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Report on
Effluent Disposal Assessment

Proposed Train Support Facility
Woodlands Close, Hexham

Prepared for QR National

Project 39798.07
November 2012

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	39798.07	Document No.	1
Document title	Report on Effluent Disposal Assessment, Proposed Train Support Facility		
Site address	Woodlands Close, Hexham		
Report prepared for	QR National		
File name	P:\39798.07\Docs\39798.07 - [Rev 7] - FINAL - 121112.doc		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
0	Catherine Karpiel	Stephen Jones	12 June 2008
1 (Draft)	Matthew Blackert	John Harvey	28 July 2011
2 (Final)	Matthew Blackert	John Harvey	22 August 2011
3 (Draft)	Matthew Blackert	Chris Bozinovski	14 May 2012
4 (Final)	Matthew Blackert	Chris Bozinovski	31 May 2012
5 (Final)	Matthew Blackert	Chris Bozinovski	27 September 2012
6 (Final)	Matthew Blackert	Chris Bozinovski	11 October 2012
7 (Final)	Matthew Blackert	Chris Bozinovski	12 November 2012

Distribution of copies

Revision	Electronic	Paper	Issued to
0	1	3	Phil Drew, QR National
1 (Draft)	1	0	John Meggitt, ADW Johnson Pty Ltd
2 (Final)	1	3	John Meggitt, ADW Johnson Pty Ltd
3 (Draft)	1	0	John Meggitt, ADW Johnson Pty Ltd
4 (Final)	1	0	John Meggitt, ADW Johnson Pty Ltd
5 (Draft)	1	0	Chris Pusleduik, Engenicom
6 (Final)	1	0	Chris Pusleduik, Engenicom
7 (Final)	1	0	Chris Pusleduik, Engenicom

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	M Blackert	12 November 2012
Reviewer	C. Bozinovski	12 November 2012

NCS INTERNATIONAL CERTIFIED QUALITY MANAGEMENT SYSTEM

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
15 Callistemon Close
Warabrook NSW 2304
PO Box 324
Hunter Region MC NSW 2310
Phone (02) 4960 9600
Fax (02) 4960 9601

Executive Summary

An effluent disposal assessment has been carried out at the proposed Train Support Facility (TSF) site, Woodlands Close, Hexham. The assessment was undertaken at the request of QR National.

The proposed effluent irrigation area comprised predominantly open grass land, with two shallow drainage channels/intermittent waterways which drain in an approximately east to west orientation. A concrete hardstand and concrete footings, associated with the former coal preparation plant, were located in the central portion of the site.

The proposed effluent disposal site has a number of limitations, including the following:

- Site adjacent to flood prone land;
- Site has localised embankment slopes greater than 20%;
- Moderate to high potential for run-on and seepage of Brancourts (formerly operated by Dairy Farmers) effluent irrigation in the northern portion of the proposed irrigation area;
- Presence of intermittent waterways, with ponded surface water.

These limitations can be appropriately mitigated through site improvements and design of the disposal area as indicated below.

Subsurface conditions comprised fill material comprising combinations of silty gravel, silty sandy gravel, clayey sandy gravel predominantly comprising coal reject. The minimum disposal areas were calculated using the hydraulic capability of the land to accept effluent and the ability of the land to accept nutrients.

The minimum irrigation area for the initial build up average dry weather flow (ADWF) is 13,600 m^2, while the ultimate ADWF is 39,300 m^2. The hydraulic balance using a conservative design irrigation rate of 14 mm / week was the limiting factor. Accordingly, the ultimate irrigation area (39,300 m^2) is considered suitable for the proposed disposal area, subject to a number of site improvements, including:

- Removal of the concrete hardstand and footings in the central portion of the site, or placement of 0.5 m of suitable clay loam fill material over the concrete;
- Addition of lime to acidic soils to maintain plant growth;
- Addition of gypsum to improve the soil structure and reduce dispersion/erosion;
- Earthworks to recontour and fill drainage channels and redirect surface water flow around the proposed effluent irrigation area (to meet recommended buffer distances);
- Where required, placement of suitable fill material or earthworks to raise site levels to at least 1 m above the permanent groundwater table and/or at least 0.6 m between the highest seasonal water table level and the base of the land application system (whichever is greater);
- Importation and placement of a suitable clay loam fill to form the surface of the irrigation area to improve soil properties and minimise potential for groundwater pollution;
- Installation of catch drains/ bunds upslope and downslope of disposal area to prevent rainfall run-on and run-off.

While the above recommendations should minimise the potential for surface water or groundwater pollution from the proposed irrigated treated effluent, preliminary sampling and analysis of surface waters and groundwater in the vicinity of the site (Ref 3) has identified elevated heavy metals, nutrients and faecal coliforms.

Given the existing surface water and groundwater impacts within the proposed Hexham Train Support Facility (TSF) site, it is recommended that additional targeted sampling of surface waters and groundwater is undertaken up-gradient, within and down-gradient of the proposed effluent irrigation area prior to development to confirm baseline surface water and groundwater quality. Groundwater wells should be located to allow for monitoring of groundwater up-gradient, within and down-gradient during operation of the effluent disposal area.

Subsurface conditions should be confirmed over the extended irrigation area prior to construction, including the southern portion following demobilisation of the storage compound by Diona, in order to confirm site conditions and possible impacts (if any) to the above design.

It is noted that the proposed effluent disposal system and disposal area for the proposed TSF is independent of the existing effluent irrigation conducted by Brancourts to the north.

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1. Introduction

This report presents the findings of an effluent disposal assessment for the proposed train support facility (TSF) off Woodlands Close, Hexham, New South Wales. The investigation was undertaken at the request of QR National and in consultation with ADW Johnson Pty Ltd.

This report supersedes the previous reports on Effluent Disposal Assessment, Proposed Hexham Redevelopment, Maitland Road and Woodlands Close, Hexham, New South Wales, dated 12 June 2008 and 22 August 2011. It has been updated with reference to the current proposed development and current guidelines/standards where applicable.

The purpose of the assessment was to provide the following:

- Subsurface conditions in the proposed effluent disposal area;
- On-site effluent disposal assessment with reference to AS/NZS 1547-2012;
- Comments on the suitability of the proposed effluent disposal area for on-site disposal of effluent;
- Estimates of minimum areas required for effluent disposal;
- Recommendations on disposal options.

The effluent disposal assessment was undertaken with reference to the current Environment and Health Protection Guidelines: "On-site Sewage Management for Single Household", (Ref 1) and AS/NZS 1547:2012 "On-site domestic-wastewater management" (Ref 2).

The effluent assessment was undertaken in two stages. Stage 1 comprised a preliminary assessment of the south-western portion of the site to assess site constraints and estimate minimum areas required for effluent disposal. Stage 2 was undertaken following preliminary design of the proposed effluent disposal area and comprised additional field work and laboratory testing to assess subsurface conditions and the suitability of the proposed primary and secondary effluent disposal area nominated by WorleyParsons Services Pty Ltd (WorleyParsons).

For the purpose of this investigation, the client/ADW Johnson Pty Ltd (ADW) supplied the following plans:

- An updated layout plan titled SKETCH 120829 Site Masterplan – Final dated 30 August 2012;
- A topographic plan of the site (untitled drawing dated May 2008);
- Engenicom updated effluent disposal layout plan titled "Water Recycling and Wastewater treatment System - General Arrangement", Reference ENG-03891-015 Issue E dated 6 September 2012, which nominates the final proposed effluent disposal area.

In 2008, WorleyParsons also supplied likely 'domestic' sewage and wagon wash down water flow rates and effluent quality the Train Support Facility (TSF) development. The flow rates were confirmed in May 2012 by WorleyParsons (Ref 3) to coincide with the updated TSF development.

The assessment was undertaken in conjunction with a Preliminary Contamination Assessment (Ref 4).

2. Site Information

The site containing the proposed TSF is bounded to the east by the Great Northern Railway which runs approximately north-south parallel to the New England Highway and the Hunter River which is situated further to the east. The north-eastern boundary is bounded by Woodlands Close, and the New England Highway bounds the northern boundary. The Hunter Water Corporation's Chichester pipeline generally runs along the western boundary. Low-lying agricultural and rural /residential properties are located along the northern portion of the western boundary, and a low-lying swamp (Hexham Swamp Nature Reserve) is located along the southern portion of the western boundary. The southern boundary is bounded by privately owned rural residential property. The TSF is located adjacent to the Great Northern Railway. The proposed TSF arrangement is shown on WorleyParsons Figure 2 in Appendix C.

The site boundary and proposed effluent disposal area (i.e. investigation area) as indicated by WorleyParsons is shown on Drawing 1, Appendix C.

Site-specific information relevant to the assessment is outlined in Table 1 below:

Table 1: Site Information

Address:	Woodlands Close, Hexham
Client:	QR National
Site Area:	Approximately 255 ha – Only part site to be used for effluent disposal
Intended Water Supply Type:	Reticulated
Special Considerations:	Former Coal Preparation Plant – coal reject disposal area.

3. Site Features

Site features in the south-eastern portion of the site (ie proposed effluent disposal area) are listed in Table 2 below and have been compared to the requirements of Ref 1 in terms of possible limitations to effluent disposal. Other pertinent site features observed during the site inspection on 30 June 2008 are described below.

Table 2: Proposed Effluent Irrigation Area Site Features

Site Feature (Proposed Irrigation Area)	Rating	Limitation[1]
Flood Potential	The site is located adjacent to flood prone land	Moderate
Exposure	Moderate to High sun and wind exposure	Minor
Slope	Generally gentle slopes (approximately 1% to 4%). Drainage channel embankments have slopes greater than 20%.	Minor to Major
Landform	Fill emplacement area ranging between RL 2.2 and 4.8 AHD with excavated drainage channels and remnants of former infrastructure	Major
Run-on and Upslope Seepage	Moderate to high potential for run-on and up slope seepage in northern portion of proposed disposal area	Moderate to Major
Erosion Potential	No obvious signs of erosion present	Minor
Site Drainage	The filled emplacement area is generally well drained, with sporadic localised depressions, possibly susceptible to surface water ponding. Ponded surface water was present within drainage channels and evidence of ponded surface water observed in localised depressions	Moderate
Fill	Fill was observed in the vicinity of the area to depths greater than 3.0 m (Ref 3)	Moderate
Depth to Bedrock	Not encountered in current investigation. Data from previous investigations nearby indicate rock is about 25 m below ground level	Minor
Rock Outcrops	None observed	Minor
Buffer Distances	A 40 m buffer distance is required from intermittent waterways and drainage channels, which are present within the proposed effluent disposal area	Moderate to Major
Land Availability	Approximately 3 ha was designated initially for the disposal area. Additional area is available to the west of this area if required.	Minor
Geology / Regolith	Filling over Quaternary Alluvium which typically comprises unconsolidated sediments deposited in a fluvial or estuarine environment and includes gravel, sand, silt and clay	Minor

Notes to Table 2:

1. Limitation as defined by the NSW Government Environment and Health Protection Guidelines (Ref 1)

It is noted that the proposed effluent disposal system and area for the TSF will be independent of existing effluent treatment and irrigation conducted by Brancourts to the north.

At the time of the assessment in 2008, the proposed effluent irrigation area comprised predominantly open grass land, with two shallow drainage channels/intermittent waterways which drain in an approximately west to east orientation. A concrete hardstand and concrete footings are located in the central portion of the site and are associated with the former coal preparation plant. The concrete hardstand and associated footings occupy an area of about 2500 m^2 within the proposed effluent disposal area. Figure 1 below shows the open grass land in the southern portion of the site looking north towards a drainage channel and the concrete hardstand in the background.

Figure 1: View to the north of the grassed area sloping toward the drainage channel in southern portion of the site, with the concrete hardstand in background (June 2008)

The ground surface generally falls toward the drainage channels, with slopes typically ranging between 1% and 4%. Localised steeper slopes are present within drainage batters, with slopes up to 37% observed on the batter of the northern drainage channel. The ground surface in the northern portion of the proposed effluent disposal area falls to the east toward a small dam.

Site observations indicate that overland surface water within the southern and central portion of the proposed effluent irrigation area would predominantly flow toward the two drainage channels. Localised surface depressions were observed in the southern and central portion of the site (Figure 2). Site observations indicate that overland surface water ponds in the depressions following rainfall.

It is noted that additional site inspection was conducted in April 2011 and found that a temporary storage compound, set up by Diona Pty Ltd to facilitate the construction of the new Hunter Water Corporation trunk main, had been established in the southern portion of the proposed primary and secondary effluent disposal area, Lot 311 DP 583724 (Ref 3). The compound's footprint occupies approximately 0.65 ha of the proposed effluent disposal area. Further investigation will be required, following the closure of the temporary compound, to determine possible contaminant impacts, as outlined in Ref 3, from the recent site activities and any implications on this assessment.

Figure 2: Localised surface depression in southern portion of the site (looking east June 2008)

The drainage channels fall to the west of the proposed effluent irrigation area. It is noted that no off-site drainage routes (ie culverts, overflow channels) were observed for the drainage channels. Figure 3 below shows the northern drainage channel, partially filled with surface water and vegetated with reeds and algae at the water surface.

Figure 3: Northern drainage channel (looking west June 2008)

The northern portion of the site is located downslope of the Dairy Farmers' effluent irrigation area. The site observations indicate this area of the proposed effluent disposal area is susceptible to run-on and seepage. Observations also indicate surface water would drain in an easterly direction towards either the small dam or drain to the east of the proposed effluent irrigation area. Figure 4 below shows the shallow dam in the northern portion of the site, which was observed to be vegetated with grass and contain shallow ponded water at the time of field work.

Figure 4: Shallow dam in northern portion of site (June 2008)

Vegetation in the southern and central portion of the site was observed to be sparse, with sporadic areas of exposed soil/fill (Figure 5). The exposed fill predominantly comprises coal reject material. A salt scald was observed in the central portion of the site (Figure 6), to the north of an elongated fill stockpile adjacent to the drainage channel (Figure 7). Site observations indicate that the stockpile may have been sourced from excavation of the adjacent drainage channel.

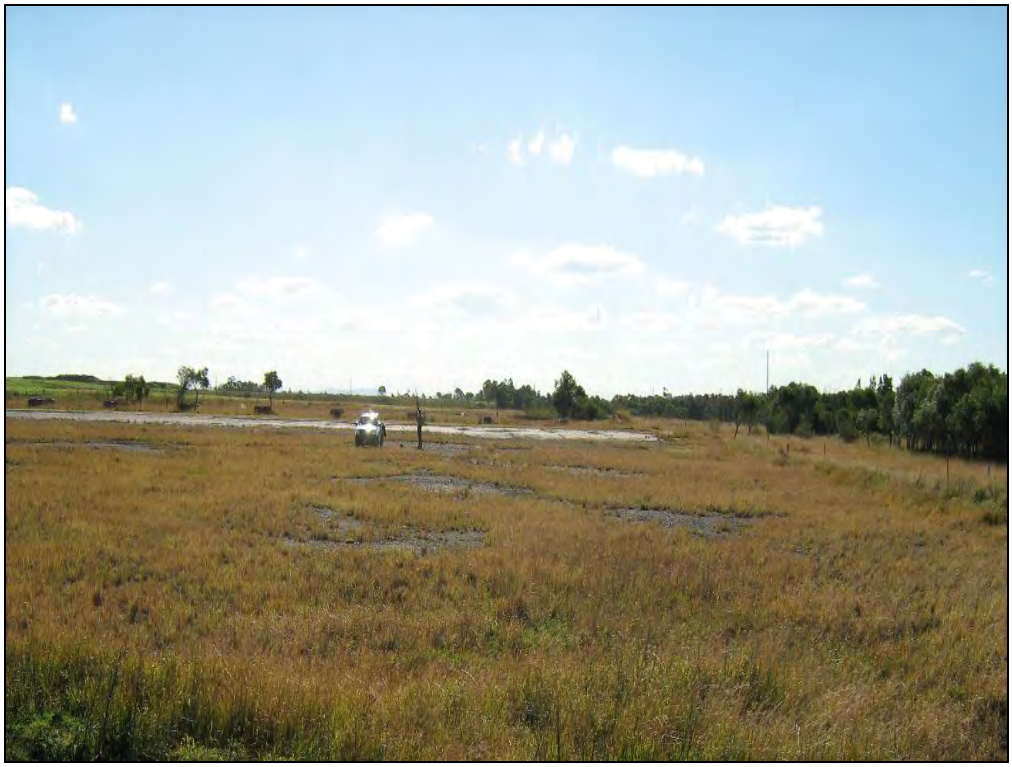

Figure 5: Central portion of site looking north across open grassland with sporadic areas of exposed soil/fill (June 2008)

Figure 6: Salt scald in central portion of site (June 2008)

Figure 7: Elongated fill stockpile to the north of the southern drainage channel (looking west June 2008)

Refer to Drawing 1 in Appendix C for the site features and locations of photos.

4. Subsurface Conditions

Field work and subsequent laboratory testing was undertaken to assess the suitability of the proposed effluent disposal area for effluent disposal. A summary of the field work test methods and results is shown below in Table 3.

Table 3: Field Work

Stage 1 - Preliminary Effluent Disposal Assessment	
Date Sampled	3 and 4 April 2008
Test Method	Test Pits (backhoe)
Number of Test Pits [1]	Pits to provide information on general site condition (Pits 122, 123, 125, 126, 137, 161)
Depth of Investigation	0.25 m to >3.3 m
Summary of Subsurface Conditions [2]	Filling to depths of 1.35 m to >3.0 m and generally comprising combinations of silt/sand/gravel overlying clayey sandy gravel, predominantly coal reject. Natural silty clay and clayey silt was identified underlying filling in Pits 122 and 125 from depths of 1.35 m and 2.0 m respectively. (Note: Pits 126, 137 and 161 were discontinued due to refusal in fill)
Groundwater Observations	Free groundwater was observed at depths of 0.8 m to 2.95 m below the surface during field work, with the deepest level encountered in Pit 123 due to the higher elevation. (ie approximately RL 1.25 AHD to 2.05 AHD)
Stage 2 – Supplementary Assessment	
Date Sampled	30 July 2008
Test Method	Test Pits (hand tools)
Number of Test Pits [1]	Six pits located in the proposed effluent disposal area (Pits 170, 170A, 171 to 174).
Depth of Investigation	0.2 m to 0.65 m
Summary of Subsurface Conditions [2]	Fill material generally comprising combinations of clayey silty gravel, silty sandy gravel, clayey sandy gravel, predominantly coal reject. Fill material comprising clayey sandy gravel (road base) was encountered in Pit 172 from the surface to termination at 0.2 m (refusal in fill). The fill materials were encountered to refusal depths ranging from 0.2 m to 0.65 m.
Groundwater Observations	No free groundwater was observed during field work.

Notes to Table 3:

1 Refer to Drawing 1 Appendix C attached for approximate Pit/Bore locations. Pits for Stage 1 were surveyed by Monteath and Powys Pty Ltd, while pits for Stage 2 were located using a hand-held GPS. GMA co-ordinate system used.

2 Detailed Test Pit Logs are attached and should be read in conjunction with the general notes preceding them.

Laboratory testing was performed by Sydney Environmental and Soil Laboratory Pty Ltd and comprised measurement of various soil parameters from samples considered representative of the predominant / controlling soil types within the proposed effluent disposal area as suggested by the NSW Government Guidelines (Ref 1).

Laboratory test results are shown in Table 4 below. Possible limitations for effluent application are indicated where compared to the recommended guideline values (Ref 1).

Table 4: Laboratory Test Results

	Stage 1 - Preliminary Effluent Disposal Assessment				Stage 2 – Supplementary Assessment		
Test Location	**Pit 122**	**Pit 122**	**Pit 125**	**Pit 126**	**Pit 170**	**Pit 172**	**Pit 174**
Depth (m)	0.5	1.5	1.0	0.5	0.2-0.3	0-0.2	0.4-0.5
Description	Sandy clayey gravel filling (coal reject)	Clayey Silt	Clayey sandy gravel filling (coal reject)	Clayey sandy gravel filling (coal reject)	Silty sandy gravel filling (coal reject)	Clayey sandy gravel filling (road base)	Clayey sandy gravel filling(coal reject)
Bulk Density (kg/L)	1.2	1.58[1]	1.0	1.41[1]	0.7	1.7	0.9
pH in Water	9.6	6.9	8.3	4.2	6.6	4.0	4.1
pH in CaCl	8.0	6.3	6.9	4.2	6.3	3.9	3.8
ESP (%)	55.2	43.2	29.7	3.3	28.3	2.7	16.9
CEC (Cmol/kg)	22.1	46.3	16.5	25.4	22.3	**12.7**	18.6
EC_e (dS/m)	3.1	10	2.7	30	15.13	15.3	12.58
Phosphorus Sorption (kg/ha)	**3650**	60000	**2400**	28500	**5600**	21500	12000
Modified Emerson Class[1]	5	5	5	5	5	**2**	5

Notes to Table 4:

ECe Electrical Conductivity (Laboratory results EC (1soil:5 water) converted to ECe using soil correction factor (Ref 3))

CEC Cation Exchange Capacity

ESP Exchangeable Sodium Percentage

1 Field Density

Bold results indicate a moderate limitation as defined by Ref 1

Shaded results indicate a major limitation as defined by Ref 1

See Section 5.2 for comments

5. Comments

5.1 Disposal Area Requirements

Estimated land areas required for irrigation systems have been provided based on typical effluent quality as published in Ref 1 and as provided by WorleyParsons. Due to the shallow groundwater table and controlling soil type (ie gravel-based coal reject) a trench / evapotranspiration type disposal system is not recommended as per AS/NZS1547-2012. Based on Ref 1, septic systems are not appropriate for irrigation disposal due to the highly infectious nature of the effluent and have therefore not been included in the design calculations.

Minimum disposal areas have been calculated by taking account of both the hydraulic capability of the land to accept effluent and the ability of the land to accept nutrients. The main parameters used in these calculations are outlined in Table 5 below:

Table 5: Model Parameters

Parameter	Model Inputs
Nitrogen loading (mg/L) [1]	10, 15 and 37
Phosphorus loading (mg/L) [1]	5 -10
Rainfall data [2]	Williamtown[4]
Evaporation data	Williamtown[4]
DIR (mm/week)	14 – 24.5
DLR (mm/day)	N/A[5]
Design Period (yrs) [3]	50

Notes to Table 5:

DIR Design Irrigation Rate in accordance with AS/NZS 1547-2012 (Ref 2) taking into account the prevailing slope at the site

DLR Design Loading Rate (ETA systems) in accordance with AS/NZS 1547-2012 (Ref 2)

1 Typical nutrient loading rates as published in Ref 1

2 Median (50th percentile or 5 Decile) monthly rainfall supplied by the Bureau of Meteorology

3 In accordance with Ref 1

4 Nearest available weather station with appropriate data

5 No loading rate is given as disposal of effluent using an ETA system is not recommended given the soil type and shallow water table

The estimated irrigation flows for the domestic sewage flow as provided by WorleyParsons (Ref 3) are presented in Table 6 below. In addition to these, irrigation flows associated with the wagon wash down facility are estimated to be 125 L/day building up to 250 L/day (ie 0.001 L/s to 0.003 L/s).

Table 6: Estimate Domestic Sewage Flow

Stage	ADWF (L/day)	PWWF (L/day)
1. Initial Build Up	4320	43,200
2. Ultimate	12960	129,600

Notes to Table 6:
ADWF average dry weather flow
PWWF peak wet weather flow

The ADWF has been used to calculate the required irrigation area. It is understood that mitigation measures including wet weather storage and a secondary disposal area are proposed to manage peak wet weather flow (PWWF). The maximum irrigation flow associated with the wagon wash down facility of 250 L/day (0.003 L/s) has been added to the ADWF to calculate the required irrigation area.

The minimum plan areas for disposal of the domestic sewage flow and the wagon wash down water flow are provided in Table 7 below.

Table 7: Minimum Plan Area (m^2) Required for Domestic Sewage Irrigation Disposal

Daily Effluent Load (L/day)	Soil Type	Phosphorus Concentrations	Nitrogen Concentrations	Nitrogen Balance Area (m^2)	Phosphorus Balance Area (m^2)	Hydraulic Balance Area (m^2)*	Hydraulic Balance Area (m^2)**
Initial Build Up - ADWF (4320 L/day) and Wagon Wash Down Water (250 L/day)							
4570	Coal Reject (Fair PSC)	5 mg/L	10 mg/L	1693	1650	13600	2490
	Coal Reject (Good PSC)				925		
	Coal Reject (Very Good)				643		
4570	Coal Reject (Fair PSC)	10 mg/L	10 mg/L	1693	3300		
	Coal Reject (Good PSC)				1850		
	Coal Reject (Very Good)				1286		
4570	Coal Reject (Fair PSC)	5 mg/L	15 mg/L	2539	1650		
	Coal Reject (Good PSC)				925		
	Coal Reject (Very Good)				643		
4570	Coal Reject (Fair PSC)	10 mg/L	15 mg/L	2539	3300		
	Coal Reject (Good PSC)				1850		
	Coal Reject (Very Good)				1286		
4570	Coal Reject (Fair PSC)	5 mg/L	37 mg/L	6263	1650		
	Coal Reject (Good PSC)				925		
	Coal Reject (Very Good)				643		
4570	Coal Reject (Fair PSC)	10 mg/L	37 mg/L	6263	3300		
	Coal Reject (Good PSC)				1850		
	Coal Reject (Very Good)				1286		

Table 7: Minimum Plan Area (m^2) Required for Domestic Sewage Irrigation Disposal (continued)

Daily Effluent Load (L/day)	Soil Type	Phosphorus Concentrations	Nitrogen Concentrations	Nitrogen Balance Area (m^2)	Phosphorus Balance Area (m^2)	Hydraulic Balance Area (m^2)*	Hydraulic Balance Area (m^2)**
Ultimate - ADWF (12960 L/day) and Wagon Wash Down Water (250 L/day)							
13210	Coal Reject (Fair PSC)	5 mg/L	10 mg/L	4893	4769	39300	7200
	Coal Reject (Good PSC)				2674		
	Coal Reject (Very Good)				1858		
13210	Coal Reject (Fair PSC)	10 mg/L	10 mg/L	4893	9538		
	Coal Reject (Good PSC)				5348		
	Coal Reject (Very Good)				3716		
13210	Coal Reject (Fair PSC)	5 mg/L	15 mg/L	7339	4769		
	Coal Reject (Good PSC)				2674		
	Coal Reject (Very Good)				1858		
13210	Coal Reject (Fair PSC)	10 mg/L	15 mg/L	7339	9538		
	Coal Reject (Good PSC)				5348		
	Coal Reject (Very Good)				3716		
13210	Coal Reject (Fair PSC)	5 mg/L	37 mg/L	18103	4769		
	Coal Reject (Good PSC)				2674		
	Coal Reject (Very Good)				1858		
13210	Coal Reject (Fair PSC)	10 mg/L	37 mg/L	18103	9538		
	Coal Reject (Good PSC)				5348		
	Coal Reject (Very Good)				3716		
	Coal Reject (Good PSC)				8847		
	Coal Reject (Very Good)				6147		

Notes to Table 7:

PSC - Phosphorus Sorption Capacity

Fair - Approximately 6000 mg/kg

Good - Approximately 12000 mg/kg

Very Good - Approximately 18000 mg/kg

*DIR - Design Irrigation Rate (14 mm/week - Conservative)

**DIR - Design Irrigation Rate (24.5 mm/week)

Limiting Factor (ie Minimum Disposal Area)*

Limiting Factor (ie Minimum Disposal Area)** - Hydraulic balance limiting factor where not highlighted

The minimum irrigation disposal area for the initial build up ADWF rate (i.e. 4570 L/day) is 13,600m^2, while the ultimate disposal area for the ultimate ADWF rate (13210L/day) is 39,300 m^2. The hydraulic balance using a conservative design irrigation rate of 14 mm/week is the limiting factor for the minimum disposal area for both design stages. It is noted, however, that elevated nitrogen concentrations of 37 mg/L requires minimum disposal areas of approximately half the hydraulic balance area, considering the conservative design irrigation rate. Thus, a less conservative hydraulic balance area (ie using a design irrigation rate of 24.5 mm/week) would only be achieved with low nitrogen concentrations and a well-drained soil.

During periods of rainfall (ie PWWF), the nutrient levels in the effluent would be diluted, increasing the importance of the hydraulic capability of the soil. It is understood a secondary disposal area, approximately half the primary disposal area is proposed for heavy rainfall periods. The secondary disposal area, along with wet weather buffer storage will assist in managing irrigation during heavy rainfall events and to spell the primary disposal area. Typically, a reserve effluent disposal area equal to 100% of the design area is nominated during the assessment to allow for resting of the effluent disposal area and/or future expansion. AS 1547 – 2012 (Ref 2) states that the "100% requirement is normally applied to septic tank units followed by a conventional trench land application system". Given the treatment systems proposed (i.e. AWTS and AWTS with nutrient removal) the reserve area could be decreased subject to regulatory approval. A 50% reserve area is considered reasonable given the treatment and application system proposed.

On this basis, the recommended minimum irrigation disposal area for the treated water is 39,300 m^2, subject to the above-mentioned mitigation measures for prolonged wet weather and provided the limitations as discussed in Section 5.2 are addressed.

5.2 Site Improvements

The following site improvements are recommended to mitigate the limitations as previously mentioned.

Soil pH

Laboratory testing by DP has indicated variable soil conditions ranging from alkaline to highly acidic within the samples analysed. The samples tested within the proposed effluent irrigation area were slightly to highly acidic.

The vegetation within the proposed effluent irrigation area appeared to have moderate to relatively good growth. Agricultural lime could be added to acidic soils to maintain plant growth and reduce the limitations by the low pH and CEC. Blending acidic and alkaline fill materials could also be considered.

Erosivity / Sodicity

Highly sodic soil conditions were found within the majority of samples analysed. The soil within the disposal area should be treated with an appropriate application of gypsum (see attached laboratory report sheets for recommended application rates). Adding gypsum to the soil increases the salinity of the soil moisture without increasing the sodium level, thereby reducing the Sodium Adsorption Ratio (SAR). This will improve the soil structure and reduce the potential for dispersion and erosion.

Soil Nutrient Capabilities

The fill materials on site were found to have highly variable Phosphorous Sorption Capacities (PSC) ranging from low to good in the Stage 1 and Stage 2 laboratory testing. Variable PSC within fill materials within the proposed effluent irrigation area has the potential to restrict nutrient uptake / immobilisation. To improve this, a clay-based filling could be imported to increase PSC levels (and Cation Exchange Capacity - CEC) within the proposed irrigation area. A reduction in the disposal area requirements could be achieved as a result (subject to other limiting factors). Additional advice should be sought from this office if this is proposed.

Run-on / Run-off

Installation of catch drains / bunds upslope and downslope of the disposal area is recommended to prevent rainfall run-on and effluent run-off.

Site Drainage

The proposed disposal area is generally well drained with the exception of localised low-lying areas susceptible to ponding surface water. In addition, two drainage channels with ponded surface water are located within the site. This represents a potential surface water/groundwater pollution hazard given the observed ponded surface water within drains and the shallow groundwater table (RL 2.05 AHD in Pit 123).

Mitigation measures to minimise the risk of surface water/groundwater pollution should include:

- Provision of suitable buffer distances from drainage channels. This will require the filling of drainage channels in the vicinity of the proposed irrigation area (see Section 5.3);
- construction of a site drainage system designed to minimise surface water ponding, with a collection system for re-application of sewage on the disposal area;
- Construction of the irrigation disposal area in an elevated area where the permanent groundwater table is more than 1.0 m below the ground surface and/or at least 0.6 m between the highest seasonal water table level and the base of the land application system (whichever is greater);
- Importation of fill or earthworks to help achieve suitable surface levels (if required);
- Provision of adequate wet weather storage and a secondary disposal area;
- Monitoring of the irrigation area during wet weather to prevent ponding/runoff of treated effluent. This could include installation of soil moisture probes within the irrigation area to monitor soil moisture and allow management of the irrigation system (ie only irrigate when soils are not saturated).

Flood Potential

In accordance with Ref 1, all components of the effluent disposal system including electrical components, vents and inspection openings of wastewater treatment devices should be located above the 1 in 100 year probability flood contour. The 1 in 20 year probability flood contour may be used as a limit for land application areas.

The 1 in 100 year probability flood contour for the site is about RL 3.7 m AHD, while the 1 in 20 year probability flood contour is about RL 1.2 AHD (data provided by WBM).

The proposed effluent irrigation area generally ranges in elevation between about RL 2.2 and 4.8 AHD which is above the 1 in 20 year flood level. It is likely that earthworks to re-contour the disposal area will be required during construction of the irrigation area.

Fill

Fill materials were identified within the proposed disposal area to depths of more than 3 m. Fill materials can have highly variable permeability, can be prone to settlement, may increase the potential for groundwater pollution and may restrict plant growth. On this basis, the conservative daily infiltration rate (DIR) is recommended to calculate the minimum disposal area required based on the hydraulic balance.

It is also recommended that a suitable clay loam filling is imported and mounded on the surface of irrigation area. The material should be moderately permeable and have a high nutrient uptake. The imported clay loam fill would improve the soil structure, reduce limitations associated with acidity and sodicity and minimise the potential for groundwater pollution. A minimum 250 mm layer is recommended. Alternatively a thicker clay loam layer could be imported and blended with existing fill materials.

It is also recommended that the concrete hardstand and footings located in the central portion of the site are removed to allow infiltration of effluent. Alternatively, suitable clay loam fill material with a minimum thickness of 0.5 m could be placed over the concrete pad.

Exposure

At the time of the investigation the proposed disposal area was vegetated with grass providing good exposure to sun and wind. Vegetation cover of shrubs and trees should be reduced in the vicinity of the disposal area to increase transpiration and evaporation conditions.

General

Disposal areas should be planted with high nutrient uptake vegetation, and grass should be regularly slashed and collected in the disposal area. Additionally the disposal area should be constructed in accordance with AS/NZS 1547-2012 (Ref 2).

5.3 Location of Disposal Systems

Effluent disposal areas within the site should comply with appropriate buffer distances based on a site specific evaluation of the site and soil constraints. Table 9 below outlines the range of setback distances recommend by AS/NZS 1547:2012 (Ref 2) and the recommended setback distances following an evaluation of the site and soil constraints.

Table 9: Recommended Buffer Distances for On-Site Systems

Recommended Buffer Distances from AS 1547:2012	Recommended Buffer Distances Following Evaluation of Site and Soil Constraints
1.5 - 50 m to property boundaries	6 m if area up-gradient and 3 m if area down-gradient
2.0 - >6 m to buildings/houses	15 m to buildings/houses
15 - 100 m to surface water (e.g. dams, rivers, streams, lakes etc. permanent or intermittent)	100 m to Hunter River and Wetlands, 40 m to low-lying areas, intermittent waterways/drainage channels, farm dams
15 - 50 m to domestic groundwater well	50 m to domestic groundwater well
3 - 15 m to recreational areas (e.g. children play areas, pools etc.)	N/A
4 - 15 m to in-ground water tanks	15 m of in-ground water tanks
3 m or 45° angle from toe of retaining walls, embankments, escarpments and cuttings	3 m from embankments
0.6 - >1.5 m vertical distance to groundwater	Permanent water table >1 m below ground surface or >0.6 m between the highest seasonal water table level and the base of the land application system (whichever is greater)

The proposed wastewater treatment system general arrangement is shown on Engenicom Drawing ENG-03891-015 in Appendix C.

5.4 Summary

Subject to a number of site improvements with the provision of adequate wet weather storage and the provision of a secondary disposal area for heavy rainfall periods, it is considered that a minimum irrigation area of 39,300 m^2 (viz ultimate ADWF rate of 13210 L/day) is suitable for the proposed disposal area. The nominated irrigation area should be constructed with consideration to the relevant buffer distance and site improvements. Subsurface conditions should be confirmed over the extended irrigation area prior to construction.

The proposed effluent irrigation area is generally underlain by highly variable fill material. There are a number of site improvements which need to be made/considered to allow effluent disposal on the site. The following site improvements are recommended for the proposed effluent disposal area:

- Removal of the concrete hardstand and footings in the central portion of the site. Alternatively 0.5 m of suitable clay loam fill material could be placed over the concrete hardstand;
- Addition of lime to acidic soils to maintain plant growth;
- Addition of gypsum to improve the soil structure and reduce the potential for dispersion and erosion;
- Earthworks to re-contour and fill drainage channels and redirect surface water flow around the proposed effluent irrigation area (to meet recommended buffer distances);
- Where required, placement of suitable fill material or earthworks to raise site levels to at least 1 m above the permanent groundwater table and/or at least 0.6 m between the highest seasonal water table level and the base of the land application system (whichever is greater);
- Importation and placement of a suitable clay loam fill to form the surface of the irrigation area to improve soil properties and minimise potential for groundwater pollution (ie reduce infiltration of treated effluent through permeable coal reject filling);
- Installation of catch drains/ bunds upslope and downslope of disposal area to prevent rainfall run-on and run-off.

While the above recommendations should minimise the potential for surface water or groundwater pollution from the proposed irrigated treated effluent, preliminary sampling and analysis of surface waters and groundwater in the vicinity of the site (Ref 3) has identified elevated heavy metals, nutrients and faecal coliforms.

It is noted that additional investigations may be required where the footprint of the temporary Diona Pty Ltd compound overlies the proposed effluent disposal area following the closure the temporary compound, to confirm site conditions and possible impacts (if any) to the above design areas / recommendations.

Given the existing surface water and groundwater impacts within the proposed Hexham TFS site, it is recommended that additional targeted sampling of surface waters and groundwater is undertaken up-gradient, within and down-gradient of the proposed effluent irrigation area prior to development to confirm baseline surface water and groundwater quality. The installed wells should be located to allow for monitoring of groundwater up-gradient, within and down-gradient during operation of the effluent disposal area.

It is noted that the effluent disposal system and area for the TSF is independent of the existing effluent irrigation conducted by Brancourts to the north.

6. References

1. Environment & Health Protection Guidelines On-Site Sewage Management Systems for Single Households, NSW EPA, NSW Department of Health", NSW Department Land & Water Conservation, NSW Department of Local Government, January 1998.
2. Australian/New Zealand Standard AS/NZS 1547-2012, "On-site domestic wastewater management", Standards Australia/Standards New Zealand.
3. WorleyParsons Services Pty Ltd, "Hexham Train Support Facility, Services Investigation Report", Ref 301020-03456-Cl-REP-001-G, 1 June 2012.
4. Douglas Partners Pty Ltd, "Preliminary Contamination Assessment, Proposed Train Support Facility, Maitland Road and Woodlands Close, Hexham", Project 39798.06, May 2012.
5. Department of Land and Water Conservation, "Site Investigations for Urban Salinity", 2002.

7. Limitations

DP has prepared this report for this project at Woodlands Close, Hexham in accordance with DP's proposal NCL120155 dated 13 April 2012 and acceptance received from Mr Andrew Williams of QR National dated 26 April 2012. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of QR National for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Pit Logs (Pits 122, 123, 125, 126, 137, 161 and 170 to 174)

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

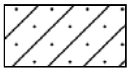
Soils


Topsoil

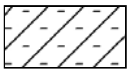

Peat


Clay

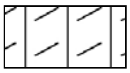

Silty clay

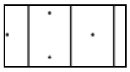

Sandy clay

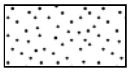

Gravelly clay

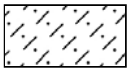

Shaly clay

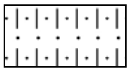

Silt


Clayey silt


Sandy silt


Sand

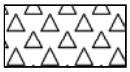

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

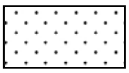

Talus

Sedimentary Rocks

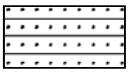

Boulder conglomerate

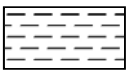

Conglomerate


Conglomeratic sandstone

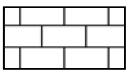

Sandstone


Siltstone


Laminite

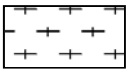

Mudstone, claystone, shale

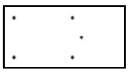

Coal


Limestone

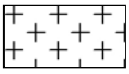
Metamorphic Rocks

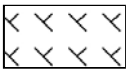

Slate, phyllite, schist

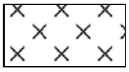

Gneiss


Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 2.6 AHD
EASTING: 377185
NORTHING: 6365818
DIP/AZIMUTH: 90°/--

PIT No: 122
PROJECT No: 39798.02
DATE: 03 Apr 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING - Generally comprising light brown silty sandy gravel, gravel pedominantly subrounded, trace rootlets, humid		D, PID	0.0 0.05		<1 ppm		
		FILLING - Generally comprising black and light brown fine to medium grained sandy clayey gravel, gravel pedominantly angular coal chiter (70%) with some caronaceous siltstone (10 - 15%)		D, PID	0.5		<1 ppm		
1	1.0	FILLING - Generally comprising dark brown sandy silty gravel, gravel predominantly coal reject (60%) and carbonaceous siltstone (35%)		D, PID	1.1		<1 ppm	▼	1
	1.35	CLAYEY SILT - Dark grey / brown clayey silt, slight organic (sulphur) odour, M>>Wp		D, PID	1.5		21 ppm		
	1.6	Pit discontinued at 1.6m, limit of investigation							
2									2
3									3
4									4
5									5

RIG: 6 tonne backhoe, 90mm bucket with teeth

LOGGED: Karpiel

WATER OBSERVATIONS: Free groundwater observed at 1.15m during test pitting

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 5.0 AHD
EASTING: 376987
NORTHING: 6365866
DIP/AZIMUTH: 90°/--

PIT No: 123
PROJECT No: 39798.02
DATE: 03 Apr 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING - Generally comprising dark brown and black course grained clayey sandy gravel with some silt, sand and gravel and predominantly coal reject, humid		D, PID	0.05		<1 ppm		
				D	0.5		<1 ppm		
	1	From 1.1m, with some angular gravel and cobbles (rail ballast)							
				D	1.5		<1 ppm		
	2								
				D	2.7		<1 ppm		
		From 2.8m, wet to saturated						▼	
	3 3.0	FILLING - Generally comprising dark grey gravel and cobbles with trace silt, gravel and cobbles predominantly carbonaceous siltstone, trace coal reject, saturated		D	3.1		<1 ppm		
	3.3	Pit discontinued at 3.3m, slow progress							
	4								
	5								

RIG: 6 tonne backhoe, 90mm bucket with teeth
LOGGED: Karpiel

WATER OBSERVATIONS: Free groundwater observed at 2.95m during test pitting

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 2.5 AHD
EASTING: 377096
NORTHING: 6366017
DIP/AZIMUTH: 90°/--

PIT No: 125
PROJECT No: 39798.02
DATE: 04 Apr 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING - Generally comprising brown silty sandy gravel, gravel predominantly coal reject with some rounded gravel, humid		PID	0.0 0.05		<1 ppm		
	0.2	FILLING - Generally comprising brown medium grained gravelly sand, gravel predominatly rounded with some coal reject, fragments of terracotta pipe, humid		D	0.3		<1 ppm		
	0.4	FILLING - Generally comprising black medium grained clayey sandy gravel, gravel predominantly coal reject (90%), humid							
1				D	1.0		<1 ppm	▼	1
	1.4	FILLING - Generally comprising black cobbly gravel, with trace sand and silt, cobbles and gravel predominantly coal reject, with some carbonaceous siltstone, saturated							
2	2.0	SILTY CLAY - Firm grey mottled orange silty clay with some grey sand, M>>Wp		D	2.2		<1 ppm		2
	2.35	Pit discontinued at 2.35m, limit of investigation							
3									3
4									4
5									5

RIG: 6 tonne backhoe, 90mm bucket with teeth

LOGGED: Karpiel

WATER OBSERVATIONS: Free groundwater observed at 1.25m during test pitting

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 2.3 AHD
EASTING: 377050
NORTHING: 6366075
DIP/AZIMUTH: 90°/--

PIT No: 126
PROJECT No: 39798.02
DATE: 04 Apr 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.2	FILLING - Generally comprised brown fine to medium grained gravelly silty sand, gravel predominantly rounded, trace rootlets, humid		D, PID	0.0 0.05		<1 ppm		
		FILLING - Generally comprising grey medium grained clayey sandy gravel, gravel predominantly coal reject, humid		D, PID	0.5		<1 ppm		
		From 0.7m to 0.75m, stained green From 0.7m to 0.8m, trace plastic and metal pipework		D, PID	0.7		<1 ppm	▼	
	1.0	FILLING - Generallly comprising black gravel (coal reject), with trace silt and sand, saturated		D, PID	1.1		<1 ppm		
	1.2	Pit discontinued at 1.2m, refusal on piece of scrap metal							

RIG: 6 tonne backhoe, 90mm bucket with teeth

LOGGED: Karpiel

WATER OBSERVATIONS: Free groundwater observed at 0.8m during test pitting

REMARKS: Pit located near sewer tank

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 4.1 AHD
EASTING: 376899
NORTHING: 6366140
DIP/AZIMUTH: 90°/--

PIT No: 137
PROJECT No: 39798.02
DATE: 03 Apr 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising light brown fine to medium grained gravelly silty sand, gravel predominately rounded, humid		D	0.1		<1 ppm		
	0.3	Pit discontinued at 0.3m, refusal on concrete slab (dipping to north)							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

1, 2, 3, 4, 5

RIG: 6 tonne backhoe, 90mm bucket with teeth

LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 3.8 AHD
EASTING: 376914
NORTHING: 6366148
DIP/AZIMUTH: 90°/--

PIT No: 161
PROJECT No: 39798.02
DATE: 03 Apr 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising black fine to medium grained gravelly silty sand (coal fines), humid		D	0.1				
	0.25	Pit discontinued at 0.25m, refusal on concrete slab (dipping to north)							

RIG: 6 tonne backhoe, 90mm bucket with teeth

LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 4.0 AHD*
EASTING: 376999
NORTHING: 6365952
DIP/AZIMUTH: 90°/--

PIT No: 170
PROJECT No: 39798.02
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.15	FILL - Generally comprising black clayey silty fine to coarse gravel, trace fine orange sand, gravel predominately coal reject (50%), some rootlets, damp		D	0.0 0.1 0.2				
		FILL - Generally comprising black silty sandy fine to coarse gravel, some clay eg gravel inclusions predominately coal reject (70%), humid		D	0.3				
	0.65	From 0.4m, with some fine to coarse gravel sized carbonaceous siltstone		A	0.5 0.65				
		Pit discontinued at 0.5m, limit of investigation							

RIG: Hand tools

LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS: *Surface level interpolated from topographic plan supplied by Worley Parsons

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 2.6 AHD*
EASTING: 376971
NORTHING: 6366023
DIP/AZIMUTH: 90°/--

PIT No: 171
PROJECT No: 39798.02
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.25	FILL - Generally comprising black silt and fine to medium grained sand, predominately coal fines with trace rootlets to 0.1m, damp		D	0.1				
	0.4	FILL - Generally comprising intermixed grey silty clay and fine to coarse gravel , gravel predominately coal reject and carbonaceous siltstone (40-50%), damp		D	0.2 0.3				
		Pit discontinued at 0.15m, slow progress		D	0.4 0.5				

RIG: Hand tools
LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS: *Surface level interpolated from topographic plan supplied by Worley Parsons

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 4.0 AHD*
EASTING: 376971
NORTHING: 6366023
DIP/AZIMUTH: 90°/--

PIT No: 171A
PROJECT No: 39798.02
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILL - Generally comprising black silt and fine to medium grained sand, predominately coal fines with trace rootlets to 0.1m, humid							
	0.15	FILL - Generally comprising light brown clayey sandy fine to coarse grained gravel, (road base), humid							
		Pit discontinued at 0.15m, refusal							

RIG: Hand tools

LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS: *Surface level interpolated from topographic plan supplied by Worley Parsons

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 2.6 AHD*
EASTING: 376964
NORTHING: 6366084
DIP/AZIMUTH: 90°/--

PIT No: 172
PROJECT No: 39798.02
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.2	FILL - Generally comprising (compacted) light brown clayey sandy fine to coarse gravel (road base) humid							
		Pit discontinued at 0.2m, refusal							

RIG: Hand tools

LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS: *Surface level interpolated from topographic plan supplied by Worley Parsons

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 4.0 AHD*
EASTING: 376878
NORTHING: 6366210
DIP/AZIMUTH: 90°/--

PIT No: 173
PROJECT No: 39798.02
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILL - Generally comprising dark grey black silty sandy fine to coarse gravel, some clay, gravel predominately coal reject (70%), humid		D	0.1 0.2				
	0.4	FILL - Generally comprising dark grey/ black silty fine to coarse grained sand with some medium to coarse gravel, sand and gravel predominately coal reject and carbonaceous siltstone, damp		D	0.5 0.6				
	0.65	Pit discontinued at 0.65m, limit of investigation							

RIG: Hand tools
LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS: *Surface level interpolated from topographic plan supplied by Worley Parsons

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Queensland Rail
PROJECT: Effluent Disposal Assessment - Proposed Redevelopment
LOCATION: Maitland Road and Woodlands Close, Hexham

SURFACE LEVEL: 4.4 AHD*
EASTING: 376857
NORTHING: 6366301
DIP/AZIMUTH: 90°/--

PIT No: 174
PROJECT No: 39798.02
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILL - Generally comprising dark brown silt with some fine to coarse gravel sized coal reject, some rootlets, damp		D	0.0 0.1				
	0.15 0.2	FILL - Generally comprising intermixed grey silty clay and clayey sily fine to coarse gravel, gravel predominately coal reject, damp		D	0.4 0.5				
	0.6	FILL - Generally comprising brown clayey sandy fine to coarse gravel, gravel predominately coal reject with some silt, damp							
		Pit discontinued at 0.6m, limit of investigation							
	1								
	2								
	3								
	4								
	5								

RIG: Hand tools

LOGGED: Karpiel

WATER OBSERVATIONS: No free groundwater observed during test pitting

REMARKS: *Surface level interpolated from topographic plan supplied by Worley Parsons

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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Appendix B

Laboratory Test Results
Laboratory Sample Receipts

Effluent Subdivison Profile

CLIENT: **Douglas Partners (Newcastle)**
PO Box 324
HRMC NSW 2310
Attn: C. Karpiel

PROJECT: Name: **Hexham**
Location:
SESL Quote N°: Client Job N°: **39798.02** Order N°: **71740**
Date Received: **28/04/2008**

SAMPLE: Batch N°: **6370** Sample N°: **1**
Name: **122 / 0.5**
Test Type: **pHEC, ECEC, ESP, PRI, mEAT, BD (4419)**

Quality System
Quality Endorsed Company
AS/NZS ISO 9001: 2000 QEC 21650

Sydney Environmental and Soil Laboratory
Specialists in Soil Chemistry, Agronomy and Contamination Assessment

Sydney Environmental & Soil Laboratory Pty Ltd
ABN 70 106 810 708
16 Chilvers Road
Thornleigh NSW 2120
Australia
Address mail to:
PO Box 357
Pennant Hills NSW 1715
Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au

TEST	RESULT	COMMENTS
pH in water 1:5	9.6	Very Strong Alkalinity
pH in $CaCl_2$ 1:5	8.0	Slight Alkalinity
EC mS/cm 1:5	.18	Moderate Salinity

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
Unit	meq%	Comment	meq%	% of ECEC	Comment
Sodium			12.2	55.20	Extreme
Potassium			.55	2.50	Very Low
Calcium			5.94	26.90	Very Low
Magnesium			3.44	15.60	Low
Aluminium			< 0.02	0	Acceptable
		ECEC	22.10		Moderate
		Ca/Mg	1.70		Low

Phosphate Retention Index % 6.10 Very Low PRI mgP/kg 303.8 PRI kg/ha 546.8 to 150mm

PHYSICAL CHARACTERISTICS

Texture: Field Density g/mL:

Structure:

Emerson Stability Class : H20 2 Low SAR 2 High SAR 5(2)

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Bulk density (AS4419): 1.2 kg/L (N.B. Sample not suitable for Wax Block Density)

For the purpose of onsite effluent disposal report, this soil shows strong alkalinity and moderate salt content. The soils ability to absorb phosphorus is very low, but to a depth of 150mm and with sufficient application area is likely to increase the longevity of the effluent disposal system.

The soil aggregates show some dispersion and susceptibility to erosion and tunneling. However, it is predicted when high ionic strength effluent is applied, the aggregates stability increases. The aggregates will disperse when severely provoked by dilution combined with significant mechanical action. They have a low erosion risk but will erode if raindrop impact and running water are combined. Precaution to reduce the velocity of running water should be employed where there is a risk (e.g. long slopes).

The sodicity is the main limitation to effluent disposal, and if initial plant growth is struggling, this soil can be ameliorated by the following recommendations:
- add 11.0 kg/m3 of gypsum incorporated into the material which will improve soil Ca:Mg, reducing the sodicity.

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992) **Chloride:** Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992). **Wax Block Density:** Method 30-4 Black (1983), **Texture:** Charman & Murphy (1991), **Emerson's Aggregate Test:** Charman & Murphy (1991), **Particle Size Analysis:** Modified Black (1983) Method 43-1 to 43-6

Checked by: Simon Leake

Consultant: Ryan Jacka

Date of Report 06/05/2008

Effluent Subdivison Profile

CLIENT: **Douglas Partners (Newcastle)**
PO Box 324
HRMC NSW 2310
Attn: C. Karpiel

PROJECT: Name: **Hexham**
Location:
SESL Quote N°: Client Job N°: **39798.02** Order N°: **71740**
Date Received: **28/04/2008**

SAMPLE: Batch N°: **6370** Sample N°: **2**
Name: **122 / 1.5**
Test Type: **pHEC, ECEC, ESP, PRI, mEAT, WBD**

Quality System
Quality Endorsed Company
AS/NZS ISO 9001: 2000 QEC 21650

Sydney Environmental and Soil Laboratory
Specialists in Soil Chemistry, Agronomy and Contamination Assessment

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16 Chilvers Road
Thornleigh NSW 2120
Australia
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PO Box 357
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Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au

TEST	RESULT	COMMENTS
pH in water 1:5	6.9	Near Neutral
pH in $CaCl_2$ 1:5	6.3	Slight Acidity
EC mS/cm 1:5	1	Saline

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
Unit	meq%	Comment	meq%	% of ECEC	Comment
Sodium			20	43.20	Extreme
Potassium			2.08	4.50	Low
Calcium			10.53	22.70	Very Low
Magnesium			13.7	29.60	Elevated
Aluminium			.02	.1	Acceptable
		ECEC	46.30		Very High
		Ca/Mg	0.80		Low

Phosphate Retention Index % 74.80 High PRI mgP/kg 3755.7 PRI kg/ha 8901.0 to 150mm

PHYSICAL CHARACTERISTICS

Texture: Field Density g/mL: 1.58

Structure:

Emerson Stability Class : H20 3 Low SAR 5(3) High SAR 5(3)

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

For the purpose of onsite effluent disposal report, this soil shows near neutral pH and high salt content. The soils ability to absorb phosphorus is high, and to a depth of 150mm can absorb a considerable amount, increase the longevity of the effluent disposal system.
The soil aggregates show some dispersion and susceptibility to erosion and tunneling. However, it is predicted when low and high ionic strength effluent is applied, the aggregates stability increases. The aggregates will disperse when severely provoked by dilution combined with significant mechanical action. They have a low erosion risk but will erode if raindrop impact and running water are combined. Precaution to reduce the velocity of running water should be employed where there is a risk (e.g. long slopes).

The sodicity is the main limitation to effluent disposal, and if initial plant growth is struggling, this soil can be ameliorated by the following recommendations:
- add 25 kg/m3 of gypsum incorporated into the material which will improve soil Ca:Mg, reducing the sodicity.

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983) **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992) **Chloride:** Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992). **Wax Block Density:** Method 30-4 Black (1983). **Texture:** Charman & Murphy (1991). **Emerson's Aggregate Test:** Charman & Murphy (1991). **Particle Size Analysis:** Modified Black (1983) Method 43-1 to 43-6

Checked by: Simon Leake

Consultant: Ryan Jacka

Date of Report 06/05/2008

Effluent Subdivison Profile

CLIENT: **Douglas Partners (Newcastle)**
PO Box 324
HRMC NSW 2310
Attn: C. Karpiel

PROJECT: Name: **Hexham**
Location:
SESL Quote N°: Client Job N°: **39798.02** Order N°: **71740**
Date Received: **28/04/2008**

SAMPLE: Batch N°: **6370** Sample N°: **3**
Name: **125 / 1.0**
Test Type: **pHEC, ECEC, ESP, PRI, mEAT, BD (4419)**

Quality System
Quality Endorsed Company
AS/NZS ISO 9001: 2000
QEC 21650

Sydney Environmental and Soil Laboratory
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Web: www.sesl.com.au

TEST	RESULT	COMMENTS
pH in water 1:5	8.3	Moderate Alkalinity
pH in $CaCl_2$ 1:5	6.9	Near Neutral
EC mS/cm 1:5	.16	Low Salinity

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
Unit	meq%	Comment	meq%	% of ECEC	Comment
Sodium			4.9	29.70	Extreme
Potassium			.5	3.00	Low
Calcium			5.19	31.50	Very Low
Magnesium			5.89	35.70	High
Aluminium			.02	.1	Acceptable
		ECEC	16.50		Moderate
		Ca/Mg	0.90		Low

Phosphate Retention Index % 4.80 Very Low PRI mgP/kg 241.8 PRI kg/ha 362.7 to 150mm

PHYSICAL CHARACTERISTICS

Texture: Field Density g/mL:

Structure:

Emerson Stability Class : H20 2 Low SAR 2 High SAR 5(2)

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Bulk density (AS4419): 1.0 kg/L (N.B. Sample not suitable for Wax Block Density)

For the purpose of onsite effluent disposal report, this soil shows moderate alkalinity and low salt content. The soils ability to absorb phosphorus is very low, but to a depth of 150mm and with sufficient application area can absorb a considerable amount, increase the longevity of the effluent disposal system.

The soil aggregates show some dispersion and susceptibility to erosion and tunneling. However, it is predicted when high ionic strength effluent is applied, the aggregates stability increases. The aggregates will disperse when severely provoked by dilution combined with significant mechanical action. They have a low erosion risk but will erode if raindrop impact and running water are combined. Precaution to reduce the velocity of running water should be employed where there is a risk (e.g. long slopes).

The sodicity is the main limitation to effluent disposal, and if initial plant growth is struggling, this soil can be ameliorated by the following recommendations:
- add 7.5 kg/m3 of gypsum incorporated into the material which will improve soil Ca:Mg, reducing the sodicity.

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992) **Chloride:** Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992). **Wax Block Density:** Method 30-4 Black (1983). **Texture:** Charman & Murphy (1991). **Emerson's Aggregate Test:** Charman & Murphy (1991), **Particle Size Analysis:** Modified Black (1983) Method 43-1 to 43-6

Checked by: Simon Leake

Consultant: Ryan Jacka

Date of Report 06/05/2008

Effluent Subdivison Profile

CLIENT: **Douglas Partners (Newcastle)**
PO Box 324
HRMC NSW 2310
Attn: C. Karpiel

PROJECT: Name: **Hexham**
Location:
SESL Quote N°: Client Job N°: **39798.02** Order N°: **71740**
Date Received: **28/04/2008**

SAMPLE: Batch N°: **6370** Sample N°: **4**
Name: **126 / 0.5**
Test Type: **pHEC, ECEC, ESP, PRI, mEAT, WBD**

Quality System
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TEST	RESULT	COMMENTS
pH in water 1:5	4.2	Extreme Acidity
pH in $CaCl_2$ 1:5	4.2	Extreme Acidity
EC mS/cm 1:5	1.74	Saline

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
Unit	meq%	Comment	meq%	% of ECEC	Comment
Sodium			.85	3.30	Acceptable
Potassium			.21	0.80	Very Low
Calcium			19.8	78.00	Elevated
Magnesium			3.16	12.40	Low
Aluminium			1.38	5.5	High
		ECEC	25.40		High
		Ca/Mg	6.30		Normal

Phosphate Retention Index % 40.90 Medium PRI mgP/kg 2053.8 PRI kg/ha 4343.8 to 150mm

PHYSICAL CHARACTERISTICS

Texture: Field Density g/mL: 1.41

Structure:

Emerson Stability Class : H20 5(2) Low SAR 5(2) High SAR 5(2)

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

For the purpose of onsite effluent disposal report, this soil shows extreme acidity and high salt content. The soils ability to absorb phosphorus is medium, and to a depth of 150mm can absorb a considerable amount, increase the longevity of the effluent disposal system.

The soil aggregates will disperse when severely provoked by dilution combined with significant mechanical action. They have a low erosion risk but will erode if raindrop impact and running water are combined. Precaution to reduce the velocity of running water should be employed where there is a risk (e.g. long slopes). The stability will not increase with the addition of effluent.

The extreme acidity is the main limitation to effluent disposal, and if initial plant growth is struggling, this soil can be ameliorated by the following recommendations:
- add 1.5 kg/m3 of lime incorporated into this material which will raise the pH and render the aluminium unavailable.

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992) **Chloride:** Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992). **Wax Block Density:** Method 30-4 Black (1983). **Texture:** Charman & Murphy (1991). **Emerson's Aggregate Test:** Charman & Murphy (1991). **Particle Size Analysis:** Modified Black (1983) Method 43-1 to 43-6

Checked by: Simon Leake

Consultant: Ryan Jacka

Date of Report 06/05/2008

Effluent Subdivison Profile

CLIENT: **Douglas Partners (Newcastle)**
PO Box 324
HRMC NSW 2310
Attn: C. Karpiel

PROJECT: Name: **Hexham**
Location:
SESL Quote N°: Client Job N°: **39798.02** Order N°: **75485**
Date Received: **04/07/2008**

SAMPLE: Batch N°: **7023** Sample N°: **1**
Name: **170/0.2-0.3**
Test Type: **Bulk Density, pHEC, CEC, ESP, PRI, mEAT**

Quality System
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QEC 21650

Sydney Environmental and Soil Laboratory
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Em: info@sesl.com.au
Web: www.sesl.com.au

TEST	RESULT	COMMENTS
pH in water 1:5	6.6	Very Slight Acidity
pH in $CaCl_2$ 1:5	6.3	Slight Acidity
EC mS/cm 1:5	.89	High Salinity

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
Unit	meq%	Comment	meq%	% of ECEC	Comment
Sodium			6.3	28.30	Extreme
Potassium			.37	1.70	Very Low
Calcium			10.06	45.10	Very Low
Magnesium			5.54	24.80	Acceptable
Aluminium			< 0.02	0	Acceptable
		ECEC	22.30		Moderate
		Ca/Mg	1.80		Low

Phosphate Retention Index % 16.90 Low PRI mgP/kg 810.7 PRI kg/ha 1580.9 to 150mm

PHYSICAL CHARACTERISTICS

Texture: Field Density g/mL:

Structure:

Emerson Stability Class : H20 2 Low SAR 5 (1) High SAR 5 (1)

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Bulk Density (AS4419): 0.7 kg/L
For the purpose of onsite effluent disposal report, this soil shows very slight acidity and high salt content. The soils ability to absorb phosphorus is low, but to a depth of 150mm can absorb a considerable amount, increase the longevity of the effluent disposal system. The soil chemistry is unbalanced with high sodicity and low calcium/potassium levels.

The soil aggregates show some dispersion and susceptibility to erosion and tunnelling. However, it is predicted when high ionic strength effluent is applied, the aggregates stability increases. The aggregates will disperse when severely provoked by dilution combined with significant mechanical action. They have a low erosion risk but will erode if raindrop impact and running water are combined. Precaution to reduce the velocity of running water should be employed where there is a risk (e.g. long slopes).

The sodicity is the main limitation to effluent disposal, and if initial plant growth is struggling, this soil can be ameliorated by the following recommendations:
- apply 6.4 kg/m^3 of gypsum incorporated into this material which will reduce the sodicity and balance the cations.

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983) **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961) **Aluminium:** Method 3500 APHA (1992) **Phosphate:** Method 9E1 Rayment & Higginson (1992) **Wax Block Density:** Method 30-4 Black (1983), **Texture:** Charman & Murphy (1991), **Emerson's Aggregate Test:** Charman & Murphy (1991), **Particle Size Analysis:** Modified Black (1983) Method 43-1 to 43-6

Checked by: Simon Leake

Consultant: Ryan Jacka

Date of Report 14/07/2008

Effluent Subdivison Profile

CLIENT: **Douglas Partners (Newcastle)**
PO Box 324
HRMC NSW 2310
Attn: C. Karpiel

PROJECT: Name: **Hexham**
Location:
SESL Quote N°: Client Job N°: **39798.02** Order N°: **75485**
Date Received: **04/07/2008**

SAMPLE: Batch N°: **7023** Sample N°: **2**
Name: **172/0-0.2**
Test Type: **Bulk Density, pHEC, CEC, ESP, PRI, mEAT**

Quality System
Quality Endorsed Company
AS/NZS ISO 9001 2000
QEC 21650

Sydney Environmental and Soil Laboratory
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TEST	RESULT	COMMENTS
pH in water 1:5	4.0	Extreme Acidity
pH in $CaCl_2$ 1:5	3.9	Extreme Acidity
EC mS/cm 1:5	.9	High Salinity

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
Unit	meq%	Comment	meq%	% of ECEC	Comment
Sodium			.34	2.70	Acceptable
Potassium			.13	1.00	Very Low
Calcium			3.2	25.20	Very Low
Magnesium			3.87	30.50	High
Aluminium			5.15	41.2	Extreme
		ECEC	12.70		Moderate
		Ca/Mg	0.80		Low

Phosphate Retention Index % 26.40 Low PRI mgP/kg 1266.4 PRI kg/ha 2469.5 to 150mm

PHYSICAL CHARACTERISTICS

Texture: Field Density g/mL:

Structure:

Emerson Stability Class : H20 2 Low SAR 2 High SAR 2

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Bulk Density (AS4419): 1.7 kg/L
For the purpose of onsite effluent disposal report, this soil shows extreme acidity and high salt content. The soils ability to absorb phosphorus is low, but to a depth of 150mm can absorb a considerable amount, increase the longevity of the effluent disposal system. The soil chemistry is unbalanced with extreme aluminium toxicity potential.

The soil aggregates on site may be provoked into dispersion if water is combined with mechanical stress. When subjected to mechanical stress crusting and emergence problems may arise. Water erosion may also be predicted from the impact energy of rainfall on bare or disturbed soil. The below amelioration should improve the soil stability.

The extreme acidity and aluminium levels are the main limitation to effluent disposal, and if initial plant growth is struggling, this soil can be ameliorated by the following recommendations:
- apply 5.0 kg/m^3 of lime incorporated into this material which will raise the pH, rendering the aluminium unavailable, reduce sodicity and balance the cations.

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983) **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961) **Aluminium:** Method 3500 APHA (1992) **Phosphate:** Method 9E1 Rayment & Higginson (1992) **Wax Block Density:** Method 30-4 Black (1983), **Texture:** Charman & Murphy (1991), **Emerson's Aggregate Test:** Charman & Murphy (1991), **Particle Size Analysis:** Modified Black (1983) Method 43-1 to 43-6

Checked by: Simon Leake

Consultant: Ryan Jacka

Date of Report 14/07/2008

Effluent Subdivison Profile

CLIENT: **Douglas Partners (Newcastle)**
PO Box 324
HRMC NSW 2310
Attn: C. Karpiel

PROJECT: Name: **Hexham**
Location:
SESL Quote N°: Client Job N°: **39798.02** Order N°: **75485**
Date Received: **04/07/2008**

SAMPLE: Batch N°: **7023** Sample N°: **3**
Name: **174/0.4-0.5**
Test Type: **Bulk Density, pHEC, CEC, ESP, PRI, mEAT**

Quality System
Quality Endorsed Company
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QEC 21650

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TEST	RESULT	COMMENTS
pH in water 1:5	4.1	Extreme Acidity
pH in $CaCl_2$ 1:5	3.8	Extreme Acidity
EC mS/cm 1:5	.74	High Salinity

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
Unit	meq%	Comment	meq%	% of ECEC	Comment
Sodium			3.15	16.90	High
Potassium			.57	3.10	Low
Calcium			7.73	41.60	Very Low
Magnesium			4.49	24.10	Acceptable
Aluminium			2.62	15.4	Extreme
		ECEC	18.60		Moderate
		Ca/Mg	1.70		Low

Phosphate Retention Index % 28.20 Low PRI mgP/kg 1354.7 PRI kg/ha 2641.7 to 150mm

PHYSICAL CHARACTERISTICS

Texture: Field Density g/mL:

Structure:

Emerson Stability Class : H20 5 (2) Low SAR 5 (2) High SAR 5 (2)

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Bulk Density (AS4419): 0.9 kg/L
For the purpose of onsite effluent disposal report, this soil shows extreme acidity and high salt content. The soils ability to absorb phosphorus is low, but to a depth of 150mm can absorb a considerable amount, increase the longevity of the effluent disposal system. The soil chemistry is unbalanced with high sodicity and extreme aluminium toxicity potential.

The soil aggregates will disperse when severely provoked by dilution combined with significant mechanical action. They have a low erosion risk but will erode if raindrop impact and running water are combined. Precaution to reduce the velocity of running water should be employed where there is a risk (e.g. long slopes). The stability is not expected to increase with the addition of effluent.

The extreme acidity, sodicity and aluminium levels are the main limitation to effluent disposal, and if initial plant growth is struggling, this soil can be ameliorated by the following recommendations:
- apply 2.6 kg/m^3 of lime incorporated into this material which will raise the pH, rendering the aluminium unavailable.
- apply 1.7 kg/m^3 of gypsum incorporated into this material which will reduce the sodicity and balance the cations.

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983) **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961) **Aluminium:** Method 3500 APHA (1992) **Phosphate:** Method 9E1 Rayment & Higginson (1992) **Wax Block Density:** Method 30-4 Black (1983), **Texture:** Charman & Murphy (1991), **Emerson's Aggregate Test:** Charman & Murphy (1991), **Particle Size Analysis:** Modified Black (1983) Method 43-1 to 43-6

Checked by: Simon Leake

Consultant: Ryan Jacka

Date of Report 14/07/2008

SAMPLE RECEIPT ADVICE

Client: Douglas Partners (Newcastle)
PO Box 324
HRMC NSW 2310

Attn: C. Karpiel

Job N°: 39798.02

Order N°: 71740

Quality System
Quality Endorsed Company
AS/NZS ISO 9001: 2000 QEC 21650

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Em: info@sesl.com.au
Web: www.sesl.com.au

Project: Hexham

SESL Job N°:
SESL Batch N°: 6370

Reporting Format: ☒ Mail ☒ Email PDF ☐ Fax ☐ Phone ☐ Email Excel

Date Samples Rec'd: 28/04/2008
Time Samples Received: 11:00
Sample Receipt Contact: Issy Purwanto
Requested Turnaround Time: Priority
Expected Report Date: 05/05/2008

Reporting Method: Results, interpretations & rec's
Reporting Contact: Paul Looby

Comments:
Please read this receipt carefully. If there are any discrepancies to expected testwork - notify laboratory immediately

Sample N°:	**1**	Samples received in adequate condition:	◉ Y	○ N	○ N/A
Name:	122 / 0.5	Sufficient sample quantity received for analysis:	◉ Y	○ N	○ N/A
Description:		Sample preservation method satisfactory:	◉ Y	○ N	○ N/A
Type:	Soil	Sample Temperature:		°C	
Test Type:	pHEC, ECEC, ESP, PRI, mEAT, BD (4419)	Adequate documentation received:	◉ Y	○ N	○ N/A
		Health Risk:	○ Y	◉ N	○ N/A
Sample N°:	**2**	Samples received in adequate condition:	◉ Y	○ N	○ N/A
Name:	122 / 1.5	Sufficient sample quantity received for analysis:	◉ Y	○ N	○ N/A
Description:		Sample preservation method satisfactory:	◉ Y	○ N	○ N/A
Type:	Soil	Sample Temperature:		°C	
Test Type:	pHEC, ECEC, ESP, PRI, mEAT, BD (4419)	Adequate documentation received:	◉ Y	○ N	○ N/A
		Health Risk:	○ Y	◉ N	○ N/A
Sample N°:	**3**	Samples received in adequate condition:	◉ Y	○ N	○ N/A
Name:	125 / 1.0	Sufficient sample quantity received for analysis:	◉ Y	○ N	○ N/A
Description:		Sample preservation method satisfactory:	◉ Y	○ N	○ N/A
Type:	Soil	Sample Temperature:		°C	
Test Type:	pHEC, ECEC, ESP, PRI, mEAT, BD (4419)	Adequate documentation received:	◉ Y	○ N	○ N/A
		Health Risk:	○ Y	◉ N	○ N/A
Sample N°:	**4**	Samples received in adequate condition:	◉ Y	○ N	○ N/A
Name:	126 / 0.5	Sufficient sample quantity received for analysis:	◉ Y	○ N	○ N/A
Description:		Sample preservation method satisfactory:	◉ Y	○ N	○ N/A
Type:	Soil	Sample Temperature:		°C	
Test Type:	pHEC, ECEC, ESP, PRI, mEAT, BD (4419)	Adequate documentation received:	◉ Y	○ N	○ N/A
		Health Risk:	○ Y	◉ N	○ N/A

Sample Receipt Advice — Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 106 610 706

Client:	Douglas Partners (Newcastle)	**Job N°:**	39798.02
Attn:	C. Karpiel	**Order N°:**	71740
Project:	Hexham	**SESL Job N°:**	
		SESL Batch N°:	6370

Key to Test Type Codes:

Disp: Dispersability
ASS: Acid Sulphate Screen
AFP/WHC: Air Filled porosity / Water Holding Capacity
BD: Bulk Density
CW 1-CW4:Cricket Wicket Package 1-4
DC: Drop cone
EAT: Emerson Aggregate Test
HC@1pt: Hydraulic conductivity @ 1pt
HCCC: Hydraulic conductivity curve
LV/ANC: Liming value/Acid Neutralising Capacity
LOI: Loss on Ignition
mEAT: modified Emerson Aggregate Test
MC: Moisture Content
NAGC: Net Acid Generating capacity
NDI: Nitrogen Drawdown Index
Olsen: Olsen Extractable Phosphorus
OM: Organic Matter
PSA : Particle Size Analysis (and Method)
PSA s+c: Particle Size Analysis / silt + clay

Perm: Permeability, **Struc**: Structure
Text: Texture
TC: Total Carbon
TN: Total Nitrogen
TS: Total Sulphur
TSS: Total Suspended Solids
Tox: Toxicity
WHC@1pt: Water Holding capacity @1pt
MRC: Moisture Release Curve
WBD: Wax Block Density
Wett: Wettability
BS: Basic Soil
MS: Major Soil,
FS: Full Soil
SS : Sub Soil
FF: Full Foliar
BW: Basic Water
MW: Major Water
FW: Full Water

BM: Basic Media
MM: Major Media
FM: Full Media
CSAW: Corrosion and Scaling for Water
CSAS: Corrosion and Scaling for Soil
eCEC: Cation exchange Capacity (solubles and exchangables)
ECEC: Cation exchange Capacity (solubles only)
AS3743 (P or R): Aust. Standard - Potting Mi xes Premium or Regular
AS4454 CSC : Aust. Standard - Composted Soil Conditioner
AS4454 CM : Aust. Standard - Composted Mulch
AS4454 PSC: Aust. Standard - Pasteurised Soil Conditioner / Fine Mulch
AS4454 PM: Aust. Standard - Pasteurised Mulch
AS4419 LD: Aust. Standard - Low Density Soil
AS4419 OS: Aust. Standard - Organic Soil
AS4419 NS: Aust. Standard - Natural Soil or Soil Blend
AS4419 TD: Aust. Standard - Top Dressing
LP1-LP7: L andscape Package 1 - Landscape Package 7
Bunker: Bunker Sand Package
EFF single: Effluent Package single dwelling
EFF sub: Effluent Package subdivision

SAMPLES RECEIVED - TERMS AND CONDITIONS

Analysis Requests - Before performing any work, SESL reviews client's analysis request document(s) and the completed Job Control Sheet (JCS) that outlines the scope and timing of the work to be performed. If such request is unclear or if the JCS is incomplete, SESL consults with the client before proceeding. In all situations, the client must provide a commercially acceptable order prior to SESL initiating the requested services.

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Turnaround Time - Standard analysis service is provided in approximately 10 working days from the date of sample receipt. Deliveries are accepted from 8:00 a.m. to 4:30 p.m. Samples received prior to 1:00 p.m. are processed that day, samples received after 1:00 p.m. are processed the next business day. Turnaround time less than standard is available per client request, subject to negotiation and priority and urgent service conditions. Analysis completion time varies with the sample type, handling requirements and the tests requested.

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Records - All records and supporting documentation remain the property of SESL and are retained for a period of five (5) years after the work has been completed. After this period, documents and computer based files may be destroyed. However, alternative retention arrangements can be made by the client at client expense.

Sample Retention Period - Unless prior arrangements are made, any portion of samples not used for analysis is held for a maximum of 90 days after delivery of analysis results. All samples are disposed of in an appropriate manner.

Any samples found to be or suspected of being hazardous are returned to the client at the client's expense. Alternatively SESL may arrange disposal of suspected hazardous samples per client's request. The client retains ownership of all samples submitted to SESL for analysis, storage and/or disposal.

Prices and Discounts - Current test prices are communicated to the client via quotes and pricelist. Quotes are valid for the period stated on the quote and are null and void after said period. If no period is stated, such quotes expire 30 days after document date. Current test prices are subject to change without notice. Unless specifically agreed to otherwise, the minimum laboratory service fee is $50.00 ex GST. Some methodologies may require an initial method setup charge, regardless of the number of samples.

Volume discounts may be offered bas ed upon a guaranteed work level. This may be structured on a project by project, or an annual contract basis. All discounts are contingent on meeting agreed payment terms and conditions. SESL reserves the right to suspend discounts due to late client payments.

Project Cancellations - When a client cancels services and/or testing for received samples, all preparatory work that has been completed up to the cancellation point is invoiced to the client plus all costs associated with procurement of client- specific materials.

Payment Terms - Our current Provision of Service Agreement applies to all works conducted by SESL. Payment terms are cash on delivery for all new clients except those who have been granted trade credit by SESL. Upon trade credit approval,SESL's standard payment terms are net 7 days with no prompt pay discounts allowed. A 1.5% per month interest charge is added to all unpaid balances. There is a $30.00 ex GST charge for returned cheques. At our discretion, we may request payment with order, and withhold results until payment has been received.

Confidentiality - SESL maintains strict confidentiality of all client information. Results or other information regarding client work is not released to any party other than the client, unless the client requests – in writing – information be provided to a third party or unless disclosure by SESL is required by law. Formal confidentiality agreements will be executed upon client request.

Warranty and Limits of Liability - SESL makes the best effort to deliver the most precise measurements but we will not assume any legal or other responsibility for erroneous results. SESL's warranty is limited to the accuracy of analyses of samples as received. SESL assumes no responsibility for the purposes for which the client uses the test results, nor liability for any other warranties, expressed or implied, including warranties of fitness for a particular purpose or for merchantability made by the client. These terms supercede any conflicting terms and conditions stated on any purchase order, or other order of work submitted by the client.

Additional Fees and Legal Costs - By submitting samples for analysis, the client agrees that our analysis fees do not include the cost of any additional or incidental services

Client:	Douglas Partners (Newcastle)	**Job N°:**	39798.02
Attn:	C. Karpiel	**Order N°:**	71740
Project:	Hexham	**SESL Job N°:**	
		SESL Batch N°:	6370

that may be associated with such samples or the analytical results thereof. Cost of additional or incidental service efforts are billed to, and paid by, the client.

END OF DOCUMENT

SAMPLE RECEIPT ADVICE

Client: Douglas Partners (Newcastle)
PO Box 324
HRMC NSW 2310

Attn: C. Karpiel

Job N°: 39798.02

Order N°: 75485

Quality System
Quality Endorsed Company
AS/NZS ISO 9001: 2000
QEC 21650

Sydney Environmental and Soil Laboratory
Specialists in Soil Chemistry Agronomy and Contamination Assessments

Sydney Environmental & Soil Laboratory Pty Ltd
ABN 70 106 810 708
16 Chilvers Road
Thornleigh NSW 2120
Australia
Address mail to:
PO Box 357
Pennant Hills NSW 1715
Tel: 02 9980 6554
Fax: 02 9484 2427
Em: info@sesl.com.au
Web: www.sesl.com.au

Project: Hexham

SESL Job N°:
SESL Batch N°: 7023

Reporting Format: ☒ Mail ☒ Email PDF ☐ Fax ☐ Phone ☐ Email Excel

Date Samples Rec'd: 04/07/2008
Time Samples Received: 15:10
Sample Receipt Contact: Issy Purwanto
Requested Turnaround Time: Normal
Expected Report Date: 18/07/2008

Reporting Method: Results, interpretations & rec's
Reporting Contact: Paul Looby

Comments:
Please read this receipt carefully. If there are any discrepancies to expected testwork - notify laboratory immediately

Sample N°:	**1**	Samples received in adequate condition:	◉ Y ○ N ○ N/A
Name:	170/0.2-0.3	Sufficient sample quantity received for analysis:	◉ Y ○ N ○ N/A
Description:		Sample preservation method satisfactory:	◉ Y ○ N ○ N/A
Type:	Soil	Sample Temperature:	°C
Test Type:	Bulk Density, pH(CaCl), pH(water), EC, CEC, ESP, PRI, mEAT	Adequate documentation received:	◉ Y ○ N ○ N/A
		Health Risk:	○ Y ◉ N ○ N/A
Sample N°:	**2**	Samples received in adequate condition:	◉ Y ○ N ○ N/A
Name:	172/0-0.2	Sufficient sample quantity received for analysis:	◉ Y ○ N ○ N/A
Description:		Sample preservation method satisfactory:	◉ Y ○ N ○ N/A
Type:	Soil	Sample Temperature:	°C
Test Type:	Bulk Density, pH(CaCl), pH(water), EC, CEC, ESP, PRI, mEAT	Adequate documentation received:	◉ Y ○ N ○ N/A
		Health Risk:	○ Y ◉ N ○ N/A
Sample N°:	**3**	Samples received in adequate condition:	◉ Y ○ N ○ N/A
Name:	174/0.4-0.5	Sufficient sample quantity received for analysis:	◉ Y ○ N ○ N/A
Description:		Sample preservation method satisfactory:	◉ Y ○ N ○ N/A
Type:	Soil	Sample Temperature:	°C
Test Type:	Bulk Density, pH(CaCl), pH(water), EC, CEC, ESP, PRI, mEAT	Adequate documentation received:	◉ Y ○ N ○ N/A
		Health Risk:	○ Y ◉ N ○ N/A

Sample Receipt Advice	**Sydney Environmental & Soil Laboratory Pty Ltd** ABN 70 106 610 706

Client:	Douglas Partners (Newcastle)	**Job N°:**	39798.02
Attn:	C. Karpiel	**Order N°:**	75485
Project:	Hexham	**SESL Job N°:**	
		SESL Batch N°:	7023

Key to Test Type Codes:

Disp: Dispersability
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BD: Bulk Density
CW 1-CW4: Cricket Wicket Package 1-4
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LV/ANC: Liming value/Acid Neutralising Capacity
LOI: Loss on Ignition
mEAT: modified Emerson Aggregate Test
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NAGC: Net Acid Generating capacity
NDI: Nitrogen Drawdown Index
Olsen: Olsen Extractable Phosphorus
OM: Organic Matter
PSA : Particle Size Analysis (and Method)
PSA s+c: Particle Size Analysis / silt + clay

Perm: Permeability, **Struc**: Structure
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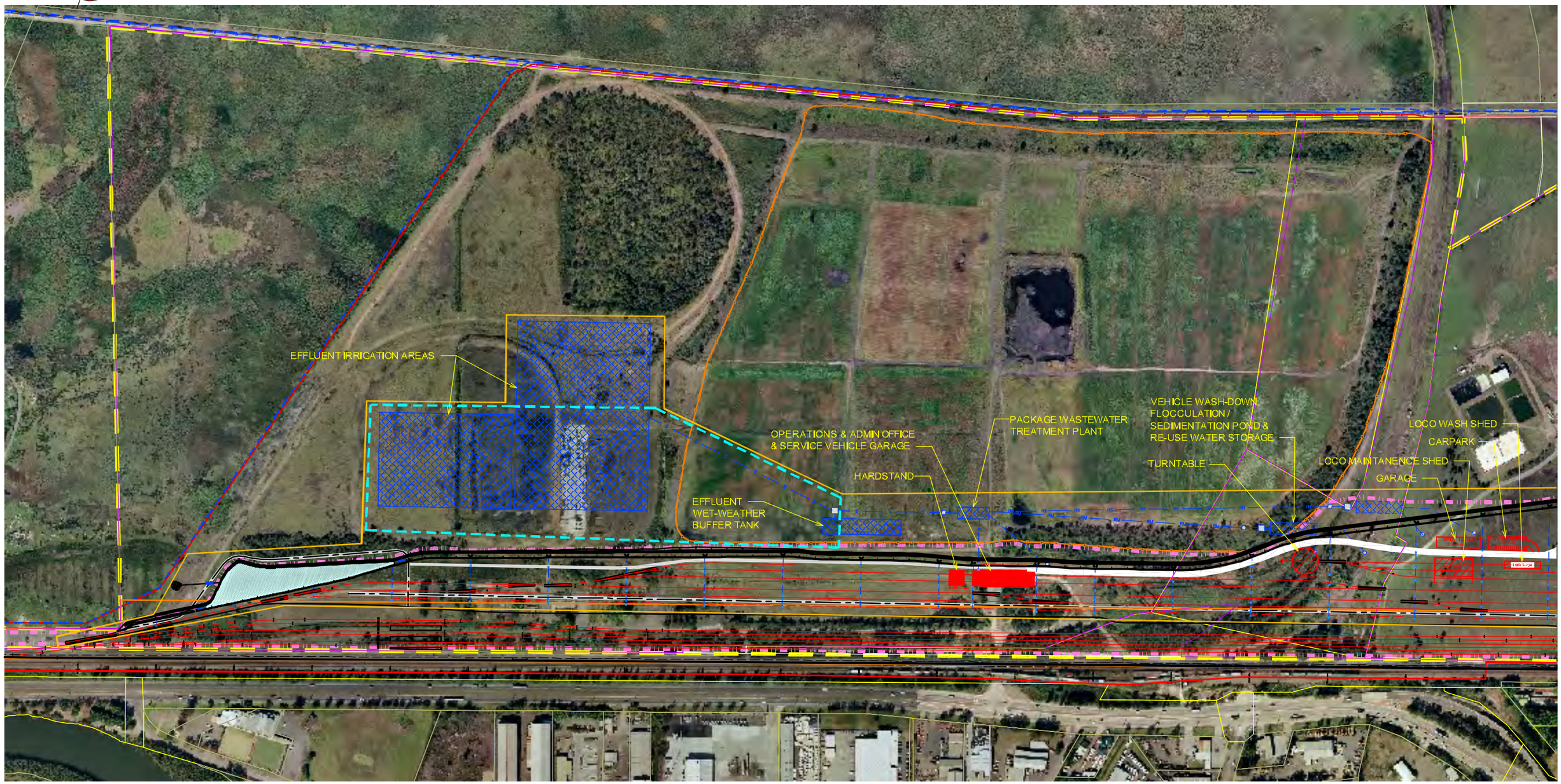
Appendix C

Figure 2 – Proposed Arrangement – Train Support Facility
(WorleyParsons) (Sheet 1 of 2 and Sheet 2 of 2)
Drawing 1 – Test Location Plan
Drawing ENG-03891-015 Issue E by Engenicom

FIGURE 2



LEGEND

- TRAIN SUPPORT FACILITY BOUNDARY
- PROPERTY BOUNDARY
- WATER RECYCLING & WASTEWATER TREATMENT SYSTEM
- HWC PROPOSED WATER MAIN
- EXISTING WATER MAIN
- PROPOSED ARTC RELIEF ROADS (TRACKS)
- TSF ROADS (TRACKS)
- STORMWATER DRAINAGE NETWORK
- COAL TAILINGS STOCKPILE EXTENTS
- PROPOSED CESS DRAIN
- PROPOSED WASTEWATER DRAINAGE LINE
- PROPOSED RISING MAIN

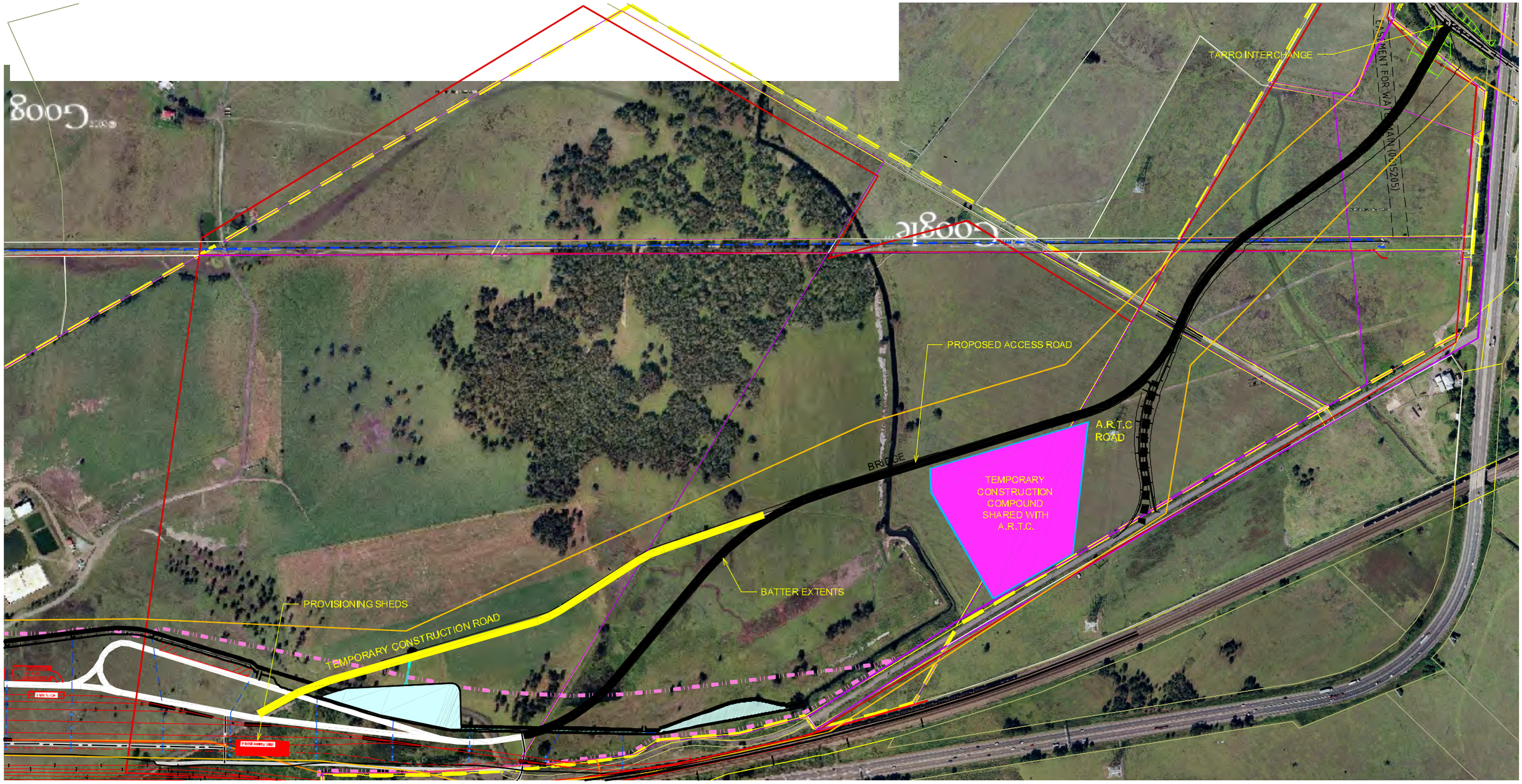
WorleyParsons
resources & energy

0 200m
1:5000

PROPOSED ARRANGEMENT TRAIN SUPPORT FACILITY SHEET 1 OF 2

O:\301020\03465 – QR TSF (GS)\12.0 Drawings\12.01 Civil Infrastructure\CAD\STORMWATER FIGURES\FIG 2-1_2-2_PROPOSED ARRANGEMENT.dwg 23/08/2012

FIGURE 2



LEGEND

- TRAIN SUPPORT FACILITY BOUNDARY
- PROPOSED CESS DRAIN
- PROPERTY BOUNDARY
- WATER RECYCLING & WASTEWATER TREATMENT SYSTEM
- TRUCK SHAKEDOWN AND WASHDOWN BAY (IF REQUIRED)

0 200m

1:5000

WorleyParsons
resources & energy

PROPOSED ARRANGEMENT
TRAIN SUPPORT FACILITY
SHEET 2 OF 2

O:\301020\03465 – QR TSF (GS)\12.0 Drawings\12.01 Civil Infrastructure\CAD\STORMWATER FIGURES\FIG 2-1_2-2_PROPOSED ARRANGEMENT.dwg 23/08/2012

LEGEND

- SITE BOUNDARY
- INVESTIGATION AREA
- PROPOSED PRIMARY AND SECONDARY EFFLUENT DISPOSAL AREA (Refer to Drawing ENG-03891-015 Issue D by Engenlcom for details)
- APPROXIMATE AREA OF DAIRY FARMERS TREATED EFFLUENT IRRIGATION
- APPROXIMATE CREEK/ DRAINAGE CHANNEL/ INTERMITTENT WATERWAY
- APPROXIMATE TEST PIT LOCATION (39798.02-2008)
- APPROXIMATE BOREHOLE LOCATION (39798.02-2008)
- APPROXIMATE BOREHOLE LOCATION (39798 -OCT 2007)
- APPROXIMATE LOCATION OF STOCKPILES
- APPROXIMATE SURFACE WATER SAMPLE LOCATION (39798.02-MAY 2008)
- W GROUNDWATER MONITORING WELL
- (3) APPROXIMATE PHOTO LOCATION & ORIENTATION
- CONTOURS - 1M INTERVALS (AHD)
- APPROXIMATE SLOPE DIRECTION AND ORIENTATION

DRAWING ADAPTED FROM PLAN SUPPLIED BY CLIENT, FILE REF SKETCH120829 Site Masterplan-Final.dwg provided 30.08.2012 AND NEAR MAP IMAGE DATED 25 JUNE 2011

Ref:/P/39798.07/Drawings/39798.07 Drawing 1

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: QR National		TITLE: **Proposed Effluent Disposal Assessment**	PROJECT No: 39798.07
OFFICE: Newcastle	DRAWN BY: PLH	**Proposed Train Support Facility**	DRAWING No: 1
SCALE: As shown	DATE: 30.08.2012	**Woodlands Close, Hexham**	REVISION: 1

SECONDARY BACK-UP EFFLUENT IRRIGATION AREA 20,000m²

PRIMARY EFFLUENT IRRIGATION AREA 40,000m²

WASTEWATER TREATED EFFLUENT BUFFER STORAGE

PACKAGE WASTEWATER TREATMENT PLANT

DIVERSION VALVE

EFFLUENT IRRIGATION PUMP STATION

OIL/GREASE SEPARATOR HOLDING TANK & SUMP & TRANSFER PUMP

1600m MIN CLEAR – No 3 ROAD

450m MIN – SHUNT NECK

R 300m

150m MIN CLEAR – CRIPPLE SIDING

No 2 WAGON ROAD

No 1 WAGON ROAD

No 3 ROAD

No 2 ROAD

No 1 ROAD (FUTURE EXPANSION OPTION)

400m MIN

500m MIN

300:9 T/O

STR

HARDSTAND

WAGON SHOP

8.750m CRS

VEHICLE WASH-DOWN FLOCCULATION/ SEDIMENTATION POND & RE-USE WATER STORAGE

COLLECTING WASTEWATER PUMP STATION

OFFICE, AMENITIES & GARAGE

CAR PARK

330m MIN

LOCO SHOP

LOCO WASH

No 3 LOCO ROAD

No 2 LOCO ROAD

No 1 LOCO ROAD

250m MIN – LOCO EXCHANGE/STORAGE

200m MIN – WAGON STORAGE

15.000 CRS

10.000m CRS

TURNTABLE

FUEL STORAGE AREA

PROVISIONING SHED

PROPOSED HOLDING ROADS

OVERFLOW STRUCTURE TO WASTEWATER SYSTEM

PETROL STORAGE

LOCO WASH DOWN AREA INCLUDING SUMPS & GROSS POLLUTANT TRAP

DETAILS AND INFORMATION ON THIS DRAWING HAVE BEEN DERIVED FROM PREVIOUS DESIGN AND DRAWINGS PREPARED BY WORLEY PARSONS. ORIGINAL PLANS WERE SUPPLIED AND USED WITH THE PERMISSION OF QR NATIONAL – THE SAME DEVELOPER/CLIENT OF THE SUBJECT SITE

DEVELOPMENT PLAN
NOT FOR CONSTRUCTION

LEGEND

- RAIL ℄ – QRN
- RAIL ℄ – QRN FUTURE
- RAIL ℄ – ARTC & Ex
- ACCESS ROADS – QRN
- ACCESS ROADS – ARTC
- EXISTING CONTOUR
- DESIGN CONTOUR
- CESS DRAIN & BANKS
- PIPES/CULVERTS; STORMWATER INLET PIT; HEADWALL
- PIPES/CULVERTS; JUMP-UP PIT; GROSS POLLUTANT TRAP
- BASIN – BANKS; WATER SURFACE;
- WASTEWATER TREATMENT SYSTEM

ISSUE	DATE	DESCRIPTION (Issue or Revision)
E	6.September.2012	ISSUED FOR PROJECT APPLICATION -Adequacy Review Update
D	29.May.2012	ISSUED FOR PROJECT APPLICATION - Irrigation Beds Moved
C	21.May.2012	ISSUED FOR PROJECT APPLICATION - Sheet numbers revised
B		- not issued -
A	26.Apr.2012	ISSUED FOR PROJECT APPLICATION

A.03891

Engenicom Pty Ltd
ABN 84 124 046 377
161 King Street, NEWCASTLE , NSW, 2300
t +61 2 4941 7500
f +61 2 4927 8581
engenicom@engenicom.com.au
www.ugm.com.au

DRAWN	DQ
DESIGNED	GC
CHECKED	EM + JH
APPROVED	----
CAD FILE	aMaster_G.dwg

QR National Limited
ACN 146 335 622
Ground Floor
GPO Box 456
BRISBANE QLD 4001
t +61 7 3235 5555
f +61 2 4924 3699
www.qrnational.com.au

QRN – HEXHAM TRAIN SUPPORT FACILITY
HEXHAM, NSW
WATER RECYCLING and WASTEWATER TREATMENT SYSTEM
General Arrangement

DRG No.	Issue	Sheet	Scale	Sheet Size
ENG-03891-015	E	12 OF 26	Plan: 1:1,500	A1

PLOTTED 06-Sep-2012 03:50 PM

DO NOT SCALE