	Anonymous	EG020A-F: Manganese	7439-96-5	0.5 mg/L	94.2	----	70	130	----	----
		EG020A-F: Zinc	7440-66-6	1 mg/L	94.6	----	70	130	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2310668)										
EB1212617-003	Anonymous	EG020A-F: Manganese	7439-96-5	0.100 mg/L	99.8	----	70	130	----	----
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	104	----	70	130	----	----
EG035F: Dissolved Mercury by FIMS (QCLot: 2310667)										
EB1212617-003	Anonymous	EG035F: Mercury	7439-97-6	0.010 mg/L	102	----	70	130	----	----



Sub-Matrix: WATER

Sub-Matrix: WATER				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
					MS	MSD	Low	High	Value	Control Limit
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number							
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2313266)										
EB1212558-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	# Not Determined	----	70	130	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2313265)										
EB1212558-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	103	----	70	130	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2312932)										
EB1212752-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	94.5	----	70	130	----	----

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EB1212746	Page	: 1 of 6
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Long Swamp Road Landfill	Date Samples Received	: 11-MAY-2012
C-O-C number	: ----	Issue Date	: 22-MAY-2012
Sampler	: B. Hart	No. of samples received	: 5
Order number	: ----	No. of samples analysed	: 5
Quote number	: BN/101/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers



Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride Discrete analyser								
Clear Plastic Bottle - Natural (ED045G) LW1, GWEX-03, LWD	GWEX-01, LW3,	09-MAY-2012	---	06-JUN-2012	----	16-MAY-2012	06-JUN-2012	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) LW1, GWEX-03	GWEX-01,	09-MAY-2012	---	05-NOV-2012	----	18-MAY-2012	05-NOV-2012	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) LW3,	LWD	09-MAY-2012	---	05-NOV-2012	----	21-MAY-2012	05-NOV-2012	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) LW1, GWEX-03	GWEX-01,	09-MAY-2012	---	06-JUN-2012	----	21-MAY-2012	06-JUN-2012	✓
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G) LW1, GWEX-03, LWD	GWEX-01, LW3,	09-MAY-2012	---	06-JUN-2012	----	22-MAY-2012	06-JUN-2012	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G) LW1, GWEX-03, LWD	GWEX-01, LW3,	09-MAY-2012	---	06-JUN-2012	----	22-MAY-2012	06-JUN-2012	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G) LW1, GWEX-03, LWD	GWEX-01, LW3,	09-MAY-2012	21-MAY-2012	06-JUN-2012	✓	21-MAY-2012	06-JUN-2012	✓
EP005: Total Organic Carbon (TOC)								
Amber VOC Vial - Sulfuric Acid (EP005) LW1, GWEX-03, LWD	GWEX-01, LW3,	09-MAY-2012	----	----	----	18-MAY-2012	06-JUN-2012	✓



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Amber Glass Bottle - Unpreserved (EP075(SIM)) GWEX-01,		GWEX-03	09-MAY-2012	16-MAY-2012	16-MAY-2012	✔	17-MAY-2012	25-JUN-2012	✔



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	18	11.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	40	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	40	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	8	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	40	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	8	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	18	5.6	5.0	✓	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	20	5.0	5.0	✓	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	40	5.0	5.0	✓	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.0	5.0	✓	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✓	ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH ₃ G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NO _x) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO ₃ - F. Combined oxidised Nitrogen (NO ₂ +NO ₃) is determined by Cadmium Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO ₃ -. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP005	WATER	APHA 21st ed., 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
ED045G: Chloride Discrete analyser	EB1212770-001	Anonymous	Chloride	16887-00-6	Not Determined		Analyte not determined in allocated original sample.
ED045G: Chloride Discrete analyser	EB1212770-001	Anonymous	Chloride	16887-00-6	Not Determined		RPD exceeds LOR based limits
Matrix Spike (MS) Recoveries							
ED045G: Chloride Discrete analyser	EB1212770-002	Anonymous	Chloride	16887-00-6	Not Determined	----	Background level of analyte not determined in original.
EK055G: Ammonia as N by Discrete Analyser	EB1212558-002	Anonymous	Ammonia as N	7664-41-7	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Laboratory Control outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EB1213202	Page	: 1 of 3
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 17-MAY-2012
Sampler	: B.Hart	Issue Date	: 25-MAY-2012
Site	: Long Swamp Road Landfill		
Quote number	: BN/101/12	No. of samples received	: 1
		No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sampling date / time

				LW2	----	----	----	----
				13-MAY-2012 15:45	----	----	----	----
<i>Compound</i>	<i>CAS Number</i>	<i>LOR</i>	<i>Unit</i>	EB1213202-001	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	53	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Manganese	7439-96-5	0.001	mg/L	0.258	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	0.052	----	----	----	----
Iron	7439-89-6	0.05	mg/L	0.58	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.16	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.02	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.3	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	0.3	----	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	<1	----	----	----	----

Environmental Division

QUALITY CONTROL REPORT

Work Order	: EB1213202	Page	: 1 of 5
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Long Swamp Road Landfill	Date Samples Received	: 17-MAY-2012
C-O-C number	: ----	Issue Date	: 25-MAY-2012
Sampler	: B.Hart	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1
Quote number	: BN/101/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED045G: Chloride Discrete analyser (QC Lot: 2312174)									
EB1213062-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	242	242	0.0	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2314765)									
EB1212984-008	Anonymous	EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.173	0.172	0.0	0% - 20%
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.27	0.29	8.4	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2318606)									
EB1212940-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.46	0.47	0.0	0% - 20%
EB1212940-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.47	0.47	0.0	0% - 20%
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2318605)									
EB1212940-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.01	0.01	0.0	No Limit
EB1212940-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.02	<0.01	0.0	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2319086)									
EB1213113-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.5	0.4	0.0	No Limit
EB1213329-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EP005: Total Organic Carbon (TOC) (QC Lot: 2315817)									
EB1213037-001	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	248	253	1.8	0% - 20%
EB1213200-001	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	113	116	2.4	0% - 20%



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)		
Method: Compound	CAS Number	LOR	Unit	Result			LCS	Low	High
ED045G: Chloride Discrete analyser (QCLot: 2312174)									
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	99.5	70	128	
EG020F: Dissolved Metals by ICP-MS (QCLot: 2314765)									
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.100 mg/L	110	86	118	
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.200 mg/L	103	87	119	
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.50 mg/L	110	84	122	
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2318606)									
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	101	70	120	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2318605)									
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.0	70	124	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2319086)									
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10.0 mg/L	79.3	70	115	
EP005: Total Organic Carbon (TOC) (QCLot: 2315817)									
EP005: Total Organic Carbon	----	1	mg/L	<1	5 mg/L	96.9	76	112	



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number				
ED045G: Chloride Discrete analyser (QCLot: 2312174)							
EB1213062-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	104	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2314765)							
EB1213056-002	Anonymous	EG020A-F: Manganese	7439-96-5	0.100 mg/L	# Not Determined	70	130
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	123	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2318606)							
EB1212940-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	111	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2318605)							
EB1212940-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	104	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2319086)							
EB1213130-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	88.9	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number		MS	MSD	Low	High	Value	Control Limit
ED045G: Chloride Discrete analyser (QCLot: 2312174)										
EB1213062-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	104	----	70	130	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2314765)										
EB1213056-002	Anonymous	EG020A-F: Manganese	7439-96-5	0.100 mg/L	# Not Determined	----	70	130	----	----
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	123	----	70	130	----	----
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2318606)										
EB1212940-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	111	----	70	130	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2318605)										
EB1212940-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	104	----	70	130	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2319086)										
EB1213130-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	88.9	----	70	130	----	----

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EB1213202	Page	: 1 of 5
Client	: CODYHART CONSULTING PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MS BARBARA HART	Contact	: Customer Services
Address	: P O BOX 1073 BURLEIGH HEADS QLD, AUSTRALIA 4220	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: pelican@codyhart.com.au	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 55205532	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 55206531	Facsimile	: +61 7 3243 7218
Project	: Armidale 243	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Long Swamp Road Landfill	Date Samples Received	: 17-MAY-2012
C-O-C number	: ----	Issue Date	: 25-MAY-2012
Sampler	: B.Hart	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1
Quote number	: BN/101/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers



Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride Discrete analyser							
Clear Plastic Bottle - Natural (ED045G) LW2	13-MAY-2012	---	10-JUN-2012	----	19-MAY-2012	10-JUN-2012	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) LW2	13-MAY-2012	---	09-NOV-2012	----	22-MAY-2012	09-NOV-2012	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) LW2	13-MAY-2012	---	10-JUN-2012	----	24-MAY-2012	10-JUN-2012	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) LW2	13-MAY-2012	---	10-JUN-2012	----	24-MAY-2012	10-JUN-2012	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) LW2	13-MAY-2012	23-MAY-2012	10-JUN-2012	✓	25-MAY-2012	10-JUN-2012	✓
EP005: Total Organic Carbon (TOC)							
Amber TOC Vial - Sulfuric Acid (EP005) LW2	13-MAY-2012	----	----	----	22-MAY-2012	10-JUN-2012	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	17	11.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	8	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	13	15.4	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	4	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	8	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	8	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	17	5.9	5.0	✓	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	4	25.0	5.0	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	8	12.5	5.0	✓	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	12	8.3	5.0	✓	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	7.7	5.0	✓	ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH3 G. Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Cadmium Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO3-. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP005	WATER	APHA 21st ed., 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG020F: Dissolved Metals by ICP-MS	EB1213056-002	Anonymous	Manganese	7439-96-5	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.

CodyHart Environmental Analyses

Due to holding time problems if sent to a NATA registered laboratory, CodyHart conducts laboratory analyses for alkalinity and free CO₂ on-site or on the evening of the sampling day. The analyses are more accurate when conducted on fresh samples. Alkalinity has always been regarded as a 'field analyte' in the literature.

- For alkalinity, CodyHart uses titration and/or colour change, on site or on the evening of sampling, to endpoint pH 4.5 as detailed in APHA (1998) section 2320, which is the NSW EPA approved method. The colour change method adopted uses a mixed indicator alkalinity (Bromocresol Green – Methyl Red) indicator solution (APHA 1992, 2-25, 2-27) which in combination with titration changes the sample colour from blue to wild moss green at approximately pH 4.5.
- High concentrations of free CO₂ indicate that landfill gas may be permeating groundwater. The APHA 4500-CO₂ C titration method is used as detailed in *Standard Methods for the Examination of Water and Wastewater*, 18th edition 1992:4-17, and/or a phenolphthalein indicator colour method which in combination with titration changes the sample colour from clear to mid-pink (APHA 1992, 2-25, 2-27) at pH 8.3.

A round of comparative testing at a number of landfill sites in June 2008, including Long Swamp Road Landfill, indicated that alkalinity lab results versus field results had an RPD of <20%. In most cases the alkalinity field results were greater. It was decided that the colour change method was the most efficient, but was inappropriate for deeply coloured samples. (Most groundwater and surface water samples are clear or slightly cloudy white.) For free CO₂, the colour change method was the most efficient.

Results 09/05/12 to 13/05/12

Historical sampling points

	LW1	LW2	LW3	LS2	LS3	LS4	LS5	LL1
Free CO ₂ (mg/L) (titration & colour change)	164	88	164	<1	<1	29	3	NT
Alkalinity (mg/L) (titration & colour change)	<1	233	200	700	713	303	156	NT

Landfill extension

	GWEX-01	GWEX-02	GWEX-03	SWEX-01	LL2
Free CO ₂ (mg/L) (titration & colour change)	165	161	176	23	NT
Alkalinity (mg/L) (titration & colour change)	3	103	250	25	NT

NT = Not tested

Appendix B

Conceptual Design Drawings

Appendix B Conceptual Design Drawings

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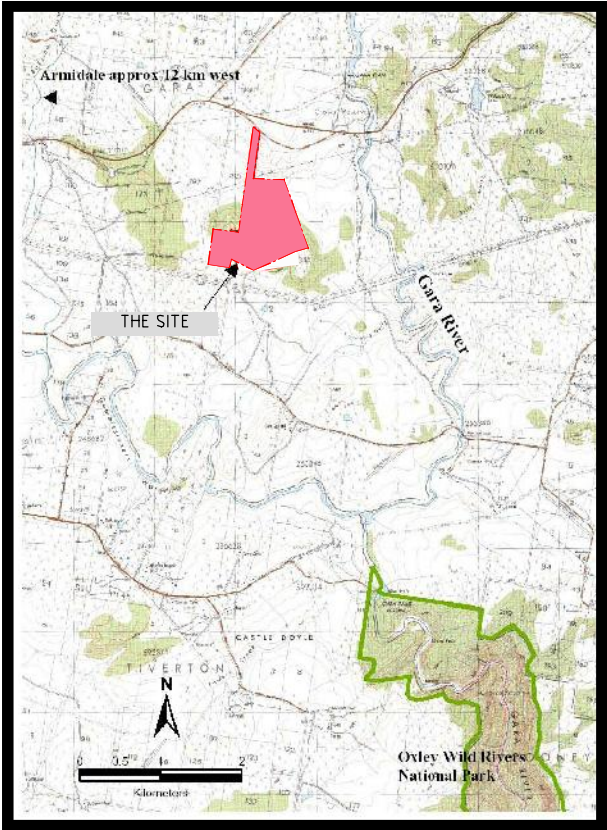
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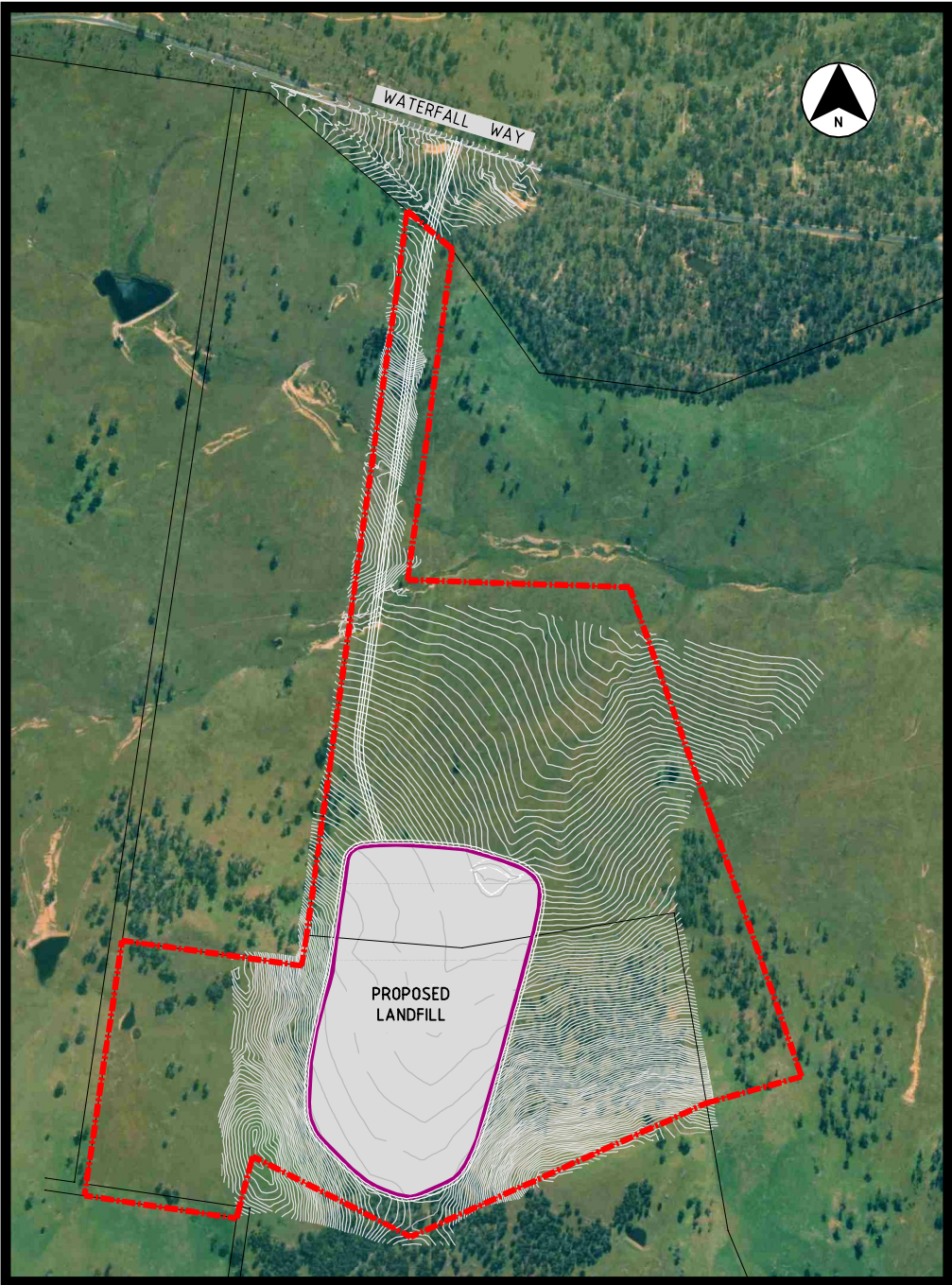
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL

DESIGN AND WATER MANAGEMENT DRAWINGS



LOCALITY PLAN



PLAN
SCALE 1:5000 (A1)

DRAWING LIST

DRAWING No.	DRAWING TITLE
20017605-CI-100	DRAWING LIST AND LOCALITY PLAN
20017605-CI-101	SITE LAYOUT PLAN
20017605-CI-102	LANDFILL FOOTPRINT
20017605-CI-103	LANDFILL SECTIONS
20017605-CI-110	STAGE 1 WATER MANAGEMENT PLAN
20017605-CI-111	STAGE 2 WATER MANAGEMENT PLAN
20017605-CI-112	STAGE 3 WATER MANAGEMENT PLAN
20017605-CI-113	STAGE 4 WATER MANAGEMENT PLAN
20017605-CI-114	STAGE 5 WATER MANAGEMENT PLAN
20017605-CI-120	TYPICAL DRAIN DETAILS AND SECTIONS
20017605-CI-121	TYPICAL DETAILS
20017605-CI-130	LEACHATE POND, SEDIMENTATION BASIN AND DRY BASIN SECTIONS

NOTES:

- CO-ORDINATES ARE TO MAP GRID OF AUSTRALIAIN 1994 ON M.G.A.
- LEVELS ARE IN METRES WITH RESPECT TO THE AUSTRALIAN HEIGHT DATUM (AHD).
- ALL DIMENSIONS ARE IN MILLIMETRES UNO.

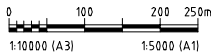
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B	TT	15.05.08	FINAL FOR REPORT BOUNDARY REVISED	AK
A	TT	05.05.08	FINAL FOR REPORT	AK
No	BY	DATE	DESCRIPTION	APPD

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000

DESIGNED	AK	CHECKED	
DRAWN	TT / AC	CHECKED	PM
APPROVED	JP	DATE	16.06.08

SCALES:



CLIENT:



CONTRACTOR:

DESIGNER:

AECOM

RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

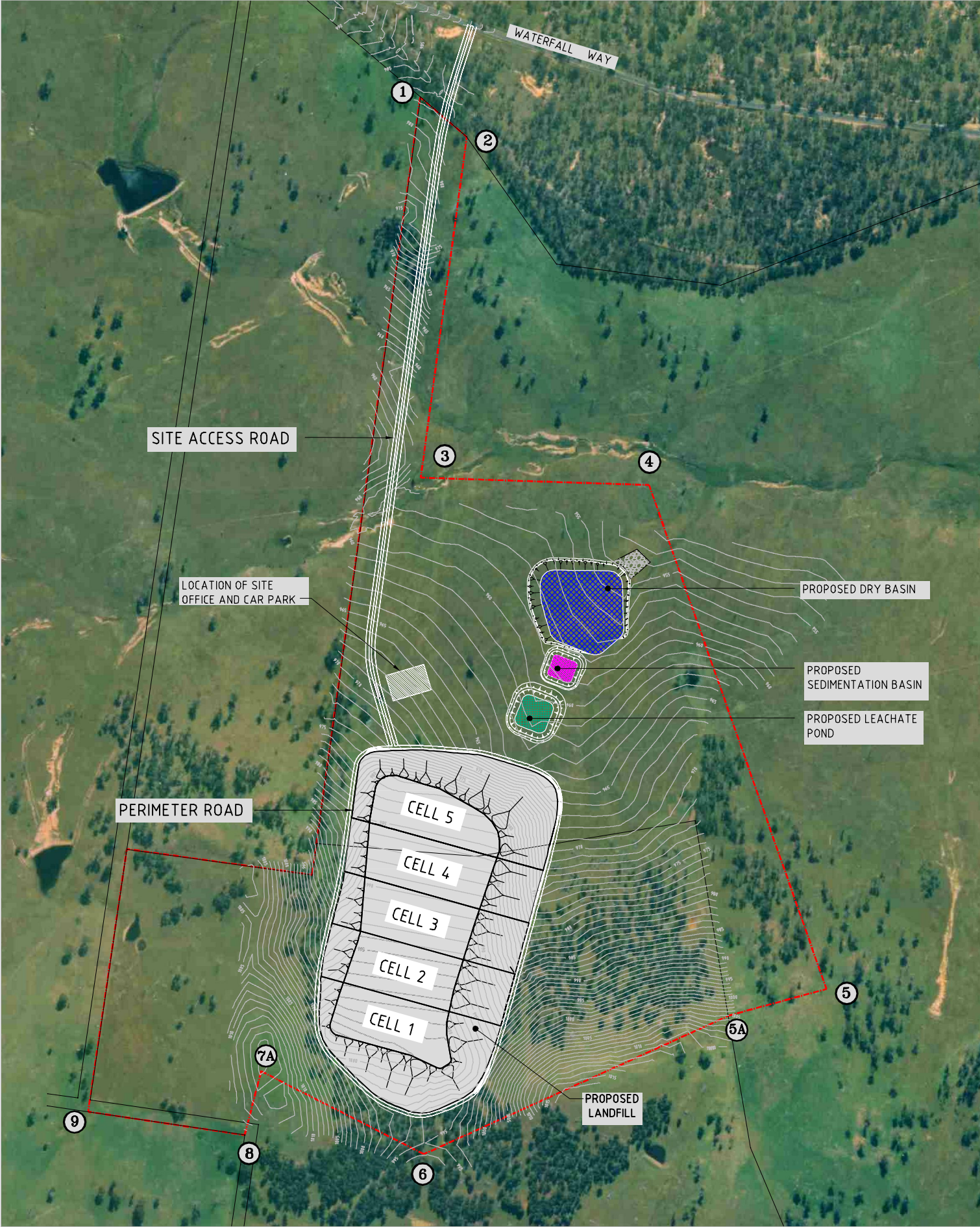
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DRAWING LIST AND LOCALITY PLAN

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3	383334	6619705
4	383706	6619693
5	383995	6618872
5A	383837	6618829
6	383339	6618603
7A	383068	6618713
8	383047	6618634
9	382792	6618672



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B	TT	15.05.08	FINAL FOR REPORT BONDARY REVISED	AK
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No	BY	DATE	DESCRIPTION	APPD

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DRAWN	TT / AC	CHECKED	PM
APPROVED	JP	DATE	16.06.08

SCALES:



CLIENT:



CONTRACTOR:

DESIGNER:

AECOM

RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL

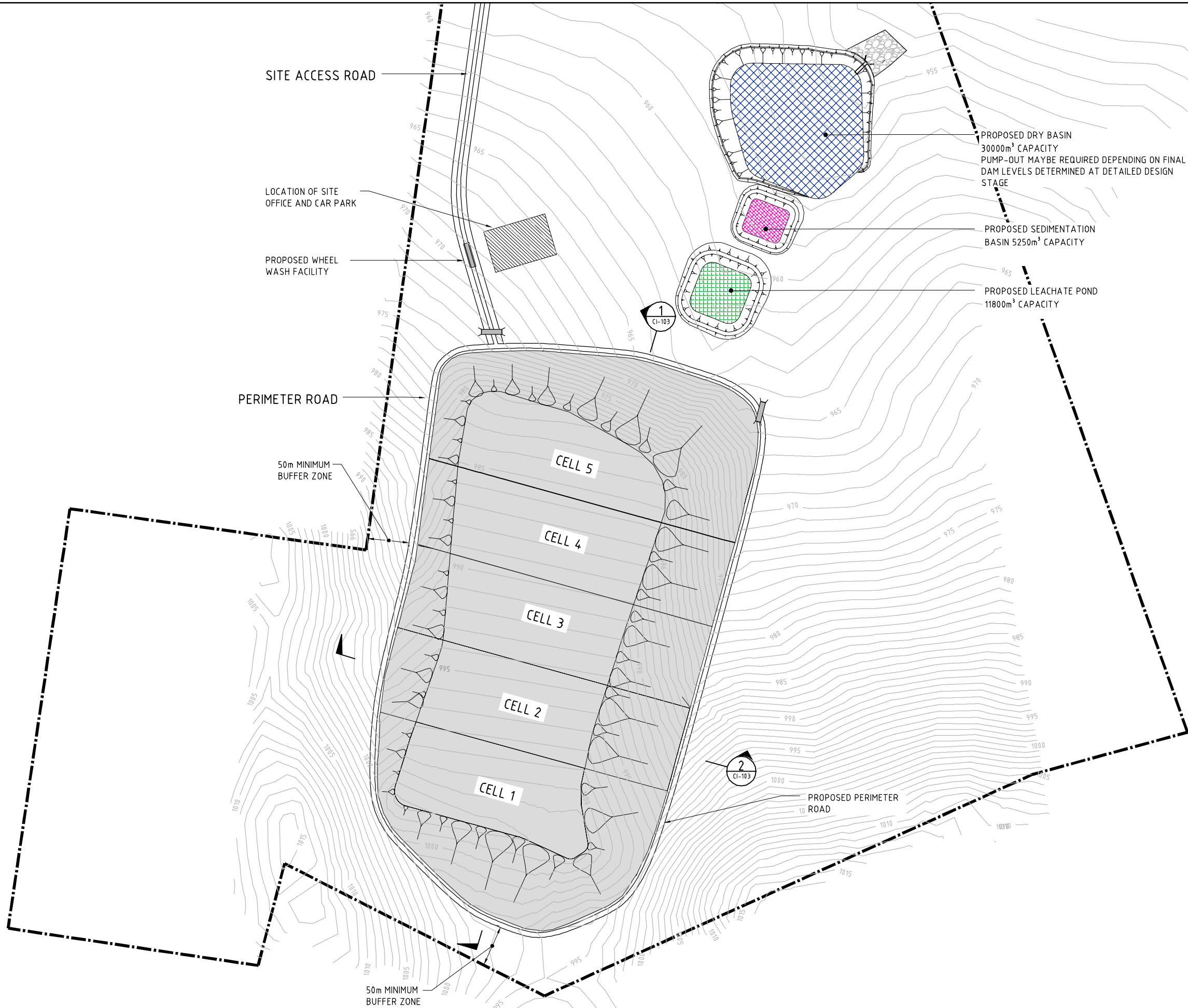
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DETAILED CONCEPT

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REV:
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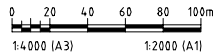
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- PROPOSED PROPERTY BOUNDARY
- PROPOSED LEACHATE POND
- PROPOSED SEDIMENTATION POND
- PROPOSED DRY BASIN
- PROPOSED LANDFILL FOOTPRINT
- PROPOSED PERIMETER ACCESS ROAD
- CONTOUR LINE

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SCALES:



CLIENT:



CONTRACTOR:

DESIGNER:

AECOM

RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL

LANDFILL FOOTPRINT

STATUS:
DETAILED CONCEPT

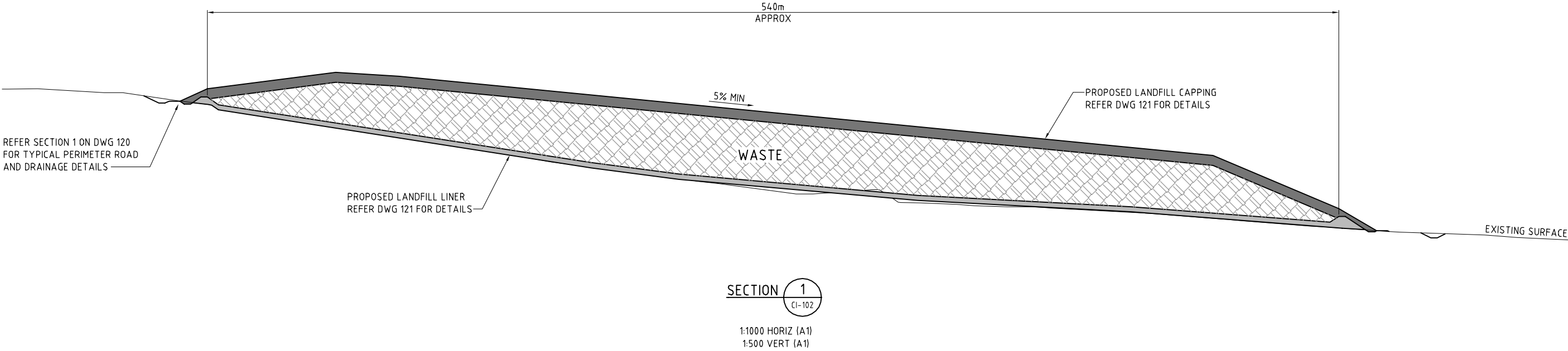
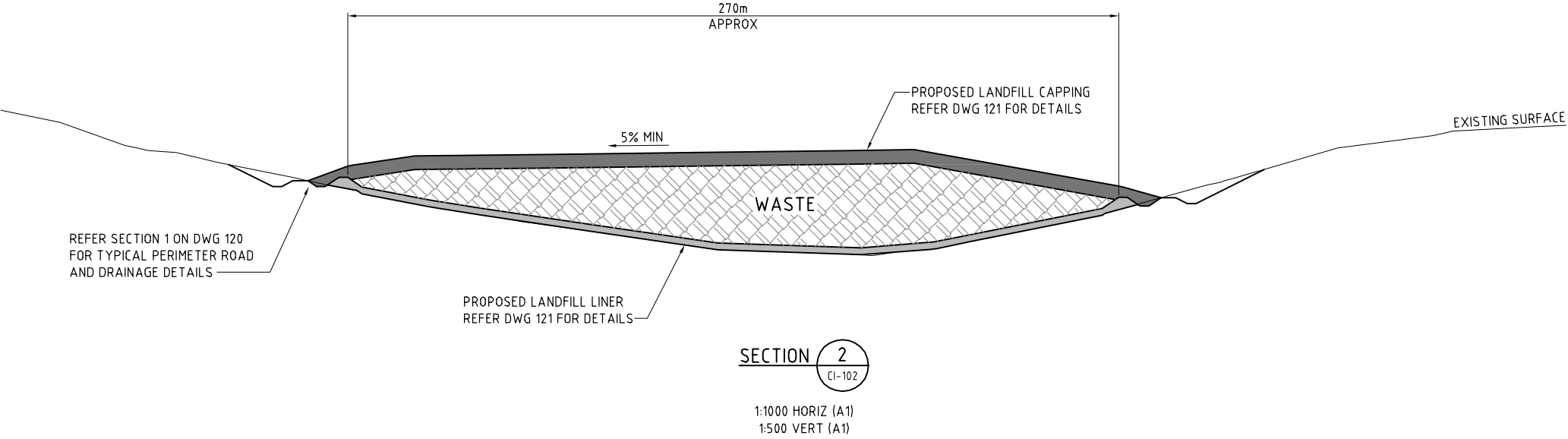
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APPROVED	JP	DATE	23.12.09

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DESIGNED	AK	CHECKED	
DRAWN	AC	CHECKED	PM
APPROVED	JP	DATE	23.12.09

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CLIENT:



CONTRACTOR:

DESIGNER:



RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL		
LANDFILL SECTIONS		
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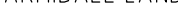


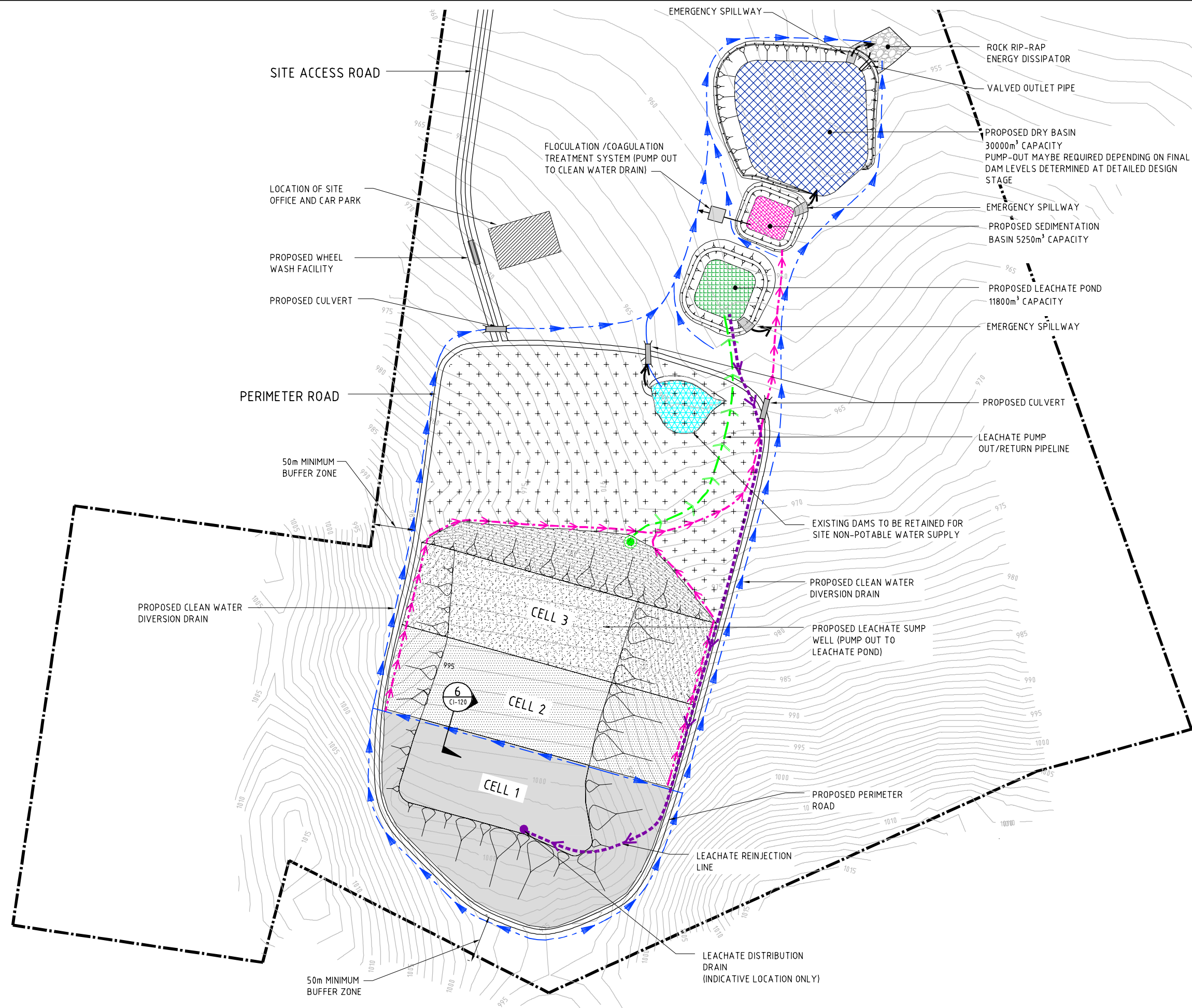
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- PROPOSED CLEAN WATER DIVERSION DRAIN
- PROPOSED DIRTY WATER DRAIN
- LEACHATE PUMP OUT PIPELINE
- LEACHATE REINJECTION LINE
- PROPOSED LEACHATE POND
- PROPOSED SEDIMENTATION POND
- PROPOSED DRY BASIN
- FUTURE LANDFILL
- ACTIVE LANDFILL AREA
- FINAL CAPPED AND NOT FULLY VEGETATED LANDFILL AREA
- FINAL CAPPED AND FULLY VEGETATED LANDFILL AREA
- PROPOSED PERIMETER ACCESS ROAD
- CONTOUR LINE

This drawing is confidential and shall only be used for the purposes of this project.					THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001-2000				SCALES:		CLIENT:		CONTRACTOR:		DESIGNER:		ARMIDALE LANDFILL								
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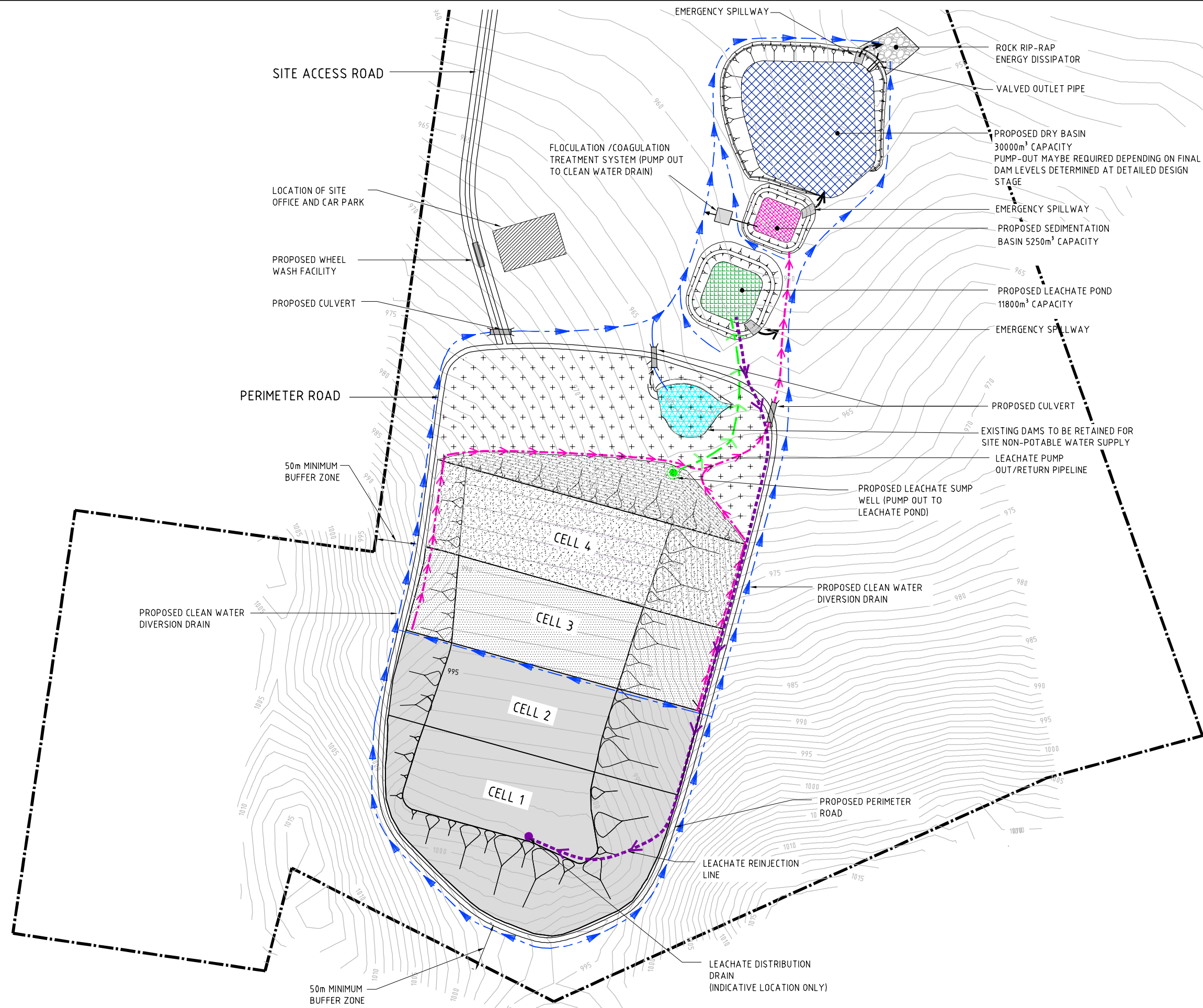
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LEGEND

- PROPOSED PROPERTY BOUNDARY
- PROPOSED CLEAN WATER DIVERSION DRAIN
- PROPOSED DIRTY WATER DRAIN
- LEACHATE PUMP OUT PIPELINE
- LEACHATE REINJECTION LINE
- PROPOSED LEACHATE POND
- PROPOSED SEDIMENTATION POND
- PROPOSED DRY BASIN
- FUTURE LANDFILL
- ACTIVE LANDFILL AREA
- FINAL CAPPED AND NOT FULLY VEGETATED LANDFILL AREA
- FINAL CAPPED AND FULLY VEGETATED LANDFILL AREA
- PROPOSED PERIMETER ACCESS ROAD
- CONTOUR LINE

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LEGEND

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- PROPOSED DIRTY WATER DRAIN
- LEACHATE PUMP OUT PIPELINE
- LEACHATE REINJECTION LINE
- PROPOSED LEACHATE POND
- PROPOSED SEDIMENTATION POND
- PROPOSED DRY BASIN
- FUTURE LANDFILL
- ACTIVE LANDFILL AREA
- FINAL CAPPED AND NOT FULLY VEGETATED LANDFILL AREA
- FINAL CAPPED AND FULLY VEGETATED LANDFILL AREA
- PROPOSED PERIMETER ACCESS ROAD
- CONTOUR LINE

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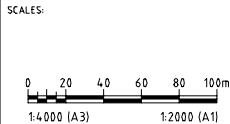
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- PROPOSED LEACHATE POND
- PROPOSED SEDIMENTATION POND
- PROPOSED DRY BASIN
- FUTURE LANDFILL
- ACTIVE LANDFILL AREA
- FINAL CAPPED AND NOT FULLY VEGETATED LANDFILL AREA
- FINAL CAPPED AND FULLY VEGETATED LANDFILL AREA
- PROPOSED PERIMETER ACCESS ROAD
- CONTOUR LINE

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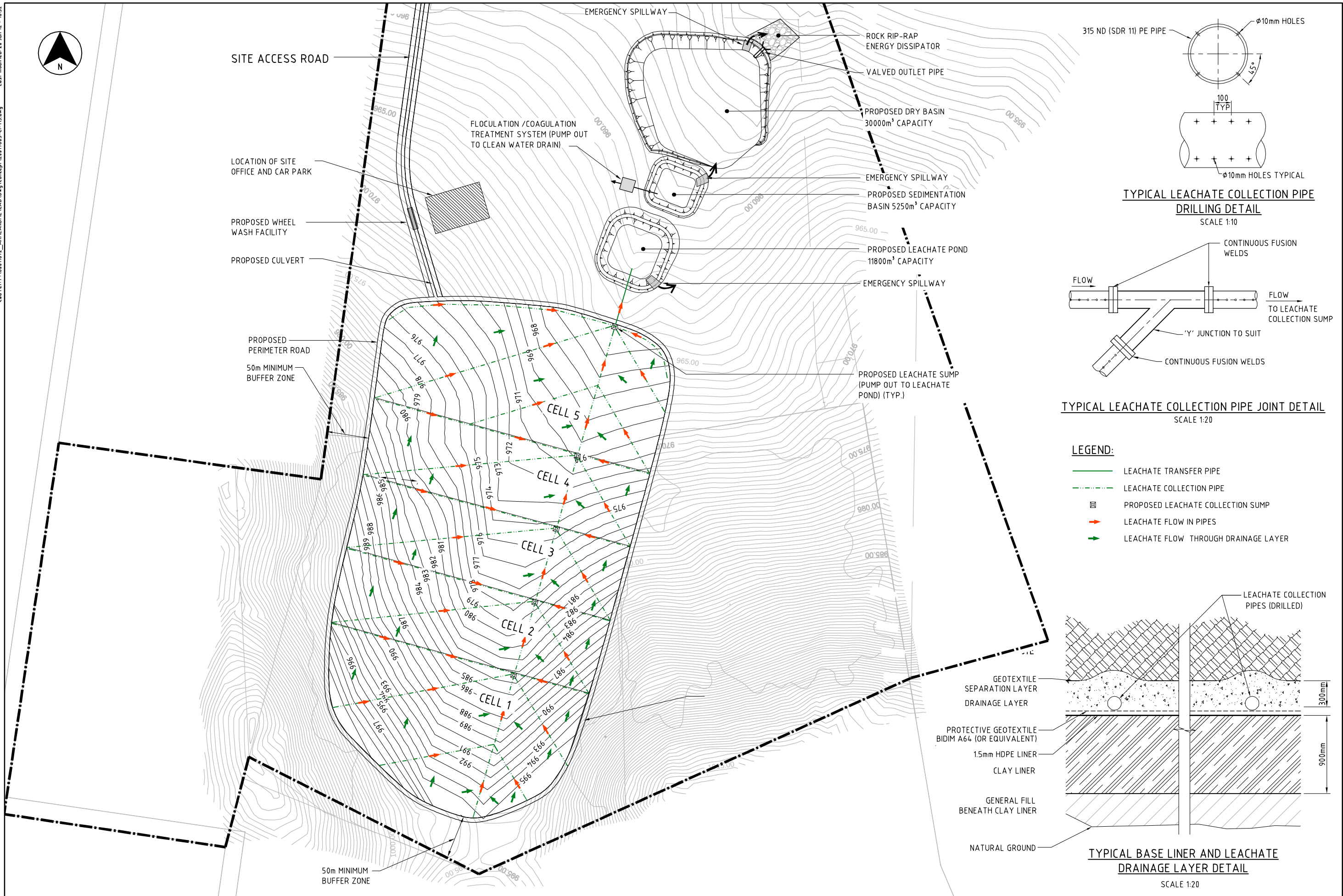
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AECOM

RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL
STAGE 5 WATER MANAGEMENT PLAN

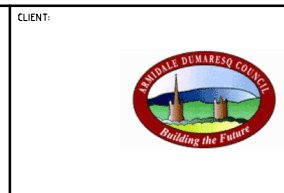
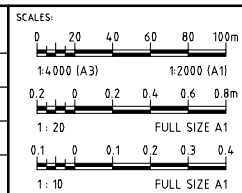
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This drawing is confidential and shall only be used for the purposes of this project.

A	SS	18.06.12	JP
By	DATE	DESCRIPTION	APPD

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000			
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DRAWN	SS	CHECKED	JA
APPROVED	JP	DATE	18.06.12

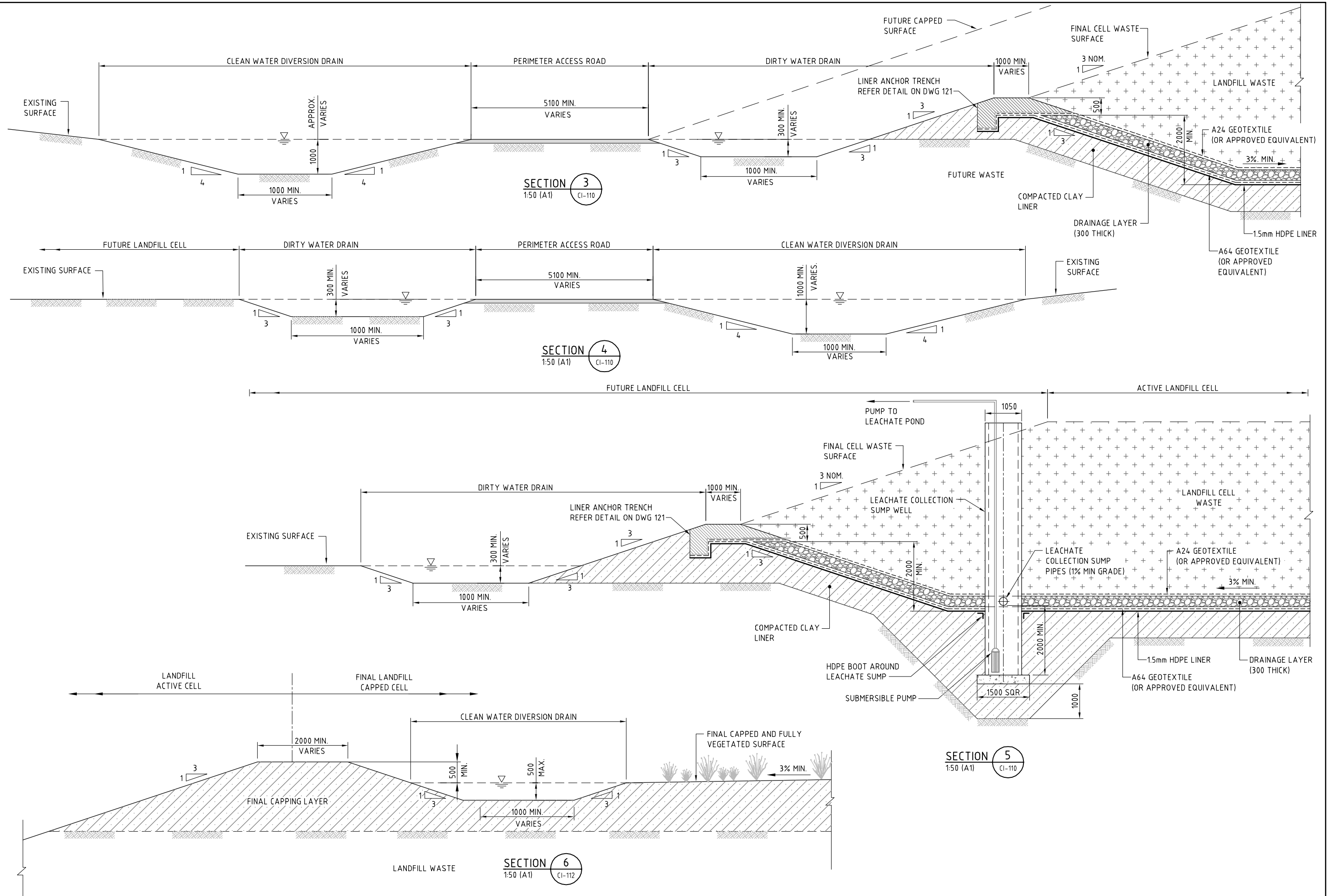


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AECOM

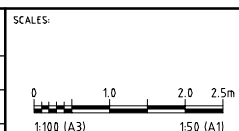
RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL		
TYPICAL LEACHATE COLLECTION AND CONVEYANCE SYSTEM		
STATUS: DETAILED CONCEPT	DRAWING NO: 20017605-CI-115	REV: A



This drawing is confidential and shall only be used for the purposes of this project.			
C	AJC	23.12.09	UPDATED CONCEPT DESIGN
B	TT	16.06.08	FINAL ISSUE
A	TT	05.05.08	FINAL FOR REPORT
No.	BY	DATE	DESCRIPTION

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000			
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APPROVED	JP	DATE	16.06.08

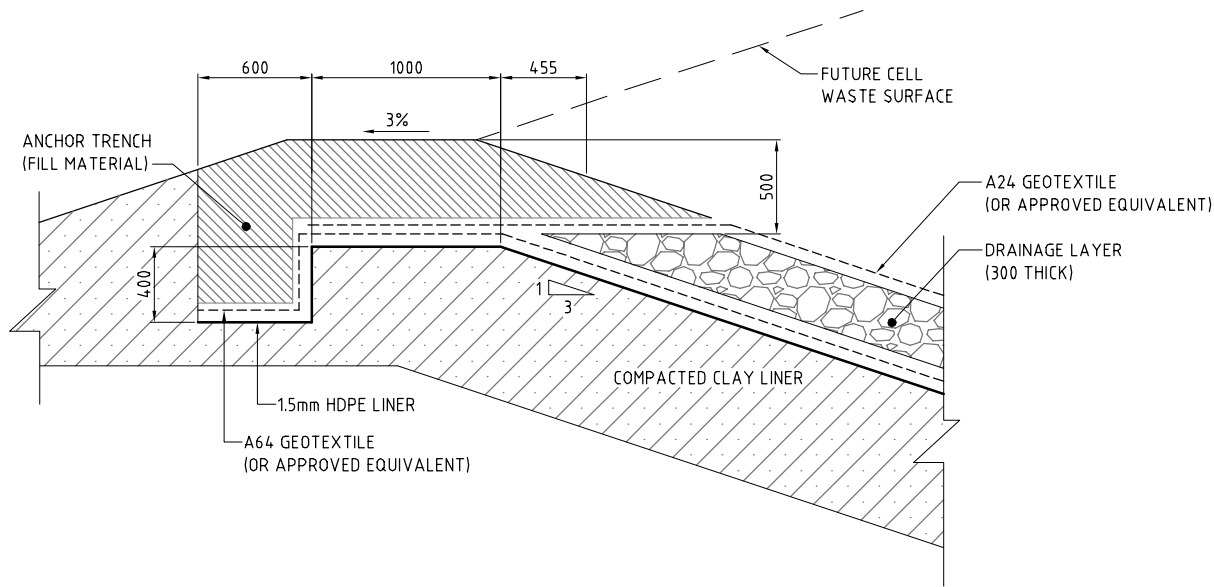


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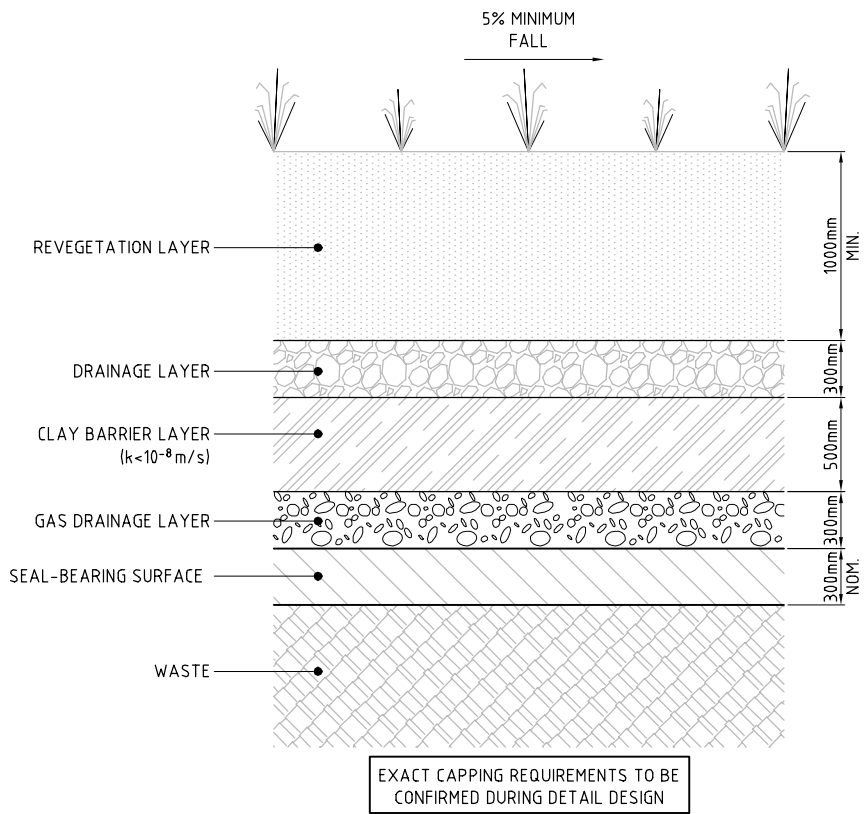
AECOM

RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

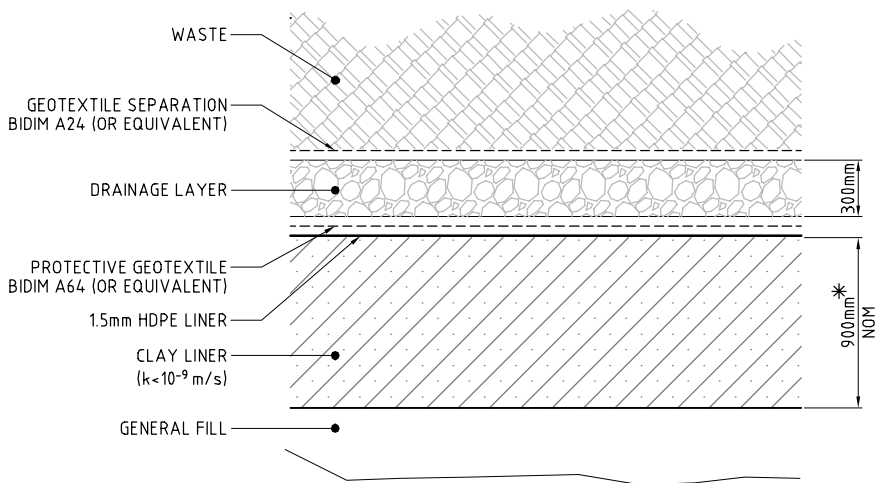
ARMIDALE LANDFILL		
TYPICAL DRAIN DETAILS AND SECTIONS		
STATUS:	DRAWING NO:	REV:
DETAILED CONCEPT	20017605-CI-120	C



LINER ANCHOR TRENCH
TYPICAL DETAIL
NOT TO SCALE



TYPICAL FINAL CAPPING DETAIL
NOT TO SCALE



TYPICAL BASE LINER DETAIL
NOT TO SCALE

* EXACT THICKNESS DEPENDENT ON
VOLUME OF CLAY WON ONSITE

This drawing is confidential and shall only be used for the purposes of this project.					
A	AJC	23.12.09	UPDATED CONCEPT DESIGN	JP	
No.	BY	DATE	DESCRIPTION	APPD	

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001-2000			
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DRAWN	AC	CHECKED	PM
APPROVED	JP	DATE	23.12.09

SCALES:

CLIENT:

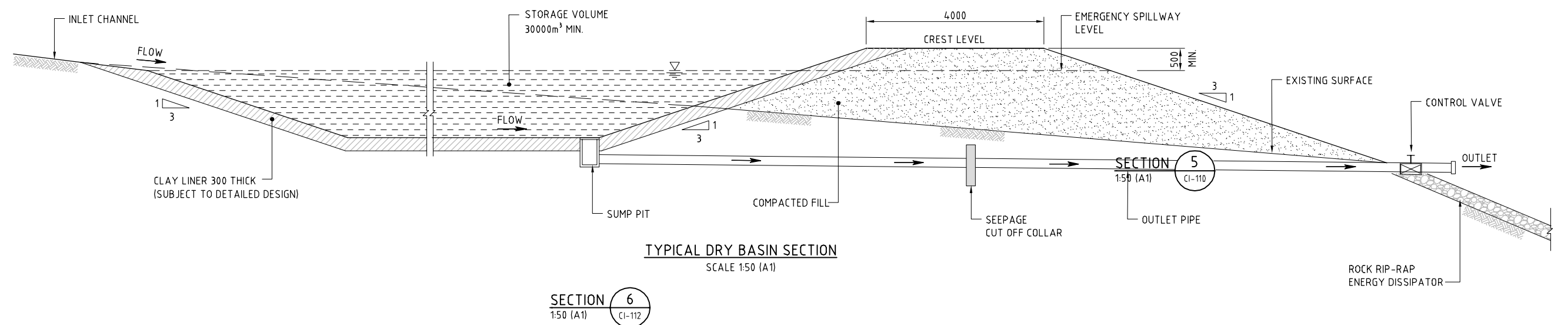
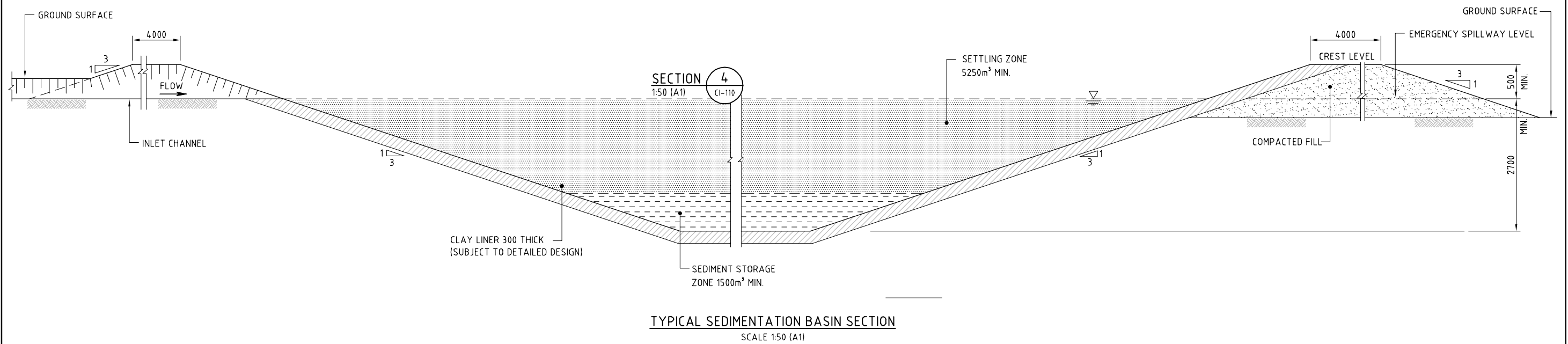
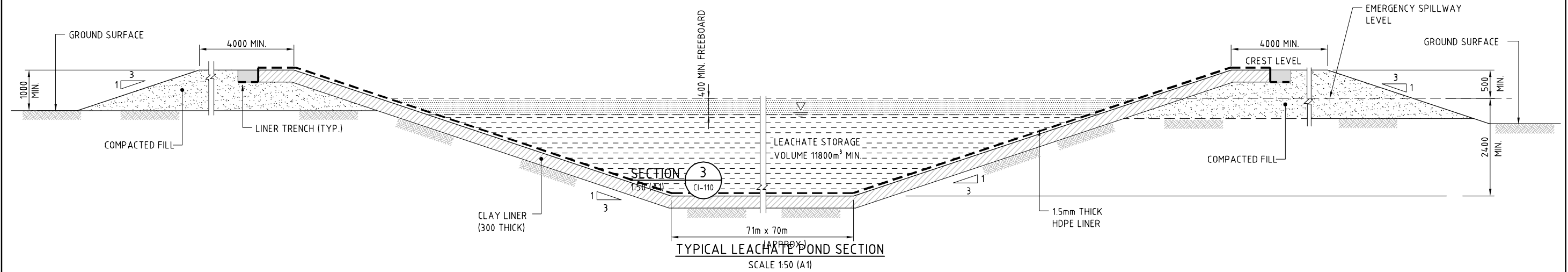

CONTRACTOR:

DESIGNER:

RPEQ No. AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL		
TYPICAL DETAILS		
STATUS: DETAILED CONCEPT	DRAWING NO: 20017605-CI-121	REV: A

Cad ref: P:\6001762_ARMIDALE\LANDFILL\CAD\DWG\Concept\20017605-CI-130.dwg
Last modified: 14 Jun 12 - 16:41



This drawing is confidential and shall only be used for the purposes of this project.

C	AJC	23.12.09	UPDATED CONCEPT DESIGN	JP	
B	TT	16.06.08	FINAL ISSUE	AK	
A	TT	05.05.08	FINAL FOR REPORT	AK	
No	BY	DATE	DESCRIPTION	APPD	

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000

DESIGNED	AK	CHECKED	
DRAWN	TT / AC	CHECKED	PM
APPROVED	JP	DATE	16.06.08

SCALES:



CLIENT:



CONTRACTOR:

DESIGNER:

AECOM

RPEQ No.
AECOM Australia Pty Ltd A.B.N. 20 093 846 925

ARMIDALE LANDFILL

LEACHATE POND, SEDIMENTATION BASIN
AND DRY BASIN SECTIONS

STATUS:
DETAILED CONCEPT

DRAWING NO:
20017605-CI-130

REV:
C

Appendix C

Letters of Commitment

Appendix C Letters of Commitment



Armidale Dumaresq Council

Address correspondence to the General Manager

Phone: (02) 6770 3600

Freecall: 1300 136 833

Fax: (02) 6772 9275

ABN 63 781 014 253

135 Rusden Street

PO Box 75A

ARMIDALE NSW 2350

Date 26 August 2009 Your Ref Our Ref CM:BA:A05/2410-2

The General Manager
Guyra Shire Council
PO Box 207
GUYRA NSW 2365

Dear Mr Cushway

REGIONAL LANDFILL

In light of the recent decision to disband NESAC, and in order to ensure that the statements made in the Environmental Assessment regarding a "Regional Landfill" are correct, I would be obliged if you could confirm Guyra Shire Council's continued commitment to participation in the new Regional Landfill whether it be in the short term or the long term.

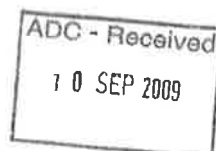
Should you require further information with regards to this matter I can be contacted by telephoning 6770 3849.

Yours sincerely

Colin Maciver
Utilities Manager
Armidale Dumaresq Council

Our ref:

Your ref: CM:BA:A05/2410-2



Civic Centre
158 Bradley Street
(PO Box 207)
GUYRA NSW 2365

8th September, 2009

General Manager
Armidale Dumaresq Council
PO Box 75A
ARMIDALE NSW 2350

Dear Mr Burns

Re: Guyra Council's use of the proposed regional landfill in Armidale.

I refer to the recent letter from your Utilities Manager in which he asked Council to confirm its support for the establishment of a regional landfill in the Armidale area. As you will be aware Council's contractors have been transporting the bulk of the waste generated in the Guyra, Black Mountain and the Ben Lomond areas to the existing Armidale Waste Facility for several years. It is anticipated that this method of waste disposal will continue until such time as there is a more environmentally sustainable, cost effective method of disposal available in the area.

As you will be aware the NSW State and the Australian Federal Governments have been encouraging the community generally and councils in particular to reduce the waste being generated and deposited to landfills by recycling and reuse wherever possible. Accordingly Guyra Council, like most other councils, are seeking every opportunity to reduce its waste and in an effort to achieve this objective are prepared to investigate and if affordable embrace innovative, proven technology to achieve these ends.

Should you require any additional information please contact Council's Director of Development and Environmental Services, Mr Bob Furze, on (02) 6770 7109 during business hours or (02) 67791246 after hours.

Yours sincerely

**FOR- DAVID CUSHWAY
GENERAL MANAGER**



Armidale Dumaresq Council

Address correspondence to the General Manager

Phone: (02) 6770 3600
Freecall: 1300 136 833
Fax: (02) 6772 9275
ABN 63 781 014 253

135 Rusden Street
PO Box 75A
ARMIDALE NSW 2350

Date 26 August 2009 Your Ref Our Ref CM:BA:A05/2410-2

The General Manager
Uralla Shire Council
PO Box 106
URALLA NSW 2358

Dear Mr O'Connor

REGIONAL LANDFILL

In light of the recent decision to disband NESAC, and in order to ensure that the statements made in the Environmental Assessment regarding a "Regional Landfill" are correct, I would be obliged if you could confirm Uralla Shire Council's continued commitment to participation in the new Regional Landfill whether it be in the short term or the long term.

Should you require further information with regards to this matter I can be contacted by telephoning 6770 3849.

Yours sincerely

Colin Maciver
Utilities Manager
Armidale Dumaresq Council

- 7 OCT 2009



Council Chambers and
Administration Centre:
32 SALISBURY STREET,
PO BOX 106,
URALLA NSW 2358

Tel: (02) 6778 4606

Fax: (02) 6778 5073

Email: council@uralla.nsw.gov.auWeb: www.uralla.nsw.gov.au

ABN: 55 868 272 018

*In reply, please
quote:*

TOC : CC U09/6615

Your Ref: AO5/2410-2

6 October 2009

Mr C Maciver
Utilities Manager
Armidale Dumaresq Council
PO Box 75A
ARMIDALE NSW 2350

Dear Mr Maciver,

Regional Landfill

Your letter of 20 August 2009 is acknowledged. The Uralla Shire Council has maintained a watching brief on the Regional Landfill project with delegates, Cr M Pearce and Cr R Filmer, on the Armidale Dumaresq Council's Waste Management Committee.

The Uralla Landfill site is currently operating an active 675 square metre cell. The original estimated life for this cell was for two years. This year the cell was estimated, at 30 June 2009, as having a further year to operate giving it a three year life. The landfill site has a further 4,825 square metres available for disposal cells. The estimated life of the current and future cells, at 30 June 2009, was estimated to be 19 years.

Since the estimates at 30 June 2009 a detailed evaluation of the effect of our increased recycling program and the capacity of the current active area has re-evaluated the life of the existing area. The estimated life of the active area is now six years. Therefore the Uralla Shire Council has a six year horizon to develop alternate strategies:-

- Continue to develop disposed cells on the 4,825 square metre site
- Develop the recycling and transfer operation for delivery of baled non-recyclable material to a Regional Landfill site.

URALLA



Armidale Dumaresq Council

Address correspondence to the General Manager

Phone: (02) 6770 3600
Freecall: 1300 136 833
Fax: (02) 6772 9275
ABN 63 781 014 253

135 Rusden Street
PO Box 75A
ARMIDALE NSW 2350

Date 26 August 2009 Your Ref Our Ref CM:BA:A05/2410-2

The General Manager
Walcha Council
PO Box 2
WALCHA NSW 2354

Dear Mr O'Hara

REGIONAL LANDFILL

In light of the recent decision to disband NESAC, and in order to ensure that the statements made in the Environmental Assessment regarding a "Regional Landfill" are correct, I would be obliged if you could confirm Walcha Council's continued commitment to participation in the new Regional Landfill whether it be in the short term or the long term.

Should you require further information with regards to this matter I can be contacted by telephoning 6770 3849.

Yours sincerely

Colin Maciver
Utilities Manager
Armidale Dumaresq Council

ADC - Received

09 SEP 2009

WALCHA COUNCIL

ABN 24 780 320 847

2W Hamilton Street
PO Box 2
WALCHA NSW 2354



Telephone: 02 6774 2500
Rates & Admin: 02 6774 2500
Engineering: 02 6774 2515
Fax: 02 6777 1181
Email: council@walcha.nsw.gov.au
Website: www.walcha.nsw.gov.au

8 September 2009

General Manager
Armidale Dumaresq Council
PO Box 75A
ARMIDALE 2350

Attention: Mr Colin Maciver

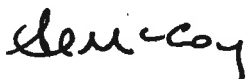
Dear Col

Regional Landfill

Your Reference: CM:BA:A05/2410-2

I refer to your letter of 26 August 2009. Walcha Council is still committed to participation in the new Regional Landfill.

Yours faithfully


+ JACK O'HARA
GENERAL MANAGER

WHEN REPLYING PLEASE QUOTE WO/2009/00852
WHEN MAKING ENQUIRIES ASK FOR STEVE MCCOY

CIM:A05/2410

25 August 2006

Mr Andrew Johnson
General Manager
Guyra Shire Council
PO Box 207
GUYRA NSW 2365

Dear Mr Johnson

NEW LANDFILL FOR ARMIDALE REGION

You will be aware that Armidale Dumaresq Council are working through the process to develop a new landfill for this Council and for the possible future needs of the other neighbouring Councils in the NESAC group.

The time has come in the preparation of the Environmental Assessment for the new landfill project where we need to get some form of commitment from the other Councils as to their likelihood of being a user of the new landfill sometime in the future.

The issue was discussed at the meeting of the Armidale Dumaresq Council Waste Management Committee held on 4 July 2006 with the following recommendation made to Council and subsequently adopted by Council at the meeting held 24 July 2006.

- *That Walcha Shire Council and other NESAC Councils be included in the Environmental Assessment (EA) Consultation matters.*
- *That Walcha Shire Council and other NESAC Councils be invited to submit an Expression of Interest to potentially participate in the New Regional Landfill.*

I would be obliged if you could arrange for this matter to be considered by your Council at its earliest convenience and I look forward to receiving your reply in due course.

Yours sincerely

Colin Maciver
Utilities Manager
Tel 02 6770 3549 e-mail - cmaciver@armidale.nsw.gov.au

Our ref: CIM:A05/2410
Your ref:



Civic Centre
158 Bradley Street
(PO Box 207)
GUYRA NSW 2365

GUYRA COUNCIL IS AN EQUAL OPPORTUNITY EMPLOYER. We are committed to providing a safe and healthy work environment for all employees.

GUYRA COUNCIL IS AN EQUAL OPPORTUNITY EMPLOYER. We are committed to providing a safe and healthy work environment for all employees.

14 September, 2006

ADC - Registered
1 8 SEP 2006

Utilities Manager
Armidale Dumaresq Council
PO Box 75A
ARMIDALE NSW 2350

Dear Mr Maciver,

RE: USE OF ARMIDALE'S PROPOSED LANDFILL

I refer to your recent letter in which you asked for a commitment by Council on the use of Armidale's proposed new landfill. As you will be aware Council has been disposing of most of the waste currently being generated in the Guyra, Llangothlin, Ben Lomond and Black Mountain areas at the Armidale Landfill for some time and does not envisage this situation changing in the foreseeable future.

Council considers that the greatest opportunity for minimising the cost of waste disposal is in a large centralised facility, which provides the necessary economies of scale. Accordingly, Council supports the establishment of a landfill servicing the region in the Armidale area. Should you have any questions regarding the above please contact Council's Director of Development and Environmental Services on (02) 6779 1577, during business hours or (02) 6779 1246 after hours.

Yours sincerely,

ANDREW JOHNSON
GENERAL MANAGER

CIM:A05/2410

25 August 2006

Mr Robert Fulcher
General Manager
Uralla Shire Council
PO Box 106
URALLA NSW 2358

Dear Mr Fulcher

NEW LANDFILL FOR ARMIDALE REGION

You will be aware that Armidale Dumaresq Council are working through the process to develop a new landfill for this Council and for the possible future needs of the other neighbouring Councils in the NESAC group.

The time has come in the preparation of the Environmental Assessment for the new landfill project where we need to get some form of commitment from the other Councils as to their likelihood of being a user of the new landfill sometime in the future.

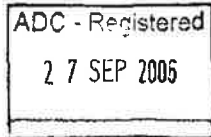
The issue was discussed at the meeting of the Armidale Dumaresq Council Waste Management Committee held on 4 July 2006 with the following recommendation made to Council and subsequently adopted by Council at the meeting held 24 July 2006.

- *That Walcha Shire Council and other NESAC Councils be included in the Environmental Assessment (EA) Consultation matters.*
- *That Walcha Shire Council and other NESAC Councils be invited to submit an Expression of Interest to potentially participate in the New Regional Landfill.*

I would be obliged if you could arrange for this matter to be considered by your Council at its earliest convenience and I look forward to receiving your reply in due course.

Yours sincerely

Colin Maciver
Utilities Manager
Tel 02 6770 3549 e-mail - cmaciver@armidale.nsw.gov.au



URALLA SHIRE COUNCIL
32 SALISBURY STREET, URALLA
PO Box 106
URALLA NSW 2358
ABN 55 868 272 018

In reply, please quote:
P-9/1

26 September 2006

Mr C Macaiver
Utilities Manager
Armidale Dumaresq Council
PO Box 75a
ARMIDALE 2350

Dear Mr Maciver

New Landfill for Armidale Region

Reference is made to your letter dated 25 August 2006 concerning the above matter.

Council considered this matter at its meeting held on 25 September 2006 and resolved:

"That Council agree to submit an expression of interest to participate in the new regional landfill in the Armidale Dumaresq Council."

Council would therefore be grateful if you could consider our expression of interest in the project, and advise Council on the manner in which to best progress this matter.

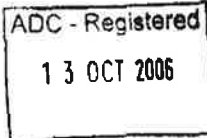
If you require any further information concerning this matter please do not hesitate in contacting Council staff on 6778 4606.

Yours faithfully

A handwritten signature in black ink, appearing to be "Craig Diss".

Craig Diss
MANAGER OF PLANNING

PHONE: 02 6778 4606
FAX: 02 6778 5073
EMAIL: COUNCIL@URALLA.NSW.GOV.AU



URALLA SHIRE COUNCIL
32 SALISBURY STREET, URALLA
PO BOX 106
URALLA NSW 2358
ABN 55 868 272 018



11 October 2006

Mr Colin Maciver
Utilities Manager
Armidale Dumaresq Council
PO Box 75A
ARMIDALE NSW 2350

Dear Mr Maciver

**re: New Landfill for Armidale Region
(Your Ref. CIM:A05/2410)**

Thank you for your letter of the 25th August 2006 concerning the new Landfill for the Armidale region.

Your letter was considered by Council at its meeting held on the 25th September 2006. Council resolved to agree to submit an expression of interest to participate in the new regional landfill in the Armidale-Dumaresq area.

Council looks forward to participating in the environmental assessment consultation issues and the Armidale-Dumaresq Council Waste Management Committee. It would be appreciated if you could advise me when and if it would be appropriate for Council staff members to become involved in working with you on this environmental assessment process.

Yours faithfully

Robert Fulcher
GENERAL MANAGER

PHONE: 02 6778 4606
FAX: 02 6778 5073
EMAIL: COUNCIL@URALLA.NSW.GOV.AU

CIM:A05/2410

25 August 2006

Mr Jack O'Hara
General Manager
Walcha Shire Council
PO Box 2
WALCHA NSW 2354

Dear Mr O'Hara

NEW LANDFILL FOR ARMIDALE REGION

You will be aware that Armidale Dumaresq Council are working through the process to develop a new landfill for this Council and for the possible future needs of the other neighbouring Councils in the NESAC group.

The time has come in the preparation of the Environmental Assessment for the new landfill project where we need to get some form of commitment from the other Councils as to their likelihood of being a user of the new landfill sometime in the future.

The issue was discussed at the meeting of the Armidale Dumaresq Council Waste Management Committee held on 4 July 2006 with the following recommendation made to Council and subsequently adopted by Council at the meeting held 24 July 2006.

- *That Walcha Shire Council and other NESAC Councils be included in the Environmental Assessment (EA) Consultation matters.*
- *That Walcha Shire Council and other NESAC Councils be invited to submit an Expression of Interest to potentially participate in the New Regional Landfill.*

I would be obliged if you could arrange for this matter to be considered by your Council at its earliest convenience and I look forward to receiving your reply in due course.

Yours sincerely

Colin Maciver
Utilities Manager
Tel 02 6770 3549 e-mail - cmaciver@armidale.nsw.gov.au

CIM:BA:A05/2410

31 October 2006

Mr. J O'Hara
General Manager
Walcha Shire Council
PO Box 2
WALCHA NSW 2354

Dear Mr O'Hara

NEW LANDFILL FOR ARMIDALE REGION

I refer to my letter dated 25 August 2006 regarding a request to your Council, to confirm its interest in the new landfill for the Armidale region.

I would appreciate your response to this letter at your earliest convenience so that I can report the responses of all NESAC Councils to our next Waste Management Committee Meeting scheduled for mid November 2006.

Yours sincerely

Colin Maciver
Utilities Manager
Tel 02 6770 3549 e-mail – cmaciver@armidale.nsw.gov.au

Colin Maciver

From: Colin Maciver
Sent: Thursday, 27 March 2008 11:54 AM
To: Jack O'Hara
Subject: New Landfill for Armidale Region
Attachments: O 2006 5520 O Hara J-New landfill for Armidale Region(2).DOC; O 2006 4403 To Walcha SC requesting EOI for participation in new landfill.DOC

Hi Jack.

Attached are copies of two letters regarding future participation by Walcha Council in the proposed Armidale Regional landfill.

This commitment (or non-commitment) by other Councils is required to be included in the Environmental Assessment for the project as it is to be assessed by the Dept of Planning as a regional landfill.

Finalisation of the Preliminary Environmental Assessment is imminent so I would appreciate your response to my letter at your earliest convenience.

Regards

Colin Maciver
Utilities Services Manager,
New England Strategic Alliance of Councils
Tel 02 67 703 849 Fax 02 6772 9275
Mob 0427 410 723
e-mail cmaciver@armidale.nsw.gov.au

ADC - Registered

- 8 MAY 2008

WALCHA COUNCIL

ABN 24 780 320 847

2W Hamilton Street
PO Box 2
WALCHA NSW 2354



Telephone: 02 6774 2500
Rates & Admin: 02 6774 2500
Engineering: 02 6774 2515
Fax: 02 6777 1181
Email: council@walcha.nsw.gov.au
Website: www.walcha.nsw.gov.au

7 May 2008

Colin Maciver
Utilities Manager
Armidale Dumaresq Council
PO Box 75A
Armidale NSW 2350

Dear Colin

NEW LANDFILL FOR ARMIDALE REGION

Walcha Council would like to be included in the Environmental Assessment (EA) Consultation matters and we formally submit an expression of interest to participate in the new Regional Landfill.

Please accept my apologies for the lateness of this reply.

Yours faithfully

JACK O'HARA
GENERAL MANAGER

WHEN REPLYING PLEASE QUOTE WO/08/521
WHEN MAKING ENQUIRIES PLEASE ASK FOR Liz Hobbs

Colin Maciver

From: Colin Maciver
Sent: Thursday, 26 March 2009 4:59 PM
To: Jack O'Hara; Steve McCoy
Subject: I 2008 09650 Request Walcha Council be ~ Assessment Consultation matters for New Landfill in Armidale Region.PDF
Attachments: I 2008 09650 Request Walcha Council be ~ Assessment Consultation matters for New Landfill in Armidale Region.PDF
Follow Up Flag: Follow up
Flag Status: Flagged

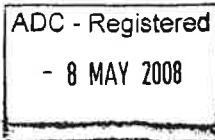
Gents,

in light of Walcha's withdrawal from NESAC and our current finalisation of the EA for the proposed new landfill, our consultant Maunsell AECOM has asked us to get written confirmation of Walcha's continued inclusion in the project as per the attached letter.

I look forward to receiving your response at your earliest convenience.

Regards

Colin Maciver
Utilities Services Manager,
New England Strategic Alliance of Councils
Tel 02 67 703 849 Fax 02 6772 9275
Mob 0427 410 723
e-mail cmaciver@armidale.nsw.gov.au



WALCHA COUNCIL

ABN 24 780 320 847

2W Hamilton Street
PO Box 2
WALCHA NSW 2354



Telephone: 02 6774 2500
Rates & Admin: 02 6774 2500
Engineering: 02 6774 2515
Fax: 02 6777 1181
Email: council@walcha.nsw.gov.au
Website: www.walcha.nsw.gov.au

7 May 2008

Colin Maciver
Utilities Manager
Armidale Dumaresq Council
PO Box 75A
Armidale NSW 2350

Dear Colin

NEW LANDFILL FOR ARMIDALE REGION

Walcha Council would like to be included in the Environmental Assessment (EA) Consultation matters and we formally submit an expression of interest to participate in the new Regional Landfill.

Please accept my apologies for the lateness of this reply.

Yours faithfully

JACK O'HARA
GENERAL MANAGER

WHEN REPLYING PLEASE QUOTE WO/08/521
WHEN MAKING ENQUIRIES PLEASE ASK FOR Liz Hobbs

WALCHA COUNCIL

ABN 24 780 320 847

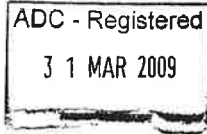
2W Hamilton Street
PO Box 2
WALCHA NSW 2354



Telephone: 02 6774 2500
Rates & Admin: 02 6774 2500
Engineering: 02 6774 2515
Fax: 02 6777 1181
Email: council@walcha.nsw.gov.au
Website: www.walcha.nsw.gov.au

27 March 2009

General Manager
Armidale Dumaresq Council
PO Box 75A
ARMIDALE 2350



Attention: Mr Colin Maciver

Dear Colin

Reaffirmation of Interest in New Regional Landfill

I refer to your email dated 26 March 2009 seeking Council's reaffirmation of its interest in the regional landfill proposed for Armidale. Council's withdrawal from NESAC in no way changes our ongoing interest in being involved in the EA consultation and the potential use of the new landfill.

Yours faithfully

JACK O'HARA
GENERAL MANAGER

WHEN REPLYING PLEASE QUOTE WO/2009/00359
WHEN MAKING ENQUIRIES ASK FOR STEVE MCCOY

Appendix D

Site Selection Additional Data

Appendix D Site Selection Additional Data



Elders Limited
ACN 004 045 121

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

**ELDERLIST
PROPERTY REPORT**

Reference 013042 *ROSE*
5/11/97

**FOR SALE
ARALUEN**

Area : 73 Hectares (180 Acres)
73 Ha UNRESTRICTED FREEHOLD

Location : 12 km north of ARMIDALE

Services Available : 240 volt power, STD telephone. Weekly stock markets Armidale and Guyra, abattoirs at Guyra.

Schools : Primary at Armidale - Bus available
Secondary at Armidale - Bus available

The road to the property is a sealed road.
A daily air service is available.

Description of Country : Undulating to gently rolling hill country, most granite with some traprock. Selectively cleared creating a parklike appearance. A considerable area of the property has been farmed.

Rainfall : The average rainfall is 800 mm.

Water : Watered by 6 dams, some new.

Pasture Type and Fertilisation : Extensive pasture improvement since 1986.
9cwt/acre super 1986/91.

Estimated Carrying Capacity : Approx. 3 D.S.E. per acre.

Paddocks : No of paddocks 5 of which 5 are watered.

Fencing : Boundary part netted, part hingejoint, front boundary new. All internal fencing new.

Main Dwelling : Delightfully renovated weatherboard home of 3 bedrooms, lounge, kitchen dining. Extensive verandahs with bullnose iron set off this attractive home.

Improvements :
Shearing Shed 2 stand electric - grinder excluded.
Machinery Shed Iron
Grain Silo Not included in sale.



Elders Limited

ACN 004 045 121

Sheep Yards Good
Cattle Yards Good

Additional Details & Comments : Araluen is a well improved and presented property with "nothing to spend". Situated in an ideal location just a few minutes north of Armidale it is ideal for the person wanting the benefits of rural living running a handy number of sheep or cattle and yet within very easy commuting distance of Armidale

Outgoings : Council Rates : \$ 464

Price : \$280,000

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : BS BREMNER

TELEPHONE 067 525871

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Elders Limited
ACN 004 045 121

ELDERLIST
PROPERTY REPORT

4 O'CONNELL STREET.
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

Reference 013007 *GARRY LOWRY*
5/11/97

FOR SALE
BELLBROOK

- Area : 481 Hectares (1,188 Acres)
481 Ha UNRESTRICTED FREEHOLD
- Location : 23 km north west of ARMIDALE
- Services Available : 240 volt power, STD telephone, mail 3 X weekly, Armidale offers excellent schooling facilities, TAFE and University. Weekly stock sales and abattoir at Guyra.
- Schools : Primary at Armidale - Bus available
Secondary at Armidale - Bus available
- The road to the property is a part sealed road.
A daily air service is available.
- Description of Country : Undulating to gentle rolling hill country rising to plateau tops. Approx 40% basalt, balance good traprock soils. Lightly timbered with Stringybark, Red Gum and Yellow Box. A well sheltered property.
- Rainfall : The average rainfall is 800 mm.
- Water : Well watered by 2km frontage to Toms Gully plus 16 dams.
- Pasture Type and Fertilisation : Aerially seeded with White and sub clover, Ryegrass and Cocksfoot. 11 cwt/ac of super over last 16 years.
- Livestock Currently Carried : Sheep - 1240 Merino wethers, 760 Merino ewes, 240 lambs & hoggets. Cattle - 45 cows & calves to 12 months, 98 yearlings.
- Estimated Carrying Capacity : Has consistently been in the order of 3 D.S.E. per acre for a number of years.
- Paddocks : No of paddocks 15 of which 15 are watered.
- Fencing : Boundary netted, internal hingejoint or plain wire. All fencing is generally of a very high standard.



Elders Limited

ACN 004 045 121

Main Dwelling : Modern 4 bedroom, concrete block home. Large lounge/dining room, family room, study, excellent kitchen, 1.5 bathrooms. Double garage. An immaculate home set in large garden.

Improvements :

- Shearing Shed Very large 3 stand electric. Cover for 1200.
- Machinery Shed 4 bay with attached single quarters.
- Hay Shed Part of the machinery shed.
- Grain Silo 2 elevated silos
- Workshops Part of hayshed
- Sheep Yards Adjoining woolshed.
- Cattle Yards Good sown timber - all facilities.
- Other Imp 1 Excellent dog kennels (6), meat house and garden
- Other Imp 2 sheds.

Additional Details & Comments : Bellbrook is a well presented property which has been successful managed and run by the present owners for the past 26 years. It is convenient to Armidale with its many educational, cultural and sporting facilities.

Price : \$891,000

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : BS BREMNER

TELEPHONE 067 525871

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Elders Limited
ACN 004 045 121

ELDERLIST
PROPERTY REPORT

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

Reference 018943
19/11/97

A/C SUTHERLAND

HUGH + RICHARD

FOR SALE
BINDAREE

Area : 495 Hectares (1,223 Acres)
495 Ha Freehold

Location : 31 km south of Armidale and
16 km east of Uralla

Services Available : Saleyards, Power

Schools : Primary at Uralla - Bus available
Area at Uralla - Bus available
Secondary at Uralla - Bus available

The road to the property is a sealed road.
A daily air service is available.

Description of Country : Gently undulating soft trap soils. Gum and box
timbers. Cleared except for shade & shelter. 85%
of the property can or has been sown to pasture
or farmed.

Rainfall : The average rainfall is 800 mm.

Water : 2 wells equipped with windmills, 9 dams, electric
pump below mill at the house.

Pasture Type and Fertilisation : Since 1985 6 to 7 hundred weight of super and
cropping fertiliser.

Crop and/or Cultivation : Black butt oats.

Livestock Currently Carried : Merino sheep and agisted cattle

Estimated Carrying Capacity : 3 DSE

Paddocks : No of paddocks 10 of which 10 are watered.

Fencing : Fences generally in good order.

**Elders Limited**

ACN 004 045 121

Main Dwelling : Weatherboard & iron roof home with 3 bedrooms, bathroom, 2 toilets, sitting room, wood heater, kitchen with electric stove.

Improvements :
Shearing Shed 2 stand with Buzacott motor
Machinery Shed Attached to woolshed
Hay Shed
Grain Silo 2 x 2000 bushel
Sheep Yards Steel
Cattle Yards Timber
Other Imp 1 Detached garage & 2 vehicle sheds

Additional Details & Comments : Bindaree is located east of the township of Uralla in some of the best fine wool growing areas of New England. Conveniently accessed from both Armidale and Uralla - school bus at the gate. Bindaree is gently undulating with oat crops used as part of the renovation of pastures. Very easily managed Bindaree comes with an excellent reputation.

Outgoings : Council Rates : \$2916

Price : \$700,000

For further information and inspection, please contact :
ELDERS REAL ESTATE
WALCHA OFFICE
32W FITZROY STREET
WALCHA
NSW 2354
TELEPHONE 067 772011

A/H : F SPILSBURY

TELEPHONE

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Elders Limited
ACN 004 045 121

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

ELDERLIST
PROPERTY REPORT

Reference 019045
3/ 3/98

FOR SALE
GOOYONG

Area : 187 Hectares (462 Acres)
187 Ha FREEHOLD

Location : 20 km north east of ARMIDALE

Services Available : Saleyards, University, Private and Public Schools.

Schools : Primary at Armidale - Bus available
Secondary at Armidale - Bus available

The road to the property is a sealed road.
A daily air service is available.

Description of Country : Undulating trap soils. Predominantly stringybark timbers. Some gum and box.

Rainfall : The average rainfall is 800 mm.

Water : Single frontage to Gara River. Water to home supplied from River.

Pasture type and Fertilisation : Native pastures.

Livestock Currently Carried : 60 head dry cattle.

Estimated Carrying Capacity : 80 head cattle.

Paddocks : No of paddocks 4 of which 4 are watered.

Fencing : BOUNDARY - Mixture of netting and hingejoint - good order. INTERNAL - Hingejoint.

Main Dwelling : Weatherboard iron roof, 4 bedrooms, lounge, dining room, kitchen breakfast room, electric O.P. hot water. Sunroom, bathroom, laundry. Established gardens, 2 ant bed tennis courts.



Elders Limited

ACN 004 045 121

Other : Nil.
Dwellings

Improvements :
Workshops 25 x 25 steel frame.
Cattle Yards Steel, loading ramp, bale head.
Other Imp 1 Double garage, steel frame, concrete floor,
Other Imp 2 storage shed 25' x 25' concrete floor.

Additional : Gooyong is only 20km from Armidale by sealed
Details & road. The Gara River is a great feature with
Comments generous surplus of water. The residence is a
large older style home with high ceilings and
plenty of space. The gardens surrounding the home
are a delight with views of the river from the
master bedroom. Two tennis courts provide the
opportunity for entertaining. Gooyong is clean
trap country ideal for fine wool production or
running breeders for beef production. Gooyong
offers a lifestyle of tranquility and peace.

Outgoings : Council Rates : \$1064

Price : \$460,000

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : F SPILSBURY .

TELEPHONE 067 727500

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Elders Limited
ACN 004 045 121

ELDERLIST
PROPERTY REPORT

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

Reference 018992
22/ 1/98

FOR SALE
JARRAH

Rico Los Parnia

Area : 85 Hectares (210 Acres)
85 Ha Torrens Title

Location : 25 km north of ARMIDALE and
16 km south of GUYRA

Services Available : Saleyards, University.

Schools : Primary at Guyra - Bus available
Area at Guyra - Bus available
Secondary at Armidale - Bus available

The road to the property is a part sealed road.
A daily air service is available.

Description of Country : Undulating to hilly. All basalt soils.
Stringybark and Black Sally.

Rainfall : The average rainfall is 900 mm.

Water : Permanent creeks and springs.

Pasture Type and Fertilisation : Clovers, Ryegrass, Fescue, Rice Grass and Natives.
3cmt in last 7 years with Molybdenum.

Livestock Currently Carried : 60 steers.

Estimated Carrying Capacity : 60 steers.

Paddocks : No of paddocks 3 of which 3 are watered.

Fencing : Boundary fence is hingejoint and netting.

Improvements :
Cattle Yards New steel - loading ramp.



Elders Limited
ACN 004 045 121

Additional
Details &
Comments

: Attractive basalt soils. The property attractively presented - neat and tidy with plenty of shade and shelter. Jarrah is ideal for the weekend farmer or to build a home and commute to Armidale. There are excellent views and homesites. Jarrah is particularly well located in a good rainfall area.

Price : \$210,000

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : F SPILSBURY

TELEPHONE 067 727500

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Elders Limited
ACN 004 045 121

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

ELDERLIST
PROPERTY REPORT

Reference 017757
19/ 3/98

FOR SALE
"Parkdale"

Area : 219 Hectares (541 Acres)
219 Ha Unrestricted Freehold

Location : 32 km north of Armidale and
12 km south of Guyra

Services Available : Rural Power, STD telephone, Saleyards at Guyra
and Armidale. Airport at Armidale, services to
Sydney and Brisbane.

Schools : Primary at B.Mount/Guyra - Bus available
Secondary at Guyra/Armidale - Bus available

The road to the property is a sealed road.
A daily air service is available.

Description of Country : Level to gently undulating, a little hillier in
places. All basalt soils, mostly red, a little
black. Timbered with Black Sally, White Gum and
Peppermint. Selectively cleared leaving a good
coverage of shade and shelter.

Rainfall : The average rainfall is 940 mm.

Water : Extremely well watered by Boorolong Creek plus
tributaries, 10 dams, mostly spring fed.

Pasture Type and Fertilisation : Mostly native grasses with a few small areas of
improved species. Only limited super

Livestock Currently Carried : Agisted cattle with some sheep.

Estimated Carrying Capacity : 1600 DSE or 3DSE per acre.

Paddocks : No of paddocks 12 of which 12 are watered.

Fencing : Boundary hingejoint and plain wire, internal the
same. All fencing in very fair to good condition

**Elders Limited**

ACN 004 045 121

Main Dwelling : Brick veneer and tile home built 1976. Three bedrooms, lounge with wood heater, family room, kitchen/dining, electric store. Double garage.

Other Dwellings : Older style 3 bedroom home - currently rented.

Improvements :

- Shearing Shed 2 stand electric timber and iron.
- Machinery Shed As new steel 2 bay.
- Hay Shed Old timber and iron.
- Sheep Yards At woolshed
- Cattle Yards 2 sets, timber construction, good order

Additional Details & Comments : "Parkdale" is located in the popular Black Mountain area ideal for commuting to Armidale and close to Guyra. "Parkdale" would respond dramatically to a superphosphate and pasture programme that would make the property an excellent fattening property for prime lamb or vealer or steer fattening.

Outgoings : Council Rates : \$ 800

Price : \$400,000

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

(w) A/H : F SPILSBURY

TELEPHONE 067 727500

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Elders Limited
ACN 004 045 121

ELDERLIST
PROPERTY REPORT

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

Reference 016948
5/11/97

*RICHARD
CROFT*

FOR SALE
"Pinaroo"

Area : 478 Hectares (1,181 Acres)
478 Ha Crown Lease

Location : 28 km north west of Armidale

Services Available : S.t.d. telephone. Rural power available, approximately \$6,000 to connect. School bus approx. 6 kms away. Saleyards at Armidale.

Schools : Primary at Armidale - Bus available
Secondary at Armidale - Bus available

The road to the property is a part sealed road.
A daily air service is available.

Description of Country : Plateau tops to mostly very hilly, to steep country. Timbered with stringybark, gum and box. Most of the useful country has been cleared with some requiring regrowth treatment. Some 250/300 acres is heavily timbered. Around 150 acres would be arable, some of which has been farmed.

Rainfall : The average rainfall is 1060 mm.

Water : 13 dams, 2 spring-fed creeks.

Pasture Type and Fertilisation : Native grasses and clovers. A lot of the open country has been fairly regularly supered in recent years.

Estimated Carrying Capacity : 2/2,500 D.S.E.

Paddocks : No of paddocks 13 of which 13 are watered.

Fencing : Boundary fencing is netted, in fair to good condition, some new. Internal fencing is plain and hingejoint in fair to good condition.

Main Dwelling : Old 3 bedroom cottage, which has been partially renovated.

Improvements :
Shearing Shed 3-stand. Solid old shed.



Elders Limited

ACN 004 045 121

Sheep Yards At woolshed.
Cattle Yards Small set.

Additional Details & Comments : "Pinaroo" is a semi-developed property with good opportunity to pasture improve the open country, which would respond well, with its high rainfall.

Price : ~~\$250,000~~ \$290,000

Terms : 10% deposit, balance on completion

Possession : On completion

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : BS BREMNER

TELEPHONE 067 525871

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Elders Limited
ACN 004 045 121

ELDERLIST
PROPERTY REPORT

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

Reference 017413

5/11/97

Alc FAED Hiscox

FOR SALE
"Prosper"

Area : 135 Hectares (333 Acres)

122 Ha Freehold
13 Ha Crown Lease

(Location : 13 km north east of Armidale

Services Available : Rural power, STD telephone. Weekly fat sales at Armidale

Schools : Primary at Armidale - Bus available
Secondary at Armidale - Bus available

The road to the property is a sealed road.
A daily air service is available.

Description of Country : Ranging from approx. 77 acres deep alluvial creek flats through to undulating to hillier country. A mix of granite and trap soils, with a little basalt. Around 40% arable. Well cleared with some timbered areas in the higher country.

Rainfall : The average rainfall is 800 mm.

(Water : Give & take frontage to permanent Puddledock Creek, spring-fed Fern Gully, 4 dams. The Malpas Dam pipeline to Armidale passes through the property and is connected.

Pasture Type and Fertilisation : Native grasses & clover. Periodically supered on the hills, well supered on the flats.

Crop and/or Cultivation : Periodic crops, such as oats, corn and millet are grown. The flats are excellent for cutting lucern

Estimated Carrying Capacity : 500 ewes and 100 wethers.

Paddocks : No of paddocks 8 of which 8 are watered.

Fencing : Boundary part netted, part plain wire, in fair to excellent condition. Internal fencing hingejoint and plain wire, only to good.



Elders Limited

ACN 004 045 121

Main Dwelling : Solid old weatherboard and brick home, with verandahs on 3 sides. 5 bedrooms. Much of the weatherboard part has timber walls and ceilings.

Improvements :
Shearing Shed 2- stand electric
Machinery Shed Very old slab building
Sheep Yards Adjoining woolshed
Cattle Yards Small old timber set, with loading ramp.

Additional Details & Comments : "Prosper" is a choice small property with close proximity to Armidale.

Outgoings : Council Rates : \$1400

Price : \$450,000

Terms : 10% deposit, balance on completion

Possession : On completion

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : BS BREMNER

TELEPHONE 067 525871

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Elders Limited
ACN 004 045 121

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

ELDERLIST
PROPERTY REPORT

Reference 016791
5/11/97

Mc EVAN FLEMING

FOR SALE
"Spring Creek"

Area : 166 Hectares (410 Acres)
166 Ha Freehold

Location : 40 km west of Armidale and
33 km north west of Uralla

Services Available : Rural power, STD telephone. Saleyards at
Armidale.

Schools : Primary at Armidale - Bus available
Secondary at Armidale - Bus available

The road to the property is a part sealed road.
A daily air service is available.

Description of Country : Mostly gently undulating to running partly up the
side of Brown's Mountain. Granite soils. Timbered
with gum, apple, yellow box and stringybark.
Mostly cleared with the balance being semi open.
Some country has been farmed, over half would be
available.

Rainfall : The average rainfall is 750 mm.

Water : 4 dams, spring-fed.

Pasture Type and Fertilisation : Native grasses.

Estimated Carrying Capacity : Maximum 1.5 DSE in a good season.

Paddocks : No of paddocks 5 of which 5 are watered.

Fencing : Boundary is part netted, part plain wire.
Internal fencing is mostly plain wire, some
netting, only in fair to poor condition.

Main Dwelling : Stylish 3 bedroom weatherboard home, with a new
timber kitchen and family room. Dining room,
study, 2 verandahs, 12,500 gallons rainwater.



Elders Limited

ACN 004 045 121

Additional Details & Comments : "Spring Creek" is a pretty hobby farm block, which could be substantially increased in carrying capacity, if required

Outgoings : Council Rates : \$ 527

Price : \$240,000

For further information and inspection, please contact :

ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : BS BREMNER

TELEPHONE 067 525871

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Elders Limited
ACN 004 045 121

4 O'CONNELL STREET
SYDNEY N.S.W. 2000
TELEPHONE (02) 2386666

ELDERLIST
PROPERTY REPORT

Reference 018965
2/12/97

FOR SALE
WARRAGUL

*Bob & Jacqui
McCarthy*

Area : 403 Hectares (995 Acres)
403 Ha Torrens Title

Location : 12 km north of Armidale

Services Available : Town water, close to Armidale Saleyards.

Schools : Primary at Armidale - Bus available
Area at Armidale - Bus available
Secondary at Armidale - Bus available

The road to the property is a sealed road.
A daily air service is available.

Description of Country : Half of the property is alluvial flats, with the balance being fine granite. Good belts of shade timber. The timbers on the property are Box, Stingybark, Peppermint, and Red Gum.

Rainfall : The average rainfall is 800 mm.

Water : Tilbuster Creek and Puddledock Creek - permanent. Only one paddock not watered by creeks - also 3 dams. Reticulated water to yards and sheds.

Pasture Type and Fertilisation : Half sown with improved species - natural grasses. Fertiliser used over the last 11 years.

Crop and/or Cultivation : Half of total area could be cropped with lucerne, corn, summer crops - oats.

Livestock Currently Carried : 120 cows and 2000 ewes and wethers.

Estimated Carrying Capacity : 3000 DSE

Paddocks : No of paddocks 14 of which 14 are watered.

Fencing : Boundary mostly netted - some ringlock. Internal fences are all ringlock.



Elders Limited

ACN 004 045 121

Other : Single bedroom cottage - all services.
Dwellings

Improvements :
Shearing Shed Steel shed - 2 stand
Machinery Shed steel - 4 sides enclosed
Hay Shed steel 5,000 bales - raised grating floor
Grain Silo 25 tonne
Workshops Part of shed
Sheep Yards Steel
Cattle Yards Steel - loading ramp and crush

Additional : Warragul Park is unique being on a sealed road
(Details & close to Armidale. Town water connected. The
Comments property has a balance of 182 hectares of rich
creek flats rising to higher soft granite
country. Well sheltered, fenced into 14 paddocks.
Extremely versatile country being able to produce
crops such as lucerne, summer and winter crops.
Ideal for cattle breeding and fallowing or fine
wool productions.

Outgoings : Council Rates : \$2540

Price : \$925,000

Terms : Cash on Completion

For further information and inspection, please contact :
ELDERS REAL ESTATE
ARMIDALE OFFICE
BUNDARRA ROAD
ARMIDALE
NSW 2350
TELEPHONE 067 727500

A/H : F SPILSBURY

TELEPHONE

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H.S.A.

FIRST NATIONAL REAL ESTATE

Hutchinson Sewell & Assoc. Pty Ltd
A.C.N. 000 543 868
Real Estate, Auctioneers
Stock & Station, Business
Property Management

184 The Mall, Beardsy Street
Armidale 2350

Correspondence:

PO Box 246, Armidale 2350

Facsimile: (02) 6772 9402

Telephone: (02) 6772 1277

22nd April, 1998

Mark Painter
Manager - Waste Services
Armidale City Council
135 Rusden Street
ARMIDALE NSW 2350

Dear Mark,

1/1098/1830
ARMIDALE CITY COUNCIL

DATE REC'D	23 APR 1998
FILE NO.	30/1068
REFERRED TO	M.P.
ACTION	NRM
	contacted S. Sewell & arranged an inspection.
COPIES TO	
COPIES MADE	
ENTERED REGISTER	11/23/98

ENTERED

23.85
changed on
part.

Further to our conversation yesterday, I unfortunately have only been able to find one property that suits your criteria.

This property is located on the Eastern side of Armidale near Metz. It is approximately 450 acres with limited neighbours (3 or 4), no creeks and perhaps the best thing is that the road that adjoins this property is constantly used by Boral trucks.

Should you wish to discuss it with me further, give me a call.

Regards,



STEVE SEWELL



H.S.A.

FIRST NATIONAL REAL ESTATE

Hutchinson Sewell & Assoc. Pty Ltd
A.C.N. 000 543 868
Real Estate, Auctioneers
Stock & Station, Business
Property Management

184 The Mall, Beardy Street
Armidale 2350

Correspondence:

PO Box 246, Armidale 2350

Facsimile: (02) 6772 9402

Telephone: (02) 6772 1277

22nd April, 1998

Mark Painter
Manager - Waste Services
Armidale City Council
135 Rusden Street
ARMIDALE NSW 2350

Dear Mark,

Further to our conversation yesterday, I unfortunately have only been able to find one property that suits your criteria.

This property is located on the Eastern side of Armidale near Metz. It is approximately 450 acres with limited neighbours (3 or 4), no creeks and perhaps the best thing is that the road that adjoins this property is constantly used by Boral trucks.

Should you wish to discuss it with me further, give me a call.

Regards,



STEVE SEWELL

Derry. C. G. J.
Sherraloy.
MSF ~~2003~~ 2003
GARA RD
ARM. 2350.





Facsimile



To: MARK PAINTER ACC

Fax No.: 02-6772 9275 No. Pages (including cover sheet): (6) Date: 30/4/98

From: DERRY CRISP Location: ARMIDALE

Fax No.: 02-6772 7082 Phone No.: 02 6772 8188

Subject: PROPERTY DETAILS

- ①. HANNOFORD 3 PAGES
- ②. PART TIURTON 277 AC Y 396 AC 1 PAGE
- ③. TIURTON 277 ACRES SURROUNDING BLOCK WITH EASEMENT & RIGHT OF WAY

Regards
Derry

Per 30/4/98

Wesfarmers Dalgety Limited, ACN 008 743 217.

Please call us if you do not receive every page. Also please contact us immediately if this facsimile is not addressed to your company. It may contain confidential information for the use of the addressee only and if you pass on this facsimile or its contents to anyone else, the intended addressee may have a claim against you.

MEMORANDUM

from the

GENERAL MANAGER

To: Director of Building and Environmental Services
Subject: Regional Waste Facility
Date: 10 June 1998 **File No:** S-1/7

On 9 June 1998, Richard Croft rang me. He owns a property 28 kilometres from Armidale in the Mt Duval area in Dumaresq Shire. The property is owned by B R Randle, R Croft and C Croft. He is interested in discussing with Council a proposal that all or part of this property be leased or purchased for a Joint Waste Facility.

Would you please arrange to identify this property and inspect it to see if it is suitable for further discussions with Mr Croft.


R G Fulcher

✓ cc: Mr C Barrass
Would you please contact Dumaresq Shire Council and obtain the details of this property so that it can be located on a topographical map.

Parish Duval Lots 92 221 DP 755819
 Parish Eumouth Lot 125 DP 755823

Area: 470.7 hectares

↑
These lots are actually old portion numbers.



FOR SALE
FARM
HANNAFORD
LONG SWAMP ROAD
ARMIDALE

Date : 14/08/97
Reference: 004315
ARMIDALE

Area : 103.0000Ha (254.5182Ac)

Location : The property is situated approximately 14kms South East of Armidale on the Long Swamp Road.

Zoning : RURAL

Services : Rural Power and Phone available. 1.3Km to school bus serving Armidale schools. Mail 3 times per week. Domestic air services at Armidale. Saleyards at Armidale. Abattoirs at Guyra, Inverell and Tamworth.

Country : Gently undulating, selectively cleared leaving good shade and shelter. Mostly Stringybark timber. Improved pastures of Clovers and Rye with a balance of native grasses.

Soil Types : Fine Granite and loamy trap soil.

Fencing : Boundary all netting in good condition. Subdivided into 3 main paddocks and 3 holding paddocks, fencing in good condition.

Water : Watered by one large dam and numerous small dams plus springs.

Rainfall : The average rainfall is 800 mm.

Improvements : No home. One set of timber sheep yards in fair condition.

Carrying Capacity : Estimated 750 DSE

Price : \$160,000

Remarks : A property situated close to Armidale City facilities and well suited to sheep or cattle



enterprises.

For more information or inspection, please contact,

DERRY CRISP

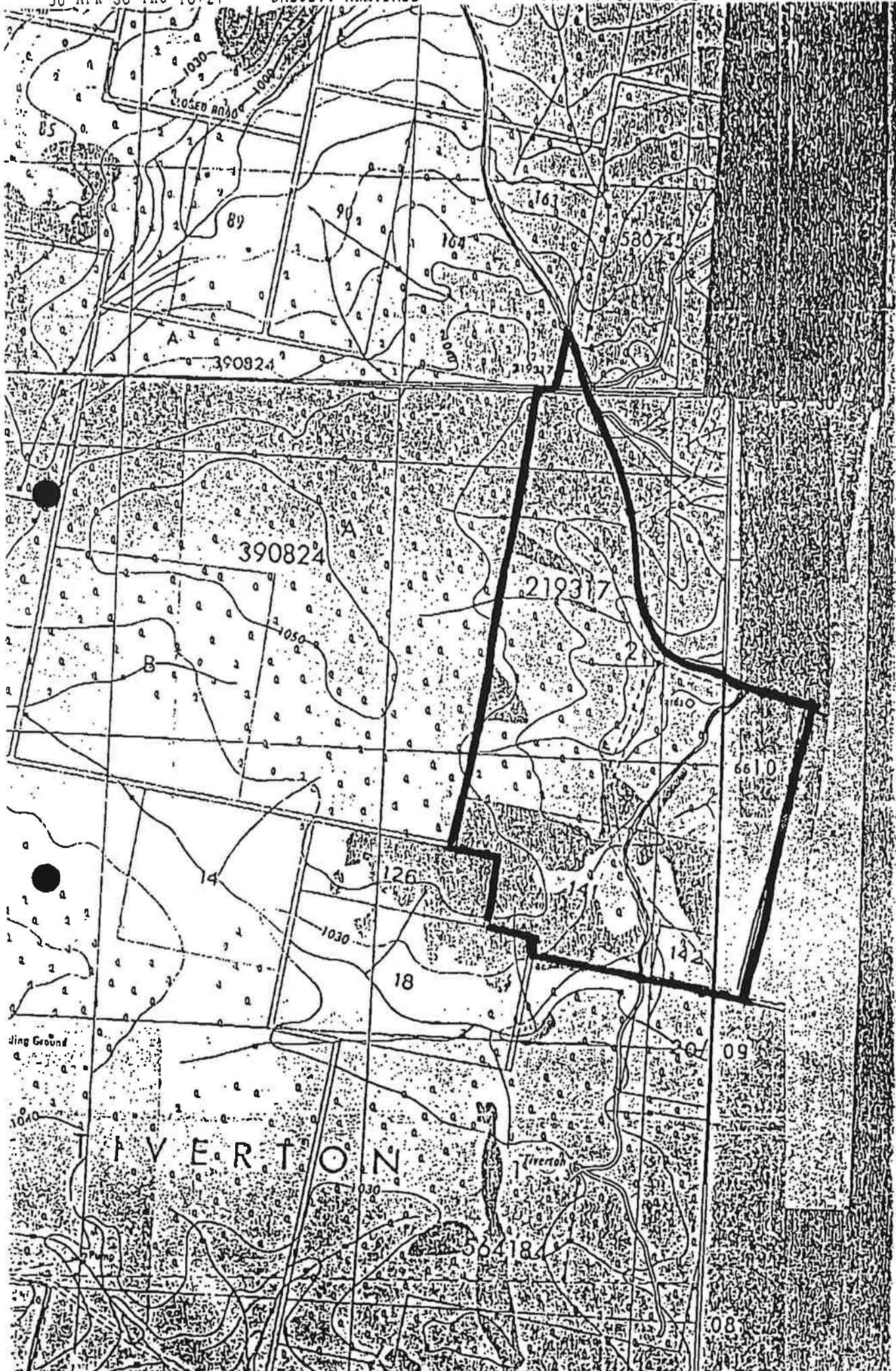
Office : 067 728188
Fax : 067 727082

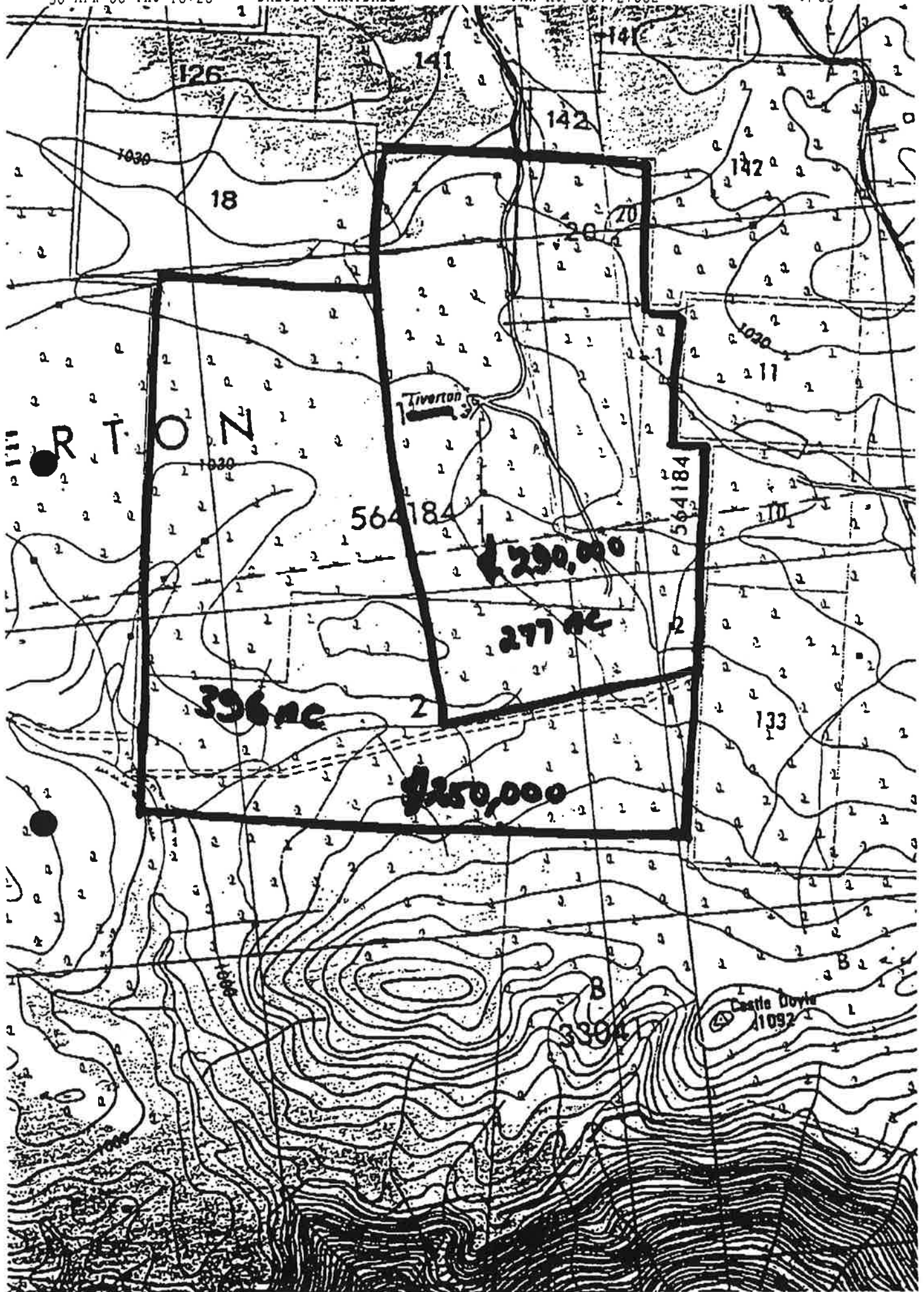
A/H : 067 753782
Mobile : 015 293419

OR

Contact the listing branch: WESFARMERS DALGETY
162 MILLER ST
ARMIDALE NS 2350
067 728188

The Vendors and/or their Agents do not give any warranty as to errors or omissions, if any in these particulars which they believe to be accurate when compiled. Prospective purchasers should satisfy themselves by inspection or otherwise as to the accuracy of the particulars.





Appendix E

Site Selection Advertisements

Appendix E Site Selection Advertisements

Locked Bag
Armidale NSW 2350
Ph: 02 6772 2418
Fax: 02 6772 5697
Enrolment enquiries:
1 800 625 654
Email: picarm@northnet.com.au

Kilda Hotel at 4pm Sunday.
Entertainment will continue all weekend.

The Express in conjunction with the Armidale Jazz Club has three double passes to jazz festival events

and Wang Dang Doodle and Paul Andrews Trio at the Wicklow Hotel.

To win, copy be one of the first three callers through to The Express Office after 10am today on 6772-9944.

The group completely redefines the possibilities of acoustic music and the limits of an all female trio.

The group has been performing for more than three years in places as diverse as Melbourne pubs, the Edinburgh Festival.

Blue House will appear at the UNE Bistro from 8.30pm Wednesday.

Hotel, 9pm-midnight
• Soft Option, Ex-Services Club, 8pm*
• Karaoke, Armidale Bowling Club, 7pm*
• Honky Tonk linedancers, Drummond School Hall, 9pm

• Linedancing with Rockers, Uralla Club, 7.30pm*
• Harley's Nightclub, England Hotel, 11pm
• Nightclub, Planet

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Armidale City Council



ACCnews

ARMIDALE BEING WATERWISE

Algae in Malpas Dam

Malpas Dam currently has no detectable blue-green algae. The water storage is continuing to be monitored twice weekly. Only a few Golden-Brown algae have been recorded on Malpas Dam in the past week. Algae activity at present is very low. Algae will be monitored very closely in the coming weeks, and significant changes reported as we move towards the summer season.

Green algae: None have been recorded.

Golden-brown algae: A few have been recorded.

Other Storages

Gara and Puddledock Dams are both clear of detectable blue-green algae.

Water Storage

All dams remain near full or 100% capacity. 20.5mm of rain was recorded in the catchment this week and Malpas Dam is at 100% capacity.

Water Consumption

This week the Community used 51ML of water, which was 9ML below the target of 65ML set last week. 47mm of rain was recorded in the City during the week.

- Total water consumption for the same week last year was 50ML.
- Average water consumption for the same week during the last 3 years was 61ML.
- The target for the coming week is 60ML.

Recreational Use of Dumaresq Dam

Dumaresq Dam remains open for recreational purposes.



PURCHASE OF MOTOR VEHICLES

Council invites Quotations for:

Purchase:

No of Vehicles	Vehicle Description	ACC Reference No
1	Three/Four Tonne Cab/Chassis	85/1221
1	4x2 One Tonne Cab/Chassis	85/1217
1	Dual Cab Three Tonne Tip Truck	85/1220
1	4x4 One Tonne Table Top	85/1216
1	Outfront Mower	85/1222
1	4x2 One Tonne Table Top	85/1218

SALE OF MOTOR VEHICLES

Sale Only (Armidale City Council Reference Number 85/1215)

Vehicle Details	Plant No	Registration No
1987 Mitsubishi FM515F 8 tonne tipper	1215	OLY-271
1995 Ford Courier Cab/Chassis	1275	TUH-877
1990 Mazda 3 tonne tipper	1520	RGD-220
1995 Mazda B2600 1 tonne table top	4052	TUH-877
1988 Case International 385 tractor	1507	OZD-254
1995 Ford Falcon Utility	1087	TUH-071

Specification and Quotation Forms may be obtained by contacting Margaret Schumacher on 6770 3556. Please quote Armidale City Council Reference Number.

Quotations must be placed in the Tender Box at Council's Civic Administration Building by 2.30pm Wednesday, 29 October 1997.

MANAGEMENT PLAN AMENDMENTS

At its meeting on Monday, 22 September 1997, Council resolved to place on public exhibition, the Draft Amendments to the 1997/2000 Management Plan. The Amendments relate to proposed fees at the Aquatic Centre, and amendments to Home Building Insurance proposals, and will be on public display in the foyer of the Civic Administration Building until Monday, 10 November 1997.

Submissions can be made in writing to the General Manager at the address below. If no submissions are received, the amendments will be adopted.

ARMIDALE BIKE PLAN - COMMUNITY SURVEY

If you would like to have your say on the future planning for the provision of cycling facilities in Armidale, now is your chance. The survey will provide valuable information in the development of the Armidale Bike Plan.

If you would like to assist by completing a survey, forms are available at the front counter of the Civic Administration Building in Rusden Street. Alternatively, contact

NOTICE OF DRAFT AMENDMENT TO POLICY PE34 POLICY FOR MALL MARKET OPERATORS MALL MARKETS OPERATIONS GUIDELINES

The Operations Guidelines have been in operation since 27 April 1994, and following a request from the Market Operators, draft amendments were prepared and have been approved by Police Citizens Youth Club (PCYC) and have been presented to Council's CBD Committee. As a consequence, the draft amendments have been included in the Guidelines and the document is now placed on public exhibition for one month with closure on Monday, 10 November 1997 at 10.00am.

Interested members of the public are invited to peruse the document on display in the foyer of the Civic Administration Building, and make any submissions in writing to the undersigned.

Should you have any further enquiries please contact Mr Bill Fisher on 6770 3570.

REGIONAL LANDFILL ESTABLISHMENT

Armidale, Dumaresq and Uralla Councils are still working closely together to find a new regional tip site. The Mayors of the three Councils have called for a report from officers by the end of November, which is to identify a preferred site.

Any landowners who wish their land to be considered can contact officers of any one of the three Councils.

A Preliminary Landfill Siting Study has also been prepared, and people should make themselves aware of its recommendations. It indicates the types of issues involved, and can assist people in determining if their land is worthy of consideration. More information is available from Peter Ainsworth on 6770 3588.

ENVIRONMENTAL MANAGEMENT PLAN

Armidale City Council's Draft Environmental Management Plan has been on public exhibition for two months, ending Friday 3 October 1997. The Plan addresses issues such as urban diversity, energy conservation, pollution control, waste management, biodiversity and transport.

The Plan is an important strategic initiative for the City, however very minimal comment has been received from our Community. Residents are urged to become aware of the Draft Environmental Management Plans recommendations and forward comments to Council.

Comments will now be received by Council up until Friday 24 October, 1997. More information is available by contacting Peter Ainsworth on 6770 3588.

W D Perry

BUILDING THE FUTURE FORUM

The Mayors of Armidale and Dumaresq wish to remind those organisations mentioned last week in relation to the Building the Future Forum, to return their submissions to the address below by Friday, 17 October 1997. This is to ensure your place at this important forum.

For further details, please contact Mrs Cynthia Mulholland on 6770 3522.

CLOSURE OF PEDESTRIAN LANE ADJACENT TO TATTERSALL'S HOTEL

The pedestrian lane between the Commonwealth Bank and the Tattersall's Hotel will be closed from 1.00pm Saturday, 11 October 1997 and all day Sunday, 12 October, 1997, to allow for erection of a protective hoarding in connection with the re-roofing of the Hotel. The lane will also be closed from 1.00pm Saturday, 18 October 1997 and

NEW

Express

10/10/97

W.D.

Peter A.

Armidale City Council



ACCnews

ARMIDALE BEING WATERWISE

Algae in Malpas Dam

Malpas Dam currently has no detectable blue-green algae. The water storage is continuing to be monitored twice weekly. Only a few Golden-Brown algae have been recorded on Malpas Dam in the past week. Algae activity at present is very low. Algae will be monitored very closely in the coming weeks, and significant changes reported as water temperatures are beginning to rise.

Green algae: None have been recorded.

Golden-brown algae: A few have been recorded.

Other Storages

Gara and Puddledock Dams are both clear of detectable blue-green algae.

Water Storage

All dams remain near full or 100% capacity. 14mm of rain was recorded in the catchment this week and Malpas Dam is at 100% capacity.

Water Consumption

This week the Community used 63ML of water, which was 3ML above the target of 60ML set last week. 9mm of rain was recorded in the City during the week.

- Total water consumption for the same week last year was 54ML.
- Average water consumption for the same week during the last 3 years was 78ML.
- The target for the coming week is 65ML.

Recreational Use of Dumaresq Dam

Dumaresq Dam remains open for recreational purposes.



ARMIDALE BIKE PLAN - COMMUNITY SURVEY

If you would like to have your say on the future planning for the provision of cycling facilities in Armidale, now is your chance. The survey will provide valuable information in the development of the Armidale Bike Plan.

If you would like to assist by completing a survey, forms are available at the front counter of the Civic Administration Building in Rusden Street. Alternatively, contact Mr Michael King on 6770 3545 and he will forward a copy, or copies to you. Surveys will be received up until 5.00pm Friday, 31 October 1997.

REGIONAL LANDFILL ESTABLISHMENT

Armidale, Dumaresq and Uralla Councils are still working closely together to find a new regional tip site. The Mayors of the three Councils have called for a report from officers by the end of November which is to identify a preferred site.

Any landowners who wish their land to be considered can contact officers of any one of the three Councils.

A Preliminary Landfill Siting Study has also been prepared, and people should make themselves aware of its recommendations. It indicates the types of issues involved, and can assist people in determining if their land is worthy of consideration. More information is available from Peter Ainsworth on 6770 3588.

BUILDING THE FUTURE FORUM

The Building the Future Forum will be held at the Armidale Town Hall on Saturday, 29 November 1997, commencing at 2.00pm. Mr Ian Kiernan, lone around the world yachtsman, 1994 Australian of the Year and motivator behind the Clean Up Australia campaign, will be Guest Speaker at the Forum.

For further details on the Building the Future Forum, please contact Mrs Cynthia Mulholland on 6770 3522.

NOTICE OF DRAFT AMENDMENT TO POLICY PE34 POLICY FOR MALL MARKET OPERATORS MALL MARKETS OPERATIONS GUIDELINES

The Operations Guidelines have been in operation since 27 April 1994, and following a request from the Market Operators, Draft Amendments were prepared and have been approved by Police Citizens Youth Club (PCYC) and have been presented to Council's CBD Committee. As a consequence, the Draft Amendments have been included in the Guidelines and the document is now placed on public exhibition for one month with closure on Monday, 10 November 1997 at 10.00am.

Interested members of the public are invited to peruse the document on display in the foyer of the Civic Administration Building, and make any submissions in writing to the undersigned.

Should you have any further enquiries please contact Mr Bill Fisher on 6770 3570.

SPONSORSHIP OPPORTUNITY

1998 NEW ENGLAND HERITAGE AND URBAN DESIGN AWARDS

In October 1998, Armidale City Council will once again be hosting the New England Heritage and Urban Design Awards. Award nominations will be sought in June 1998 and the Awards will be presented at a special presentation dinner.

Council is offering sponsorship opportunities for interested companies and individuals to be associated with these prestigious Awards and their promotion.

Sponsorship of these Awards will provide your organisation with an excellent opportunity to raise its profile in the New England region, with extensive promotion set to commence in early 1998.

We are seeking Expressions of Interest for Sponsorship of these Awards. If you have any queries regarding sponsorship, please contact Mr Chris Berry on 6770 3569 or Ms Debra Lane on 6770 3574. Expressions of Interest may be sent to the address below.

ARMIDALE CITY RECYCLING SERVICE

Materials should be placed at the kerbside on the same day as your household garbage collection, and please ensure that recyclables are placed in separate containers for the following two groups of materials:

- Paper and Cardboard, or
- Glass, aluminium, steel cans, plastic milk bottles and PET.

Materials should be presented in the approved recyclable collection container, or a similar container which is solid, rigid, not too heavy and has external handles.

CBD COMMITTEE - COMMUNITY REPRESENTATIVES

The role of the CBD Committee is to advise Armidale City Council on planning and related issues in the Central Business District, and to provide a "co-ordination" forum for discussion and community input on CBD matters.

The Committee meets monthly in the Civic Administration Building.

Applications in writing are invited for Community membership of the above Committee until September 1999. Interested persons should contact Ms Debra Lane on 6770 3574 in the first instance to obtain a copy of the Terms of Reference.

Applications close on Friday, 31 October 1997, at the address below.

Armidale City Council
PO Box 75A
Armidale NSW 2350

W D Perry
General Manager
Telephone: 6770 3600
Facsimile: 6772 9275

CALENDAR OF EVENTS - The Week Ahead

- 2 Nov Packsaddle Fundraiser Selling Exhibition - NERAM. Contact 6772 5255.
- 25 Strathlea Nursing Home Fete - 11am. Contact Lyn Mitchell 6772 3627.
- 25 Race Meeting - Armidale. Contact John Cannon 6772 9355.
- 25-26 Lismore Christadelphians Bible Addresses and Meeting - Armidale Town Hall. 25/10 - 3pm - 6pm; 26/10 - 9.30am - 4pm.
- 25-26 PLC 110 Year Anniversary Reunion. Contact Mrs J Sholl 6772 2418.
- 26 Armidale Symphony Orchestra Concert - Lazenby Hall. Contact Dr Bruce Menzies, 145 Faulkner St.
- 26 Markets in the Mall. Contact PCYC 6772 1023.
- 30 Armidale & District Cancer Action Group Luncheon and Guest Speakers. Ex-Services Club, 12.30pm. Contact Poh Woodland 6772 7025.

FREE INTERNET ACCESS!

The Town Library is offering free access to the Internet for members of the community. For information and booking times, please contact the Library on 6772 4711.

FOR ACC NEWS - 2/4/98 AND 9/4/98

REGIONAL LANDFILL ESTABLISHMENT

Armidale, Dumaresq and Uralla Councils are still working closely together to find a new regional tip site. Previous attempts to locate a suitable site have been unsuccessful, as available land which has been investigated has proven unsuitable.

Any landowners who wish their land to be considered can contact officers of any of the three Councils.

A Preliminary Landfill Siting Study has been prepared, and interested people should make themselves aware of its recommendations. It indicates the types of issues involved, and can assist people in determining if their land is worthy of consideration.

More information is available from Mark Painter on 6770 3571.

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Search continues for regional landfill site

A JOINT council regional advisory committee has been established to further investigate the establishment of a regional landfill.

Formation of the committee, made up of councillors and staff, from Armidale City and Dumaresq Shire councils, is the latest move in the long-running search for a suitable landfill site.

Issues to be investigated by the new group will include location, estimated cost and financing of land

purchase and construction, ownership and management, and publicity and public issues.

Armidale City will be represented by Crs Herman Beyersdorf, Rob Richardson and Bruce Whan, and the general manager's nominee.

At least seven sites have been considered in the four years that the project has been on the drawing board.

A workshop earlier this month was told that the Armidale Long Swamp Rd

site is nearing capacity and Dumaresq's Tiltbuster facility has limited operational time remaining.

Initially, Uralla, Guyra and Walcha councils were also involved.

In 1996 a consultant was commissioned to produce a preliminary landfill siting study.

A public meeting in December that year adopted the study as a basis for further public consultation and site identification.

The study allowed the councils to concentrate the search for a new site in areas which demonstrated greatest potential.

The consultant originally identified Metz Quarry but subsequently recommended that the councils consider other sites which could be more easily and economically developed, and were more likely to meet the rigorous requirements of the EIS.

In 1997 negotiations were opened to secure an option for a site at Tiltbuster, but the owner subsequently advised that the land was no longer for sale.

In July this year an area 15km east of Armidale became the seventh site to be considered.

Uralla Council then withdrew from the project, leaving Armidale and Dumaresq.

need more information about the importance of having a will, according to Bill Darwen, the Public Trustee of NSW. Almost 3500 telephone calls were received of 1800 number set up specifically for the Good Will campaign, which is aimed to raise awareness of the importance of having a professionally drafted will.

Mr Darwen said while it is recommended everyone over age 18 has a will, it is particularly important to make or review a will upon marriage or divorce when entering into a de facto or same sex relationship.

Ticket to ride and enjoy

THE NEW look State Government internet portal easy access to over 1100 links to information and services making it one of Australia's most useful web sites.

Information Technology Minister Kim Yeadon said ABS figures show that 1,245,000 households in Australia had access to the internet from home. The Government is electronically delivering the services that large community wants at www.nsw.gov.au, Mr Ye said.

"Using the NSW Government's web site you can your Countrylink train travel, consider holiday destinations and accommodation; check out the 1999 Sydney Festival program and book tickets, and wonder what's on a Sydney Opera House and then book on impulse, all without leaving your home."

New tourism awards

THE Big Sky Country Regional Tourism Organisation will host its inaugural Awards for Excellence in Tourism a gala function on March 19.

The Regional Awards for Excellence will highlight and showcase the best tourism product the region has to offer and celebrate the region's rich and vibrant tourism industry. Operators interested in participating in the regional awards are invited to attend the special information seminars being held in Armidale and Tamworth December 15.

Timber industry welcomes new forestry plan

FENNING Timbers (Aust) P/L has welcomed the news that the State Government's Forestry and National Park Estate Bill has been passed through the Parliament.

"This legislation delivers ecologically sustainable forest management, certainty to the NSW timber industry and a framework for investment, new technology and the creation of new jobs," said general manager Phil Sly.

"It is a tribute to both the Coalition and the Government and the support of Don Page, Member for Ballina and Shadow Minister for Forests, played an integral part in getting the Bill through parliament."

"It achieves the goals of the National Forest Policy statement and the NSW Government's Forest Policy, which is a remarkable outcome."

This show of bi-partisan support by the major parties in the NSW Parliament is a welcome sign for the Forest Industry and should see us celebrate one of the best Christmas's we've ever had," said Mr Sly.

"We hope that the green movement will abide by this decision and that we can get on with business without fear of reprisal."

EDITORIAL Page 6

Family reunited after 50 years

FROM PAGE 1
reunion was a bit different, everyone else was there and it was a bit closer.

"You can't drop 50 years of your life and pick it up in one sitting, but some people can."

together.
"It's something I've always wanted. I ran away when I was 14 or 15 to try and find my parents but I kept getting caught and they'd take me

they all spoke of needing to do one thing before the reunion is complete.
Les said "Armidale has good memories because a lot of my family is up here but"

Brennan's
T JAG CAP & silver JAG picture frame
valued at \$50
Ph: 6771 1888

Sticky Fingers
Goodies
to the value of \$50
Ph: 6772 6411

1st Hair Service
\$25 hair care products by Delorenzo. Valued at \$50
Ph: 6772 9833

1 basket of Rosegarden toiletries by Trellivings
Valued at \$50
Ph: 6772 6787

Che for Beauty

Live and LOCAL
Sunday turn on FM 92.1
7-9am
Sunday Country
9am - 12 noon
This, that & the other

EXRRES
30/11/98