Environment

City of Edmonton

Edmonton City Centre Airport
Phase II Environmental Site Assessment

Prepared by:

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Project Number:

60156759

Date:

September, 2010

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September 1, 2010

Dave Lapp
Environmental Scientist
Transportation Department
City of Edmonton
2nd Floor, 11404 – 60 Avenue
Edmonton, AB T6H 1J5

Dear Mr. Lapp:

Project No: 60156759

Regarding: Edmonton City Centre Airport - Phase II Environmental Site Assessment

We are pleased to provide you with the Phase II Environmental Site Assessment of the Edmonton City Centre Airport.

If you have any questions or comments regarding the attached please contact the undersigned at (780) 486-7000.

Sincerely,
AECOM Canada Ltd.

Tami Dolen
Project Manager, Environment Group
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DM:slm

Distribution List

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	Tami Dolen	August 31, 2010	Draft
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PERMIT NUMBER: P10450
The Association of Professional Engineers, Geologists and Geophysicists of Alberta.

Executive Summary

AECOM at the request of the City of Edmonton, conducted a Phase II Environmental Site Assessment (ESA) for a portion of the Edmonton City Centre Airport (ECCA) (Site) located south of Yellowhead Trail and west of 109 Street, in Edmonton, AB. The area of the assessment is centralized around the main runway (16/34); running north-south located on the east side of the ECCA including the buildings situated along the east boundary of the airport. The total area of interest occupies approximately 85 hectares. The legal description for the Site is Plan 9220135, Block 6A, Lots 1 & 2.

AECOM completed a Limited Phase I ESA in March 2010 to identify areas of potential environmental concern as a result of on or off-site current and historical activities. The Phase I included a historical evaluation, visual site inspection, and a review of environmental reports completed for the site and at adjacent properties. As part of the assessment the laboratory results for the soil and groundwater samples collected during previous investigations were re-compared to the current applicable Alberta Environment criteria. It was concluded that petroleum hydrocarbon and metal concentrations in some of the soil and groundwater samples collected from the site exceeded current Alberta Environment criteria. A review of previous investigation reports completed on the adjacent property identified potential volatile organic compounds (VOC's) and petroleum hydrocarbon concentrations in the soil and groundwater that exceed the current applicable Alberta Environment criteria. Furthermore, the historical evaluation and visual site inspection indicated potential glycol and herbicide contamination of the soil and groundwater surrounding the runway. Recommendations were made to re-investigate the areas and confirm petroleum hydrocarbon, metal, herbicide, glycol, and/or VOC concentrations in the soil and groundwater in the areas of potential environmental concern.

The Phase II ESA completed by AECOM included the advancement of 25 boreholes and the installation of monitoring wells in 10 of the boreholes, at the areas of potential environmental concern identified in the Phase I ESA. Where possible, the monitoring wells installed during previous investigations were utilized in groundwater analysis.

The results of the analyzed petroleum hydrocarbon, herbicide, VOC, metal and glycol concentrations in the soil and the petroleum hydrocarbon, herbicide and glycol concentrations in groundwater were compared to the Alberta Tier 1 Soil and Groundwater Remediation Guidelines, February 2009. The Tier 2, FWAL criteria exclusion was applied in comparing metal concentrations in the groundwater retrieved from the monitoring wells located at Building 7, Building 11, and along Bush Pilot Road; the herbicide concentrations in the groundwater retrieved from the airside monitoring wells and VOC concentrations in the soil and groundwater retrieved in the monitoring wells located along the north side of Bush Pilot Road.

The following table outlines the conclusions determined by the results of the Phase II ESA, and appropriate recommendations identified for each location investigated.

Summary of Conclusions and Recommendations

Location	Conclusions	Recommendations
Pest Management Building	A review of a Phase II ESA report completed in the vicinity of the former waste pesticide UST concluded that herbicide and hydrocarbon concentrations in the soil and groundwater were below the applicable current Tier 1 guidelines	The former investigation did not confirm contamination at the site, and therefore the risk to the surrounding environment due to these concerns is low, and no further action is recommended.
City of Edmonton Parks Yard	Petroleum hydrocarbon concentrations in the soil sample collected from the borehole advanced adjacent to the above ground diesel tank in the Parks yard were below the applicable Tier 1 criteria.	There are no further recommendations with respect to petroleum hydrocarbon concentrations in the soil in this area.
Building 3	Petroleum hydrocarbon concentrations in the soil and groundwater collected nearby the AST's and former UST location west of Building 3 exceeded the Tier 1 criteria.	It is recommended that the petroleum hydrocarbon concentrations in the soil and groundwater exceeding the applicable criteria be delineated. Once the area is delineated and operations have been decommissioned, the contaminated area should be remediated.
Building 4	No exceedances of the soil petroleum hydrocarbon Tier 1 guidelines	The analysis did not confirm petroleum hydrocarbon contamination of the soil at the site, and therefore, no further action is recommended.
Building 7	Barium concentrations within the soil were found to be elevated over the relevant Tier 1 guideline. Uranium, selenium, sodium, iron, and manganese in the water were found to be elevated over the relevant Tier 2 guidelines.	A geophysical survey should be completed in an effort to locate the suspected UST described in the March 2010 Phase I ESA following the airport closure and decommissioning. Background metal concentrations in the soil and groundwater should be confirmed. There are no further recommendations with respect to petroleum hydrocarbon and metals concentrations in the soil and metals concentrations in the groundwater in the vicinity of Building 7.
Building 8	No exceedances of petroleum hydrocarbon Tier 1 guidelines were found.	There are no further recommendations with respect to petroleum hydrocarbon concentrations in the soil in the vicinity of Building 8.
Building 11	Groundwater sample analysis indicates manganese concentrations elevated over Tier 2 guideline values. The elevated manganese concentrations may be indicative of background concentrations.	Background metal concentrations in the soil and groundwater should be confirmed.
Building 12	No exceedances of petroleum hydrocarbon Tier 1 guidelines were found	The analysis did not confirm petroleum hydrocarbon contamination at the site, and therefore, no further action is recommended. A geophysical survey should be completed in an effort to locate the suspected UST described in the March 2010 Phase I ESA following the airport closure and decommissioning.
Airside	No exceedances of herbicide and glycol Tier 1 guidelines were found	There are no further recommendations with respect to herbicide and glycol concentrations in the soil and groundwater in this area.
Bush Pilot Road	Elevated soil concentrations of ethylbenzene, PHC F1 and F2, selenium, and VOCs (ethylbenzene, trichloroethene and tetrachloroethene) and elevated groundwater concentrations of uranium, sodium, manganese, and VOCs (trichloroethene, tetrachloroethene, and benzene) all exceed the respective Tier 1 and 2 criteria values.	It is recommended that the concentrations in the soil and groundwater exceeding the applicable criteria be delineated. Once the area is delineated and operations have been decommissioned, the contaminated area should be remediated.

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1. Introduction

AECOM at the request of the City of Edmonton (COE) conducted a Phase II Environmental Site Assessment (ESA) for a portion of the Edmonton City Centre Airport (ECCA) located south of Yellowhead Trail and west of 109 Street. The legal description for the investigated area (Site) is Plan 9220135, Block 6A, Lots 1 & 2.

The site location is shown in Figure 1 located in Appendix A.

The investigation's purpose was to confirm the absence or presence of contamination in the soil and groundwater within areas of potential environmental concern identified during the March 2010 Limited Phase I ESA. The following report presents a summary of the field data gathered by AECOM in May 2010.

2. Background

The ECCA has operated since the early 1920's and became Canada's first municipal airport in January 1927. The airport was the focal point for northern flights and established Edmonton as a freight shipping centre. During World War II (WWII) in 1939, the Federal Government assumed control over the property. Following the war's end, the Federal Government relinquished all facilities and equipment to the COE for one dollar. The ECCA presently operates as a base for flight training, charter aircraft, and private aircraft operations. The hangar buildings have been converted into commercial businesses, office spaces, and manufacturing operations to accommodate this.

A Limited Phase I ESA was completed by AECOM in March 2010 to identify areas of potential environmental concern as a result of on or off-site current and historical activities. The scope of work for the Phase I ESA included a historical evaluation, visual site inspection, and a review of environmental reports completed for the site and at adjacent properties. The laboratory results for the soil and groundwater samples collected during previous investigations were compared to the current applicable Alberta Environment criteria. It was concluded that petroleum hydrocarbon and metal concentrations in some of the soil and groundwater samples collected from the site exceeded current Alberta Environment criteria. A review of previous investigations completed on the adjacent property identified potential volatile organic compounds (VOC's) and petroleum hydrocarbon concentrations in the soil and groundwater that exceed the current applicable Alberta Environment criteria. Furthermore, the historical evaluation and visual site inspection indicated potential glycol and herbicide contamination of the soil and groundwater surrounding the runway. Recommendations were made to re-investigate the areas and confirm petroleum hydrocarbon, metal, herbicide, glycol, and/or VOC concentrations in the soil and groundwater in the areas of potential environmental concern.

3. Scope and Methodology

This subsurface investigation was conducted utilizing assessment methods outlined in the *Canadian Standards Association (CSA) Standard Z769-01, Phase II Environmental Site Assessment*. The investigation was completed to confirm petroleum hydrocarbon, metal, solvent, herbicide, and/or glycol concentrations in the soil and/or groundwater at each area of potential environmental concern identified during the March 2010 Phase I ESA.

The following tasks were completed in the project scope of work:

- Conduct a pre-drilling site visit to survey and landmark points representing proposed borehole/monitoring well locations throughout the site as per the conclusions of the March 2010 Phase I ESA (areas requiring confirmatory analysis);
- Apply for a Facilities Alteration Permit prior to commencing any work at the airport.
- Locate public utility lines at the site using Alberta One-Call “Call Before You Dig” primary locating services;
- Drill investigative boreholes in the determined locations, finishing several of these boreholes as monitoring wells;
- Collect confirmatory samples from the auger flights every 0.6 m, and field screen the samples for VOC headspace concentrations utilizing a field portable combustible gas meter (Gastech 1238);
- Submit a selection of soil samples to the laboratory for analysis of hydrocarbons, VOC’s, herbicides, glycols, and/or metals;
- Complete a groundwater monitoring program for the installed monitoring wells including groundwater level measurement, a single well response to confirm the hydraulic conductivity of the aquifer, and collection of a water sample from two of the wells for hydrocarbons, VOC’s, herbicides, glycols, and/or metals; and
- Present the results of the investigation program in a detailed summary report.

4. Physical Site Description

4.1 Property Description

The site is located in the ECCA of Edmonton, Alberta and occupies a total area of approximately 85 hectares. The site layout is depicted in Figure 2 in Appendix A. The assessment was centralized around the main runway (16/34), which runs north-south and is on the east side of the ECCA and includes the buildings situated along the east boundary of the airport. The west boundary of the assessment area was delineated by the intersection of 121 Street and Bush Pilot Road, running in a diagonal direction parallel to the west runway (12/30). Taxiways Charlie, Echo, Bravo and a portion of Delta were also assessed.

At the time of the investigation, the runways and taxiways were paved and the clearway was vegetated with grass. Ten buildings were situated in a north-south direction along the east boundary of the site. The COE was the property owner, but the buildings were privately leased by various businesses and organizations. Building 3, the furthest north location, was occupied by the COE. Building 4 was located immediately south and owned by the provincial government. Airco Charters, Aircraft Services Transport Canada, and the RCMP occupied Buildings 5 to 7, respectively. Celtic Homes (mobile home manufacturer) occupied Building 8. Building 11 was leased as office space and Building 12 was demolished in 1999. The Brigadier James Jefferson Building was located south of the former Building 12, as a newly constructed office space occupied by DND. The property leases were separated by chain link fencing (6 m height) and there was restricted airside access on the west boundary of the yards for Buildings 8, 11, and 12.

There were two fenced compounds located on the east side of the site and north of Building 3. One of the compounds was vacant and the other was occupied by the City of Edmonton Parks and Recreation Branch. The COE River Valley, Forestry, and Environmental Services Branch was located to the north, but also occupied an adjacent property to the east, outside of the ECCA. Because of its airside access, the building was included with the assessment.

There were three fenced compounds located on the east side of the site north of the City of Edmonton River Valley, Forestry, and Environmental Services Branch. Mobile trailers were stored in one compound, the second was vacant, and the third formed an extension to the City of Edmonton Corporate Mobile Equipment Services (MES) yard. MES utilizes this fenced compound for vehicle storage and the remaining area of the site was vegetated vacant land.

4.2 Surficial Geology

The surficial geology of this portion of Edmonton is described to be approximately 5 to 8 m of glaciolacustrine deposits of bedded sands, silts, and clays from a large preglacial lake called Glacial Lake Edmonton. These deposits overlay approximately 21 to 28 m of glacial till consisting of an unsorted and unstratified unit composed of clay, silt, and sand with pebbles and boulders. These deposits overlay approximately 5 to 10 m of disturbed Saskatchewan gravels and sands that have been reworked by glacier ice. Bedrock (Edmonton Formation) is located approximately 38 metres below the surface (mBGS) (Kathol and McPherson, 1975).

4.3 Groundwater Usage

A search of the Alberta Environment online water well information database indicated there are six data records (water well drilling reports) within a 1 km radius of the site. Well ID 0163075 is located on the site and reported for stock use. The status of this well is unknown.

The database stipulates, "*The list is not intended to be a true reflection of the exact number and location of the water wells for the area. The report may also appear as if certain records are duplicated. The same record will appear multiple times on the summary sheet each time a different well test is conducted*". This indicates that the well locations are not necessarily accurate, but are close to the location of interest. The following table provides a summary of the wells.

Table 4.1 - Summary of Water Well Records

Well ID	Date Complete	Approximate Distance from Site	Well Depth	Non Pumping Static Level	Anticipated Use
0163075	1989/09/11	0 m	54.86 m	14.69 m	Stock
0081648	1962/04/30	290 m	41.15 m	11.89 m	Domestic
0081646	1987/05/27	420 m	18.29 m	Unknown	Domestic
0081626	1976/01/09	570 m	42.67 m	12.19 m	Domestic
0081625	1916/01/01	830 m	48.77 m	Unknown	Domestic & Stock
0081627	Unknown	850 m	152.4 m	Unknown	Unknown

4.4 Zoning

At the time of the investigation, the area of the site in which the runway is located was zoned Municipal Airfield Zone (MA1) and the eastern area, where the buildings and hangars are located, was zoned Municipal Airport Business Industrial Zone (MA2). Permitted use under both these zonings include aircraft sales/rentals, government services, and general industrial uses. Discretionally uses include fleet services, hotels, and speciality food services.

5. Phase II Methodology

5.1 Soil Sampling Program

Sun Alta Drilling Ltd. of Morinville, Alberta completed the borehole drilling portion of the site investigation using a truck mounted B-61 drilling rig. Boreholes were drilled using solid stem augers.

The auger stems were 1.5 m long and drilled into the ground and removed in sequence. The soils on each auger flight were classified and logged. The borehole logs are included in Appendix B. To avoid cross contamination, the soil samples were collected using a clean putty knife and nitrile gloves. The samples were trimmed to remove the outer 10 to 15 mm of soil and any soil which came in contact with the auger. The sample was then jarred and/or bagged according to the analysis required. Select samples were stored in a chilled cooler until delivered to the laboratory.

5.2 Heated Head Space Testing

Heated head space (HHS) testing is used to obtain a vertical profile of the relative level of hydrocarbon contamination through the depth investigated by comparing hydrocarbon vapour readings of each soil sample. HHS tests are conducted by filling a plastic bag approximately half full with soil, sealing it, and warming the bag up to facilitate the release of hydrocarbons.

For this investigation, hydrocarbon vapour readings were obtained using a GasTech Model 1238 Hydrocarbon Surveyor field instrument, calibrated to a hexane standard. This device assesses the electrical potential of ionized vapours in an air sample and converts this potential to parts per million (ppm) output reading. HHS testing is not used to determine concentrations of contaminants, but instead provides an indication of the relative levels of organic vapours present in the soil.

5.3 Monitoring Well Installation and Groundwater Sampling

Groundwater monitoring wells were installed according to CCME document EPC-NCSRP-48E March 1994; entitled Subsurface Assessment Handbook for Contaminated Sites.

Each groundwater monitoring well was completed as a flush mounted well, consisting of a 50 mm diameter machine slotted (0.010 slot) PVC well screen. The annulus around and just above the screened portion was backfilled with silica #9 frac sand. The remainder of the borehole was fitted with solid 50 mm PVC pipe and backfilled with a bentonite seal to prevent infiltration of surface water. The detailed completion of each monitoring well is recorded in the borehole logs in Appendix B.

The water level was measured using an electronic water level tape on June 17, 2010. The groundwater monitoring wells were developed by bailing three well volumes using a one-litre capacity dedicated PVC bailer. Groundwater samples for laboratory analysis were stored in laboratory provided containers.

5.4 Laboratory Analysis

Selected soil and groundwater samples were submitted to Exova in Edmonton, AB for analytical determination of petroleum hydrocarbons, pesticides, glycols, volatile organic compounds (VOC), and regulated metals. Exova is a member of the Canadian Association of Environmental Analytical Laboratories (CAEAL) and is accredited by the Standards Council of Canada (SCC). Analytical summary tables are presented in Section 6 accompanying the discussion of the investigation results. Copies of the laboratory analytical reports are reproduced in Appendix C.

5.5 Regulatory Criteria

The results of laboratory analyses were compared to the Alberta Tier 1 and 2 Soil and Groundwater Remediation (AB Tier 1 and/or 2) Guidelines, February 2009. These guidelines introduce a set of soil and groundwater quality guidelines derived specifically for the protection of ecological receptors and for human health. These guidelines allow for the consideration of site-specific conditions through the modifications of Tier 1 guidelines and/or removal of exposure pathways that may not be applicable to the site (Tier 2). In instances where the parameter exceeds the Tier 1 criteria and the governing pathway may be excluded resulting in a less stringent value, then the Tier 2 criteria was applied. Otherwise, the laboratory results were compared to the Tier 1 criteria.

Under the Tier 2 guidelines, the protection of a Freshwater Aquatic Life (FWAL) pathway can be excluded under circumstances where the contamination is located at least 300 m from a surface water body. The nearest water body to the site is the North Saskatchewan River which is located at least 2.5 km to the south/southeast. The Tier 2, FWAL criteria exclusion was applied in comparing metal concentrations in the groundwater retrieved from the monitoring wells located at Building7, Building 11 and along Bush Pilot Road; the herbicide concentrations in the groundwater retrieved from the airside monitoring wells and VOC concentrations in the soil and groundwater retrieved in the monitoring wells located along the north side of Bush Pilot Road.

Governing remediation land use criteria for the site would be commercial, given the current zoning. To allow for the unrestricted future land use of the site and for planning purposes, it is recommended that any laboratory analyzed parameters be compared to residential criteria. The underlying lithology at the site is fine grained clay soils.

6. Investigation and Results

The following details the subsurface investigation conducted within the study area for the Phase II ESA. The investigation was subdivided based on building numbers and the results and assessment is presented this way for comprehensive purposes. Figures 1 to 11 provided in Appendix A outline the borehole and monitoring well locations. The borehole logs are located in Appendix B and may be referenced for site lithology. The complete analytical reports of all soil and groundwater analysis are reproduced in Appendix C.

Where possible, the monitoring wells installed during previous investigations were utilized in groundwater analysis. The locations of these monitoring wells are shown on the figures. Boreholes were advanced to re-confirm petroleum hydrocarbon and/or metal concentrations in the soil and were located adjacent to the previously installed monitoring wells and/or boreholes. There is no direct reference to the monitoring wells/boreholes advanced during the previous investigations and therefore the monitoring well/borehole locations of previous investigations are not shown on the figures.

6.1 City of Edmonton Pest Management Building

A 34,125 L fibreglass UST containing waste pesticides located adjacent to the northwest corner of the building was removed in 1998. A Phase II ESA completed by Thurber Environmental Consultants Ltd. in 1998 was provided by the City of Edmonton to AECOM for review. The following provides a summary of the 1998 investigation.

Phase II Environmental Site Assessment, Pest Control Management Building Underground Storage Tank, 12304 – 107 Street, Edmonton, Alberta, Thurber Environmental Consultants Ltd., December 1998.

The 1998 investigation included the advancement of five boreholes in the vicinity of the former UST located on the north side of the building. The borehole depths ranged from 3.8 to 5.3 mBGS and a monitoring well was installed in three of the boreholes. Field observations included a sulphurous odour at 3.7 mBGS in the borehole located east of the drain into the UST and black staining of the clay layer at 1.0 mBGS in the borehole located northwest of the drain into the UST. A soil sample from each of the boreholes at an unspecified depth was submitted for petroleum hydrocarbon analysis, two of the soil samples were also analyzed for herbicides. A groundwater sample retrieved from each of the monitoring wells was also analyzed for herbicides.

The petroleum hydrocarbon and herbicide concentrations in the soil samples submitted and the herbicide concentrations in the groundwater samples submitted were below the Tier 1 criteria. Due to the low concentrations of petroleum hydrocarbon and herbicides in the soil and groundwater, an additional investigation was not completed at this site in 2010.

6.2 City of Edmonton Parks Yard

The City of Edmonton Parks Yard is a fenced compound located north of Building 3, used by the City of Edmonton Parks and Recreation Department since the late 1990's for the storage of miscellaneous materials and fuel. During the March 2010 Phase I ESA site visit, surficial staining was observed in the vicinity of the above ground diesel tank in the yard. Due to the length of time the AST was at this location and the noted surficial staining in this area, it was recommended that petroleum hydrocarbon concentrations in this area be confirmed.

One borehole completed as a monitoring well was advanced adjacent to the above ground diesel tank as outlined in Figure 3. The field observations did not report any odours or staining in the soil samples collected from the auger flights during the drilling operation. The soil sample with the highest field vapour reading, retrieved at 4.6 mBGS, was submitted for petroleum hydrocarbon analysis. Table 6.1 presents the results of the analysis in comparison with the AB Tier 1 guidelines, of which there is compliance for all of the parameters.

Table 6.1 - City of Edmonton Parks Yard Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 1[1] (mg/kg)	PY-MW1 (mg/kg)
Depth (mBGS)	N/A	4.6
Headspace (ppm)		40
Benzene	0.046	<0.004
Toluene	0.52	<0.005
Ethylbenzene	0.11	<0.010
Xylenes	15	<0.010
F1 (C6-C10, less BTEX)	210	<4
F2 (C10-C16)	150	29
F3 (C16-C34)	1,300	118
F4 (C34-C50)	5,600	<20

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

A groundwater sample collected from PY-MW1 was also analyzed for petroleum hydrocarbons; Table 6.2 presents the analytical results of the groundwater in comparison with the applicable guidelines.

Table 6.2 - City of Edmonton Parks Yard Laboratory Analysis of Petroleum Hydrocarbons in Groundwater

Parameter	AB Tier 1[1] (mg/L)	PY-MW1 (mg/L)
Benzene	0.005	<0.001
Toluene	0.024	<0.001
Ethylbenzene	0.0024	<0.001
Xylenes	0.3	<0.001
F1 (C6-C10, less BTEX)	2.2	<0.2
F2 (C10-C16)	1.1	<0.1

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

The hydrocarbon concentrations in the groundwater sample were below the laboratory detection limits and the Tier 1 criteria.

6.3 Building 3

ECCA currently occupies Building 3, and utilizes it for general maintenance. Areas of potential environmental concern identified at Building 3 during the Limited Phase 1 ESA, March 2010 included a former UST and surficial staining on the asphalt surface in the vicinity of three AST's, all located west of the building. The former UST was removed in December 1997 as part of a remediation program. A comparison of the petroleum hydrocarbon concentrations in the confirmatory soil samples collected from the base and east wall of the excavated area exceeds the current Tier 1 criteria. Additionally, petroleum hydrocarbon concentrations in a groundwater sample collected during the same sampling event also exceed current Tier 1 criteria. Recommendations from the Phase I ESA included confirming petroleum hydrocarbon concentrations in the soil and groundwater in the vicinity of the 1997 excavation.

Two boreholes were advanced along the west and south limits of the December 1997 excavation, south of Building 3, as depicted in Figure 4**.** During the drilling event, elevated field readings and slight hydrocarbon odours were noted in B3-MW1 between 2.4 to 3.1 mBGS and in B3-BH2 between 1.8 to 2.5 mBGS.

One soil sample from B3-MW1 (at 3.05 mBGS) and two from B3-BH2 (at 2.29 and 3.05 mBGS) were submitted for laboratory analysis of petroleum hydrocarbons. Table 6.3 presents the analytical results of the soil in comparison to AB Tier 1 criteria.

Table 6.3 - Building 3 Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 1[1] (mg/kg)	B3-MW1 (mg/kg)	B3-BH2 (mg/kg)	B3-BH2 (mg/kg)
Depth (mBGS)	N/A	**3.05 m**	**2.29 m**	**3.05 m**
Headspace (ppm)		240	400	70
Benzene	0.046	0.007	**7.47**	**1.35**
Toluene	0.52	<0.005	0.083	0.024
Ethylbenzene	0.11	0.073	**6.54**	**1.51**
Xylenes	15	0.01	0.28	0.11
F1 (C6-C10, less BTEX)	210	52	**289**	118
F2 (C10-C16)	150	29	61	53
F3 (C16-C34)	1,300	71	42	70
F4 (C34-C50)	5,600	<20	<20	22

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria

Benzene and ethylbenzene concentrations in B3-BH2 at 2.29 and 3.05 mBGS exceed the Tier 1 criteria. The PHC F1 fraction in the soil sample retrieved from B3-BH2 at 2.29 mBGS also exceeds the Tier 1 criteria.

A groundwater sample collected from B3-MW1 was also analyzed for petroleum hydrocarbons; Table 6.4 presents the analytical results of the groundwater in comparison with the applicable guidelines.

Table 6.4 - Building 3 Laboratory Analysis of Petroleum Hydrocarbons in Groundwater

Parameter	AB Tier 1[1] (mg/L)	B3-MW1 (mg/L)
Benzene	0.005	**0.022**
Toluene	0.024	<0.001
Ethylbenzene	0.0024	**0.074**
Xylenes	0.3	0.002
F1 (C6-C10, less BTEX)	2.2	0.5
F2 (C10-C16)	1.1	0.1

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria

Benzene and ethylbenzene concentrations in the groundwater sample exceed the Tier 1 criteria.

6.4 Building 4

Building 4 is owned and operated by the Alberta Government. A subsurface investigation completed in 1998 to confirm potential contamination as the result of the long time usage of former vintage WWII hangers was reviewed in the March 2010 ESA. The findings of the March 2010 Phase I ESA indicated that petroleum hydrocarbon concentrations in the soil samples collected during the 1998 investigation exceed the current Tier 1 criteria.

B4-BH1 was advanced south west of Building 4 in the vicinity of the 1998 investigation, as shown in Figure 5. There were no field observations of odour or staining in the soil during the drilling operation. A soil sample was collected from 0.76 m and 1.52 mBGS and submitted for petroleum hydrocarbon analysis. These depths were chosen because hydrocarbon concentrations in the soil collected during the previous investigation at these depths exceeded the current Tier 1 criteria. Table 6.18 presents the results of the analysis in comparison with the AB Tier 1 criteria.

Table 6.5 - Building 4 Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 1[1] (mg/kg)	B4-BH1 (mg/kg)	B4-BH1 (mg/kg)
Depth (m)		0.76	1.52
Headspace (ppm)	N/A	60	35
Benzene		<0.004	<0.004
Toluene	0.046	<0.005	<0.005
Ethylbenzene	0.52	<0.010	<0.010
Xylenes	0.11	<0.010	<0.010
F1 (C6-C10, less BTEX)	15	<4	<4
F2 (C10-C16)	210	19	11
F3 (C16-C34)	150	96	58
F4 (C34-C50)	1,300	<20	<20

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

Hydrocarbon concentrations in the soil samples submitted were below the applicable Tier 1 criteria.

6.5 Building 7

The Royal Canadian Mounted Police (RCMP) have occupied Building 7 since 1978. Potential environmental concerns identified in the March 2010 Phase I ESA included a 1,135 L waste oil AST situated on the asphalt surface on the south side of the building with no secondary containment; a suspect UST located northeast of the building and petroleum hydrocarbon and metal concentrations in soil samples analyzed in previous investigations that exceed the Tier 1 criteria.

The March 2010 Phase I ESA recommended a subsurface investigation be completed in the vicinity of the existing AST and at the areas previously investigated to confirm petroleum hydrocarbon and metal concentrations in the soil and groundwater. The completion of a geophysical survey to confirm the presence of a UST was also recommended. Due to the potential interference of the fences and vehicles parked in this area, it was decided that the geophysical survey be completed once the airport is closed and the site has been decommissioned.

Borehole B7-BH3 was advanced east of the existing AST. Four boreholes (B7-BH1 to B7-BH5) were advanced adjacent in the vicinity of the previously investigated areas. Two of these boreholes were located adjacent to the previously installed monitoring wells, H1-1 and H1-4. The field observations did not report any odours or staining in the soil samples collected from the auger flights during the drilling operation. Borehole and monitoring well locations are provided in Figure 6.

Soil samples collected from B7-BH1 (at 0.91 mBGS), B7-BH3 (at 0.3 mBGS), and B7-BH5 (at 0.76 mBGS) were analyzed for petroleum hydrocarbons. Soil samples collected at a depth of 0.91 mBGS from B7-BH1 and B7-BH4 and at 0.76 mBGS from B7-BH2 were also submitted for metals analysis. These depths were chosen because petroleum hydrocarbon and selenium concentrations in the soil samples collected from this area during previous investigations exceed the current Tier 1 criteria. Tables 6.5 and 6.6 present the results of the soil sample analysis compared to the applicable Alberta Environment criteria.

Table 6.6 - Building 7 Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 11 (mg/kg)	B7-BH1 (mg/kg)	B7-BH3 (mg/kg)	B7-BH5 (mg/kg)
Depth (m)	N/A	**0.91 m**	**0.3 m**	**0.76 m**
Headspace (ppm)		40	40	35
Benzene	0.046	<0.004	<0.004	<0.004
Toluene	0.52	<0.005	<0.005	<0.005
Ethylbenzene	0.11	<0.010	<0.010	<0.010
Xylenes	15	<0.010	<0.010	<0.010
F1 (C6-C10, less BTEX)	210	<4	<4	<4
F2 (C10-C16)	150	12	<10	14
F3 (C16-C34)	1,300	65	<30	59
F4 (C34-C50)	5,600	<20	<20	<20

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

Table 6.7 - Building 7 Laboratory Analysis of Regulated Metals in Soil

Parameter	AB Tier 1[1] (mg/kg)	B7-BH1 (mg/kg)	B7-BH2 (mg/kg)	B7-BH4 (mg/kg)
Depth (m)	N/A	0.91	0.76	0.91
Antimony	-	<0.2	<0.2	<0.2
Arsenic	-	8.0	6.2	7.6
Barium	500	308	200	**559**
Beryllium	5	1	0.6	1.2
Boron (hot water soluble)	2	1.1	0.6	1.2
Cadmium	10	0.23	0.22	0.07
Chromium (total)	64	35.0	23.4	38.1
Cobalt	20	16.2	9.3	13.6
Copper	63	31	21	32
Lead	140	93.9	12.8	14.0
Mercury	6.6	0.04	0.03	0.04
Molybdenum	4	<1	<1	<1
Nickel	50	35.8	36.6	45.3
Selenium	1	0.6	0.4	0.4
Silver	20	0.2	0.2	0.2
Thallium	1	0.31	0.21	0.30
Tin	5	<1	<1	<1
Uranium	23	1.2	1.2	1.1
Vanadium	130	61.9	41.9	64.9
Zinc	200	124	62	79

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria

The petroleum hydrocarbon concentrations in the three soil samples submitted were below the Tier 1 criteria.

With the exception of barium concentrations in B7-BH4, the metals concentrations for the samples analyzed were below the Tier 1 criteria. Barium concentrations in all the soil samples submitted during this investigation, although below criteria, were elevated and therefore the exceedance may be indicative of background conditions.

A groundwater sample was collected from the previously installed monitoring wells H1-1 and H1-4 and submitted for laboratory analysis of regulated metals. Table 6.7 presents the results of the groundwater sample analysis collected during this and the 1998 Phase II investigation compared to the applicable Tier 2 criteria.

Table 6.8 - Building 7 Laboratory Analysis of Regulated Metals in Groundwater

Parameter	AB Tier 2[1] (mg/L)	H1-1 (mg/L)		H1-4 (mg/L)	
		May-98	Jun-10	May-98	Jun-10
Silicon	-	-	9.63	-	5.88
Sulfur	-	-	55.7	-	375
Mercury	0.001[2]	-	<0.0001	-	<0.0001
Aluminum		1.17	0.007	2.05	<0.004
Antimony	0.006	-	0.0002	-	<0.0004
Arsenic	0.01[2]	<10	0.0009	<10	0.0004
Barium	1	-	0.041	-	0.033
Beryllium	-	-	<0.0001	-	<0.0002
Bismuth	-	-	0.001	-	<0.001
Boron	5	-	0.362	-	0.11
Cadmium	0.005[2]	0.0003	0.00003	0.00032	0.0001
Chromium	0.05[2]	0.0079	0.0013	0.0061	<0.001
Cobalt	-	-	0.0002	-	0.002
Copper	1[2]	0.03	0.003	0.02	0.003
Lead	0.01[2]	0.0011	0.0001	0.0023	<0.0002
Lithium	-	-	0.187	-	0.274
Molybdenum	-	-	0.002	-	<0.002
Nickel	-	0.003	0.0025	0.011	0.0076
Selenium	0.01[2]	0.0008	**0.0111**	0.0014	0.0005
Silver	-	<0.00005	<0.00001	<0.00005	<0.00002
Strontium	-	-	0.995	-	1.99
Thallium	-	-	<0.00005	-	<0.0001
Tin	-	-	<0.001	-	<0.002
Titanium	-	-	0.0019	-	0.012
Uranium	0.02	-	0.0153	-	**0.0304**
Vanadium	-	-	0.0023	-	0.0009
Zinc	5[2]	0.0162	0.004	0.0396	0.01
Calcium	-	-	189	-	196
Magnesium	-	-	24.6	-	118
Sodium	200	-	31.4	-	**298**
Potassium	-	-	4	-	7
Iron	0.3	**0.909**	<0.01	**1.92**	<0.02
Manganese	0.05	-	<0.005	-	**0.457**

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 Exclusion of the Pathway for the Protection of Freshwater Aquatic Life.
3 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria.

The selenium concentration in the groundwater sample collected from H1-1 in 2010 exceeds the Tier 2 criteria; although, it complied with criteria when sampled in 1998.

Uranium, sodium, and manganese concentrations in the groundwater sample collected from H1-4 exceed the Tier 2 criteria. The groundwater samples submitted during the 1998 investigation were not analyzed for uranium, sodium and manganese; however, these concentrations may be indicative of background concentrations.

Iron concentrations in the groundwater samples collected from H1-1 and H1-4 during the 1998 investigation exceed the Tier 2 criteria. However, iron concentrations in the groundwater samples collected during this investigation are below the Tier 2 criteria. Iron concentrations are frequently elevated in groundwater in the City of Edmonton. The elevated concentrations in the groundwater during the 1998 investigations may therefore be indicative of background concentrations.

6.6 Building 8

Formerly Hangar 2, Building 8 is one of the oldest buildings at the airport. Previous subsurface investigations include a 1994 remediation program at a former UST location and a 1998 site investigation completed to confirm potential contamination as the result of the long time usage of former vintage WWII hangars.

The findings of the March 2010 Phase I ESA indicated that petroleum hydrocarbon concentrations in the soil samples collected from the north and east walls of the 1994 remediation program potentially exceed the current Tier 1 criteria. It also indicated that selenium concentrations in the soil collected during the 1998 site investigation exceed the current Tier 1 criteria. It was recommended that petroleum hydrocarbon and metal concentrations in the vicinity of the 1994 remediation program and 1998 site investigations in the soil be confirmed.

Borehole B8-BH1 was advanced in the vicinity of the 1994 remediation program at the former UST location. Soil samples collected from B8-BH1 at depths of 0.61 m and 1.52 mBGS were submitted for petroleum hydrocarbon analysis. A sample collected from 0.91 mBGS in B8-BH1 was also submitted for metal analysis. Boreholes B8-BH2 and B8-BH3 were advanced in the vicinity of the 1998 investigations. Soil samples were collected from both boreholes at 0.91 mBGS and analyzed for metals. This depth was selected because selenium concentrations in the soil samples collected from this area during previous investigations exceed the current Tier 1 criteria. Figure 7 shows the borehole locations in relation to Building 8. Tables 6.8 and 6.9 present the results of the soil sample analysis for comparison with the guidelines.

Table 6.9 - Building 8 Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 1[1] (mg/kg)	B8-BH1 (mg/kg)	B8-BH1 (mg/kg)
Depth (m)	N/A	0.61	1.52
Headspace (ppm)		100	10
Benzene	0.046	<0.004	<0.004
Toluene	0.52	<0.005	<0.005
Ethylbenzene	0.11	<0.010	<0.010
Xylenes	15	0.01	<0.010
F1 (C6-C10, less BTEX)	210	11	<4
F2 (C10-C16)	150	15	26
F3 (C16-C34)	1,300	51	113
F4 (C34-C50)	5,600	<20	<20

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

The petroleum hydrocarbon concentrations in the two soil samples submitted were below the Tier 1 criteria.

Table 6.10 - Building 8 Laboratory Analysis of Regulated Metals in Soil

Parameter	AB Tier 1[1] (mg/kg)	B8-BH1 (mg/kg)	B8-BH2 (mg/kg)	B8-BH3 (mg/kg)
Depth (m)	N/A	0.91	0.91	0.91
Antimony	-	<0.2	<0.2	0.4
Arsenic	-	7	6.2	7.5
Barium	500	214	184	462
Beryllium	5	1	1.1	1.2
Boron (hot water soluble)	2	1.2	1.1	1.2
Cadmium	10	0.12	0.09	0.18
Chromium (total)	64	33.3	35.5	38.6
Cobalt	20	10.2	10.3	14.4
Copper	63	26	22	32
Lead	140	11.4	13	13.4
Mercury	6.6	0.03	0.04	0.04

Parameter	AB Tier 1[1] (mg/kg)	B8-BH1 (mg/kg)	B8-BH2 (mg/kg)	B8-BH3 (mg/kg)
Molybdenum	4	<1	<1	2
Nickel	50	33	27.3	38.3
Selenium	1	0.5	0.4	0.6
Silver	20	0.2	0.2	0.3
Thallium	1	0.23	0.26	0.31
Tin	5	<1	<1	2
Uranium	23	0.9	1.3	2.0
Vanadium	130	56.4	64.3	66.6
Zinc	200	57	65	79

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

The metals concentrations in the three soil samples submitted were below the Tier 1 criteria.

6.7 Building 11

Building 11 was constructed for use as a US Air Force Hangar 3, but is currently leased for office space. Previous investigations summarized in the March 2010 Phase I ESA include a site investigation completed in 1998 to confirm potential contamination as the result of the long time usage of former vintage WWII hangars. Subsequent delineation and remediation programs were completed in 1999.

The March 2010 Phase I ESA indicated that petroleum hydrocarbon concentrations in the soil samples collected during the 1998 and 1999 investigations exceed current Tier 1 criteria. Additionally petroleum hydrocarbon and metal concentrations in the groundwater collected during the 1998 site investigation also exceed Tier I criteria.

Four boreholes were advanced in the vicinity of the previously investigated areas. Two of the boreholes (B11-BH1 and B11-BH2) were advanced adjacent to the previously installed monitoring wells H3-3 and H3-2 respectively. The field observations did not report any odours or staining in the soil samples collected from the auger flights during the drilling operation. Soil was analyzed for petroleum hydrocarbon concentrations from samples collected at a depth of 0.8 mBGS from B11-BH1, B11-BH2, and B11-BH4 and at a depth of 1.2 mBGS from B11-BH3. Figure 8 shows the borehole and monitoring well locations in relation to Building 11. Table 6.10 presents the results of the soil sample analysis for comparison with the guidelines.

Table 6.11 - Building 11 Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 1[1] (mg/kg)	B11-BH1 (mg/kg)	B11-BH2 (mg/kg)	B11-BH3 (mg/kg)	B11-BH4 (mg/kg)
Depth (m)	N/A	0.8	1.2	0.8	0.8
Headspace (ppm)		110	100	110	110
Benzene	0.046	<0.004	<0.004	<0.004	<0.004
Toluene	0.52	<0.005	0.011	<0.005	<0.005
Ethylbenzene	0.11	<0.010	<0.010	<0.010	<0.010
Xylenes	15	<0.010	<0.010	<0.010	<0.010
F1 (C6-C10, less BTEX)	210	<4	<4	<4	<4
F2 (C10-C16)	150	<10	20	14	12
F3 (C16-C34)	1,300	46	138	69	57
F4 (C34-C50)	5,600	<20	30	<20	<20

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

Petroleum hydrocarbon concentrations in the soil samples analyzed were below the Tier 1 criteria.

Groundwater samples were retrieved from the existing monitoring wells H3-2 and H3-3 and analyzed for metals. Table 6.11 presents the results of the groundwater analysis in comparison to the applicable Alberta Environment guidelines.

Table 6.12 - Building 11 Laboratory Analysis of Regulated Metals in Groundwater

Parameter	AB Tier 2[1] (mg/L)	H3-3 (mg/L)		H3-2 (mg/L)	
		Jun-98	Jun-10	Jun-98	Jun-10
Silicon	-	-	5.73	-	8.65
Sulfur	-	-	9	-	114
Mercury	0.001[2]	-	<0.0001	-	<0.0001
Aluminum		0.26	0.004	1.02	<0.002
Antimony	0.006	-	<0.0002	-	<0.0002
Arsenic	0.01[2]	**<0.01[4]**	0.0008	**<0.01[4]**	0.0009
Barium	1	-	0.071	-	0.067
Beryllium	-	-	<0.0001	-	<0.0001
Bismuth	-	-	<0.0005	-	<0.0005
Boron	5	-	0.142	-	0.227
Cadmium	0.005[2]	0.00041	0.00005	0.00012	0.00004
Chromium	0.05[2]	**2.3**	0.0009	**2.1**	0.0017
Cobalt	-	-	0.0001	-	0.0028
Copper	1[2]	0.01	0.002	0.026	0.002
Lead	0.01[2]	0.0004	<0.0001	0.0013	<0.0001
Lithium	-	-	0.055	-	0.163
Molybdenum	-	-	<0.001	-	<0.001
Nickel	-	0.015	0.0059	0.069	0.0205
Selenium	0.01[2]	0.0003	0.0006	0.0012	0.0003
Silver	-	<0.05	<0.00001	<0.05	<0.00001
Strontium	-	-	0.696	-	1.8
Thallium	-	-	<0.00005	-	0.00006
Tin	-	-	<0.001	-	<0.001
Titanium	-	-	<0.0005	-	0.004
Uranium	0.02	-	0.0028	-	0.0099
Vanadium	-	-	0.0023	-	0.0036
Zinc	5[2]	0.0382	0.002	0.0035	0.017
Calcium	-	-	74	-	212
Magnesium	-	-	38.6	-	82.9
Sodium	200	-	55.2	-	122
Potassium	-	-	2.6	-	3.8
Iron	0.3	**0.329**	<0.01	**1.32**	<0.01
Manganese	0.05	-	0.024	-	**1.61**

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 Exclusion of the Pathway for the Protection of Freshwater Aquatic Life.
3 The complete Exova laboratory analysis report is available in Appendix C.
4 The readable detection limit exceeds the guideline value.
Notes: Bold values exceed criteria

There was a decrease in chromium and iron concentrations since the 1998 sampling event in the groundwater retrieved from both H3-2 and H3-3 from values exceeding Tier 2 criteria, to the measured 2010 concentrations, which currently comply with the Tier 2 criteria.

Manganese concentrations in the groundwater sample collected from H3-2 exceed the Tier 2 criteria for the 2010 sample. The groundwater samples submitted during the 1998 investigation were not analyzed for manganese; however, these concentrations may be indicative of background concentrations.

6.8 Former Building 12

Building 12 was demolished in 1999 and a new building was constructed south of the former Building 12 location. Previous investigations summarized in the 2010 Phase I ESA which identified potential environmental concerns include a former Texaco UST site between Buildings 11 and 12 and a site investigation completed in 1998 to confirm potential contamination related to operations within WWII hangars, and subsequent delineation and remediation programs completed in 1999.

The 2010 Phase I ESA indicated a Phase II ESA completed in 1996 did not identify any UST's or petroleum hydrocarbon contamination in the soil and groundwater between Buildings 11 and 12 in the vicinity of the former Texaco UST. It was however recommended a geophysical survey be conducted to confirm the absence/presence of a UST. Due to the potential interference of the fences and vehicles parked in the area it is recommended the survey be completed once the airport is closed and the site has been decommissioned.

Additionally a comparison of the soil and groundwater laboratory analytical data from the 1998 and 1999 investigations summarized in the March 2010 Phase I ESA identified hydrocarbon concentrations in the soil and groundwater exceeding the current Tier 1 criteria. A subsurface investigation in these areas was therefore recommended.

Two boreholes were advanced in the vicinity of the previously investigated area; a monitoring well was installed in one of the boreholes. The field observations did not report any odours or staining in the soil samples collected from the auger flights during the drilling operation. Soil samples were collected at a depth of 0.91 mBGS from B12-MW1 and B12-BH2 and analyzed for petroleum hydrocarbons. Figure 9 shows the borehole and monitoring well locations in relation to the former Building 12. Table 6.12 presents the results of the soil sample analysis in comparison to the guidelines.

Table 6.13 - Building 12 Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 1[1] (mg/kg)	B12-MW1 (mg/kg)	B12-BH2 (mg/kg)
Depth (m)	N/A	0.91	0.91
Headspace (ppm)		20	10
Benzene	0.046	<0.004	<0.004
Toluene	0.52	<0.005	<0.005
Ethylbenzene	0.11	<0.010	<0.010
Xylenes	15	<0.010	<0.010
F1 (C6-C10, less BTEX)	210	<4	<4
F2 (C10-C16)	150	32	20
F3 (C16-C34)	1,300	88	70
F4 (C34-C50)	5,600	<20	<20

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

Petroleum hydrocarbon concentrations in the soil samples analyzed were below the Tier 1 criteria.

A groundwater sample collected from B12-MW1 was also analyzed for petroleum hydrocarbons; Table 6.13 presents the analytical results of the groundwater in comparison with the applicable guidelines.

Table 6.14 - Building 12 Laboratory Analysis of Petroleum Hydrocarbons in Groundwater

Parameter	AB Tier 1[1] (mg/L)	B12-MW1 (mg/L)
Benzene	0.005	<0.001
Toluene	0.024	<0.001
Ethylbenzene	0.0024	<0.001
Xylenes	0.3	<0.001
F1 (C6-C10, less BTEX)	2.2	<0.2
F2 (C10-C16)	1.1	<0.1

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

The hydrocarbon concentrations in the groundwater sample were below the laboratory detection limits and the Tier 1 criteria.

6.9 Airside

The airside location includes the undeveloped, vegetated areas west of Runway 16/34. Due to the historical use of herbicides and/or de-icing solvents it was recommended in the March 2010 Phase I ESA that the soil and groundwater along the perimeter of the runway and taxiways be investigated.

Three boreholes all completed as monitoring wells were advanced in this areas shown in Figure 10. A soil sample from the boreholes was collected from between 0.3 m and 0.8 mBGS and analyzed for regulated herbicides and glycols. A soil sample was also collected from borehole (BPR-MW3) located on the north side of Bush Pilot Road and analyzed for regulated herbicides and glycols. Tables 6.14 and 6.15 present the results of the analysis in comparison to the AB Tier 1 guidelines.

Table 6.15 - Airside Laboratory Analysis of regulated Herbicides in Soil

Parameter	AB Tier 1[1] (mg/kg)	AS-MW1 (mg/kg)	AS-MW2 (mg/kg)	AS-MW3 (mg/kg)	BPR - MW3 (mg/kg)
Depth (mBGS)	N/A	0.8	0.3	0.5	0.76
2,4,5-T	-	<0.02	<0.02	<0.02	<0.02
2,4,5-TP	-	<0.02	<0.02	<0.02	<0.02
2,4-D	0.43	<0.02	<0.02	<0.02	<0.02
2,4-DB	-	<0.02	<0.02	<0.02	<0.02
Bromoxynil	0.18[2]	<0.02	<0.02	<0.02	<0.02
Clopyralid	-	<0.02	<0.02	<0.02	<0.02
Dicamba	0.5	<0.02	<0.02	<0.02	<0.02
Dichlorprop	-	<0.02	<0.02	<0.02	<0.02
Dinoseb	2.8	<0.02	<0.02	<0.02	<0.02
Imazamox	-	<0.02	<0.02	<0.02	<0.02
Imazapyr	-	<0.02	<0.02	<0.02	<0.02
Imazethapyr	-	<0.02	<0.02	<0.02	<0.02
MCPA	0.02	<0.02	<0.02	<0.02	<0.02
MCPB	-	<0.02	<0.02	<0.02	<0.02
Mecoprop	-	<0.02	<0.02	<0.02	<0.02
Picloram	0.64[2]	<0.02	<0.02	<0.02	<0.02
Triclopyr	-	<0.02	<0.02	<0.02	<0.02

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009
2 Exclusion of the Pathway for the Protection of Freshwater Aquatic Life
3 The complete Exova laboratory analysis report is available in Appendix C.

Table 6.16 - Airside Laboratory Analysis of Glycols in Soil

Parameter	AB Tier 1[1] (mg/kg)	AS-MW1 (mg/kg)	AS-MW2 (mg/kg)	AS-MW3 (mg/kg)	BPR - MW3 (mg/kg)
Depth (m)	N/A	0.8	0.3	0.5	0.76
Ethylene Glycol	60	<10	<10	<10	<10
Propylene Glycol	-	<10	<10	<10	<10
Diethylene Glycol	-	<10	<10	<10	<10
Triethylene Glycol	-	<10	<10	<10	<10
Tetraethylene Glycol	-	<10	<10	<10	<10

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

The herbicide and glycol concentrations in the four soil samples submitted were below the laboratory detection limits and applicable criteria.

Groundwater samples were collected from the airside monitoring wells and BPR-MW3, located on the north side of Bush Pilot Road and analyzed for herbicides and glycols. Tables 6.16 and 6.17 present the results of the analysis in comparison to the AB Tier 1 and 2 guidelines, as labelled in the tables.

Table 6.17 - Airside Laboratory Analysis of Regulated Herbicides in Groundwater

Parameter	AB Tier 2[1] (mg/L)	AS-MW1 (mg/L)	AS-MW2 (mg/L)	AS-MW3 (mg/L)	BPR-MW3 (mg/L)
2,4,5-T	-	<0.0001	<0.0001	<0.0001	<0.0001
2,4,5-TP	-	<0.0001	<0.0001	<0.0001	<0.0001
2,4-D	0.1[2]	<0.0001	<0.0001	<0.0001	<0.0001
2,4-DB	-	<0.0001	<0.0001	<0.0001	<0.0001
Bromoxynil	0.005	<0.0001	<0.0001	<0.0001	<0.0001
Clopyralid	-	<0.0001	<0.0001	<0.0001	<0.0001
Dicamba	0.12[2]	<0.0001	<0.0001	<0.0001	<0.0001
Dichlorprop	-	<0.0001	<0.0001	<0.0001	<0.0001
Dinoseb	0.01[2]	<0.0001	<0.0001	<0.0001	<0.0001
Imazamox	-	<0.0001	<0.0001	<0.0001	<0.0001
Imazapyr	-	<0.0001	<0.0001	<0.0001	<0.0001
Imazethapyr	-	<0.0001	<0.0001	<0.0001	<0.0001
MCPA	0.0047[2]	<0.0001	<0.0001	<0.0001	<0.0001
MCPB	-	<0.0001	<0.0001	<0.0001	<0.0001
Mecoprop	-	<0.0001	<0.0001	<0.0001	<0.0001
Picloram	0.19[2]	<0.0001	<0.0001	<0.0001	<0.0001
Triclopyr	-	<0.0001	<0.0001	<0.0001	<0.0001

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 Exclusion of the Pathway for the Protection of Freshwater Aquatic Life.
3 The complete Exova laboratory analysis report is available in Appendix C.

Table 6.18 - Airside Laboratory Analysis of Glycols in Groundwater

Parameter	AB Tier 1[1] (mg/L)	AS-MW1 (mg/L)	AS-MW2 (mg/L)	AS-MW3 (mg/L)	BPR-MW3 (mg/L)
Ethylene Glycol	31	<10	<10	<10	<10
Propylene Glycol	-	<10	<10	<10	<10
Diethylene Glycol	-	<10	<10	<10	<10
Triethylene Glycol	-	<10	<10	<10	<10
Tetraethylene Glycol	-	<10	<10	<10	<10

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

The herbicide and glycol concentrations in the four groundwater samples submitted were below the laboratory detection limits and applicable criteria. Although the analyzed herbicide concentrations in the groundwater were below the laboratory detection limits, the Tier 2, exclusion of FWAL criteria was chosen because the laboratory detection level for dinoseb exceeds the Tier 1 criteria.

6.10 Bush Pilot Road

A hydrocarbon soil remediation program completed in 2000 on the north side of Bush Pilot Road reviewed in the March 2010 Phase I ESA, identified hydrocarbon concentrations in the soil exceeding the current Tier 1 criteria. Also reviewed were previous investigations completed on the adjacent property north (12345 - 121 Street) which identified petroleum hydrocarbons, metals, and solvents concentrations in the soil and groundwater exceeding the current Tier 1 criteria.

To confirm hydrocarbon, metal and solvent concentrations in the soil and groundwater four monitoring wells (BPR-MW1 to BPR-MW4) were advanced along the north side of Bush Pilot Road and south of the adjacent property (12345 - 121 Street). All of the borehole and monitoring well locations are presented in Figure 11.

Soil samples collected at 0.76 mBGS from BPR-MW1 and BPR-MW2, and 1.52 and 2.29 mBGS from BPR-MW3 and BPR-MW4 were analyzed for petroleum hydrocarbons. Soil samples were also collected from BPR-MW1 and BPR-MW2 at 0.76 mBGS and from BPR-MW3 and BPR-MW4 at 1.52 mBGS and analyzed for metals and VOC's. Table 6.19 to 6.21 presents the results of the soil analysis in comparison with the AB Tier 1 or 2 guidelines, as labelled in the tables.

Table 6.19 - Bush Pilot Road Laboratory Analysis of Petroleum Hydrocarbons in Soil

Parameter	AB Tier 1[1] (mg/kg)	BPR-MW4 (mg/kg)	BPR-MW4 (mg/kg)	BPR-MW1 (mg/kg)	BPR-MW2 (mg/kg)	BPR-MW3 (mg/kg)	BPR-MW3 (mg/kg)
Depth (m)	N/A	1.52	2.29	0.76	0.76	1.52	2.29
Headspace (ppm)		60	10	50	35	30	150
Benzene	0.046	<0.004	<0.004	<0.004	<0.004	0.01	0.01
Toluene	0.52	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.11	<0.010	<0.010	<0.010	<0.010	**0.158**	<0.010
Xylenes	15	<0.010	<0.010	<0.010	<0.010	0.03	<0.010
F1 (C6-C10, less BTEX)	210	<4	<4	<4	<4	**300**	11
F2 (C10-C16)	150	15	<10	<10	<10	**666**	15
F3 (C16-C34)	1,300	117	<30	<30	<30	215	92
F4 (C34-C50)	5,600	42	<20	<20	<20	21	37

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria

Table 6.20 - Bush Pilot Road Laboratory Analysis of Regulated Metals in Soil

Parameter	AB Tier 1[1] (mg/kg)	BPR-MW4 (mg/kg)	BPR-MW1 (mg/kg)	BPR-MW2 (mg/kg)	BPR-MW3 (mg/kg)
Depth (m)	N/A	1.52	0.76	0.76	1.52
Antimony	20	<0.2	<0.2	<0.2	<0.2
Arsenic	17	8.5	8.5	5.7	7.6
Barium	500	311	249	174	297
Beryllium	5	1	1.2	1	1
Boron (hot water soluble)	2	1.0	1.5	0.7	1.3
Cadmium	10	0.22	0.06	0.1	0.18
Chromium (total)	64	33.0	46.3	33.8	38.1
Cobalt	20	13.4	14.2	13	13.9

Parameter	AB Tier 1[1] (mg/kg)	BPR-MW4 (mg/kg)	BPR-MW1 (mg/kg)	BPR-MW2 (mg/kg)	BPR-MW3 (mg/kg)
Copper	63	29	31	17	30
Lead	140	14.7	13.7	11.8	13.1
Mercury	6.6	0.04	0.04	0.02	0.04
Molybdenum	4	<1	<1	<1	<1
Nickel	50	36.0	40.5	21.5	36.9
Selenium	1	0.5	**1.1**	0.8	0.5
Silver	20	0.3	0.3	0.2	0.2
Thallium	1	0.30	0.32	0.24	0.3
Tin	5	<1	<1	<1	<1
Uranium	23	1.2	1.4	1.6	1.4
Vanadium	130	58.3	82.4	67.9	68.4
Zinc	200	76	72	66	78

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.

Table 6.21 - Bush Pilot Road Laboratory Analysis of VOCs in Soil

Parameter	AB Tier 2[1] (mg/kg)	BPR-MW4 (mg/kg)	BPR-MW1 (mg/kg)	BPR-MW2 (mg/kg)	BPR-MW3 (mg/kg)
Depth (m)	N/A	1.52	0.76	0.76	1.52
Headspace (ppm)		60	50	35	30
Acetone	-	<0.25	<0.25	<0.25	<0.25
Acetonitrile	-	<0.25	<0.25	<0.25	<0.25
Acrylonitrile	-	<0.25	<0.25	<0.25	<0.25
Alkyl Chloride	-	<0.25	<0.25	<0.25	<0.25
Benzene	0.046	<0.01	<0.01	<0.01	0.01
Bromobenzene	-	<0.01	<0.01	<0.01	<0.01
Bromochloromethane	-	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane	-	<0.01	<0.01	<0.01	<0.01
Bromoform	-	<0.01	<0.01	<0.01	<0.01
Bromomethane	-	<0.1	<0.1	<0.1	<0.1
2-Butanone (MEK)	-	<0.25	<0.25	<0.25	<0.25
n-Butylbenzene	-	<0.01	<0.01	<0.01	10.7
sec-Butylbenzene	-	<0.01	<0.01	<0.01	7.00
tert-Butylbenzene	-	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	0.013	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	0.39	<0.01	<0.01	<0.01	<0.01
Chloroethane	-	<0.1	<0.1	<0.1	<0.1
2-Chloroethyl Vinyl Ether	-	<0.01	<0.01	<0.01	<0.01
Chloroform	0.0029	<0.01	<0.01	<0.01	<0.01
Chloromethane	-	<0.1	<0.1	<0.1	<0.1
2-Chlorotoluene	-	<0.01	<0.01	<0.01	<0.01
4-Chlorotoluene	-	<0.01	<0.01	<0.01	<0.01
Dibromochloromethane	0.91	<0.01	<0.01	<0.01	<0.01
1,2-Dibromo-3-Chloropropane	-	<0.01	<0.01	<0.01	<0.01
1,2-Dibromoethane	-	<0.01	<0.01	<0.01	<0.01
Dibromomethane	-	<0.01	<0.01	<0.01	<0.01
1,4-Dichloro-2-Butene(cis)	-	<0.25	<0.25	<0.25	<0.25
1,4-Dichloro-2-Butene(trans)	-	<0.25	<0.25	<0.25	<0.25
1,2-Dichlorobenzene	0.097	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	-	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.051	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethane	-	<0.01	<0.01	<0.01	<0.01

Parameter	AB Tier 2[1] (mg/kg)	BPR-MW4 (mg/kg)	BPR-MW1 (mg/kg)	BPR-MW2 (mg/kg)	BPR-MW3 (mg/kg)
1,2-Dichloroethane	0.025	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethene	0.15	<0.01	<0.01	<0.01	<0.01
1,2-Dichloroethene(cis)	-	<0.01	<0.01	<0.01	9.92
1,2-Dichloroethene(trans)	-	<0.01	<0.01	<0.01	0.36
Dichlorodifluoromethane	-	<0.1	<0.1	<0.1	<0.1
1,2-Dichloropropane	-	<0.01	<0.01	<0.01	<0.01
1,3-Dichloropropane	-	<0.01	<0.01	<0.01	<0.01
2,2-Dichloropropane	-	<0.1	<0.1	<0.1	<0.1
1,1-Dichloropropene	-	<0.01	<0.01	<0.01	<0.01
1,3-Dichloropropene(cis)	-	<0.01	<0.01	<0.01	<0.01
1,3-Dichloropropene(trans)	-	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	0.11	<0.01	<0.01	<0.01	**0.28**
Ethyl Methacrylate	-	<0.25	<0.25	<0.25	<0.25
Hexachlorobutadiene	0.16[2]	<0.01	<0.01	<0.01	<0.01
Hexachloroethane	-	<0.01	<0.01	<0.01	<0.01
2-Hexanone	-	<0.25	<0.25	<0.25	<0.25
Iodomethane	-	<0.01	<0.01	<0.01	<0.01
p-Isopropyltoluene	-	<0.01	<0.01	<0.01	3.76
Methacrylonitrile	-	<0.25	<0.25	<0.25	<0.25
Methyl t-Butyl Ether	0.044	<0.01	<0.01	<0.01	<0.01
Methylene Chloride	0.21[2]	<0.1	<0.1	<0.1	<0.1
Methyl Methacrylate	1.3	<0.25	<0.25	<0.25	<0.25
4-Methyl-2-Pentanone (MIBK)	-	<0.25	<0.25	<0.25	<0.25
Naphthalene	28[2]	<0.05	<0.05	<0.05	5.62
Pentachloroethane	-	<0.01	<0.01	<0.01	<0.01
Propionitrile	-	<0.25	<0.25	<0.25	<0.25
iso-Propylbenzene	-	<0.01	<0.01	<0.01	3.90
n-Propylbenzene	-	<0.01	<0.01	<0.01	7.02
Styrene	110	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	-	<0.01	<0.01	<0.01	<0.01
1,1,2,2-Tetrachloroethane	-	<0.01	<0.01	<0.01	<0.01
Tetrachloroethene	0.77[2]	<0.01	<0.01	<0.01	**209**
Toluene	0.52	<0.01	<0.01	<0.01	<0.01
1,2,3-Trichlorobenzene	1.9[2]	<0.01	<0.01	<0.01	<0.01
1,2,4-Trichlorobenzene	2.0[2]	<0.01	<0.01	<0.01	<0.01
1,1,1-Trichloroethane	-	<0.01	<0.01	<0.01	<0.01
1,1,2-Trichloroethane	-	<0.01	<0.01	<0.01	<0.01
Trichloroethene	0.054	<0.01	<0.01	<0.01	**34.3**
Trichlorofluoromethane	-	<0.01	<0.01	<0.01	<0.01
1,2,3-Trichloropropane	-	<0.01	<0.01	<0.01	<0.01
1,2,4-Trimethylbenzene	-	<0.01	<0.01	<0.01	16.1
1,3,5-Trimethylbenzene	-	<0.01	<0.01	<0.01	1.83
Vinyl Chloride	0.0083	**<0.1**[4]	**<0.1**[4]	**<0.1**[4]	**<0.1**[4]
Total Xylenes	15	<0.01	<0.01	<0.01	0.03

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 Exclusion of the Pathway for the Protection of Freshwater Aquatic Life.
3 The complete Exova laboratory analysis report is available in Appendix C.
4 The readable detection limit exceeds the guideline value.
Notes: Bold values exceed criteria

Ethylbenzene (for VOCs and petroleum hydrocarbon analysis), PHC F1 and F2, tetrachloroethene, and trichloroethene concentrations in the soil sample retrieved from BPR-MW3 at 1.52 mBGS exceeds the applicable criteria. Petroleum hydrocarbon and VOC concentrations in the remaining analyzed soil samples comply with criteria.

Selenium concentration in the soil sample retrieved from BPR-MW1 at 0.76 mBGS also exceeds the Tier 1 criteria. The metal concentrations in the remaining samples submitted are below the applicable criteria.

Groundwater samples were collected from the four monitoring wells located on the north side of Bush Pilot Road and analyzed for hydrocarbons, glycols, and VOC's. Tables 6.22 to 6.24 below present the results of the analysis in comparison with the AB Tier 1 or 2 guidelines, as labelled.

Table 6.22 - Bush Pilot Road Laboratory Analysis of Petroleum Hydrocarbons in Groundwater

Parameter	AB Tier 1[1] (mg/L)	BPR-MW4 (mg/L)	BPR-MW1 (mg/L)	BPR-MW2 (mg/L)	BPR-MW3 (mg/L)
Benzene	0.005	0.001	<0.001	<0.001	**0.011**
Toluene	0.024	<0.001	<0.001	<0.001	0.001
Ethylbenzene	0.0024	0.002	<0.001	<0.001	<0.001
Xylenes	0.3	0.001	<0.001	<0.001	<0.001
F1 (C6-C10, less BTEX)	2.2	<0.2	<0.2	<0.2	**2.4**
F2 (C10-C16)	1.1	<0.1	<0.1	<0.1	<0.1

1 Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria

Table 6.23 - Bush Pilot Road Laboratory Analysis of Regulated Metals in Groundwater

Parameter	AB Tier 2[1] (mg/L)	BPR-MW4 (mg/L)	BPR-MW1 (mg/L)	BPR-MW2 (mg/L)	BPR-MW3 (mg/L)
		6.56	10.4	10.6	12.5
Silicon	-	294	710	873	830
Sulfur	-	<0.0001	<0.0001	<0.0001	<0.0001
Mercury	0.001[2]	<0.002	<0.004	<0.004	<0.01
Aluminum		<0.0002	<0.0004	<0.0004	<0.001
Antimony	0.006	0.0019	0.0005	0.0008	0.001
Arsenic	0.01[2]	0.121	0.026	0.07	0.069
Barium	1	<0.0001	<0.0002	<0.0002	<0.0005
Beryllium	-	<0.0005	<0.001	<0.001	<0.002
Bismuth	-	0.128	0.231	0.272	0.29
Boron	5	0.00014	0.00023	0.00026	0.0004
Cadmium	0.005[2]	0.0011	<0.001	<0.001	<0.002
Chromium	0.05[2]	0.0111	0.0027	0.003	0.0077
Cobalt	-	0.002	0.004	0.005	0.005
Copper	1[2]	<0.0001	<0.0002	<0.0002	<0.0005
Lead	0.01[2]	0.07	0.314	0.5	0.547
Lithium	-	0.001	<0.002	<0.002	<0.005
Molybdenum	-	0.015	0.012	0.0271	0.031
Nickel	-	0.0009	0.0008	0.0009	0.001
Selenium	0.01[2]	<0.00001	<0.00002	<0.00002	<0.00005
Silver	-	1.27	3.77	5.89	5.73
Strontium	-	0.00007	<0.0001	<0.0001	<0.0002
Thallium	-	<0.001	<0.002	<0.002	<0.005
Tin	-	0.01	0.024	0.0283	0.03
Titanium	-	0.0043	**0.0519**	**0.0721**	**0.0812**
Uranium	0.02	0.0028	0.002	0.0027	0.004

Parameter	AB Tier 2[1] (mg/L)	BPR-MW4 (mg/L)	BPR-MW1 (mg/L)	BPR-MW2 (mg/L)	BPR-MW3 (mg/L)
Vanadium	-	0.004	0.01	0.01	0.01
Zinc	5[2]	234	467	511	547
Calcium	-	111	281	444	448
Magnesium	-	190	**248**	**296**	137
Sodium	200	4.2	7.9	9.9	9.5
Potassium	-	0.03	<0.02	<0.02	<0.05
Iron	0.3	**1.85**	**0.74**	**1.15**	**1.61**
Manganese	0.05				

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 Exclusion of the Pathway for the Protection of Freshwater Aquatic Life.
3 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria

Table 6.24 - Bush Pilot Road Laboratory Analysis of VOCs in Groundwater

Parameter	AB Tier 2[1] (mg/L)	BPR-MW4 (mg/L)	BPR-MW1 (mg/L)	BPR-MW2 (mg/L)	BPR-MW3 (mg/L)
Acetone	-	<0.025	<0.025	<0.025	<0.025
Acetonitrile		<0.025	<0.025	<0.025	<0.025
Acrylonitrile	-	<0.025	<0.025	<0.025	<0.025
Alkyl Chloride	-	<0.025	<0.025	<0.025	<0.025
Benzene	0.005	<0.001	<0.001	<0.001	**0.009**
Bromobenzene	-	<0.001	<0.001	<0.001	<0.001
Bromochloromethane	-	<0.001	<0.001	<0.001	<0.001
Bromodichloromethane	-	<0.001	<0.001	<0.001	<0.001
Bromoform	-	<0.001	<0.001	<0.001	<0.001
Bromomethane	-	<0.01	<0.01	<0.01	<0.01
2-Butanone (MEK)	-	<0.025	<0.025	<0.025	<0.025
n-Butylbenzene	-	<0.001	<0.001	<0.001	<0.001
sec-Butylbenzene	-	<0.001	<0.001	<0.001	<0.001
tert-Butylbenzene	-	<0.001	<0.001	<0.001	<0.001
Carbon Tetrachloride	0.005	<0.001	<0.001	<0.001	<0.001
Chlorobenzene	0.03[2]	<0.001	<0.001	<0.001	<0.001
Chloroethane	-	<0.01	<0.01	<0.01	<0.01
2-Chloroethyl Vinyl Ether	-	<0.001	<0.001	<0.001	<0.001
Chloroform	0.05[2]	<0.001	<0.001	<0.001	<0.001
Chloromethane	-	<0.01	<0.01	<0.01	<0.01
2-Chlorotoluene	-	<0.001	<0.001	<0.001	<0.001
4-Chlorotoluene	-	<0.001	<0.001	<0.001	<0.001
Dibromochloromethane	0.190	<0.001	<0.001	<0.001	<0.001
1,2-Dibromo-3-Chloropropane	-	<0.001	<0.001	<0.001	<0.001
1,2-Dibromoethane	-	<0.001	<0.001	<0.001	<0.001
Dibromomethane	-	<0.001	<0.001	<0.001	<0.001
1,4-Dichloro-2-Butene(cis)	-	<0.025	<0.025	<0.025	<0.025
1,4-Dichloro-2-Butene(trans)	-	<0.025	<0.025	<0.025	<0.025
1,2-Dichlorobenzene	0.003[2]	<0.001	<0.001	<0.001	<0.001
1,3-Dichlorobenzene	-	<0.001	<0.001	<0.001	<0.001
1,4-Dichlorobenzene	0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethane	-	<0.001	<0.001	<0.001	<0.001
1,2-Dichloroethane	0.005	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethene	0.014	<0.001	<0.001	<0.001	0.004
1,2-Dichloroethene(cis)	-	<0.001	<0.001	<0.001	5.48
1,2-Dichloroethene(trans)	-	<0.001	<0.001	<0.001	0.298
Dichlorodifluoromethane	-	<0.01	<0.01	<0.01	<0.01

Parameter	AB Tier 2[1] (mg/L)	BPR-MW4 (mg/L)	BPR-MW1 (mg/L)	BPR-MW2 (mg/L)	BPR-MW3 (mg/L)
1,2-Dichloropropane	-	<0.001	<0.001	<0.001	<0.001
1,3-Dichloropropane	-	<0.001	<0.001	<0.001	<0.001
2,2-Dichloropropane	-	<0.01	<0.01	<0.01	<0.01
1,1-Dichloropropene	-	<0.001	<0.001	<0.001	<0.001
1,3-Dichloropropene(cis)	-	<0.001	<0.001	<0.001	<0.001
1,3-Dichloropropene(trans)	-	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	0.0024	<0.001	<0.001	<0.001	<0.001
Ethyl Methacrylate	-	<0.025	<0.025	<0.025	<0.025
Hexachlorobutadiene	0.006[2]	<0.001	<0.001	<0.001	<0.001
Hexachloroethane	-	<0.001	<0.001	<0.001	<0.001
2-Hexanone	-	<0.025	<0.025	<0.025	<0.025
Iodomethane	-	<0.001	<0.001	<0.001	<0.001
p-Isopropyltoluene	-	<0.001	<0.001	<0.001	<0.001
Methacrylonitrile	-	<0.025	<0.025	<0.025	<0.025
Methylene Chloride	0.05	<0.005	<0.005	<0.005	<0.005
Methyl Methacrylate	0.47	<0.025	<0.025	<0.025	<0.025
4-Methyl-2-Pentanone (MIBK)	-	<0.025	<0.025	<0.025	<0.025
Methyl t-Butyl Ether	-	<0.001	<0.001	<0.001	<0.001
Naphthalene	0.47[2]	<0.005	<0.005	<0.005	<0.005
Pentachloroethane	-	<0.001	<0.001	<0.001	<0.001
Propionitrile	-	<0.025	<0.025	<0.025	<0.025
iso-Propylbenzene	-	<0.001	<0.001	<0.001	<0.001
n-Propylbenzene	-	<0.001	<0.001	<0.001	<0.001
Styrene	2.8[2]	<0.001	<0.001	<0.001	<0.001
1,1,1,2-Tetrachloroethane	-	<0.001	<0.001	<0.001	<0.001
1,1,2,2-Tetrachloroethane	-	<0.001	<0.001	<0.001	<0.001
Tetrachloroethene	0.03	<0.001	<0.001	<0.001	**4.08**
Toluene	0.024	<0.001	<0.001	<0.001	<0.001
1,2,3-Trichlorobenzene	0.014[2]	<0.001	<0.001	<0.001	<0.001
1,2,4-Trichlorobenzene	0.015	<0.001	<0.001	<0.001	<0.001
1,1,1-Trichloroethane	-	<0.001	<0.001	<0.001	0.002
1,1,2-Trichloroethane	-	<0.001	<0.001	<0.001	<0.001
Trichloroethene	0.005	<0.001	<0.001	<0.001	**2.14**
Trichlorofluoromethane	-	<0.001	<0.001	<0.001	<0.001
1,2,3-Trichloropropane	-	<0.001	<0.001	<0.001	<0.001
1,2,4-Trimethylbenzene	-	0.002	<0.001	<0.001	<0.001
1,3,5-Trimethylbenzene	-	<0.001	<0.001	<0.001	<0.001
Vinyl Chloride	0.002	<0.002	<0.002	<0.002	<0.002
Total Xylenes (m,p,o)	0.3	0.002	<0.001	<0.001	<0.001

1 Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Fine-Grained Soil-Type, Residential/Parkland Land Use, February 2009.
2 Exclusion of the Pathway for the Protection of Freshwater Aquatic Life.
3 The complete Exova laboratory analysis report is available in Appendix C.
Notes: Bold values exceed criteria

The following outlines the results of the groundwater sampling analysis completed in the monitoring wells located on the north side of Bush Pilot Road:

- Benzene, PHC F1, tetrachloroethene, and trichloroethene in the groundwater retrieved from BPR-MW3 exceeds AB Tier I criteria;
- Uranium concentrations in the groundwater retrieved from BPR-MW1, BPR-MW2, and BPR-MW3 exceed the Tier 1 criteria, these concentrations may be indicative of background concentrations;
- Sodium concentrations in the groundwater retrieved from BPR-MW1 and BPR-MW2 exceed the Tier 1 criteria;
- Manganese concentrations in the groundwater retrieved from BPR-MW4, BPR-MW1, BPR-MW2, and BPR-MW3 exceeded the Tier 1 criteria, these concentrations may be indicative of background concentrations; and
- All other analyzed petroleum hydrocarbons, VOC, and metal parameters analyzed complied with the guidelines.

7. Quality Assurance and Quality Control (QA/QC)

7.1 QA/QC Procedures and Evaluation

To confirm that the sampling and analytical data collected were interpretable, defensible and comparable, a Quality Assurance and Quality Control (QA/QC) program was implemented. This involved following QA/QC measures in both the collection and analysis of environmental samples. The following discussion includes a brief summary of the QA/QC measures followed during the investigation.

7.2 AECOM QA/QC Program

Quality Control (QC) measures used in the collection, preservation, shipment, and analysis of samples include the following:

- Sampling techniques were performed in accordance with standard written protocols;
- Field notes were recorded during the investigation within the borehole logs;
- All samples were kept cool prior to shipment to the laboratory, packed with ice inside of insulated coolers;
- Samples were assigned unique sample control numbers and transported under chain of custody procedures; and
- The analytical laboratory has proficiency certification issued by the Canadian Association for Laboratory Accreditation Inc. (CALA) for the specific analyses conducted.

Quality Assurance (QA) measures established for the investigation included collection of duplicate field samples at a rate of approximately 10%. A blind duplicate sample consists of a second aliquot of an individual sample that is submitted to the analytical laboratory under a separate label such that the analytical laboratory has no prior knowledge that it is a duplicate. Duplicate samples from two locations were submitted to the laboratory for analysis. The relative percent difference (RPD) between duplicate results was used to assess overall sampling precision. The RPD is a measure of the variability between two duplicate analyses and is calculated by the following equation:

$$RPD = 100 \times \left((2 \times (x_1 - x_2)) / (x_1 + x_2) \right)$$

Where x_1 is the primary result and x_2 is the blind duplicate result. Acceptable RPD values vary on the analytical parameters, the sample matrix, and the concentrations of parameters analyzed within the sample. In the event that a value was determined to be below reportable detection limits, the RPD was not calculated. It is recommended that RPD values less than 35% for inorganic parameters and 50% for organic parameters.

7.3 Summary of QA/QC Results

Tables 7.1 to 7.3 present the results of the RPD analysis for the soil and groundwater samples and the duplicate samples labelled as QA/QC, accordingly. As shown in Table 7.1, the RPD for the F3 hydrocarbon fraction QA/QC#2 exceeded the recommended RPD of 50% for organic parameters. The RPD for silver QA/QC #1 and uranium QA/QC#3 exceeded the recommended RPD of 35% for inorganic parameters. All other parameters analysed produced acceptable RPD values below the recommended limits. The low RPD values indicate good reproducibility of the data.

Table 7.1 - Summary of QA/QC in Hydrocarbons Soil

Parameter	BPR-MW1 (mg/kg)	QA/QC#1 (mg/kg)	RPD	B4-BH1 (mg/kg)	QA/QC#2 (mg/kg)	RPD
Depth (mBGS)	0.91	0.91	-	1.52	1.52	-
Benzene	<0.004	<0.004	NC	<0.004	<0.004	NC
Toluene	<0.005	<0.005	NC	<0.005	<0.005	NC
Ethylbenzene	<0.010	<0.010	NC	<0.010	<0.010	NC
Xylenes	<0.010	<0.010	NC	<0.010	<0.010	NC
F1	<4	<4	NC	<4	<4	NC
F2	<10	16	NC	19	14	30.30
F3	<30	68	NC	93	46	**67.63**
F4	<20	<20	NC	<20	<20	NC

Table 7.2 - Summary of QA/QC in Metals Soil

Parameter	BPR-MW4 (mg/kg)	QA/QC#1 (mg/kg)	RPD	B8-BH2 (mg/kg)	QA/QC#3 (mg/kg)	RPD
Depth (mBGS)	1.52	1.52	-	0.91	0.91	-
Antimony	<0.2	<0.2	NC	<0.2	<2	NC
Arsenic	8.5	8.7	2.33	6.2	7.1	13.53
Barium	311	309	0.65	184	227	20.92
Beryllium	1	0.8	22.22	1.1	1	9.52
Boron	1	1.1	9.52	1.1	1.4	24.00
Cadmium	0.22	0.2	9.52	0.09	0.11	20.00
Chromium	33	29.6	10.86	35.5	36.9	3.87
Cobalt	13.4	12.2	9.38	10.3	10.5	1.92
Copper	29	31	6.67	22	26	16.67
Lead	14.7	14.1	4.17	13	11.9	8.84
Mercury	0.04	0.05	22.22	0.04	0.03	28.57
Molybdenum	<1	<1	NC	<1	<1	NC
Nickel	36	33.3	7.79	27.3	33.1	19.21
Selenium	0.5	0.5	0.00	0.4	0.5	22.22
Silver	0.3	0.2	**40.00**	0.2	0.2	0.00
Thallium	0.3	0.29	3.39	0.26	0.24	8.00
Tin	<1	<1	NC	<1	<1	NC
Uranium	1.2	1.3	8.00	1.3	0.8	**47.62**
Vanadium	58.3	52.7	10.09	64.3	66.1	2.76
Zinc	76	86	12.35	65	59	9.68

Table 7.32 - Summary of QA/QC in Water

Parameter	PY-MW1 (mg/L)	H1-4 (mg/L)	QA/QC#1 (mg/L)	RPD
Petroleum Hydrocarbons (water)				
Benzene	<0.001	-	<0.001	NC
Toluene	<0.001	-	<0.001	NC
Ethylbenzene	<0.001	-	<0.001	NC
Xylenes	<0.001	-	<0.001	NC
F1 (C6-C10, less BTEX)	<0.2	-	<0.2	NC

Parameter	PY-MW1 (mg/L)	H1-4 (mg/L)	QA/QC#1 (mg/L)	RPD
F2 (C10-C16)	<0.1	-	<0.1	NC
Regulated Metals (water)				
Silicon	-	5.88	6.09	3.51
Sulfur	-	375	383	2.11
Mercury	-	<0.0001	<0.0001	NC
Aluminum	-	<0.004	<0.004	NC
Antimony	-	<0.0004	<0.0004	NC
Arsenic	-	0.0004	0.0004	0.00
Barium	-	0.033	0.033	0.00
Beryllium	-	<0.0002	<0.0002	NC
Bismuth	-	<0.001	<0.001	NC
Boron	-	0.11	0.1	9.52
Cadmium	-	0.0001	0.0001	0.00
Chromium	-	<0.001	<0.001	NC
Cobalt	-	0.002	0.002	0.00
Copper	-	0.003	0.003	0.00
Lead	-	<0.0002	<0.0002	NC
Lithium	-	0.274	0.269	1.84
Molybdenum	-	<0.002	<0.002	NC
Nickel	-	0.0076	0.0075	1.32
Selenium	-	0.0005	0.0005	0.00
Silver	-	<0.00002	<0.00002	NC
Strontium	-	1.99	1.96	1.52
Thallium	-	<0.0001	<0.0001	NC
Tin	-	<0.002	<0.002	NC
Titanium	-	0.012	0.012	0.00
Uranium	-	0.0304	0.0304	0.00
Vanadium	-	0.0009	0.001	10.53
Zinc	-	0.01	0.01	0.00
Calcium	-	196	204	4.00
Magnesium	-	118	122	3.33
Sodium	-	298	309	3.62
Potassium	-	7	7.2	2.82
Iron	-	<0.02	<0.02	NC
Manganese	-	0.457	0.455	0.44

Exova was the laboratory selected for the Phase II ESA. Exova ran replicate samples, surrogate analysis, and calibrations to determine analytical accuracy. All results were within acceptable limits. The laboratory also ran laboratory duplicate samples to ascertain analytical precision and, as mentioned above, all results were within acceptable limits. Method blank samples were run to ensure that there was no carry-over from analysis to analysis and that analytes were not introduced due to the reagents or methods used.

8. Conclusions

8.1 City of Edmonton Pest Management Building

A former 34,125 L fibreglass UST containing waste pesticides and located adjacent to the northwest corner of the building was removed in 1998. A review of a Phase II ESA completed in the vicinity of the former UST concluded that the petroleum hydrocarbon and herbicide concentrations in the analysed soil samples were below the Tier 1 criteria. The herbicide concentration in the analysed groundwater samples were also below the Tier 1 criteria. Due to the low concentrations of petroleum hydrocarbon and herbicides in the soil and groundwater, an additional investigation was not completed at this site in 2010.

8.2 City of Edmonton Parks Yard

Petroleum hydrocarbon concentrations in the soil sample collected from the borehole advanced adjacent to the above ground diesel tank in the Parks Yard were below the applicable Tier 1 criteria. There are no further recommendations with respect petroleum hydrocarbon concentrations in the soil in this area.

8.3 Building 3

Petroleum hydrocarbon concentrations in the soil west and south of the existing AST's and former UST location west of Building 3 exceeded the Tier 1 criteria. Petroleum hydrocarbon concentrations in the groundwater retrieved from the monitoring well south of the existing AST's and former UST location exceed the Tier 1 criteria.

8.4 Building 4

Petroleum hydrocarbon concentrations in the soil sample collected from the boreholes in the vicinity of the 1998 site investigation were below the applicable Tier 1 criteria.

8.5 Building 7

A geophysical survey as per the recommendations of the March 2010 ESA, to investigate a suspect UST located northeast Building 7 was not completed due to the potential interference of the fences and vehicles parked in this area, it was decided that the survey be completed once the airport is closed and the site has been decommissioned.

Petroleum hydrocarbon concentrations in the soil samples collected from the borehole adjacent to the 1,135 L of waste oil AST and in the soil samples collected adjacent to the previously installed monitoring wells were below the applicable Tier 1 criteria. Barium concentrations in B7-BH4 exceeded the Tier 1 criteria. Barium concentrations in the remaining soil samples submitted at this site; although, below criteria were elevated and therefore the exceedance may be indicative of background conditions.

Uranium, selenium, sodium, and manganese concentrations in the groundwater also exceeded the Tier 2 criteria. These concentrations may be indicative of background conditions.

8.6 Building 8

Petroleum hydrocarbon concentrations in the soil sample collected from the borehole in the vicinity of the 1994 remediation program were below the applicable Tier 1 criteria. Metal concentrations in particular selenium, in the soil samples collected from the boreholes installed adjacent to the investigated area were also below the applicable Tier 1 criteria.

8.7 Building 11

Petroleum hydrocarbon concentrations in the soil samples collected from the vicinity of the previously investigated areas were below the applicable Tier 1 criteria. Chromium, iron, and nickel concentrations in the groundwater retrieved from both monitoring wells decreased to below the applicable Tier 2 criteria since the 1998 sampling event. Manganese concentrations in the groundwater sample collected from one of the monitoring wells exceeded the Tier 2 criteria. This concentration may be indicative of background concentrations.

8.8 Former Building 12

Petroleum hydrocarbon concentrations in the soil and groundwater samples collected from the boreholes in the vicinity of the 1998 remediation program were below the applicable Tier 1 criteria.

A geophysical survey as per the recommendations of the March 2010 ESA, to investigate a suspect UST located northeast of Buildings 11 and 12 was not completed due to the potential interference of the fences and vehicles parked in this area, it was decided that the survey be completed once the airport is closed and the site has been decommissioned.

8.9 Airside

Herbicide and glycol concentrations in the soil and groundwater samples collected from boreholes advanced along the perimeter of the undeveloped, vegetated area west of Runway 16/34 were below the applicable Tier 1 criteria.

8.10 Bush Pilot Road

Petroleum hydrocarbon and VOC concentrations in the soil and groundwater samples retrieved from one of the boreholes located along the north side of Bush Pilot Road exceed the applicable Tier 1 and 2 criteria indicating potential migration of hydrocarbon and VOC's originating from the adjacent property north onto the site.

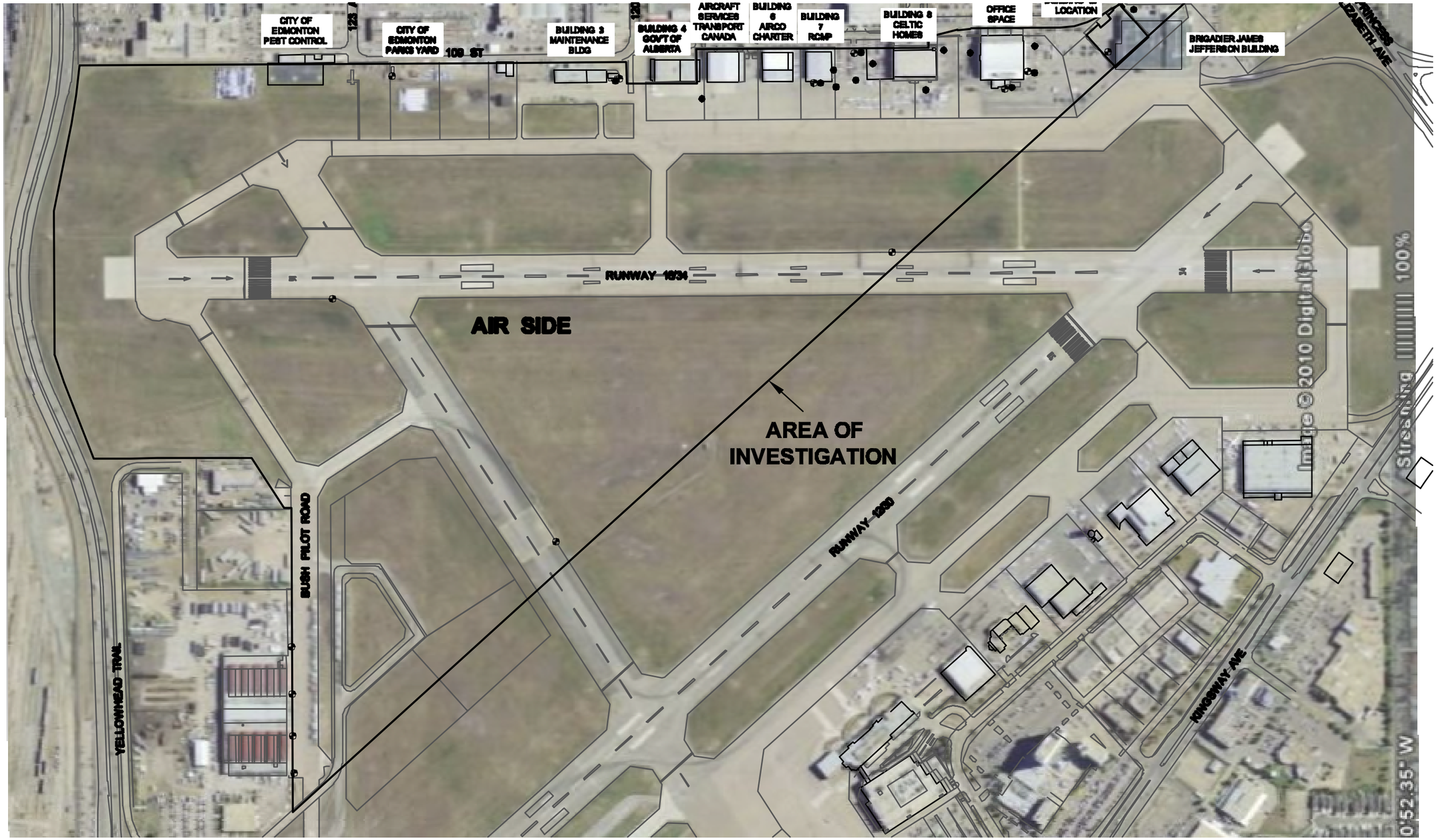
Selenium concentration in the soil sample retrieved from one of the boreholes also exceeds the Tier 1 criteria.

Uranium and/or manganese concentrations in the groundwater retrieved from the monitoring wells exceed the applicable criteria. These concentrations may be indicative of background concentrations.

9. Recommendations

Based on data collected to date, the following recommendations are made:

- It is recommended that the petroleum hydrocarbon concentrations in the soil and groundwater exceeding the applicable criteria south of Building 3 be delineated. Once the area is delineated and operations have been decommissioned, the contaminated area should be remediated.
- The petroleum hydrocarbon and VOC concentrations in the soil and groundwater exceeding the applicable criteria along the north side of Bush Pilot Road be delineated. Once the area is delineated and operations have been decommissioned, the contaminated area should be remediated. A hydrocarbon resistant liner should be placed along the north excavation wall so as to prevent the migration of contaminates from the adjacent property north back on to the site.
- A geophysical survey as per the recommendations of the March 2010 ESA, to investigate a suspect UST located in the vicinity of Building 7 and northeast of Buildings 11 and 12 should be completed once the airport is closed and the site has been decommissioned.
- Background concentrations of metals in the soil and groundwater at Buildings 7, Building 11 and along Bush Pilot Road should be confirmed.
- There are no further recommendations with respect to petroleum hydrocarbon and/or, metals in the soil and/or groundwater in the vicinity of the City of Edmonton Parks Yard and Buildings 7, 8, 11, 12, and 4. There are no further recommendations with respect to herbicides and glycol concentrations in the soil and groundwater with respect to airside operations.



LEGEND:

- BOREHOLE
- MONITORING WELL

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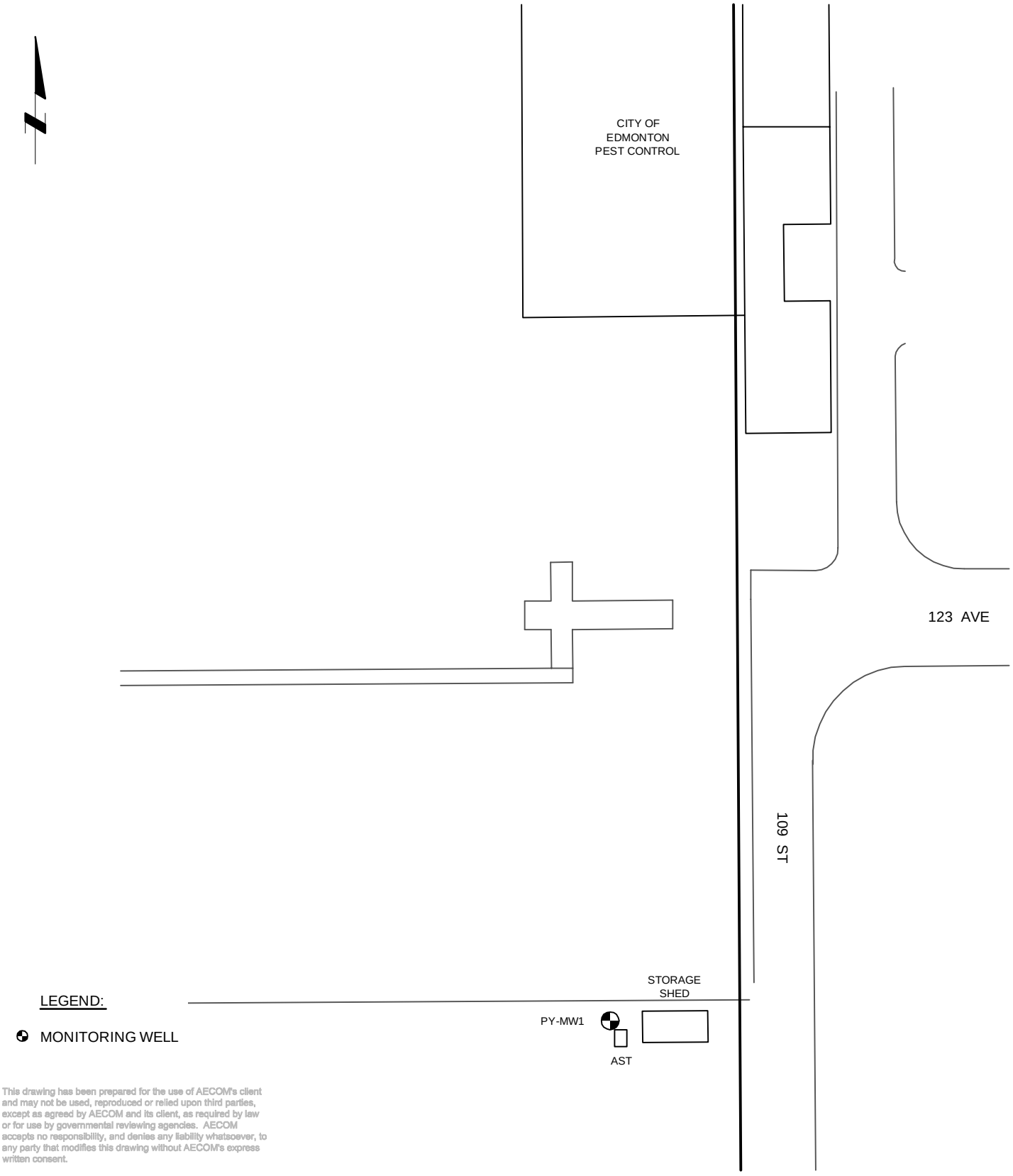
AECOM

The City of Edmonton

Edmonton City Centre Airport, Edmonton, AB

Phase II ESA - Borehole & Monitoring Well Locations
Site Plan



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City of Edmonton

Edmonton City Centre Airport, Edmonton, AB

Phase II ESA, City of Edm Parks Yard

Monitoring Well Site Plan

August, 2010

Figure 3

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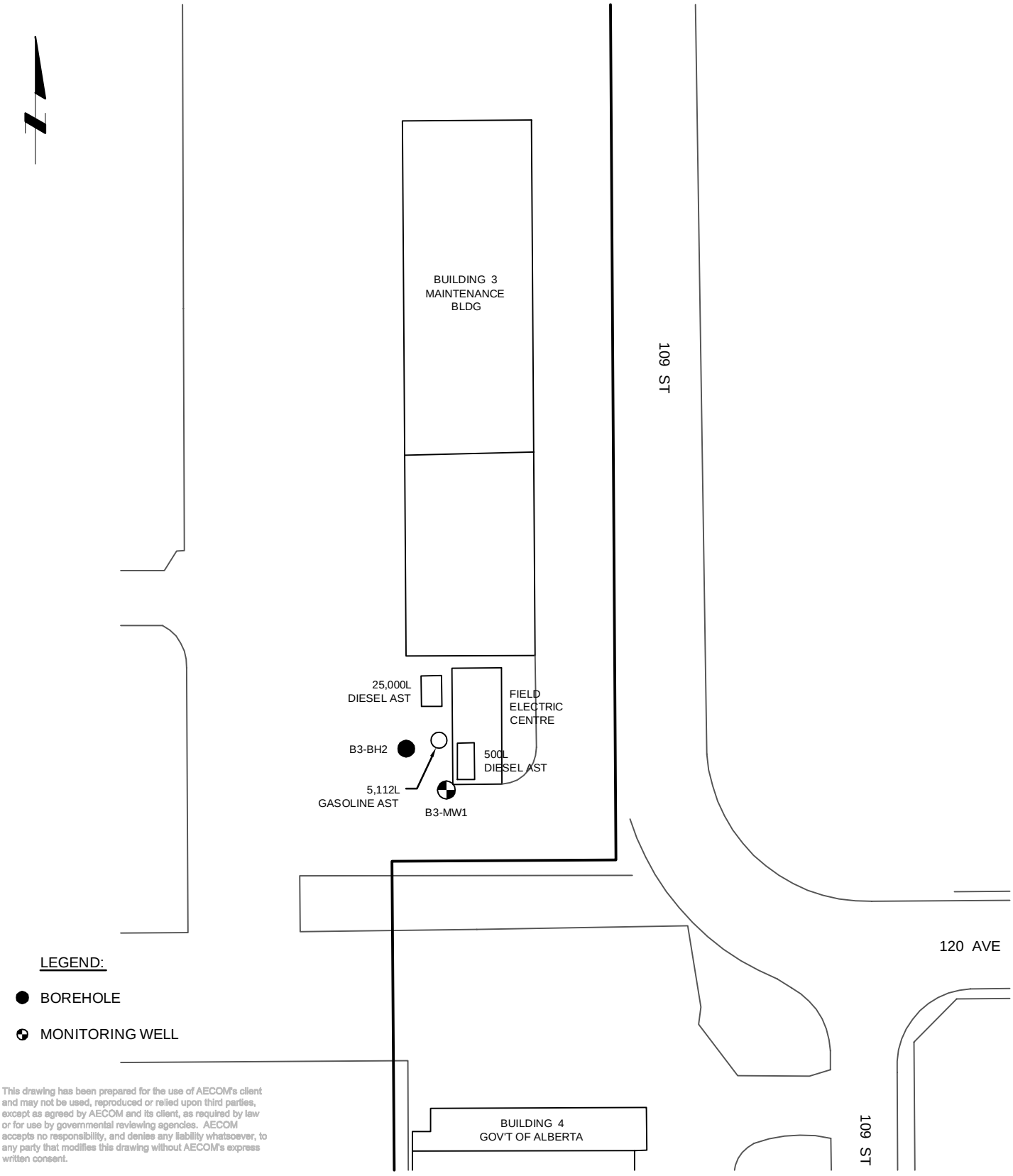

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City of Edmonton

Edmonton City Centre Airport, Edmonton, AB

Phase II ESA, Building 3

Borehole & Monitoring Well Site Plan

August, 2010

Figure 4

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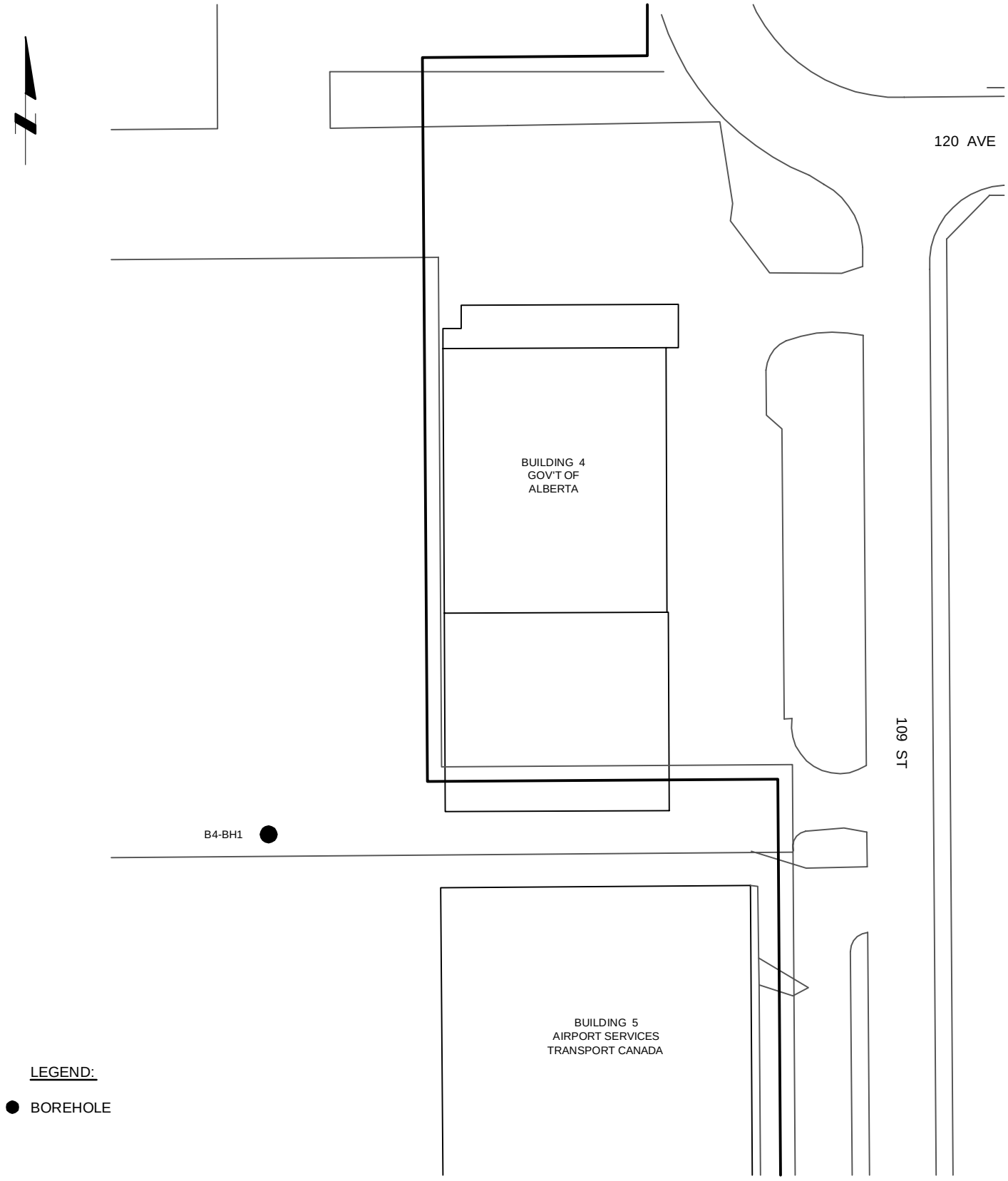

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City of Edmonton

Edmonton City Centre Airport, Edmonton, AB

Phase II ESA, Building 4
Borehole Site Plan

August, 2010

Figure 5

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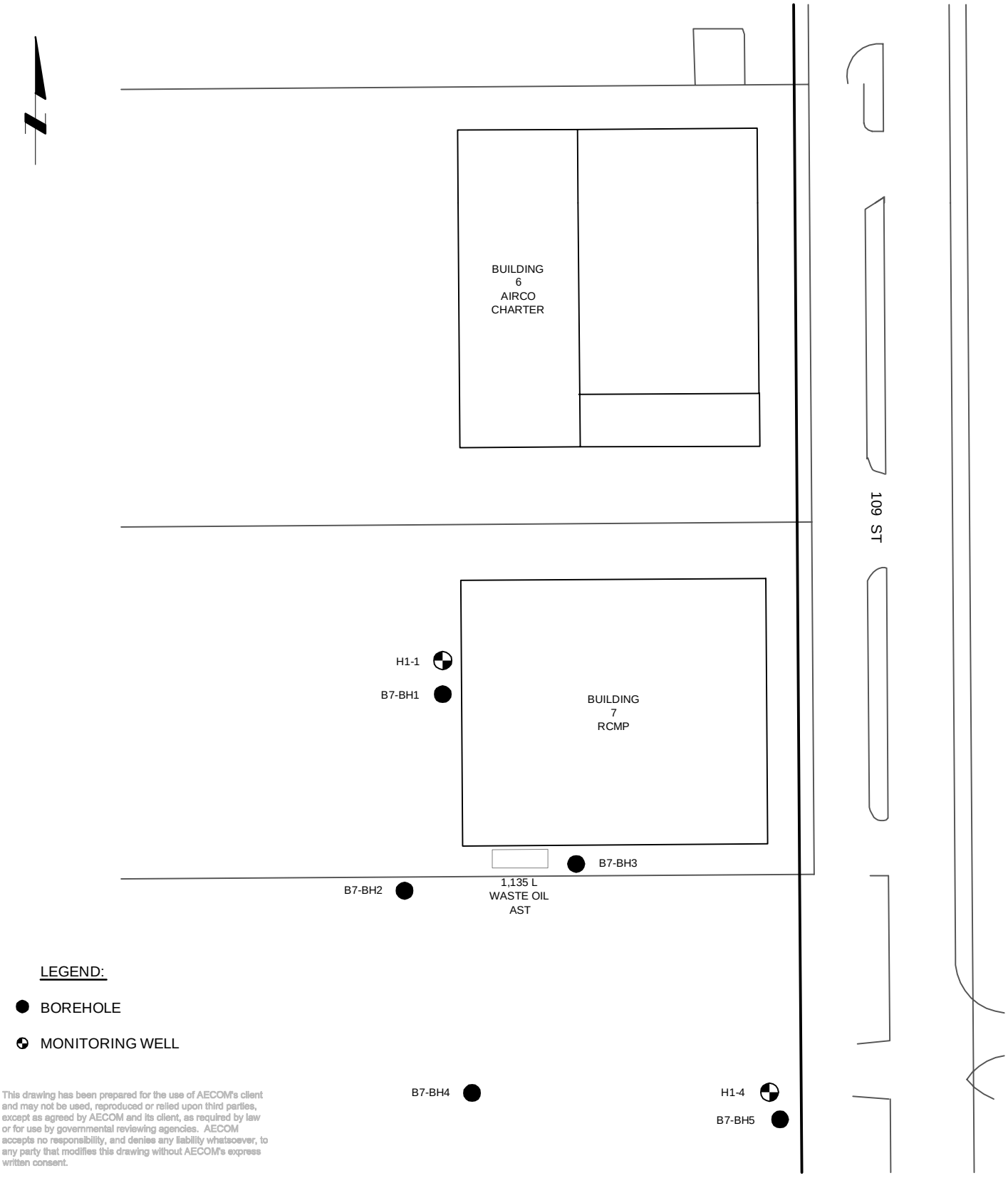

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City of Edmonton

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Phase II ESA, Building 7
Borehole & Monitoring Well Site Plan

August, 2010

Figure 6

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Edmonton City Centre Airport, Edmonton, AB

Phase II ESA

Borehole Site Plan

August, 2010

Figure 7

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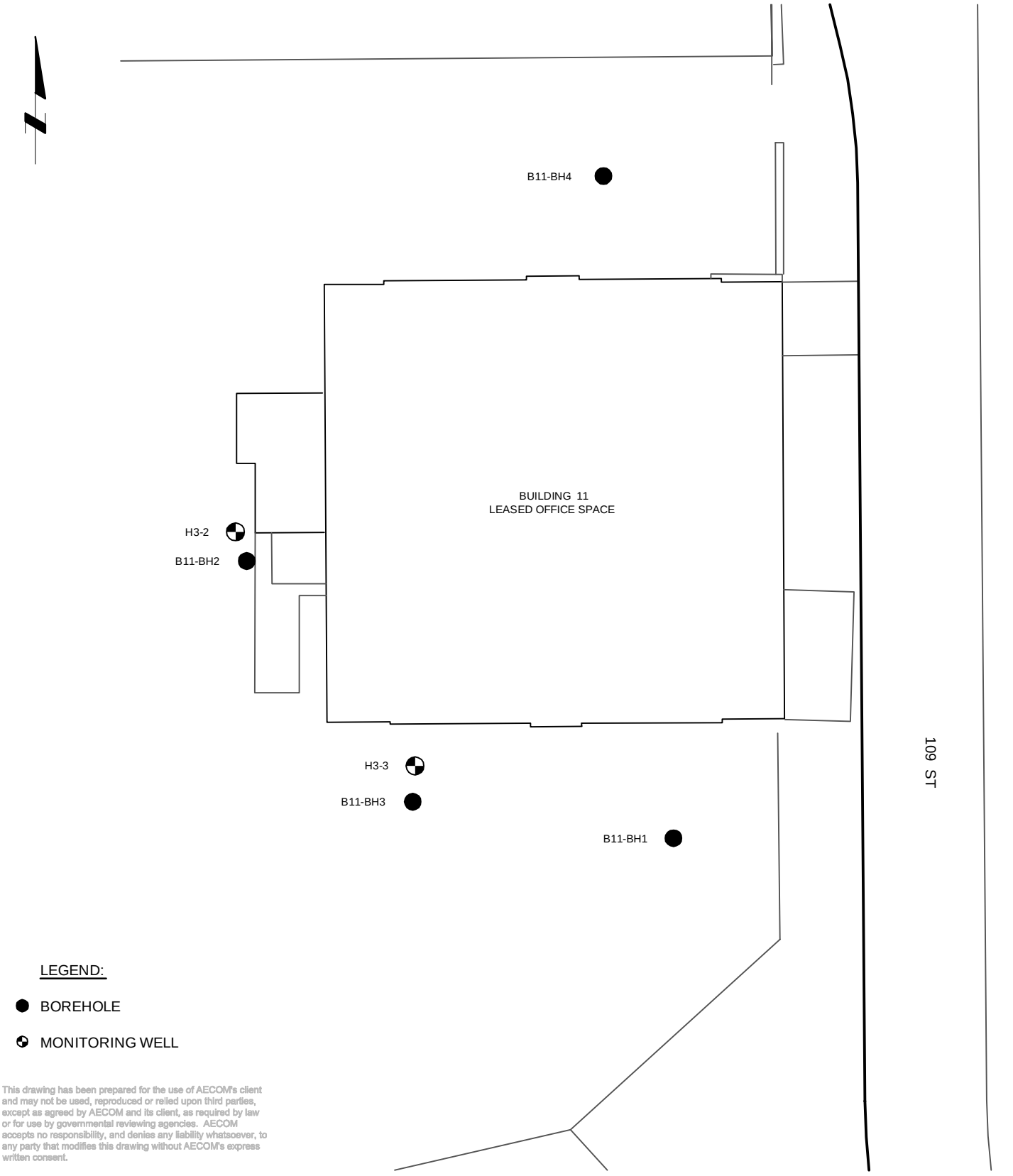

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City of Edmonton

Edmonton City Centre Airport, Edmonton, AB

Phase II ESA

Borehole & Monitoring Well Site Plan

August, 2010

Figure 8

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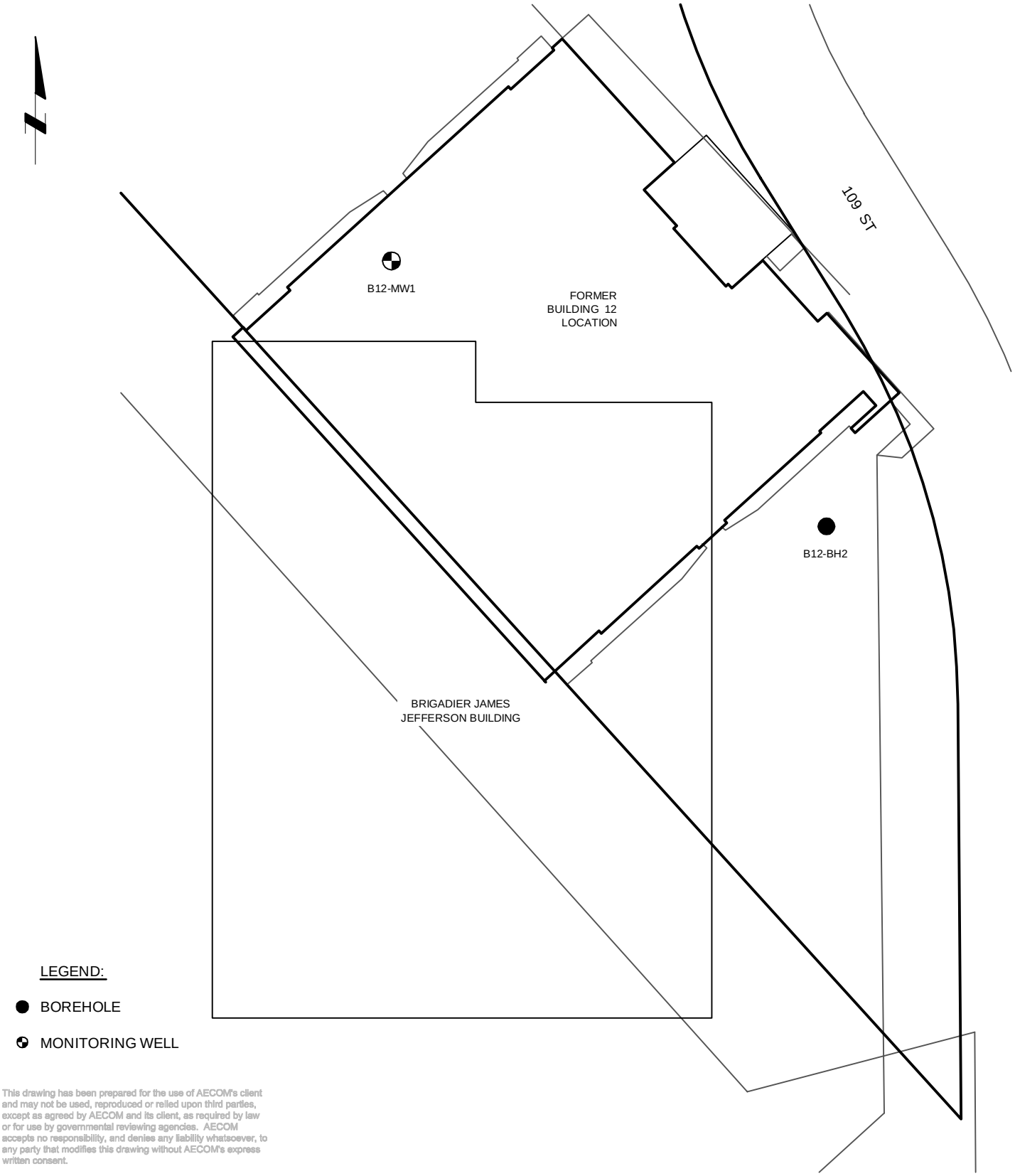

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Phase II ESA

Borehole & Monitoring Well Site Plan

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Figure 9

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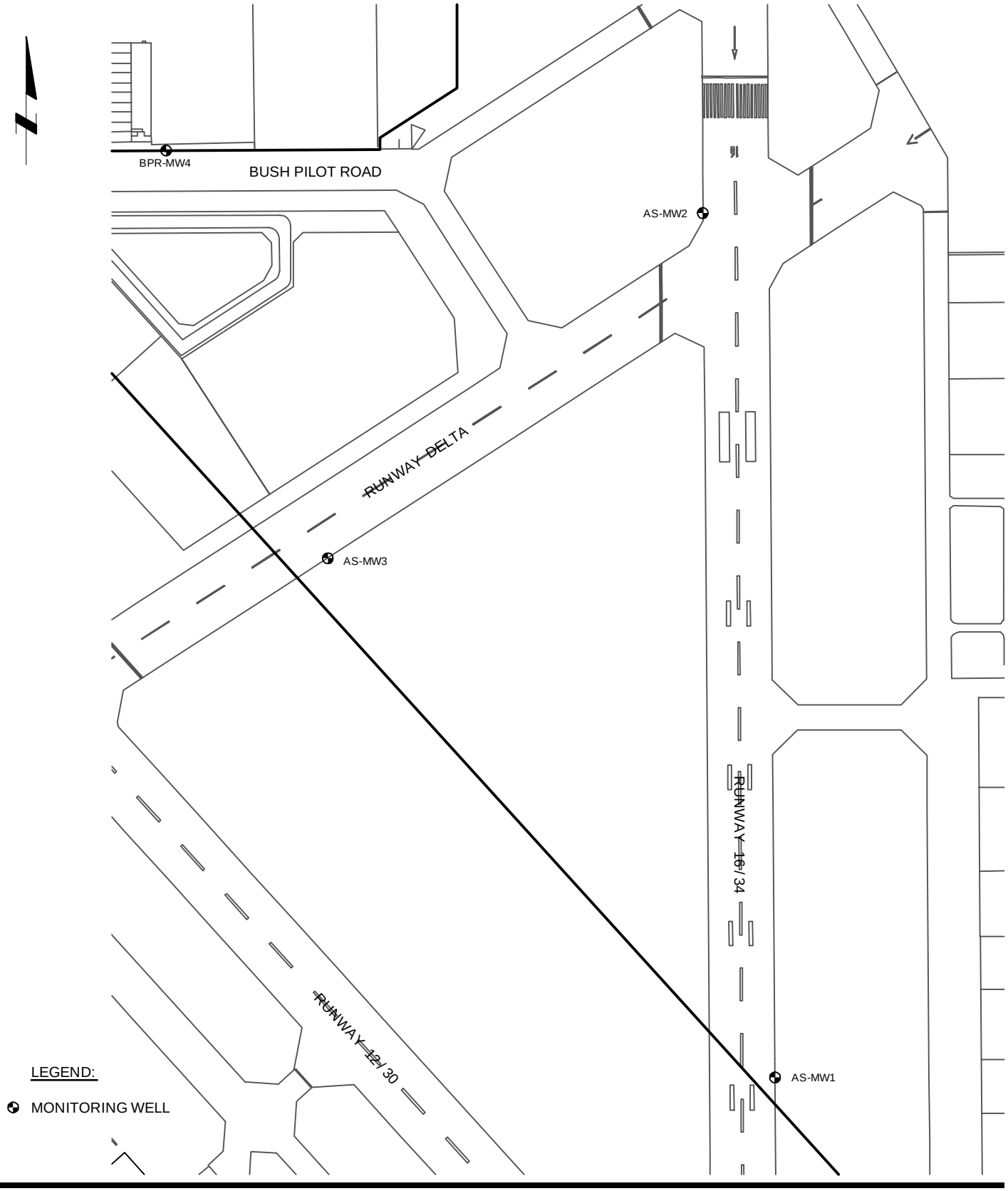

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City of Edmonton

Edmonton City Centre Airport, Edmonton, AB

Phase II ESA

Monitoring Well Site Plan

August, 2010

Figure 10

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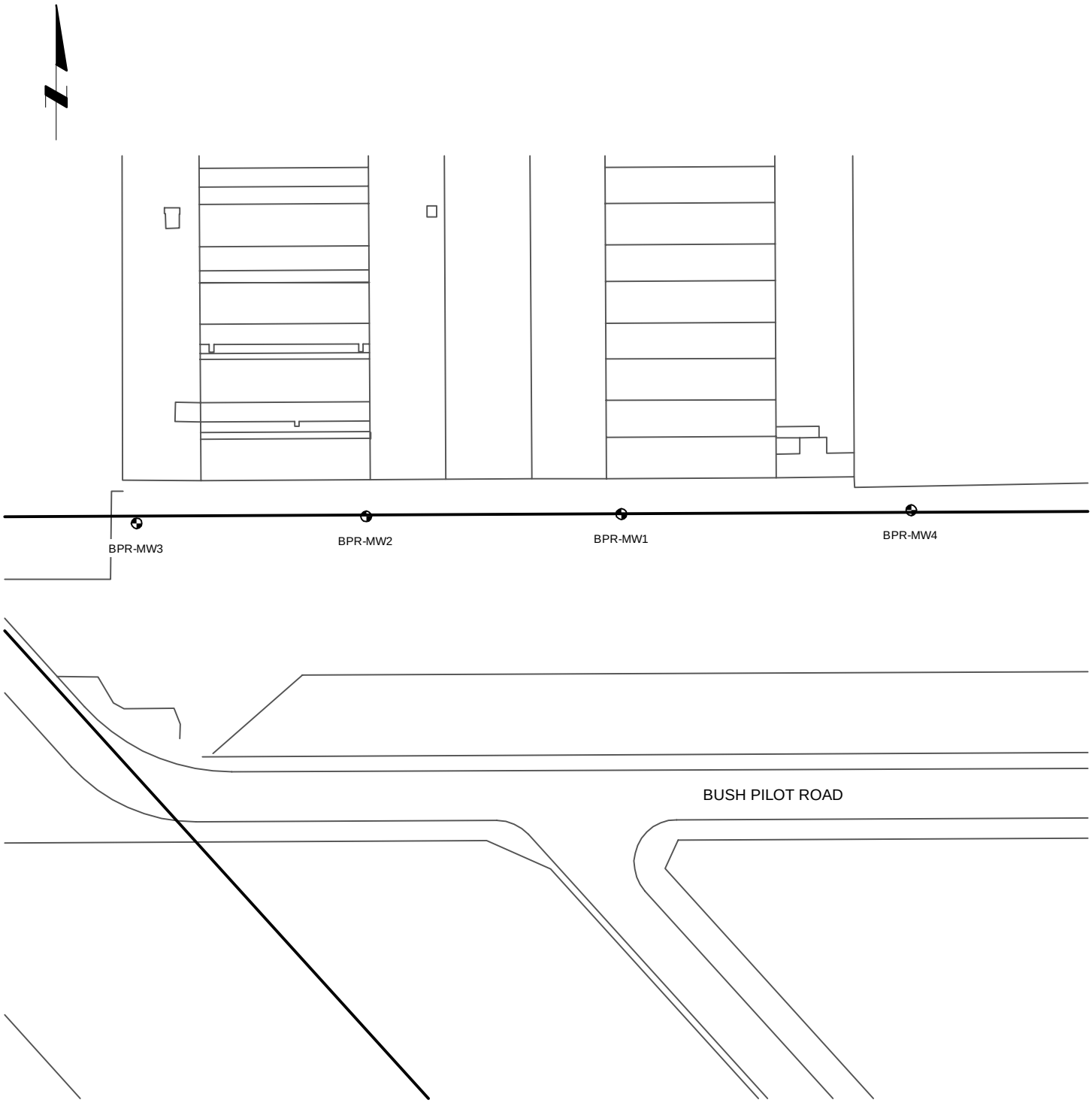

LEGEND:

MONITORING WELL

SCALE: NTS

City of Edmonton

Edmonton City Centre Airport, Edmonton, AB

Phase II ESA

Monitoring Well Site Plan

August, 2010

Figure 11

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