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Our reference: 2145167A/PR2:14895:RevA/JP

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NCSI Certified Quality System ISO 9001

8 July 2005

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Dear Daniel

DBNGP Looping 10 Acid Sulphate Soil Risk Classification and Preliminary Site investigation Sample and Analysis Plan

Parsons Brinckerhoff (PB) was engaged by ECOS Consulting (ECOS) to undertake a desktop assessment to predict the acid generating potential of soils encountered along the Alinta Gas proposed Looping 10 expansion of the Dampier Bunbury Natural Gas Pipeline to assist with obtaining government approvals for the expansion. The Looping 10 expansion extends for 22.65 km from Thomas Road, Kwinana to Jarrah Road, Hopeland, Western Australia (Figure 1).

This preliminary work will allow areas of acid sulphate soils to be identified to a relatively high level of confidence, field sampling and validation are likely to be required by the Department of Environment (DoE) to meet current guidelines.

The following data sources were reviewed as part of the desktop investigation:

- WAPC Bulletin 64 - South Metropolitan Region Scheme Acid Sulphate Soil Map
- Perth Metropolitan Region 1:50,000 Environmental Geology Series Maps – Fremantle, Rockingham Sheets.
- Groundwater and Wetland Areas Maps (provided by ECOS)
- WRC, Perth Groundwater Atlas

Assessment Methodology

Data from each of the above sources was mapped along the line of the Looping 10 pipeline route Figures 2-5. In addition to the original WAPC Acid Sulphate Soil Risk Map, a risk ranking of potential for acid sulphate soil occurrence was assigned based on geological/lithological units, wetland classifications and depth to water/topography. The risk classifications are summarised in Table 1.

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Table 1: Acid Sulphate Soil Risk Classification Criteria

ASS Risk Ranking	Geology	Wetland Classification	Depth to Groundwater
1 - LOW	LIMESTONE, SAND of residual origin	NONE	>5 m
2 - MEDIUM	SAND of eolian origin, SILT	MULTIPLE USE	1 – 5 m
3 - HIGH	SILT of lacustrine origin	RESOURCE ENHANCED or CONSERVATION CATEGORY	<1 m

A level of intrusive investigation is then assigned based on the risk of acid sulphate soils being present along the pipeline route. It should be noted that a conservative approach has been adopted in that where geological/lithological, wetland or water level data indicates a higher risk of acid sulphate soils than the WAPC maps, a higher level of intrusive investigation has been assigned. The level of intrusive investigation, based on the acid sulphate soil risk classification, for the preliminary acid sulphate soil investigation is defined as follows:

1 – LOW: Site walkover to confirm soil types only. Where ground truthing indicates a deviation from the predicted occurrence a soil bore will be installed at a frequency up to 1 soil bore per 500 m. Field analysis of pH_F and pH_{FOX} (pH after oxidation) at 0.25 m intervals will be undertaken where soil bores are installed. Laboratory analysis will only be undertaken if pH_F or $pH_{FOX} < 5$ or $\Delta pH_{F-FOX} > 1$.

2 – MEDIUM: Soil bores will be installed at a frequency of 1 soil bore per 200 m. Field analysis of pH_F and pH_{FOX} (pH after oxidation) at 0.25 m intervals will be undertaken. The highest risk soil sample from each bore will be sent for laboratory analysis by the Chromium Reducible Sulphur Suite (S_{CR}) and 1 in every 10 bores will be laboratory analysed for S_{CR} at 0.5 m intervals through the bore profile

3 – HIGH: Soil bores will be installed at a frequency of 1 soil bore per 100 m or one bore per area, whichever is greater. Field analysis of pH_F and pH_{FOX} (pH after oxidation) at 0.25 m intervals will be undertaken. The highest risk soil sample from each bore will be sent for laboratory analysis for S_{CR} and 1 bore per area will be laboratory analysed for S_{CR} at 0.5 m intervals through the bore profile.

Attachment 1 summarises the risk of acid sulphate soil occurrence along Looping 10 based on the investigated parameters.

Preliminary ASS Investigation

Table 1 summarises the preliminary acid sulphate soil sample and analysis plan. Soil bores will need to be installed to 1 m below the proposed depth of pipeline excavation. It is noted that the preliminary intrusive acid sulphate soil investigation is a screening program only to verify the presence or absence of acid sulphate soils. Where acid sulphate soils are identified a subsequent detailed site investigation will likely be required by the DoE as part of the acid sulphate soil management plan development.

Table 1: Summary Sampling and Analysis Plan

ASS Risk Ranking	No. Kilometers	No. Proposed Soil Bores	No. Proposed Field Tests	No. Proposed S_{CR} Analysis
LOW	10			
MEDIUM	9.4	47	611	77
HIGH	1.9	20	260	49

1. Soil bores are assumed to be installed to 3 metres below ground level

Due to the length of the pipeline, the preliminary intrusive investigation programme has been developed using a risk-based interpretation of the Department of Environment's *Acid Sulphate Soil Guidelines* relating to investigation density. It is recommended that the Department of Environment are provided the opportunity to comment on this approach, prior to undertaking the investigation. Should you have any further queries pertaining to the contents of this report, please do not hesitate to contact me on 9489 9700.

Yours sincerely

Julie Palich

Environmental Geoscientist
Parsons Brinckerhoff Australia Pty Limited

Attachment 1: Acid Sulphate Soil Risk Classification

LOOPING 10 AREA	GEOLOGY		WETLAND CLASSIFICATION		DEPTH TO GROUNDWATER	WAPC ASS RATING		ASS RISK RANKING
	Dist (km)	Description	Dist (km)	Classification	mBGL	Dist (km)	Rating	
KP-0	0 - 1	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	0 – 1	NONE	>20	0 – 1	LOW	1
KP-1	1 – 1.3	SAND – pale yellowish brown, medium to coarse grained, sub-angular quartz, trace of feldspar, moderately sorted, of residual origin.	1 - 2	NONE – Resource enhanced category and/or EPP wetlands 300 – 500 m to east and west	20 – 7	1 – 2	LOW – high risk in adjacent wetland areas	1
	1.3 - 2	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.						
KP-2	2 - 3	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	2 – 3	NONE – Conservation and resource enhanced category and/or EPP wetlands 250 m west	7 – 5	2 – 3	LOW – high risk in adjacent wetland areas	1
KP-3	3 - 4	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	3 – 4	NONE – Conservation and resource enhanced category EPP wetlands 250 m west	5 – 1	3 – 4	LOW – high risk in adjacent wetland areas	2

LOOPING 10 AREA	GEOLOGY		WETLAND CLASSIFICATION		DEPTH TO GROUNDWATER	WAPC ASS RATING		ASS RISK RANKING
	Dist (km)	Description	Dist (km)	Classification	mBGL	Dist (km)	Rating	
KP-4	4 - 5	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	4 – 5	NONE – Conservation category EPP wetlands 250 west	5 - 9	4 – 5	LOW – high risk in adjacent wetland areas	1
KP-5	5 – 5.85	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	5 - 6	NONE – Conservation category EPP wetlands at least 250 m west	8 - 25	5 – 6	LOW – high risk in adjacent wetland areas	1
	5.85 – 5.95	SAND – pale yellowish brown, medium to coarse grained, sub-angular quartz, trace of feldspar, moderately sorted, of residual origin.						
KP-6	5.95 - 7	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	6 - 7	NONE – Conservation category EPP wetlands at least 250 m west	25 - 38	6 – 7	LOW – high risk in adjacent wetland areas	1
KP-7	7 - 8	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	7.25 – 7.3	CONSERVATION/ EPP WETLAND immediately to west	25 – 5	7 – 8	LOW – high risk in adjacent wetland areas	1
KP-8	8 - 9	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	8 – 9	NONE – Conservation category EPP wetland 250 m to south at 8.4 – 8.6	25 - 11	8 - 9	LOW – high risk in adjacent wetland areas	1

LOOPING 10 AREA	GEOLOGY		WETLAND CLASSIFICATION		DEPTH TO GROUNDWATER	WAPC ASS RATING		ASS RISK RANKING
	Dist (km)	Description	Dist (km)	Classification	mBGL	Dist (km)	Rating	
KP-9	9 - 10	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	9 – 10	NONE	11 - 9	9 – 10	LOW	1
KP-10	10 – 10.5	LIMESTONE – pale yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, of eolian origin.	10.95 – 11	MULTIPLE USE	24 - 1	10 – 11	LOW	1
	10.5 – 10.8	SAND – pale yellowish brown, medium to coarse grained, sub-angular quartz, trace of feldspar, moderately sorted, of residual origin.						
	11.8 – 11	SAND – very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin						
KP-11	11 - 12	SILT – very pale brown silt, soft when moist, low clay content, of alluvial origin	11 – 12	MULTIPLE USE	1 - 5	11 – 12	MODERATE	2
KP-12	12 – 13	SAND – very light grey over strong blocky brown silts and clays.	12 – 12.4	MULTIPLE USE	<1	12 – 13	MODERATE	2
			12.4 – 12.5	RESOURCE ENHANCED				3
			12.5 – 13	MULTIPLE USE				2

LOOPING 10 AREA	GEOLOGY		WETLAND CLASSIFICATION		DEPTH TO GROUNDWATER	WAPC ASS RATING		ASS RISK RANKING
	Dist (km)	Description	Dist (km)	Classification	mBGL	Dist (km)	Rating	
KP-13	13 – 14	SAND – very light grey over strong blocky brown silts and clays.	13 - 14	MULTIPLE USE – Resource enhanced and/or EPP Wetlands 100 m to west and east from 13.0 – 13.2	<1	13 – 14	MODERATE – high risk in adjacent wetland areas	2
KP-14	14 – 15	SAND – very light grey over strong blocky brown silts and clays.	14 – 14.5	NONE	<1	14 – 14.5	MODERATE	2
			14.5 – 14.6	RESOURCE ENHANCED		14.5 – 14.6	HIGH	3
			14.6 – 15	MULTIPLE USE		14.6 – 15	MODERATE	2
KP-15	15 – 16	SAND – very light grey over strong blocky brown silts and clays.	15 – 16	MULTIPLE USE	<1	15 – 16	MODERATE	2
KP-16	16 – 17	SILT – very pale brown silt, soft when moist, low clay content, of alluvial origin	16 – 17	MULTIPLE USE – Conservation category EPP wetland 100 m east and 200 m west	<1	16 – 17	MODERATE	2
KP-17	17 – 18	SAND – very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin	17.2 – 18	RESOURCE ENHANCED EPP	<1	17 – 18	MODERATE	3
KP-18	18 - 19	SAND – very light grey over strong blocky brown silts and clays.	18 – 18.3	RESOURCE ENHANCED EPP	<1	18 – 18.3	MODERATE	3
			18.4 – 18.6	CONSERVATION CATEGORY		18.4 – 18.6	HIGH	3
			18.6 – 19	MULTIPLE USE		18.6 – 19	MODERATE	2

LOOPING 10 AREA	GEOLOGY		WETLAND CLASSIFICATION		DEPTH TO GROUNDWATER	WAPC ASS RATING		ASS RISK RANKING
	Dist (km)	Description	Dist (km)	Classification	mBGL	Dist (km)	Rating	
KP-19	19 - 20	SAND – very light grey over strong blocky brown silts and clays.	19 – 19.9	MULTIPLE USE	<1	19 – 19.9	MODERATE	2
			19.9 – 20	RESOURCE ENHANCED		19.9 – 20	HIGH	3
KP-20	20 – 20.6	SAND – very light grey over strong blocky brown silts and clays.	20 – 21	NONE – Conservation category EPP wetland immediately east at 20.5 – 20.6	<1	20 – 21	MODERATE – high in adjacent wetland areas	2
	20.6 – 21	SAND – very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin						
KP-21	21 - 22	SAND – very light grey over strong blocky brown silts and clays.	21 – 21.4	MULTIPLE USE	<1	21 - 22	MODERATE – high in adjacent wetland areas	2
			21.4 – 21.9	NONE				
			21.9 – 22	MULTIPLE USE				
KP-22	22 – 22.3	SAND – very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin	22 – 22 1	MULTIPLE USE	<1	22 – 23	MODERATE – high in adjacent wetland areas	2
	22.3 – 22.7	SAND – very light grey over strong blocky brown silts and clays.	22.1 – 22.4	NONE				
			22.4 – 22.5	CONSERVATION CATEGORY/EPP				3