

12/07/2016

**Terry Sargent**  
**Director Commercial Enterprises**  
Shire of Esperance  
PO Box 507  
Windich Street, Esperance  
WA 6450

Dear Terry,

## **LANDFILL SITE SELECTION STUDY**

### **Site 11 Update**

The Shire of Esperance (the Shire) has commissioned Talis Consultants Pty Ltd (Talis) to undertake a Site Selection Study with the objective of selecting a suitable site for the development of a modern landfill facility. As part of this study, Talis has undertaken a variety of investigation works on the Preferred Freehold Site – Site 11 (the Site) including:

- Hydrogeological Investigations
- Geotechnical Investigations; and
- Due Diligence, Landfill Capability Assessment and Approvals Path.

Talis has prepared this letter to provide the Shire with an update on the key findings of these works with a particular emphasis on the Hydrogeological and Geotechnical investigations undertaken on the Site. In addition, this letter includes Talis' recommendations in relation to moving forward.

## **1 Site Conditions**

Hydrogeological mapping works obtained by Talis indicated that the Site is underlain by two distinctly different aquifers, with a sandstone aquifer of minor to major resource situated within the south eastern portion of the Site. The remainder of the Site is underlain by a fractured aquifer of minor or no resource. On site drilling confirmed the occurrence of these aquifers with metagranites encountered at approximately 6 metres depth below ground level across the majority of the site and a weathered sandstone encountered within the south eastern portion, underlain by further metagranites. Due to the sandstone being a minor to major resource, the investigation targeted the fractured aquifer which was regarded by Talis as a more desirable area of the Site for the siting and development of a modern landfill facility.

Superficial soils encountered were homogeneous across the Site. A clayey sand was encountered beneath the topsoil and was underlain by a stiff to hard, low plasticity clay. Beneath this clay, a weathering profile of the underlying metaigneous material was

encountered and described as clayey sands and gravels. Seepage was noted from within this weathering profile. The fresh hard rock was described as metaigneous material.

### 1.1 Soil Analysis

Undisturbed and disturbed samples were collected during the investigation to ascertain the engineering potential and permeability of soils within the general area of the landfill footprint. Geotechnical testing confirmed the visual assessment with relation to the quality of the soils, with the clays being stiff to very hard, limited moisture and of low plasticity. Laboratory permeability analysis highlighted that the clays were essentially impermeable in nature.

### 1.2 Groundwater Analysis

Groundwater monitoring wells were installed across the Site to ascertain depth to groundwater. Following installation, groundwater wells were gauged to ascertain groundwater depth and direction of flow across the Site while groundwater samples were collected to gain an understanding of the quality of water and, subsequently, its potential beneficial use.

Following groundwater gauging, groundwater depth was shown to be between 0.7 m below ground level (bgl) and 7.36 mbgl within the fractured aquifer. Depth to groundwater within the sandstone aquifer was shown to be between 6.59 mbgl and 10.79 mbgl. Of interest, the groundwater level within the central and northern portion of the Site, where the footprint of the landfill was envisaged, was shown to vary between 0.7 mbgl and 2.9 mbgl. Depth to groundwater within the fractured aquifer within the southern area was shown to be 7.36 mbgl. This is shown within the attached Figure.

Groundwater depth within the central and northern area of the Site was unexpected based on the depth to the aquifer and the overlying impermeable clay. It would appear that within this area groundwater is confined and once the confining clays are pierced groundwater flows to between 0.7 mbgl and 2.9 mbgl, likely to be its potentiometric surface or structurally controlled from an unknown geological feature within the central area.

Groundwater sampling confirmed the quality of the sandstone aquifer to be fresh to brackish and likely used for stock waters within the general area. The quality of the fractured aquifer was poorer and saline in nature but could likely be used for non-potable purposes, however, salinity may be too high.

### 1.3 Key Findings

Initial assessment of the Site suggested that groundwater within the fractured aquifer would be confined at depth, with the impermeable clay acting as an aquiclude confining the groundwater to depths thus supportive to the development of a landfill across the majority of the Site. However, following ongoing assessment, it would appear that the clay is not acting as an impervious aquiclude. Therefore, should any excavations be undertaken across the centre and northern areas of the Site, it would be likely that groundwater would impact and

seep into any excavation flowing to a depth of between 1 mbgl and 2 mbgl. This has the potential to cause basal upheave issues and/or cause issue with relation to leachate generation. In addition, potential pumping activities to try to control the groundwater across this area of the Site would need to be extensive to ensure that they are managed to appropriate standards requiring significant capital and operational expenditure. In addition such pumping activities would significantly increase the risk profile of the project and based on experience, Talis believes would be unacceptable to the Department of Environmental Regulation. Talis also considered the option of developing an above ground landfill facility however the potential costs associated with the significant additional earthworks required to lift the base of the landfill and construct appropriate side walls would make the project financially unattractive.

Therefore, Talis is of the view that the central and northern areas of the Site should be deemed unsuitable for the siting and construction of landfill due to this confined aquifer.

## 1.4 Further Investigations

It should be noted that the depth to groundwater within the sandstone aquifer within the south-eastern area of the Site is between 6.59 mbgl and 10.79 mbgl, which is likely to be suitable depth to groundwater for a proposed landfill facility. Further to this, groundwater within the fractured aquifer within the south western area is 7.36 mbgl highlighting potentially a suitable depth to groundwater as well. This analysis also supports Talis' current view that there is potentially an unknown geological feature within the central proportion of the Site which is confining the groundwater system of the northern and central areas of the Site.

Talis is of the view that there are a variety of strong attributes in relation to the southern area of the Site in relation to the development of a landfill including significant separation distance from sensitive receptors (residential dwellings), ability to establish large internal buffers within the Site as well as significant available area for the establishment of a landfill facility. However, no assessment of a superficial aquifer within the southern proportion has been undertaken. Therefore, should the Shire wish to fully evaluate all options for the siting of a landfill within this Site, the following further investigations would be required:

- Five sets of groundwater wells (two per location targeting superficial and sandstone aquifer) within the sandstone aquifer to confirm depth to groundwater and soil composition;
- Five sets groundwater wells (two per location targeting superficial and fractured aquifer) within the fractured aquifer within the south western area to confirm groundwater depth and soil quality;
- Installation of six monitoring wells within the shallow soils (3.0m) to ascertain the potential for groundwater under pressure causing seepage within the top 3 m of the soil profile;
- Sinking of several trial excavations, fenced and left open for a period of 1 week to assess the potential for groundwater seepage;
- Installation of six soil and rock profiling bores across the site, from the south to north, to fully understand the geological sequence across the site.

Based on our experience in undertaking similar works, Talis recognises that these works will take 3 months to complete from commencement.

## 1.5 Discussion and Recommendations

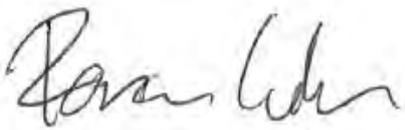
Based on the information obtained from the Hydrogeological and Geotechnical Investigations undertaken across the Site, Talis has determined that the central and northern areas of the Site are unsuitable for the siting and establishment of a landfill due to the unexpected groundwater issues within those areas which we suspect is due to an unknown geological feature located along the central to southern proportion of the Site. However, initial investigations indicate that the southern proportion of the Site could be suitable for the development of the landfill, subject to confirmation from further on site investigations. It will take 3 months to complete the investigation works within the southern area of the Site.

Talis recommends that the Shire seeks to negotiate an extension to the Site Investigation / Due Diligence phase of the current Sale Agreement with the landowner of Site 11 as a priority, particularly given that the Site is the only land that the Shire currently has access to. In addition, Talis recommends that the Shire consider options to obtain access to other Sites including Freehold and Crown and Shire land.

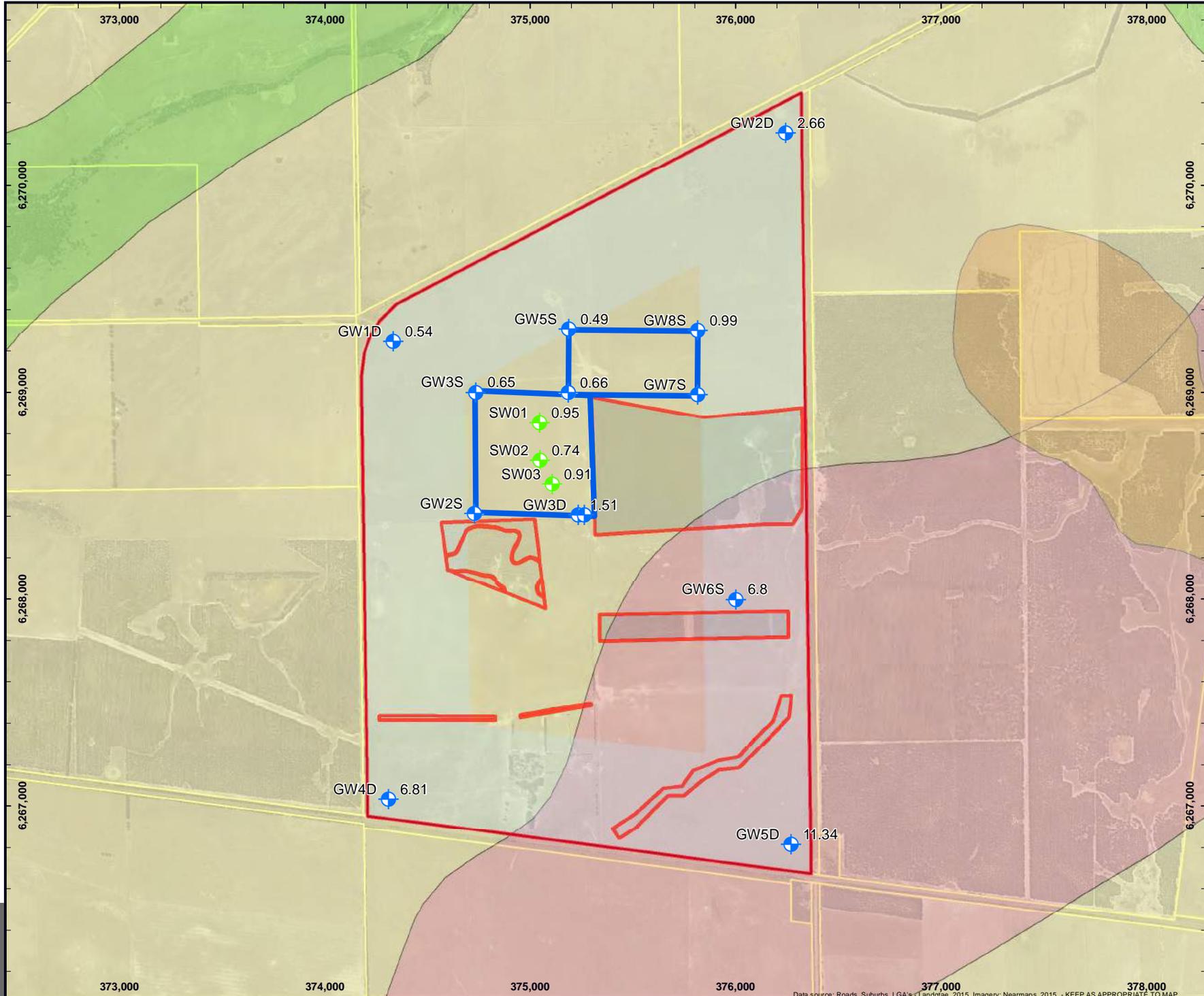
### *Closing*

If you have any queries, please do not hesitate to contact me by any of the means listed below.

*Yours sincerely,*



Ronan Cullen  
**Director & Waste Management Section Leader**  
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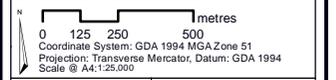
**LEGEND**

- Sites of Interest
  - Alternative Landfill Areas
  - Bores and Wells 2016**
  - ◆ GW
  - ◆ SW
  - Mapped Aquifers**
  - Sedimentary aquifer - extensive aquifer, minor to major groundwater resources
  - Surficial aquifer - local sedimentary aquifer, minor groundwater resources
  - Fractured and weathered rocks - local aquifer, very minor or no groundwater resources
  - Sedimentary aquitards and local aquifer - minor to no groundwater resources
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**SITE 11  
GROUNDWATER LEVELS**

Esperance Landfill Study



Prepared: J. Southwood	Date: 12/07/2016
Checked:	Project No: TW16022
Reviewed: Ronan Cullen	Revision: A

Figure 1