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# 2008 Interim Monitoring Program, Former Waste Control Site, Bellevue, WA

**Submitted to:**

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REPORT

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### 1.0 INTRODUCTION

The Department of Environment and Conservation (DEC) engaged Golder Associates Pty Ltd (Golder) to undertake an interim groundwater monitoring program on selected wells and surface water locations at the Former Waste Control Site in Bellevue, WA (the site). A location plan showing the regional setting of the Site is included as Figure 1. The sampling locations are shown in Figure 2.

The site was historically occupied by Waste Control Pty. Ltd., operating as a chemical/oil recycling and treatment facility until a fire destroyed the facility in February 2001. In the aftermath, Cleanaway Technical Services were contracted to clean up the site and the surrounding area to ensure safe reoccupation of the area by residents and businesses. The site has remained unoccupied since the fire.

Following the fire, a number of investigations were conducted at the site to assess the extent of soil and groundwater contamination. In March 2008, installation of 21 new monitoring wells and the sampling of 41 monitoring wells was undertaken (Golder, 2008a). A recommendation from this work was that an interim groundwater monitoring program be undertaken at select new monitoring well locations installed in March 2008 in order to confirm the results of the initial monitoring.

While results from existing monitoring wells could be compared against historical results to assess consistency, results from new monitoring wells could only be interpreted in the context of historical information in surrounding areas. As many of these new wells provide important information on the currently underway delineation of the downgradient groundwater plume, which is necessary information for remedial planning; it is therefore important that the initial results be verified prior to the next sampling event, which is not scheduled until March 2009. Additionally, there were QA/QC concerns regarding the March 2008 sampling event around the detection of phthalates in many of the new monitoring wells, especially in cases where the concentrations were above risk-based criteria. Detection of phthalates may be related to the plastic wrap around well construction materials or the PVC liners. A final point is that this interim event would allow collection of water samples from the Helena River, which was not included in the 2008 monitoring program although it had been included in the 2006 groundwater monitoring plan (Golder, 2006). This report details the 2008 interim groundwater sampling program.

### 1.1 Objectives and Scope of Works

Groundwater sampling results obtained after monitoring well installation can be anomalous due to so called "aquifer trauma" resulting from the disturbance by drilling which introduces heat, oxygen and in some cases fluids to the formation. Despite rigorous development and purging these disturbances may persist and the passage of time is required to restore the hydrochemical equilibrium. Hence, initial monitoring results, while informative, should be confirmed and is often done through subsequent monitoring. The objectives of the interim groundwater monitoring program therefore were to verify the initial results of key new monitoring wells, to clarify QA/QC issues potentially related to the well installation process and to evaluate water quality in the Helena River.

The scope of work for the interim groundwater monitoring program comprised the following activities:

- measuring of water levels at each well and surface water location prior to sampling;
- collection of groundwater samples from monitoring wells at the site, Southwest Industrial Area, Lot 2 and Damplands; and
- collection of water samples from surface water locations in the Damplands and Helena River.

#### **Sampling Locations**

Golder conducted the Interim 2008 groundwater sampling program between 12 October 2008 and 15 October 2008 based on recommendations from Golder (2008a). Samples were collected from 20 monitoring wells and surface water in the Damplands Pond and Helena River. The monitoring wells and surface water locations that were sampled are summarised in Table 1 which includes their location, targeted



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groundwater zone and rationale for their inclusion in the interim program. The sampling locations are shown on Figure 2.

Wells that had concentrations below Limit of Reporting (LOR) in the previous sampling round were not included in the interim program. These wells will be re-tested during the 2009 annual monitoring program, scheduled for March 2009.

**Table 1: Interim Monitoring Program**

Monitoring Well	Groundwater Zone	Rationale
<b><i>Damplands</i></b>		
MWG66	Alluvial	Verify bis(2-ethylhexyl)phthalate
MWG67	Alluvial	Verify bis(2-ethylhexyl)phthalate
MWG73	Base of Guildford	Leading edge of plume
MWG74	Alluvial	Leading edge of plume
MWG75	Base of Guildford	Leading edge of plume
MWG76	Leederville	Leading edge of plume
MWG78	Base of Guildford	Leading edge of plume
MWG77	Alluvial	Leading edge of plume (in advance of)
MWG79	Alluvial	Leading edge of plume
<b><i>Southwest Industrial Area</i></b>		
MWG70	Regional Watertable	High TCE, near potential local source
MWG72	Regional Watertable	West boundary of plume
MWG80	Base of Guildford	West boundary of plume
MWG81	Regional Watertable	West plume boundary, verification of bis(2-ethylhexyl)phthalate
<b><i>Lot 2</i></b>		
MWG83	Base of Guildford	Confirm TCE concentrations
MWG84	Regional Watertable	High TCE well
<b><i>Surface Waters</i></b>		
SG03 (Pond)	Middle of Pond	Pond water near leading edge of plume
SG05 (River)	Downstream	Helena River Downstream
SG06 (River)	Midstream	Helena River Midstream
SG07 (River)	Upstream	Helena River Upstream
<b><i>Waste Control Site</i></b>		
MW25	Base of Guildford	Confirmation of benzene detection



### 2.0 METHODOLOGY

Seven wells in Lot 2 and the Southwest Industrial Area (MW25, MWG70, MWG72, MWG80, MWG81, MWG83 and MWG84) were purged and sampled using a submersible QED micropurge bladder pump operating at a relatively low flow rate of approximately 240 to 360 mL/min. Thirteen locations in the Damplands and Helena River (MWG66, MWG67, MWG73, MWG74, MWG75, MWG76, MWG77, MWG78, MWG79, SG03, SG05, SG06 and SG07) were purged and sampled using a peristaltic pump, also operating at a relatively low flow rate of about 250 to 500 mL/min. The peristaltic pump in conjunction with dedicated tubing was used where possible as the pump is external to the well, eliminating a potential source of cross-contamination. As peristaltic pumps only work efficiently up to a depth to groundwater of approximately 4 m when collecting samples for volatile organic compound (VOC) analysis, the submersible pump was required at many locations. A water level was taken prior to pumping at each location using a water level meter and drawdown was monitored when using the submersible pump to ensure that the groundwater level did not fall below the intake valve of the pump. Water levels of the four surface water points were also collected during the surface water sampling event.

During purging of each well, near continuous measurement of field groundwater parameters was made, including pH, temperature, conductivity, reduction potential and dissolved oxygen using a pre-calibrated TPS90 FLMV water quality meter. The calibration of the meter (pH and conductivity) was checked twice daily by submersing the probes into two standard pH solutions (pH 4 and pH 7) and a standard conductivity solution (2.76 mS/cm). A groundwater sample was collected once the field parameters stabilised (to within  $\pm 10\%$ ).

Each groundwater sample and surface water sample was collected using dedicated nitrile gloves, dedicated high density polyethylene tubing and placed into bottles supplied by the laboratory with the relevant preservatives. Samples for ferrous iron analysis were field filtered with a single-use disposable 0.45 micron filter prior to mixing with preservative. Samples were stored under cool conditions in an esky with ice or freezer bricks while in the field and in transit to the laboratory. Each sample, including all quality assurance samples, were given a unique Sample Control Number, which was recorded on a Chain of Custody (CoC) form with all other relevant sampling information. A CoC record was kept for samples from the time of sample collection until delivery to the laboratory. All primary samples were submitted to Leeder Consulting (Leeder), who are NATA accredited for all analyses. Blind duplicate samples were also submitted to Leeder. Blind triplicate samples were submitted to ALS Environmental (ALS), who is NATA accredited for all analyses. The chain of custody forms and the laboratory certificates are included as Appendix A.

Sampling was carried out in accordance with standard quality procedures adopted by Golder to minimise the risk of cross contamination. In particular, the submersible pump was thoroughly decontaminated prior to use and between each sampling location. The decontamination procedure involved disassembling the pump and washing all components in a water/decon90 mix followed by rinsing them at an initial distilled water station, and again at a second distilled water wash station. The pump was finally sprayed a third time with distilled water using a hand sprayer prior to installation into the well. Nitrile gloves were replaced between each of the three wash stations and hand spray rinse, with the water used to clean the pump changed between each sample location. All non-stainless steel pump components (Teflon bladder and o-rings) were also replaced between locations. Field rinsate wash blanks were also collected as a check on the decontamination process by rinsing laboratory supplied nanopure water over and through the pump after it had been decontaminated.

The monitoring wells sampled using the submersible pump were generally collected in an order from least contaminated to most contaminated based on previous chemical data obtained at the site to further minimise the potential for cross contamination.

All monitoring wells were tested for the following suite of parameters:

- field parameters: electrical conductivity (EC), dissolved oxygen (DO), temperature, pH, water level and redox potential (Eh);



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- VOC scan (including chlorinated ethenes, dichloroethane, vinyl bromide and BTEX);
- total petroleum hydrocarbons (C<sub>6</sub>-C<sub>36</sub>); and
- phthalates.

River water samples were also analysed for inorganics and metals as these locations were not sampled in the 2008 monitoring round and parameters have previously been noted as elevated above aquatic screening criteria in several of the Damplands wells. River water samples were tested for the following inorganic parameters:

- Major ions and total dissolved solids (sulphate, chloride, nitrate and alkalinity) and cations (calcium, magnesium, potassium and sodium).
- Total (unfiltered) metals: aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, and zinc.
- Dissolved metals: ferrous iron.

The field QA/QC program adopted for the investigation included the following:

- Equipment wash blank collected each day that the submersible pump that was used. The equipment wash blank were be analysed for TPHs and VOCs to assess quality of decontamination techniques.
- As the sampling included highly volatile compounds, the QA/QC program included the submission of one trip blank during each day. The trip blank was analysed for VOCs.
- A total of 24 samples were collected, including 4 QA/QC samples. Of these QA/QC samples, two duplicate samples were submitted to Leeder for analysis of VOCs, TPHs and pthalates, one triplicate sample was submitted to ALS for analysis of VOCs, TPHs and pthalates and one duplicate sample was sent to Leeder for analysis of VOCs, TPHs, pthalates, major anions and cations, TDS, total metals and dissolved metals. Both laboratories selected are NATA accredited for the analysis selected.
- Waste groundwater generated from the sampling program was collected in 205 L drums provided by Cleanaway and will be temporarily stored on the site. Once the waste has been characterised it will be disposed of by Cleanaway.

### 3.0 EVALUATION CRITERIA

Results from the interim groundwater monitoring program wells are provided in Tables A to D. Groundwater results on site, Lot 2 and the Southwest Industrial Area were compared against the revised site-specific Risk-Based Criteria (RBC) for the site and Lot 2 (Golder 2008b). These site-specific RBC cover potential indoor air inhalation pathways for environmental works and exposure of a worker performing irrigation. The results of the interim 2008 groundwater results for site, Lot 2 and the Southwest Industrial Area are presented in Table C, along with the results from the 2008 annual groundwater sampling events conducted in March 2008.

Results for the Damplands and Surface Water were compared against both health RBC (Golder 2008b) for the Damplands and recently updated Aquatic Ecological Screening Criteria (Golder, 2009). The Damplands RBC address potential exposure of outdoor workers performing irrigation and swimmers entering the surface waters. The risk assessment focussed on the ecological risks associated with the migration of contaminants to the Helena River via groundwater. Although applied to these wells as a conservative approach, the screening criteria for aquatic ecosystems strictly apply at the point of discharge of the groundwater (i.e. criteria need to be achieved immediately before the River). The results of the interim 2008 groundwater sampling for sampling points located in the Damplands and the Helena River are presented in Table D along with previous sampling results.





### 4.0 2008 INTERIM MONITORING RESULTS

The following discussion summarises locations where key analytes were detected which were above the site-specific RBC and aquatic screening criteria appropriate for that area. Monitoring locations where groundwater and surface water concentrations reported in the interim results exceeded the site-specific RBC or aquatic screening criteria are shown on Figure 3. A comparison of the interim results exceeding criteria in comparison to previous exceedences from March 2008 is shown on Figure 4.

#### 4.1 Water Levels

Water levels collected during the interim 2008 sampling program have been included in Table A along with historical measurements for the monitoring locations. For all new monitoring wells the October measurement is only the second time water levels have been collected. The measurements collected during the program indicate the water table elevation ranges from 0.595 m to 1.2 m greater than in March. This is consistent with expectations, as the March measurements were collected at the end of summer (dry season) whereas the October measurements were collected at the end of winter (wet season). The Helena River measurements indicated the water level is significantly greater than in March as the upstream location in February 2008 was dry whereas in October it was 1.025 m (6.769 m AHD).

#### 4.2 Water Quality

##### 4.2.1 Field Parameters

Field parameter results collected during the monitoring round for each well sampled are presented in Table B. This table includes pH, reduction potential, temperature, conductivity and dissolved oxygen. The original field sheets are provided in Appendix B.

The pH of wells ranged between 5.19 (MWG79, Damplands, Alluvial) and 7.03 (SG06, Helena River Midstream). The pH differences compared to the last monitoring round were not considered to be significant at any of the monitoring locations.

Eight wells had dissolved oxygen (DO) levels above 1 mg/L (MWG79, MWG74, MWG80, MWG83, MWG72, MWG81, MWG70 and MWG75) with the highest reading at MWG81 (3.31 mg/L, Regional Watertable). In all but one instance, the concentration of dissolved oxygen had increased. In many of these instances the difference in the concentrations of DO could be considered to be within the degree of error of the instrument however the following locations experienced larger changes:

- MWG83 (Base of Guildford, Lot 2) DO increased from 0.01 mg/L in March 2008 to 2.92 mg/L October 2008;
- MWG81 (Regional Watertable, Southwest Industrial Area) DO increased from 1.13 mg/L in March 2008 to 3.31 mg/L October 2008; and
- MWG80 (Base of Guildford, Southwest Industrial Area) DO increased from 0.05 mg/L in March 2008 to 3.6 mg/L October 2008.

It is possible the increases in groundwater DO may result from groundwater recharge from precipitation during the winter (wet season). All of the surface water locations had DO levels above 1 mg/L with the highest reading at SG06 (5.52 mg/L Midstream).

The conductivity measured during sampling ranged from 424  $\mu\text{S}/\text{cm}$  (MWG74, Damplands, Alluvium) to 2451  $\mu\text{S}/\text{cm}$  (MWG77, Damplands, Alluvium).

##### 4.2.2 Site

Only monitoring well MW25 (Base of Guildford) was sampled from the Waste Control Site. This was undertaken for the purpose of verifying the detection of benzene in samples collected in 2008. Samples collected from MW25 were analysed for TPHs, monocyclic aromatic hydrocarbons (MAHs), and VOCs.





### 4.2.2.1 Total Petroleum Hydrocarbons

Results indicate that concentrations of TPH fractions C<sub>6</sub>-C<sub>9</sub> and C<sub>10</sub>-C<sub>14</sub> have decreased. TPH fraction C<sub>6</sub>-C<sub>9</sub> has decreased from 0.82 mg/L to 0.04 mg/L whereas TPH fraction C<sub>10</sub>-C<sub>14</sub> has decreased from 0.24 mg/L to 0.04 mg/L. Concentrations of all TPH fractions are below the associated RBC.

### 4.2.2.2 Monocyclic Aromatic Hydrocarbons and Volatile Organic Compounds

Results indicate detections of 1,2,4-trimethylbenzene (0.007 mg/L), 1,3,5-trimethylbenzene (0.001 mg/L), benzene (0.024 mg/L), ethylbenzene (0.009 mg/L), xylene (m&p) (0.025 mg/L) and xylene (o) (0.002 mg/L) in samples collected from MW25. In comparison to results from March 2008 concentrations of 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and benzene have decreased, whereas the concentration of xylene (m&p) has doubled.

In March 2008 the concentration of benzene (0.051 mg/L) at MW25 was found to exceed RBC in the Base of Guildford for the first time. Though the recent result indicates a decrease in benzene concentrations (0.024 mg/L), it was still above RBC. This verifies that benzene contamination has likely reached the Base of Guildford beneath the former Waste Control Site

### 4.2.3 Southwest Industrial Area

Four monitoring wells in the Southwest Industrial Area were included in the interim groundwater monitoring program; MWG70 (Regional Watertable), MWG72 (Regional Watertable), MWG80 (Base of Guildford) and MWG81 (Regional Watertable). Samples collected from the Southwest Industrial monitoring wells were analysed for TPHs, MAHs, VOCs and pthalates.

#### 4.2.3.1 Total Petroleum Hydrocarbons

Previous results indicated concentrations of TPH fractions C<sub>6</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub> and C<sub>15</sub>-C<sub>28</sub> in MWG80 (Base of Guildford) and MWG81 (Regional Watertable). Results from the interim monitoring program indicated concentrations of all TPH fractions in all the Southwest Industrial Area monitoring wells were below LOR. The decreases in TPH concentrations can be summarised as follows:

- Total TPH C<sub>6</sub>-C<sub>36</sub> in MWG80 from 0.07 mg/L to <0.05 mg/L and in MWG81 from 0.24 mg/L to <0.05 mg/L;
- TPH fraction C<sub>6</sub>-C<sub>9</sub> in MWG81 from 0.01 mg/L to < 0.01 mg/L;
- TPH fraction C<sub>10</sub>-C<sub>14</sub> in MWG80 from 0.01 mg/L to < 0.01 mg/L and in MWG81 from 0.04 mg/L to <0.01 mg/L;
- TPH fraction C<sub>15</sub>-C<sub>28</sub> in MWG80 from 0.06 mg/L to <0.05 mg/L and in MWG81 from 0.13 mg/L to <0.05 mg/L; and
- TPH fraction C<sub>29</sub>-C<sub>36</sub> in MWG81 from 0.06 mg/L to <0.05 mg/L.

#### 4.2.3.2 Monocyclic Aromatic Hydrocarbons and Volatile Organic Compounds

Consistent with March 2008 results, no MAHs were detected at concentrations above LOR.

In MWG70, MWG72, MWG80, and MWG81 a total of fourteen VOCs were detected in the Southwest Industrial Area during the March 2008 monitoring round. Results from the interim monitoring round detected only TCE, PCE and trichlorofluoromethane in MWG70 and cis-DCE, TCE, PCE and trichlorofluoromethane in MWG81. A summary of significant differences in chlorinated solvent concentrations between March 2008 and October 2008 are as follows:

- an increase in TCE in MWG70 (Regional Watertable) from 0.22 mg/L to 0.3 mg/L;



- a decrease in PCE in MWG70 (Regional Watertable) from 0.004 mg/L to 0.002 mg/L;
- a decrease in cis-1,2-DCE in MWG81 (Regional Watertable), from 0.009 mg/L to 0.003 mg/L;
- a decrease in TCE in MWG81 (Regional Watertable) from 0.007 mg/L to 0.001 mg/L; and
- a decreased in PCE in MWG81 (Regional Watertable) from 0.021 mg/L to 0.002 mg/L.

Similar to results in March 2008, the concentration of TCE in MWG70 (Regional Watertable) was found to be above RBC.

### 4.2.3.3 *Phthalates*

Results from March 2008 indicated bis(2-ethylhexyl) phthalate in MWG72 (Regional Watertable) and MWG80 (Base of Guildford). Recent results indicate a decrease in concentrations of phthalate with 0.0003 mg/L in MWG72 (previously 0.0091 mg/L) and below LOR in MWG80 (previously 0.0066 mg/L).

### 4.2.4 *Lot 2*

Monitoring wells MWG83 (Base of Guildford) and MWG84 (Regional Watertable) were selected for monitoring for the interim program to confirm concentrations of chlorinated solvents. Samples collected from Lot 2 monitoring wells were analysed for TPHs, MAHs, VOCs and phthalates.

#### 4.2.4.1 *Total Petroleum Hydrocarbons*

Previous results indicated TPH concentrations below LOR in MWG83 (Base of Guildford), however interim results indicate a nominal increase in concentrations of C<sub>10</sub>-C<sub>14</sub> fraction to 0.01 mg/L. Interim monitoring results indicate the following differences in TPH concentrations for MWG84 (Regional Watertable):

- decrease in TPH C<sub>6</sub>-C<sub>9</sub> fraction from 0.55 mg/L to 0.44 mg/L;
- decrease in TPH C<sub>10</sub>-C<sub>14</sub> fraction from 0.72 mg/L which was above RBC to 0.44 mg/L; and
- increase in TPH C<sub>15</sub>-C<sub>28</sub> fraction from 0.06 mg/L to 0.72 mg/L.

None of the TPH concentrations were above RBC in MWG84.

#### 4.2.4.2 *Monocyclic Aromatic Hydrocarbons and Volatile Organic Compounds*

Results from the interim monitoring indicate that VOCs concentration at MWG84 have increased in comparison to results from March 2008. A summary of the significant differences between the two set of monitoring results for MWG84 (Regional Watertable) are as follows:

- increase in cis-1,2-DCE from 0.022 mg/L to 1 mg/L;
- increase in TCE from 0.022 mg/L to 0.037 mg/L;
- increase PCE from 0.058 mg/L to 0.075 mg/L;
- increase 1,2-DCA from 0.009 mg/L to 0.021 mg/L;
- increase 1,4-dichlorobenzene (1,4-DCB) from 0.004 mg/L to 0.031 mg/L; and
- increase vinyl bromide from 0.047 mg/L to 0.15 mg/L.

In March 2008, ten VOCs were found in concentrations above LORs in MWG83. In comparison only five VOCs were found during the interim monitoring program. A summary of the significant differences between results for MWG83 (Base of Guildford) are as follows:



- increase in cis-1,2-DCE from 0.009 mg/L to 0.023 mg/L.
- twofold increase in TCE from 0.002 mg/L to 0.004 mg/L;
- increase in PCE 0.003 mg/L to 0.007 mg/L; and
- decrease in vinyl bromide from 0.0016 mg/L to 0.001 mg/L.

Results from March 2008 indicated trans 1,2-dibromoethene in concentrations above LOR in MWG83 and MWG84. However samples were not analysed for these contaminants during the interim sampling as only vinyl bromide in the suit of brominated compounds was required under the sampling plan. The LOR for carbon tetrachloride was above the associated RBC as it is below the laboratory practical quantitative limit.

Contaminants with concentrations above RBC in MWG84 were 1,2-DCA, 1,4-DCB, TCE, and vinyl bromide. The previous round of monitoring did not detect concentrations of TCE above RBC. Results indicated that none of the concentrations of VOCs in MWG83 were above RBC.

### 4.2.4.3 Phthalates

Previous results indicated concentrations of diethyl phthalate (0.001 mg/L) in MWG84. Results from the interim monitoring program found concentrations of phthalates in MWG83 and MWG84 to be below LOR.

### 4.2.5 Damplands

Monitoring wells MWG66 (Alluvial), MWG67 (Alluvial), MWG73 (Base of Guildford), MWG74 (Alluvial), MWG75 (Base of Guildford), MWG76 (Leederville), MWG77 (Alluvial), MWG78 (Base of Guildford) and MWG79 (Alluvial) were included in the interim monitoring program. Samples collected from the Damplands monitoring wells were analysed for TPHs, MAHs, VOCs and phthalates.

#### 4.2.5.1 Total Petroleum Hydrocarbons

Results obtained from the March 2008 sampling round indicated concentrations of TPH fraction C<sub>6</sub>-C<sub>9</sub> above LOR for MWG75 (only in the triplicate sample) as well as concentrations of TPH fractions C<sub>6</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub> and C<sub>15</sub>-C<sub>28</sub> above LOR for MWG78. Sample results for MWG78 indicated concentrations of TPH are below laboratory LOR.

#### 4.2.5.2 Monocyclic Aromatic Hydrocarbons and Volatile Organic Compounds

Results indicate concentrations of MAHs are not above laboratory LOR for all wells sampled in the Damplands. The following VOCs were detected in the Damplands:

- cis-1,2-DCE in MWG75 (Base of Guildford), MWG78 (Base of Guildford), MWG79 (Alluvial);
- TCE in MWG66 (Alluvial), MWG73 (Base of Guildford), MWG74 (Alluvial), MWG75 (Base of Guildford), MWG78 (Base of Guildford), MWG79 (Alluvial);
- PCE in MWG75 (Base of Guildford), MWG78 (Base of Guildford), MWG79 (Alluvial);
- trichlorofluoromethane in MWG75 (Base of Guildford), MWG78 (Base of Guildford);
- vinyl bromide in MWG76 (Leederville), MWG78 (Base of Guildford), MWG79 (Alluvial);
- chloroform in MWG78 (Base of Guildford) and MWG79 (Alluvial); and
- 1,1-DCA in MWG75 (Base of Guildford), MWG78 (Base of Guildford) MWG79 (Alluvial).

Results from March 2008 indicated cis 1,2-dibromoethene and trans 1,2-dibromoethene in concentrations above LOR in the Dampland monitoring wells, however samples were not analysed for these contaminants during the interim sampling.



Results from the March 2008 results indicated the only VOCs above RBC concentrations in the Damplands was TCE in MWG75. As the current results indicate that TCE in MWG75 has dropped from 0.099 mg/L to 0.046 mg/L none of the monitoring wells in the Damplands have contaminants above RBC.

### 4.2.5.3 *Phthalates*

Results from the annual monitoring program in March 2008 indicated concentrations of phthalates above LOR in nine of the monitoring locations (MWG66 (Alluvial), MWG67 (Alluvial), MWG73 (Base of Guildford), MWG74 (Alluvial), MWG75 (Base of Guildford), MWG76 (Leederville), MWG77 (Alluvial), MWG78 (Base of Guildford) and MWG79 (Alluvial)). Three of these monitoring wells (MWG66, MWG67 and MWG77) had concentrations of bis(2-ethylhexyl) phthalate above associated RBC. Results from the interim monitoring indicate that concentrations of phthalates the nine monitoring wells were below LOR levels and therefore there are no exceedences of RBC.

### 4.2.6 *Surface Water*

Four surface water locations were chosen for sampling in the interim monitoring program as they had not been included in the annual monitoring undertaken in March 2008. Samples collected from SG03 (middle of the Damplands pond), SG05 (downstream), SG06 (midstream) and SG07 (upstream) were analysed for inorganics, TPHs, MAHs, VOCs, phthalates, and VOCs.

#### 4.2.6.1 *Inorganics and Metals*

All results of cadmium concentrations were non-detects. However the laboratory LOR for cadmium was above the associated RBC and required ultra trace analysis. As the primary contaminants of concern from the site are organics, the LOR for cadmium is not considered significant.

Iron concentrations exceeded the aquatic screening criterion in all of the surface water samples collected. The highest concentration of iron was 2.1 mg/L in SG03 (Damplands Pond). Results from SG07 (upstream) were found to have concentrations of both aluminium (0.065 mg/L) and zinc (0.019) above aquatic screening criteria. Results from SG06 (midstream) indicated concentrations of zinc (0.008 mg/L) equal to the aquatic screening criteria. Other than iron and cadmium all concentrations of inorganics and metals were below relevant criteria in the downstream samples.

#### 4.2.6.2 *Total Petroleum Hydrocarbons*

Concentrations of TPHs in all surface water samples collected were below LOR.

#### 4.2.6.3 *Volatile Organic Compounds*

Concentrations of all VOCs in all surface water samples collected were below LOR.

#### 4.2.6.4 *Semi-Volatile Organic Compounds*

Concentrations of all sVOCs in all surface water samples collected were below LOR.

## 5.0 *QUALITY ASSURANCE/QUALITY CONTROL*

### 5.1 *Field Testing*

The water quality meters used for field parameter measurement during the 2008 interim sampling round were calibrated by the supplier (EnviroEquip Pty Ltd) prior to shipment. The calibration certificates are included in Appendix C. The calibration (pH and conductivity) of the water quality meter was checked twice-daily (before commencing work and at the end of the day) during the field program to ensure the calibrations were accurate and monitor drift.

The greatest pH deviation from both the pH 4 and 7 calibration solution occurred at the end of the final day of sampling (15 October 2008). The results indicated the pH meter likely drifted during the day as the pH meter



read 6.5 (for pH 7 solution) and 3.7 (for pH 4 solution). The locations sampled during the final day consisted of the surface water locations SG03, SG05, SG06 and SG07, hence field measured pH values at these locations may be biased low by 0.3 to 0.5 pH units. Overall, however, the pH calibration was considered satisfactory for the purpose of this investigation.

Overall temperature and pH of the samples collected did not differ significantly from the previous results collected. It was noted that the conductivity at MWG72, MWG78 and MWG81 differed by more than 200  $\mu\text{S}/\text{cm}$ . Results from the conductivity check indicated an only minor deviation from the calibration solution. The redox potential at MWG74, MWG80 and MWG83 differed by more than 100 mV.

The reduction potential of MWG80 and MWG83 both in the Southwest Industrial Area increased from -139mV to 68mV and -168mV to 94mV, respectively. This is potentially due to seasonality as groundwater would become oxygenated throughout the winter due to recharge from infiltration.

In comparison, field results indicate MWG74 (Damplands) became reducing, decreasing to -160mV from 277mV. As this location is downgradient from site the change in redox could be a result of the degradation processes which consume oxygen.

## 5.2 Field Duplicates

Four field duplicates were taken during groundwater sampling. Three of these duplicates were sent to the primary laboratory (Leeder), while the remaining sample went to the secondary laboratory (ALS). The duplicates were taken from three locations, from a well on the site (MW25), a relatively uncontaminated well in the Damplands (MWG75) and from the Damplands Pond (SG03). The field duplicate results are presented in Table E.

A comparison between duplicate sample results can be conducted using a Relative Percentage Difference (RPD) to analyse the duplicate samples. This is a measure of the difference between the primary and duplicate samples as a percentage of their average value. RPDs are calculated according to the following formula:

$$\% \text{ RPD} = \frac{|A - B|}{\frac{A + B}{2}} \times 200$$

Where:

A is the concentration of the primary laboratory analyte, and

B is the corresponding duplicate result.

In calculating RPD values, the following protocols have been adopted:

- Where both concentrations are below limits of reporting (LOR), no RPD is calculated and a nominal value of less than 50% is assigned.
- Where one laboratory concentration is below the LOR and one is above, a value of one half of the detection limit is substituted for the non-detect sample.
- Where both concentrations were above laboratory LOR, the RPD was calculated as per the formula above.

In line with the Australian Standard (AS 4482.1), RPDs of less than 50% are considered to be satisfactory for soil analyses. RPDs greater than 50% may be acceptable for a) organic analyses and b) low concentrations (<10 times the method LOR). This standard has also been adopted in the review of groundwater samples for this investigation.





### 5.2.1 Primary Laboratory (Leeder)

Field duplicates sent for analyses at the same laboratory were submitted as 'blind' duplicates, i.e. the laboratory were not aware that the two samples came from the same location. This gives a measure of the reproducibility of results received from this laboratory.

Comparison of the primary and duplicate samples indicates the following RPDs were greater than 50%:

- MWG25 (Site, Base of Guildford) for contaminants 1,3,5-trimethylbenzene, TPH C<sub>6</sub>-C<sub>9</sub> and TPH C<sub>10</sub>-C<sub>14</sub>;
- MWG75 (Damplands, Base of Guildford) for contaminant 1,1-dichloroethene; and
- SG03 (Damplands Pond) for aluminium.

In all of these cases the differences between the primary and secondary samples were less or equal to ten times the laboratory limit of reporting. Considering all the results were below the relevant site specific RBC, Golder considers these RPDs as acceptable for the purposes of this investigation.

### 5.2.2 Secondary Laboratory (ALS)

The triplicate sample sent to ALS was generally within the acceptable range set by the laboratory, with the exception of TPH C<sub>6</sub>-C<sub>9</sub> fraction, trichlorofluoromethane, 1,1-DCA and 1,1-DCE which had RPD values greater than 50%. In three of the four instances, the LOR used by ALS was greater than the concentration detected in the primary sample by Leeder. For TPH C<sub>6</sub>-C<sub>9</sub> fraction, the amount detected in the triplicate sample was less than 10 times the limit of reporting whereas Leeder reported concentrations below LOR. Considering all the results were below the relevant site specific RBC, Golder considers these RPDs as acceptable for the purposes of this investigation.

## 5.3 Laboratory Duplicates

Laboratory duplicates were analysed by Leeder and ALS over the duration of the investigation. The internal laboratory duplicates were conducted on groundwater samples, trip blanks and wash blanks. The laboratory duplicates were analysed for a range of analytes.

The laboratory duplicates did not report any RPDs greater than 50%, hence indicated satisfactory correlation between results and acceptable internal laboratory reproducibility of results.

## 5.4 Blank Samples

Results of the field wash blanks and trip blanks analysis are presented in Table F.

### 5.4.1 Laboratory Blanks

The results of the laboratory blank analyses indicate that no analytes were detected above the laboratory LOR in any of the laboratory blanks.

### 5.4.2 Trip Blanks

Five trip blanks (1 per day + 1 per batch to secondary laboratory) were analysed for TPH C<sub>6</sub>-C<sub>9</sub> and VOCs to assess whether cross contamination of volatiles may be occurring in transit. Trip blanks were provided by the respective laboratory.

Three of the four trip blanks sent to Leeder returned concentrations of chloroform of 0.002 mg/L. Leeder was contacted and they suggested the possibility that the laboratory water used to prepare the trip blanks was contaminated with chloroform. Leeder has since changed their trip blank procedures. This procedure includes the analysis of each trip blank sample prior to dispatch ensuring that no contamination is present at that time. The concentrations of chloroform were less than ten times the laboratory limit of reporting and



below the relevant site specific RBC, therefore Golder considers the results of the trip blanks to not have significantly impacted the results.

### 5.5 Wash Blanks

Wash blanks were samples consisting of rinse water provided by Leeder. The bottles for each wash blank were filled with the relevant rinse water by rinsing the decontaminated parts of the sampling equipment, which had contact with the groundwater. Wash blanks test for cross-contamination between wells, according to which, if any analytes are still present on the pump after decontamination. Two wash blanks were collected during the investigation. Wash blanks were collected only on days when the submersible pump was used to collect groundwater samples. All wash blanks were analysed for TPH and VOCs (including vinyl bromide).

The results of the wash blank testing indicate the presence of chloroform (0.002 mg/L) in both samples. Leeder was contacted and they suggested the possibility that the laboratory water used to prepare the trip blanks contained chloroform. The concentrations of chloroform were less than ten times the laboratory limit of reporting and below the relevant site specific RBC, therefore Golder considers the results of the wash blanks to not have significantly impacted the results.

### 5.6 Surrogate Recoveries

The results of the surrogate analyses from the primary and secondary laboratories are presented in the laboratory certificates of analysis, presented in Appendix A.

The surrogate recoveries are a measure of the amount of a chemical the laboratory has actually retrieved during a sample analysis. A known quantity of a similar chemical that is not present in the groundwater sample is added to the sample, and then the percentage retrieved during analysis is measured and used as a base measure for the expected percentage of similar analytes retrieved, as opposed to how much is actually present. NATA and Leeder have established a standard of 60% to 130% as the acceptable range for surrogate recoveries.

All of the Leeder surrogates had recoveries above 60%, although 66 of them were below 70%. In Golder's opinion these results have not affected the outcomes of the investigation as they are acceptable under NATA and Leeder standards.

Eleven of the surrogates from ALS had recoveries below 60%, with nine of them being phenols. The lowest recoveries were for phenol-d6 (26.8% to 38.1%) and 2-fluorophenol (34.3% to 51.4%). ALS was contacted regarding the low recoveries for the surrogates. According to ALS, phenol-d6 and 2-fluorophenol are the most volatile of the surrogates and it is not unusual for low recoveries in water. The results of the surrogate recoveries are within the USEPA surrogate recovery limits (USEPA, 1996). According to the USEPA recovery limits, between 10%-110% for phenol-d6 and between 21%-110% for 2-fluorophenol are considered acceptable (USEPA, 1996). Phenols were not analysed for in the interim monitoring program, therefore in Golder's opinion these results have not affected the outcomes of the investigation. The one surrogate that was not a phenol and had recovery rates below 60% was 1,2-dichlorobenzene-D4 and would only have affected triplicate result from ALS, not the primary and duplicate, which were analysed by Leeder. For both the triplicate and the primary samples all benzene compounds were below detection limits.

### 5.7 Spike Recoveries

The results of spike recoveries from the primary and secondary laboratories are presented in the laboratory certificates of analysis, presented in Appendix A.

Spike recoveries are samples (either blank samples or actual samples) to which a known amount of the analytes being tested for have been added and then recovered through the same process as the actual samples to provide an indication of how efficient the recovery process is. As with surrogates, Leeder have a general acceptance limit of 60% to 130%.





All of the spike recoveries were found to be within acceptable limits.

### 5.8 Quality Assurance/Quality Control Summary

A summary of the QA/QC assessments undertaken as part of the investigation is provided below.

Fieldwork was undertaken using procedures to minimise the risk of cross contamination which included:

- collection of samples using new disposable nitrile gloves for each sample collected;
- collection of groundwater samples using dedicated sampling equipment (tubing, pump bladders and o-rings) at each location;
- decontamination of sampling equipment prior to sample collection at each location;
- groundwater samples for metals were field filtered using a disposable, one use 0.45 µm filter; and
- samples were collected into clean laboratory provided sample containers with appropriate preservatives where required.

Based on this, the risk of cross contamination was considered to have been successfully minimised. Additionally, the QA/QC program included:

- The calibration (pH and conductivity) of the water quality meter used to measure field parameters was checked during the investigation and considered to be satisfactorily calibrated.
- The laboratory LOR for contaminants of concern were targeted at being below the adopted screening criteria and site-specific RBC allowing satisfactory interpretation of results. Laboratory LOR did not meet the associated criteria for carbon tetrachloride in all wells, as the criteria are below the achievable laboratory LOR.
- In the instances where the laboratory LOR was elevated due to matrix conditions, it did not affect the interpretation of the data.
- Field blind and field split duplicate groundwater samples were collected and analysed at an acceptable rate (i.e. greater than 10% for contaminants of concern).
- The RPDs calculated for the field blind and field split duplicates were generally within the acceptable range of 0% to 50%. All of the duplicates with RPDs exceeding 50% were related to concentrations on or close to laboratory LOR. The results were all below relevant screening criteria.
- The results of the internal laboratory QA/QC assessment involving duplicate, spike, surrogate and laboratory blank analyses were judged to be acceptable for the purposes of this investigation.
- Wash blank samples were collected and analysed as a check on decontamination procedures and data quality. A review of the wash blank results indicated that chloroform was detected; however there does not appear to be any data quality issues associated with its presence.
- Trip blank samples were analysed as part of the field QA program. The results of the trip blank analyses indicated that chloroform was detected; however there does not appear to be any data quality issues associated with its presence as it is likely a result of the preparation of the sample at the laboratory and not due to cross contamination.

Overall, it is Golder's opinion that the quality assurance objectives for the investigation have been met and that the data integrity is acceptable for the purposes of this off-site investigation.



### 6.0 SUMMARY AND CONCLUSIONS

A primary aim of the interim groundwater monitoring program was to verify the results of the 2008 annual groundwater monitoring program in newly installed monitoring wells. The interim program also included the monitoring of surface water locations and well MW25 as the March 2008 results noted an increase in the concentration of benzene. The investigation was undertaken in October 2008 and a summary of the conclusions are as follows:

- Analytical results indicated that bis(2-ethylhexyl)phthalate was noted in concentrations above LOR only in MWG72 (Southwest Industrial Area, Regional Watertable). The concentrations of bis(2-ethylhexyl)phthalate in MWG72 were not above RBC. No other phthalates were detected during the interim monitoring program. It is therefore suspected that the presence of phthalates in the groundwater during the 2008 annual monitoring programme was an artefact of the drilling process.
- Concentration of benzene in MW25 (Base of Guildford) had halved from 0.051 mg/L to 0.024 mg/L, however they were still above RBC and greater than concentrations noted in monitoring wells prior to 2008. Therefore, the October 2008 results confirm that benzene in groundwater has migrated o the Base of the Guildford beneath the former Waste Control Site.
- Results from the interim monitoring round indicated that concentrations of metals such as aluminium, iron, zinc were above aquatic screening criteria. Inorganic exceedences are likely not a result of on-site contamination, as SG07 (upstream) had exceedences of these metals.
- VOCs, phenols, TPHs and MAHs were not detected in the samples collected from surface water locations, indicating that organic contaminants from the Waste Control Site have not impacted the Helena River.
- Overall no obvious trend in the concentrations of chlorinated solvents were noted, however a number of changes were noted including:
  - Increase in concentrations of PCE, TCE and cis-1,2-DCE in Lot 2 wells MWG83 (Base of Guildford) and MWG84 (Regional Watertable).
  - Decrease in concentrations of PCE, TCE, and cis-1,2-DCE for Southwest Industrial wells MWG81.
  - A doubling (0.03 mg/L to 0.061 mg/L) in the concentration of TCE in monitoring well MWG74 (Damplands, Alluvial).
  - In March 2008 the monitoring well with concentrations of TCE above LOR closest to the Helena River was monitoring well WCB02 (0.011 mg/L, Damplands, Alluvial). In comparison, concentrations of TCE in the interim results were above LOR in MWG66 (0.002 mg/L, Damplands, Alluvial), which is approximately 45 m closer to the Helena River then WCB02.
- Concentrations of chlorinated solvents in MWG76 (Damplands, Leederville) are below LOR indicating the plume has likely not extended into the Leederville Formation.

Golder recommends an annual monitoring round should be undertaken in March 2009. The proposed monitoring program should include surface water sample collected from SG03, SG05, SG06 and SG07.

### 7.0 LIMITATIONS

Your attention is drawn to the document 'Limitations', which is included in Appendix D of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.



### REFERENCES

Golder (2006) Proposed Monitoring Schedule Former Waste Control Site, Bellevue WA, September 2006.

Golder (2008a) Proposed 2008 Interim Groundwater Monitoring Program for Former Waste Control Site, Bellevue WA, Letter dated 30 September 2008.

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## Report Signature Page

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