CONSULTING EARTH SCIENTISTS

SURFACE & GROUNDWATER IMPACT ASSESSMENT

MANGROVE MOUNTAIN LANDFILL,
HALLARDS ROAD, CENTRAL MANGROVE, NSW.
PREPARED FOR VERDE TERRA PTY LTD
CES DOCUMENT REFERENCED: CES110703-VDT-FD

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Date: 15 June 2016

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Revision Number	Revision Date	Description
1	12/04/16	Initial Issue to Client
FD	15/06/16	Final

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CONTENTS

1. Introduction and Purpose 4

2. Pollutants of Concern 4

3. Characteristics of Groundwater, Surface Water & Leachate 5

4. Measures to Prevent, Control & Mitigate Pollution 7

5. Receiving Waters and Their Environmental Values 8

Appendix A Photographs taken 26 February 2016

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1. INTRODUCTION AND PURPOSE

This Surface and Groundwater Impact Assessment has been prepared in response to comments and queries raised by the NSW Environmental Protection Authority (EPA) in their correspondence referenced: DOC15/527997 dated 23 December 2015 and particularly with reference to Item 7 of the EPA letter, which in summary requests the following:

- Identification of pollutants of concern that could potentially be mobilised and transported to surface water or groundwater from materials at the premises.
- A characterisation of the leachate and stormwater generated on the premises, identifying all pollutants that pose a risk of non-trivial harm to human health or the environment.
- An assessment of practical measures that could be taken to prevent, control, abate or mitigate pollution from the premises, and to protect the environment from harm as a result of that pollution.
- Identify the environmental values of the receiving waters and provide an assessment of the potential impact of any discharges from the sediment basins and leachate holding pond on these values.

Consulting Earth Scientists Pty Ltd (CES) herein provides the requested information and assessment.

2. POLLUTANTS OF CONCERN

Mangrove Mountain Landfill under Environmental Protection Licence (EPL) number 11395 is permitted to accept General Solid Waste (non-putrescible). The Landfill Environmental Management Plan refers to four sub-plans which primarily relate to the management and control of water quality at the site, these sub-plans are namely:

- Landfill Environmental Management Plan 2014 (LEMP 2014) (CES Document Referenced: CES110703-VDT-FA dated 14 June 2016).
- The Leachate Management Plan 2014 (LMP 2014) (CES Document Reference: CES110703-VDT-FB dated 14 June 2016).

- The Soil and Water Management Plan (SWMP) (CES Document Reference: CES110703-VDT-FC dated 14 June 2016).
- Quality Assurance/Quality Control (QA/QC) Plan: Environmental Monitoring Programme (CES Document Reference: CES110703-VT-QAQC-CC Dated 30 May 2016).

These plans prescribe the systems and controls which are designed to prevent the migration of potentially contaminated surface water and leachate from the site and prevent adverse impact to groundwater. The LEMP 2014, LMP 2014, SWMP and QAQC Plan provide the requirements for the surface water, leachate and groundwater management and monitoring infrastructure, management controls and operating procedures.

In terms of pollutants of concern at the site, which could be present and potentially be mobilised and transported by surface waters (and in some cases) groundwater, the principal pollutants that would typically be of concern in relation to a general solid waste (non-putrescible) landfill are:

- Suspended solids/turbidity
- Dissolved solids/electrical conductivity
- pH and alkalinity
- Ammonia (nitrogen)
- Total organic carbon
- Hydrocarbons
- Chloride
- Sulphate
- Phosphate
- Nitrate and Nitrite
- Metals

3. CHARACTERISTICS OF GROUNDWATER, SURFACE WATER & LEACHATE

3.1 Groundwater

CES undertake environmental monitoring of groundwater at the site as required under the EPL on a quarterly basis. This involves the monitoring of ten monitoring wells around the perimeter of the landfill facility. A primary purpose of this monitoring is to assess whether leachate or surface water from the landfill facility is affecting the quality of groundwater.

The regular environmental monitoring over the last five years has shown that groundwater in the monitoring wells surrounding the landfill is characterised by the following properties:

- pH 3.7 to 5.5 (slightly acidic).
- Electrical conductivity (EC) (total dissolved solids), Biochemical Oxygen Demand (BOD), Total Organic carbon (TOC), alkalinity, redox, ammonia, nitrogen, phosphorous, potassium, sulphate, chloride, hydrocarbons, pesticides, phenolics and metals are all at very low or undetected levels.

Ammonia, chloride, sulphate, nitrate and nitrite and TOC are used as general indicators of leachate contamination within groundwater and they have been consistently below the Practical Quantification Limit (PQL), which is the laboratory limit of detection, or at low levels since CES commenced monitoring in 2010. pH has been shown to be low (acidic), which is typical of Hawkesbury Sandstone environments.

The monitoring program has been in place since 2010 and to date there has been no evidence of groundwater being impacted by leachate.

3.2 Leachate

Leachate in the holding pond was most recently monitored in October 2015. As would be expected, leachate in the holding pond was shown to possess elevated levels of several analytes including electrical conductivity, TOC, alkalinity, Total Suspended Solids (TSS) and petroleum hydrocarbons, and a pH of 8.4.

3.3 Surface Water

The surface water retained in the Sediment Basins at the site was most recently monitored in October 2015. Three ponds (SW02, SW03, SW04) are located in the eastern corner of the landfill site and the fourth (SW05) lies further downslope and in the north-east corner of the golf course. This Golf Course Pond is the lowest topographically, and the pond from which any overflow or discharge would occur.

These four ponds showed significantly lower levels of all analytes than the leachate holding pond. The two ponds immediately adjacent to the leachate holding pond showed partly elevated concentrations of ammonia and (in SW03) TSS. However, both pond SW04 and the Golf Course Pond (SW05, from which any discharge would occur), showed levels of all analytes which satisfied the licence discharge criteria. The discharge criteria which apply under the EPL are as follows:

- Ammonia 0.9 mg/l

- pH 6.5 – 8.5
- Total Suspended Solids (TSS) 50 mg/l.

This large contrast in contaminant concentrations between the leachate in the leachate holding pond and the surface water in the Golf Course Pond (the basin from which water would discharge from the site into the adjacent creek) indicates that there is very little or no impact on the potential discharge waters from the site from leachate.

4. MEASURES TO PREVENT, CONTROL & MITIGATE POLLUTION

As described above, the primary control and management plans under the Landfill Environmental Management Plan that prescribe the infrastructure, monitoring requirements, management and control measures to be implemented at the site to mitigate water pollution impacts are the Soil and Water Management Plan (SWMP) and the Leachate Management Plan 2014 (LMP2014) and the Quality Assurance/Quality Control (QA/QC) Plan: Environmental Monitoring Programme. The measures and controls in these plans are summarised briefly below:

- Measures to be implemented during landfill operations to minimise leachate generation.
- Progressive landfill cell construction and capping.
- Provision of an engineered leachate barrier with design performance greater than prescribed EPA Benchmark Techniques.
- Provision of a leachate collection and conveyance system and mechanisms for backflushing and maintenance and no pumping or mechanical extraction requirements during the non-active and post landfill closure stages.
- Management, control and monitoring requirements for leachate in the landfill cell and leachate holding pond.
- Provision of a new specifically designed leachate holding dam with capacity to hold leachate generated from new proposed cells and existing landfill areas. Holding dam designed with a conservative approach.
- Provision of extraordinary supplementary backup leachate management measures such as installation of a leachate cut off trench that would intercept any fugitive leachate.
- Environmental monitoring of groundwater, leachate and surface water quality to ensure relevant criteria are being met.
- Surface water control strategies prescribed to:

  - Minimise areas of exposed and disturbed soil at any time;
  - Minimise runoff volumes by minimising catchment areas at any time;
  - Diverting and intercepting clean runoff from adjoining lands;
  - Provide for operational uses for surface water runoff, e.g. for dust suppression.

- Installation and construction of appropriate infrastructure such as
  - Erosion control measures;
  - Perimeter drains to convey runoff within the site into sedimentation dams;
  - A system of sediment and stormwater retention basins to contain sediment and runoff.
  - Construction of perimeter containment bunds along the southern and eastern site boundaries to prevent clean runoff entering the landfill from offsite.

It is considered that the measures and controls outlined in the SWMP and the LMP, and summarised above, will provide a high level of protection to both surface waters and groundwater.

5. RECEIVING WATERS AND THEIR ENVIRONMENTAL VALUES

The primary surface water body in close proximity to the landfill is a small unnamed creek which passes along the northern boundary of the current area regulated under the EPL. This is the creek into which during periods of prolonged heavy rainfall, water retained in the Sediment Retention Basins at the site may overtop and discharge. This creek shall be referred to as Creek A.

Creek A flows in an easterly direction for approximately 330m along the northern extent of the Mangrove Mountain Memorial Golf Course into a dam operated by the golf course that is used for golf course irrigation purposes. Creek A then flows in an easterly direction for approximately 2km to the confluence with the larger Ourimbah Creek at Stringybark Point. Along this section, Creek A flows through steep terrain which consists of forested gorges and sandstone ledges of the Ourimbah State Forest.

It should be noted that Creek A is distinctly separate to Hallards Creek. Hallards Creek passes further to the north and east of the landfill site and drains the area to the north and west of the landfill site. A very small area within the north-western corner of the landfill property boundary

(and the area defined in the EPL) drains to the north and west into small drainage lines which flow ultimately to Hallards Creek. This area (approximately 3,000 m^2) includes an unsealed car park and vehicle turning area. No part of the active landfill operational area or former filling area drain to Hallards Creek. In addition, a section of the unsealed access road off Hallards Road to the landfill facilities also drains to the north west towards Hallards Creek. This area also does not include any operational components or facilities associated with the landfill operation, only part of the access road which is largely unsealed.

Hallards Creek is separated from Creek A by a ridgeline and as such the golf course area drains toward Creek A and then to Ourimbah Creek and not via Hallards Creek. Hallards Creek does however also flow into Ourimbah Creek converging with it at a point approximately 300m upstream of Stringybark Point.

From Stringybark Point, Ourimbah Creek flows to the south-east through the densely wooded Ourimbah State Forest for approximately 4km before the valley floor widens and the adjacent land is occupied by cleared private rural properties. Ourimbah Creek then becomes larger and the valley widens further, passing for a further 15km through largely cleared agricultural land before it heads north-east to Palmdale and the M1 Sydney to Newcastle Motorway. Ourimbah Creek then passes under the Motorway and meanders through largely semi-rural and built-up industrial and residential land before entering Tuggerah Lake at Chittaway Point, approximately 10 km east of the Motorway.

A weir is located on Ourimbah Creek on the western side of the Motorway approximately 1km south of Palmdale. This weir provides water which is pumped to Mardi Dam (about 5 km to the north) where, following treatment, it is used to augment the Central Coast and Wyong reticulated water supply system.

It should be noted that the main catchment area of Ourimbah Creek lies upstream of Stringybark Point and the confluence of Creek A and Ourimbah Creek. This upstream part of the Ourimbah Creek catchment is largely within the heavily timbered area of Ourimbah State Forest, but much of it also includes the cleared agricultural areas on the eastern side of George Downes Drive and the southern side of Springs Road, Greta Road and Forest Road. This significant area of cleared agricultural land forms the headwaters of the many small tributaries of the upper part of Ourimbah Creek. Land uses here include orchards, market gardening and horticulture, poultry

sheds, horse and cattle grazing, a car or go-kart race track as well as other rural activities and numerous rural-residential holdings.

The environmental values of Ourimbah Creek (in terms of water quality) are affected by activities in the substantial areas of cleared and largely agricultural land located upstream and downstream of the confluence with Creek A at Stringybark Point.

There is little publically available information with regards to water quality of Ourimbah Creek. Wyong Shire Council have carried out some water quality monitoring in Ourimbah Creek and describe the Creek as being 'under stress' in their State of the Environment Report for 2003/4. It is also noted that flows in Ourimbah Creek (and therefore water quality) in the downstream section are affected by water supply extractions at the weir adjacent to the M1 Sydney to Newcastle Motorway. The report also states that nutrient concentrations in Ourimbah Creek were reported to be relatively high. Council also noted that at a popular swimming point in the lower reaches (near Chittaway Point and Tuggerah Lake) found faecal bacteria levels that were found to fail the guidelines for safe swimming throughout the summer of 2003/4.

Another report prepared in 2004 by the Federal Department of the Environment and the NSW EPA on NSW coastal river health between 1994 and 1999 assessed Ourimbah Creek near the M1 Sydney to Newcastle Motorway and found that concentrations of nitrates and nitrites were higher than expected for this type of stream, pH was low (6.3 to 6.5) and turbidity was high. Conductivity was moderate (130 to 220 uS/cm). The relatively low pH in Ourimbah Creek could be in part due to the naturally low pH of groundwater in Hawkesbury Sandstone environments throughout the greater Sydney area, as well as surface contributions in forested and agricultural areas from humic and formic acids.

The environmental values that apply to water quality within the Ourimbah Creek catchment can be considered under four categories:

- Aquatic ecosystems and biological habitat;
- Recreational water (human health issues relating to primary and secondary contact and visual quality);
- Drinking water (raw water) quality and use; and
- Primary industries (for both irrigation and animal use) and other industries.

Concerns relating to aquatic ecosystems apply throughout all sections of the Creek (headwaters, upstream and downstream), but particularly to the upper and middle reaches. Uses of the Creek waters for recreational, drinking purposes and agricultural/industrial uses are primarily within the lower and downstream sections of the Creek, where dilution from multiple catchment area

contributions and a multitude of other pollutant sources make the potential impacts from a single source (such as the subject site) within the headwaters far less significant to the catchment as a whole.

Summary

Given the existing environment of the Ourimbah Creek valley and consideration to the aforementioned reports on water quality in Ourimbah Creek and assuming proper implementation of the systems and management procedures prescribed under the LEMP2014, the LMP 2014, the SWMP and the QA/QC Plan and assuming good landfill operational procedure and management and application of the discharge criteria stated in Environment Protection Licence Number 11395, it is assessed that there would be little or no significant impact to the receiving waters, and therefore to the environmental values of Ourimbah Creek attributable to the activities at the landfill site.

APPENDIX A

Photographs Taken 26 February 2016

Photograph 1: Golf Course Dam in the (lowest) north east corner of the golf course

Photograph 2: Drainage from the golf course flowing to Ourimbah State Forest

Photograph 3: Small creek line draining from the golf course through Ourimbah State Forest (no turbidity observed)

Photograph 4: Ourimbah Creek in open cleared valley, downstream from Ourimbah State Forest. Note sediment build-up from clearing and erosion within the valley.

Photograph 5: Turbid middle reaches of Ourimbah Creek, showing sediment build-up and suspended sediment from local run-off.

Photograph 6: Ourimbah Creek immediately upstream of the weir near F3 Motorway, showing turbidity from local run-off waters.