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Tweed Shire Council

Report for Quirks Quarry Landfill

Draft Landfill Environmental Management Plan

November 2011

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

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1. Introduction

1.1 General

GHD was commissioned by Tweed Shire Council (TSC) to prepare this Draft Landfill Environmental Management Plan (LEMP) for the proposed Quirks Quarry Landfill. This Draft LEMP has been prepared to incorporate the future planned landfill development. Implementation of the draft LEMP will ensure environmental management techniques form an integral part of the operations at Quirks Quarry Landfill,

The following documents have been considered in the preparation of this document:

- NSW Environment Protection Authority's Environmental Guidelines: Solid Waste Landfills (1996);
- Draft Environmental Guidelines: Landfilling, Department of Environment and Conservation NSW, August 2007;
- NSW Environment Protection Authority's Environmental Guidelines: Composting And Related Organics Processing Facilities (2004);
- NSW Environment Protection Authority's LEMP Preparation Manual (1996);
- NSW Department of Environment and Climate Change's Managing urban stormwater: Soils and construction, Volume 2B – Waste Landfills, June 2008;
- Protection of the Environment Operations Act 1997 (POEO Act 1997); and
- Waste Avoidance and Resource Recovery Act 2001.

1.2 Scope of the Plan

1.2.1 Background

To provide a consistent and environmentally responsible approach to managing landfills within NSW, the NSW Department of Environment, Climate Change and Water (DECCW, formerly EPA) issued guidelines in 1996 for solid waste landfills titled Environmental Guidelines: Solid Waste Landfills (the Landfill Guidelines). A performance-based approach to landfill management has been adopted by the DECCW that allows the most appropriate mechanisms to be implemented at each landfill site to achieve specific environmental goals. The goals and the approach to landfill regulation and management are described in the guidelines. The environmental goals identified in the guidelines are:

- Preventing water pollution;
- Preventing air pollution;
- Promoting responsible land management and conservation; and
- Preventing hazards and loss of amenity.

The mechanism for DECCW regulation of landfill operations is based around licensing those facilities that have the greatest potential to cause environmental impact. All licensed waste facilities are required to have a LEMP, which describes the strategies and measures for managing the landfilling operation and achieving the environmental goals as identified in the Landfill Guidelines. Operation of the landfill must then comply with the LEMP.

1.2.2 Contents

This Draft LEMP has been developed to facilitate the safe and efficient operation of the proposed landfill and to ensure that the environment and the surrounding community is safeguarded from pollution and off-site effects. It describes the level of performance expected in managing, operating, monitoring and rehabilitating the site.

TSC shall ensure that all staff and sub-contractors at the site are familiar with the relevant requirements described in this Draft LEMP.

A copy of TSC's Environment Protection License (EPL) (pending approval of the project) for the site and the finalised LEMP shall be kept on site at all times and shall be made available for inspection to the DECCW upon request (a copy of the EPL will be included in Appendix B once granted). Further, TSC will ensure that the landfill and its associated facilities are operated in accordance with all regulatory requirements.

The Draft LEMP addresses the following:

- Approvals and licensing;
- The existing site, including a brief history of the site;
- Design and construction of the landfill;
- Management and operation of the landfill;
- Environmental management measures;
- Environmental monitoring program;
- Site rehabilitation and post closure management; and
- Reporting.

1.2.3 Goals

A summary of the environmental goals identified in the Landfill Guidelines, together with where to find the measures proposed to achieve the goals in this LEMP, is provided in Table 1.

Table 1 Environmental Goals and Control Measures

Environmental Goals	Addressed in section
Water Pollution	
Preventing pollution of water by leachate	4.7, 7.3
Detecting water pollution	7.2, 7.3, 7.4
Remediation of water pollution	7.3, 7.4
Air Pollution	
Preventing landfill gas emissions	5.9, 6.2
Detecting landfill gas emissions	6.2, 7.5
Remediation of landfill gas emissions	6.2, 7.5

Environmental Goals	Addressed in section
Land Management and Conservation	
Assuring quality of design, construction and operation	4
Assuring quality of incoming waste	5.3, 5.5, 5.16,
Recording of wastes received	5.3, 5.5, 5.15
Minimising landfill space used	5.6.12
Maximisation of recycling	5.6
Remediation of landfill post closure	8
Hazards and Loss of Amenity	
Preventing unauthorised entry	5.10
Preventing degradation of local amenity	5.1, 6
Preventing noise pollution	6.5
Adequate fire-fighting capacity	5.14
Adequate staffing and training	5.3

1.2.4 Figures

This Draft LEMP refers to the Figures listed in Table 2, which are included in 0

Table 2 List of Figures

Figure Number	Title
Figure 01	LOCALITY PLAN AND FIGURE LIST
Figure 02	EXISTING SITE PLAN
Figure 03	CELL ARRANGEMENT AND PROPOSED EXCAVATION CONTOURS
Figure 04	FINAL WASTE FILL CONTOURS AND CAP DETAILS
Figure 05	CUT AND FILL PLAN
Figure 06	LEACHATE ARRANGEMENT AND DETAILS
Figure 07	TYPICAL CROSS SECTIONS
Figure 08	TYPICAL DETAILS
Figure 09	STORMWATER ARRANGEMENT AND DETAILS
Figure 10	STORMWATER AND SEDIMENT CONTROL DETAILS
Figure 11	TYPICAL GAS EXTRACTION INFRASTRUCTURE

Figure 12	Bureau of Meteorology Murwillumbah (Bray Park) Climate Data

1.2.5 Revisions and Updates

TSC will revise and update the Draft LEMP as required to ensure that it reflects the facilities and operations at the proposed Quirks Quarry Landfill facility and any changes in regulatory requirements. This shall include undertaking revisions and updates due to changes in the site's future EPL or due to changes in operations or directives from TSC or the DECCW.

TSC shall review and update the Draft LEMP (as necessary) after every review of the site's future EPL or at least every 3 years (see Section 9.3).

This Draft LEMP has been prepared as part of TSC's application to DECCW for the future planned Quirks Quarry Landfill development.

2. Site Overview

2.1 Site Location

The proposed Quirks Quarry Landfill site falls within the Tweed Shire Council Shire adjacent to the Pacific Motorway in the suburb of Environ. The council owned site is situated south of Chinderah, approximately 11.3 Kilometres northeast of Murwillumbah and 22 kilometres south of Tweed Heads. The site is shown on drawing number 41-20864-FIG 01 (located in Appendix A).

2.2 Site History

Quirks Quarry has been operating since the 1950's. An Environmental Impact Statement (EIS) was prepared in 1996 to assess proposed extensions for the 'continued operation' of the existing quarry. Prior to 1996, the quarry had a threshold annual extraction rate of 50,000 tonnes (Brian J. Mackney & Associates, 1996).TSC purchased the Quarry in 1996 and at this time the quarry began operating under the current quarry management plans.

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

2.3 Land Use

The site has been used as a quarry since the 1950's. A description of the quarry operations is provided in the Quirks Quarry Plan of Management V3.0 (TSC, 2006).

The Quarry covers an area of approximately 3.82 ha and straddles the border of two lots, being predominantly located on Lot 602 DP 1001049, with a small portion falling within Lot 1 1159352. Most of the site is zoned 5(a) – Special Uses (Garbage Depot) under the Tweed Shire Local Environmental Plan (2000). In addition, the northern most portion of Lot 602 DP 1001049 and the eastern portion of Lot 1 DP1159352 are zoned 1(b) Agricultural Protection.

2.4 Land Ownership

TSC owns both Lot 1 DP1159352 and Lot 602 DP 1001049 on which the site is located.

2.5 Topography

The existing quarry site is located on a low relief, westerly tending spur of the Condong Range. The spur protrudes onto the flatter cane lands between the coastal ranges and the Tweed River.

Runoff from the extraction area drains to a small stream south-west of the site. This stream enters a series of cane drains to the north of the site which eventually flow into the main trust canal. This canal enters the Tweed River approximately 3.5 Km north of the quarry site.

2.6 Geology

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

2.7 Soils

The predominant soil type within the region comprise of massive black and grey coastal (alluvial) clays. These soils are found in the coastal areas and the Tweed River flood plain, and are prone to localised acidification subject to draining / desaturation. The alluvial deposits can be up to 20 m in depth. Soils located within the rocky subcrop generally comprise clayey residual soils, being formed by weathering of the underlying basement sequences.

2.8 Groundwater Hydrology

It is currently understood that groundwater at the site flows from the south west to the north east. During initial concept design, GHD used groundwater monitoring data from August 2008. Preliminary analysis of additional standing water level data verified that the initial concept design level of RL 2 m (located at the lowest point of the landfill area, Stage 2) was suitable for sub-grade base levels. Table 3 shows the historical range of standing water levels recorded for the monitoring wells within the proposed landfill area to date.

During detailed design or at the construction phase, further geological and hydrogeological investigations and assessments are required to further understand the local groundwater conditions.

Table 3 Groundwater Levels

Ground water ID	Top Casing (RL)	Standing Water Level (RL)	Date of Sample
GW4	1.15	0.101 to 0.095	04 Sep 07 to 02 Jul 09
GW7	2.18	0.701 to 0.561	04 Sep 07 to 02 Jul 09
GW8	2.04	0.822 to 0.625	04 Sep 07 to 02 Jul 09
GW9	2.81	-0.09 to 0.14	05 Aug 08 to 02 Jul 09
GW10	3.94	0.11 to -0.19	05 Aug 08 to 02 Jul 09
GW11	9.17	5.85 to 6.26	05 Aug 08 to 02 Jul 09
GW23	3.66	0.62 to 0.57	21 Apr 09 to 02 Jul 09
GW24	36.49	9.39 to 8.89	21 Apr 09 to 02 Jul 09

2.9 Surface Hydrology

Surface water drainage at the site comprises a number of small drainage channels which flow north/north east into a larger un-named channel which flows from south east to north west through the site. This larger channel continues to the north close to the edge of the Tweed River floodplain at the break in slope and discharges to Leddays Creek, eventually discharging into the Tweed River to the north of the site.

2.10 Climate

Climate data gathered from the Bureau of Meteorology Murwillumbah (Bray Park) Site shows that the area has an average annual rainfall of 1518.4 mm. Mean annual temperatures range from 14.4°C to 25.8°C. Mean monthly maximum temperatures range from 21.0°C in July to 29.6°C in January. Mean monthly minimum temperatures range from 8.5°C in July to 19.7°C in January (BOM 2008). The mean monthly and annual climatic data has been summarised in Table 4 and Figure 12 (located in Appendix A).

Table 4 Average Climatic Data

Statistic Element	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Mean maximum temperature (Degrees C)	29.6	29	28.1	26.2	23.6	21.4	21	22.4	25.1	26.3	27.6	29.2	25.8
Mean minimum temperature (Degrees C)	19.7	19.6	18.1	15.4	12.6	9.8	8.5	8.8	11.4	14.1	16.5	18.4	14.4
Mean rainfall (mm)	198.7	229.5	211.2	161.7	138.3	96.8	67.7	51.3	42.4	87.6	128.8	158.8	1581.3
Mean 3pm wind speed (km/h)	17	15.5	15.5	13.5	11.2	11	12.6	14.6	17.9	18.1	16.9	16.9	15.1

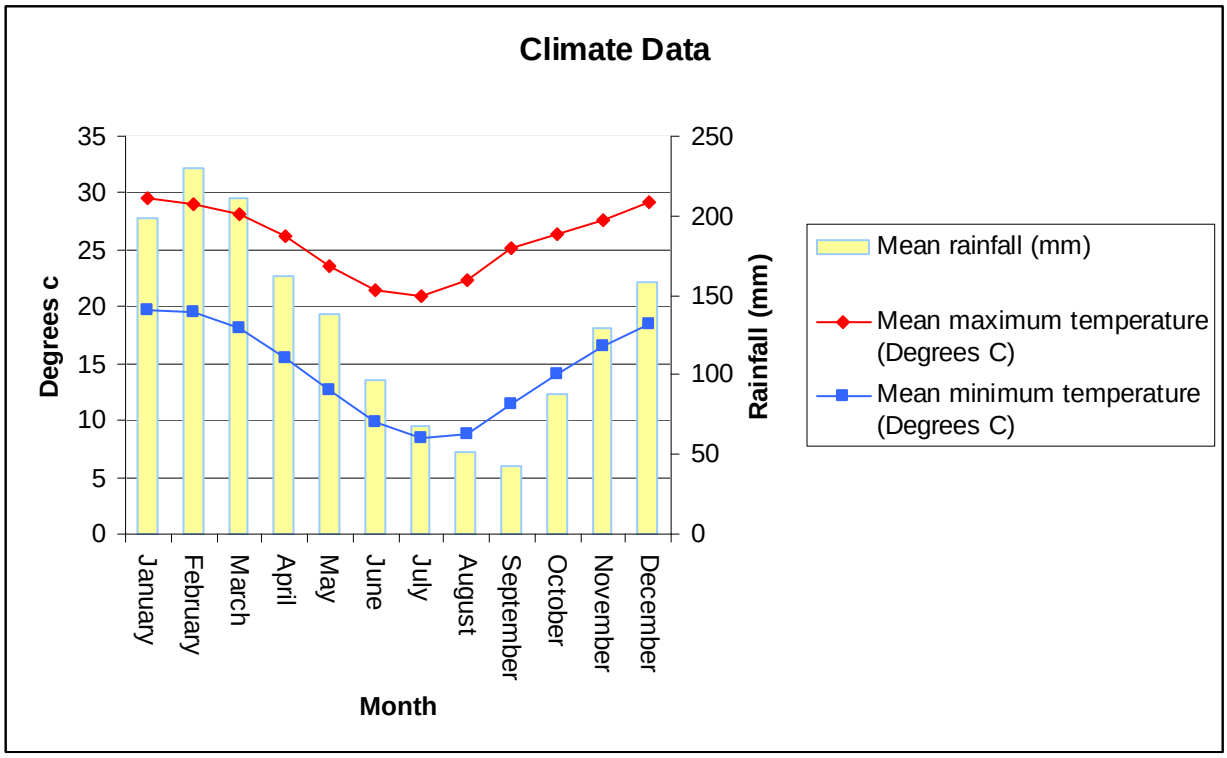

Figure 1 Bureau of Meteorology Murwillumbah (Bray Park) Climate Data

3. Approvals and Licensing

3.1 Environment Protection Licence

This Draft LEMP has been prepared as part of the Environmental Assessment for TSC's Stage 1 Project Application for the Environ Road Landfill and Quarry Proposal. Subsequently this Draft LEMP will form an integral part of TSC's application for an Environmental Protection Licence (EPL) for the landfill operations under the *Protection of the Environment Operations Act 1997* (POEO ACT).

It is proposed that the Quirks Quarry Landfill will be licensed as a Solid Waste Class 1 Landfill, able to accept inert waste, solid waste (including putrescible solid waste), asbestos waste and general clinical waste.

3.2 Development Consent

The quarry activities were previously conducted by TSC under the *Plan of Management, Quirks Quarry V3.0 Eviron Road, Eviron* which was approved on the 16th of June 2000. Landfill development consent is currently being sought.

4. Facility Design and Construction

4.1 General

The Quirks Quarry Landfill will be operated in accordance with the commitments made in this LEMP to achieve the required environmental goals, and will comply with the requirements of DECCW and all other relevant statutory requirements. TSC will implement a range of measures to minimise the potential for environmental impacts from the future landfill.

All front end landfill infrastructure including the gate house, office, recycling facilities, green waste processing and the small vehicle drop of point areas will be retained at the Stotts Creek Landfill Facility and will continue to be managed under the three Stotts Creek Landfill Facility LEMPs (one for each Environmental Protection Licence).

4.2 Facility Layout

The layout of the proposed Quirks Quarry Landfill is shown on Figure 03. Access to the landfill will be via haul road constructed between the existing Stotts Creek facility and the Quirks Quarry Landfill.

The main features of the landfill site include the following:

- Active landfilling area (for council and contractor vehicles only);
- Sediment basin and stormwater drains.

Some of these features are described in more detail in the following sections.

4.3 Staging/Filling of the Landfill

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

The initial development sequence will be as follows:

- Development of Stage 1
  - Cells split into Stage 1A and 1B by internal bund;
  - Lining placed to an RL 15 m.
- Landfilling of waste in Stage 1A:
  - Management of leachate in Stage 1A only, stored within cell;
  - Rainfall on Stage 1B treated as stormwater and pumped to natural drainage.
- Landfilling of waste in Stage 1B:
  - Management of leachate in Stage 1A & 1B, stored within Stage 1 (combined);
  - Management of stormwater from cell to sediment basin once waste reaches RL 15 m;
  - Development of leachate disposal infrastructure, treatment plant and irrigation area, based on collection of leachate quality and quantity data.

- Development of Stage 2 with landfilling of waste continuing in Stage 1 (1A and 1B) to a level of approximately RL 30 m;
  - Leachate disposed by treatment and irrigation stored within Stage 1.
- Intermediate capping of Stage 1 (1A and 1B) and establishment of temporary vegetation to a level of approximately RL 30 m;
- Landfilling of waste in Stage 2;
  - Management of leachate in Stage 1 and 2 and disposal by treatment and irrigation;
  - Excess leachate stored within Stage 1 and 2.
- Development of Stage 3 with landfilling of waste continuing in Stage 2 to a level of approximately RL 25 m;
- Intermediate capping of Stage 2 and establishment of adequate ground cover to a level of approximately RL 25 m;
- Landfilling of waste in Stage 3;
  - Management of leachate in Stages 1 to 3, and disposal by treatment and irrigation;
  - Excess leachate stored within Stage 1 and 2.
- Final capping of Stage 3 and establishment of adequate ground cover to a final design level of approximately RL 20;
- Landfilling of waste in Stage 2 and Stage 3 to final design levels and management of leachate in Stages 1 to 3;
- Final capping of Stage 2 and 3 and establishment of adequate ground cover to a final design levels; and
- Continue management of leachate in Stages 1 to 3 based on recommendations of closure plan (closure plan to be developed a minimum 6 months prior to final placement of waste).

4.4 Final Landform and Life of Site

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

As the landfill reaches the final landform level, areas of suitable size and gradient will be identified and capped as required. Potential capping specification options are discussed in Section 5.9.

Estimated landfill consumption for the landfill is displayed in Table 5 and includes the following assumptions:

- Average increase in annual waste volumes of 3% per annum;
- A waste conversion rate of 1 m^3 to 1 tonne; and
- An estimated annual daily cover of 20% of annual waste volume.

Table 5 Life Expectancy for Landfill Footprint

Year	Annual Waste tonnage	Waste volume @ 1000kg/m3	Daily Cover Volume (20%)	Total Volume of Waste and Daily Cover (m^3)	Cumulative Volume of Waste and Daily Cover
2012	47,893	47,893	9,579	57,472	57,472
2013	48,851	48,851	9,770	58,621	116,093
2014	50,316	50,316	10,063	60,380	176,472
2015	51,826	51,826	10,365	62,191	238,663
2016	53,381	53,381	10,676	64,057	302,720
2017	54,982	54,982	10,996	65,978	368,699
2018	56,632	56,632	11,326	67,958	436,656
2019	58,330	58,330	11,666	69,997	506,653
2020	75,030[1]	75,030	15,006	90,036	596,689
2021	77,131	77,131	15,426	92,557	689,246
Total	574,371	574,371	114,874	689,246	**689,246**

1 Inert landfill at Stotts Creek closes in 2019, inert waste accepted at Quirks Quarry Landfill from 2020 onwards.

4.5 Stormwater Management Works

4.5.1 Existing Stormwater Infrastructure

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

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

The sediment basin and culverts located at the western edge of the existing access track will be retained. These will collect stormwater runoff from current vegetated ground cover areas not associated with the proposed landfill area.

Refer to Figure 41-20806-FIG 09 for locations of the current stormwater infrastructure.

4.5.2 Proposed Stormwater Infrastructure

The proposed stormwater drainage system will comprise:

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

The landfill surface shall be bunded and contoured to prevent the run-on or run-off of surface waters onto / from areas where waste has been deposited. Landfill areas not being actively landfilled will be covered with intermediate cover and the runoff directed to suitable stormwater drainage systems.

Following the closure of an area, intermediate covering and temporary re-vegetation will ensure minimisation of stormwater volumes and improved water quality.

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

It is proposed to install silt fencing as required around the site and to finally restore areas of the site as soon as reasonably practicable. Once final capping and revegetation has occurred at the site, stormwater management will become a less significant issue. Re-vegetation of the site's surface by this time will considerably reduce the rate of erosion of the site and will help to trap sediment entrained in stormwater runoff.

4.6 Green Waste Processing Area Works

No green waste processing will occur at the Quirks Quarry Landfill. Green waste will continue to be processed at the Stotts Creek Landfill Facility and will be managed in accordance with the Stotts Creek Landfill Facility, LEMP.

4.7 Leachate Management

Leachate will be managed by a herringbone arrangement of leachate collection points which discharge to a leachate sump located at the lowest point of each cell.

The leachate will be conveyed from the sump by use of pumps via a leachate riser pipe which will then be gravity fed (where ever possible) to the leachate treatment plant for disposal by irrigation.

4.8 Small Vehicle Drop-off Point

There will be no public access to the Quirks Quarry Landfill, rather the site will be operated with one active area for waste disposal. Small vehicle deliveries by members of the public will be made at the

existing, dedicated small vehicle drop-off point (SVDP) close to the main entrance after being processed through the weighbridge at the Stotts Creek Landfill Facility. This allows for the separation of small vehicles from larger waste disposal trucks, and therefore improves safety and waste segregation. The waste deposited at the SVDP will subsequently be transferred by TSC to the waste disposal area at the Quirks Quarry Landfill via the sealed haul road.

5. Facility Management and Operation

5.1 General

The Quirks Quarry Landfill will be operated by TSC in accordance with the anticipated future Environment Protection Licence and other relevant regulatory directions.

TSC will implement a comprehensive range of measures to minimise the potential for environmental impacts from the future waste management operations conducted at this site. This will include:

- Appropriate site management and staffing to ensure effective and efficient operation of waste management processes;
- A waste screening and inspection program (existing facility at Stotts Creek Landfill);
- Recycling and resource recovery activities (existing facility at Stotts Creek Landfill);
- Landfilling techniques that minimise nuisance e.g. litter, vermin, odour, dust and noise;
- Appropriate leachate minimisation and management measures;
- Appropriate landfill gas management measures;
- Appropriate stormwater management measures which aim to minimise the generation of contaminated water and prevent detrimental impact on adjacent waterways; and
- A comprehensive environmental monitoring and reporting program.

5.2 Planning

TSC will review this LEMP each year or at least after each review of the future site EPL. The purpose of the review is to:

- Evaluate the rate of landfilling and revise the staging / filling plans as required;
- Review site operations and identify areas where site operations / performance can be improved;
- Modify the LEMP to better reflect site operations; and
- Make any changes arising out of legislative changes or changes in TSC's waste management policy.

TSC will update the LEMP incorporating all changes arising from the review process.

5.3 Management, Supervision and Staffing

TSC will provide suitably trained and experienced personnel as necessary to manage, supervise, operate and maintain the Quirks Quarry Landfill in accordance with the site's EPL and other relevant regulatory requirements. This shall include provision of staff to undertake the following activities:

- Planning of the staging of the landfilling operation;
- Overall management, supervision, operation and maintenance of the site and its waste management operations. This shall include personnel experienced in the operation of a solid waste management facility/landfilling operation;
- Design, construction and maintenance of all site roads;

- Supervision of the active tipping face of any waste disposal area;
- Managing cover material at the site, including excavation, separation from incoming waste materials, stockpiling, and transporting on-site using appropriate landfilling / earthworks equipment;
- Spreading, compaction and covering of the deposited waste using appropriate landfilling equipment / earthmoving equipment;
- Management, operation and maintenance of all environmental management measures / controls at the site;
- Management, operation and maintenance of all other facilities and structures at the site including monitoring boreholes, fencing, gatehouse, weighbridge etc.
- Recording of incoming vehicles including waste quantity, type, and source (conducted at existing Stotts Creek Landfill Facility); and
- Securing the site so that unauthorised persons do not enter.

TSC will implement effective control of traffic at the site, and in particular at the active tipping face. TSC will ensure that the equipment engaged in the movement, spreading, compaction and covering of deposited waste in the vicinity of any active tipping face is not operated in such a way as to constitute a risk to persons disposing of waste. TSC will supply and place barricades and / or signs in order to achieve this requirement.

- TSC will keep an operators daily log book for recording activities and incidents that occur during the operation of the site.
- TSC will provide a minimum of two personnel at the site at all operational times.
- TSC will ensure that all staff employed at the site are appropriately trained, qualified and experienced.
- Training will be undertaken to ensure that site staff operate the site in accordance with this LEMP, the EPL and other relevant guidelines and legislation, and will include training to ensure the following:
- All operators of compaction or earthworks equipment are skilled at undertaking all tasks required of them; and
- All those inspecting incoming wastes are skilled at accurate data recording and identifying wastes that are unacceptable.

TSC will provide regular training to all operative and managerial staff on topics including:

- Waste categories recognition;
- Waste management practices, guidelines and regulations;
- Environmental requirements for landfilling, green waste processing and recycling operations;
- OH&S regulations and practices; and
- First aid.

When the landfill site is open, the gatehouse will be manned, and the active tipping area and recycling processing areas will be supervised.

TSC will maintain safe work methods and other Procedures. A copy of these procedures will be kept at the site office and reviewed annually.

5.4 Hours of Operation

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

5.5 Waste Accepted at Facility

5.5.1 Waste types

The Quirks Quarry Landfill will only accept waste in accordance with its EPL. It is proposed that the site will be licensed as a Solid Waste Class 1 Landfill and will be permitted to accept inert waste, solid waste (including putrescible solid waste), asbestos waste and certain clinical waste. Tyres may be accepted at the landfill in accordance with the conditions outlined in Section 5.6.8.

Grease trap waste and waste oil may be stored, but not disposed of, at the premises. No other hazardous or industrial materials may be stored at the site except where they have been illegally dumped at the tipping face and are stored for subsequent removal.

Liquid wastes received will be stored in a bunded concrete tank on site. Liquid waste removal contractors will periodically empty the tank. No liquid wastes will be disposed of on-site.

5.6 Recycling and Resource Recovery

5.6.1 General

State and Federal Governments have adopted significant waste minimisation policies aimed at reducing waste to landfill. TSC supports this waste minimisation initiative and promotes it wherever possible for both the environmental and practical benefits.

TSC will continue the range of resource recovery activities currently conducted at the Stotts Creek site, including collection of source segregated recyclables, separation of clean fill and the collection and processing of green waste.

TSC personnel will take all reasonable efforts to ensure that recyclable and reusable items are diverted from the current and future landfill operations.

5.6.2 General recyclable materials

TSC will endeavour to recycle as much general recyclable materials as practicable. This may be done by advising customers of where recyclables should be placed, explaining to customers the benefits of separating recyclables from general waste, or recovering recyclables from the general waste stream.

This will generally occur at the existing Stotts Creek Landfill Facility prior to the waste entering the Quirks Quarry Landfill. However, should recyclables be commingled with the general waste delivered to the Quirks Quarry Landfill, TSC shall make all reasonable efforts to segregate the recyclable materials and transfer them back to the Stotts Creek Landfill Facility for recycling / processing.

5.6.3 Green waste

Green waste will not be processed at the Quirks Quarry Landfill, rather source separated loads will be diverted to the green waste processing area at the Stotts Creek Landfill Facility. Where green waste is delivered to the Quirks Quarry Landfill (via commingled loads), TSC will make all reasonable efforts to segregate and transfer the green waste back to the Sotts Creek Landfill Facility for processing.

The following quantities of greenwaste are proposed to be stockpiled at the greenwaste facility at the Stotts Creek Landfill:

- 3000m^3 of raw unprocessed greenwaste; and
- 1000m^3 of finished product.

5.6.4 Timber

TSC will separate timber materials into a separate stockpile at least 50 m clear of all combustible items. Treated timber shall not be placed in this stockpile, but shall be disposed of in the landfill. The hierarchy for managing timber will be:

1. Sell it to the public;
2. Mulch unsaleable timber and mix with other green waste. Make the mulch available for sale to the public.

The temporary timber stockpile shall be relocated to the Stotts Creek Landfill Facility for sale or processing as per above.

5.6.5 Motor oil

Materials that may pose a risk to the environment, such as waste oil containers prior to decanting, will be stored in bunded areas at the Stotts Creek Landfill Facility. Site staff will be responsible for decanting of any waste oils into the waste oil collection tank provided. Customers will not be permitted to have access to the oil collection tank for any reason.

5.6.6 Chemicals and chemical containers

Chemical containers will be collected at the site and managed under the DrumMuster scheme. DrumMuster collections will be undertaken as required, although as a minimum, two coordinated events will be scheduled per year. In addition a dedicated hazardous chemical collection will be undertaken by a licenced contractor on an annual basis. Outside of this time the facility will not accept chemicals for onsite storage.

Where possible, TSC will detect chemicals and chemical containers in the general waste stream prior to them being unloaded, or identify them as they are being unloaded. Where materials are detected at this early stage, TSC will explain to the customer that council operates under the DrumMuster collection program for the disposal of these materials.

Where the customer leaves the site prior to these materials being detected, TSC will remove the chemicals from the waste disposal area and store them on a bunded pallet. TSC will check that all containers are adequately sealed against the weather to prevent chemicals from escaping into the environment. TSC will be advised of chemicals stored on the site, and all chemicals stored will be

removed with the annual chemical/hazardous chemical collection program. All chemicals will be handled in accordance with all relevant OH&S requirements..

5.6.7 Scrap metal

TSC will arrange for the separation of scrap metal delivered to the site, including car bodies and parts, white goods, roofing etc. at the existing Stotts Creek Landfill Facility, prior to delivery to the Quirks Quarry Landfill.

5.6.8 Tyres

TSC will use its best efforts to minimise the number of tyres disposed of into the landfill. Where tyres are delivered to the site, TSC will ensure that they are placed in a separate stockpile and are neatly stacked at the Stotts Creek Landfill Facility. The total mass of tyres stored in this stockpile shall not exceed fifty tonnes and will comply with the conditions of the EPL. Commercial quantities of tyres (more than five in a load) will accepted at the site for a fee.

5.6.9 Batteries

Car batteries, truck batteries and solar lead acid batteries will be managed at the Stotts Creek Landfill Facility and will be segregated from the landfill and placed on a pallet within a bunded area for recycling. TSC will ensure that, as soon as one pallet fills, arrangements are made for the collection of the batteries. All arrangements for the removal of batteries, as well as all income from the recycling of the batteries, reside with TSC.

No more than two (2) full pallets of batteries will be permitted to be on the site at any time.

5.6.10 Concrete, Bricks and Tiles

TSC will separate and stockpile all concrete, bricks and tiles disposed of at the Stotts Creek Landfill Facility, which are either saleable or useable for construction. TSC will sell these materials or use them for site road construction as necessary.

The stockpile of concrete, bricks and tiles will be managed in accordance with the Stotts Creek Landfill Facility management procedures and operating licences.

5.6.11 Clean Fill

TSC will ensure that clean fill delivered to the site is stockpiled in a location where it is able to be easily used for cover material or for rehabilitating the site. Where required, TSC will also source clean fill for use as landfill cover or other site development works. Where TSC sources material for landfill lining or bund walls, this material will be tested to ensure it is of an adequate quality to meet the requirements for this use.

TSC will not source or store clean fill on the site in excess of the site needs, and will not use excessive amounts of cover in operating the landfill.

5.6.12 Waste Handling, Deposition, and Compaction

All waste will be deposited in a manner that minimises any nuisance or environmental impacts, and achieves maximum practical in situ density.

Waste will not be deposited into water. Each active waste disposal area will be maintained in a dry condition as far as is possible during the life of the cell.

Every layer of waste deposited in the landfill will be evenly placed and compacted by the landfill equipment to achieve an effective waste density >750 kg/m^3. Large bulky wastes such as furniture and tree trunks, if not deposited in the recycling area or Green Waste Processing Area (GWPA), will be broken up before covering. Such wastes will not be deposited in the final lift of a waste disposal area since settlement of the fill may result in these large items piercing the landfill cap.

The landfilling equipment will generally make 3 to 5 passes over the waste and will generally not operate on slopes exceeding 1:3 (V:H) due to reduced compaction and operational safety considerations. Heavy vehicles may also be directed over completed areas to aid in compaction of the waste.

5.7 Special Waste Handling Procedures

The Quirks Quarry Landfill may be licensed to accept asbestos waste and general clinical waste. TSC will ensure all asbestos waste received has been wetted and sealed in heavy duty plastic. TSC must be contacted prior to disposal to ensure a special burial of the asbestos waste.

Clinical Waste accepted by TSC must comply with the requirements of Part 4, Clause 43 of the *Protection of the Environment Operations (Waste) Regulation 2005* including:

- TSC will provide written approval before the waste is received disposed of;
- The waste will not be disposed of unless it was generated outside the regulated area;
- The waste will not contain any recognisable body parts, sharps waste, cytotoxic waste or radioactive waste;
- The waste will be packaged in accordance with the requirements set out in the NSW Health *Waste Management Guidelines for Health Care Facilities*;
- The waste will not be disposed of in amounts that exceed 40 kg at any time; and
- The waste will be buried, or be immediately contained, in a manner that prevents the waste coming into contact with any person or animal.

5.8 Covering Layers

5.8.1 Daily Cover

To maintain sanitary conditions and minimise the environmental impact of the landfilling operation, at the end of each working day all exposed waste surfaces will be covered by TSC with a layer of compacted soil or other EPA approved material to a minimum depth of 150 mm. The daily cover layer will be graded to minimise ponding of water.

Waste may be covered throughout the working day, as well as at the end of the day if necessary to prevent environmental impacts such as litter or odour.

The material used for the covering of waste will be clean soil and virgin excavated natural material (VENM), including material sourced from materials excavated on-site and suitable incoming waste materials. This may include waste materials such as clean soil, VENM, road base, asphalt and

crushed concrete, as approved by the EPA. Other materials may be used as daily cover subject to EPA approval. TSC will ensure there is, at all times, sufficient cover material on site for daily covering of the deposited waste. Cover material used for daily covering will be stockpiled at a point convenient to the active waste disposal area. The stockpile will be maintained to provide at least two weeks supply of cover material.

TSC will not source or store clean fill on the site in excess of the site's needs, and will not use excessive amounts of cover in operating the landfill. Silt fences and other approved sediment control measures shall be provided by TSC as required.

5.8.2 Intermediate Cover

Where a filled area has not reached the final landform level, but due to the staging of the filling will remain inactive for a period greater than 90 days, TSC shall apply an intermediate covering layer. The intermediate covering layer shall be a 300 mm thick layer of compacted soil or other suitable material approved by the EPA.

5.8.3 Final Cover

The landfill will be progressively rehabilitated as filling is completed. This will involve placing an engineered cover layer over each tipping area as it is completed, and revegetating the final cover. The average slope angle shall not exceed 1:4 (V:H), and level parts of the landfill will be domed or graded to a minimum 5% (1:20).

5.9 Final Cap

The total area to receive a final cap at this site is approximately 6 ha. Details on the final capping options for the landfill are provided in section 4.6 of GHD's Conceptual Landfill Design Report, October 2009, the final capping maximum requirements are as follows.

- Linear low density polyethylene (LLDPE) liner to achieve a permeability of less than 1×10^{-8} m/s;
- 500 mm revegetation layer which will be suitable for plant growth; and
- 100 mm of mulch or topsoil.

The selection of the final capping option will be dependent on the operational procedures implemented over the life of the landfill. Waste type, quantity, daily and intermediate cover practices, and rainfall and infiltration data may all impact on the selection of a final cap. Final cap options should be further reviewed during the landfill post closure investigations to determine the most suitable cap for the site.

5.9.1 Final Cover Specification

There are several options for the final cover layer, which are dependent upon the availability and suitability of materials for construction of this layer.

In general, it would be anticipated that the final cover layer would consist of the following:

- A 500 mm thick revegetation layer; overlying;
- A "Sealing Layer"; overlying;

- A 150 mm thick seal-bearing layer.

The Sealing Layer could constitute one of the following:

- A 500 mm thick compacted clay layer (permeability k < 10^{-8} m/s); or
- A geosynthetic clay liner (GCL) (permeability k < 10^{-11} m/s); or
- A geomembrane (permeability k < 10^{-13} m/s) protected by layers of geotextile (top and bottom).

The final sealing layer selected for this site will be in accordance with the relevant EPA requirements contained within the Landfill Guidelines.

The material to be used for the revegetation layer will be suitable for the establishment of grasses (prior to the development of the botanic gardens) on the site, and may incorporate compost, mulched green waste or mulched green waste blends generated at the Stotts Creek Landfill facility.

5.9.2 Seal Bearing Layer

When the site has been filled to the relevant height to allow the final cover layer to be constructed, a 150 mm thick seal bearing layer shall be placed and compacted across the area to be restored. This will comprise material such as soil, VENM or crushed bricks and concrete.

5.9.3 Sealing Layer

Once the most appropriate sealing layer has been selected, it and any associated protective geotextiles will be placed over the seal-bearing layer. Whichever sealing layer is selected, it will be capable of meeting the EPA requirements contained within the Landfill Guidelines. Any laboratory testing required of the sealing layer to confirm that the materials used will meet the required EPA criteria shall be completed by TSC.

5.9.4 Revegetation Layer

Material for the revegetation layer shall be sourced by TSC, and may comprise uncontaminated topsoil delivered to the site, or appropriate subsoils blended with processed green waste from the GWPA.

The revegetation layer shall be able sustain a healthy cover of vegetation over the capped landfill areas, and shall be resistant to erosion. The revegetation material shall be generally classifiable as silt, and shall contain greater than 5% organic matter (% dry matter as per test methods in AS 4454-2003).

5.9.5 Construction quality control

Prior to the construction of the final cover layer, a construction quality control plan will be produced by TSC. This document will detail requirements of TSC and their sub-contractors to conduct appropriate tests in line with the requirement of the Landfill Guidelines, or alternative design as approved by the DECCW. Records shall be kept of all testing completed, any failures observed and any remedial actions taken. These records shall indicate the time, date and location of the tests, failures and remedial actions. Observations regarding weather conditions at the time of conducting any test, or in the case of laboratory samples, collecting the sample. Appropriately qualified personnel shall collect all samples, and all tests conducted by a laboratory registered by NATA for the tests conducted.

5.9.6 Equipment

TSC will maintain and/or engage sufficient and appropriate machinery, plant and equipment to meet the requirements of the LEMP. This will include, but is not limited to, equipment for:

- Spreading, compaction and covering of deposited waste;
- Managing stockpiles of scrap metal;
- Managing stockpiles/windrows of green waste (processed and unprocessed);
- Compacting, trimming, shaping, grading and levelling of cover layers;
- Construction of the final cover layer, including compaction of the sealing layer; and
- Any other operation required for the proper and efficient operation of the landfill.

All plant and equipment will conform to the relevant Australian Standards and be operated in a proper and efficient manner.

All machinery, equipment, and plant will be maintained in a proper and efficient working condition, in accordance with the manufacturer's requirements. In the event of equipment or plant failure, TSC will organise replacement plant or equipment as soon as practical to ensure the requirements of the LEMP are fully complied with at all times.

5.10 Security

Outside opening hours the access gates will be locked by TSC. Coded locks and keys will be provided by TSC to sub-contractors as required, and only TSC provided locks will be used for access gates. Sub-contractors will not “piggy back” or “dummy lock” locks.

Only necessary sub-contractor staff and TSC employees will keep keys to gates and buildings. Approval will be required from TSC for issue of new keys to any party.

Current security measures at the weigh bridge, small vehicle drop-off point and recycling processing areas at the Stotts Creek Landfill Facility will continue to be implemented.

The Quirks Quarry Landfill will not be accessed by the general public. .

5.11 Health and Safety Procedures

TSC will undertake all necessary precautions to ensure the safety of all personnel, users and visitors to the site. The supervising staff at the landfill will undergo a full induction prior to commencing work at the site. An inducted site supervisor will conduct inductions for operational staff or sub-contractors conducting site works.

TSC will be responsible for ensuring that all employees are instructed in potential hazards at the landfill and that all sub-contractor staff observe safe working practices.

TSC will provide, equip and maintain first aid treatment facilities at the landfill and will have a person trained in first aid on site during all operating times.

It is the responsibility of TSC and their sub-contractors to be familiar with the provisions of the *Occupational Health and Safety Act 2000* (OH&S Act) and regulations. The duties and all other obligations that the OH&S Act places on an employer will be properly discharged by TSC and their sub-contractors so that all employees are aware of their responsibilities under the OH&S Act.

TSC will ensure that all necessary protective clothing and safety equipment is available and/or issued to all employees, is maintained in good condition, and is used where necessary.

TSC will ensure that site infrastructure is adequate to meet the OH&S requirements of TSC and sub-contractor personnel, as well as the general public. This includes conducting mulching of green waste away from the general public, and ensuring large depressions are appropriately barricaded.

All contracts and tenders that TSC makes for the site will ensure that contracting companies comply with insurance and health & safety requirements. These companies include waste collection contractors, revegetation & landscaping companies, recycling contractors and environmental consultants.

5.12 Wet Weather Operation

TSC will ensure the landfill is able to accept solid waste under all reasonable weather conditions without compromising the environmental management of the site. This includes placing adequate broken rock, bricks or concrete at the tipping area. If access issues are encountered during wet weather, waste may be deposited near the front of the waste disposal area and pushed to the back of this area by waste handling equipment.

5.13 Access Road Maintenance

TSC will construct all necessary temporary internal access roads within waste disposal areas to provide effective access across the waste disposal areas, to minimise damage to vehicles using the roads. All access roads will be constructed and maintained using suitable bricks, concrete and crushed rock that will be stockpiled on-site for use when required. Access roads will be wide enough to permit safe two-way movement by all vehicles using the site. If insufficient width is available for safe two-way movement, then the roads will be arranged to permit one-way flow of traffic.

Where necessary, site access roads will be constructed to withstand the traffic of waste handling equipment, however the traffic of heavy earth moving machinery on site access roads will be minimised.

5.14 Fire Control

The following measures will be implemented to prevent and control fires:

- Regular compaction and covering of landfilled waste;
- Posted, formal fire management procedures to follow in the event of a fire. These procedures include persons responsible, contact numbers and equipment to be used;
- Maintenance schedule for all fire fighting equipment and facilities. This will include, at a minimum, weekly checks of equipment and facilities for damage, and test operation every three months;
- Fire fighting equipment at site buildings;
- Clear signposting and access of all fire fighting equipment;
- Construction and maintenance of appropriate firebreaks;
- Staff training in fire fighting techniques; and
- Management of the size of green waste stockpiles (processed and un-processed).

In the event of a fire occurring at the site, TSC will take prompt action to extinguish the fire. The local Fire Service will be immediately notified of all fires irrespective of the extent of the fire and whether or not it has been controlled. TSC will cooperate fully with the Fire Service in fighting fires on the site.

TSC will take all reasonable measures to prevent water that has been used to extinguish fires from entering the stormwater system.

All fire events will be recorded in detail including the date, time, location, inferred cause of the fire, time it was extinguished, notification of authorities, and whether any future preventative measures are appropriate or were taken. This information will be recorded in the site's Daily Log Book.

With the exception of burning of the timber stockpile, all fires will be reported to the EPA as well as the Fire Service.

5.15 Waste Recording and Reporting

5.15.1 Waste Reporting

All vehicles entering the site will have a receipt completed and issued by the gatehouse operator. The receipt will include the vehicle registration, waste classification, and amount of money paid. The gatehouse at the site will be staffed by TSC at all times during operating hours to ensure that all vehicles are recorded. Access to the site will be controlled by means of fencing, gates, boom gates and traffic lights to manage the security of the site.

Where waste is to enter the site outside of operating hours, arrangements will be made with the site supervisor to ensure that the site is manned during the deposition of the waste.

The following records will be kept and retained at the landfill operations office:

- A copy of this Landfill Environmental Management Plan; and its various attachments and addendums;
- The site's EPL;
- Site Diary;
- Operator procedures manual; and
- Worksite OH&S Field Folder.

Waste quantities will be electronically recorded and can be reproduced by TSC.

5.15.2 Annual Return

TSC will prepare and submit an Annual Return in accordance with the requirements of the EPL. Annual reporting is discussed further in Section 9.1.

5.15.3 Airspace Surveys

TSC shall engage a suitably qualified surveyor to undertake a topographic survey of the landfill every six months to determine the volume of landfill airspace consumed. Council will revise the staging/filling plans based on the most up to date landfilling rate calculations after each survey. Section 5.2 discusses other LEMP revision requirements.

5.16 Quality Assurance

5.16.1 Design

Suitably qualified and experienced personnel or consultants will undertake all design work in accordance with quality principles.

5.16.2 Construction

Suitably qualified and experienced personnel or construction companies will undertake all construction work in accordance with quality principles.

Key construction work at the site includes the construction of each additional stage, a pipeline connection to sewer and the landfill final cover. Quality assurance of the construction of these and other significant construction works shall be conducted during their construction. Prior to the commencement of any major construction works on site, TSC will prepare a Construction Quality Assurance (CQA) Plan for the relevant works in accordance with the requirements of the DECCW.

5.16.3 Operation

Operation of the landfill and its associated activities will be undertaken in accordance with this LEMP.

All environmental monitoring will be undertaken by suitably qualified and experienced personnel and in accordance with relevant Australian Standards and NSW EPA Guidelines. All sampling will be undertaken in accordance with EPA relevant Australian Standards, NSW EPA Guidelines and other recognised standards. See Section 7 for further details.

6. Environmental Management

6.1 Water

6.1.1 General

TSC will take all practical steps to prevent contaminated waters flowing into the nearby creeks and cane drains and subsequently to the Tweed River.

- Site operations will generate different quality waters, including:
- Runoff from undisturbed areas of the landfill site (clean stormwater runoff);
- Runoff from rehabilitated (revegetated) areas of the landfill site (clean stormwater runoff);
- Runoff from disturbed areas of the landfill site (potentially turbid stormwater runoff);
- Runoff from within the active landfilling area (potentially leachate);
- Leachate from within the landfill.

Management of water at the landfill is aimed at:

- Minimising the generation of contaminated water;
- Preventing deterioration of water quality standards in local surface waterways and groundwater in the vicinity of the site; and
- Ensuring that water is available to meet operational requirements.

Where practical, clean stormwater runoff will be diverted around disturbed areas of the site to minimise the volume of dirty water to manage.

The following sections outline the management of clean stormwater, dirty water, and leachate.

6.1.2 Stormwater

There are three main types of stormwater generated on the site:

- Clean stormwater runoff from undisturbed and rehabilitated / revegetated areas of the site;
- Potentially sediment laden stormwater runoff from disturbed areas of the site; and
- Potentially leachate contaminated stormwater runoff from the active landfilling area.

The fundamental approach to stormwater management is as follows:

- Maintain undisturbed and rehabilitated / revegetated area as filters for sediment from disturbance above;
- Minimise disturbed areas on the site;
- Maintain all stormwater runoff from disturbed areas as diffuse as possible to minimise sediment loads and maximise the opportunities for the vegetation to strip sediment from the runoff. Any concentration of flow will be avoided;
- Erosion control (re-vegetation, silt fencing etc.) shall be established on disturbed areas as soon as practicable and maintained;

- Ensure that water falling in the active tipping area does not leave the site, by placing a series of bund walls along the tipping perimeter. This water will be permitted to drain into the waste.

TSC will design, construct and maintain a series of temporary stormwater drains during landfilling operations to prevent stormwater runoff from entering the active waste disposal area. Details of stormwater management measures are shown on Figure 09 Stormwater Arrangements and Details and Figure 10 Stormwater and Sediment Control Details.

Where the area drained is undisturbed, these drains will drain from the site. Where the area drained is likely to contribute sediment to the stormwater, the drains will either drain to a sediment pond, or will be constructed to spread turbid water over vegetated areas of the site in order to enable the settlement of sediments from the water. If this is not possible, sediment fencing will be installed and maintained at the site perimeter as a temporary measure.

All drainage structures will be designed in accordance with the relevant design criteria including those specified in the EPA publication *Environmental Guidelines: Solid Waste Landfills, January 1996*, NSW Department of Environment and Climate Change's *Managing urban stormwater: Soils and construction, Volume 2B – Waste Landfills, June 2008* and *Australian Rainfall and Runoff*. Where required, approvals licences will be obtained for the drainage structures from TSC, DECCW, and /or the Department of Water and Energy (DWE).

6.1.3 Leachate

Leachate is deemed to include all water that has come into contact with waste. A range of appropriate measures will be implemented to minimise, contain, collect and dispose of leachate generated during landfilling at the site. This will primarily involve implementing all practicable measures to minimise the volume of leachate generated such as:

- Diverting upstream clean stormwater runoff, where possible;
- Minimising exposed areas at the active landfilling area by regular covering of the landfilled waste (at least daily);
- Grading filled areas to direct surface water runoff away from the active waste disposal area; and
- Progressive capping and rehabilitation of landfilled areas.

All leachate collected by the leachate containment and collection systems shall be managed by TSC to prevent adverse impacts on local surface waters and local groundwater. All leachate collected shall be stored, treated and disposed of in accordance with the LEMP (Section 4.7), the EPL and the relevant EPA guidelines.

Leachate collected in the active waste disposal area and leachate sumps will flow, or be stored for the first 2 years in Stage 1. Following assessment of actual leachate generation rates, the leachate will be pumped to a leachate treatment plant prior to being irrigated.

Surface water and groundwater will be monitored to evaluate the effectiveness of these measures. The monitoring network is discussed in more detail in Section 7.

6.1.4 Maintenance

All stormwater drainage, green waste run-off and leachate management works will be maintained in proper functioning order so as to:

- Minimise flooding of the landfill area; and
- Prevent contamination of local groundwater and surface water.

Maintenance will include:

- Regular cleaning of drains/pipes/pits and removal of accumulated sediments and litter;
- Removal of flow concentrations from disturbed areas; and
- Stabilisation of eroded drains.

6.2 Air

6.2.1 Landfill Gas

The requirement for installation of a landfill gas extraction system will be dependent upon the type and quantity of waste landfilled, and the requirements of the landfill license. Based upon various landfill gas assessments carried out by GHD, it is expected that at a minimum, gas extraction wells and a flare will be required. Further information regarding landfill gas extraction infrastructure is provided in section 3.9.3 of the Conceptual Landfill Design Report October 2009.

6.2.2 Odour

The landfill will be operated to minimise the generation and effect of odours arising from the waste management operations on adjoining land users.

All practicable measures will be taken to contain any odours within the boundaries of the site. Odours will be significantly reduced by operating the site in accordance with sanitary landfilling methods and good site management.

Odours will be minimised by:

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

A record of complaints regarding odours will be kept by TSC in accordance with the complaint management system, and reported to the EPA as required in the Annual Return.

6.2.3 Dust

All practicable measures will be taken by TSC to minimise dust emissions arising from the operations of the landfill and its associated waste management activities. These will include:

- Immediate burial and covering of dusty loads;

- Access roads to be well maintained;
- Speed limits to be enforced;
- Earthworks to be undertaken on days with little or no wind and/or when the soil to be excavated is moist, where practical; and
- Use of a water cart as required.

6.3 Litter

TSC will implement all practicable measures to minimise litter generation and confine litter arising from the operation of the landfill within the boundaries of the site. Where possible, all landfill tipping cells will be designed to face a direction which provides the greatest protection against the prevailing winds.

Other control measures may include the following:

- Undertaking landfilling within a bunded waste disposal area;
- Maintaining a small active waste disposal (tipping) area;
- Regular compaction of landfilled waste throughout the day;
- Covering of all landfilled waste at the end of each day; and
- Use of mobile litter fences around the active tipping area, as required.

All litter shall be cleared continually in order of priority. All loads entering the landfill will be required to be covered. TSC personnel will enforce load covering to prevent litter.

6.4 Vermin

While pesticides and baits may be occasionally used at this site, the preferred overall method of vermin control for the site includes good compaction and covering of deposited waste, including compaction of the covering layers. If used, care will be taken to ensure that pesticides do not enter stormwater, green waste run-off or leachate, or pose an airborne pollution hazard or nuisance.

Vermin control measures that will be implemented by TSC include:

- Daily compaction and covering of landfilled waste;
- More regular compaction and covering of waste throughout the day, if required;
- The use of insecticides and pesticides, as required; and
- The use of scarecrows and bird scarers, as required.

TSC are also responsible for the control of mosquitos and flies at the site. As such, TSC will ensure that any green waste runoff, stormwater ponds or leachate ponds are kept free of mosquito breeding larvae and that water does not pond in any other location that may propagate mosquito breeding.

6.5 Noise

All practicable measures will be taken by TSC to minimise noise emissions arising from the operations of the landfill and its associated waste management activities.

The impact of noise arising from the landfill operations on all surrounding rural residential areas will be minimised by implementing the following measures:

- Maintaining all landfill plant and machinery in proper working order;
- Ensuring all vehicles accessing the site use the designated access roadways; and
- Operating plant and equipment within specified working hours.

TSC will implement such measures as are necessary to satisfy all EPA requirements relating to noise pollution.

7. Environmental Monitoring

7.1 General

TSC will undertake all monitoring of groundwater and surface water, including leachate, in accordance with EPL requirements to ensure operation of the Quirks Quarry Landfill is not causing a detrimental environmental impact. In addition, every 12 months the operation of the landfill will be reviewed by TSC to assess the compliance of the landfill operation with regulatory requirements and this LEMP.

All sampling will be carried out by suitably qualified and experienced personnel, in accordance with EPA accepted procedures, including those described in the EPA publication *Environmental Guidelines: Solid Waste Landfills* and the EPA publication *Methods for Sampling and Analysis of Water Pollutants in NSW*. All analysis of samples will be performed by a laboratory accredited by the National Association of Testing Authorities (NATA) to undertake the analyses specified.

A Quality Assurance and Control (QA/QC) Program will be included as part of the Environmental Monitoring Program in accordance with Section 8 of the Australia Standard AS 44821.1. The QA/QC program will include the collection of:

- Field Split Duplicates;
- Blind Duplicates; and
- Rinsate Blanks.

Additionally, the analytical laboratories will complete their own internal QA procedures (as required by NATA registration) during the analysis of the samples.

Details of the monitoring to be performed for individual aspects are provided in the following sections.

7.2 Groundwater

7.2.1 Groundwater monitoring locations

Table 7 summarises the existing groundwater monitoring locations installed at the Quirks Quarry Landfilll site. Figure 41-20806-FIG 02 shows the locations of these monitoring wells.

Table 6 Groundwater monitoring system

Borehole ID	EPA Monitoring Point	Monitors
GW4	TBA	As per EPL, quarterly and annual monitoring suites
GW7	TBA	As per EPL, quarterly and annual monitoring suites
GW8	TBA	As per EPL, quarterly and annual monitoring suites
GW9	TBA	As per EPL, quarterly and annual monitoring suites
GW10	TBA	As per EPL, quarterly and annual monitoring suites
GW11	TBA	As per EPL, quarterly and annual monitoring suites

Borehole ID	EPA Monitoring Point	Monitors
GW23	TBA	As per EPL, quarterly and annual monitoring suites to be installed
GW24	TBA	As per EPL, quarterly and annual monitoring suites to be installed

Future expansion of the existing landfill may require additional monitoring points to ensure that all areas of the landfill are adequately monitored for potential impacts.

7.2.2 Groundwater monitoring

The following will be undertaken at the boreholes identified in Table 8 on a quarterly basis:

- Field water quality measurements – temperature, electrical conductivity, salinity, pH, dissolved oxygen (DO), and redox potential;
- Measurements of depth to the water table; and
- Sampling and analysis of samples for the parameters required in the site's EPL.

Appropriately trained personnel will conduct all sampling and analysis.

Boreholes that are dry or damaged will not be sampled and consideration will be given to their re-installation by TSC if considered appropriate.

An appropriate quality control program shall be in place to ensure that results of analysis are reliable and accurate.

Results of analysis will be compared to ANZECC/ARMCANZ guidelines for aquatic ecosystems where relevant trigger levels exist. Should monitoring indicate that contamination of the groundwater or sub soil has occurred; the affected monitoring boreholes will be re-sampled as soon as possible after identification of the possible contamination. If the contamination is confirmed by the re-sampling, the EPA will be notified in writing within 14 days. Within 28 days of the written notification, a groundwater assessment program will be prepared, which aims to identify the specific contaminants and extent of pollution of the groundwater. This plan would be submitted to the EPA for approval prior to implementation. Information collected during the groundwater assessment program will be used to prepare a groundwater remediation plan, if required.

7.3 Leachate

7.3.1 Monitoring

Monthly measurement of depth (and volume) of the leachate levels will be undertaken. In addition, the following will be undertaken on a quarterly basis:

- Conducting quarterly field water quality measurements – temperature, electrical conductivity, salinity, pH, dissolved oxygen (DO), and redox potential; and
- Sampling and analysis of samples for the parameters in the EPL plus Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and heavy metals (Cd, Cr, Hg, Pb etc.)

7.4 Stormwater

TSC will monitor the quality of stormwater at this site on a quarterly basis and during selected storm events. Monitoring will encompass undertaking the following at the stormwater pond release point on a quarterly basis:

- Field water quality measurements – temperature, electrical conductivity, salinity, pH, DO, and redox potential; and
- Sampling and analysis of surface water samples for the parameters in the sites EPL plus Total Suspended Solids (TSS).

The location of the surface water sampling location is shown on Figure 02 in Appendix A

In addition to quarterly monitoring, samples should be collected from the surface water locations during or within 24 hours of a significant rainfall event at least twice a year. Samples will be analysed for analytes in the EPL plus TSS.

Should monitoring indicate that contamination of any local surface water ways has occurred, the affected sampling locations will be re-sampled as soon as possible after identification of the possible contamination. If the contamination is confirmed by the re-sampling, the EPA will be notified by TSC in writing within 14 days. Within 28 days of the written notification a surface water assessment program will be prepared, which aims to identify the specific contaminants, causes and extent of pollution of the surface water. This plan would be submitted to the EPA for approval prior to implementation. Information collected during the surface water assessment program will be used to determine necessary remedial drainage measures and to prepare a surface water remediation plan, if required.

7.5 Landfill Gas

Surface gas monitoring for methane will be conducted quarterly on a progressively expanding 25 m grid across the site as the landfill expands, in accordance with Benchmark Technique 17 of the EPA's (1996) Environmental Guidelines: Solid Waste Landfills.

Perimeter landfill gas monitoring bores will be installed around the entire perimeter of the landfill site on a risk assessment basis. These bores will be monitored on a risk assessment basis.

In addition to this, gas accumulation (i.e. methane concentrations) will be monitored monthly in all buildings within 250 m of the deposited waste, in accordance with Benchmark Technique 18 of the EPA's (1996) Environmental Guidelines: Solid Waste Landfills.

Any gas monitoring completed at the site (including surface emissions, sub-surface and in-building) which detects landfill gas above the nominated investigation levels in EPA's (1996) Environmental Guidelines: Solid Waste Landfills, will be advised to EPA by TSC within 24 hours of detection. A written assessment will be provided to the EPA within 14 days of the incident identifying management controls implemented.

7.6 Monitoring Program Review

The groundwater, green waste runoff, leachate, stormwater and landfill gas monitoring program will be reviewed every 12 months to assess trends in the monitoring data, the suitability of the parameters tested for, and recommendations will be made regarding improvements to the program. This review

will be organised by TSC and submitted to the EPA as part of the annual review. It is further recommended that the monitoring location plan is reviewed every 12 months and updated as required.

7.7 Complaints

TSC will handle any complaints through its existing corporate record management system. Complaint records will include:

- Date and time of the complaint;
- Complaint method;
- Any personal details of the complainant if provided;
- Nature of the complaint;
- Subsequent action taken by the licensee; and
- If no action was taken, include the reason why no action was taken.

All complaints received over the course of a reporting year will be reported to the EPA in the annual review report referred to in Section 9.1.

The record of all complaints will be kept for at least 4 years from the date of complaint.

7.8 Record Keeping

The results of all monitoring will be recorded and retained as required in the EPL. The records will include the following:

- Sampling dates(s);
- Sampling time(s);
- Sampling point(s);
- Sampling results; and
- The name of the person who collected the sample.

The monitoring records will be kept for at least four (4) years after the monitoring event and will be produced to any authorised officer on request.

All environmental monitoring will be performed by suitably trained personnel. The requirements of the EPA's Environmental Guidelines must be followed to ensure that all requirements are met.

8. Site Rehabilitation and Post Closure Management

8.1 Final Landuse and Site Rehabilitation

The site is earmarked to form part of the future botanical gardens as detailed in the local planning scheme and the Tweed Shire Botanic Gardens Master Plan.

8.2 Closure Plan

TSC will prepare and submit to the NSW EPA a Closure Plan at least three months prior to the last load of waste being landfilled at the site. The Closure Plan will address the following in detail:

- Final landform selected, land use and landscaping / revegetation;
- Final capping;
- Post closure management and maintenance;
- Post closure environmental management e.g. of groundwater, green waste runoff, leachate, stormwater, landfill gas;
- Post closure environmental monitoring and reporting;
- Certificate of completion; and
- Implementation program.

The following sections generally describe some of these activities

8.3 Post Closure Management

Post closure management of the Quirks Quarry Landfill would encompass ongoing environmental management, environmental monitoring, and maintenance of the landfill.

8.3.1 Environmental Management

Ongoing environmental management of the site would be undertaken by TSC following closure of the site for landfilling. This would consist primarily of:

- Ongoing management and maintenance of stormwater measures;
- Ongoing management and maintenance of the leachate management system;
- Ongoing management and maintenance of the landfill gas management system;
- Ongoing management and maintenance of vegetation;

It is anticipated that following site closure and redevelopment, TSC will continue to monitor the environmental impacts of the site and conduct landscaping and gardening activities.

TSC will ensure that all green waste runoff collection, leachate collection, landfill gas management, stormwater controls and reporting practices are maintained at the same level employed during the operational life of the landfill. These environmental management measures will continue until TSC can demonstrate that the landfill does not pose a threat to the environment.

TSC will ensure that waste materials are not received for landfilling at the site after the landfilling operations cease. Any waste materials that are intended for use in the rehabilitation will be documented and reported in the same method used during the operation of the landfill.

8.3.2 Environmental Monitoring

TSC will maintain the same monitoring program and reporting practices for leachate, groundwater, stormwater and landfill gas as used throughout the operation of the site and described in section 7. Monitoring will continue until TSC is able to demonstrate that the landfilled waste no longer have the direct potential to impact on the environment. TSC will ensure that all neighbouring residents are advised of contact persons to discuss any problems. Any complaints that are received will be recorded in the complaints register.

8.3.3 Maintenance

TSC will undertake regular maintenance of the final landform selected and landscaping as required to maintain its integrity. This will include the following:

- Monitoring of surface water drains and structures, and undertaking repairs where necessary;
- Monitoring of landfill gas emissions, and undertaking repairs where necessary;
- Filling of any cracks that may occur in the final cover layer;
- Filling of depressions created by settling of the landfilled waste (to ensure shedding of surface water runoff);
- Replacement of vegetation affected by landfill gas or erosion if necessary, to maintain the density of the vegetation cover;
- Design and construction of any remedial works if significant areas of vegetation are impacted from landfill gas, leachate or landslips;
- Repairing erosion scours; and
- Ensuring that all monitoring boreholes and locations are maintained and operational as required

9. Reporting and Review

9.1 Annual Reporting

TSC will prepare an Annual Return as required by the EPL. The Annual Return will include a certified "Statement of Compliance" and a signed "Monitoring and Complaints Summary".

The Annual Return will be prepared for the required reporting period, i.e. 12 month period, and will be submitted to the EPA no later than 60 days after the end of the reporting period. TSC will retain a copy of the Annual Return for a period of at least 4 years after the Annual Return is supplied to the EPA.

The Monitoring and Complaints Summary will generally include the following information:

- Tabulated results of all monitoring data collected;
- Graphical presentation of data from at least the last three years in order to show variability/and or trends. Any statistically significant variations or anomalies will be highlighted and explained;
- An analysis and interpretation of all monitoring data;
- An analysis of, and response to, any complaints received;
- Identification of any deficiencies in environmental performance identified by the monitoring data, trends or incidents;
- Remedial action taken or proposed to be taken to address the abovementioned deficiencies; and
- Recommendations on improving the environmental performance of the facility.

9.2 Incident Reporting

Any incident that represents a threat to the environment and which may lead to a breach of licence conditions, will be communicated by TSC to the EPA as soon as practicable after TSC first becomes aware of the incident. Initial contact will be via the EPA pollution line service (131 555) or Client Manager for the site. Written notice must follow within 7 days of the incident. Examples of incidents that require reporting include but are not limited to:

- Identification of non-domestic quantities (>200 g/tonne) of hazardous waste mixed amongst solid waste;
- Fires at the landfill (other than those approved for fire hazard reduction by the EPA);
- Entry of green waste runoff, leachate or waste into the stormwater management system;
- Identification of any failure of an environmental protection system;
- Identification of a significant difference in groundwater or stormwater indicator parameters;
- Identification of a breach of nominated landfill gas investigation levels; and
- Any other incident or observation that could potentially pose an immediate environmental hazard outside normal operating conditions.

The occurrence of any such incident will also be recorded in the site's daily logbook as appropriate.

A written incident report will be provided to the EPA if requested by an authorised officer of the EPA. The report will include, but not be limited to, the following details:

1. The cause, time and duration of the event;
3. The type, volume and concentration of every pollutant discharged as a result of the event;
4. The name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
5. The name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
6. Action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
7. Details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
8. Any other relevant matters.

9.3 Landfill Environmental Management Plan Review

TSC will review the LEMP after each review of the site EPL, or at least every 3 years. The purpose of this review is to identify areas where site performance can be improved, the LEMP modified to better reflect site operations, and any changes arising out of legislative changes or changes in TSC policy can be incorporated.

10. References

Bureau of Meteorology (2008) Climate statistics for the Murwillumbah (Bray Park) Site http://www.bom.gov.au/climate/averages/tables/cw_058158.shtml number 058158. www.bom.gov.au accessed 26 May 2009.

NSW Department of Environment and Climate Change (DECC) and Sydney Metropolitan Catchment Management Authority (CMA); *Managing urban stormwater: Soils and construction, Volume 2B – Waste Landfills, June 2008*

NSW Department of Environment and Conservation (July 2004); *Environmental Guidelines: Composting And Related Organics Processing Facilities*

NSW EPA (January 1996), *Environmental Guidelines: Solid Waste Landfills*

NSW EPA (1996), *LEMP Preparation Manual*

NSW Government, *Protection of the Environment Operations Act 1997*

NSW Government, *Waste Avoidance and Resource Recovery Act 2001*

Brian J. Mackney and Associates. Pty. Ltd. (1995) *Environmental Impact Statement, Quirks Quarry, Eviron Road, Eviron*.

Tweed Shire Council (2004) Stotts Creek Landfill Facility, *Landfill Environmental Management Plan For Solid Waste Landfill Expansion.*

Appendix A

Figures

TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN
41-20806

LOCALITY PLAN

FIGURE LIST

FIG No.	DRAWING TITLE
41-20806-FIG 01	LOCALITY PLAN AND DRAWING LIST
41-20806-FIG 02	EXISTING SITE PLAN
41-20806-FIG 03	CELL ARRANGEMENT
41-20806-FIG 04	CAP ARRANGEMENT AND DETAILS
41-20806-FIG 05	CUT AND FILL PLAN
41-20806-FIG 06	LEACHATE ARRANGEMENT AND DETAILS
41-20806-FIG 07	TYPICAL CROSS SECTIONS
41-20806-FIG 08	TYPICAL DETAILS
41-20806-FIG 09	STORMWATER ARRANGEMENT AND DETAILS
41-20806-FIG 10	STORMWATER AND SEDIMENT CONTROL DETAILS
41-20806-FIG 11	TYPICAL GAS EXTRACTION INFRASTRUCTURE

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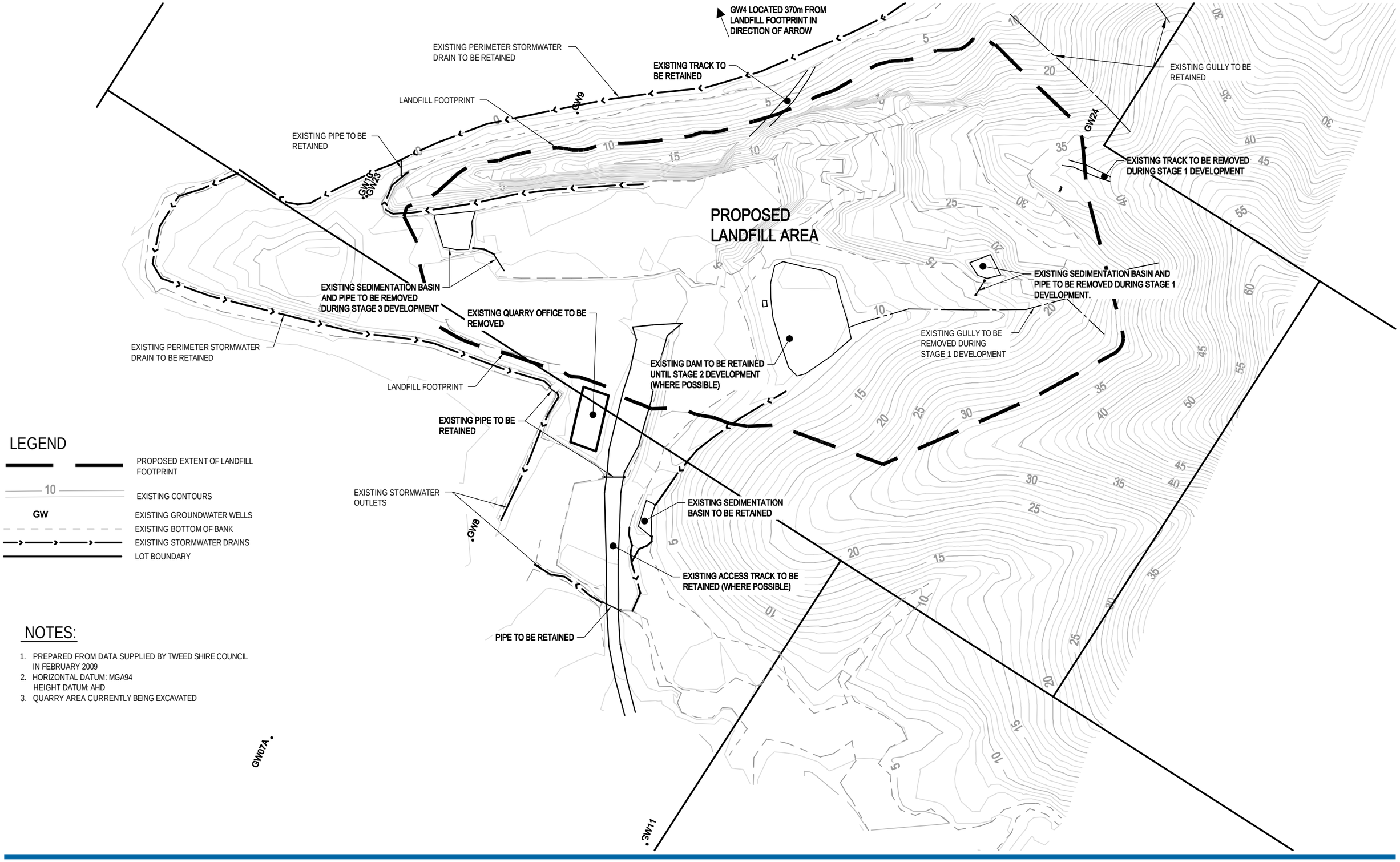
TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN

LOCALITY PLAN AND
DRAWING LIST

Job Number | 41-20806
Revision | B
Date | SEPT 2009

Figure 01

Plot Date: 9 June 2011 - 4:24 PM Plotted by: Emma Cornelius/GoldCoast/GHD/AU , Hervey Bay Cad File No: N:\AU\Brisbane\Projects\41\20806\CADD\Drawings\41-20806-FIG 01 - Standard\41-20806-FIG 01.dwg



LEGEND

- PROPOSED EXTENT OF LANDFILL FOOTPRINT
- 10 — EXISTING CONTOURS
- GW — EXISTING GROUNDWATER WELLS
- EXISTING BOTTOM OF BANK
- EXISTING STORMWATER DRAINS
- LOT BOUNDARY

NOTES:

1. PREPARED FROM DATA SUPPLIED BY TWEED SHIRE COUNCIL IN FEBRUARY 2009
2. HORIZONTAL DATUM: MGA94
   HEIGHT DATUM: AHD
3. QUARRY AREA CURRENTLY BEING EXCAVATED

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE (A3)

TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN

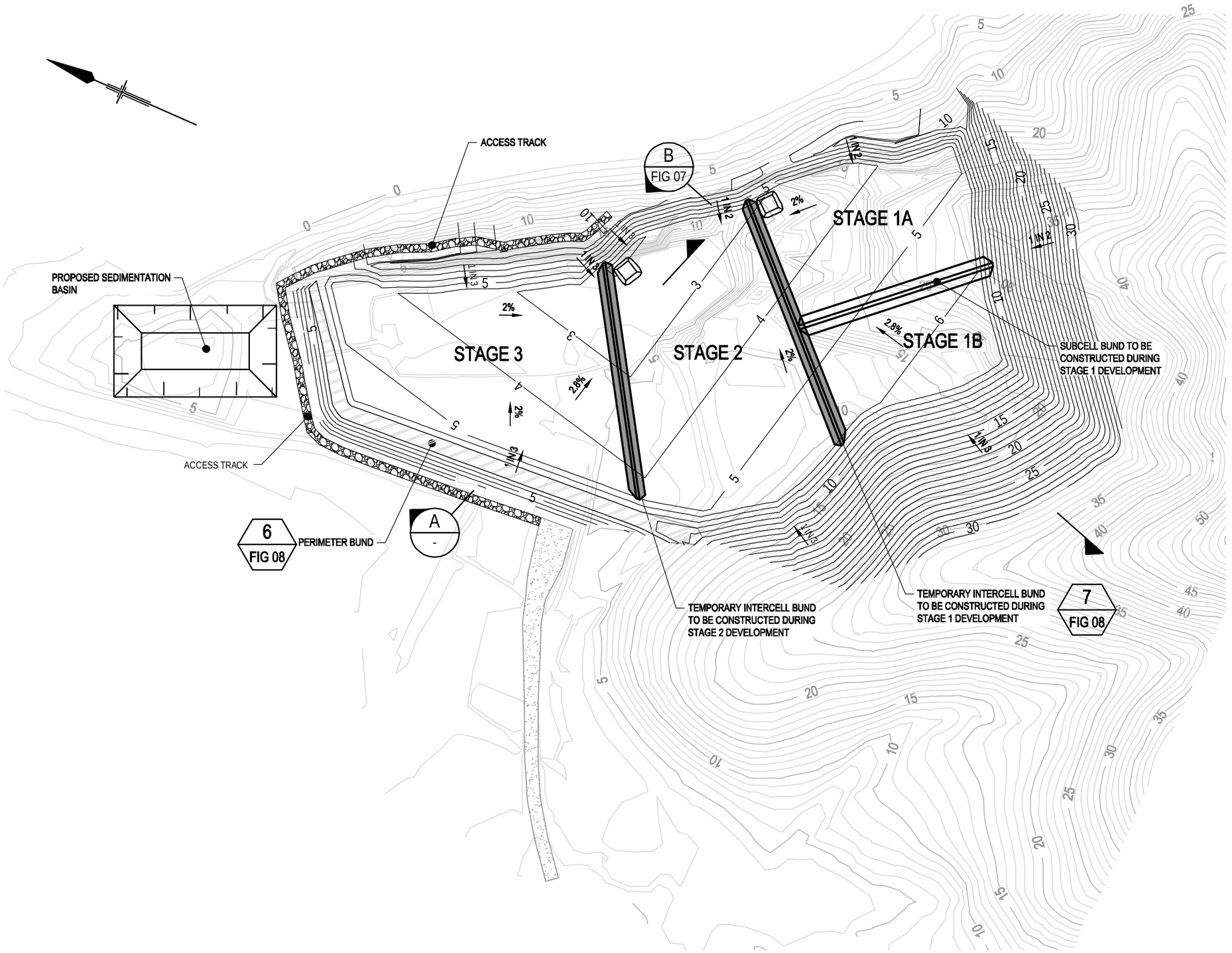
EXISTING SITE PLAN

Job Number 41-20806
Revision C
Date OCT 2009

Figure 02

Level 4, 201 Charlotte St Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Plot Date: 26 October 2010 - 2:54 PM Plotted by: Nicola Hankin/Brisbane/GHD/AU Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 02-RC.dwg



NOTES:

1. THIS DESIGN ONLY ALLOWS FOR GENERAL LANDFILL CELL/ CAP ARRANGEMENT & MORPHOLOGY. NO SLOPE OR CELL/ CAP LINER STABILITY ASSESSMENT WAS INCLUDED AS PART OF THE APPROVED SLOPE OF WORKS. GHD RECOMMENDS THAT PRIOR TO CONSTRUCTION A REVISION OF SLOPE STABILITY BE UNDERTAKEN.
2. GROUND WATER INVESTIGATION TO BE CARRIED OUT PRIOR TO CONSTRUCTION WORKS
3. EXISTING QUARRY AREA CONTOURS IN ACCORDANCE WITH RAY SARGENT & ASSOCIATES - APRIL 2000
   - INTERNAL BATTER SLOPES 1 IN 2
   - BASE CONTOURS : 2.8%
4. REMAINING INTERNAL BATTERS AT 1 IN 3
5. VOLUMES CALCULATED FROM DATA SUPPLIED BY TWEED SHIRE COUNCIL IN FEBRUARY 2009
6. PROGRESSIVE QUARRYING WITHIN EXISTING QUARRY AREA WILL VARY CUT & FILL VOLUME

VOLUME CALCULATIONS

VOLUME CALCULATIONS TO SUBGRADE PROFILE

STAGE 1	
PLAN AREA	26,100 m²
CUT VOLUME	245,000 m³
FILL VOLUME	800 m³
STAGE 2	
PLAN AREA	17,000 m²
CUT VOLUME	62,000 m³
FILL VOLUME	400 m³
STAGE 3	
PLAN AREA	14,400 m²
CUT VOLUME	8,000 m³
FILL VOLUME	32,180 m³
TOTAL	
PLAN AREA	57,500 m²
CUT VOLUME	315,000 m³
FILL VOLUME	33,380 m³

LEGEND

TEMPORARY INTERCELL BUND

5 — PROPOSED SUBGRADE CONTOURS

10 — EXISTING CONTOURS

0 20 40 60m

SCALE 1:2000 AT ORIGINAL SIZE (A3)

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TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN

CELL ARRANGEMENT AND PROPOSED SUBGRADE CONTOURS

Job Number 41-20806
Revision C
Date OCT 2009

Figure 03

Unit 2, 8 Neils St Hervey Bay QLD 4655 Australia **T** 61 7 4191 2000 **F** 61 7 4191 2099 **E** hvbmail@ghd.com.au **W** www.ghd.com.au

Plot Date: 26 October 2010 - 2:57 PM Plotted by: Nicola Hankin/Brisbane/GHD/AU , Hervey Bay Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 03-RC.dwg

NOTES

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

VOLUME CALCULATIONS

VOLUME CALCULATIONS FOR WASTE / DAILY COVER VOID CAPACITYTO SUBGRADE PROFILE

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

LEGEND

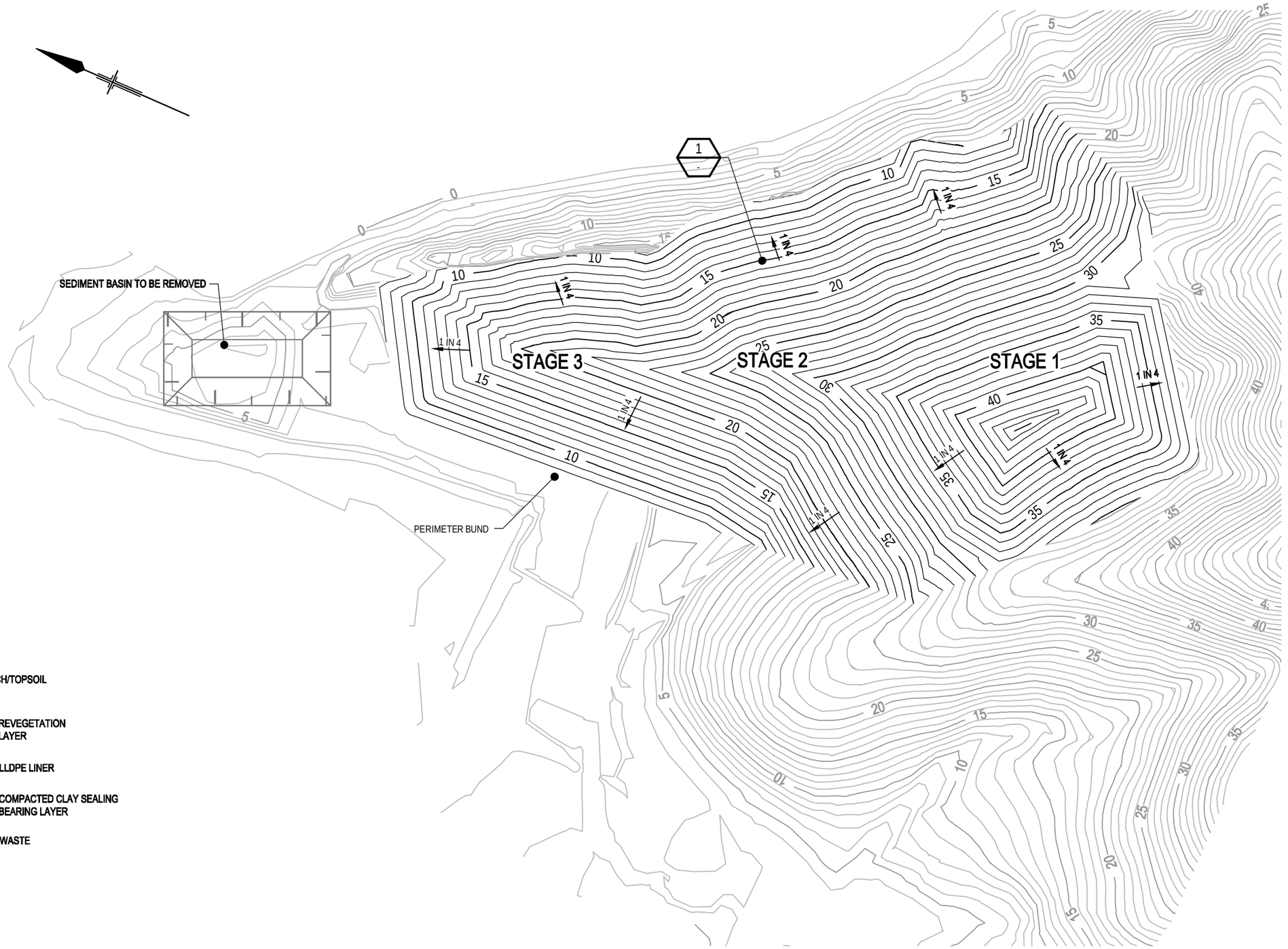
10 — EXISTING CONTOURS

5 — PROPOSED WASTE CONTOURS

TYPICAL FINAL CAPPING LAYER PROFILE

1 / - DETAIL

SCALE 1 : 50



0 0.5 1.0 1.5m
SCALE 1:50 AT ORIGINAL SIZE (A3)

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE (A3)

TWEED SHIRE COUNCIL
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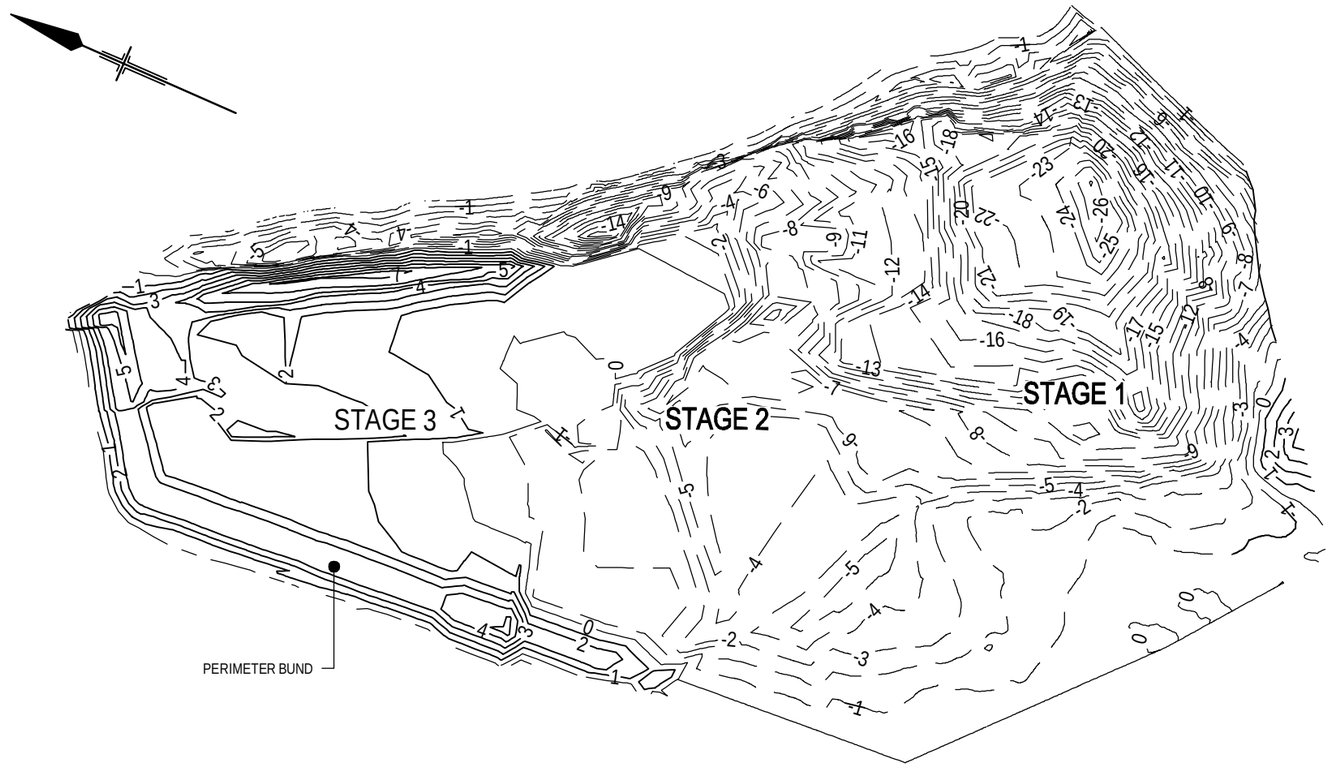
FINAL WASTE FILL CONTOURS AND CAP DETAILS

Job Number 41-20806
Revision C
Date OCT 2009

Figure 04

Level 4, 201 Charlotte St Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Plot Date: 26 October 2010 - 2:58 PM Plotted by: Nicola Hankin/Brisbane/GHD/AU Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 04-RC.dwg



NOTES:

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

VOLUME CALCULATIONS

PLAN AREA OF LANDFILL FOOTPRINT	57,500 m^2
TOTAL CUT TO SUBGRADE PROFILE	315,00 m^3
TOTAL FILL TO SUBGRADE PROFILE	33,000 m^3
TOTAL VOID CAPACITY	750,000 m^3
TOTAL CLAY LINER MATERIAL	55,600 m^3
TOTAL HDPE LINER	38,800 m^2
TOTAL LEACHATE AGGREGATE	10,100 m^3
TOTAL SEPARATION GEOTEXTILE	60,000 m^2
TOTAL PROTECTION GEOTEXTILE	60,000 m^2
TOTAL LLDPE LINER	60,300 m^3
TOTAL VEGETATIVE MEDIUM	36,100 m^3

LEGEND

1 — DEPTH CONTOUR - FILL TO SUBGRADE PROFILE

-1 — DEPTH CONTOUR - CUT TO SUBGRADE PROFILE

0 20 40 60m

SCALE 1:2000 AT ORIGINAL SIZE (A3)

TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN

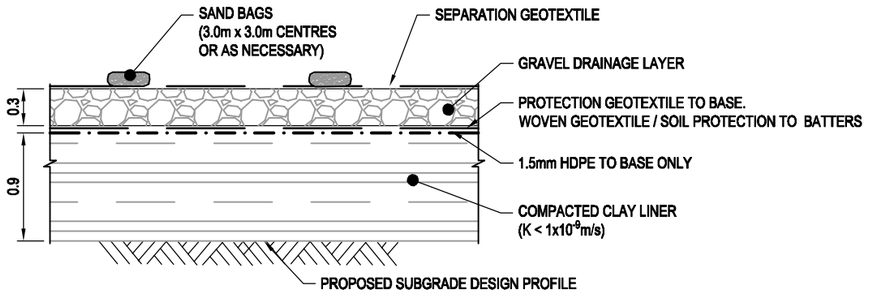
CUT AND FILL PLAN

Job Number 41-20806
Revision C
Date OCT 2009

Figure 05

Level 4, 201 Charlotte St Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

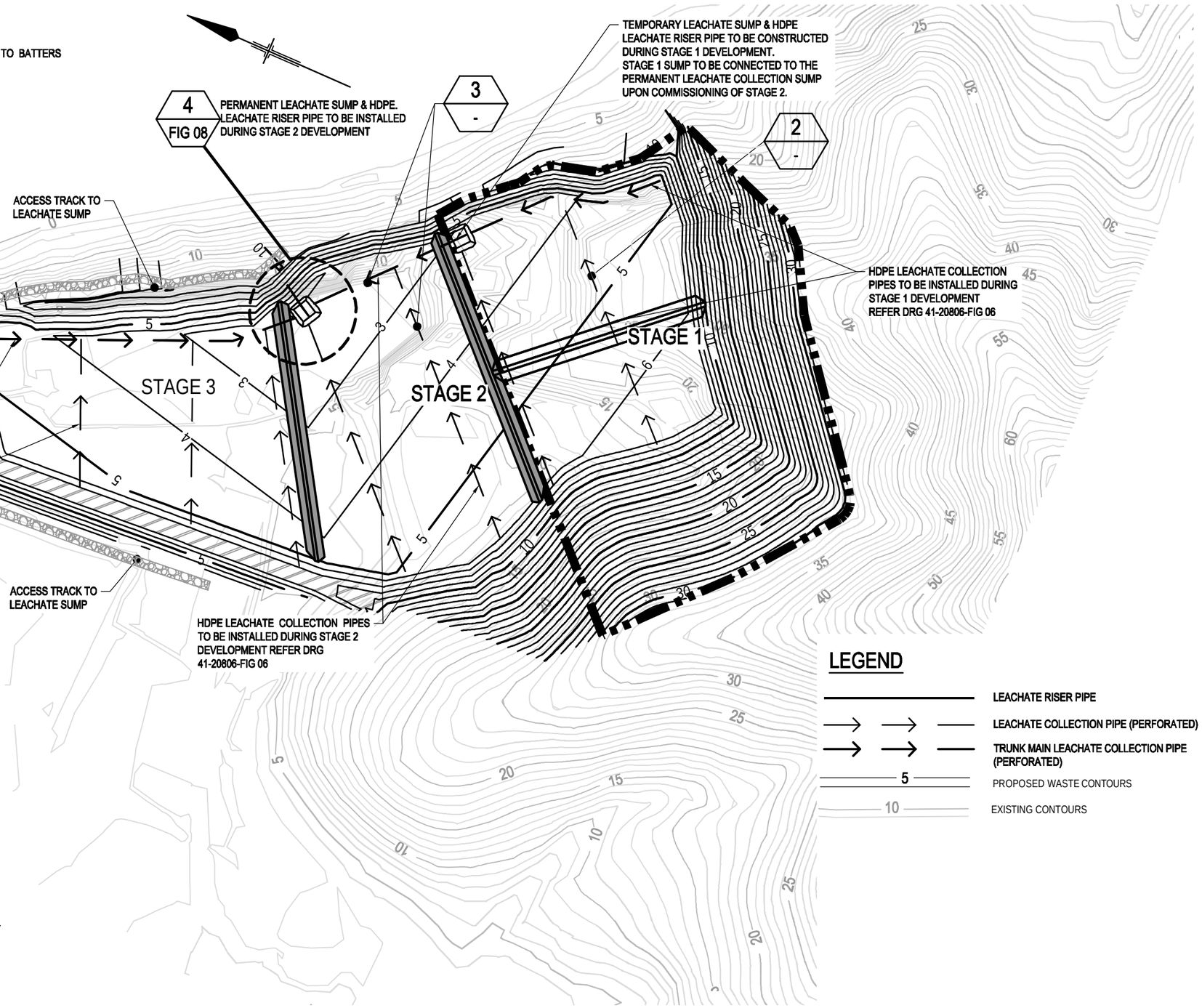
Plot Date: 26 October 2010 - 3:41 PM Plotted by: Nicola Hankin/Brisbane/GHD/AU Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 05-RC.dwg

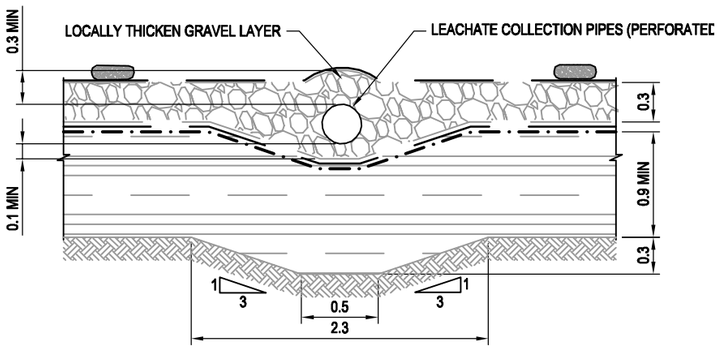


TYPICAL LINER DETAIL

2 / - DETAIL

SCALE 1 : 25





TYPICAL LINER DETAIL AT LEACHATE COLLECTION TRENCHES (NOT REQUIRED IN SUMP AREA)

3 / - DETAIL

SCALE 1 : 25

0 0.25 0.5 0.75m
SCALE 1:25 AT ORIGINAL SIZE (A3)

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE (A3)

TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN

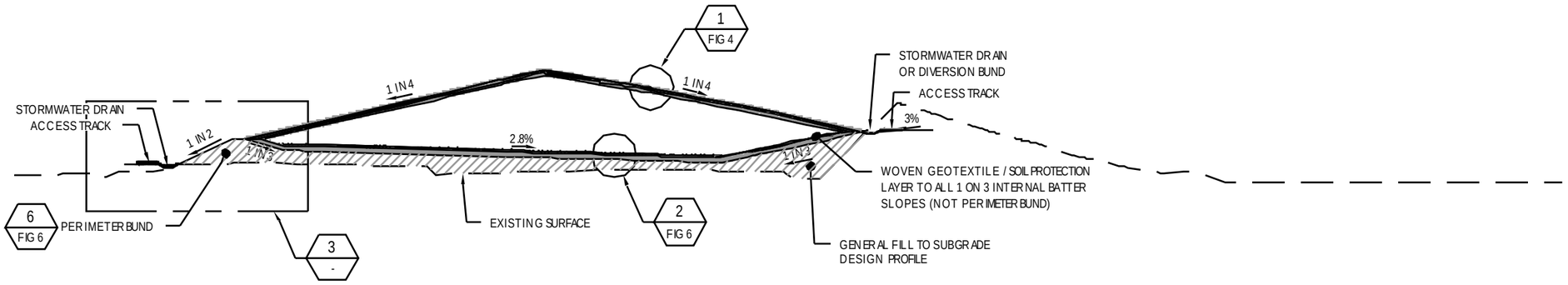
LEACHATE ARRANGEMENT AND DETAILS

Job Number 41-20806
Revision C
Date OCT 2009

Figure 06

Level 4, 201 Charlotte St Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

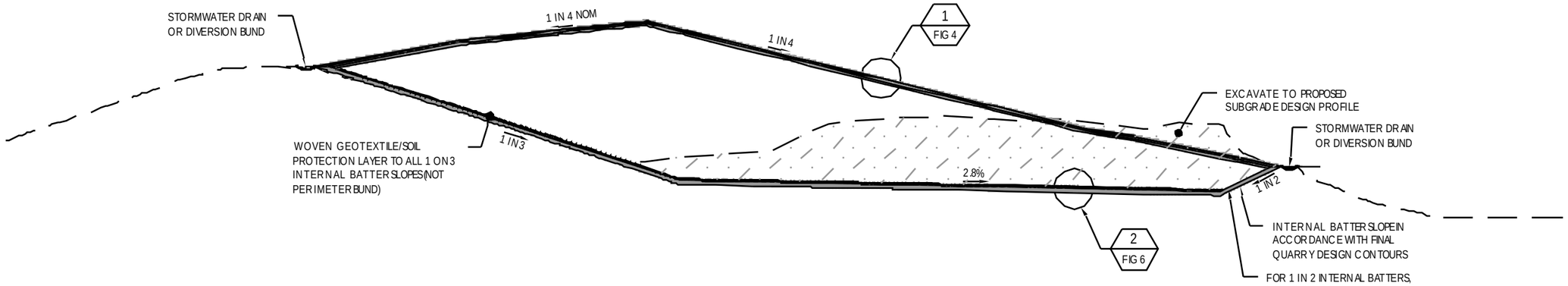
Plot Date: 26 October 2010 - 3:43 PM Plotted by: Nicola Hankin/Brisbane/GHD/AU Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 06-RC.dwg



TYPICAL PROFILE

A SECTION

FIG 3 SCALE 1 : 1000



TYPICAL PROFILE

B SECTION

FIG 3 SCALE 1 : 1000

0 10 20 30m

SCALE 1:1000 AT ORIGINAL SIZE (A3)

GHD

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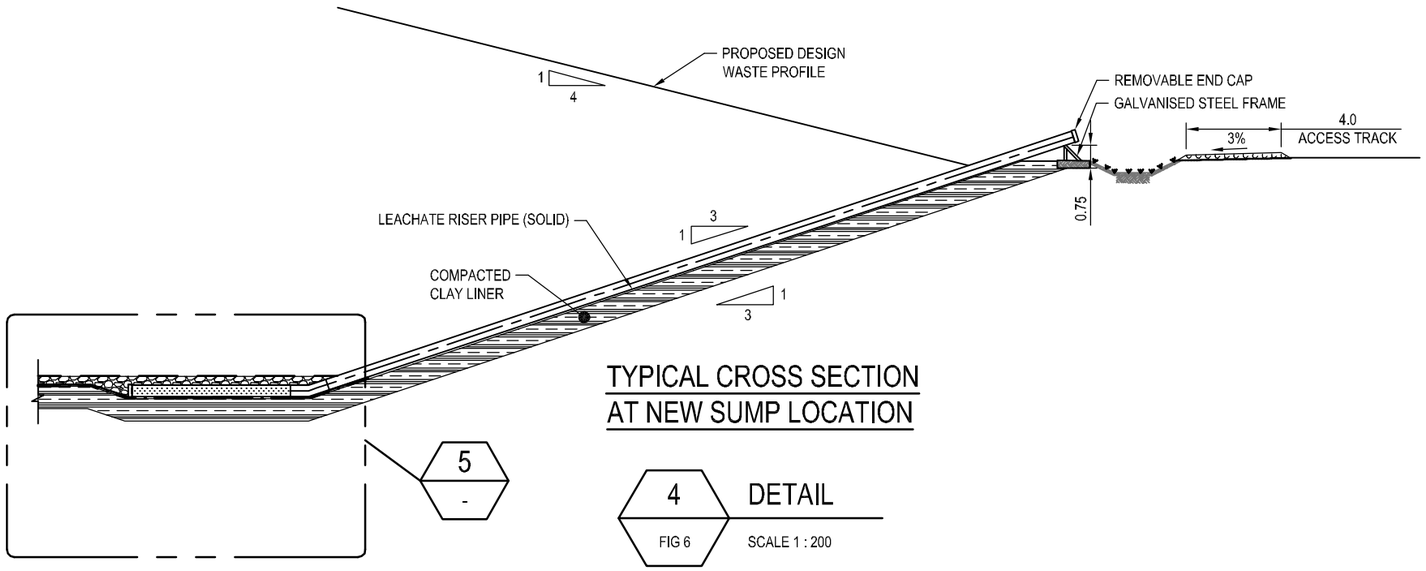
TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN

TYPICAL CROSS SECTIONS

Job Number 41-20806
Revision B
Date OCT 2009

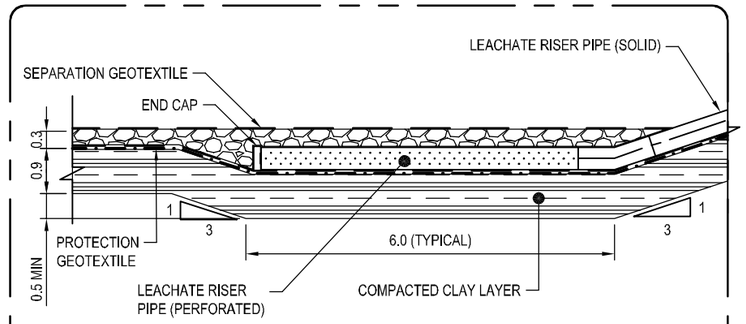
Figure 07



TYPICAL CROSS SECTION AT NEW SUMP LOCATION

4 / FIG 6 — DETAIL

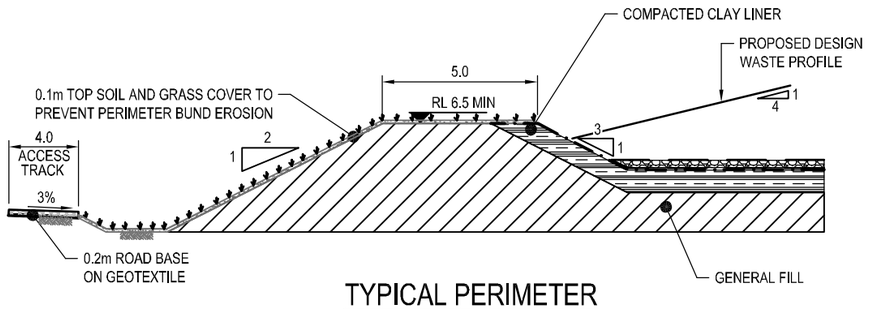
SCALE 1 : 200



SUMP DETAIL

5 / - — DETAIL

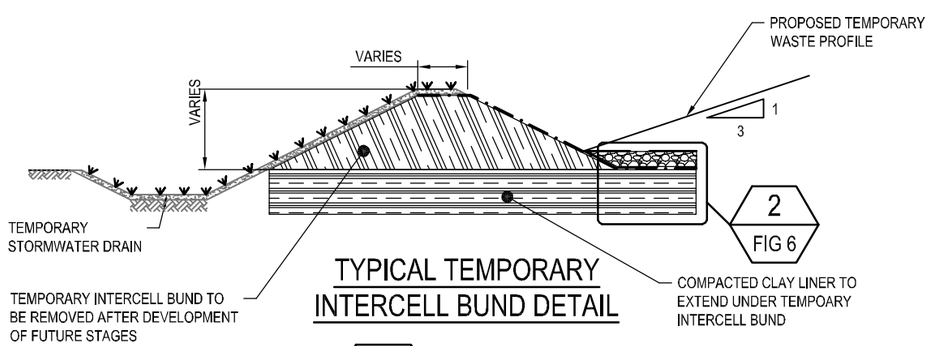
SCALE 1 : 50



TYPICAL PERIMETER BUND DETAIL

6 / FIG 3 — DETAIL

SCALE 1 : 200



TYPICAL TEMPORARY INTERCELL BUND DETAIL

7 / FIG 3 — DETAIL

SCALE 1 : 100

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE (A3)

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE (A3)

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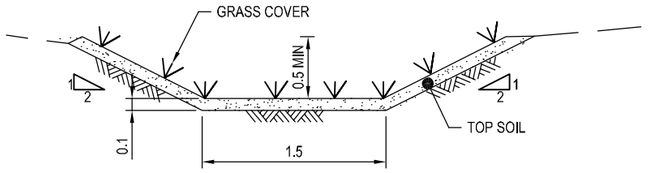
TWEED SHIRE COUNCIL
QUIRKS QUARRY CONCEPTUAL DESIGN

TYPICAL DETAILS

Job Number 41-20806
Revision B
Date OCT 2009

Figure 08

Plot Date: 21 October 2009 - 12:45 PM Plotted by: Nicola Hankin, Brisbane Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 08.dwg



TYPICAL CROSS STORMWATER DRAINS AT SLOPES <5%

8 / - DETAIL
SCALE 1 : 25

EXISTING GULLY

EXISTING STORMWATER DRAIN TO BE RETAINED

ACCESS TRACK

PROPOSED SEDIMENTATION BASIN TO BE INSTALLED DURING STAGE 1 DEVELOPMENT

TEMPORARY CLEAN STORMWATER DRAIN WHILE FILLING UP TO RL 15 IN STAGE 1

TEMPORARY CLEAN STORMWATER DRAIN WHILE LANDFILLING IN STAGE 1

TEMPORARY CLEAN STORMWATER DRAIN WHILE LANDFILLING IN STAGE 2

PUMP CLEAN STORMWATER TO TEMPORARY DRAIN WHEN FILLING IN STAGE 1A ONLY

8 / -

9 / -

ACCESS TRACK

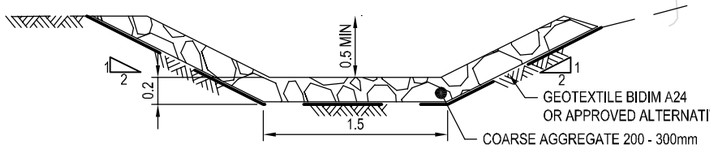
DISCHARGE TO NATURAL WATER COURSE

EXISTING STORMWATER DRAIN TO BE UTILISED AS REQUIRED

EXISTING DAM TO BE UTILISED DURING STAGE 1 DEVELOPMENT (IF POSSIBLE)

EXISTING SEDIMENTATION BASIN TO BE UTILISED AS REQUIRED

EXISTING ACCESS ROAD



TYPICAL CROSS STORMWATER DRAINS AT SLOPES >5%

9 / - DETAIL
SCALE 1 : 25

LEGEND

- TEMPORARY INTERCELL BUND
- 5 — PROPOSED WASTE CONTOURS
- PROPOSED TEMPORARY STORMWATER DRAINAGE
- SW — PROPOSED STORMWATER INFRASTRUCTURE
- EXISTING STORMWATER INFRASTRUCTURE
- 10 — EXISTING CONTOURS

NOTES:

1. SEDIMENTATION BASIN
   - SIZED TO CONTROL STORMWATER RUNOFF FOR STAGES 1 & 3
   - SIZED IN ACCORDANCE WITH MANAGING URBAN STORMWATER, LANDCOM.
   - CATCHMENT AREA : 5.7 Ha
   - ASSUMED POND CAPACITY AT SPILLWAY CREST: 0.9 ML
   - TOP AREA AT SPILLWAY CREST: 85m x 55m
   - DEPTH TO SPILLWAY CREST: 2.5 m
2. STORMWATER DRAINS
   - ALL DRAINS SIZED FOR 1 IN 20 YEAR STORM EVENT
   - CATCHMENT AREA: 2.8 Ha
   - ASSUMED MINIMUM GRADE: 0.5 %
   - ASSUMED CHANNEL CAPACITY: 1.4 m^3/s

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE (A3)

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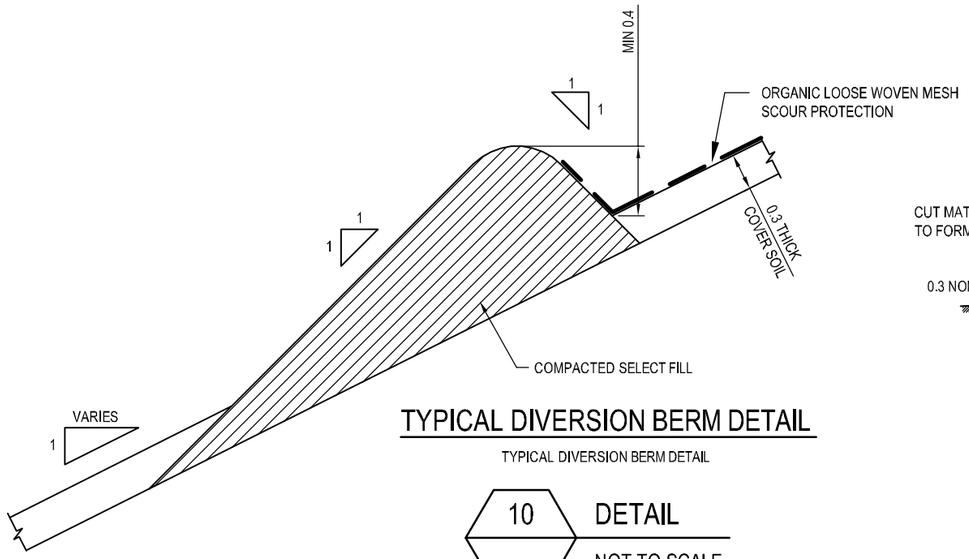
STORMWATER ARRANGEMENT AND DETAILS

Job Number 41-20806
Revision B
Date OCT 2009

Figure 09

Unit 2, 8 Neils St Hervey Bay QLD 4655 Australia **T** 61 7 4191 2000 **F** 61 7 4191 2099 **E** hvbmail@ghd.com.au **W** www.ghd.com.au

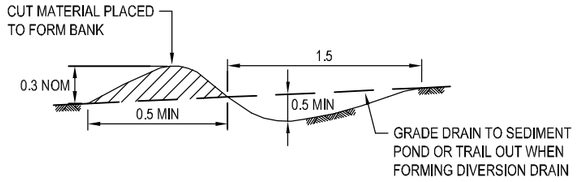
Plot Date: 21 October 2009 - 12:55 PM Plotted by: Nicola Hankin, Brisbane Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 09.dwg



TYPICAL DIVERSION BERM DETAIL

TYPICAL DIVERSION BERM DETAIL

10 DETAIL
- NOT TO SCALE



TYPICAL DIVERSION DRAIN DETAIL

NOT TO SCALE

11 DETAIL
- NOT TO SCALE

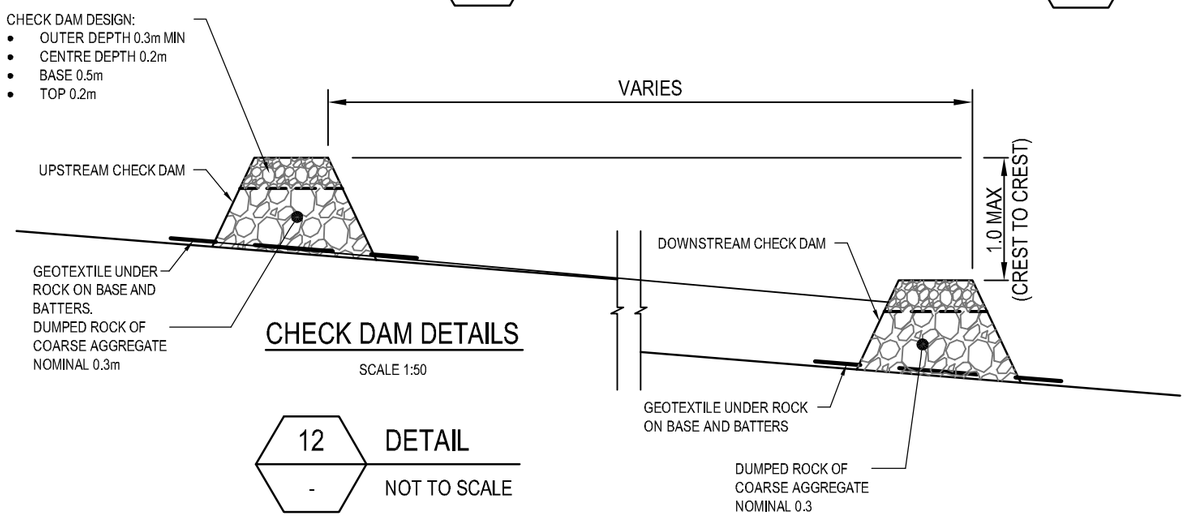
NOTES:

1. SEDIMENT AND EROSION
- 1.1 ALL EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE INSTALLED PRIOR TO SITE DISTURBANCE.
- 1.2 TOPSOIL FROM ALL AREAS THAT WILL BE DISTURBED TO BE STRIPPED AND STOCKPILED SEPERATE FROM ROCK AT NOMINATED LOCATIONS.
- 1.3 ALL EROSION AND SEDIMENT CONTROL STRUCTURES MUST BE INSPECTED AFTER EACH RAINFALL EVENT FOR STRUCTURAL DAMAGE AND ALL TRAPPED SEDIMENT TO BE REMOVED TO THE SOIL STOCKPILE LOCATIONS.
- 1.4 DISTURBED AREAS ARE TO BE REVEGETATED WITHIN 14 DAYS OF THE COMPLETION OF EARTHWORKS.
- 1.5 CHANNELS AND BERMS DESIGNED FOR 20 YEAR ARI EVENT.
- 1.6 LOCATE AND PROTECT ALL SERVICES PRIOR TO THE START OF CONSTRUCTION.

2. DIVERSION BERM CONSTRUCTION:
- 2.1 COMPACTED SELECT FILL SHALL BE KEYED INTO COVER SOILS.
- 2.2 DIVERSION BERM LONGDITUDINAL FLOWLINE SHALL BE MINIMUM 1%.
- 2.3 ORGANIC LOOSE WOVEN MESH TO BE INSTALLED AS PER MANUFACTURER'S GUIDELINES.

3. STOCKPILE CONSTRUCTION
- 3.1. LOCATE STOCKPILE AT LEAST 5m FROM EXISTING VEGETATION, CONCENTRATED WATER FLOWS, ROADS, HAZARD AREAS AND LANDFILL STAGE BATTERS.
- 3.2 CONSTRUCT ON THE CONTOUR AS A LOW, FAT, ELONGATED MOUND.
- 3.3 WHERE THERE IS SUFFICIENT AREA TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT

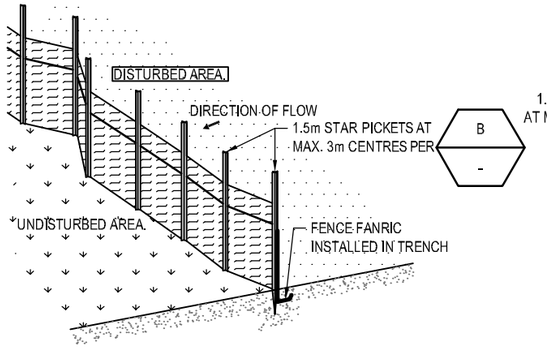
4.SILT FENCE CONSTRUCTION
- 4.1 CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE TO PARALLEL TO THE CONTOURS OF THE SITE.
- 4.2 DRIVE 1.5m LONG STAR PICKETS INTO GROUND 3m APART.
- 4.3 DIG A 0.15m DEEP TRENCH ALONG THE UPSIDE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
- 4.4 BACKFILL TRENCH OVER BASE OF FABRIC.
- 4.5 FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POST WITH WIRE TIES OR PER SILT FENCE AS PER MANUFACTURER'S GUIDELINES. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 0.15m OVERLAP.



CHECK DAM DETAILS

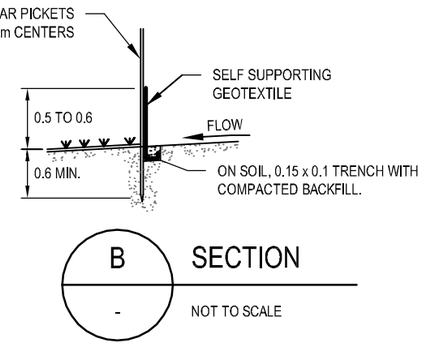
SCALE 1:50

12 DETAIL
- NOT TO SCALE



TYPICAL SILT FENCE

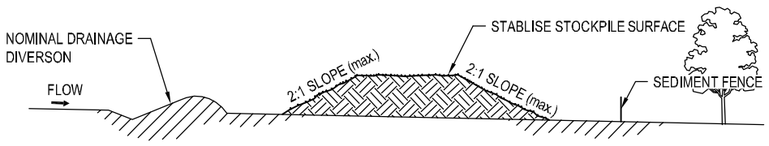
NOT TO SCALE



B SECTION
- NOT TO SCALE

TYPICAL SILT FENCE SECTION

NOT TO SCALE

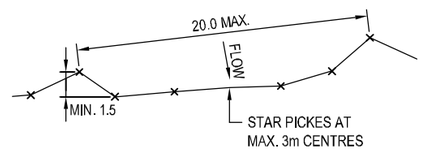


TYPICAL STOCKPILE SECTION DETAIL

NOT TO SCALE

13 DETAIL
- NOT TO SCALE

14 DETAIL
- NOT TO SCALE



SILT FENCE PLAN

NOT TO SCALE

0 0.5 1.0 1.5m
SCALE 1:50 AT ORIGINAL SIZE (A3)

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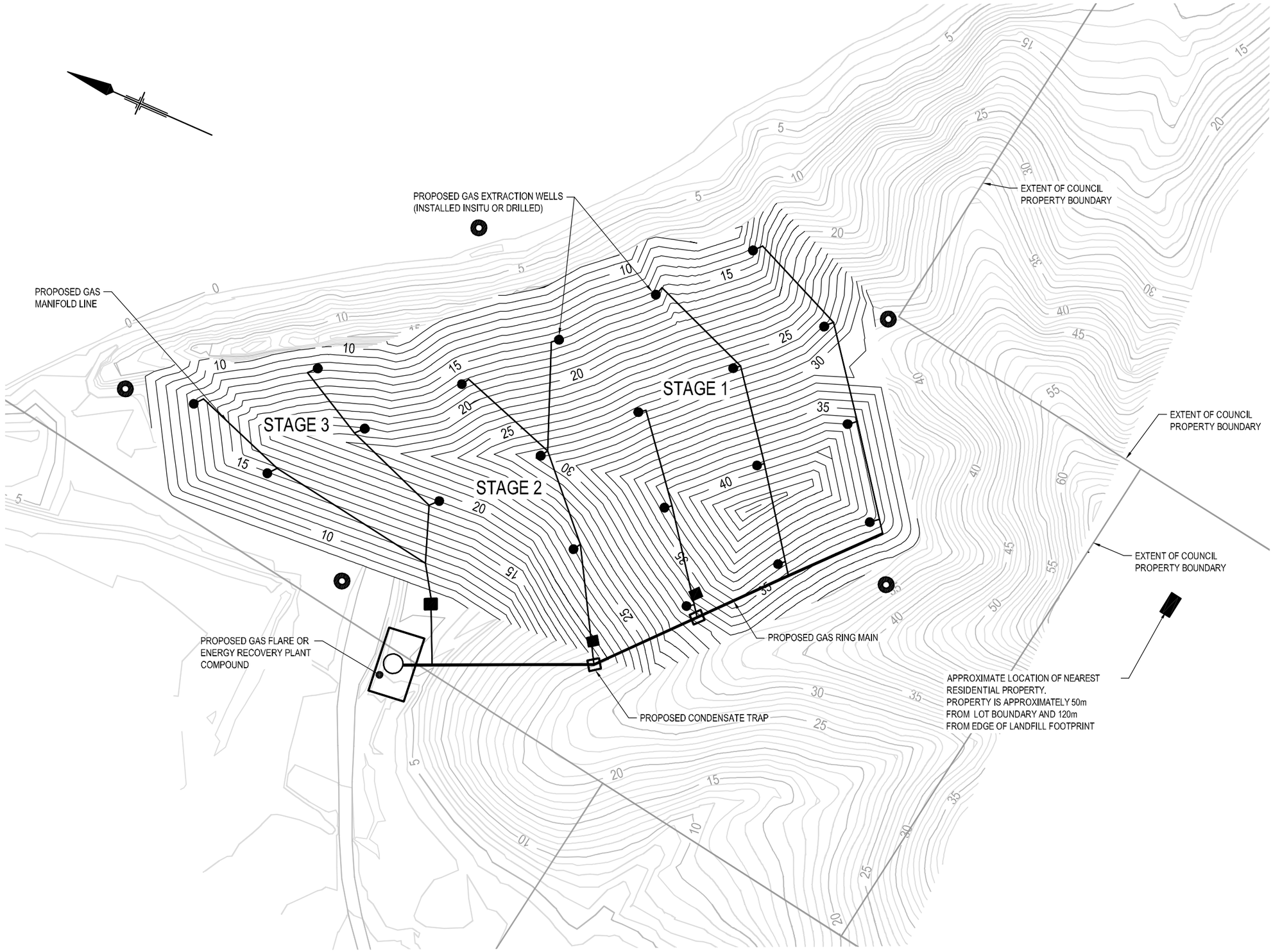
STORMWATER AND SEDIMENT CONTROL DETAILS

Job Number 41-20806
Revision B
Date OCT 2009
Figure 10

Plot Date: 16 October 2009 - 2:16 AM Plotted by: Nicola Hankin, Brisbane Cad File No: G:\41\20806\CADD\Drawings\41-20806-FIG 10.dwg



NOTES:

1. LOCATION OF GAS EXTRACTION INFRASTRUCTURE IS INDICATIVE ONLY AND MUST NOT BE USED FOR CONSTRUCTION WORKS.
2. ASSESSMENT OF GAS PRODUCTION AND GAS INFRASTRUCTURE TO BE CARRIED OUT BY AN EXPERIENCED LANDFILL GAS CONTRACTOR / ENGINEER.
3. GAS INFRASTRUCTURE WILL BE PROGRESSIVELY INSTALLED DURING THE DEVELOPMENT OF EACH STAGE AND IN ACCORDANCE WITH LICENSE CONDITIONS.
4. GAS EXTRACTION WELLS MAY BE INSTALLED AT 50m CENTRES, OR AS STIPULATED FOLLOWING A LANDFILL GAS ASSESSMENT.

LEGEND

- 20 — PROPOSED WASTE CONTOURS
- ASSUMED EXTENT OF COUNCIL PROPERTY BOUNDARY
- PROPOSED GAS MONITORING WELL LOCATIONS
- PROPOSED GAS EXTRACTION WELL LOCATIONS
- PROPOSED GAS RING MAIN
- PROPOSED GAS MANIFOLD LINES FOR EACH STAGE
- PROPOSED GAS FLARE OR ENERGY RECOVERY PLANT COMPOUND
- PROPOSED CONDENSATE TRAP

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE (A3)

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TYPICAL GAS EXTRACTION INFRASTRUCTURE

Job Number 41-20806
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Date OCT 2009

Figure 11

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Appendix B

Environment Protection Licence

Environment Protection Licence (insert licence number when granted)

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
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