ECOS

Wetland Management Plan

Hydrogeological Management Plan

Report

October 2005

Contents

Table Index

Figure Index

1. Introduction

ECOS Pty Ltd (ECOS) commissioned GHD Pty Ltd (GHD) to assist in the establishment of a hydrogeological Wetland Management Plan for the groundwater management component during the installation of a gas pipeline within the existing Dampier-Bunbury Natural Gas Pipeline (DBNGP) easement.

1.1 Background

ECOS is in the process of compiling an Environmental Management Plan to address potential environmental issues associated with installation activities of an underground gas pipeline. It is anticipated that the gas pipeline will be installed at a maximum completion depth of 1.5 below ground level (bgl), approximately four to six metres east of an existing gas pipeline installed to the same completion depth in the 1980s.

2. Objectives

The objectives of the hydrogeological wetland management plan are to assess potential dewatering impacts on groundwater dependant ecosystems and potential groundwater issues that may adversely affect the environment associated with the installation and long term operation of the proposed gas pipeline and propose appropriate management strategies to mitigate adverse effects.

3. Scope of Work

To meet the project objectives detailed above, GHD undertook the following scope of work:

» desktop review of available information pertaining to the study area;

» hydrogeological assessment of dewatering rates and associated radius of influence;

» development of management strategies addressing potential adverse environmental impacts associated with dewatering activities and long term operation of the proposed gas pipeline.

This report was prepared to document the findings of this study.

4. Dewatering Discharge

To assess potential adverse environmental effects associated with the installation and the long-term operation of the proposed gas pipeline, the following analytical and interpretive evaluation methodologies were used:

» assessment of the dewatering water discharge options; and

» groundwater drawdown analysis associated with trench dewatering.

4.1 Groundwater Dewatering Analysis

During trenching and installation of the proposed gas pipeline dewatering measures may be required to provide a dry work environment.

The dewatering rates are based on the estimation that the maximum drawdown depth at the trench will be 2m bgl. It is understood that the maximum trenching depth is to be 1.5m bgl, however, a 0.5m buffer was incorporated in the calculation of the maximum required drawdown as a safety buffer.

A hydraulic permeability coefficient (15m/d), consistent with documented geology (Bassendean Sands), was used in the calculation of the dewatering rates.

Dewatering rates were calculated based on modified Dupuit-Forcheimer equation (Freeze, 1979) according to Driscoll (1986). The Dupuit-Forcheimer equation provides an evaluation of the discharge rates in a linear dewatering array. The modified Dupuit-Forcheimer equation evaluates the trench end conditions, incorporating a radial dewatering array (Figure 1).

Based on the modified Dupuit-Forcheimer, a dewatering rate of approximately 1000m^3/d was calculated. It is noted that the calculated dewatering rate is based on a trench length of 800m, corresponding to the maximum daily open trench length.

4.2 Radius of Influence

Dewatering of the trench will result in drawdown in the aquifer surrounding the excavation trench. The radius of influence resulting from trench dewatering has the potential to adversely affect the environment if the extending into watertable dependant ecosystems.

The radius of influence was estimated based on the hydraulic conductivity of the underlying geology (Bassendean Sands) and a range of dewatering rates.

Based on the above assumptions, an estimate for the maximum radius of influence associated with trench dewatering is 20 m from the centre line of the trench.

4.3 Discussions

The dewatering rate and radius of influence have been based on typical parameters for the anticipated geology and various assumptions that will need to be ratified following further site evaluation in particular in regards to the Site geology.

It is understood that an Acid Sulphate Soil investigation is currently being conducted along the proposed gas pipeline alignment. Review of the Interim Acid Sulphate Soil Report[1] indicated that the acid generating capacity of soils, including organic sands and peat, encountered during the investigation was overall, low. It noted however that the preliminary conclusions are based on field testing and logging and consequently are indicative only. The results of laboratory analyses are pending. It is further noted that acidic groundwater conditions were encountered in all of the 13 groundwater monitoring bores. While acidic groundwater conditions may in part reflect natural conditions, it is considered that management of the abstracted acidic groundwater during dewatering will be required.

PB, August 2005; Interim Report: Preliminary Acid Sulphate Soil Investigation – Kemerton Lateral Pipeline

5. Impacts of the Proposed Gas Pipeline on Static Groundwater Flow

The proposed gas pipeline is to be installed at the same depth as an adjacent existing pipeline. It is noted that the diameter of the proposed gas pipeline is larger than the existing one, however the difference in pipe diameter is small and it is considered will have an insignificant effect on the static groundwater flow,.

As the proposed gas pipeline is to be installed in an unconfined sand aquifer, groundwater has the potential to flow over and under the proposed gas pipeline.

The potential for minor disruptions in the local groundwater flow regime is noted, however it is not anticipated that any of these local effects have the potential to cause significant adverse effects on groundwater dependant ecosystems.

The proposed gas pipeline can only have an effect on the local groundwater flow direction if installed at the watertable. Should the proposed gas pipeline be installed under the groundwater table, groundwater can freely flow above the pipeline. Should the pipeline be installed above the watertable, the local groundwater flow regime will not be disturbed.

6. Management Plan

The proposed gas pipeline alignment transects a sump lands with a high density of perennial wetland bodies. In order not to adversely affect the sump land, nor the perennial wetlands, the hydrogeological dewatering plan detailed in Table 1 has been compiled.

Activity	Potential Risk to the Environment	Management Strategy	Management Solutions
Dewatering	Dewatering radius of influence interacts with groundwater table dependant ecosystems (i.e. wetlands)	Where open water bodies are present within 40m of the proposed gas pipeline alignment, dewatering of the trench will require management as not to affect the water level in these open water bodies. Based on proposed gas pipeline alignment is not within 40m of any perennial open water bodies.	Open water bodies that are within 40m of the dewatering trench will require water level monitoring during the dewatering exercise. Should dewatering affect the open water table, then one of the following management solutions should be envisaged depending on site conditions. It is noted that water level monitoring is required at all times to assess the outcome of the proposed management solution: » reduce the length of the open excavation such that lower dewatering rates can be applied; » infiltration of abstracted trench dewatering water in proximity to the open water body; » controlled dewatering inflow directly into the open water body depending on water compatibility and approval through relevant regulatory bodies.
	Trench dewatering may lower the groundwater table such that roots of groundwater dependant vegetation may not be adequate to reach the altered groundwater elevation.	During trench dewatering, it is considered that the dewatering period is not significant enough to adversely affect groundwater dependant flora.	Should dewatering be sustained for significant periods (greater than 24 hrs) at a given location then the areas affected by the dewatering cone of depression are to be irrigated by discharge water.

Activity	Potential Risk to the Environment	Management Strategy	Management Solutions
Dewatering (Continued)	Dewatering discharge waters may adversely affect the discharge environment due to various chemical and physical water quality parameters.	Abstracted groundwater during the trench dewatering exercise will require disposal in a way that does not impact the natural or cultural environment, or any environmental values.	There are several options for disposal of abstracted groundwater (see DoE/WRC Water Quality Protection Note, *Dewatering of Soil,* August 2003). Groundwater quality requires assessment to determine compatibility of dewatering discharge and receptor water. DoE dewatering management guidelines should be reviewed to determine the required parameters prior to the discharge of abstracted groundwater, which include: pH, Total Titratable Acidity; Total Alkalinity; Electrical Conductivity; temperature; turbidity; and iron and aluminium (dissolved and total). These groundwater parameters are to be assessed in accordance with DoE (2003) "Assessment Levels for Soil, Sediment and Groundwater. Due to the sensitivity of the subject area, it is furthermore recommended to establish dewatering assessment criteria with DoE to address the current acidic nature of groundwater at the subject area. Due to the mobility of the planned works, the recommended dewatering discharge methodology is to discharge groundwater by means of flooding and subsequent infiltration into the immediate surrounding of the excavation trench.

Activity	Potential Risk to the Environment	Management Strategy	Management Solutions
	Dewatering discharge can potentially facilitate the spread of *Phytophthora cinnamomi* (i.e. Dieback).	Dewatering of areas that are potentially affected by *Phytophthora cinnamomi* will require disposal to a an area of the same *Phytophthora cinnamomi* classification.	Prior to trench dewatering, the contractor will consult the *Phytophthora cinnamomi* spread map to assess potential occurrence of *Phytophthora cinnamomi* in the works area. Dewatering discharge will be disposed of in an area of the same *Phytophthora cinnamomi* classification as the origin of the discharge water. It is understood that the majority of the proposed pipeline alignment and surrounding areas are currently affected by *Phytophthora cinnamomi*. The contractor will adhere to the Hygiene Plan when moving machinery, equipment and personnel from one *Phytophthora cinnamomi* classification area to the other in order to minimise the potential spread of *Phytophthora cinnamomi* into areas that are currently not impacted.
Acid Sulphate Soils	Excavation of potential Acid Sulphate Soils may lead to the acidification of soils and through leaching thereof may acidify the local groundwater.	An acid sulphate soil study is required in the area to assess the potential for soils to acidify groundwater. An Acid Sulphate Soil investigation has been completed by PB (August, 2005), with an Acid Sulphate Soils Management plan pending. This plan should be referred to contractors prior to conducting earthworks.	An Acid Sulphate Soil Management Plan should be adhered to whilst conducting excavation and dewatering works at the Site.

Activity	Potential Risk to the Environment	Management Strategy	Management Solutions
Trench Construction	Puncturing of Coffee Rock resulting in vertical hydraulic shortcut.	In the area of the proposed gas pipeline, a Coffee Rock layer has been reported at shallow depths. The Coffee Rock acts as a local aquitard and potential puncturing thereof will allow shallow perched groundwater to flow freely into the underlying aquifer, or conversely will allow for confined water to flow freely into the perched unconfined aquifer. Where Coffee Rock is encountered, the earthworks contractor will ensure that works will be conducted in a manor as not to disrupt the Coffee Rock horizon.	Where Coffee Rock is encountered by the earthworks contractor, excavation should be conducted as not to breech this layer. Should the Coffee Rock layer be breached during earthworks or other, then sealing thereof by means of grouting is required as not to create a hydraulic shortcut. It is noted that based on the Interim Acid Sulphate Report provided by PB (August, 2005) Coffee Rock was not encountered at depths shallower than 2.75m bgs.

7. Conclusions

Trench dewatering has the potential to significantly affect surrounding groundwater dependant wetlands and consequently management of dewatering activities is required as not to adversely impact groundwater dependant ecosystems. Management strategies are presented in Table 1 addressing identified trench construction and trench dewatering issues.

It is apparent that the existing pipeline, installed to the same completion depth as the proposed gas pipeline, has had no significantly adverse effect on the environment in the study area.

8. Limitations

This report presents a hydrogeological management plan, prepared for the purpose of this commission. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent engineer/scientist before being used for any other purpose. Gutteridge Haskins and Davey Pty Ltd (GHD) accepts no responsibility for other use of the data.

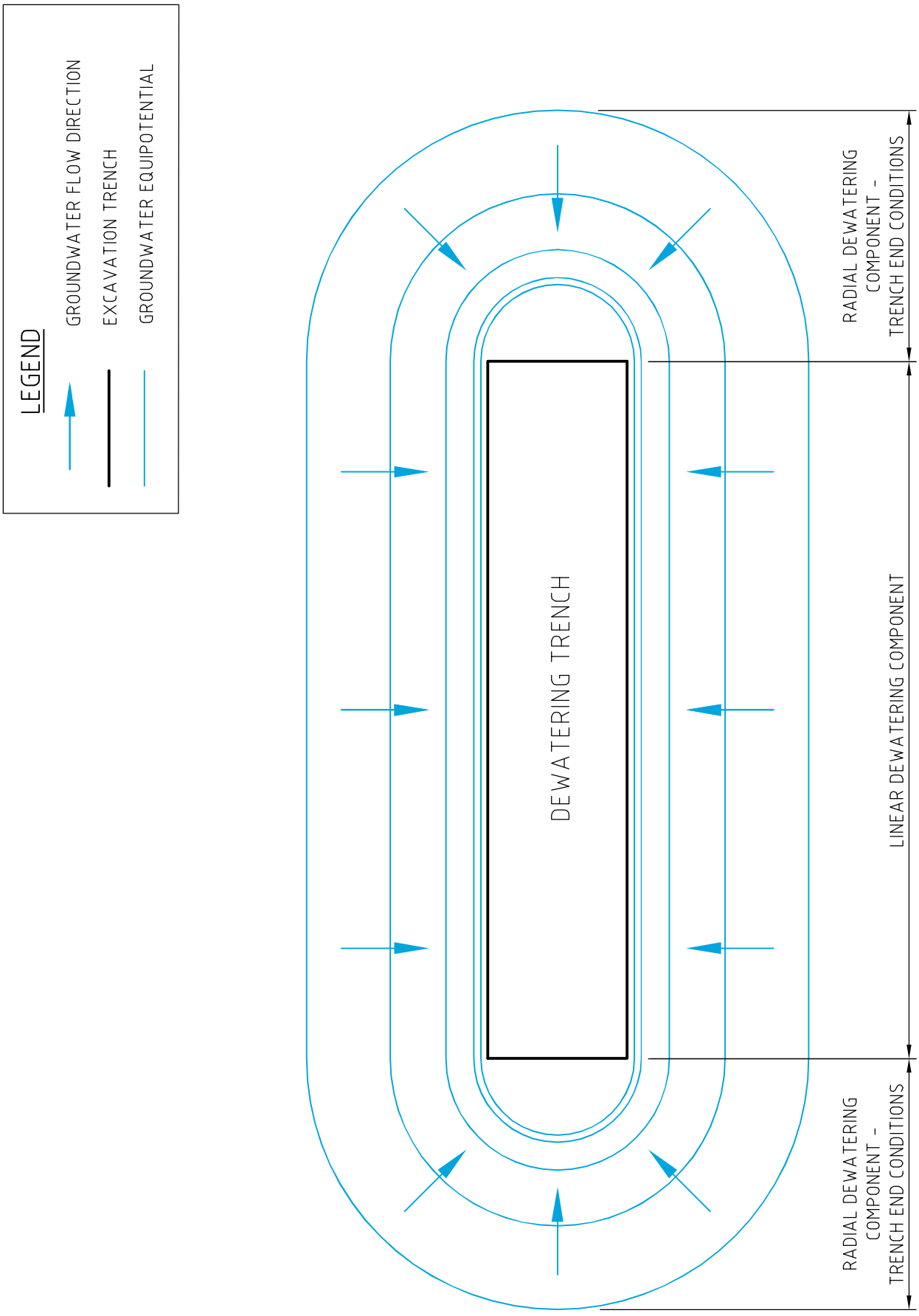
Where drill hole or test pit logs, laboratory tests, geophysical test and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

The advice tendered in this report is based on information obtained from the assessment locations, tests points and sample points and is not warranted in respect to the conditions that may be encountered across the site at other than these locations. It is emphasised that the actual characteristics of the subsurface materials may vary significantly between adjacent test points and sample intervals and at locations other than where observations, explorations and investigations have been made. Subsurface conditions, including groundwater levels and contaminant concentrations can change in a limited time. This should be borne in mind when assessing the data.

It should be noted that because of the inherent uncertainties in subsurface evaluations, changed or unanticipated subsurface conditions may occur that could affect total project cost and/or execution. GHD does not accept responsibility of the consequences of significant variances in the conditions and the requirements for execution of the work.

During subsequent investigations and excavations the subsurface and surface earthworks and excavations should be examined by a suitably qualified and experienced Engineer/Scientist who shall judge whether the revealed conditions accord with both the assumptions in this report and/or the design of the works. If they do not accord, the Engineer/Scientist shall modify the advice in this report and/or design of the works to accord with the circumstances that are revealed.

An understanding of the subsurface site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experience-based. Hence this report should not be altered, amended or abbreviated, issued in part, or issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances which arise from the issue of the report which has been modified in any way as outlined above.



PRELIMINARY

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Approved		Original Size A4	Drawing No: FIGURE 1 Rev: A
Date			

This Drawing must not be used for Construction unless signed as Approved

Plot Date: 22 August, 2005
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