H.1.1 Introduction

Alcan has undertaken groundwater monitoring and sampling at the refinery since 1994. Bore construction details and locations for the refinery groundwater monitoring and recovery bores are provided in URS (2003c).

H.1.2 Groundwater Monitoring Program

The groundwater monitoring program at the refinery comprises groundwater level measurements, groundwater sampling and laboratory analysis of groundwater samples. Historically, the program has been rationalised and modified on several occasions. The groundwater monitoring program for the period 1999 to 2002 is summarised in Tables H.1.1 and H.1.2. On some occasions, due to logistical and access restrictions, the groundwater monitoring program could not be completed. There were no geophysical surveys completed during the review period.

Table H.1.1
Laboratory Analysis

Caustic Indicators		Nutrient Indicators	Caustic Indicators	Hydrocarbon Indicators	Surfactant indicators
T1	**T2**	**T3**	**T6**	**T7**	**T8**
Sulphate Aluminium Arsenic Molybdenum Vanadium Zinc	pH EC Calcium Magnesium Sodium Potassium Redox Chloride Carbonate Bicarbonate Alkalinity	Total Nitrogen Total Organic Carbon Total Phosphorus	Mercury	Total Petroleum Hydrocarbons Polynuclear Aromatic Hydrocarbons	Methylene Blue Active Substances
K1	**K2**	**K3**	**K6**	**K7**	**K8**
Aluminium Vanadium	pH EC Redox Alkalinity	Total Organic Carbon		Total Petroleum Hydrocarbons	

Table H.1.2
Groundwater Monitoring Program

Bore	Monthly Sampling	Bi-Annual Sampling	Annual Sampling
G001A		K1, K2, K3	T1, T2, T3
G001B		K1, K2, K3	T1, T2, T3
G002A		K1, K2, K3	T1, T2, T3
G002B		K1, K2, K3	T1, T2, T3, T6
G003A			T1, T2, T3
G003B			T1, T2, T3

Bore	Monthly Sampling	Bi-Annual Sampling	Annual Sampling
G004A		K1, K2, K3	T1, T2, T3
G004B		K1, K2, K3	T1, T2, T3
G005			GP
G006A			GP
G006B			GP
G007A			T1, T2, T3
G007B			T1, T2, T3
G008A		K1, K2, K3	T1, T2, T3
G008B		K1, K2, K3	T1, T2, T3
G009A			GP
G009B			T1, T2, T3
G010A		FL	GP
G010B			T1, T2, T3
G013A		K1, K2, K3	T1, T2, T3
G013B		K1, K2, K3	T1, T2, T3
G014		K1, K2, K3	T1, T2, T3
G015			T1, T2, T3
G019A			GP
G019B			GP
G020			GP
G023A		K1, K2, K3	T1, T2, T3
G023B		K1, K2, K3	T1, T2, T3
G024		T7	T1, T2, T3, T7, T8
G025		T7	T1, T2, T3, T7, T8
G026		T7	T1, T2, T3, T7, T8
G027A		K1, K2, K7	T1, T2, T3, T7, T8
G027B		K1, K2, K7	T1, T2, T3, T7, T8
G030A			GP
G030B			GP
G032			GP
G033A		K1, K2, K3, K7, K8	T1, T2, T3, T7, T8
G033B		K1, K2, K3, K7, K8	T1, T2, T3, T7, T8
G034A		FL	GP
G034B		FL	GP
G035		K1, K2, K3, K7, K8	T1, T2, T3, T7, T8
G037			T1, T2, T3, T7, T8
G038			T1, T2, T3
G039A			T1, T2, T3
G039B			T1, T2, T3
G040A		K1, K2, K3	T1, T2, T3, T6
G040B		K1, K2, K3	T1, T2, T3
G041			GP
G042A			GP
G042B			GP
G043P	field parameters		T1, T2, T3
G044P	field parameters		T1, T2, T3, T6
G045			T1, T2, T3
G046P			GP
G047P	field parameters		T1, T2, T3
G048P			GP
G049A		K1, K2, K3	T1, T2, T3
G049B		K1, K2, K3	T1, T2, T3
G050			

Table H.1.2 (cont'd)

Bore	Monthly Sampling	Bi-Annual Sampling	Annual Sampling
G051			
G052			
G053			
G054			
G055			
G056			
G057			
G063P			
G064P	field parameters		T1, T2, T3
G065P			GP
G066P	field parameters		T1, T2, T3, T6
G067P	field parameters		T1, T2, T3
G068P	field parameters		T1, T2, T3
G069P	field parameters		T1, T2, T3, T6
G070P	field parameters		T1, T2, T3, T6
G071P	field parameters		T1, T2, T3, T6
G072P	field parameters		T1, T2, T3
G073			T1, T2, T3
G074			GP
G075			T1, T2, T3
G076			T1, T2, T3
G077			T1, T2, T3
G078			T1, T2, T3, T6
G079			GP
G080			T1, T2, T3
G081			GP
G082			T1, T2, T3
G083			GP
G084A		K1, K2, K3	T1, T2, T3
G084B		K1, K2, K3	T1, T2, T3, T6
G085A		K1, K2, K3	T1, T2, T3, T6
G085B		K1, K2, K3	T1, T2, T3, T6
G086			GP
G087		T7	T1, T2, T3, T7, T8
G088A		K1, K2, K7	T1, T2, T3, T7, T8
G088B			T1, T2, T3, T7, T8
G089		K1, K2, K3	T1, T2, T3
G090P	field parameters	FL	T1, T2, T3, T6, T7, T8
G091			T1, T2, T3
G092P			GP
G094P	field parameters	FL	T1, T2, T3, T6, T7, T8
G095P	field parameters	FL	T1, T2, T3, T6, T7, T8
G096A			T1, T2, T3
G096B			T1, T2, T3
G097A		K1, K2, K3	T1, T2, T3
G097B		K1, K2, K3	T1, T2, T3
G098A		K1, K2, K3	T1, T2, T3
G098B		K1, K2, K3	T1, T2, T3
G099A			T1, T2, T3
G099B			T1, T2, T3
G103P	field parameters		T1, T2, T3
G104P	field parameters		T1, T2, T3
G105P	field parameters		T1, T2, T3
G0100A			T1, T2, T3, T7, T8

Table H.1.2 (cont'd)

Bore	Monthly Sampling	Bi-Annual Sampling	Annual Sampling
G0100B			T1, T2, T3, T7, T8
G0101A			T1, T2, T3, T7, T8
G0101B			T1, T2, T3, T7, T8
G0102A		K1, K2, K3, K7, K8	T1, T2, T3, T7, T8
G0102B		K1, K2, K3, K7, K8	T1, T2, T3, T7, T8
G0106			T1, T2, T3
G0107			T1, T2, T3, T6
G0116P	field parameters		T1, T2, T3
G0117P	field parameters		T1, T2, T3
G0118P	field parameters		T1, T2, T3
G0119P	field parameters		GP
G0120P	field parameters	K1, K2, K3	T1, T2, T3
G0121		FL	
G0122			T1, T2, T3, T7, T8
G0123			T1, T2, T3, T7, T8

Note
Static groundwater levels were measured in each bore prior to sampling or profiling.
Field parameters – pH and EC profiling.
FL – measurement of fluid levels only.
GP = Geophysical survey.
Recovery bores are identified using the letter P as a suffix after the bore number.

Groundwater monitoring events for the period January 1999 to July 2002 are summarised in Table H.1.3.

Table H.1.3
Groundwater Monitoring Events – January 1999 to July 2002

Year	Bi-annual Sampling	Annual Sampling
1999	February and October	June
2000	February and November	July
2001	July and November	April
2002	March and October	November

H.1.3 Groundwater Monitoring Procedures

Groundwater monitoring and sampling procedures are described in URS (2003c) (Alcan Procedure EM-01).

H.1.4 Laboratory Analysis

Laboratory analysis of the groundwater samples was completed by Australian Government Analytical Laboratories (AGAL) in Sydney, NSW. A copy of the analytical methods for each of the analytes is provided in URS (2003c).

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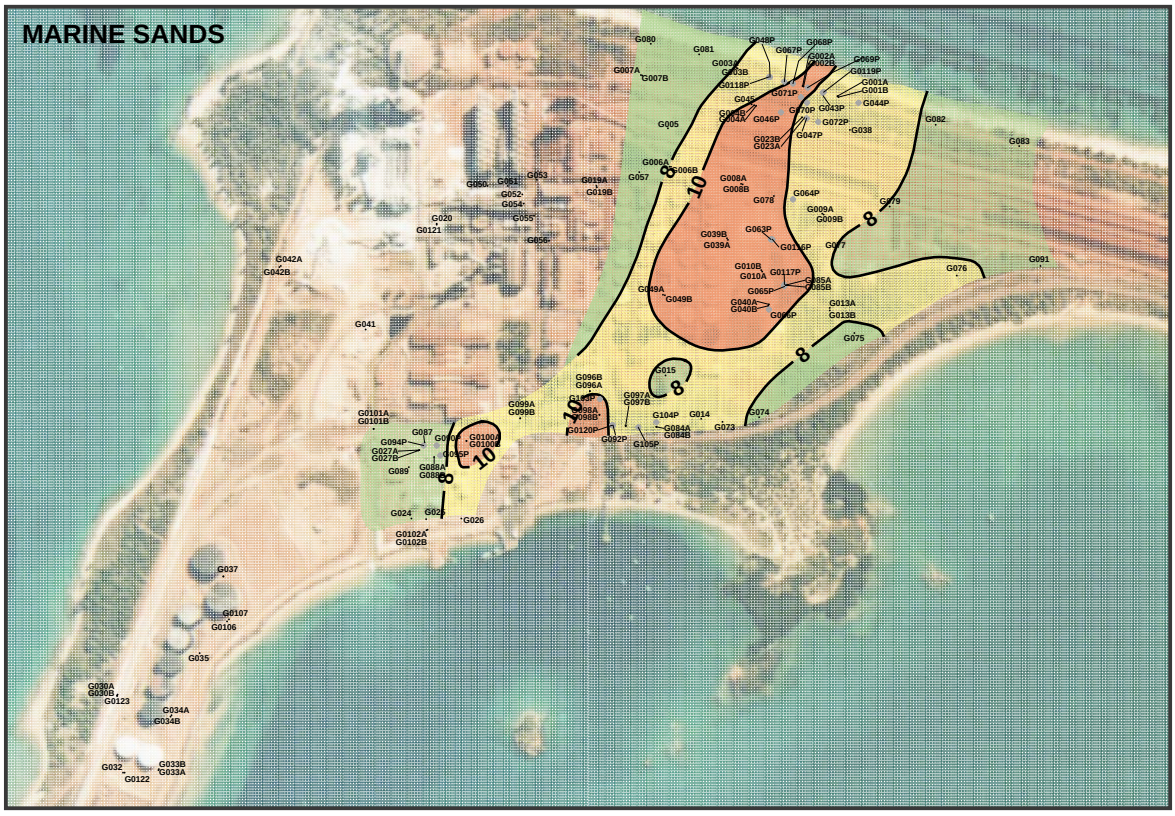

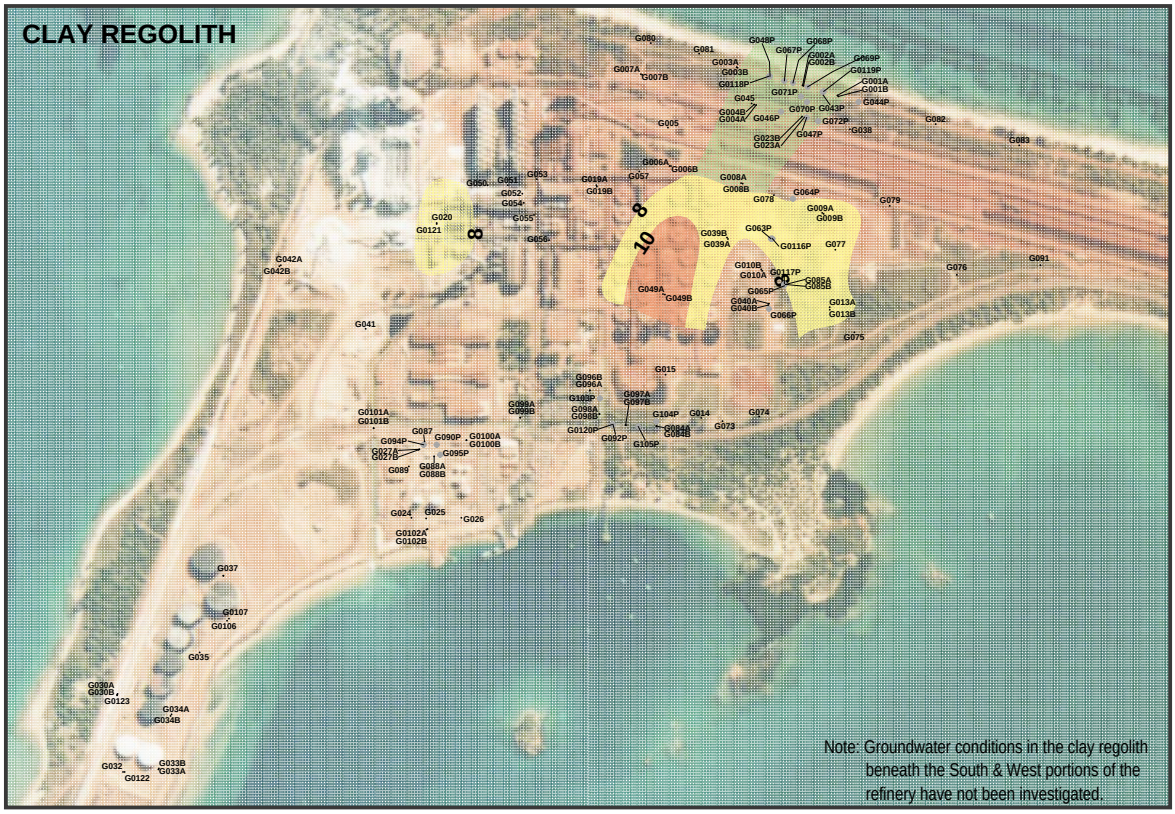

LEGEND

pH

- >10
- 8-10
- <8

0 250 500m

SCALE 1 : 15 000 at A4

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INTERPRETED pH DISTRIBUTION MARINE SAND AND CLAY REGOLITH

FIGURE H1

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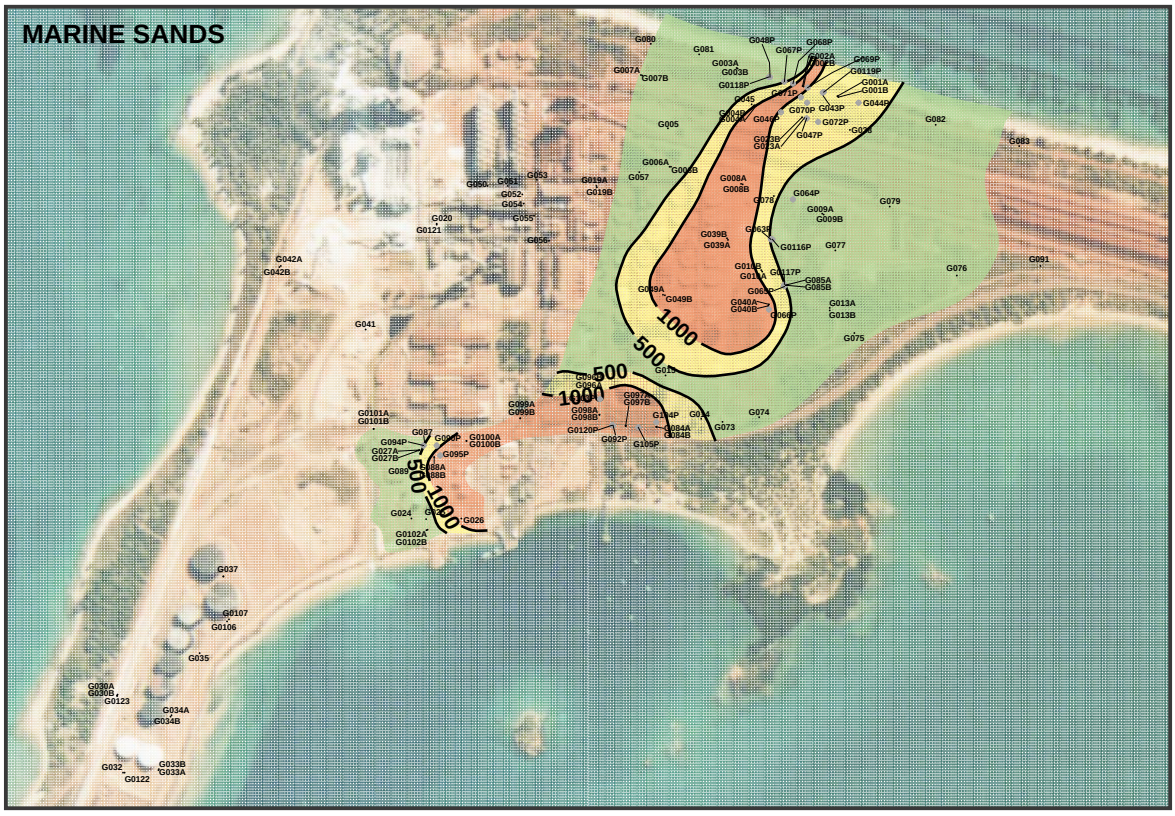

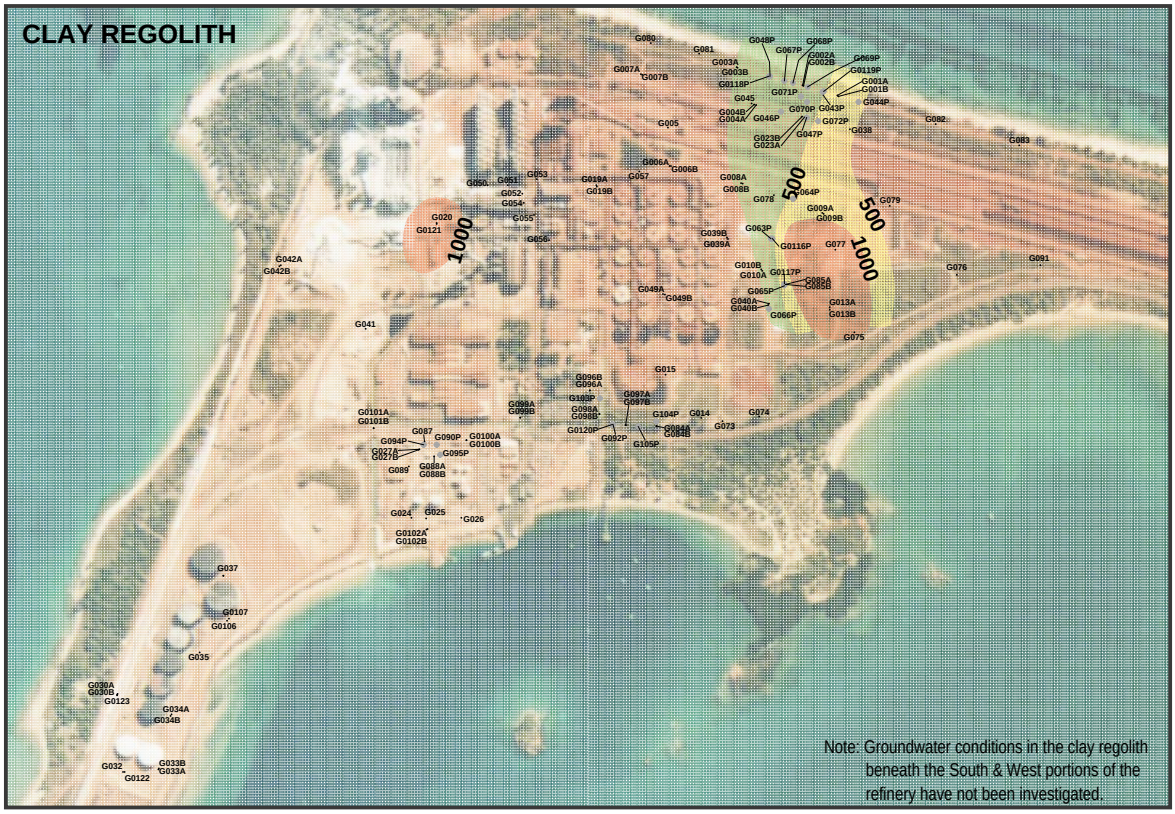

LEGEND

Total Alkalinity (mg/L)

- >1000
- 500-1000
- <500

0 250 500m

SCALE 1 : 15 000 at A4

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INTERPRETED TOTAL ALKALINITY MARINE SAND AND CLAY REGOLITH

FIGURE H2

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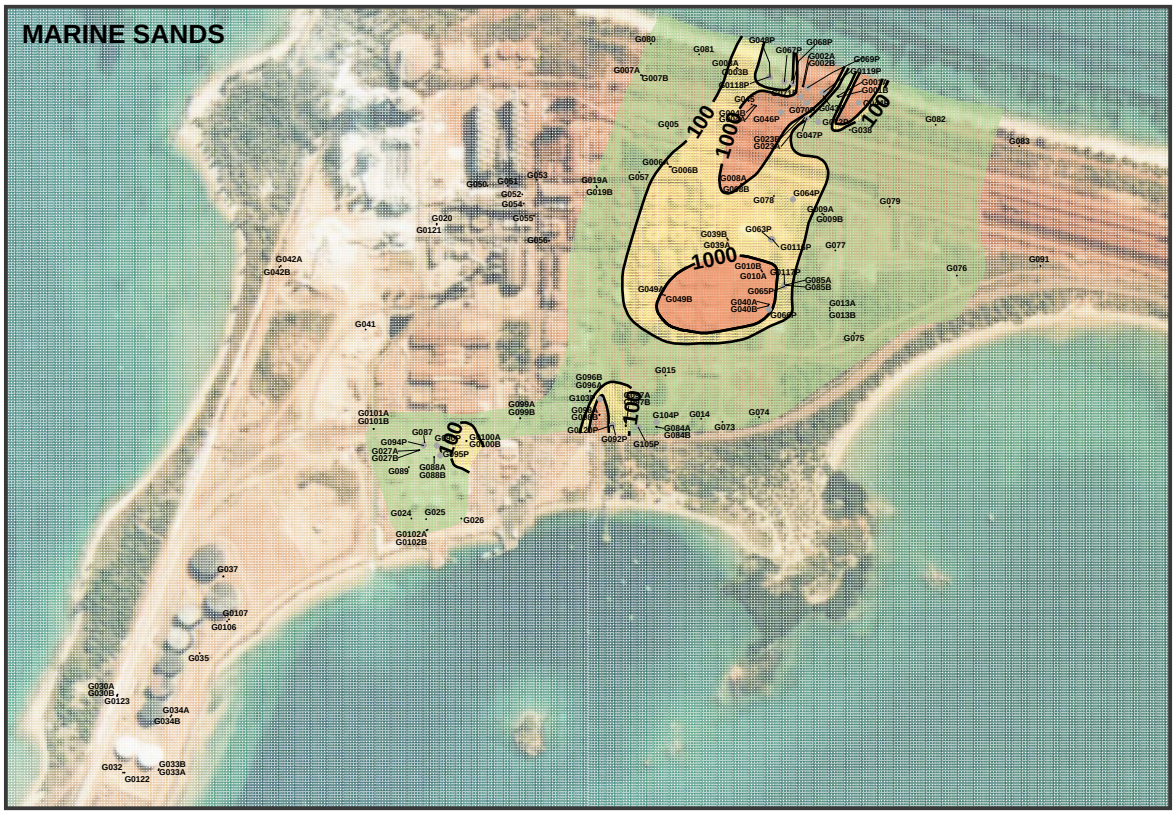

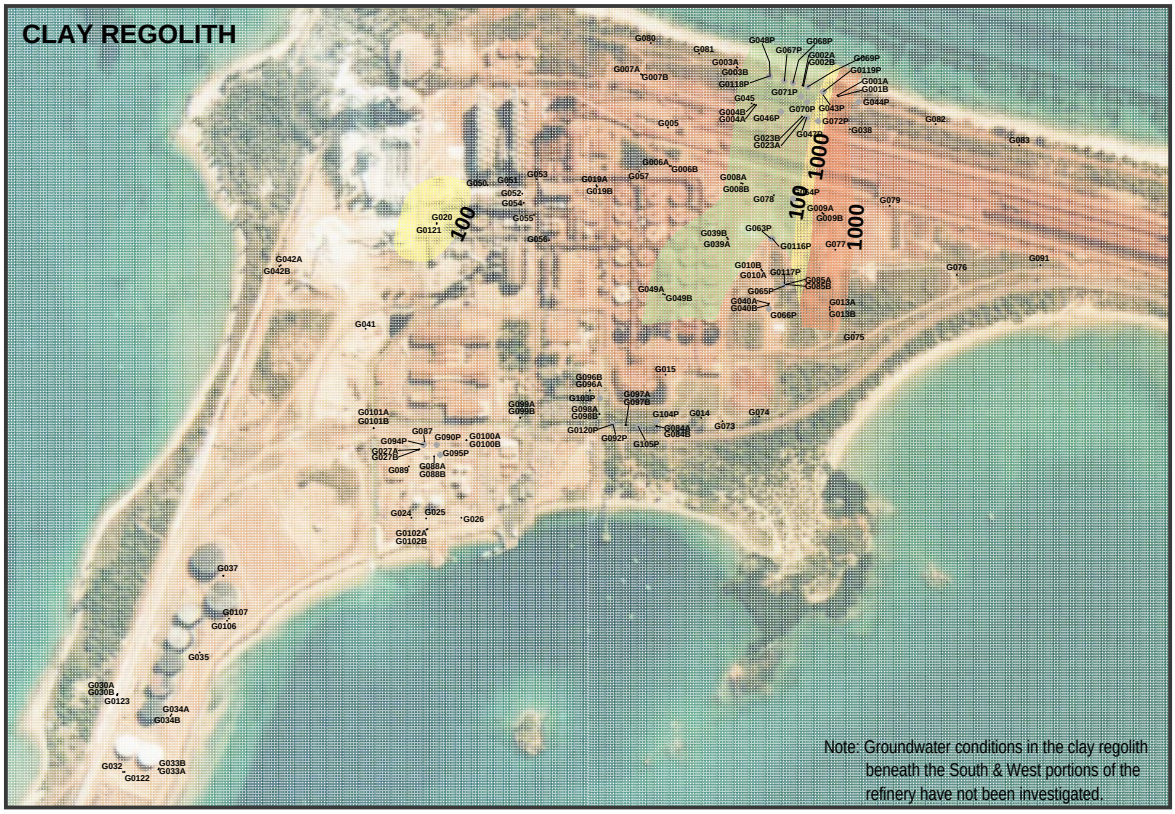

LEGEND

Aluminium Concentration (µg/L)

- >1000
- 100-1000
- <100

0 250 500m

SCALE 1 : 15 000 at A4

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INTERPRETED ALUMINIUM DISTRIBUTION MARINE SAND AND CLAY REGOLITH

FIGURE H3

URS AUSTRALIA PTY LTD

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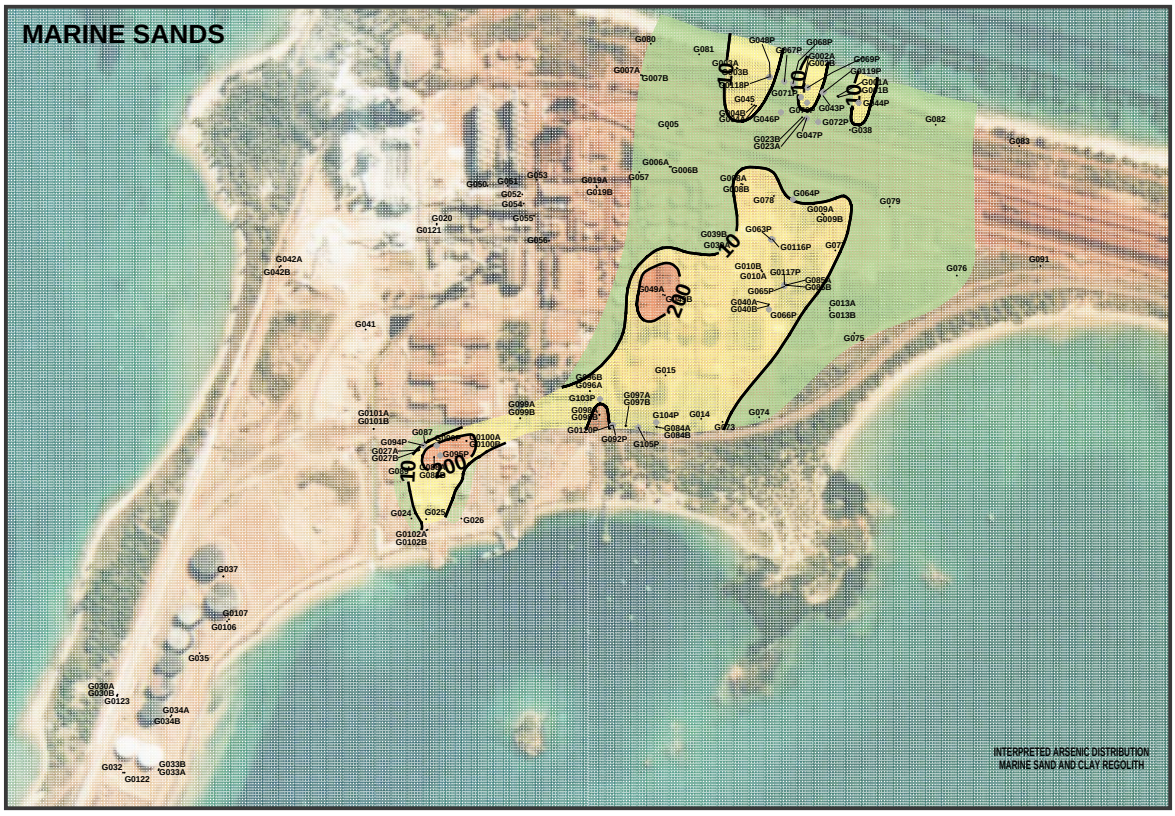

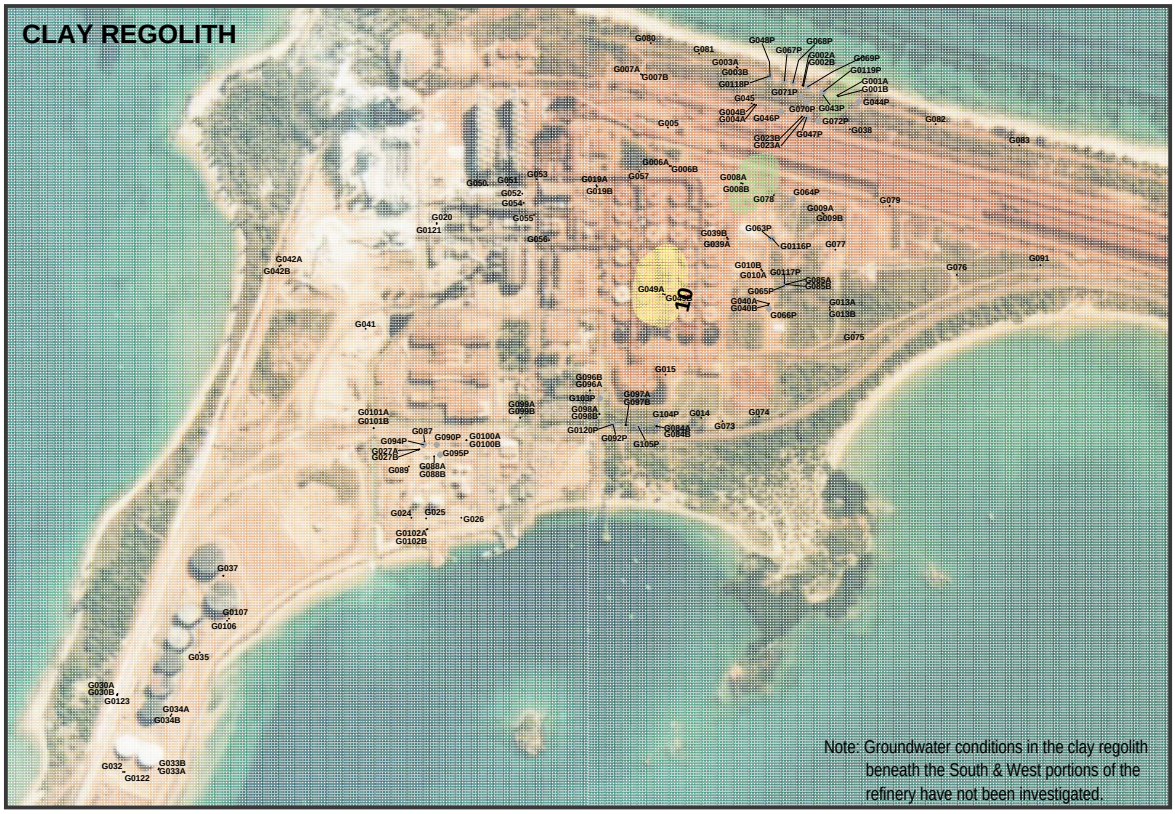

LEGEND

Arsenic Concentration (µg/L)

- >200
- 10-200
- <10

0 250 500m

SCALE 1 : 15 000 at A4

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Alcan Gove Pty Ltd REFINERY GROUNDWATER REVIEW 2003		INTERPRETED ARSENIC DISTRIBUTION MARINE SAND AND CLAY REGOLITH
Prep. By: JB	Chk'd By: JB	
Project No.: 12373-021-562	Date: Jan 04	FIGURE H4
File No.: 12373021r004fh4.dgn		

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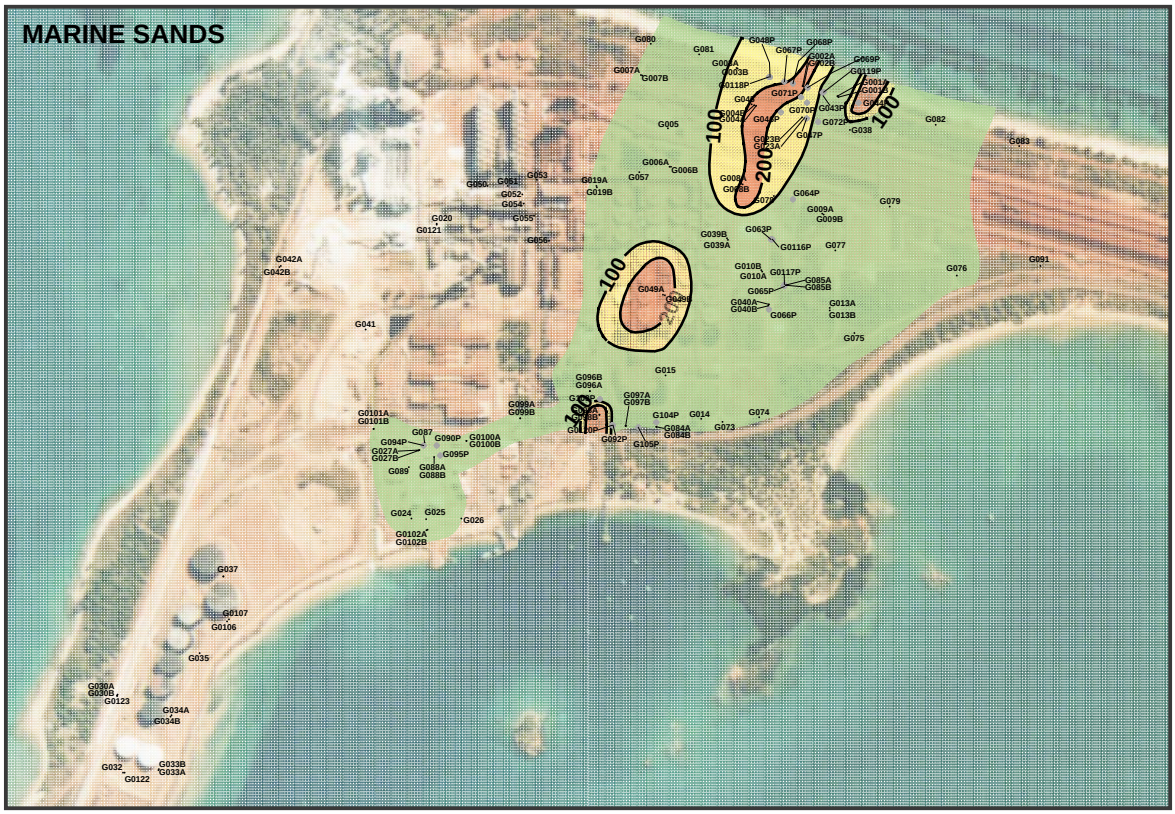

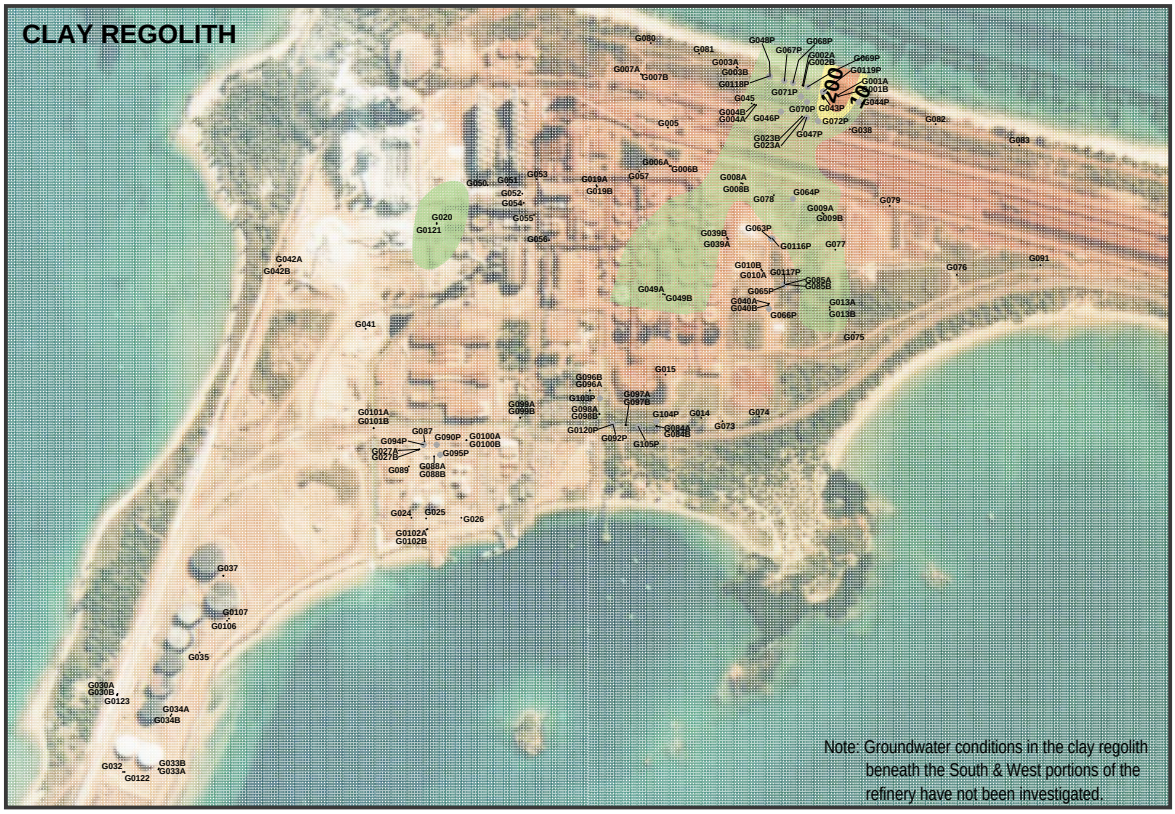

LEGEND

Vanadium Concentration (µg/L)

- >200
- 10-200
- <10

0 250 500m

SCALE 1 : 15 000 at A4

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INTERPRETED VANADIUM DISTRIBUTION MARINE SAND AND CLAY REGOLITH

FIGURE H5

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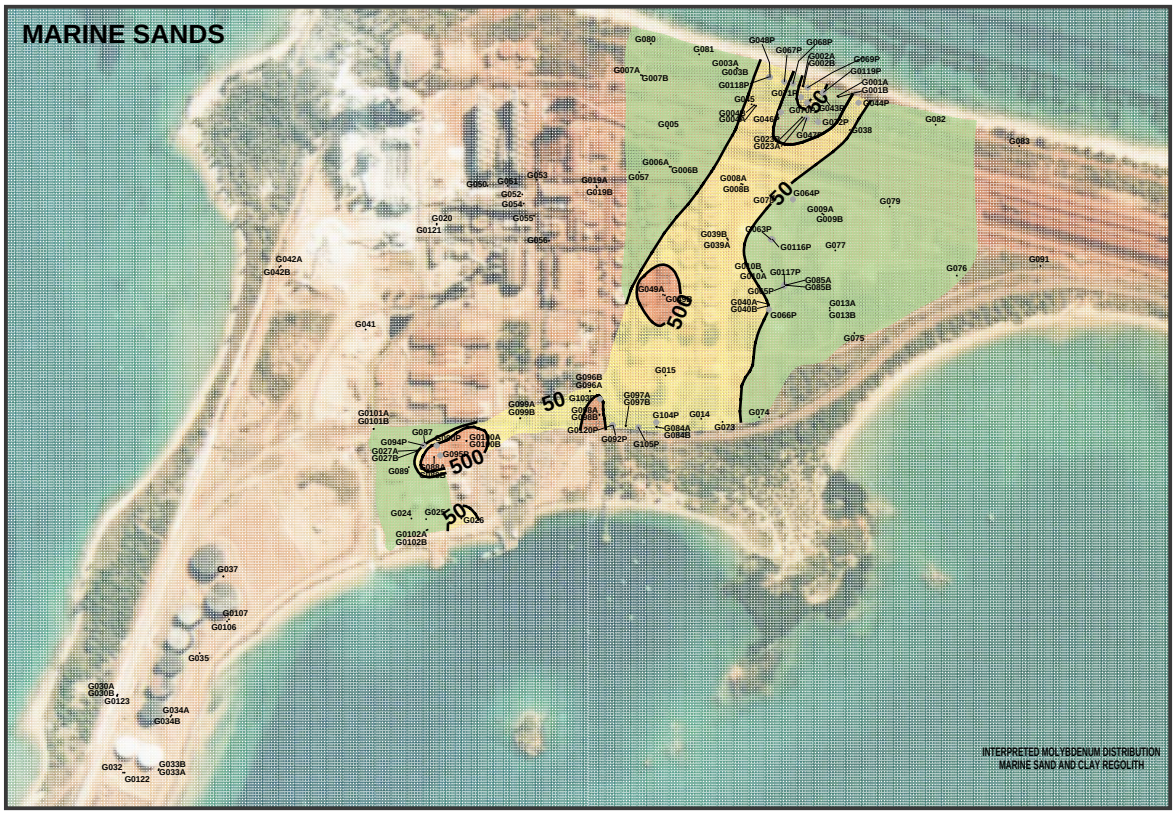

LEGEND

Molybdenum Concentration (µg/L)

- >500
- 50-500
- <50

0 250 500m

SCALE 1 : 15 000 at A4

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File No.: 12373021r004fh6.dgn

INTERPRETED MOLYBDENUM DISTRIBUTION
MARINE SAND AND CLAY REGOLITH

FIGURE H6

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H.2.1 Introduction

Alcan has undertaken groundwater monitoring and sampling at the RDA since 1991. A list of the RDA groundwater monitoring bores is provided in URS (2003c).

During the review period, additional monitoring bores were installed at the RDA to investigate groundwater associated with:

- Pond 5 (G1034 to G1054);
- The Northern Ponds (G1060 to G1078, except G1070); and
- Pond 6 raise and Pond 7 (G1055, G1056, G1057, G1058, G1059, G1070, G1079 and G1080).

Bore construction details and locations for the refinery groundwater monitoring and recovery bores are provided in URS (2003c).

H.2.2 Groundwater Monitoring Program

The groundwater monitoring program at the RDA comprises groundwater level measurements, groundwater sampling and laboratory analysis of groundwater samples. The groundwater monitoring program for 1999 to 2002 is summarised in Tables H.2.1 and H.2.2.

Table H.2.1
Laboratory Analysis

Caustic Indicators		Nutrient Indicators	Caustic Indicators	Hydrocarbon Indicators	Surfactant indicators
T1	**T2**	**T3**	**T6**	**T7**	**T8**
Sulphate Aluminium Arsenic Molybdenum Vanadium Zinc	PH EC Calcium Magnesium Sodium Potassium Redox Chloride Carbonate Bicarbonate Alkalinity	Total Nitrogen Total Organic Carbon Total Phosphorus	Mercury	Total Petroleum Hydrocarbons Polynuclear Aromatic Hydrocarbons	Methylene Blue Activated Substances (MBAS)
K1	**K2**	**K3**	**K6**	**K7**	**K8**
Aluminium Vanadium	pH EC Redox Alkalinity	Total Organic Carbon		Total Petroleum Hydrocarbons	

Table H.2.2

Groundwater Monitoring Program

Site	Bi-Annual Monitoring	Annual Monitoring
G1000		GP
G1001A	FL	T1, T2, T3
G1001B	FL	T1, T2, T3
G1002	FL	T1, T2, T3
G1003A	FL	T1, T2, T3
G1003B	FL	T1, T2, T3
G1004A	K1, K2	T1, T2, T3
G1004B	K1, K2	T1, T2, T3
G1005A	FL	T1, T2, T3
G1005B	FL	T1, T2, T3
G1006	K1, K2	T1, T2, T3, T6
G1007	FL	T1, T2, T3
G1008	K1, K2	T1, T2, T3
G1009A	FL	T1, T2, T3
G1009B	K1, K2	T1, T2, T3
G1010	FL	T1, T2, T3
G1011A	K1, K2	T1, T2, T3
G1011B	FL	T1, T2, T3
G1012	FL	T1, T2, T3
G1013	K1, K2	T1, T2, T3
G1014		GP
G1015A		GP
G1015B		GP
G1016		GP
G1017	FL	T1, T2, T3
G1018A	FL	T1, T2, T3
G1018B	FL	T1, T2, T3
G1019	FL	T1, T2, T3
G1020	FL	T1, T2, T3
G1021	FL	T1, T2, T3
G1022	FL	T1, T2, T3
G1023	FL	T1, T2, T3
G1024		GP
G1031A	FL	T1, T2, T3
G1031B		GP
G1032	FL	T1, T2, T3
G1033A	FL	T1, T2, T3
G1033B	FL	T1, T2, T3
G1034A	K1, K2	T1, T2, T3
G1034B	K1, K2	T1, T2, T3
G1035A		GP
G1035B		GP
G1036	K1, K2, K3	
G1037		GP
G1038		GP

Table H.2.2 (continued)

Site	Bi-Annual Monitoring	Annual Monitoring
G1039A	K1, K2	T1, T2, T3, T6
G1039B	K1, K2	T1, T2, T3, T6
G1040A	K1, K2	T1, T2, T3
G1040B	K1, K2	T1, T2, T3
G1041A		GP
G1041B		GP
G1042A	K1, K2	T1, T2, T3
G1042B	K1, K2	T1, T2, T3
G1043A		GP
G1043B		GP
G1044A	FL	T1, T2, T3
G1044B	FL	T1, T2, T3
G1045A		GP
G1045B		GP
G1046A	FL	T1, T2, T3
G1046B	FL	T1, T2, T3
G1047A	FL	T1, T2, T3
G1047B	FL	T1, T2, T3
G1048A	K1, K2	T1, T2, T3
G1048B	K1, K2	T1, T2, T3
G1049A	FL	T1, T2, T3
G1049B	FL	T1, T2, T3
G1050A	FL	T1, T2, T3
G1050B	FL	T1, T2, T3
G1051	FL	T1, T2, T3
G1052A	K1, K2	T1, T2, T3
G1052B	K1, K2	T1, T2, T3
G1053A	FL	T1, T2, T3
G1053B	FL	T1, T2, T3
G1054A	FL	T1, T2, T3
G1054B	FL	T1, T2, T3
G1055A	K1, K2, K3	
G1055B	K1, K2, K3	
G1056A	FL	GP
G1056B	FL	GP
G1057	FL	GP
G1058	K1, K2, K3	
G1059A	K1, K2, K3	
G1059B	K1, K2, K3	
G1060A	FL	GP
G1060B	FL	GP
G1061A	FL	GP
G1061B	FL	GP
G1062A	FL	GP
G1062B	FL	GP
G1063A	K1, K2, K3	T1, T2, T3
G1063B	K1, K2, K3	T1, T2, T3

Table H.2.2 (continued)

Site	Bi-Annual Monitoring	Annual Monitoring
G1064A		GP
G1064B		GP
G1065A	FL	GP
G1065B	FL	GP
G1066A	FL	GP
G1066B	FL	GP
G1067A	FL	GP
G1067B	FL	GP
G1068A	FL	GP
G1068B	FL	GP
G1069A	FL	GP
G1069B	FL	GP
G1070	K1, K2, K3	
G1071A	K1, K2, K3	
G1071B	K1, K2, K3	
G1072A	FL	GP
G1072B	FL	GP
G1073A	FL	GP
G1073B	FL	GP
G1074A	FL	GP
G1074B	FL	GP
G1075A	K1, K2, K3	T1, T2, T3
G1075B	K1, K2, K3	T1, T2, T3
G1076A	FL	GP
G1076B	FL	GP
G1077A	FL	GP
G1077B	FL	GP
G1078A	FL	GP
G1078B	FL	GP
G1079	K1, K2, K3	
G1080	K1, K2, K3	
MN19	K1, K2, K3	T1, T2, T3
MN20	K1, K2, K3	T1, T2, T3
MN21	K1, K2, K3	T1, T2, T3
MN22	K1, K2, K3	T1, T2, T3
MN23	K1, K2, K3	T1, T2, T3
MN24	K1, K2, K3	T1, T2, T3

Note
Static groundwater levels were measured in each bore prior to sampling or profiling.
FL – measurement of fluid levels only.
GP = Geophysical survey.

Groundwater monitoring events for the period January 1999 to July 2002 are summarised in Table H.2.3.

Table H.2.3

Groundwater Monitoring Events – January 1999 to July 2002

Year	Bi-annual Sampling	Annual Sampling
1999	February and October	June
2000	February and November	July
2001	April and November	July

H.2.3 Groundwater Monitoring Procedures

Groundwater monitoring and sampling procedures are described in URS (2003c) (Alcan Procedure EM-01).

H.2.4 Laboratory Analysis

The Australian Government Analytical Laboratories (AGAL) in Sydney, NSW undertook the laboratory analysis of the groundwater samples. A copy of the analytical methods for each of the analytes is provided in URS (2003c).