

# 2014 Supplementary Report on Soil and Groundwater Results for the Recreation Area Sewage Lagoon and the Administration Area Sewage Lagoon at Elk Island National Park, Alberta

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## EXECUTIVE SUMMARY

This report is a continuation of the Phase II Environmental Site Assessment (ESA) of the Recreation Area Sewage Lagoon and the Administration Area Sewage Lagoon that was conducted by ESG in November 2013. The Phase II ESA included results from sediment and surface water samples collected from inside the lagoons and from the wetlands adjacent to the lagoons. This supplemental report includes the results from soil and groundwater samples collected from monitoring wells located upgradient and downgradient of the lagoons. Soil samples were collected in March 2014, and groundwater samples were collected in April and May 2014.

Soil and groundwater samples were analyzed for inorganic elements, pesticides and polycyclic aromatic hydrocarbons (PAHs) at both lagoons, and volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene and xylenes (BTEX) at the Administration Area Sewage Lagoon only.

At the Recreation Area Sewage Lagoon all soil samples results were below the CCME soil quality guidelines (SQGs) for all parameters. Groundwater results were below the Federal Interim Groundwater Quality Guidelines (FIGQG) for pesticides. Results in groundwater were above the FIGQG for three PAHs in the April groundwater results, and for 20 inorganic elements in the April and May groundwater results. The soil and groundwater results were used to update the National Classification System for Contaminated Sites (NCSCS) scoring for the Rec Lagoon resulting in a total NCSCS score of 68.8, a site classification of 2 and a certainty percentage of 75%.

At the Administration Area Sewage Lagoon results from soil samples were below the SQGs for pesticides, PAHs, BTEX, and VOCs, and inorganic elements with the exception of one surface sample at the upgradient monitoring well which exceeded the SQG for selenium. Groundwater results were below the FIGQG for PAHs, BTEX and VOCs, but exceeded the FIGQG for 19 inorganic elements. The soil and groundwater results were used to update the NCSCS scoring for the Admin Lagoon resulting in a total NCSCS score of 79.3, a site classification of 1 and a certainty percentage of 69%.

Exceedances of guideline values for inorganic elements were observed in upgradient and downgradient wells at both lagoons. There are several possible explanations for these observed results. One possible explanation is that the exceedances are due to the presence of a naturally occurring and/or anthropogenic source of elevated inorganic elements upgradient of both lagoons. A second possible explanation is that



lagoon effluent is seeping out from the walls of the lagoon which may have deteriorated. The third possible explanation is a combination of both these possible causes.

Based on the result of the Phase II investigationn ESG recommends the following additional assessment activities be undertaken to establish the impact of the wetland on surrounding groundwater and adjacent wetlands:

- Conduct a background sampling program upgradient of the two lagoons to determine if there is a naturally elevated upgradient source of inorganic elements to the groundwater.
- Continue sampling for PAHs at the Rec Lagoon to determine if PAHs should be retained as a CoC
- Conduct sediment and surface water sampling in the wetlands and along the flow path as detailed in the Phase II ESA report.
- If available, soil samples from the installation of the engineering wells in the lagoon berms are , should be analyzed for CoCs to establish if lagoon effluent is seeping out from the lagoon
- Boron and sulfur were above the applicable guidelines for sediment and should be included as part of the analytical suite in future soil and sediment analyses.



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## GLOSSARY AND LIST OF ABBREVIATIONS

BTEX	benzene, toluene, ethylbenzene and xylenes
CCME	Canadian Council of Ministers of the Environment
CWS	Canada Wide Standards
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
ESA	environmental site assessment
FIGQG	Federal Interim Groundwater Quality Guidelines
INS	insufficient information
NCSCS	National Classification System for Contaminated Sites
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PHC	petroleum hydrocarbon
SQGs	Soil Quality Guidelines (CCME)
VOC	volatile organic compound

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## **I. INTRODUCTION**

This report is a supplement to the report on the Phase II environmental site assessment (ESA) of the Recreation Area Sewage Lagoon (Rec Lagoon) and the Administration Area Sewage Lagoon (Admin Lagoon) at Elk Island National Park, written by the Environmental Sciences Group (ESG) in 2014 (ESG 2014). The Phase II ESA report detailed the results of the sediment and surface water sampling conducted in October and November 2013. The National Classification System for Contaminated Sites (NCSCS) scoring matrix was also provided in the Phase II report. The supplementary report is intended to detail the results of the groundwater and soil borehole sampling and provide an update of the NCSCS score for both lagoons using the new data.

## **II. PROGRAM DETAILS**

Four monitoring wells were installed at each lagoon. One well was installed upgradient from each of the lagoons and three were installed downgradient from the lagoons. Monitoring wells were installed by Thurber Environmental in March 2014. During installation, soil samples were collected from the boreholes at regular intervals (approximately every 75 cm), and two samples from each borehole were submitted for analysis.

Groundwater samples were collected from the newly installed monitoring wells on April 22–23 and again on May 21–22 and were submitted for analysis.

Additionally, wells were installed by a separate organization as part of an engineering assessment of the integrity of the berms surrounding the lagoons. The wells from the engineering work that were used as part of this report include: three wells in the berms at the Rec Lagoon and four wells in the berms at the Admin Lagoon. Groundwater samples were also collected from these wells if sufficient water was present.

Parameters for analysis were based on the contaminants present in the sediment and surface water at each lagoon. For the Rec Lagoon, soil and groundwater samples were analyzed for inorganic elements, pesticides and polycyclic aromatic hydrocarbons (PAHs). The groundwater at the Rec Lagoon was also analyzed for petroleum hydrocarbons (PHCs). Soil and groundwater samples from the Admin Lagoon were analyzed for the same parameters as well as for volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene and xylenes (BTEX).



### III. APPLICABLE GUIDELINES

As the site is on federal land, federal guidelines have been applied when available. Province of Alberta guidelines are also provided for reference or if there are no federal guidelines for a parameter. The applicable soil guidelines are

- Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines (SQGs) (CCME 1999)
- Alberta Tier 1 Soil Remediation Guidelines (Alberta 2010).

The applicable groundwater guidelines are

- Federal Interim Groundwater Quality Guidelines (FIGQG) (EC 2012)
- Alberta Tier 1 Groundwater Remediation Guidelines (Alberta 2010)

The guidelines are developed on the basis of land use. The Agricultural land use was used in evaluating contaminant concentrations in soil and groundwater. Agricultural land use, by definition, includes habitat for wildlife and native flora, such as national parks. Alberta Tier 1 guidelines for Natural Areas land use were used to evaluate results if there were no applicable federal guidelines. The Natural Areas land use classification, by definition, includes provincial and national parks.

The FIGWQG and Alberta Tier I soil and groundwater guidelines are also presented for two soil types: fine soils, which consist of clays and silts, and coarse soils, which consist of gravels and sands. If the mean particle size is greater than 75  $\mu\text{m}$ , the soil is classified as coarse; if it is less than 75  $\mu\text{m}$ , the soil is considered fine-grained. The soil particle size has not been tested for the site, but previous work completed in the area, including monitoring well installation, has described the soil as clay, silt and some sand; as a result, the guidelines for fine-grained soil are used for this report.

The Alberta soil and groundwater remediation guidelines were updated in 2014. However, the requirement to use the updated guidelines does not take effect until December 1, 2014. As the results included in this report build on the Phase II ESA completed using the 2010 guidelines, the 2010 Alberta guidelines were used for the evaluation of the results in this report.

It should be noted that the detection limits of a number of parameters in soil and groundwater were higher than the guideline values. The results with detection limits above the guidelines could not be evaluated for exceedances of the guidelines.



## **IV. RECREATION AREA SEWAGE LAGOON RESULTS**

Four monitoring wells were installed at the Rec Lagoon for the purposes of soil and groundwater assessment. MW01 was installed upgradient from the lagoon MW02 and MW03 were installed downgradient from the lagoon and MW04 was installed downgradient from the lagoon and also from the wetland into which the lagoon discharges (Appendix A, Map A-1).

Three wells (TH14-03, -04 and -05) were installed in the berms as part of an engineering assessment. TH14-04 is on the upgradient berm and TH14-03 and -05 are on downgradient berms (Appendix A, Map A-1).

### **A. Soil Results**

Two soil samples from various depths from each of the four monitoring well boreholes (MW01 to MW04) were analyzed for inorganic elements, pesticides, and PAHs. All results were below the CCME SQGs (Appendix B, Tables B-1 to B-3). Note that the detection limit for total endosulfan was higher than the guideline value.

### **B. Groundwater Results**

Six groundwater samples from the four monitoring wells, and two of the engineering assessment wells TH14-03 and TH14-05 were analyzed in the April sampling event. Five groundwater samples were collected and analyzed in the May event as TH14-05 had insufficient water for sample collection.

Results exceeded the FIGQG for aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, titanium, uranium, vanadium and/or zinc (Appendix B, Table B-4). The exceedances were present in only some of the wells, in the case of barium and beryllium, while other exceedances were present in all the wells, as for aluminium, cadmium, copper, manganese and zinc. Many of the inorganic element exceedances were observed at both upgradient and downgradient monitoring wells.

In the PAH analysis, results for anthracene and naphthalene in the sample from the upgradient MW01 collected during the April sampling event were above the FIGQG. Pyrene results were above the guideline for samples collected from MW01 and TH14-03 during the April sampling event. Results for all other PAH compounds were below the guidelines for samples collected during the April sampling event, and all PAH results



were below the guidelines for samples collected during the May sampling event (Appendix B, Table B-5).

PHC and pesticide results were below the respective guidelines for samples from both sampling events (Appendix B, Tables B-6 and B-7). Note that the detection limit for mercury, DDT and acridine were above the guideline values.

### **C. Updated NCSCS Scoring**

The NCSCS scoring conducted for the Phase II assessment for the Rec. Lagoon resulted in a total score of 69.5 but a classification of INS (insufficient information). On the basis of the soil and groundwater results, the scoring for the Rec Lagoon was updated. The Rec Lagoon is now scored with a site letter grade of D, a total NCSCS score of 68.8, a site classification of 2 and a certainty percentage of 75%. The updated NCSCS scoring may be found in Appendix C.

### **D. Recreation Area Sewage Lagoon Summary**

All soil results were below guideline values. However, groundwater results indicated exceedances of the FIGQG for 20 inorganic elements and three PAHs, and the inorganic element exceedances were observed in both up and downgradient wells. PAHs were only above guideline values in the April sampling event. Additional samples should be collected to determine if the PAHs were a one-time occurrence or are the result of seepage from the lagoon.

The inorganic element results are confounding, because there are a number of possible explanations for the presence of elevated levels of inorganic elements upgradient and downgradient from the lagoon. One possible explanation is that the berms are ineffective at preventing seepage out of the lagoon on all sides and consequently the contaminants are moving into the groundwater from all areas of the lagoon. Seepage from the lagoon could also explain the above guideline PAH results. Another possibility is that some of the inorganic element exceedances are due to elevated concentrations of these elements from an upgradient source, either naturally elevated or an anthropogenic input, in the groundwater. The differences in the inorganic elements above guideline values in surface water and sediment inside of the lagoon from the 2013 results versus in the inorganic elements in the groundwater around the lagoon in the 2014 results support the supposition of an upgradient source. A third possible explanation for elevated inorganic



element concentrations in the groundwater is a combination of seepage through the berms and high naturally occurring element levels.

The updated NCSCS scoring was conducted conservatively, on the assumption that the elevated groundwater contaminant levels resulted from contamination seeping out of the lagoon, but a comment was added stating that the observed inorganic element concentrations in groundwater could be indicative of naturally elevated background levels of these elements.

To determine whether the groundwater inorganic element results are from an anthropogenic or naturally occurring source upgradient it is recommended that a background groundwater sampling program be conducted upgradient from the lagoon.

The results of the sediment, surface water, soil and groundwater sample analyses suggest that seepage from the Recreation Area Sewage Lagoon has resulted in contamination of the adjacent wetland and possibly of the groundwater. Given the analytical results for soil downgradient from the wetland, it appears that contamination is limited to the wetland sediment and is not present in the soil. Additional sediment and surface water sampling should be conducted, as recommended in the Phase II ESA. If soil samples from the engineering assessment are available, analysis of those samples for inorganic elements and PAHs could assist with determining if seepage is occurring through the berms of the lagoon. For any additional soil or sediment sampling, boron and sulfur should be included in the analytical suite, as these two parameters were elevated in the sediment results but were not included in the analytical suite for the soil.

## **V. ADMINISTRATION AREA SEWAGE LAGOON RESULTS**

Four monitoring wells were installed at the Admin Lagoon. MW05 was installed upgradient from the lagoon, MW06 was installed downgradient from the lagoon, MW07 was installed downgradient from the lagoon but upgradient from the southern wetland and MW08 was installed downgradient from the lagoon and the southern wetland (Appendix A, Map A-2).

Four wells were also installed in the berms of the Admin Lagoon as part of the engineering assessment of the berms. TH14-08 was installed in the upgradient berm and TH14-09, -10 and -11 were installed in downgradient berms (Appendix A, Map A-2).



## **A. Soil Results**

The surface soil sample at upgradient monitoring well MW05 exceeded the CCME SQG for selenium (Appendix B, Table B-8). The selenium concentration in this sample was 1.2 mg/kg and the guideline is 1.0 mg/kg. The selenium concentration in the depth sample (5.25 m) from this sampling location was below the guideline.

All other results for inorganic elements, PAHs, VOCs, BTEX and pesticides were below the CCME SQGs (Appendix B, Tables B-9 to B-12). Note that the detection limit for total endosulfan was higher than the guideline value.

## **B. Groundwater Results**

Groundwater samples were collected and analyzed from all four monitoring wells and from TH14-09 and TH14-11 in April and again in May.

Results were above the FIGQG for 19 inorganic elements: aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, titanium, uranium, vanadium and/or zinc (Appendix B, Table B-13). The exceedances were present in only some of the wells, in the case of barium, cobalt and nickel, while other exceedances were present in all the wells, as for aluminium, arsenic, cadmium, copper, and zinc. It is notable that many of the exceedances were observed in samples from both the upgradient and the downgradient monitoring wells.

All results for PAHs, VOCs, BTEX, PHCs and pesticides were below the FIGQG (Appendix B, Tables B-14 to B-17). Note that the detection limits for mercury, DDT and acridine were above the guideline values.

## **C. NCSCS Updated Scoring**

The NCSCS scoring for the Admin Lagoon conducted for the Phase II ESA report resulted in a total score of 74.4, but with a classification of INS. On the basis of the new soil and groundwater results, the scoring for the Admin Lagoon was updated. The updated score is a site letter grade of D, with a total NCSCS score of 79.3, a site classification of 1 and a certainty percentage of 69% (Appendix C).



## **D. Administration Area Sewage Lagoon Summary**

One upgradient surface soil sample exceeded the SQG for selenium. All other soil results were below guideline values. As selenium is commonly present naturally in soil, and, as this result was only slightly above the guideline, it is likely that the selenium in this soil sample was naturally occurring.

Groundwater results exceeded the FIGQG for 19 inorganic elements. All results for VOCs, BTEX, PHCs, PAHs and pesticides were below guideline values. As is the case for the Rec Lagoon, it is possible that the elevated levels of inorganic elements are from an upgradient source in the groundwater, are present as a result of seepage from the lagoon, or are the result of a combination of the two. In the 2013, ESA, only nine inorganic elements exceeded the sediment or surface water guidelines; eight of those elements are among the 19 that exceeded guidelines in the 2014 groundwater sampling (there is no groundwater guideline for the ninth, tin). These differences in the inorganic elements above guideline values in surface water and sediment inside of the lagoon versus in the groundwater around the lagoon support the supposition of an upgradient source.

The updated NCSCS scoring was conducted conservatively, on the assumption that the elevated groundwater inorganic element levels resulted from contamination seeping out of the lagoon, but a comment was added stating that the observed inorganic element concentrations in groundwater could be indicative of naturally elevated background levels of these elements.

To determine whether the groundwater inorganic element results are from an upgradient source (natural or anthropogenic) in the groundwater it is recommended that a background groundwater sampling program be conducted upgradient from the lagoon.

The sediment, surface water, soil and groundwater samples suggest that seepage from the Admin Lagoon has resulted in contamination to the wetland and possibly to the groundwater. Given the analytical results for soil downgradient from the wetland, it appears that contamination is limited to the wetland sediment and is not present in the soil. Additional sediment and surface water sampling should be conducted, as recommended in the Phase II ESA. For any additional soil or sediment sampling, boron and sulfur should be included in the analytical suite, as these two parameters were elevated in the sediment results but were not included in the analytical suite for the soil.



## VI. SUMMARY AND CONCLUSIONS

Overall, there is minimal soil contamination at the locations of the environmental monitoring wells at either lagoon. All results for pesticides, VOCs, BTEX were below guidelines in soil and groundwater at the two lagoons. PAHs results were below CCME SQGs in soil at both lagoons and below the FIGQG in the groundwater at the Admin Lagoon. There are inorganic elements at levels exceeding the FIGQG in groundwater at both lagoons, and PAHs at levels above the FIGQG in groundwater at the Rec Lagoon. Additional groundwater sampling should be conducted at the wells at the Rec Lagoon to determine if the PAH exceedances were a one-time occurrence or from seepage from the lagoon.

Possible causes of the elevated levels of inorganic elements in groundwater are the presence of elevated levels from a natural or anthropogenic source upgradient of the lagoons, seepage of contaminants from the lagoons through the berms, or a combination of these. Since the inorganic elements are similar in groundwater at both lagoons, but different from the sediment and surface water inorganic exceedances in the sediment and surface water inside the lagoons, it is possible the exceedances are from an upgradient source of inorganic elements, either natural or anthropogenic.

To determine whether the inorganic elements with elevated levels are from an upgradient anthropogenic or natural source in the groundwater, it is recommended that a background groundwater sampling program be conducted upgradient from the lagoons. If soils samples are available from the engineering assessment, analysis of those soils could assist with determining if seepage is occurring through the berms of the lagoons. For any additional soil or sediment sampling, boron and sulfur should be included in the analytical suite, as these two parameters were elevated in the sediment results but were not included in the analytical suite for the soil.



## VII. REFERENCES

Alberta Environment and Sustainable Resource Development (Alberta 2010). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. December 2010.

Canadian Council of Ministers of the Environment (CCME 1999). Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health. Winnipeg, MB.

Environment Canada (EC 2012). Federal Interim Groundwater Quality Guidelines. November 2012.

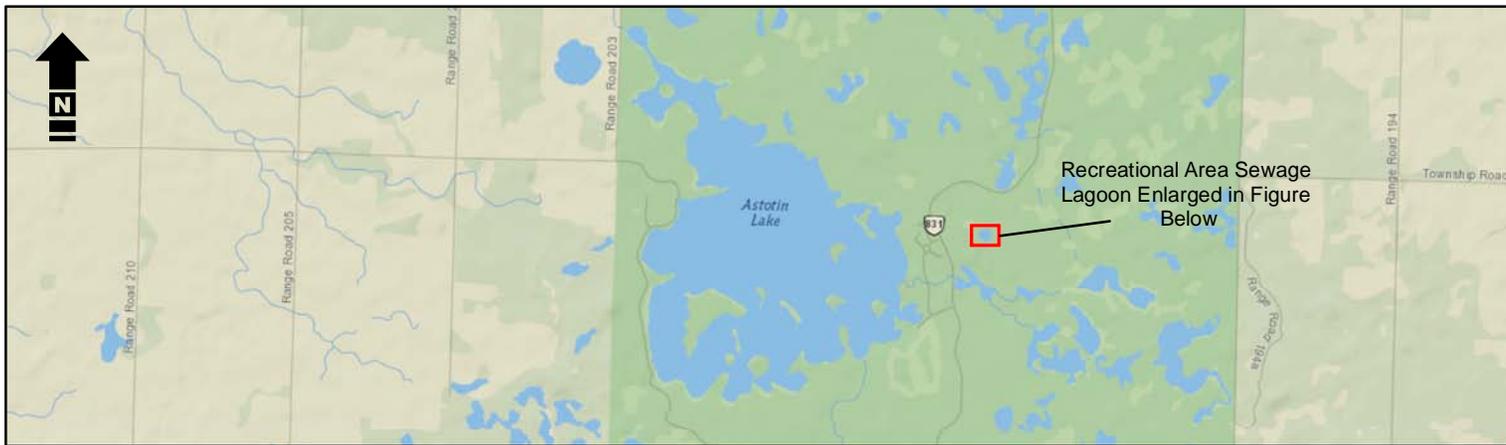
Environmental Sciences Group (ESG 2014). Phase II Environmental Site Assessment of the Recreation Area Sewage Lagoon and the Administration Area Sewage Lagoon at Elk Island National Park. March 2014.

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## APPENDIX A: MAPS OF WELL LOCATIONS

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## Map A-1: Elk Island National Park Recreation Area Sewage Lagoon 2014 Groundwater Well Locations

### LEGEND

- Discharge Outlet from Lagoon
- Grounwater Well - Installed March 26/2014
- Groundwater Well - Historic
- Control Structure
- Sewage Lagoon Perimeter
- Wetland

### NOTES:

Sewage Lagoon Perimeter was accurately surveyed using a differential global positioning system on October 26th 2013

### DATA RESOURCES

<b>Original Sources:</b> Government of Canada Environmental Sciences Group Parks Canada ESRI - ArcGIS Base Imagery	<b>Datum:</b> North American Datum 1983 (NAD83)
<b>Projection:</b> Universal Transverse Mercator (UTM) Zone 12N	<b>Software:</b> ESRI - ArcMAP 10.0
<b>File Path:</b> J:\Projects\Elk Island - Alberta\2014 ESR\IMXD\Map A-1 - Recreational Area Sewage Lagoon\Well Locations	<b>Published:</b> REVISED: June 24/2014 PRINTED: June 24/2014 Jeff Donald GIS Technician



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## Map A-2: Elk Island National Park Administration Area Sewage Lagoon 2014 Groundwater Well Locations

### LEGEND

- Discharge Outlet from Lagoon
- Grounwater Well - Installed March 26/2014
- Groundwater Well - Historic
- Control Structure
- Sewage Lagoon Perimeter
- Wetland

### NOTES:

Sewage Lagoon Perimeter was accurately surveyed using a differential global positioning system on October 26th 2013

### DATA RESOURCES

<b>Original Sources:</b> Government of Canada Environmental Sciences Group Parks Canada ESRI - ArcGIS Base Imagery	<b>Datum:</b> North American Datum 1983 (NAD83)
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<b>File Path:</b> J:\Projects\Elk Island - Alberta\2014 ESR\IMXD\Map A-2 - Administration Area Sewage Lagoon\Well Locations	<b>Published:</b> REVISED: June 24/2014 PRINTED: June 24/2014  Jeff Donald GIS Technician



PHOTO: Elk Island, Alberta PHOTO CREDIT: ALBERTAWOW.COM



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**APPENDIX B: DATA TABLES OF SOIL AND GROUNDWATER SAMPLE  
RESULTS**

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**Table B-1: Recreation Area Sewage Lagoon Soil Sample Inorganic Analytical Results**

Sample #	Location	Date	Depth (m)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Tin (Sn)	Uranium (U)	Vanadium (V)	Zinc (Zn)
				[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
<b>CCME Soil Quality Guidelines - Agricultural</b>				<b>20</b>	<b>12</b>	<b>750</b>	<b>4.0</b>	<b>1.4</b>	<b>64</b>	<b>40</b>	<b>63</b>	<b>70</b>	<b>6.6</b>	<b>5.0</b>	<b>50</b>	<b>1.0</b>	<b>20</b>	<b>1.0</b>	<b>5.0</b>	<b>23</b>	<b>130</b>	<b>200</b>
Alberta Tier I Soil Remediation Guidelines - Natural Areas, Fine Grain (2010)				20	17	750	5.0	3.8	64	20	63	70	12	4.0	50	1.0	20	1.0	5.0	33	130	200
<b>MW1 @ 0M</b>	Upgradient	2014/03/25	0	<1.0	4.4	81	0.48	<0.10	26	9.7	10	7.3	<0.050	0.99	18	<0.50	<1.0	<0.30	<1.0	<1.0	27	36
<b>MW1 @ 9M</b>	Upgradient	2014/03/25	9.00	<1.0	6.5	140	0.57	0.24	28	9.2	20	7.3	0.056	1.0	28	<0.50	<1.0	<0.30	<1.0	<1.0	28	57
<b>MW2 @ 0.75M</b>	NW Corner	2014/03/25	0.75	<1.0	6.8	150	0.66	<0.10	24	6.4	13	7.6	<0.050	0.90	21	<0.50	<1.0	<0.30	<1.0	<1.0	33	39
<b>MW2 @ 1.5M</b>	NW Corner	2014/03/25	1.5	<1.0	3.4	130	0.68	<0.10	26	8.0	12	7.8	0.051	<0.40	23	<0.50	<1.0	<0.30	<1.0	<1.0	33	30
<b>MW3 @ 2.5</b>	South Corner	2014/03/25	2.5	<1.0	7.3	170	0.75	0.34	28	9.4	21	9.9	<0.050	1.4	29	<0.50	<1.0	<0.30	<1.0	<1.0	38	62
<b>MW3 @ 3.5M</b>	South Corner	2014/03/25	3.5	<1.0	6.3	45	<0.40	<0.10	5.4	3.1	<5.0	2.1	<0.050	0.68	5.8	<0.50	<1.0	<0.30	<1.0	<1.0	8.6	13
<b>MW4 @ 0M</b>	South of wetland	2014/03/25	0	<1.0	4.0	85	0.46	<0.10	21	5.2	7.2	6.4	<0.050	0.53	13	<0.50	<1.0	<0.30	<1.0	<1.0	28	34
<b>MW4 @ 2M</b>	South of wetland	2014/03/25	2.0	<1.0	3.7	110	0.48	<0.10	22	4.4	12	7.1	<0.050	0.51	15	<0.50	<1.0	<0.30	<1.0	<1.0	26	46
<b>DUP B</b>	Control	2014/03/25		<1.0	5.9	51	<0.40	<0.10	7.2	3.5	<5.0	2.4	<0.050	0.70	6.8	<0.50	<1.0	<0.30	<1.0	<1.0	11	16
<b>MW4 @ 0.75M</b>	South of wetland	2014/03/25	0.75	<1.0	4.5	110	0.52	0.16	20	6.1	12	6.6	<0.050	0.62	20	<0.50	<1.0	<0.30	<1.0	<1.0	25	32

RDL = Reportable Detection Limit  
 ND = Not detected

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**Table B-2: Recreation Area Lagoon Soil Sample Polyaromatic Hydrocarbons (PAH) Analytical Results**

Sample #	Location	Date	Depth (cm)	Moisture (%)	Acenaphthene	Acenaphthylene	Acridine	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene equivalency	Benzo(b)fluoranthene	Benzo(c)phenanthrene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(ah)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	2-Methylnaphthalene	Naphthalene	Perylene	Phenanthrene	Pyrene	Quinoline
					[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
CCME Soil Quality Guidelines - Agricultural					NG	NG	NG	2.5	0.10	20	NG	0.10	NG	NG	NG	0.10	NG	0.10	50	NG	0.10	NG	0.013	NG	0.046	0.10	0.10
Alberta Tier 1 Soil Remediation Guidelines - Natural Areas, Fine Grain (2010)					0.32	5.0	NG	0.0046	0.070	0.60	0.60	6.2	NG	NG	NG	6.2	6.2	7.4	0.032	0.29	NG	NG	0.016	NG	0.051	0.034	NG
MW1 @ 0M	Upgradient	2014/03/25	0	11	<0.00050	<0.00050	<0.010	<0.00050	0.00057	0.00089	<0.10	0.0065	<0.0050	<0.0050	0.0031	0.00088	0.0014	<0.0010	0.0020	<0.00050	0.0024	<0.0050	<0.00050	0.017	0.0023	0.0026	<0.010
MW1 @ 9M	Upgradient	2014/03/25	9	18	<0.00050	<0.00050	<0.010	<0.00050	0.0016	0.0095	<0.10	0.020	<0.0050	0.011	0.0096	0.0033	0.0019	0.0015	0.0036	<0.00050	0.0077	<0.0050	<0.00050	0.17	0.0011	0.0071	<0.010
MW2 @ 0.75M	NW Corner	2014/03/25	.75	21	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	<0.0010	<0.0050	<0.0050	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	0.0011	<0.00050	<0.010
MW2 @ 1.5M	NW Corner	2014/03/25	1.5	20	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	<0.0010	<0.0050	<0.0050	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	<0.0050	<0.00050	<0.010
MW3 @ 2.5M	South Corner	2014/03/25	2.5	20	<0.00050	<0.00050	<0.010	<0.00050	0.00068	0.0011	<0.10	0.0088	<0.0050	0.0067	0.0062	0.0012	0.0019	0.0016	0.00074	<0.00050	0.0046	<0.0050	0.00065	0.018	0.0039	0.0015	<0.010
MW3 @ 3.5M	South Corner	2014/03/25	3.5	18	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	<0.0010	<0.0050	<0.0050	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	<0.0050	<0.00050	<0.010
MW4 @ 0M	South of wetland	2014/03/25	0	13	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	<0.0010	<0.0050	<0.0050	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	0.0014	<0.00050	<0.010
MW4 @ 2M	South of wetland	2014/03/25	2	18	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	0.0011	<0.0050	<0.0050	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	0.0013	<0.00050	<0.010
DUP B	Control	2014/03/25		18	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	<0.0010	<0.0050	<0.0050	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	<0.0050	<0.00050	<0.010
MW4 @ 0.75M	South of wetland	2014/03/25	0.75	19	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	<0.0010	<0.0050	<0.0050	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	0.0011	<0.00050	<0.010

NG - Non Given  
 \* Detection limits varied for some parameters due to varying moisture content in the sample:  
 (1) Detection limit raised due to matrix interference.

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Table B-3: Recreation Area Sewage Lagoon Soil Sample Pesticide Analytical Results

Sample #	Location	Date	Depth (cm)	aldrin	alpha-BHC*	beta-BHC	delta-BHC	DDD (Total) o,pDDD+p,pDDD	DDE (Total) o,p+p,p	DDT (Total) o,p+p,p	Total DDT's (Sum of DDD, DDE, DDT)	dieldrin*	endosulfan I	Endosulfan II	endosulfan sulfate	Total Endosulfan	endrin	endrin aldehyde	heptachlor	Heptachlor epox iso B "epoxide"	methoxychlor	chlordan	Heptachlor-Heptachlor epoxide	Total PCB	a-chordan	g-chordan	Lindane	Hexachlorobenzene	Endrin ketone	Mirex	Octachlorostyrene	Toxaphene			
				[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
CCME Soil Quality Guidelines - Agricultural				NG	NG	NG	NG	NG	NG	NG	0.70	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	
Alberta Tier I Soil Remediation Guidelines - Natural Areas, Fine Grain (2010)				5.9	NG	NG	NG	NG	NG	0.015	NG	0.011	NG	NG	NG	NG	0.0013	0.0075	NG	0.039	0.039	0.046	NG	0.039	1.3	NG	NG	0.31	NG	NG	NG	NG	NG	NG	3.3
JD6516\MW1 0M	Upgradient	2014/03/25	0	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0040	0.0060	0.010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6517\MW1 9M	Upgradient	2014/03/25	9	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6518\MW2 0.75M	NW Corner		0.75	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6519\MW2 1.5M	NW Corner	2014/03/25	1.50	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6520\MW3 2.5M	South Corner	2014/03/25	2.50	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6521\MW3 3.5M	South Corner		3.50	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6522\MW4 0M	South of wetland	2014/03/25	0	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6523\MW4 2M	South of wetland		2	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6533\DUP B	Control	2014/03/25		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		
JD6534\MW4 0.75M	South of wetland		0.75	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080		

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Table B-4: Recreation Area Sewage Lagoon Groundwater Sample Inorganic Analytical Results

Sample #	Location	Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulfur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	pH	Hardness	
			[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]
Federal Interim Groundwater Quality Guidelines-fine			0.1*	2	0.005	0.5	0.0053	0.5	0.00017	NG	0.0089	0.05	0.004**	0.3	0.007***	NG	NG	0.2	0.000026	0.073	0.15****	NG	NG	0.001	NG	0.0001	NG	NG	NG	0.0008	NG	0.1	0.01	0.1	0.01	6.5-9		
Alberta Tier I Groundwater Guidelines - Natural Area, fine grain (2010)			0.1*	0.006	0.005	1	NG	1.5	0.000097^	NG	0.05	NG	0.055	0.3	0.007***	NG	NG	0.05	0.000005	NG	0.15****	NG	NG	0.001	NG	0.0001	200	NG	NG	NG	0.0008	NG	0.1	0.01	0.1	0.01	6.5-8.5	
PMW-1	Upgradient	2014/04/22	0.70	0.0013	0.0027	0.093	<0.0010	0.17	0.00032	260	0.0048	0.01	0.016	3.0	0.0014	0.11	110	1.4	0.000012	0.0028	0.041	0.11	7.9	0.0022	9.5	0.00010	55	1.1	170	<0.00020	0.0016	0.021	0.026	0.0031	0.037	7.83	1100	
PMW-2	SW Downgradient	2014/04/22	43	<0.0060	0.040	0.79	<0.010	0.14	0.0030	270	0.096	0.07	0.12	120	0.048	0.10	92	7.8	0.00084	0.0039	0.20	3.0	8.6	<0.0020	74	<0.0010	24	0.8	36	<0.0020	<0.010	0.40	0.023	0.14	0.27	7.6	760	
PMW-3	South Downgradient	2014/04/22	100	<0.0060	0.33	2.0	<0.010	0.1	0.0029	320	0.23	0.18	0.25	470	0.12	0.16	140	7.2	<0.00050	0.012	0.43	13	20	0.0023	95	0.0015	35	0.63	19	<0.0020	<0.010	0.71	0.011	0.36	0.93	7.77	730	
PMW-4	South of Wetland	2014/04/22	11	<0.00060	0.011	0.35	<0.0010	0.057	0.00036	180	0.023	0.012	0.022	24	0.01	0.068	68	0.67	<0.00050	0.0018	0.035	0.66	4.5	0.00082	32	0.00013	22	0.56	42	<0.00020	<0.0010	0.27	0.0088	0.032	0.090	7.96	710	
TH14-03	SW Downgradient	2014/04/22	140	<0.0060	0.14	1.8	0.013	0.25	0.0077	920	0.37	0.18	0.5	310	0.17	0.27	220	6.2	0.0011	0.014	0.55	6.8	30	0.059	130	0.0019	53	1.8	38	0.0025	<0.010	1.7	0.038	0.48	1.1	7.95	740	
TH14-05	Between Lagoon & wetland	2014/04/22	12	0.0016	0.024	0.42	0.0017	0.15	0.0050	250	0.024	0.056	0.072	41	0.018	0.11	81	2.9	<0.00050	0.0043	0.16	1.3	10	0.006	28	0.00022	100	1.2	140	0.00033	0.0033	0.39	0.034	0.046	0.11	7.8	900	
PMW1	Upgradient	2014/05/22 13:10	11	0.00073	0.019	0.44	0.0010	0.21	0.0012	310	0.026	0.022	0.035	38	0.015	0.13	120	3.0	0.00018	0.0030	0.065	1.1	12	0.0019	30	0.00020	87	1.6	260	0.00041	0.0017	0.35	0.017	0.040	0.12			
PMW2	SW Downgradient	2014/05/22 14:20	6.6	<0.00060	0.0073	0.35	<0.0010	0.11	0.00034	190	0.014	0.021	0.021	17	0.0075	0.046	66	6.3	<0.00050	0.0013	0.064	0.50	3.1	0.00045	25	0.00012	18	0.69	8.1	<0.00020	0.0015	0.14	0.020	0.025	0.065			
PMW3	South Downgradient	2014/05/22 14:05	24	<0.00060	0.10	0.80	0.0024	0.061	0.00078	220	0.053	0.050	0.061	130	0.029	0.059	88	5.2	0.00082	0.0049	0.12	3.8	7.3	0.0013	64	0.00034	38	0.46	10	0.00048	0.0013	0.33	0.0035	0.092	0.23			
PMW4	South of Wetland	2014/05/22 13:45	3.7	<0.00060	0.0039	0.25	<0.0010	0.058	0.00018	160	0.0070	0.0048	0.0096	8.7	0.0039	0.065	62	0.34	<0.00050	0.0012	0.016	0.38	3.0	0.00047	21	<0.00010	23	0.54	11	<0.00020	<0.0010	0.11	0.0061	0.011	0.043			
TH 14-03	SW Downgradient	2014/05/22 14:30	3.3	<0.00060	0.0062	0.21	<0.0010	0.093	0.00017	200	0.0071	0.010	0.0095	8.2	0.0032	0.064	82	1.7	<0.00050	0.0031	0.028	0.11	8.5	0.0014	19	<0.00010	36	0.86	18	<0.00020	<0.0010	0.14	0.011	0.012	0.040			

\*Aluminum guideline is 0.005 mg/L if pH <6.5, and 0.1 mg/L if pH >6.5

\*\* Copper guideline is 0.004 mg/L for hardness > 180 mg/L

\*\*\*Lead guideline is 0.007 mg/L for hardness > 180 mg/L

\*\*\*\*Nickel guideline is 0.15 mg/L for hardness > 180 mg/L

^ Cadmium guideline is 0.000097 mg/L for hardness of 350 mg/L.

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**Table B-5: Recreation Area Sewage Lagoon Groundwater Sample PAHs Analytical Results**

Sample #	Location	Date	Acenaphthene	Acenaphthylene	Acridine	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(c)phenanthrene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Benzo(e)pyrene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indene(1,2,3-cd)pyrene	2-Methylnaphthalene	Naphthalene	Perylene	Phenanthrene	Pyrene	Quinoline
			[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]
Federal Interim Groundwater Quality Guidelines-fine grain			5.8	46	0.05	0.012	0.018	0.01	0.48	NG	0.21	0.48	NG	0.1	0.28	0.04	3	0.23	180	1.1	NG	0.4	0.025	3.4
Alberta Tier 1 Groundwater Guidelines - Natural Areas, fine grain (2010)			5.8	46	NG	0.012	0.018	0.017	0.48	NG	0.21	0.48	NG	1.4	0.28	0.04	3	0.23	NG	1.1	NG	0.4	0.025	NG
PMW-1	Upgradient	2014/04/22	<0.10	0.31	<0.20	<b>0.14</b>	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	0.021	0.17	<0.0085	0.61	<b>4.8</b>	<0.050	0.11	<b>0.026</b>	1.0
PMW-2	SW Downgradient	2014/04/22	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	0.017	<0.050	<0.0085	<0.1	<0.1	<0.050	0.074	<0.020	<0.20
PMW-3	South Downgradient	2014/04/22	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	0.012	<0.050	<0.0085	<0.1	<0.1	<0.050	0.059	<0.020	<0.20
PMW-4	South of Wetland	2014/04/22	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
TH14-03	SW Downgradient	2014/04/22	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<b>0.027</b>	<0.20
TH14-05	Between Lagoon & wetland	2014/04/22	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	0.010	<0.050	<0.0085	<0.1	0.16	<0.050	<0.050	<0.020	<0.20
PMW1	Upgradient	2014/05/22 13:10	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	0.018	<0.050	<0.0085	<0.1	<0.1	<0.050	0.057	0.023	<0.20
PMW2	SW Downgradient	2014/05/22 14:20	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
PMW3	South Downgradient	2014/05/22 14:05	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
PMW4	South of Wetland	2014/05/22 13:45	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
TH 14-03	SW Downgradient	2014/05/22 14:30	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
TH 14-05	Between Lagoon & wetland	2014/05/22 13:30	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	0.011	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20

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**Table B-6: Reception Area Sewage Lagoon Groundwater Sample Hydrocarbon Analytical Results**

Sample #	Location	Date	Benzene	Toluene	Ethylbenzene	o-Xylene	m+p-Xylene	Xylenes (Total)	PHC			
			[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C34-C50)
Federal Interim Groundwater Quality Guidelines-fine grain			0.088	4.9	3.2	NG	NG	13	6.5	1.8	NG	NG
Alberta Tier 1 Groundwater Guidelines - Natural Areas, fine grain (2010)			0.0050	0.024	0.0024	NG	NG	0.30	2.2	1.1	NG	NG
PMW-1	Upgradient	2014/04/22							0.10	<0.10	<0.20	<0.20
PMW-2	SW Downgradient	2014/04/22							<0.10	<0.10	<0.20	<0.20
PMW-3	South Downgradient	2014/04/22							<0.10	<0.10	<0.20	<0.20
PMW-4	South of Wetland	2014/04/22							<0.10	<0.10	<0.20	<0.20
TH14-03	SW Downgradient	2014/04/22							<0.10	<0.10	<0.20	<0.20
TH14-05	Between Lagoon & wetland	2014/04/22							<0.10	<0.10	<0.20	<0.20
PMW1	Upgradient	2014/05/22 13:10							<0.10	<0.10	<0.20	<0.20
PMW2	SW Downgradient	2014/05/22 14:20							<0.10	<0.20	<0.20	<0.20
PMW3	South Downgradient	2014/05/22 14:05							<0.10	<0.20	<0.20	<0.20
PMW4	South of Wetland	2014/05/22 13:45							<0.10	<0.20	<0.20	<0.20
TH 14-03	SW Downgradient	2014/05/22 14:30							<0.10	<0.10	<0.20	<0.20
TH 14-05	Between Lagoon & wetland	2014/05/22 13:30							<0.11	<0.27	<0.20	<0.20

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**Table B-7: Recreation Area Sewage Lagoon Groundwater Pesticide Analytical Results**

Sample #	Location	Date	DDT+Metabolites	o,p DDD+ p,p DDD	o,p DDE+ p,p DDE	o,p DDT + p,p DDT	o,p DDD	p,p DDD	o,p DDE	p,p DDE	o,p DDT	p,p DDT
			[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]
<b>Federal Interim Groundwater Quality Guidelines-fine grain, agricultural land use</b>			<b>0.0010</b>	<b>NG</b>	<b>NG</b>	<b>NG</b>	<b>NG</b>	<b>NG</b>	<b>NG</b>	<b>NG</b>	<b>NG</b>	<b>NG</b>
Alberta Tier 1 Groundwater Guidelines - Natural Areas, fine grain (2010)			0.0010	NG	NG	NG	NG	NG	NG	NG	NG	NG
PMW-1	Upgradient	22-Apr	<0.007	<0.007	<0.005	<0.005	<0.007	<0.005	<0.005	<0.005	<0.005	<0.005
PMW-2	SW Downgradient	22-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW-3	South Downgradient	22-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW-4	South of Wetland	22-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-03	SW Downgradient	22-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-05	Between Lagoon & wetland	22-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW1	Upgradient	22-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW2	SW Downgradient	22-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW3	South Downgradient	22-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW4	South of Wetland	22-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-03	SW Downgradient	22-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-05	Between Lagoon & wetland	22-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

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**Table B-8: Administration Area Sewage Lagoon Soil Sample Inorganic Analytical Results**

Sample #	Location	Date	Depth (m)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Tin (Sn)	Uranium (U)	Vanadium (V)	Zinc (Zn)
				[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
<b>CCME Soil Quality Guidelines - Agricultural</b>				<b>20</b>	<b>12</b>	<b>750</b>	<b>4.0</b>	<b>1.4</b>	<b>64</b>	<b>40</b>	<b>63</b>	<b>70</b>	<b>6.6</b>	<b>5.0</b>	<b>50</b>	<b>1.0</b>	<b>20</b>	<b>1.0</b>	<b>5.0</b>	<b>23</b>	<b>130</b>	<b>200</b>
Alberta Tier I Soil Remediation Guidelines - Natural Areas, Fine Grain (2010)				20	17	750	5.0	3.8	64	20	63	70	12	4.0	50	1.0	20	1.0	5.0	33	130	200
MW5 @ 0M	Upgradient	2014/03/24	0	<1.0	7.4	140	0.68	<0.10	30	7.6	18	11	<0.050	1.2	19	1.2	<1.0	<0.30	<1.0	<1.0	47	62
MW5 @ 5.25M	Upgradient	2014/03/24	5.25	<1.0	6.1	120	0.42	0.12	21	5.0	14	6.3	<0.050	1.1	18	<0.50	<1.0	<0.30	<1.0	<1.0	21	39
MW6 @ 0M	SW Side	2014/03/24	0	<1.0	7.5	110	0.62	<0.10	25	7.9	15	8.9	0.050	1.1	20	<0.50	<1.0	<0.30	<1.0	<1.0	35	49
MW6 @ 0.75M	SW Side	2014/03/24	0.75	<2.0	2.0	60	<0.80	<0.20	2.5	6.9	<10	<2.0	<0.10	1.1	8.7	<1.0	<2.0	<0.60	<2.0	2.5	4.5	37
MW7 @ 0M	SE Side	2014/03/24	0	<1.0	6.9	220	0.79	0.21	25	14	19	9.7	<0.050	0.82	27	0.90	<1.0	<0.30	<1.0	<1.0	34	75
MW7 @ 1.5M	SE Side	2014/03/24	1.5	<1.0	3.2	120	0.61	0.20	27	4.7	12	8.3	<0.050	0.48	18	<0.50	<1.0	<0.30	<1.0	<1.0	27	66
MW8 @ 0M	South of wetland	2014/03/24	0	<1.0	6.7	140	0.54	0.11	24	7.4	14	7.7	<0.050	1.1	23	<0.50	<1.0	<0.30	<1.0	<1.0	31	43
MW8 @ 1.5M	South of wetland	2014/03/24	1.50	<1.0	5.3	160	<0.40	0.24	15	7.2	12	6.6	<0.050	0.82	19	<0.50	<1.0	<0.30	<1.0	<1.0	21	45
DUP A	Control	2014/03/24		<1.0	5.9	110	0.51	<0.10	22	5.7	11	7.5	<0.050	0.99	18	<0.50	<1.0	<0.30	<1.0	<1.0	31	40

RDL = Reportable Detection Limit  
 ND = Not detected

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**Table B-9: Administration Area Lagoon Soil Sample Polyaromatic Hydrocarbons (PAH) Analytical Results**

Sample #	Location	Date	Depth (cm)	Moisture (%)	Acenaphthene	Acenaphthylene	Acridine	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene equivalency	Benzo(b)fluoranthene	Benzo(c)phenanthrene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(ab)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	2-Methylnaphthalene	Naphthalene	Perylene	Phenanthrene	Pyrene	Quinoline
					[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
CCME Soil Quality Guidelines - Agricultural					NG	NG	NG	2.5	0.10	20	NG	0.10	NG	NG	NG	0.10	NG	0.10	50	NG	0.10	NG	0.013	NG	0.046	0.10	0.10
Alberta Tier 1 Soil Remediation Guidelines - Natural Areas, Fine Grain (2014)					0.32	5.00	NG	0.0046	0.070	0.60	0.60	6.2	NG	NG	NG	6.2	6.2	7.4	0.032	0.29	NG	NG	0.016	NG	0.051	0.034	NG
MW5 @ 0M	Upgradient	2014/03/24	0	24	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	0.0025	<0.0050	<0.0050	<0.0010	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	0.0013	<0.00050	<0.010
MW5 @ 5.25M	Upgradient	2014/03/24	5.25	13	<0.00050	<0.00050	<0.010	<0.00050	0.0011	0.0040	<0.10	0.014	<0.0050	0.011	0.010	0.0019	0.0032	0.0020	0.0042	<0.00050	0.0066	<0.0050	<0.00050	0.083	0.0037	0.012	<0.010
MW6 @ 0M	SE corner	2014/03/24	0	29	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	0.0015	<0.0050	<0.0050	<0.0010	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	0.0010	<0.00050	<0.010
MW6 @ 0.75M	SE corner	2014/03/24	0.75	79	<0.0024	<0.0024	<0.047	<0.0024	<0.0024	<0.0024	<0.10	<0.0047	<0.024	<0.024	<0.0047	<0.0024	<0.0024	<0.0047	0.0093	<0.0040	<0.0047	<0.024	0.0061	<0.024	0.019	0.0061	<0.047
MW7 @ 0M	SW corner	2014/03/24	0	30	<0.00050	<0.00050	<0.010	0.0012	<0.00050	<0.00050	<0.10	0.0013	<0.0050	<0.0050	<0.0010	<0.00050	0.00094	<0.0010	0.0011	<0.00050	<0.0010	<0.0050	0.00090	<0.0050	0.0025	0.0010	<0.010
MW7 @ 1.5M	SW corner	2014/03/24	1.5	32	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	<0.00050	<0.10	<0.0010	<0.0050	<0.0050	<0.0010	<0.00050	<0.00050	<0.0010	0.00095	<0.00050	<0.0010	<0.0050	<0.00050	<0.0050	0.0013	0.00097	<0.010
MW8 @ 0M	South wetland	2014/03/24	0	20	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	0.00063	<0.10	0.0029	<0.0050	<0.0050	0.0017	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	0.0016	<0.0050	<0.00050	0.0095	0.0015	<0.00050	<0.010
MW8 @ 1.5M	South wetland	2014/03/24	1.5	18	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	0.00076	<0.10	0.0034	<0.0050	<0.0050	0.0020	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	0.0018	<0.0050	0.00062	0.012	0.0014	<0.00050	<0.010
DUP A	Control	2014/03/24		18	<0.00050	<0.00050	<0.010	<0.00050	<0.00050	0.00082	<0.10	0.0039	<0.0050	<0.0050	0.0023	0.00061	0.00066	<0.0010	<0.00050	<0.00050	0.0020	<0.0050	0.00077	0.013	0.0019	<0.00050	<0.010

NG - Non Given  
 \* Detection limits varied for some parameters due to varying moisture content in the sample:  
 (1) Detection limit raised due to matrix interference.

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Table B-10: Administration Area Sewage Lagoon Soil Sample VOC and BTEX Analytical Res

Sample #	Location	Date	Depth (cm)	Benzene	Toluene	Ethyl-benzene	o-Xylene	m-p-Xylene	Xylenes (Total)	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3,5-Trichlorobenzene	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon Tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dichloromethane (methylene chloride)	Methyl methacrylate	Methyl tert-butyl ether	Styrene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-Dichloropropene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride				
				[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
CCME Soil Quality Guidelines - Agricultural				0.0068	0.080	0.018	NG	NG	2.4	NG	0.10	0.10	0.10	0.10	0.10	0.050	0.050	NG	NG	0.10	0.10	0.10	0.10	0.1	NG	0.10	0.10	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.1	NG	NG	0.044	0.68	0.69	NG	NG	0.054	NG	NG	0.014	
Alberta Tier 1 Soil Remediation Guidelines - Natural Areas, Fine Grain (2010)				0.046	0.52	0.11	NG	NG	15	NG	NG	NG	NG	NG	0.15	0.26	0.78	NG	NG	0.097	0.025	NG	1.9	NG	NG	0.051	NG	NG	NG	NG	0.059	0.61	NG	NG	0.0029	NG	NG	NG	0.10	1.3	0.044	0.68	0.69	NG	NG	0.054	NG	NG	0.014		
MW5 @ 0M	Upgradient	2014/03/24	0	<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030		
MW5 @ 5.25M	Upgradient	2014/03/24	5.25	<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030		
MW6 @ 0M	SE corner	2014/03/24	0	<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030					
MW6 @ 0.75M	SE corner	2014/03/24	0.75	<0.025	<0.10	<0.050	<0.10	<0.20	<0.20	<0.50	<0.10	<0.025	<0.10	<0.10	<0.10	<0.20	<0.20	<2.5	<0.010	<0.10	<0.010	<0.10	<0.20	<2.5	<0.10	<0.10	<0.15	<0.25	<0.10	<0.0025	<0.0050	<0.10	<0.10	<0.0040	<0.15	<0.10	<0.10	<0.15	<0.20	<0.15	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.050	<0.10	<0.0015		
MW7 @ 0M	SW corner	2014/03/24	0	<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030				
MW7 @ 1.5M	SW corner	2014/03/24	1.5	<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030					
MW8 @ 0M	South wetland	2014/03/24	0	<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030					
MW8 @ 1.5M	South wetland	2014/03/24	1.5	<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030					
DUP A	Control	2014/03/24		<0.0050	<0.020	<0.010	<0.020	<0.040	<0.040	<0.10	<0.020	<0.050	<0.020	<0.020	<0.020	<0.040	<0.040	<0.50	<0.0020	<0.020	<0.0020	<0.020	<0.040	<0.50	<0.020	<0.020	<0.030	<0.050	<0.020	<0.00050	<0.0010	<0.020	<0.020	<0.00080	<0.030	<0.020	<0.020	<0.030	<0.040	<0.030	<0.020	<0.020	<0.020	<0.010	<0.020	<0.00030					

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Table B-11: Administration Area Sewage Lagoon Soil Sample Pesticide Analytical Results

Sample #	Location	Date	Depth (cm)	aldrin	alpha-BHC*	beta-BHC	delta-BHC	DDD (Total) o,p,DDD-p,p,DDD	DDE (Total) o,p-p,p	DDT (Total) o,p-p,p	Total DDTs (Sum of DDD, DDE, DDT)	dieldrin*	endosulfan I	Endosulfan II	endosulfan sulfate	Total Endosulfan	endrin	endrin aldehyde	heptachlor	Heptachlor epox iso B "epoxide"	methoxychlor	chlordan	Heptachlor-Heptachlor epoxide	Total PCB	a-chordan	g-chordan	Lindane	Hexachlorobenzene	Endrin ketone	Mirex	Octachlorostyrene	Toxaphene		
				[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
CCME Soil Quality Guidelines - Agricultural				NG	NG	NG	NG	NG	NG	NG	0.70	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	
Alberta Tier 1 Soil Remediation Guidelines - Natural Areas, Fine Grain (2010)				5.9	NG	NG	NG	NG	NG	0.015	NG	0.011	NG	NG	NG	NG	0.0013	0.0075	NG	0.039	0.039	0.046	NG	0.039	1.3	NG	NG	0.31	NG	NG	NG	NG	NG	3.3
JD6524\MW5 0M	Upgradient	2014/03/25	0	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080
JD6525\MW5 5.25M	Upgradient	2014/03/25	5.25	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080
JD6526\MW6 0M	SE corner	2014/03/25	0	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0080	<0.0030	<0.025	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.15
JD6527\MW6 0.75M	SE corner	2014/03/24	0.75	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.020	<0.0080	<0.0080	<0.060	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.35
JD6528\MW7 0M	SW corner	2014/03/24	0	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080
JD6529\MW7 1.5M	SW corner	2014/03/24	1.5	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080
JD6530\MW8 0M	South wetland	2014/03/24	0	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080
JD6531\MW8 1.5M	South wetland	2014/03/24	1.5	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080
JD6532\DUPLICATE A	Control			<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.015	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.080

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Table B-12: Administration Area Sewage Lagoon Groundwater Sample Inorganic Analytical Results

Sample #	Location	Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulfur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	pH	Hardness
			[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]
Federal Interim Groundwater Quality Guidelines- fine grain, agricultural			0.1*	2	0.005	0.5	0.0053	0.5	0.000017	NG	0.0089	0.05	0.004**	0.3	0.007***	NG	NG	0.2	0.000026	0.073	0.15****	NG	NG	0.001	NG	0.0001	NG	NG	NG	0.0008	NG	0.1	0.01	0.1	0.01	6.5-9	
Alberta Tier I Groundwater Quality Guidelines Natural Area Fine Grain			0.1*	0.006	0.005	1	NG	1.5	0.000097^	NG	0.05	NG	0.055	0.3	0.007***	NG	NG	0.05	0.000005	NG	0.15****	NG	NG	0.001	NG	0.0001	200	NG	NG	NG	NG	NG	0.02	NG	0.03	6.5-8.5	
PMW-5	Upgradient	2014/04/23	3.4	<0.00060	0.0083	0.15	<0.0010	0.20	0.00080	640	0.0067	0.017	0.011	13	0.0058	0.16	150	2.5	0.000054	0.0012	0.075	0.50	9.2	0.0016	15	0.00015	49	2.1	610	<0.00020	<0.0010	0.097	0.027	0.013	0.052	7.51	2200
PMW-6	SW Side	2014/04/23	17	0.00061	0.022	0.45	0.0016	0.14	0.0033	250	0.034	0.050	0.078	46	0.022	0.058	88	5.9	<0.00050	0.0032	0.19	1.5	8.5	0.0023	37	0.00039	75	0.79	140	0.00066	0.0033	0.23	0.012	0.058	0.18	7.62	730
PMW-7	SE Side	2014/04/22	82	<0.0060	0.068	1.4	<0.010	0.3	0.013	470	0.16	0.13	0.26	150	0.089	0.20	160	8.0	0.0010	0.0061	0.50	5.1	18	0.0066	97	0.0016	98	1.7	290	0.0031	<0.010	0.51	0.027	0.23	0.94	7.74	1500
PMW-8	S of Wetland	2014/04/23	8.8	0.001	0.022	0.36	<0.0010	0.18	0.0010	660	0.019	0.020	0.030	33	0.014	0.25	340	1.6	0.00011	0.0032	0.089	0.90	10	0.0031	23	0.00023	260	3	950	0.00029	0.0012	0.29	0.058	0.034	0.098	7.71	2900
TH14-09	SW Side	2014/04/23	68	<0.0060	0.16	4.1	<0.010	0.13	0.010	320	0.16	0.16	0.34	290	0.21	0.14	86	7.0	0.00089	0.0061	0.39	7.9	25	0.032	79	0.0021	35	0.93	11	<0.0020	<0.010	0.46	0.011	0.27	1	7.93	350
TH14-11	NE Side	2014/04/22	32	0.00077	0.058	0.95	0.0029	0.41	0.0030	460	0.074	0.07	0.12	77	0.042	0.25	160	3.4	<0.00050	0.0061	0.17	2.1	15	0.0042	55	0.00059	330	2.8	590	0.00054	0.0025	0.52	0.043	0.12	0.33	7.87	1600
PMW 5	Upgradient	2014/05/21 15:15	17	0.00090	0.040	0.74	0.0019	0.23	0.0013	640	0.045	0.037	0.055	76	0.031	0.21	170	2.5	0.00012	0.0040	0.10	2.0	13	0.0030	42	0.00041	51	2.6	560	0.00066	0.0014	0.39	0.038	0.066	0.19		
PMW 6	SW Side	2014/05/21 16:05	3.9	<0.00060	0.0095	0.22	<0.0010	0.13	0.0011	170	0.0082	0.019	0.019	21	0.0052	0.039	70	4.0	0.000081	0.0013	0.053	0.51	5.6	0.0010	17	0.00014	72	0.69	40	0.00023	<0.0010	0.084	0.0046	0.013	0.055		
PMW 7	SE Side	2014/05/21 16:55	4.6	<0.00060	0.0055	0.17	<0.0010	0.23	0.00082	330	0.0084	0.012	0.016	11	0.0047	0.10	120	4.2	<0.00050	0.00083	0.047	0.34	7.5	0.00067	18	0.00014	92	1.4	200	<0.00020	<0.0010	0.086	0.0065	0.014	0.076		
PMW 8	S of Wetland	2014/05/21 17:20	2.8	<0.00060	0.0079	0.18	<0.0010	0.20	0.00037	560	0.0061	0.0060	0.012	12	0.0046	0.27	350	0.56	0.000013	0.0017	0.034	0.42	8.4	0.0017	15	0.00014	260	3.4	820	<0.00020	<0.0010	0.11	0.058	0.011	0.049		
TH 14-09	SW Side	2014/05/21 15:45	8.8	0.00082	0.049	0.99	<0.0010	0.075	0.0010	130	0.018	0.017	0.039	61	0.023	0.042	40	3.3	0.000075	0.0029	0.041	1.3	13	0.0037	31	0.00021	44	0.55	12	0.00026	<0.0010	0.17	0.0017	0.036	0.13		
TH 14-11	NE Side	2014/05/21 14:30	1.4	<0.00060	0.021	0.061	<0.0010	0.39	0.00020	380	0.0027	0.011	0.0047	8.5	0.0017	0.22	130	1.4	0.0000075	0.0035	0.024	<0.10	9.2	0.00044	13	<0.00010	310	2.8	520	<0.00020	<0.0010	0.050	0.029	0.0063	0.037		

\*Aluminum guideline is 0.005 mg/L if pH <6.5, and 0.1 mg/L if pH >6.5  
 \*\* Copper guideline is 0.004 mg/L for hardness > 180 mg/L  
 \*\*\*Lead guideline is 0.007 mg/L for hardness > 180 mg/L  
 \*\*\*\*Nickel guideline is 0.15 mg/L for hardness > 180 mg/L  
 ^ Cadmium guideline is 0.000097 mg/L for hardness of 350 mg/L

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**Table B-13: Administration Area Sewage Lagoon Groundwater Sample PAHs Analytical Results**

Sample #	Location	Date	Acenaphthene	Acenaphthylene	Acridine	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(c)phenanthrene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Benzo(e)pyrene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	2-Methylnaphthalene	Naphthalene	Perylene	Phenanthrene	Pyrene	Quinoline
			[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]
Federal Interim Groundwater Quality Guidelines- fine grain			5.8	46	0.05	0.012	0.018	0.01	0.48	NG	0.21	0.48	NG	0.1	0.28	0.04	3	0.23	180	1.1	NG	0.4	0.025	3.4
Alberta Tier 1 Groundwater Guidelines - Natural Areas, fine grain (2010)			5.8	46	NG	0.012	0.018	0.017	0.48	NG	0.21	0.48	NG	1.4	0.28	0.04	3	0.23	NG	1.1	NG	0.4	0.025	NG
PMW-5	Upgradient	2014/04/23	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	0.014	<0.050	<0.0085	<0.1	<0.1	<0.050	0.052	<0.020	<0.20
PMW-6	SW Side	2014/04/23	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
PMW-7	SE Side	2014/04/22	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	0.021	<0.050	<0.0085	<0.1	<0.1	<0.050	0.10	0.020	<0.20
PMW-8	S of Wetland	2014/04/23	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
TH14-09	SW Side	2014/04/23	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
TH14-11	NE Side	2014/04/22	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
PMW 5	Upgradient	2014/05/21 15:15	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	0.010	<0.050	0.0090	<0.0085	<0.050	<0.0085	0.016	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
PMW 6	SW Side	2014/05/21 16:05	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
PMW 7	SE Side	2014/05/21 16:55	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
PMW 8	S of Wetland	2014/05/21 17:20	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
TH 14-09	SW Side	2014/05/21 15:45	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20
TH 14-11	NE Side	2014/05/21 14:30	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0075	<0.0085	<0.050	<0.0085	<0.0085	<0.050	<0.0085	<0.0075	<0.01	<0.050	<0.0085	<0.1	<0.1	<0.050	<0.050	<0.020	<0.20

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**Table B-14: Administration Area Sewage Lagoon Groundwater Sample Hydrocarbon Analytical Results**

Sample #	Location	Date	Benzene [mg/L]	Toluene [mg/L]	Ethyl- benzene [mg/L]	o-Xylene [mg/L]	m+p-Xylene [mg/L]	Xylenes (Total) [mg/L]	PHC			
									F1 (C6-C10) [mg/L]	F2 (C10-C16) [mg/L]	F3 (C16-C34) [mg/L]	F4 (C34- C50) [mg/L]
Federal Interim Groundwater Quality Guidelines-fine grain			0.088	4.9	3.2	NG	NG	13	6.5	1.8	NG	NG
Alberta Tier 1 Groundwater Guidelines - Natural Areas, fine grain (2010)			0.0050	0.024	0.0024	NG	NG	0.30	2.2	1.1	NG	NG
PMW-5	Upgradient	2014/04/23	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
PMW-6	SW Side	2014/04/23	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
PMW-7	SE Side	2014/04/22	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
PMW-8	S of Wetland	2014/04/23	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
TH14-09	SW Side	2014/04/23	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
TH14-11	NE Side	2014/04/22	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
PMW 5	Upgradient	2014/05/21 15:15	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
PMW 6	SW Side	2014/05/21 16:05	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
PMW 7	SE Side	2014/05/21 16:55	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
PMW 8	S of Wetland	2014/05/21 17:20	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
TH 14-09	SW Side	2014/05/21 15:45	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
TH 14-11	NE Side	2014/05/21 14:30	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20

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**Table B-16: Administration Area Sewage Lagoon Groundwater Pesticide Analytical Results**

Sample #	Location	Date	DDT+Metabolites	o,p DDD+ p,p DDD	o,p DDE+ p,p DDE	o,p DDT + p,p DDT	o,p DDD	p,p DDD	o,p DDE	p,p DDE	o,p DDT	p,p DDT
			[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]	[ug/L]
Federal Interim Groundwater Quality Guidelines-fine grain, agricultural land use			0.0010	NG	NG	NG	NG	NG	NG	NG	NG	NG
Alberta Tier 1 Groundwater Guidelines - Natural Areas, fine grain (2010)			0.0010	NG	NG	NG	NG	NG	NG	NG	NG	NG
PMW-5	Upgradient	23-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW-6	SW Side	23-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW-7	SE Side	22-Apr	<0.007	<0.007	<0.005	<0.005	<0.005	<0.007	<0.005	<0.005	<0.005	<0.005
PMW-8	S of Wetland	23-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-09	SW Side	23-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-11	NE Side	22-Apr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW5	Upgradient	21-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW6	SW Side	21-May-14	0.006	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	0.006
PMW7	SE Side	21-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PMW8	S of Wetland	21-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-09	SW Side	21-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TH14-11	NE Side	21-May-14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

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## APPENDIX C: NCSCS SCORING SPREADSHEETS

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**CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)  
Pre-Screening Checklist**

Question	Response (yes / no)	Comment
1. Are <b>Radioactive material, Bacterial contamination or Biological hazards</b> likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there <b>no contamination exceedances</b> (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards.	No	If yes (i.e., there are no exceedances), do not proceed through the NCSCS.
3. Have <b>partial/incompleted or no environmental site investigations</b> been conducted for the Site?	No	If yes, do not proceed through the NCSCS.
4. Is there direct and significant evidence of <b>impacts to humans</b> at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
5. Is there direct and significant evidence of <b>impacts to ecological receptors</b> at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant <b>adverse effects in the exposure zone</b> (i.e., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
7. Do measured concentrations of volatiles or unexploded ordnances represent an <b>explosion hazard</b> ?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, and do not continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on explosive hazards and measurement of lower explosive limits.

If none of the above applies, proceed with the NCSCS scoring.

**CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)  
Summary of Site Conditions**

<b>Subject Site:</b>	<b>Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park</b>	
Civic Address: <i>(or other description of location)</i>	Elk Island National Park, Fort Saskatchewan, AB T8G 2N7	
Site Common Name : <i>(if applicable)</i>	Astotin Lade Recreational Area Sewage Lagoon	
Site Owner or Custodian: <i>(Organization and Contact Person)</i>	Parks Canada Agency	
Legal description or metes and bounds:	Elk Island National Park	
Approximate Site area:	250 m x 150 m	
PID(s): <i>(or Parcel Identification Numbers [PIN] if untitled Crown land)</i>		
Centre of site: <i>(provide latitude/longitude or UTM coordinates)</i>	Latitude:	_____ degrees _____ min _____ secs
	Longitude:	_____ degrees _____ min _____ secs
Site Land Use:	UTM Coordinate:	Northing 5949592 Easting 379856
	Current:	National Park - Agricultural
	Proposed:	Agricultural
<b>Site Plan</b>	<b>To delineate the bounds of the Site a site plan MUST be attached. The plan must be drawn to scale indicating the boundaries in relation to well-defined reference points and/or legal descriptions. Delineation of the contamination should also be indicated on the site plan.</b>	
Provide a brief description of the Site:	<p>The recreational area sewage lagoon (Rec Lagoon) was constructed in 1964 and has not been upgraded or modified. The lagoon is a single cell design that can hold up to 22,000 m3 of contents. Dumping practices into the Rec Lagoon prior to 1995 are not fully known. Currently all of the washrooms and showers in the campground area are gravity fed to the nearby lift station and then pumped into the Rec Lagoon through the inlet pipe in the southwestern side of the lagoon. The Rec Lagoon also receives contents from the outhouses that are deposited by a vacuum truck into the north side of the lagoon. The outlet structure located on the east side of the lagoon consists of a system of three valves at various levels to control the discharge. However, the control structure is in poor repair and the middle valve is stuck in the open position. As a result, the lagoon discharges whenever the level in the lagoon is above the middle valve.</p> <p>The outlet of the discharge structure is located to the east of the lagoon and the discharge flows through the outlet, to a wetland located approximately 10 m away.</p> <p>PCA has requested a Phase II assessment of the environmental concerns with the lagoon and associated wetlands. The work in 2013 will build and expand upon the limited Phase II conducted in 2000/2001 (O'Connor, 2001).</p>	

**CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)**  
**Summary of Site Conditions**

Affected media and Contaminants of Potential Concern (COPC):	<p>Affected media includes sediment in the lagoon and wetland, and surface water in the lagoon and wetlands, and groundwater.</p> <p>COPC include inorganic elements (aluminum, arsenic, cadmium, chromium, lead, mercury, zinc), DDD, DDE, DDT, and PAHs.</p>
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Please fill in the "letter" that best describes the level of information available for the site being assessed

Site Letter Grade

If letter grade is F, do not continue, you must have a minimum of a Phase I Environmental Site Assessment or equivalent.

Scoring Completed By:	Shari Reed
Date Scoring Completed:	21-Jul-14

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CCME National Classification System (2008, 2010 v 1.2)

(I) Contaminant Characteristics

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
<b>1. Residency Media (replaces physical state)</b>				
Which of the following residency media are known (or strongly suspected) to have one or more exceedances of the applicable CCME guidelines? <b>yes</b> = has an exceedance or strongly suspected to have an exceedance <b>no</b> = does not have an exceedance or strongly suspected not to have an exceedance		All samples collected from the bottom of the lagoon and the wetlands are scored as sediment samples. Sediment exceedances include inorganic elements and pesticides (DDD, DDE, DDT). CCME guidelines were used where possible. However, if there was no CCME criterion for a parameter in sediment, the soil criterion was used instead.  Soil was sampled in March 2013 and there were no exceedances of the CCME SQGs.	The overall score is calculated by adding the individual scores from each residency media (having one or more exceedance of the most conservative media specific and land-use appropriate CCME guideline).  Summary tables of the Canadian Environmental Quality Guidelines for soil, water (aquatic life, non-potable groundwater environments, and agricultural water uses) and sediment are available on the CCME website at <a href="http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=124">http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=124</a> .  For potable groundwater environments, guidelines for Canadian Drinking Water Quality (for comparison with groundwater monitoring data) are available on the Health Canada website at <a href="http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html">http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html</a> .	An increasing number of residency media containing chemical exceedances often equates to a greater potential risk due to an increase in the number of potential exposure pathways.
A. Soil	No			
Yes No Do Not Know		Groundwater was sampled in April & May 2014. Exceedances of the Federal Interim Groundwater Quality Guidelines were observed for inorganic elements and PAHs. However, exceedances of many of the inorganic elements and the PAHs were present in both upgradient and downgradient wells making it difficult to ascertain if the lagoon effluents are the source of the observed exceedances; the exceedances could be natural due to local geological conditions or present from other sources.		
B. Groundwater	Yes			
Yes No Do Not Know				
C. Surface water	Yes			
Yes No Do Not Know		Surface water sample exceedances include Inorganic Elements & PAHs (x3).		
D. Sediment	Yes			
Yes No Do Not Know				
"Known" -score	6			
"Potential" - score	---			
<b>2. Chemical Hazard</b>				
What is the relative degree of chemical hazard of the contaminant in the list of hazard rankings proposed by the Federal Contaminated Sites Action Plan (FCSAP)?  High Medium Low Do Not Know	High	Multiple contaminants are in the High category in sediment and surface water: Arsenic, Cadmium, DDD, DDE, DDT, Mercury, Benzo(a)anthracene, and Benzo(a)pyrene.	The relative degree of chemical hazard should be selected based on the most hazardous contaminant known or suspected to be present at the site.  The degree of hazard has been defined by the Federal Contaminated Sites Action Plan (FCSAP) and a list of substances with their associated hazard (Low, Medium and High) has been provided as a separate sheet in this file.  <i>See Attached Reference Material for Contaminant Hazard Rankings.</i>	Hazard as defined in the revised NCS pertains to the physical properties of a chemical which can cause harm. Properties can include toxic potency, propensity to biomagnify, persistence in the environment, etc. Although there is some overlap between hazard and contaminant exceedance factor below, it will not be possible to derive contaminant exceedance factors for many substances which have a designated chemical hazard designation, but don't have a CCME guideline. The purpose of this category is to avoid missing a measure of toxic potential.
"Known" -score	8			
"Potential" - score	---			
<b>3. Contaminant Exceedance Factor</b>				
What is the ratio between the measured contaminant concentration and the applicable CCME guidelines (or other "standards")?  Mobile NAPL High (>100x) Medium (10x to 100x) Low (1x to 10x) Do Not Know	High (>100x)	DDD is 13x above ISQG  Groundwater: Al, Cd, Cu, Fe, Zn >100X FIGQG	Ranking of contaminant "exceedance" is determined by comparing contaminant concentrations with the <i>most conservative media-specific and land-use appropriate CCME</i> environmental quality guidelines. <b>Ranking should be based on contaminant with greatest exceedance of CCME guidelines.</b>  Ranking of contaminant hazard as high, medium and low is as follows: High = One or more measured contaminant concentration is greater than 100 X appropriate CCME guidelines Medium = One or more measured contaminant concentration is 10 - 99.99 X appropriate CCME guidelines Low = One or more measured contaminant concentration is 1 - 9.99 X appropriate CCME guidelines  Mobile NAPL = Contaminant is a non-aqueous phase liquid (i.e., due to its low solubility, it does not dissolve in water, but remains as a separate liquid) and is present at a sufficiently high saturation (i.e., greater than residual NAPL saturation) such that there is significant potential for mobility either downwards or laterally.  Other standards may include local background concentration or published toxicity benchmarks.  Results of toxicity testing with site samples can be used as an alternative. This approach is only relevant for contaminants that do not biomagnify in the food web, since toxicity tests would not indicate potential effects at higher trophic levels. High = lethality observed. Medium = no lethality, but sub lethal effects observed. Low = neither lethal nor sub lethal effects observed.	In the event that elevated levels of a material with no associated CCME guidelines are present, check provincial and USEPA environmental criteria.  Hazard Quotients (sometimes referred to as a screening quotient in risk assessments) refer to the ratio of measured concentration to the concentration believed to be the threshold for toxicity. A similar calculation is used here to determine the contaminant exceedance factor (CEF). Concentrations greater than one times the applicable CCME guideline (i.e., CEF=>1) indicate that risks are possible. Mobile NAPL has the highest associated score (8) because of its highly concentrated nature and potential for increase in the size of the impacted zone.
"Known" -score	6			
"Potential" - score	---			

CCME National Classification System (2008, 2010 v 1.2)

(I) Contaminant Characteristics

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
<b>4. Contaminant Quantity (known or strongly suspected)</b>				
What is the known or strongly suspected quantity of all contaminants?  >10 hectare (ha) or 5000 m <sup>3</sup> 2 to 10 ha or 1000 to 5000 m <sup>3</sup> <2 ha or 1000 m <sup>3</sup> Do Not Know	>10 hectare (ha) or 5000 m <sup>3</sup>	Minimum area if entire lagoon plus wetland is contaminated is: lagoon 125m x 105m = 13,125 m <sup>2</sup> east wetland 30m x 10m + 10 x 7 + 12 x 1 = 382m <sup>2</sup> Minimum depth of 0.5 = 6754 m <sup>3</sup> But boundaries are not defined so the area could be larger. As the minimum area is over 5000 m <sup>3</sup> , the area is scored in the highest category.	Measure or estimate the area or quantity of total contamination (i.e., all contaminants known or strongly suspected to be present on the site). The "Area of Contamination" is defined as the area or volume of contaminated media (soil, sediment, groundwater, surface water) exceeding appropriate environmental criteria.	A larger quantity of a potentially toxic substance can result in a larger frequency of exposure as well as a greater probability of migration, therefore, larger quantities of these substances earn a higher score.
"Known" -score	9			
"Potential" - score	---			
<b>5. Modifying Factors</b>				
Does the chemical fall in the class of persistent chemicals based on its behavior in the environment?  Yes No Do Not Know	Yes	DDE and DDT are persistent chemicals.	Persistent chemicals, e.g., PCBs, chlorinated pesticides etc. either do not degrade or take longer to degrade, and therefore may be available to cause effects for a longer period of time. Canadian Environmental Protection Act (CEPA) classifies a chemical as persistent when it has at least one of the following characteristics: (a) in air, (i) its half-life is equal to or greater than 2 days, or (ii) it is subject to atmospheric transport from its source to a remote area; (b) in water, its half-life is equal to or greater than 182 days; (c) in sediments, its half-life is equal to or greater than 365 days; or (d) in soil, its half-life is equal to or greater than 182 days.  This list does not include metals or metalloids, which in their elemental form do not degrade. However metals and metalloids form chemical species in the environment, many of which are not readily bioavailable.	<i>Examples of Persistent Substances are provided in attached Reference Materials</i>
Are there contaminants present that could cause damage to utilities and infrastructure, either now or in the future, given their location?  Yes No Do Not Know	No	Underground sewage main is constructed of asbestos cement which is resistant to the contamination present in the lagoon.		Some contaminants may react or absorb into underground utilities and infrastructure. For example, organic solvents may degrade some plastics, and salts could cause corrosion of metal.
How many different contaminant classes have representative CCME guideline exceedances?  one two to four five or more Do Not Know	two to four	3 classes: Inorganics, PAHs, Pesticides	For the purposes of the revised NCS ranking system, the following chemicals represent distinct chemical "classes": inorganic substances (including metals), volatile petroleum hydrocarbons, light extractable petroleum hydrocarbons, heavy extractable petroleum hydrocarbons, PAHs, phenolic substances, chlorinated hydrocarbons, halogenated methanes, phthalate esters, pesticides.	<i>Refer to the Reference Material sheet for a list of example substances that fall under the various chemical classes.</i>
"Known" - Score	4			
"Potential" - Score	---			

**Contaminant Characteristic Total**

Raw Total Scores- "Known"	33
Raw Total Scores- "Potential"	0
Raw Combined Total Scores	33
<b>Total Score (Raw Combined / 40 * 33)</b>	<b>27.2</b>

CCME National Classification System (2008, 2010 v 1.2)  
**(II) Migration Potential** (Evaluation of contaminant migration pathways)  
 Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes	
<b>1. Groundwater Movement</b>					
<b>A. Known COPC exceedances and an operable groundwater pathway within and/or beyond the property boundary.</b>					
i) For <b>potable groundwater environments</b> , 1) groundwater concentrations exceed background concentrations and 1X the Guideline for Canadian Drinking Water Quality (GCDWQ) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater contamination. For <b>non-potable environments</b> (typically urban environments with municipal services), 1) groundwater concentrations exceed 1X the applicable non-potable guidelines or modified generic guidelines (which exclude ingestion of drinking water pathway) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater impacts.  ii) Same as (i) except the information is not known but <b>strongly suspected</b> based on indirect observations.  iii) Meets GCDWQ for <b>potable environments</b> , meets non-potable criteria or modified generic criteria (excludes ingestion of drinking water pathway) for <b>non-potable environments</b> or Absence of groundwater exposure pathway (i.e., there is no aquifer (see definition at right) at the site or there is an adequate isolating layer between the aquifer and the contamination, and within 5 km of the site there are no aquatic receiving environments and the groundwater does not daylight).	12	Groundwater was sampled in April & May 2014. Groundwater exceeded the FIGQG for inorganic elements & PAHs.  However exceedances are present in both upgradient and downgradient wells for most parameters, therefore it is possible that parameters are naturally elevated.	Review chemical data and evaluate groundwater quality.  The evaluation method concentrates on 1) a potable or non-potable groundwater environment; 2) the groundwater flow system and its potential to be an exposure pathway to known or potential receptors  An aquifer is defined as a geologic unit that yields groundwater in usable quantities and drinking water quality. The aquifer can currently be used as a potable water supply or could have the potential for use in the future. Non-potable groundwater environments are defined as areas that are serviced with a reliable alternative water supply (most commonly provided in urban areas). The evaluation of a non-potable environment will be based on a site specific basis.  Physical evidence includes significant sheens, liquid phase contamination, or contaminant saturated soils.  Seeps and springs are considered part of the groundwater pathway.  In Arctic environments, the potability and evaluation of the seasonal active layer (above the permafrost) as a groundwater exposure pathway will be considered on a site-specific basis.	The 1992 NCS rationale evaluated the off-site migration as a regulatory issue. The exposure assessment and classification of hazards should be evaluated regardless of the property boundaries.  Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a groundwater supply source in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links.  Note that for potable groundwater that also daylight into a nearby surface water body, the more stringent guidelines for both drinking water and protection of aquatic life should be considered.  <b>Selected References</b> <b>Potable Environments</b> <a href="#">Guidelines for Canadian Drinking Water Quality: www.hc-sc.gc.ca/ewh-smmt/pubs/water-sau/doc_sup-appui/sum_guide-res_recom/index_e.html</a>  <b>Non-Potable Environments</b> Canadian Water Quality Guidelines for Protection of Aquatic Life. CCME. 1999 <a href="#">www.ccme.ca</a>  Compilation and Review of Canadian Remediation Guidelines, Standards and Regulations. Science Applications International Corporation (SAIC Canada), report to Environment Canada, January 4, 2002.	
	9				
	0				
	Score	12			
<b>NOTE: If a score is assigned here for Known COPC Exceedances, then you can skip Part B (Potential for groundwater pathway) and go to Section 2 (Surface Water Pathway)</b>					
<b>B. Potential for groundwater pathway.</b>					
a. Relative Mobility  High Moderate Low Insignificant Do Not Know		Known is scored	Organics Koc (L/kg)  Koc < 500 (i.e., log Koc < 2.7) Koc = 500 to 5000 (i.e., log Koc = 2.7 to 3.7) Koc = 5,000 to 100,000 (i.e., log Koc = 3.7 to 5) Koc > 100,000 (i.e., log Koc > 5)	Metals with higher mobility at acidic conditions pH < 5 pH = 5 to 6 pH > 6  Metals with higher mobility at alkaline conditions pH > 8.5 pH = 7.5 to 8.5 pH < 7.5	Reference: US EPA Soil Screening Guidance (Part 5 - Table 39)  If a score of zero is assigned for relative mobility, it is still recommended that the following sections on potential for groundwater pathway be evaluated and scored. Although the Koc of an individual contaminant may suggest that it will be relatively immobile, it is possible that, with complex mixtures, there could be enhanced mobility due to co-solvent effects. Therefore, the Koc cannot be relied on solely as a measure of mobility. An evaluation of other factors such as containment, thickness of confining layer, hydraulic conductivities and precipitation infiltration rate are still useful in predicting potential for groundwater migration, even if a contaminant is expected to have insignificant mobility based on its chemistry alone.
	Do Not Know	Score	2		
b. Presence of engineered sub-surface containment?  No containment Partial containment Full containment Do Not Know		Known is scored	Review the existing engineered systems or natural attenuation processes for the site and determine if full or partial containment is achieved.  Full containment is defined as an engineered system or natural attenuation processes, monitored as being effective, which provide for full capture and/or treatment of contaminants. All chemicals of concern must be contained for "Full Containment" scoring. Natural attenuation must have sufficient data, and reports cited with monitoring data to support steady state conditions and the attenuation processes. If there is no containment or insufficient natural attenuation process, this category is evaluated as high. If there is less than full containment or if uncertain, then evaluate as medium. In Arctic environments, permafrost will be evaluated, as appropriate, based on detailed evaluations, effectiveness and reliability to contain/control contaminant migration.	Someone experienced must provide a thorough description of the sources researched to determine the containment of the source at the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps, geotechnical reports or natural attenuation studies and other resources such as internet links.  <b>Selected Resources:</b> United States Environmental Protection Agency (USEPA) 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. EPA/600/R-98/128. Environment Canada – Ontario Region – Natural Attenuation Technical Assistance Bulletin (TABS) Number 19 –21.	
	Do Not Know	Score	1.5		
c. Thickness of confining layer over aquifer of concern or groundwater exposure pathway 3 m or less including no confining layer or discontinuous confining layer 3 to 10 m > 10 m Do Not Know		Known is scored	The term "confining layer" refers to geologic material with little or no permeability or hydraulic conductivity (such as unfractured clay); water does not pass through this layer or the rate of movement is extremely slow.  Measure the thickness and extent of materials that will impede the migration of contaminants to the groundwater exposure pathway. The evaluation of this category is based on: 1) The presence and thickness of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as drinking water sources or 2) The presence and thickness of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated zone (e.g., water table aquifer, first hydrostratigraphic unit or other groundwater pathway).		
	Do Not Know	Score	0.5		
d. Hydraulic conductivity of confining layer >10 <sup>-4</sup> cm/s or no confining layer 10 <sup>-4</sup> to 10 <sup>-5</sup> cm/s <10 <sup>-5</sup> cm/s Do Not Know		Known is scored	Determine the nature of geologic materials and estimate hydraulic conductivity from published material (or use "Range of Values of Hydraulic Conductivity and Permeability" figure in the Reference Material sheet). Unfractured clays should be scored low. Silts should be scored medium. Sand, gravel should be scored high. The evaluation of this category is based on: 1) The presence and hydraulic conductivity ("K") of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as a drinking water source, groundwater exposure pathway or 2) The presence and permeability ("k") of unsaturated subsurface materials that impede the vertical		

(II) Migration Potential (Evaluation of contaminant migration pathways)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
	Do Not Know			
Score	0.5		by the presence and permeability (i.e., infiltration) of subsurface materials that impede the vertical migration of contaminants from the source location to the saturated water table aquifer, first hydrostratigraphic unit or other groundwater pathway.	
<b>B. Potential for groundwater pathway.</b>				
e. Precipitation infiltration rate (Annual precipitation factor x surface soil relative permeability factor) High Moderate Low Very Low None Do Not Know	Do Not Know	Known is scored	<b>Precipitation</b> Refer to Environment Canada precipitation records for relevant areas. Divide annual precipitation by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score).  <b>Permeability</b> For surface soil relative permeability (i.e., infiltration) assume: gravel (1), sand (0.6), loam (0.3) and pavement or clay (0).  Multiply the surface soil relative permeability factor with precipitation factor to obtain the score for precipitation infiltration rate.	
Score	0.4			
f. Hydraulic conductivity of aquifer >10 <sup>-2</sup> cm/s 10 <sup>-2</sup> to 10 <sup>-4</sup> cm/s <10 <sup>-4</sup> cm/s Do Not Know	Do Not Know	Known is scored	Determine the nature of geologic materials and estimate hydraulic conductivity of all aquifers of concern from published material (refer to "Range of Values of Hydraulic Conductivity and Permeability" in the Reference Material sheet).	
Score	1			
Potential groundwater pathway total	5.9			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
<b>Groundwater pathway total</b>	<b>12</b>			
<b>2. Surface Water Movement</b>				
<b>A. Demonstrated migration of COPC in surface water above background conditions</b>				
Known concentrations of surface water:  i) Concentrations exceed background concentrations and exceed CCME CWQG for protection of aquatic life, irrigation, livestock water, and/or recreation (whichever uses are applicable at the site) by >1 X; or There is known contact of contaminants with surface water based on site observations. or In the absence of CWQG, chemicals have been proven to be toxic based on site specific testing (e.g. toxicity testing; or other indicator testing of exposure).  ii) Same as (i) except the information is not known but <u>strongly suspected</u> based on indirect observations.  iii) Meets CWQG or absence of surface water exposure pathway (i.e., Distance to nearest surface water is > 5 km.)	12  8  0  12 12	SW exceedances of the CCME CWQG for FAL for Inorganic Elements, and Atracene, Benzo(a)anthracene, Benzo(a)pyrene.	Collect all available information on quality of surface water near to site. Evaluate available data against Canadian Water Quality Guidelines (select appropriate guidelines based on local water uses e.g., recreation, irrigation, aquatic life, livestock watering, etc.). The evaluation method concentrates on the surface water flow system and its potential to be an exposure pathway. Contamination is present on the surface (above ground) and has the potential to impact surface water bodies. Surface water is defined as a water body that supports one of the following uses: recreation, irrigation, livestock watering, aquatic life.	General Notes: Someone experienced must provide a thorough description of the sources researched to classify the surface water body in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links.  Selected References:  CCME. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life <a href="http://www.ccme.ca">www.ccme.ca</a>  CCME. 1999. Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) <a href="http://www.ccme.ca">www.ccme.ca</a>  Health and Welfare Canada. 1992. Guidelines for Canadian Recreational Water Quality.
<b>NOTE: If a score is assigned here for Demonstrated Migration in Surface Water, then you can skip Part B (Potential for migration of COPCs in surface water) and go to Section 3 (Surface Soils)</b>				
<b>B. Potential for migration of COPCs in surface water</b>				
a. Presence of containment No containment Partial containment Full containment Do Not Know	Do Not Know	Known is scored	Review the existing engineered systems and relate these structures to site conditions and proximity to surface water and determine if full containment is achieved: score low if there is full containment such as capping, berms, dikes; score medium if there is partial containment such as natural barriers, trees, ditches, sedimentation ponds; score high if there are no intervening barriers between the site and nearby surface water. Full containment must include containment of all chemicals.	
Score	3			
b. Distance to Surface Water 0 to <100 m 100 - 300 m >300 m Do Not Know	Do Not Know	Known is scored	Review available mapping and survey data to determine distance to nearest surface water bodies.	
Score	2			

(II) Migration Potential (Evaluation of contaminant migration pathways)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<p>c. Topography</p> <p>Contaminants above ground level and slope is steep Contaminants at or below ground level and slope is steep Contaminants above ground level and slope is intermediate Contaminants at or below ground level and slope is intermediate Contaminants above ground level and slope is flat Contaminants at or below ground level and slope is flat Do Not Know</p>	<p>Do Not Know</p> <p>Score 1</p>	Known is scored	<p>Review engineering documents on the topography of the site and the slope of surrounding terrain. Steep slope = &gt;50% Intermediate slope = between 5 and 50% Flat slope = &lt; 5% Note: Type of fill placement (e.g., trench, above ground, etc.).</p>	
<p>d. Run-off potential</p> <p>High (rainfall run-off score &gt; 0.6) Moderate (0.4 &lt; rainfall run-off score &lt;0.6) Low (0.2 &lt; rainfall run-off score &lt;0.4) Very Low (0 &lt; rainfall run-off score &lt; 0.2) None (rainfall run-off score = 0) Do Not Know</p>	<p>Do Not Know</p> <p>Score 0.4</p>	Known is scored	<p><b>Rainfall</b> Refer to Environment Canada precipitation records for relevant areas. Divide rainfall by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score). The former definition of "annual rainfall" did not include the precipitation as snow. This minor adjustment has been made. The second modification was the inclusion of permeability of surface materials as an evaluation factor.</p> <p><b>Permeability</b> For infiltration assume: gravel (0), sand (0.3), loam (0.6) and pavement or clay (1). Multiply the infiltration factor with precipitation factor to obtain rainfall run off score.</p>	<p>Selected Sources: Environment Canada web page link <a href="http://www.msc.ec.gc.ca">www.msc.ec.gc.ca</a> Snow to rainfall conversion apply ratio of 15 (snow):1 (water)</p>
<p>e. Flood potential</p> <p>1 in 2 years 1 in 10 years 1 in 50 years Not in floodplain Do Not Know</p>	<p>Do Not Know</p> <p>Score 0.5</p>	Known is scored	<p>Review published data such as flood plain mapping or flood potential (e.g., spring or mountain run-off) and Conservation Authority records to evaluate flood potential of nearby water courses both up and down gradient. Rate zero if site not in flood plain.</p>	
Potential surface water pathway total	6.9			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
<b>Surface water pathway total</b>	<b>12</b>			
<b>3. Surface Soils (potential for dust, dermal and ingestion exposure)</b>				
<b>A. Demonstrated concentrations of COPC in surface soils (top 1.5 m)</b>				
<p>COPCs measured in surface soils exceed the CCME soil quality guideline.</p> <p>Strongly suspected that soils exceed guidelines</p> <p>COPCs in surface soils does not exceed the CCME soil quality guideline or is not present (i.e., bedrock).</p>	<p>12</p> <p>9</p> <p>0</p> <p>0</p> <p>Score 0</p>	All soil samples were below the CCME SQGs.	<p>Collect all available information on quality of surface soils (i.e., top 1.5 metres) at the site. Evaluate available data against Canadian Soil Quality Guidelines. Select appropriate guidelines based on current (or proposed future) land use (i.e., agricultural, residential/parkland, commercial, or industrial), and soil texture if applicable (i.e., coarse or fine).</p>	<p>Selected References: CCME. 1999. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health <a href="http://www.ccme.ca">www.ccme.ca</a></p>
<b>NOTE: If a score is assigned here for Demonstrated Concentrations in Surface Soils, then you can skip Part B (Potential for a surface soils migration pathway) and go to Section 4 (Vapour)</b>				
<b>B. Potential for a surface soils (top 1.5 m) migration pathway</b>				
<p>a. Are the soils in question covered?</p> <p>Exposed Vegetated Landscaped Paved Do Not Know</p>	<p>Do Not Know</p> <p>Score 4</p>	Known is scored	<p>Consult engineering or risk assessment reports for the site. Alternatively, review photographs or perform a site visit. Landscaped surface soils must include a minimum of 0.5 m of topsoil.</p>	<p>The possibility of contaminants in blowing snow have not been included in the revised NCS as it is difficult to assess what constitutes an unacceptable concentration and secondly, spills to snow or ice are most efficiently mitigated while freezing conditions remain.</p>
<p>b. For what proportion of the year does the site remain covered by snow?</p> <p>0 to 10% of the year 10 to 30% of the year More than 30% of the year Do Not Know</p>	<p>Do Not Know</p> <p>Score 3</p>	Known is scored	<p>Consult climatic information for the site. The increments represent the full span from soils which are always wet or covered with snow (and therefore less likely to generate dust) to those soils which are predominantly dry and not covered by snow (and therefore are more likely to generate dust).</p>	
Potential surface soil pathway total	7			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed		
<b>Soil pathway total</b>	<b>0</b>			

(II) Migration Potential (Evaluation of contaminant migration pathways)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>4. Vapour</b>				
<b>A. Demonstrated COPCs in vapour.</b>				
Vapour has been measured (indoor or outdoor) in concentrations exceeding risk based concentrations.	12	unknown, potential is scored.	Consult previous investigations, including human health risk assessments, for reports of vapours detected.	
Strongly suspected (based on observations and/or modelling)	9			
Vapour has not been measured and volatile hydrocarbons have not been found in site soils or groundwater.	0			
Score	Go to Potential ---			
<b>NOTE: If a score is assigned here for Demonstrated COPCs in Vapour, then you can skip Part B (Potential for COPCs in vapour) and go to Section 5 (Sediment)</b>				
<b>B. Potential for COPCs in vapour</b>				
a. Relative Volatility based on Henry's Law Constant, H' (dimensionless) High (H' > 1.0E-1) Moderate (H' = 1.0E-1 to 1.0E-3) Low (H' < 1.0E-3) Not Volatile Do Not Know	High 4	Mercury has the greatest volatility based on a H' of 4.67e-1, which is high.	Reference: US EPA Soil Screening Guidance (Part 5 - Table 36)  Provided in Attached Reference Materials	If the Henry's Law Constant for a substance indicates that it is not volatile, and a score of zero is assigned here for relative volatility, then the other three questions in this section on Potential for COPCs will be automatically assigned scores of zero and you can skip to section 5.
b. What is the soil grain size? Fine Coarse Do Not Know	Fine 2	Grain size has not been tested but on soil borehole logs indicate silts and clays with some sands.	Review soil permeability data in engineering reports. The greater the permeability of soils, the greater the possible movement of vapours.  Fine-grained soils are defined as those which contain greater than 50% by mass particles less than 75 µm mean diameter (D50 < 75 µm). Coarse-grained soils are defined as those which contain greater than 50% by mass particles greater than 75 µm mean diameter (D50 > 75 µm).	
c. Is the depth to the source less than 10m? Yes No Do Not Know	Yes 2	Source is in the surface for sediment, not in the surface for soil.	Review groundwater depths below grade for the site.	
d. Are there any preferential pathways? Yes No Do Not Know	Yes 2	Underground sewage piping could be a preferential pathway.	Visit the site during dry summer conditions and/or review available photographs. Where bedrock is present, fractures would likely act as preferential pathways.	Preferential pathways refer to areas where vapour migration is more likely to occur because there is lower resistance to flow than in the surrounding materials. For example, underground conduits such as sewer and utility lines, drains, or septic systems may serve as preferential pathways. Features of the building itself that may also be preferential pathways include earthen floors, expansion joints, wall cracks, or foundation perforations for subsurface features such as utility pipes, sumps, and drains.
Potential vapour pathway total	10	<b>Note: If a "known" score is provided, the "potential" score is disallowed.</b>		
Allowed Potential score	10			
<b>Vapour pathway total</b>	<b>10</b>			
<b>5. Sediment Movement</b>				
<b>A. Demonstrated migration of sediments containing COPCs</b>				
There is evidence to suggest that sediments originally deposited to the site (exceeding the CCME sediment quality guidelines) have migrated.	12	unknown, potential is scored.	Review sediment assessment reports. Evidence of migration of contaminants in sediments must be reported by someone experienced in this area.	Usually not considered a significant concern in lakes/marine environments, but could be very important in rivers where transport downstream could be significant.
Strongly suspected (based on observations and/or modelling)	9			
Sediments have been contained and there is no indication that sediments will migrate in future. or Absence of sediment exposure pathway (i.e., within 5 km of the site there are no aquatic receiving environments, and therefore no sediments).	0			
Score	Go to Potential ---			
<b>NOTE: If a score is assigned here for Demonstrated Migration of Sediments, then you can skip Part B (Potential for Sediment Migration) and go to Section 6 (Modifying Factors)</b>				

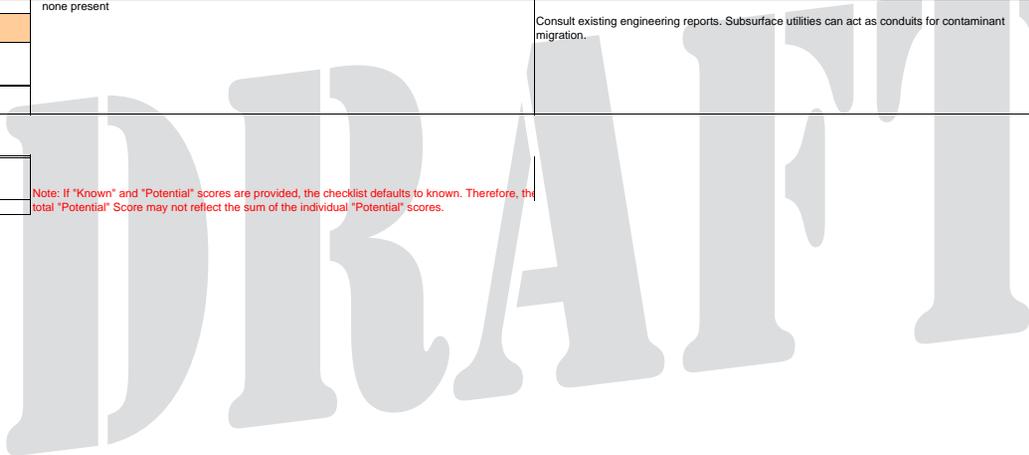
(II) Migration Potential (Evaluation of contaminant migration pathways)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>B. Potential for sediment migration</b>				
a. Are the sediments having COPC exceedances capped with sediments having no exceedances ("clean sediments")? Yes No Do Not Know	No  4	Sediments are in a wetland, not a river or water body.  Sediments are not capped.	Review existing sediment assessments. If sediment coring has been completed, it may indicate that historically contaminated sediments have been covered over by newer "clean" sediments. This assessment will require that cores collected demonstrate a low concentration near the top and higher concentration with sediment depth.	
b. For lakes and marine habitats, are the contaminated sediments in shallow water and therefore likely to be affected by tidal action, wave action or propeller wash? Yes No Do Not Know	No  0	No tidal action.		
c. For rivers, are the contaminated sediments in an area prone to sediment scouring? Yes No Do Not Know	Yes  4	Sediment scouring is possible in the drainage channel from the outlet to the wetland. However, once the sediment reaches the wetland movement would be limited.		
Potential sediment pathway total	8			
Allowed Potential score	8	Note: If a "known" score is provided, the "potential" score is disallowed.		
<b>Sediment pathway total</b>	<b>8</b>			
<b>6. Modifying Factors</b>				
Are there subsurface utility conduits in the area affected by contamination? Yes No Do Not Know	No  0	none present	Consult existing engineering reports. Subsurface utilities can act as conduits for contaminant migration.	
Known Potential	0 0			

Migration Potential Total	
Raw "known" total	24
Raw "potential" total	18.0
Raw combined total	42.0
<b>Total (max 33)</b>	<b>21.7</b>

Note: If "Known" and "Potential" scores are provided, the checklist defaults to known. Therefore, the total "Potential" Score may not reflect the sum of the individual "Potential" scores.



(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>1. Human</b>				
<b>A. Known exposure</b>				
Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to humans as a result of the contaminated site. (Class 1 Site*)	22	No documented human known exposures. Potential is scored.	*Where adverse effects on humans are documented, the site should be automatically designated as a Class 1 site (i.e., action required). There is no need to proceed through the NCS in this case. However, a scoring guideline (22) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class 1 sites).	Known adverse impact includes domestic and traditional food sources. Adverse effects based on food chain transfer to humans and/or animals can be scored in this category. However, the weight of evidence must show a direct link of a contaminated food source/supply and subsequent ingestion/transfer to humans. Any associated adverse effects to the environment are scored separately later in this worksheet. Someone experienced must provide a thorough description of the sources researched to evaluate and determine the quantified exposure/impact (adverse effect) in the vicinity of the contaminated site.
Same as above, but "Strongly Suspected" based on observations or indirect evidence.	10		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1 for noncarcinogenic chemicals and incremental cancer risks that exceed acceptable levels defined by the jurisdiction for carcinogenic chemicals (for most jurisdictions this is typically either >10 <sup>3</sup> or >10 <sup>4</sup> ). Known impacts can also be evaluated based on blood testing (e.g. blood lead >10 ug/dL) or other health based testing.	<b>Selected References:</b> Health Canada – Federal Contaminated Site Risk Assessment in Canada Parts 1 and 2 Guidance on Human Health Screening Level Risk Assessments ( <a href="http://www.hc-sc.gc.ca/ewh-sem/pubs/contam/site/index_e.html">www.hc-sc.gc.ca/ewh-sem/pubs/contam/site/index_e.html</a> ) United States Environmental Protection Agency, Integrated Risk Information System (IRIS) <a href="http://toxnet.nlm.nih.gov">http://toxnet.nlm.nih.gov</a>
No quantified or suspected exposures/impacts in humans.	0		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 0.2 for non-carcinogenic chemicals and incremental lifetime cancer risks for carcinogenic chemicals that are within acceptable levels as defined by the jurisdiction (for most jurisdictions this is less than either 10 <sup>3</sup> or 10 <sup>4</sup> ).	
	<b>Go to Potential</b>			
	Score			
	---			
<b>NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Human Exposure) and go to Section 2 (Human Exposure Modifying Factors)</b>				
<b>B. Potential for human exposure</b>				
a) Land use (provides an indication of potential human exposure scenarios)  Agricultural Residential / Parkland Commercial Industrial Do Not Know		National Parks fall in the agricultural land use category.	Review zoning and land use maps over the distances indicated. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place. Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	This is the main "receptor" factor used in site scoring. A higher score implies a greater exposure and/or exposure of more sensitive human receptors (e.g., children).
	<b>Agricultural</b>			
	Score			
	3			
b. Indicate the level of accessibility to the contaminated portion of the site (e.g., the potential for coming in contact with contamination)  Limited barriers to prevent site access; contamination not covered Moderate access or no intervening barriers, contaminants are covered. Remote locations in which contaminants not covered. Controlled access or remote location and contaminants are covered  Do Not Know		The Recreational lagoon is in an area of limited access, within a locked fence.	Review location and structures and contaminants at the site and determine if there are intervening barriers between the site and humans. A low rating should be assigned to a (covered) site surrounded by a fence or in a remote location, whereas a high score should be assigned to a site that has no cover, fence, natural barriers or buffer.	
	<b>Controlled or remote</b>			
	Score			
	0			
<b>B. Potential for human exposure</b>				
c) Potential for intake of contaminated soil, water, sediment or foods for operable or potentially operable pathways, as identified in Worksheet II (Migration Potential).  i) direct contact Is dermal contact with contaminated surface water, groundwater, sediments or soils anticipated? Yes No Do Not Know		Dermal contact is not anticipated due to the remote location.	If soils or potable groundwater are present exceeding their respective CCME guidelines, dermal contact is assumed. Exposure to surface water, non-potable groundwater or sediments exceeding their respective CCME guidelines will depend on the site. Select "Yes" if dermal exposure to surface water, non-potable groundwater or sediments is expected. For instance, dermal contact with sediments would not be expected in an active port. Only soils in the top 1.5 m are defined by CCME (2003) as surface soils. If contaminated soils are only located deeper than 1.5 m, direct contact with soils is not anticipated to be an operable contaminant exposure pathway.	Exposure via the skin is generally believed to be a minor exposure route. However for some organic contaminants, skin exposure can play a very important component of overall exposure. Dermal exposure can occur while swimming in contaminated waters, bathing with contaminated surface water/groundwater and digging in contaminated dirt, etc.
	<b>No</b>			
	Score			
	0			
ii) inhalation (i.e., inhalation of dust, vapour)  Vapour - Are there inhabitable buildings on the site within 30 m of soils or groundwater with volatile contamination as determined in Worksheet II (Migration Potential)?  Yes No Do Not Know		No buildings within 30 m.	If inhabitable buildings are on the site within 30 m of soils or groundwater exceeding their respective guidelines for volatile chemicals, there is a potential of risk to human health (Health Canada, 2004). Review site investigations for location of soil samples (having exceedances of volatile substances) relative to buildings. Refer to (II) Migration Potential worksheet, 4B.a) <i>Potential for COPCs in Vapour</i> for a definition of volatility.	Exposure via the lungs (inhalation) can be a very important exposure pathway. Inhalation can be via both particulates (dust) and gas (vapours). Vapours can be a problem where buildings have been built on former industrial sites or where volatile contaminants have migrated below buildings resulting in the potential for vapour intrusion. Assesses the potential for humans to be exposed to vapours originating from site soils. The closer the receptor is to a source of volatile chemicals in soil, the greater the potential of exposure. Also, coarser-grained soil will convey vapour much more efficiently in the soil than finer grained material such as clays and silts.
	<b>No</b>			
	Score			
	0			
Dust - If there is contaminated surface soil (e.g. top 1.5 m), indicate whether the soil is fine or coarse textured. If it is known that surface soil is not contaminated, enter a score of zero.  Fine Coarse Surface soil is not contaminated or absent (bedrock) Do Not Know Texture		Surface soils are clay in the lagoon and silts in the wetland.	Consult grain size data for the site. If soils (containing exceedances of the CCME soil quality guidelines) predominantly consist of fine material (having a median grain size of 75 microns; as defined by CCME (2006)) then these soils are more likely to generate dusts.	General Notes: Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a vapour migration and/or dust generation in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.  <b>Selected References:</b> Canadian Council of Ministers of the Environment (CCME). 2006. Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN 1332 <a href="http://www.ccme.ca">www.ccme.ca</a> Golder. 2004. Soil Vapour Intrusion Guidance for Health Canada Screening Level Risk Assessment (SLRA) Submitted to Health Canada, Burnaby, BC
	<b>Fine</b>			
	Score			
	3			
inhalation total				
	3			

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>B. Potential for human exposure</b>				
<p>iii) Ingestion (i.e., ingestion of food items, water and soils [for children]), including traditional foods.</p> <p>Drinking Water: Choose a score based on the proximity to a drinking water supply, to indicate the potential for contamination (present or future).</p> <p>0 to 100 m 100 to 300 m 300 m to 1 km 1 to 5 km No drinking water present Do Not Know</p> <p>No drinking water present</p> <p>Score</p> <p>Is an alternative water supply readily available?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Is human ingestion of contaminated soils possible?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Are food items consumed by people, such as plants, domestic animals or wildlife harvested from the contaminated land and its surroundings?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Ingestion total</p> <p>Human Health Total "Potential" Score</p> <p>Allowed "Potential" Score</p>	<p>0 0 Yes 0 Yes 3 No 0 3 9 9</p>	<p>Drinking water is not present on the site. Drinking water is provided in neighbouring communities and at the park's campground facilities.</p> <p>Alternate water supplies are available in the park</p> <p>Contamination is in the surface sediments, but not in the surface soils. Ingestion is possible.</p> <p>Traditional plants are allowed to be harvested from the park with a permit. Also bison present in the park are sold at auction and the end use is unknown but could include consumption. Deer, elk and ducks can move out of the park where they could be hunted and consumed. Therefore category is scored as "yes".</p> <p>Note if a "Known" Human Health score is provided, the "Potential" score is disallowed.</p>	<p>Review available site data to determine if drinking water (groundwater, surface water, private, commercial or municipal supply) is known or suspected to be contaminated above Guidelines for Canadian Drinking Water Quality. If drinking water supply is known to be contaminated, some immediate action (e.g., provision of alternate drinking water supply) should be initiated to reduce or eliminate exposure.</p> <p>The evaluation of significant potential for exceedances of the water supply in the future may be based on the capture zones of the drinking water wells; contaminant travel times; computer modelling of flow and contaminant transport.</p> <p>If contaminated soils are located within the top 1.5 m, it is assumed that ingestion of soils is an operable exposure pathway. Exposure to soils deeper than 1.5 m is possible, but less likely, and the duration is shorter. Refer to human health risk assessment reports for the site in question.</p> <p>Use human health risk assessment reports (or others) to determine if there is significant reliance on traditional food sources associated with the site. Is the food item in question going to spend a large proportion of its time at the site (e.g., large mammals may spend a very small amount of time at a small contaminated site)? Human health risk assessment reports for the site in question will also provide information on potential bioaccumulation of the COPC in question.</p>	<p><b>Selected References:</b> Guidelines for Canadian Drinking Water Quality <a href="http://www.hc-sc.gc.ca/hec/sesc/water/publications/drinking_water_quality_guidelines/toc.htm">www.hc-sc.gc.ca/hec/sesc/water/publications/drinking_water_quality_guidelines/toc.htm</a></p> <p>Drinking water can be an extremely important exposure pathway to humans. If site groundwater or surface water is not used for drinking, then this pathway is considered to be inoperable.</p> <p>Consider both wild foods such as salmon, venison, caribou, as well as agricultural sources of food items if the contaminated site is on or adjacent to agricultural land uses.</p>
<b>2. Human Exposure Modifying Factors</b>				
<p>a) Strong reliance of local people on natural resources for survival (i.e., food, water, shelter, etc.)</p> <p>Yes No Do Not Know</p> <p>Known</p> <p>Potential</p> <p>Raw Human "known" total</p> <p>Raw Human "potential" total</p> <p>Raw Human Exposure Total Score</p> <p>Human Health Total (max 22)</p>	<p>No 0 --- 0 9 9 9.0</p>	<p>No, these resources are available in neighbouring communities. The consumption described above is not a strong reliance.</p>		
<b>3. Ecological</b>				
<b>A. Known exposure</b>				
<p>Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to terrestrial or aquatic organisms as a result of the contaminated site.</p> <p>Score</p>	<p>18 12 0 Go to Potential ---</p>	<p>Potential scored. No documented evidence.</p>	<p>Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are deemed to be severe, the site may be categorized as class one (i.e., a priority for remediation or risk management), regardless of the numerical total NCS score. For the purpose of application of the NCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction. If ecological effects are determined to be severe and an automatic Class 1 is assigned, there is no need to proceed through the NCS. However, a scoring guideline (18) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class sites).</p> <p>This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients &gt;1. Alternatively, known impacts can also be evaluated based on a weight of evidence assessment involving a combination of site observations, tissue testing, toxicity testing and quantitative community assessments. Scoring of adverse effects on individual rare or endangered species will be completed on a case-by-case basis with full scientific justification.</p> <p>This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 1 and no other observable or measurable sign of impacts. Alternatively, it can be based on a combination of other lines of evidence showing no adverse effects, such as site observations, tissue testing, toxicity testing and quantitative community assessments.</p>	<p>CCME, 1999: Canadian Water Quality Guidelines for the Protection of Aquatic Life <a href="http://www.ccme.ca">www.ccme.ca</a> CCME, 1999: Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses <a href="http://www.ccme.ca">www.ccme.ca</a> Sensitive receptors- review: Canadian Council on Ecological Areas <a href="http://www.ccea.org">www.ccea.org</a></p> <p>Ecological effects should be evaluated at a population or community level, as opposed to at the level of individuals. For example, population-level effects could include reduced reproduction, growth or survival in a species. Community-level effects could include reduced species diversity or relative abundances. Further discussion of ecological assessment endpoints is provided in <i>A Framework for Ecological Risk Assessment: General Guidance</i> (CCME 1996).</p> <p>Notes: Someone experienced must provide a thorough description of the sources researched to classify the environmental receptors in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other source such as internet links.</p>
<p><b>NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Ecological Exposure) and go to Section 4 (Ecological Exposure Modifying Factors)</b></p>				

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>B. Potential for ecological exposure (for the contaminated portion of the site)</b>				
a) Terrestrial i) Land use Agricultural (or Wild lands) Residential/Parkland Commercial Industrial Do Not Know Agricultural (or Wild land): Score	3	National park falls in the land use category of agricultural/wild lands	Review zoning and land use maps. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place (indicate in the worksheet that future land use is the consideration).  Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Wild lands are grouped with agricultural land due to the similarities in receptors that would be expected to occur there (e.g., herbivorous mammals and birds) and the similar need for a high level of protection to ensure ecological functioning. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	
ii) Uptake potential  Direct Contact - Are plants and/or soil invertebrates likely exposed to contaminated soils at the site? Yes No Do Not Know Score	Yes  1	Exposure through direct contact with contaminated sediments is possible. Muskrat were observed inside the lagoon.	If contaminated soils are located within the top 1.5 m, it is assumed that direct contact of soils with plants and soil invertebrates is an operable exposure pathway. Exposure to soils deeper than 1.5 m possible, but less likely.	
iii) Ingestion (i.e., wildlife or domestic animals ingesting contaminated food items, soils or water) Are terrestrial animals likely to be ingesting contaminated water at the site? Yes No Do Not Know Score  Are terrestrial animals likely to be ingesting contaminated soils at the site? Yes No Do Not Know Score  Can the contamination identified bioaccumulate? Yes No Do Not Know Score  Distance to sensitive terrestrial ecological area 0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know Score	Yes 1  Yes 1  Yes 1  Yes 1  0 to 300 m 3 Raw Terrestrial Total Potential 10 Allowed Terrestrial Total Potential 10	Mammals are present in the lagoon and the likelihood of ingesting contaminated water is high.          DDD/DDE have log Kow greater than 4.   National parks are considered sensitive terrestrial ecological areas. Bison are present in the park.	Refer to an Ecological Risk Assessment for the site. If there is contaminated surface water at the site, assume that terrestrial organisms will ingest it.   Refer to an Ecological Risk Assessment report. Most animals will co-ingest some soil while eating plant matter or soil invertebrates.   Bioaccumulation of contaminants within food items is considered possible if: 1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in soils exceed the most conservative CCME soil quality guideline for the intended land use, or 2) The contaminant in collected tissue samples exceeds the Canadian Tissue Residue Guidelines.	Environmental receptors include: local, regional or provincial species of interest or significance; arctic environments (on a site specific basis); nature preserves, habitats for species at risk, sensitive forests, natural parks or forests.
<b>B. Potential for ecological exposure (for the contaminated portion of the site)</b>				
b) Aquatic i) Classification of aquatic environment Sensitive Typical Not Applicable (no aquatic environment present) Do Not Know Score	Sensitive 3	There is a Trumpeter Swan reintroduction program in Elk Island NP. Therefore it was rated as a sensitive aquatic environment.	"Sensitive aquatic environments" include those in or adjacent to shellfish or fish harvesting areas, marine parks, ecological reserves and fish migration paths. Also includes those areas deemed to have ecological significance such as for fish food resources, spawning areas or having rare or endangered species.  "Typical aquatic environments" include those in areas other than those listed above.	
ii) Uptake potential  Does groundwater daylighting to an aquatic environment exceed the CCME water quality guidelines for the protection of aquatic life at the point of contact? Yes No (or Not Applicable) Do Not Know Score  Distance from the contaminated site to an important surface water resource 0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know Score	Do Not Know 0.5  0 to 300 m 3	Groundwater does exceed FIGQG, however it is not known if contaminated groundwater daylighting to an aquatic environment.    Astotin lake is between 780-940 m away. However, there is another smaller lake within 300 m. Because the lakes are inside a NP it is considered to be an important SW resource.	Groundwater concentrations of contaminants at the point of contact with an aquatic receiving environment can be estimated in three ways: 1) by comparing collected nearshore groundwater concentrations to the CCME water quality guidelines (this will be a conservative comparison, as contaminant concentrations in groundwater often decrease between nearshore wells and the point of discharge). 2) by conducting groundwater modeling to estimate the concentration of groundwater immediately before discharge. 3) by installing water samplers, "peepers", in the sediments in the area of daylighting groundwater.  It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor or important water resource located within this area of the site will be subject to further evaluation. It is also considered that any environmental receptor located greater than 5 km away will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link: <a href="http://www.ccea.org">www.ccea.org</a>	Environmental receptors include: local, regional or provincial species of interest or significance, sensitive wetlands and fens and other aquatic environments

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
Are aquatic species (i.e., forage fish, invertebrates or plants) that are consumed by predatory fish or wildlife consumers, such as mammals and birds, likely to accumulate contaminants in their tissues? Yes No Do Not Know	Yes 1 Score 1	DDD/DDE/DDT have log Kow greater than 4.	1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in sediments exceed the CCME ISQGs. 2) The contaminant in collected tissue samples exceeds the CCME tissue quality guidelines.	
Raw Aquatic Total Potential Allowed Aquatic Total Potential	7.5 7.5	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
<b>4. Ecological Exposure Modifying Factors</b>				
a) Known occurrence of a species at risk. Is there a potential for a species at risk to be present at the site? Yes No Do Not Know	Yes 2 Score ---	Plain Bison, Elk and Trumpeter Swan reintroduction and breeding programs occur in the park. Tiger Salamander are also present inside the park.	Consult any ecological risk assessment reports. If information is not present, utilize on-line databases such as Eco Explorer, Regional, Provincial (Environment Ministries), or Federal staff (Fisheries and Oceans or Environment Canada) should be able to provide some guidance.	Species at risk include those that are extirpated, endangered, threatened, or of special concern. For a list of species at risk, consult Schedule 1 of the federal Species at Risk Act ( <a href="http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1">http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1</a> ). Many provincial governments may also provide regionally applicable lists of species at risk. For example, in British Columbia, consult: BCMWLP, 2005. Endangered Species and Ecosystems in British Columbia. Provincial red and blue lists. Ministry of Sustainable Resource Management and Water, Land and Air Protection <a href="http://srmwww.gov.bc.ca/atrisk/red-blue.htm">http://srmwww.gov.bc.ca/atrisk/red-blue.htm</a>
b) Potential impact of aesthetics (e.g., enrichment of a lake or tainting of food flavor). Is there evidence of aesthetic impact to receiving water bodies? Yes No Do Not Know Is there evidence of olfactory impact (i.e., unpleasant smell)? Yes No Do Not Know Is there evidence of increase in plant growth in the lake or water body? Yes No Do Not Know Is there evidence that fish or meat taken from or adjacent to the site smells or tastes different? Yes No Do Not Know	Do Not Know --- 1 No 0 --- Do Not Know --- 1 Do Not Know --- 1 Ecological Modifying Factors Total - Known Ecological Modifying Factors Total - Potential Raw Ecological Total - Known Raw Ecological Total - Potential Raw Ecological Total Ecological Total (Max 18)	Did not investigate  The lagoon has an unpleasant smell from the sewage but not from the contaminants.  Did not investigate  Did not investigate	Documentation may consist of environmental investigation reports, press articles, petitions or other records.  Examples of olfactory change can include the smell of a COPC or an increase in the rate of decay in an aquatic habitat.  A distinct increase of plant growth in an aquatic environment may suggest enrichment. Nutrients e.g., nitrogen or phosphorous releases to an aquatic body can act as a fertilizer.  Some contaminants can result in a distinctive change in the way food gathered from the site tastes smells.	This Item will require some level of documentation by user, including contact names, addresses, phone numbers, e-mail addresses. Evidence of changes must be documented, please attach copy of report containing relevant information.
<b>5. Other Potential Contaminant Receptors</b>				
a) Exposure of permafrost (leading to erosion and structural concerns) Are there improvements (roads, buildings) at the site dependant upon the permafrost for structural integrity? Yes No Do Not Know Is there a physical pathway which can transport soils released by damaged permafrost to a nearby aquatic environment? Yes No Do Not Know	No 0 --- No 0 ---	permafrost is not present  permafrost is not present	Consult engineering reports, site plans or air photos of the site. When permafrost melts, the stability of the soil decreases, leading to erosion. Human structures, such as roads and/or buildings are often dependent on the stability that the permafrost provides.  Melting permafrost leads to a decreased stability of underlying soils. Wind or surface run-off erosion can carry soils into nearby aquatic habitats. The increased soil loadings into a river can cause an increase in total dissolved solids and a resulting decrease in aquatic habitat quality. In addition, the erosion can bring contaminants from soils to aquatic environments.	Plants and lichens provide a natural insulating layer which will help prevent thawing of the permafrost during the summer. Plants and lichens may also absorb less solar radiation. Solar radiation is turned into heat which can also cause underlying permafrost to melt.
Other Potential Receptors Total - Known Other Potential Receptors Total - Potential	0 0			
<b>Exposure Total</b>				
Raw Human Health + Ecological Total - Known Raw Human Health + Ecological Total - Potential Raw Total Exposure Total (max 34)	2 29.5 31.5 23.3	Only includes "Allowed potential" - if a "Known" score was supplied under a given category then the "Potential" score was not included.		

**CCME National Classification System (2008, 2010 v 1.2)  
Score Summary**

Scores from individual worksheets are tallied in this worksheet.  
Refer to this sheet after filling out the revised NCS completely.

**I. Contaminant Characteristics**

	Known	Potential
1. Residency Media	6	---
2. Chemical Hazard	8	---
3. Contaminant Exceedance Factor	6	---
4. Contaminant Quantity	9	---
5. Modifying Factors	4	---

**Raw Total Score** 33 0

**Raw Total Score (Known + Potential)** 33

**Adjusted Total Score (Raw Total / 40 \* 33)** 27.2 (max 33)

**II. Migration Potential**

	Known	Potential
1. Groundwater Movement	12	---
2. Surface Water Movement	12	---
3. Soil	0	---
4. Vapour	---	10
5. Sediment Movement	---	8
6. Modifying Factors	0	0

**Raw Total Score** 24 18

**Raw Total Score (Known + Potential)** 42

**Adjusted Total Score (Raw Total / 64 \* 33)** 21.7 (max 33)

**III. Exposure**

	Known	Potential
1. Human Receptors		
A. Known Impact	---	
B. Potential		
a. Land Use		3
b. Accessibility		0
c. Exposure Route		
i. Direct Contact		0
ii. Inhalation		3
iii. Ingestion		3
2. Human Receptors Modifying Factors	0	---
<b>Raw Total Human Score</b>	0	9

Raw Total Human Score (Known + Potential) 9  
Adjusted Total Human Score 9.0 (maximum 22)

3. Ecological Receptors		
A. Known Impact	---	
B. Potential		
a. Terrestrial		10
b. Aquatic		7.5
4. Ecological Receptors Modifying Factors	2	3
<b>Raw Total Ecological Score</b>	2	20.5

Raw Total Ecological Score (Known + Potential) 22.5  
Adjusted Total Ecological Score 18.0 (maximum 18)

5. Other Receptors	0	0
Total Other Receptors Score (Known + Potential)	0	

**Total Exposure Score (Human + Ecological + Other)** 27.0

**Adjusted Total Exposure Score (Total Exposure / 46 \* 34)** 20.0 (max 34)

**Site Score**

Astotin Lake Recreational Area Sewage Lagoon Elk Island National Park

<b>Site Letter Grade</b>	D
<b>Certainty Percentage</b>	75%
<b>% Responses that are "Do Not Know"</b>	7%

<b>Total NCS Score for site</b>	68.8
<b>Site Classification Category</b>	2

**Site Classification Categories\*:**

- Class 1 - High Priority for Action (Total NCS Score >70)
- Class 2 - Medium Priority for Action (Total NCS Score 50 - 69.9)
- Class 3 - Low Priority for Action (Total NCS Score 37 - 49.9)
- Class N - Not a Priority for Action (Total NCS Score <37)
- Class INS - Insufficient Information (>15% of responses are "Do Not Know")

\* NOTE: The term "action" in the above categories does not necessarily refer to remediation, but could also include risk assessment, risk management or further site characterization and data collection.

**CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)  
Pre-Screening Checklist**

Question	Response (yes / no)	Comment
1. Are <b>Radioactive material, Bacterial contamination</b> or <b>Biological hazards</b> likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there <b>no contamination exceedances</b> (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards.	No	If yes (i.e., there are no exceedances), do not proceed through the NCSCS.
3. Have <b>partial/incompleted or no environmental site investigations</b> been conducted for the Site?	No	If yes, do not proceed through the NCSCS.
4. Is there direct and significant evidence of <b>impacts to humans</b> at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
5. Is there direct and significant evidence of <b>impacts to ecological receptors</b> at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant <b>adverse effects in the exposure zone</b> (i.e., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
7. Do measured concentrations of volatiles or unexploded ordnances represent an <b>explosion hazard</b> ?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, and do not continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on exposive hazards and measurement of lower explosive limits.

If none of the above applies, proceed with the NCSCS scoring.

**CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)  
Summary of Site Conditions**

<b>Subject Site:</b>	<b>Administration Area Sewage Lagoon Elk Island National Park</b>	
Civic Address: <i>(or other description of location)</i>	Elk Island National Park, Fort Saskatchewan, AB T8G 2N7	
Site Common Name : <i>(if applicable)</i>	Administration Area Sewage Lagoon	
Site Owner or Custodian: <i>(Organization and Contact Person)</i>	Parks Canada Agency	
Legal description or metes and bounds:	Elk Island National Park	
Approximate Site area:	150 m x 150 m	
PID(s): <i>(or Parcel Identification Numbers [PIN] if untitled Crown land)</i>		
Centre of site: <i>(provide latitude/longitude or UTM coordinates)</i>	Latitude:	_____ degrees _____ min _____ secs
	Longitude:	_____ degrees _____ min _____ secs
Site Land Use:	UTM Coordinate:	Northing 5949858 Easting 376280
	Current:	National Park - Agricultural
	Proposed:	Agricultural
<b>Site Plan</b>	<b>To delineate the bounds of the Site a site plan MUST be attached. The plan must be drawn to scale indicating the boundaries in relation to well-defined reference points and/or legal descriptions. Delineation of the contamination should also be indicated on the site plan.</b>	
Provide a brief description of the Site:	<p>The Administration Area Sewage Lagoon was constructed in Elk Island NP in the 1964 to receive inputs from the main park offices, maintenance buildings, and residences in the area around the lagoon. The lagoon was modified in the mid-70s and re-designed in early 80s to a two cell design. Sewage flows through collection mains from the buildings to a pump station, which then pumps the contents through force mains to the lagoon. The Admin lagoon historically received wastewater from the garage which contained inorganic elements, petroleum hydrocarbons, and polycyclic aromatic hydrocarbons, however this practice no longer occurs.</p> <p>The lagoon is currently in poor shape as a result of damage by beavers, and in order to determine the way ahead with the lagoon, PCA has requested a Phase II assessment of the environmental concerns with the lagoon and associated wetlands. The work in 2013 will build and expand upon the limited Phase II conducted in 2000/2001 (O'Connor, 2001).</p>	

**CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)  
Summary of Site Conditions**

Affected media and Contaminants of Potential Concern (COPC):	<p>Affected media includes surface water in the lagoon and wetlands, and sediment inside the lagoon and in the wetlands and groundwater.</p> <p>CoPC include: inorganic elements (aluminum, arsenic, cadmium, copper, chromium, mercury, selenium, tin, zinc), PHC F3, DDD, DDE, DDT, PAHs, and VOCs.</p>
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Please fill in the "letter" that best describes the level of information available for the site being assessed

Site Letter Grade

If letter grade is F, do not continue, you must have a minimum of a Phase I Environmental Site Assessment or equivalent.

Scoring Completed By:	Shari Reed
Date Scoring Completed:	21-Jul-14

DRAFT

CCME National Classification System (2008, 2010 v 1.2)

(I) Contaminant Characteristics

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
<b>1. Residency Media (replaces physical state)</b>				
Which of the following residency media are known (or strongly suspected) to have one or more exceedances of the applicable CCME guidelines? <b>yes</b> = has an exceedance or strongly suspected to have an exceedance <b>no</b> = does not have an exceedance or strongly suspected not to have an exceedance		All samples collected from the bottom of the lagoon and the wetlands are scored as sediment samples. Sediment exceedances include Inorganic Elements, PAHs, Pesticides (DDD, DDE, DDT), Toluene, VOCs, PHC F3. If there was no sediment criterion available for a given chemical parameter in sediment, the applicable soil criterion was used instead.  One soil sample exceeded the SQG for Selenium at surface (1.2 mg/kg, guideline 1.0 mg/kg).	The overall score is calculated by adding the individual scores from each residency media (having one or more exceedance of the most conservative media specific and land-use appropriate CCME guideline).  Summary tables of the Canadian Environmental Quality Guidelines for soil, water (aquatic life, non-potable groundwater environments, and agricultural water uses) and sediment are available on the CCME website at <a href="http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=124">http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=124</a> .	An increasing number of residency media containing chemical exceedances often equates to a greater potential risk due to an increase in the number of potential exposure pathways.
A. Soil	Yes			
	Yes No Do Not Know			
B. Groundwater	Yes	Groundwater exceeded the FIGQG for inorganic elements, however many of the exceedances were elevated in both upgradient and downgradient wells. It is possible that some of the exceedances are naturally occurring due to local geological conditions.	For potable groundwater environments, guidelines for Canadian Drinking Water Quality (for comparison with groundwater monitoring data) are available on the Health Canada website at <a href="http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html">http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html</a> .	
	Yes No Do Not Know			
C. Surface water	Yes	Surface water samples exceedances include Inorganic Elements & PAHs.		
	Yes No Do Not Know			
D. Sediment	Yes			
	Yes No Do Not Know			
"Known" -score	8			
"Potential" - score	---			
<b>2. Chemical Hazard</b>				
What is the relative degree of chemical hazard of the contaminant in the list of hazard rankings proposed by the Federal Contaminated Sites Action Plan (FCSAP)?	High	Multiple contaminants are in the High category in sediment and surface water: Arsenic, Cadmium, 1,4-Dichlorobenzene, DDD, DDE, DDT, Mercury, Benzo(a)anthracene, and Dibenzo(a,h)anthracene.	The relative degree of chemical hazard should be selected based on the most hazardous contaminant known or suspected to be present at the site.  The degree of hazard has been defined by the Federal Contaminated Sites Action Plan (FCSAP) and a list of substances with their associated hazard (Low, Medium and High) has been provided as a separate sheet in this file.  <i>See Attached Reference Material for Contaminant Hazard Rankings.</i>	Hazard as defined in the revised NCS pertains to the physical properties of a chemical which can cause harm. Properties can include toxic potency, propensity to biomagnify, persistence in the environment, etc. Although there is some overlap between hazard and contaminant exceedance factor below, it will not be possible to derive contaminant exceedance factors for many substances which have a designated chemical hazard designation, but don't have a CCME guideline. The purpose of this category is to avoid missing a measure of toxic potential.
	High Medium Low Do Not Know			
"Known" -score	8			
"Potential" - score	---			
<b>3. Contaminant Exceedance Factor</b>				
What is the ratio between the measured contaminant concentration and the applicable CCME guidelines (or other "standards")?	High (>100x)	Aluminum, cadmium, iron, and zinc in groundwater are all >100x the FIGQG.	Ranking of contaminant "exceedance" is determined by comparing contaminant concentrations with the <i>most conservative media-specific and land-use appropriate CCME</i> environmental quality guidelines. <b>Ranking should be based on contaminant with greatest exceedance of CCME guidelines.</b> Ranking of contaminant hazard as high, medium and low is as follows: High = One or more measured contaminant concentration is greater than 100 X appropriate CCME guidelines Medium = One or more measured contaminant concentration is 10 - 99.99 X appropriate CCME guidelines Low = One or more measured contaminant concentration is 1 - 9.99 X appropriate CCME guidelines Mobile NAPL = Contaminant is a non-aqueous phase liquid (i.e., due to its low solubility, it does not dissolve in water, but remains as a separate liquid) and is present at a sufficiently high saturation (i.e., greater than residual NAPL saturation) such that there is significant potential for mobility either downwards or laterally. Other standards may include local background concentration or published toxicity benchmarks.  Results of toxicity testing with site samples can be used as an alternative. This approach is only relevant for contaminants that do not biomagnify in the food web, since toxicity tests would not indicate potential effects at higher trophic levels. High = lethality observed. Medium = no lethality, but sub lethal effects observed. Low = neither lethal nor sub lethal effects observed.	In the event that elevated levels of a material with no associated CCME guidelines are present, check provincial and USEPA environmental criteria.  Hazard Quotients (sometimes referred to as a screening quotient in risk assessments) refer to the ratio of measured concentration to the concentration believed to be the threshold for toxicity. A similar calculation is used here to determine the contaminant exceedance factor (CEF). Concentrations greater than one times the applicable CCME guideline (i.e., CEF=>1) indicate that risks are possible. Mobile NAPL has the highest associated score (8) because of its highly concentrated nature and potential for increase in the size of the impacted zone.
	Mobile NAPL High (>100x) Medium (10x to 100x) Low (1x to 10x) Do Not Know			
"Known" -score	6			
"Potential" - score	---			

CCME National Classification System (2008, 2010 v 1.2)

(I) Contaminant Characteristics

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
<b>4. Contaminant Quantity (known or strongly suspected)</b>				
What is the known or strongly suspected quantity of all contaminants?  >10 hectare (ha) or 5000 m <sup>3</sup> 2 to 10 ha or 1000 to 5000 m <sup>3</sup> <2 ha or 1000 m <sup>3</sup> Do Not Know	2 to 10 ha or 1000 to 5000 m <sup>3</sup>	Minimum area if entire lagoon plus wetlands are contaminated is: lagoon 72m x 42m = 3,110 m <sup>2</sup> south wetland 30m x 20m = 600 m <sup>2</sup> west wetland 22m x 18m = 400 m <sup>2</sup> Minimum depth of 0.5 = 2,055 m <sup>3</sup> But boundaries are not defined so the area could be larger. Scored as between 1000 - 5000 m <sup>3</sup> as the contaminated area is a minimum of 2000 m <sup>3</sup>	Measure or estimate the area or quantity of total contamination (i.e., all contaminants known or strongly suspected to be present on the site). The "Area of Contamination" is defined as the area or volume of contaminated media (soil, sediment, groundwater, surface water) exceeding appropriate environmental criteria.	A larger quantity of a potentially toxic substance can result in a larger frequency of exposure as well as a greater probability of migration, therefore, larger quantities of these substances earn a higher score.
"Known" -score	6			
"Potential" - score	---			
<b>5. Modifying Factors</b>				
Does the chemical fall in the class of persistent chemicals based on its behavior in the environment?  Yes No Do Not Know	Yes	DDE and DDT are persistent chemicals.	Persistent chemicals, e.g., PCBs, chlorinated pesticides etc. either do not degrade or take longer to degrade, and therefore may be available to cause effects for a longer period of time. Canadian Environmental Protection Act (CEPA) classifies a chemical as persistent when it has at least one of the following characteristics: (a) in air, (i) its half-life is equal to or greater than 2 days, or (ii) it is subject to atmospheric transport from its source to a remote area; (b) in water, its half-life is equal to or greater than 182 days; (c) in sediments, its half-life is equal to or greater than 365 days; or (d) in soil, its half-life is equal to or greater than 182 days.  This list does not include metals or metalloids, which in their elemental form do not degrade. However metals and metalloids form chemical species in the environment, many of which are not readily bioavailable.	<i>Examples of Persistent Substances are provided in attached Reference Materials</i>
Are there contaminants present that could cause damage to utilities and infrastructure, either now or in the future, given their location?  Yes No Do Not Know	Yes	Underground pipes to carry the sewage to the lagoon are HDPE which can be degraded by aromatic and halogenated hydrocarbons present in the lagoon.		Some contaminants may react or absorb into underground utilities and infrastructure. For example, organic solvents may degrade some plastics, and salts could cause corrosion of metal.
How many different contaminant classes have representative CCME guideline exceedances?  one two to four five or more Do Not Know	five or more	5 classes: Inorganics, VOCs, PHC F3, PAHs, Pesticides	For the purposes of the revised NCS ranking system, the following chemicals represent distinct chemical "classes": inorganic substances (including metals), volatile petroleum hydrocarbons, light extractable petroleum hydrocarbons, heavy extractable petroleum hydrocarbons, PAHs, phenolic substances, chlorinated hydrocarbons, halogenated methanes, phthalate esters, pesticides.	<i>Refer to the Reference Material sheet for a list of example substances that fall under the various chemical classes.</i>
"Known" - Score	7			
"Potential" - Score	---			

**Contaminant Characteristic Total**

Raw Total Scores- "Known"	35
Raw Total Scores- "Potential"	0
Raw Combined Total Scores	35
<b>Total Score (Raw Combined / 40 * 33)</b>	<b>28.9</b>

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(II) Migration Potential (Evaluation of contaminant migration pathways)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes		
<b>1. Groundwater Movement</b>						
<b>A. Known COPC exceedances and an operable groundwater pathway within and/or beyond the property boundary.</b>						
<p>i) For <b>potable groundwater environments</b>, 1) groundwater concentrations exceed background concentrations and 1X the Guideline for Canadian Drinking Water Quality (GCDWQ) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater contamination. For <b>non-potable environments</b> (typically urban environments with municipal services), 1) groundwater concentrations exceed 1X the applicable non-potable guidelines or modified generic guidelines (which exclude ingestion of drinking water pathway) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater impacts.</p> <p>ii) Same as (i) except the information is not known but <b>strongly suspected</b> based on indirect observations.</p> <p>iii) Meets GCDWQ for <b>potable environments</b>; meets non-potable criteria or modified generic criteria (excludes ingestion of drinking water pathway) for <b>non-potable environments</b> or Absence of groundwater exposure pathway (i.e., there is no aquifer (see definition at right) at the site or there is an adequate isolating layer between the aquifer and the contamination, and within 5 km of the site there are no aquatic receiving environments and the groundwater does not daylight).</p>	12	Groundwater was sampled in April and May 2014. Samples exceeded the FIGQG for 19 inorganic elements. However many of the exceedances were present in both upgradient and downgradient samples; the exceedances could be naturally occurring due to local geological conditions.	Review chemical data and evaluate groundwater quality.  The evaluation method concentrates on 1) a potable or non-potable groundwater environment; 2) the groundwater flow system and its potential to be an exposure pathway to known or potential receptors.  An aquifer is defined as a geologic unit that yields groundwater in usable quantities and drinking water quality. The aquifer can currently be used as a potable water supply or could have the potential for use in the future. Non-potable groundwater environments are defined as areas that are serviced with a reliable alternative water supply (most commonly provided in urban areas). The evaluation of non-potable environment will be based on a site specific basis.  Physical evidence includes significant sheens, liquid phase contamination, or contaminant saturated soils.  Seeps and springs are considered part of the groundwater pathway.  In Arctic environments, the potability and evaluation of the seasonal active layer (above the permafrost) as a groundwater exposure pathway will be considered on a site-specific basis.	The 1992 NCS rationale evaluated the off-site migration as a regulatory issue. The exposure assessment and classification of hazards should be evaluated regardless of the property boundaries.  Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a groundwater supply source in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links.  Note that for potable groundwater that also daylights into a nearby surface water body, the more stringent guidelines for both drinking water and protection of aquatic life should be considered.  <b>Selected References</b>  <u>Potable Environments</u>  Guidelines for Canadian Drinking Water Quality; <a href="http://www.hc-sc.gc.ca/ewh-sem/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html">www.hc-sc.gc.ca/ewh-sem/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html</a>  <u>Non-Potable Environments</u>  Canadian Water Quality Guidelines for Protection of Aquatic Life. CCME. 1999 <a href="http://www.ccme.ca">www.ccme.ca</a>  Compilation and Review of Canadian Remediation Guidelines, Standards and Regulations. Science Applications International Corporation (SAIC Canada), report to Environment Canada, January 4, 2002.		
	9					
	0					
	Score	12				
<b>NOTE: If a score is assigned here for Known COPC Exceedances, then you can skip Part B (Potential for groundwater pathway) and go to Section 2 (Surface Water Pathway)</b>						
<b>B. Potential for groundwater pathway.</b>						
<p>a. Relative Mobility</p> <p>High Moderate Low Insignificant Do Not Know</p>	4 3 2 1 0 Do Not Know	Known is scored	Organics Koc (L/kg) Koc < 500 (i.e., log Koc < 2.7) Koc = 500 to 5000 (i.e., log Koc = 2.7 to 3.7) Koc = 5,000 to 100,000 (i.e., log Koc = 3.7 to 5) Koc > 100,000 (i.e., log Koc > 5)	Metals with higher mobility at acidic conditions pH < 5 pH = 5 to 6 pH > 6	Metals with higher mobility at alkaline conditions pH > 8.5 pH = 7.5 to 8.5 pH > 7.5	Reference: US EPA Soil Screening Guidance (Part 5 - Table 39)  If a score of zero is assigned for relative mobility, it is still recommended that the following sections on potential for groundwater pathway be evaluated and scored. Although the Koc of an individual contaminant may suggest that it will be relatively immobile, it is possible that with complex mixtures, there could be enhanced mobility due to co-solvent effects. Therefore, the Koc cannot be relied on solely as a measure of mobility. An evaluation of other factors such as containment, thickness of confining layer, hydraulic conductivities and precipitation infiltration rate are still useful in predicting potential for groundwater migration, even if a contaminant is expected to have insignificant mobility based on its chemistry alone.
	Score	2				
<p>b. Presence of engineered sub-surface containment?</p> <p>No containment Partial containment Full containment Do Not Know</p>	3 1.5 0 Do Not Know	Known is scored	Review the existing engineered systems or natural attenuation processes for the site and determine full or partial containment is achieved.  Full containment is defined as an engineered system or natural attenuation processes, monitored as being effective, which provide for full capture and/or treatment of contaminants. All chemicals of concern must be contained for "Full Containment" scoring. Natural attenuation must have sufficient data, and reports cited with monitoring data to support steady state conditions and the attenuation processes. If there is no containment or insufficient natural attenuation process, this category is evaluated as high. If there is less than full containment or if uncertain, then evaluate as medium. In Arctic environments, permafrost will be evaluated, as appropriate, based on detailed evaluations, effectiveness and reliability to contain/control contaminant migration.	Someone experienced must provide a thorough description of the sources researched to determine the containment of the source at the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps, geotechnical reports or natural attenuation studies and other resources such as internet links.  <b>Selected Resources:</b> United States Environmental Protection Agency (USEPA) 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. EPA/600/R-98/128, Environment Canada – Ontario Region – Natural Attenuation Technical Assistance Bulletin (TABs) Number 19 –21.		
	Score	1.5				
<p>c. Thickness of confining layer over aquifer of concern or groundwater exposure pathway</p> <p>3 m or less including no confining layer or discontinuous confining layer 3 to 10 m &gt; 10 m Do Not Know</p>	3 1.5 0 Do Not Know	Known is scored	The term "confining layer" refers to geologic material with little or no permeability or hydraulic conductivity (such as unfractured clay); water does not pass through this layer or the rate of movement is extremely slow.  Measure the thickness and extent of materials that will impede the migration of contaminants to the groundwater exposure pathway.  The evaluation of this category is based on: 1) The presence and thickness of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as drinking water sources or 2) The presence and thickness of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated zone (e.g., water table aquifer, first hydrostratigraphic unit or other groundwater pathway).			
	Score	0.5				
<p>d. Hydraulic conductivity of confining layer</p> <p>&gt;10<sup>-4</sup> cm/s or no confining layer 10<sup>-4</sup> to 10<sup>-6</sup> cm/s &lt;10<sup>-6</sup> cm/s Do Not Know</p>	3 1.5 0 Do Not Know	Known is scored	Determine the nature of geologic materials and estimate hydraulic conductivity from published material (or use "Range of Values of Hydraulic Conductivity and Permeability" figure in the Reference Material sheet). Unfractured clays should be scored low. Silts should be scored medium. Sand, gravel should be scored high. The evaluation of this category is based on: 1) The presence and hydraulic conductivity ("K") of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as a drinking water source, groundwater exposure pathway or 2) The presence and permeability ("k") of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated water table aquifer, first hydrostratigraphic unit or other groundwater pathway.			
	Score	0.5				

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(II) Migration Potential (Evaluation of contaminant migration pathways)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>B. Potential for groundwater pathway.</b>				
<p>e. Precipitation infiltration rate</p> <p>(Annual precipitation factor x surface soil relative permeability factor)</p> <p>High Moderate Low Very Low None Do Not Know</p>	<p>Low</p> <p>Score 0.4</p>	Known is scored	<p><b>Precipitation</b> Refer to Environment Canada precipitation records for relevant areas. Divide annual precipitation by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score).</p> <p><b>Permeability</b> For surface soil relative permeability (i.e., infiltration) assume: gravel (1), sand (0.6), loam (0.3) and pavement or clay (0).</p> <p>Multiply the surface soil relative permeability factor with precipitation factor to obtain the score for precipitation infiltration rate.</p>	
<p>f. Hydraulic conductivity of aquifer</p> <p>&gt;10<sup>-2</sup> cm/s 10<sup>-2</sup> to 10<sup>-4</sup> cm/s &lt;10<sup>-4</sup> cm/s Do Not Know</p>	<p>Do Not Know</p> <p>Score 1</p>	Known is scored	Determine the nature of geologic materials and estimate hydraulic conductivity of all aquifers of concern from published material (refer to "Range of Values of Hydraulic Conductivity and Permeability" in the Reference Material sheet).	
Potential groundwater pathway total	5.9			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
<b>Groundwater pathway total</b>	<b>12</b>			
<b>2. Surface Water Movement</b>				
<b>A. Demonstrated migration of COPC in surface water above background conditions</b>				
<p>Known concentrations of surface water:</p> <p>i) Concentrations exceed background concentrations and exceed CCM CWQG for protection of aquatic life, irrigation, livestock water, and/or recreation (whichever uses are applicable at the site) by &gt;1 X; or There is known contact of contaminants with surface water based on site observations. or In the absence of CWQG, chemicals have been proven to be toxic based on site specific testing (e.g. toxicity testing; or other indicator testing of exposure).</p> <p>ii) Same as (i) except the information is not known but <u>strongly suspected</u> based on indirect observations.</p> <p>iii) Meets CWQG or absence of surface water exposure pathway (i.e., Distance to nearest surface water is &gt; 5 km.)</p>	<p>12</p> <p>8</p> <p>0</p> <p>to Potential</p> <p>Score 12</p>	For surface water - exceedances of the CCME CWQG for freshwater aquatic life for inorganic elements, and Benzo(a)anthracene.	<p>Collect all available information on quality of surface water near to site. Evaluate available data against Canadian Water Quality Guidelines (select appropriate guidelines based on local water use, e.g., recreation, irrigation, aquatic life, livestock watering, etc.). The evaluation method concentrates on the surface water flow system and its potential to be an exposure pathway. Contamination is present on the surface (above ground) and has the potential to impact surface water bodies. Surface water is defined as a water body that supports one of the following uses: recreation, irrigation, livestock watering, aquatic life.</p>	<p>General Notes: Someone experienced must provide a thorough description of the sources researched to classify the surface water body in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.</p> <p>Selected References: CCME. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life <a href="http://www.ccme.ca">www.ccme.ca</a> CCME. 1999. Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) <a href="http://www.ccme.ca">www.ccme.ca</a> Health and Welfare Canada. 1992. Guidelines for Canadian Recreational Water Quality.</p>
<p><b>NOTE: If a score is assigned here for Demonstrated Migration in Surface Water, then you can skip Part B (Potential for migration of COPCs in surface water) and go to Section 3 (Surface Soils)</b></p>				
<b>B. Potential for migration of COPCs in surface water</b>				
<p>a. Presence of containment</p> <p>No containment Partial containment Full containment Do Not Know</p>	<p>Do Not Know</p> <p>Score 3</p>	Known is scored	Review the existing engineered systems and relate these structures to site conditions and proximity to surface water and determine if full containment is achieved; score low if there is full containment such as capping, berms, dikes; score medium if there is partial containment such as natural barriers, trees, ditches, sedimentation ponds; score high if there are no intervening barriers between the site and nearby surface water. Full containment must include containment of all chemicals.	
<p>b. Distance to Surface Water</p> <p>0 to &lt;100 m 100 - 300 m &gt;300 m Do Not Know</p>	<p>Do Not Know</p> <p>Score 2</p>	Known is scored	Review available mapping and survey data to determine distance to nearest surface water bodies.	

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(II) Migration Potential (Evaluation of contaminant migration pathways)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<p>c. Topography</p> <p>Contaminants above ground level and slope is steep</p> <p>Contaminants at or below ground level and slope is steep</p> <p>Contaminants above ground level and slope is intermediate</p> <p>Contaminants at or below ground level and slope is intermediate</p> <p>Contaminants above ground level and slope is flat</p> <p>Contaminants at or below ground level and slope is flat</p> <p>Do Not Know</p>	<p>Do Not Know</p> <p>1</p>	Known is scored	<p>Review engineering documents on the topography of the site and the slope of surrounding terrain.</p> <p>Steep slope = &gt;50%</p> <p>Intermediate slope = between 5 and 50%</p> <p>Flat slope = &lt; 5%</p> <p>Note: Type of fill placement (e.g., trench, above ground, etc.).</p>	
<p>d. Run-off potential</p> <p>High (rainfall run-off score &gt; 0.6)</p> <p>Moderate (0.4 &lt; rainfall run-off score &lt; 0.6)</p> <p>Low (0.2 &lt; rainfall run-off score &lt; 0.4)</p> <p>Very Low (0 &lt; rainfall run-off score &lt; 0.2)</p> <p>None (rainfall run-off score = 0)</p> <p>Do Not Know</p>	<p>Do Not Know</p> <p>0.4</p>	Known is scored	<p><b>Rainfall</b></p> <p>Refer to Environment Canada precipitation records for relevant areas. Divide rainfall by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score).</p> <p>The former definition of "annual rainfall" did not include the precipitation as snow. This minor adjustment has been made. The second modification was the inclusion of permeability of surface materials as an evaluation factor.</p> <p><b>Permeability</b></p> <p>For infiltration assume: gravel (0), sand (0.3), loam (0.6) and pavement or clay (1).</p> <p>Multiply the infiltration factor with precipitation factor to obtain rainfall run off score.</p>	<p>Selected Sources:</p> <p>Environment Canada web page link <a href="http://www.msc.ec.gc.ca">www.msc.ec.gc.ca</a></p> <p>Snow to rainfall conversion apply ratio of 15 (snow):1 (water)</p>
<p>e. Flood potential</p> <p>1 in 2 years</p> <p>1 in 10 years</p> <p>1 in 50 years</p> <p>Not in floodplain</p> <p>Do Not Know</p>	<p>Do Not Know</p> <p>0.5</p>	Known is scored	<p>Review published data such as flood plain mapping or flood potential (e.g., spring or mountain run-off) and Conservation Authority records to evaluate flood potential of nearby water courses both up and down gradient. Rate zero if site not in flood plain.</p>	
Potential surface water pathway total	6.9	<p>Note: If a "known" score is provided, the "potential" score is disallowed.</p>		
Allowed Potential score	---			
Surface water pathway total	12			
3. Surface Soils (potential for dust, dermal and ingestion exposure)				
A. Demonstrated concentrations of COPC in surface soils (top 1.5 m)				
<p>COPCs measured in surface soils exceed the CCME soil quality guideline</p> <p>Strongly suspected that soils exceed guidelines</p> <p>COPCs in surface soils does not exceed the CCME soil quality guideline or is not present (i.e., bedrock).</p>	<p>12</p> <p>9</p> <p>0</p> <p>Do Not Know</p> <p>12</p> <p>Score</p> <p>12</p>	One soil sample exceeded the SQG for selenium at the surface.	<p>Collect all available information on quality of surface soils (i.e., top 1.5 metres) at the site. Evaluate available data against Canadian Soil Quality Guidelines. Select appropriate guidelines based on current (or proposed future) land use (i.e., agricultural, residential/parkland, commercial, or industrial), and soil texture if applicable (i.e., coarse or fine).</p>	<p>Selected References:</p> <p>CCME, 1999. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health</p> <p><a href="http://www.ccme.ca">www.ccme.ca</a></p>
<p>NOTE: If a score is assigned here for Demonstrated Concentrations in Surface Soils, then you can skip Part B (Potential for a surface soils migration pathway) and go to Section 4 (Vapour)</p>				
B. Potential for a surface soils (top 1.5 m) migration pathway				
<p>a. Are the soils in question covered?</p> <p>Exposec</p> <p>Vegetated</p> <p>Landscaped</p> <p>Paved</p> <p>Do Not Know</p>	<p>6</p> <p>4</p> <p>2</p> <p>0</p> <p>Do Not Know</p> <p>Score</p> <p>4</p>	Known is scored	<p>Consult engineering or risk assessment reports for the site. Alternatively, review photographs or perform a site visit.</p> <p>Landscaped surface soils must include a minimum of 0.5 m of topsoil.</p>	<p>The possibility of contaminants in blowing snow have not been included in the revised NCS as it is difficult to assess what constitutes an unacceptable concentration and secondly, spills to snow or ice are most efficiently mitigated while freezing conditions remain.</p>
<p>b. For what proportion of the year does the site remain covered by snow?</p> <p>0 to 10% of the year</p> <p>10 to 30% of the year</p> <p>More than 30% of the year</p> <p>Do Not Know</p>	<p>6</p> <p>Do Not Know</p> <p>Score</p> <p>3</p>	Known is scored	<p>Consult climatic information for the site. The increments represent the full span from soils which are always wet or covered with snow (and therefore less likely to generate dust) to those soils which are predominantly dry and not covered by snow (and therefore are more likely to generate dust).</p>	
Potential surface soil pathway total	7	<p>Note: If a "known" score is provided, the "potential" score is disallowed.</p>		
Allowed Potential score	---			
Soil pathway total	12			

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(II) Migration Potential (Evaluation of contaminant migration pathways)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>4. Vapour</b>				
<b>A. Demonstrated COPCs in vapour.</b>				
Vapour has been measured (indoor or outdoor) in concentrations exceeding risk based concentrations.	12	No previous investigations included vapours. Potential is scored.	Consult previous investigations, including human health risk assessments, for reports of vapours detected.	
Strongly suspected (based on observations and/or modelling)	9			
Vapour has not been measured and volatile hydrocarbons have not been found in site soils or groundwater.	0			
Score	---			
<b>NOTE: If a score is assigned here for Demonstrated COPCs in Vapour, then you can skip Part B (Potential for COPCs in vapour) and go to Section 5 (Sediment)</b>				
<b>B. Potential for COPCs in vapour</b>				
a. Relative Volatility based on Henry's Law Constant, H' (dimensionless) High (H' > 1.0E-1) Moderate (H' = 1.0E-1 to 1.0E-3) Low (H' < 1.0E-3) Not Volatile Do Not Know	High 4	Toluene and Chlorobenzene both have high volatility based on a H' > 1.0e-1.	Reference: US EPA Soil Screening Guidance (Part 5 - Table 36)  Provided in Attached Reference Materials	If the Henry's Law Constant for a substance indicates that it is not volatile, and a score of zero is assigned here for relative volatility, then the other three questions in this section on Potential for COPCs will be automatically assigned scores of zero and you can skip to section 5.
b. What is the soil grain size? Fine Coarse Do Not Know	Fine 2	Grain size has not been tested but on soil borehole logs indicate silts and clays with some sands.	Review soil permeability data in engineering reports. The greater the permeability of soils, the greater the possible movement of vapours.  Fine-grained soils are defined as those which contain greater than 50% by mass particles less than 75 µm mean diameter (D50 < 75 µm). Coarse-grained soils are defined as those which contain greater than 50% by mass particles greater than 75 µm mean diameter (D50 > 75 µm).	
c. Is the depth to the source less than 10m? Yes No Do Not Know	Yes 2	Source is in the surface.	Review groundwater depths below grade for the site.	
d. Are there any preferential pathways? Yes No Do Not Know	Yes 2	Underground sewage piping could be a preferential pathway.	Visit the site during dry summer conditions and/or review available photographs. Where bedrock is present, fractures would likely act as preferential pathways.	Preferential pathways refer to areas where vapour migration is more likely to occur because there is lower resistance to flow than in the surrounding materials. For example, underground conduits such as sewer and utility lines, drains, or septic systems may serve as preferential pathways. Features of the building itself that may also be preferential pathways include earthen floors, expansion joints, wall cracks, or foundation perforations or subsurface features such as utility pipes, sumps, and drains.
Potential vapour pathway total	10	<b>Note: If a "known" score is provided, the "potential" score is disallowed.</b>		
Allowed Potential score	10			
<b>Vapour pathway total</b>	<b>10</b>			
<b>5. Sediment Movement</b>				
<b>A. Demonstrated migration of sediments containing COPCs</b>				
There is evidence to suggest that sediments originally deposited to the site (exceeding the CCME sediment quality guidelines) have migrated.	12	Unknown, potential is scored.	Review sediment assessment reports. Evidence of migration of contaminants in sediments must be reported by someone experienced in this area.	Usually not considered a significant concern in lakes/marine environments, but could be very important in rivers where transport downstream could be significant.
Strongly suspected (based on observations and/or modelling)	9			
Sediments have been contained and there is no indication that sediments will migrate in future. or Absence of sediment exposure pathway (i.e., within 5 km of the site there are no aquatic receiving environments, and therefore no sediments).	0			
Score	---			
<b>NOTE: If a score is assigned here for Demonstrated Migration of Sediments, then you can skip Part B (Potential for Sediment Migration) and go to Section 6 (Modifying Factors)</b>				

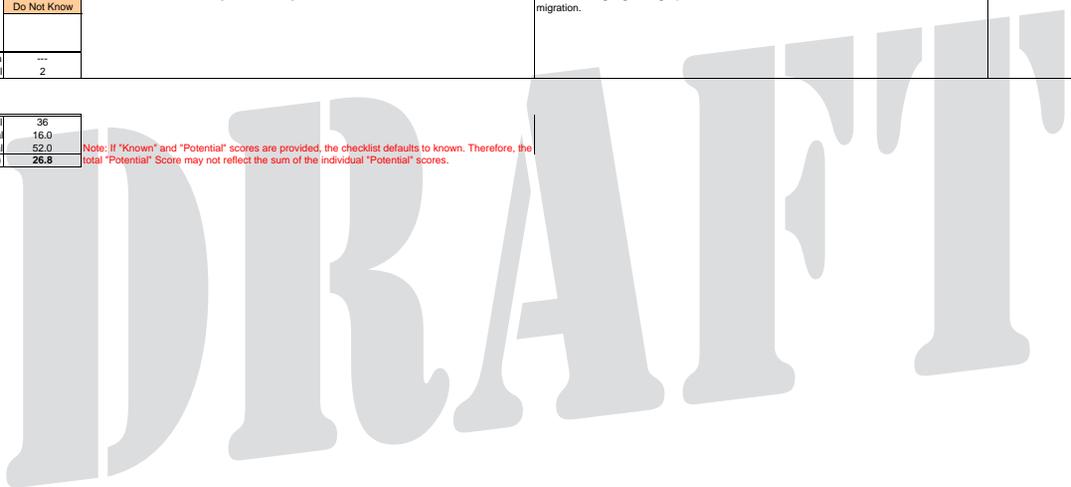
(II) Migration Potential (Evaluation of contaminant migration pathways)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>B. Potential for sediment migration</b>				
a. Are the sediments having COPC exceedances capped with sediments having no exceedances ("clean sediments")? Yes No Do Not Know	No 4	Sediments are in a wetland, not a river or water body. Sediments are not capped.	Review existing sediment assessments. If sediment coring has been completed, it may indicate that historically contaminated sediments have been covered over by newer "clean" sediments. This assessment will require that cores collected demonstrate a low concentration near the top and higher concentration with sediment depth.	
b. For lakes and marine habitats, are the contaminated sediments in shallow water and therefore likely to be affected by tidal action, wave action or propeller wash? Yes No Do Not Know	No 0	No tidal action.	Review existing sediment assessments. If the sediments present at the site are in a river, select "no" for this question.	
c. For rivers, are the contaminated sediments in an area prone to sediment scouring? Yes No Do Not Know	No 0	In the wetland flow is overlaid and no scouring. However downstream there is more of a channel where scouring is possible but samples have not been collected in that area.	Review existing sediment assessments. It is important that the assessment is made under worst case flows (high yearly flows). Under high yearly flows, areas which are commonly depositional may	
Potential sediment pathway total	4			
Allowed Potential score	4			
<b>Sediment pathway total</b>	<b>4</b>	<b>Note: If a "known" score is provided, the "potential" score is disallowed.</b>		
<b>6. Modifying Factors</b>				
Are there subsurface utility conduits in the area affected by contamination? Yes No Do Not Know	Do Not Know	Pipes to transport the sewage from the lift station into the lagoon are present in the subsurface. However, it is unknown if they are affected by the contamination.	Consult existing engineering reports. Subsurface utilities can act as conduits for contaminant migration.	
Known	---			
Potential	2			

Migration Potential Total	
Raw "known" total	36
Raw "potential" total	16.0
Raw combined total	52.0
<b>Total (max 33)</b>	<b>26.8</b>

**Note: If "Known" and "Potential" scores are provided, the checklist defaults to known. Therefore, the total "Potential" Score may not reflect the sum of the individual "Potential" scores.**



(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>1. Human</b>				
<b>A. Known exposure</b>				
Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to humans as a result of the contaminated site. (Class 1 Site*)	22	No documented known human exposures. Potential is scored.	*Where adverse effects on humans are documented, the site should be automatically designated as a Class 1 site (i.e., action required). There is no need to proceed through the NCS in this case. However, a scoring guideline (22) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class 1 sites).	Known adverse impact includes domestic and traditional food sources. Adverse effects based on food chain transfer to humans and/or animals can be scored in this category. However, the weight of evidence must show a direct link of a contaminated food source/supply and subsequent ingestion/transfer to humans. Any associated adverse effects to the environment are scored separately later in this worksheet. Someone experienced must provide a thorough description of the sources researched to evaluate and determine the quantified exposure/impact (adverse effect) in the vicinity of the contaminated site.
Same as above, but "Strongly Suspected" based on observations or indirect evidence.	10		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1 for noncarcinogenic chemicals and incremental cancer risks that exceed acceptable levels defined by the jurisdiction for carcinogenic chemicals (for most jurisdictions this is typically either <math>10^{-5}</math> or <math>10^{-6}</math>). Known impacts can also be evaluated based on blood testing (e.g. blood lead >10 ug/dL) or other health based testing.	
No quantified or suspected exposures/impacts in humans.	0		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 0.2 for non-carcinogenic chemicals and incremental lifetime cancer risks for carcinogenic chemicals that are within acceptable levels as defined by the jurisdiction (for most jurisdictions this is less than either <math>10^{-6}</math> or <math>10^{-5}</math>).	
Score	---			
<b>NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Human Exposure) and go to Section 2 (Human Exposure Modifying Factors)</b>				
<b>B. Potential for human exposure</b>				
a) Land use (provides an indication of potential human exposure scenarios)  Agricultural Residential / Parkland Commercial Industrial Do Not Know		National Parks fall in the agricultural land use.	Review zoning and land use maps over the distances indicated. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place. Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	This is the main "receptor" factor used in site scoring. A higher score implies a greater exposure and/or exposure of more sensitive human receptors (e.g., children).
Score	Agricultural 3			
b. Indicate the level of accessibility to the contaminated portion of the site (e.g., the potential for coming in contact with contamination)  Limited barriers to prevent site access; contamination not covered Moderate access or no intervening barriers, contaminants are covered. Remote locations in which contaminants not covered. Controlled access or remote location and contaminants are covered  Do Not Know		Sewage lagoon is in a locked, fenced area. However the wetland areas are not. The Admin lagoon is in an area of low access, typically only the Park Staff are in the area.	Review location and structures and contaminants at the site and determine if there are intervening barriers between the site and humans. A low rating should be assigned to a (covered) site surrounded by a fence or in a remote location, whereas a high score should be assigned to a site that has no cover, fence, natural barriers or buffer.	
Score	Mod. access, covered 1			
<b>B. Potential for human exposure</b>				
c) Potential for intake of contaminated soil, water, sediment or foods for operable or potentially operable pathways, as identified in Worksheet II (Migration Potential).  i) direct contact Is dermal contact with contaminated surface water, groundwater, sediments or soils anticipated? Yes No Do Not Know		Dermal contact is not anticipated. The lagoon is in a locked fenced area. The wetlands are outside the fence but are located in close proximity to the lagoon and off the road by a minimum of 15 m. However water from the wetlands can flow through a culvert under the road and into a stream near where public may go to view beavers in a pond nearby.	If soils or potable groundwater are present exceeding their respective CCME guidelines, dermal contact is assumed. Exposure to surface water, non-potable groundwater or sediments exceeding their respective CCME guidelines will depend on the site. Select "Yes" if dermal exposure to surface water, non-potable groundwater or sediments is expected. For instance, dermal contact with sediments would not be expected in an active port. Only soils in the top 1.5 m are defined by CCME (2003) as surface soils. If contaminated soils are only located deeper than 1.5 m, direct contact with soils is not anticipated to be an operable contaminant exposure pathway.	Exposure via the skin is generally believed to be a minor exposure route. However for some organic contaminants, skin exposure can play a very important component of overall exposure. Dermal exposure can occur while swimming in contaminated waters, bathing with contaminated surface water/groundwater and digging in contaminated dirt, etc.
Score	Yes 3			
ii) inhalation (i.e., inhalation of dust, vapour)  Vapour - Are there inhabitable buildings on the site within 30 m of soils or groundwater with volatile contamination as determined in Worksheet II (Migration Potential)?  Yes No Do Not Know		No buildings within 30 m.	If inhabitable buildings are on the site within 30 m of soils or groundwater exceeding their respective guidelines for volatile chemicals, there is a potential of risk to human health (Health Canada, 2004). Review site investigations for location of soil samples (having exceedances of volatile substances) relative to buildings. Refer to (II) Migration Potential worksheet, 4B.a), <i>Potential for COPCs in Vapour</i> for a definition of volatility.	Exposure via the lungs (inhalation) can be a very important exposure pathway. Inhalation can be via both particulates (dust) and gas (vapours). Vapours can be a problem where buildings have been built on former industrial sites or where volatile contaminants have migrated below buildings resulting in the potential for vapour intrusion.  Assesses the potential for humans to be exposed to vapours originating from site soils. The closer the receptor is to a source of volatile chemicals in soil, the greater the potential of exposure. Also, coarser-grained soil will convey vapour much more efficiently in the soil than finer grained material such as clays and silts.
Score	No 0			
Dust - If there is contaminated surface soil (e.g. top 1.5 m), indicate whether the soil is fine or coarse textured. If it is known that surface soil is not contaminated, enter a score of zero.  Fine Coarse Surface soil is not contaminated or absent (bedrock) Do Not Know Texture		Surface soils are clay in the lagoon and silts in the wetland.	Consult grain size data for the site. If soils (containing exceedances of the CCME soil quality guidelines) predominantly consist of fine material (having a median grain size of 75 microns; as defined by CCME (2006)) then these soils are more likely to generate dusts.	General Notes: Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a vapour migration and/or dust generation in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.  Selected References: Canadian Council of Ministers of the Environment (CCME). 2006. Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN 1332. <a href="http://www.ccme.ca">www.ccme.ca</a> Golder. 2004. Soil Vapour Intrusion Guidance for Health Canada Screening Level Risk Assessment (SLRA) Submitted to Health Canada, Burnaby, BC
Score	Fine 3			
inhalation total	3			

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>B. Potential for human exposure</b>				
<p>iii) Ingestion (i.e., ingestion of food items, water and soils [for children]), including traditional foods.</p> <p>Drinking Water: Choose a score based on the proximity to a drinking water supply, to indicate the potential for contamination (present or future).</p> <p>0 to 100 m 100 to 300 m 300 m to 1 km 1 to 5 km No drinking water present Do Not Know</p> <p>No drinking water present</p> <p>Score</p> <p>Is an alternative water supply readily available?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Is human ingestion of contaminated soils possible?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Are food items consumed by people, such as plants, domestic animals or wildlife harvested from the contaminated land and its surroundings?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Ingestion total</p> <p>Human Health Total "Potential" Score</p> <p>Allowed "Potential" Score</p>	<p>0</p> <p>Yes</p> <p>0</p> <p>Yes</p> <p>3</p> <p>Yes</p> <p>1</p> <p>4</p> <p>14</p> <p>14</p>	<p>Drinking water is not present on the site.</p> <p>Alternate water supplies are available in the park</p> <p>Contamination is in the surface soils and sediment so ingestion is possible.</p> <p>Traditional plants are allowed to be harvested from the park with a permit. Also bison present in the park are sold at auction and the end use is unknown but could include consumption. Deer, elk and ducks can move out of the park where they could be hunted and consumed. Therefore category is scored as "yes".</p> <p>Note if a "Known" Human Health score is provided, the "Potential" score is disallowed.</p>	<p>Review available site data to determine if drinking water (groundwater, surface water, private, commercial or municipal supply) is known or suspected to be contaminated above Guidelines for Canadian Drinking Water Quality. If drinking water supply is known to be contaminated, some immediate action (e.g., provision of alternate drinking water supply) should be initiated to reduce or eliminate exposure.</p> <p>The evaluation of significant potential for exceedances of the water supply in the future may be based on the capture zones of the drinking water wells; contaminant travel times; computer modelling of flow and contaminant transport.</p> <p>If contaminated soils are located within the top 1.5 m, it is assumed that ingestion of soils is an operable exposure pathway. Exposure to soils deeper than 1.5 m is possible, but less likely, and the duration is shorter. Refer to human health risk assessment reports for the site in question.</p> <p>Use human health risk assessment reports (or others) to determine if there is significant reliance on traditional food sources associated with the site. Is the food item in question going to spend a large proportion of its time at the site (e.g., large mammals may spend a very small amount of time at a small contaminated site)? Human health risk assessment reports for the site in question will also provide information on potential bioaccumulation of the COPC in question.</p>	<p><b>Selected References:</b> Guidelines for Canadian Drinking Water Quality: <a href="http://www.hc-sc.gc.ca/hec/sesc/water/publications/drinking_water_quality_guidelines/toc.htm">www.hc-sc.gc.ca/hec/sesc/water/publications/drinking_water_quality_guidelines/toc.htm</a></p> <p>Drinking water can be an extremely important exposure pathway to humans. If site groundwater or surface water is not used for drinking, then this pathway is considered to be inoperable.</p> <p>Consider both wild foods such as salmon, venison, caribou, as well as agricultural sources of food items if the contaminated site is on or adjacent to agricultural land uses.</p>
<b>2. Human Exposure Modifying Factors</b>				
<p>a) Strong reliance of local people on natural resources for survival (i.e., food, water, shelter, etc.)</p> <p>Yes No Do Not Know</p> <p>Known</p> <p>Potential</p> <p>Raw Human "known" total</p> <p>Raw Human "potential" total</p> <p>Raw Human Exposure Total Score</p> <p>Human Health Total (max 22)</p>	<p>No</p> <p>0</p> <p>---</p> <p>0</p> <p>14</p> <p>14</p> <p>14.0</p>	<p>No, there are communities close by that provide these services. The consumption described above is not a strong reliance.</p>		
<b>3. Ecological</b>				
<b>A. Known exposure</b>				
<p>Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to terrestrial or aquatic organisms as a result of the contaminated site.</p> <p>Score</p>	<p>18</p>	<p>Potential scored, No documented evidence.</p>	<p>Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are deemed to be severe, the site may be categorized as class one (i.e., a priority for remediation or risk management), regardless of the numerical total NCS score. For the purpose of application of the NCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction. If ecological effects are determined to be severe and an automatic Class 1 is assigned, there is no need to proceed through the NCS. However, a scoring guideline (18) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class 1 sites).</p> <p>This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients &gt;1. Alternatively, known impacts can also be evaluated based on a weight of evidence assessment involving a combination of site observations, tissue testing, toxicity testing and quantitative community assessments. Scoring of adverse effects on individual rare or endangered species will be completed on a case-by-case basis with full scientific justification.</p> <p>This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 1 and no other observable or measurable sign of impacts. Alternatively, it can be based on a combination of other lines of evidence showing no adverse effects, such as site observations, tissue testing, toxicity testing and quantitative community assessments.</p>	<p>CCME, 1999: Canadian Water Quality Guidelines for the Protection of Aquatic Life. <a href="http://www.ccme.ca">www.ccme.ca</a></p> <p>CCME, 1999: Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses. <a href="http://www.ccme.ca">www.ccme.ca</a></p> <p>Sensitive receptors- review: Canadian Council on Ecological Areas; <a href="http://www.ccea.org">www.ccea.org</a></p> <p>Ecological effects should be evaluated at a population or community level, as opposed to at the level of individuals. For example, population-level effects could include reduced reproduction, growth or survival in a species. Community-level effects could include reduced species diversity or relative abundances. Further discussion of ecological assessment endpoints is provided in <i>A Framework for Ecological Risk Assessment: General Guidance</i> (CCME 1996).</p> <p>Notes: Someone experienced must provide a thorough description of the sources researched to classify the environmental receptors in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.</p>
<p>Same as above, but "Strongly Suspected" based on observations or indirect evidence.</p> <p>Score</p>	<p>12</p>			
<p>No quantified or suspected exposures/impacts in terrestrial or aquatic organisms</p> <p>Score</p>	<p>0</p> <p>Go to Potential</p> <p>---</p>			
<p><b>NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Ecological Exposure) and go to Section 4 (Ecological Exposure Modifying Factors)</b></p>				

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
<b>B. Potential for ecological exposure (for the contaminated portion of the site)</b>				
a) Terrestrial i) Land use Agricultural (or Wild lands) Residential/Parkland Commercial Industrial Do Not Know	Agricultural (or Wild lands) Score 3	National park falls in agricultural land use/Wild Lands	Review zoning and land use maps. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place (indicate in the worksheet that future land use is the consideration).  Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Wild lands are grouped with agricultural land due to the similarities in receptors that would be expected to occur there (e.g., herbivorous mammals and birds) and the similar need for a high level of protection to ensure ecological functioning. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	
ii) Uptake potential  Direct Contact - Are plants and/or soil invertebrates likely exposed to contaminated soils at the site? Yes No Do Not Know	Yes   Score 1	There is potential for direct contact with contamination in surface sediments. Beavers are present in the area and inside the lagoon.	If contaminated soils are located within the top 1.5 m, it is assumed that direct contact of soils with plants and soil invertebrates is an operable exposure pathway. Exposure to soils deeper than 1.5 m is possible, but less likely.	
iii) Ingestion (i.e., wildlife or domestic animals ingesting contaminated food items, soils or water) Are terrestrial animals likely to be ingesting contaminated water at the site? Yes No Do Not Know	Yes   Score 1	Beavers are present in the lagoons.	Refer to an Ecological Risk Assessment for the site. If there is contaminated surface water at the site, assume that terrestrial organisms will ingest it.	
Are terrestrial animals likely to be ingesting contaminated soils at the site? Yes No Do Not Know	Yes   Score 1	PAHs, DDD/DDE/DDT have log Kow greater than 4.	Refer to an Ecological Risk Assessment report. Most animals will co-ingest some soil while eating plant matter or soil invertebrates.	
Can the contamination identified bioaccumulate? Yes No Do Not Know	Yes   Score 1			
Distance to sensitive terrestrial ecological area 0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know	0 to 300 m     Score 3	National parks are considered sensitive terrestrial ecological areas. Bison are present in the park.	Bioaccumulation of contaminants within food items is considered possible if: 1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in soils exceed the most conservative CCME soil quality guideline for the intended land use, or 2) The contaminant in collected tissue samples exceeds the Canadian Tissue Residue Guidelines.	Environmental receptors include: local, regional or provincial species of interest or significance; arctic environments (on a site specific basis); nature preserves, habitats for species at risk, sensitive forests, natural parks or forests.
Raw Terrestrial Total Potential Allowed Terrestrial Total Potential	10 10	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
<b>B. Potential for ecological exposure (for the contaminated portion of the site)</b>				
b) Aquatic i) Classification of aquatic environment Sensitive Typical Not Applicable (no aquatic environment present) Do Not Know	Sensitive   Score 3	There is a Trumpeter Swan reintroduction program in Elk Island NP. Therefore it was rated as a sensitive aquatic environment.	"Sensitive aquatic environments" include those in or adjacent to shellfish or fish harvesting areas, marine parks, ecological reserves and fish migration paths. Also includes those areas deemed to have ecological significance such as for fish food resources, spawning areas or having rare or endangered species.  "Typical aquatic environments" include those in areas other than those listed above.	
ii) Uptake potential  Does groundwater daylighting to an aquatic environment exceed the CCME water quality guidelines for the protection of aquatic life at the point of contact? Yes No (or Not Applicable) Do Not Know	Do Not Know   Score 0.5	Groundwater is above CCME FIGQG but it is unknown if the groundwater is daylighting to an aquatic environment.	Groundwater concentrations of contaminants at the point of contact with an aquatic receiving environment can be estimated in three ways: 1) by comparing collected nearshore groundwater concentrations to the CCME water quality guidelines (this will be a conservative comparison, as contaminant concentrations in groundwater often decrease between nearshore wells and the point of discharge). 2) by conducting groundwater modeling to estimate the concentration of groundwater immediately before discharge. 3) by installing water samplers, "peepers", in the sediments in the area of daylighting groundwater.	
Distance from the contaminated site to an important surface water resource 0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know	0 to 300 m     Score 3	Astotin lake is 220m away based on a straight line path, however flow path would be over 300 m. Because it is inside a NP it is considered to be an important SW resource. To be conservative, the 220m distance to water body was used.	It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor or important water resource located within this area of the site will be subject to further evaluation. It is also considered that any environmental receptor located greater than 5 km away will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link: <a href="http://www.ccea.org">www.ccea.org</a> .	Environmental receptors include: local, regional or provincial species of interest or significance, sensitive wetlands and fens and other aquatic environments.
			Bioaccumulation of food items is possible if:	

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Administration Area Sewage Lagoon Elk Island National Park

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
Are aquatic species (i.e., forage fish, invertebrates or plants) that are consumed by predatory fish or wildlife consumers, such as mammals and birds, likely to accumulate contaminants in their tissues? Yes No Do Not Know	Yes 1 Score 1	PAHs, DDD/DDE/DDT have log Kow greater than 4.	1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in sediments exceed the CCME ISQGs. 2) The contaminant in collected tissue samples exceeds the CCME tissue quality guidelines.	
Raw Aquatic Total Potential Allowed Aquatic Total Potential	7.5 7.5	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
<b>4. Ecological Exposure Modifying Factors</b>				
a) Known occurrence of a species at risk. Is there a potential for a species at risk to be present at the site? Yes No Do Not Know	Yes 2 Score ---	Plain Bison, Elk and Trumpeter Swan reintroduction and breeding programs occur in the park. Tiger Salamanders are also present in the park.	Consult any ecological risk assessment reports. If information is not present, utilize on-line databases such as Eco Explorer, Regional, Provincial (Environment Ministries), or Federal staff (Fisheries and Oceans or Environment Canada) should be able to provide some guidance.	Species at risk include those that are extirpated, endangered, threatened, or of special concern. For a list of species at risk, consult Schedule 1 of the federal Species at Risk Act ( <a href="http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1">http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1</a> ). Many provincial governments may also provide regionally applicable lists of species at risk. For example, in British Columbia, consult: BCMWVLP, 2005. Endangered Species and Ecosystems in British Columbia. Provincial red and blue lists, Ministry of Sustainable Resource Management and Water, Land and Air Protection. <a href="http://srmmww.gov.bc.ca/atrisk/red-blue.htm">http://srmmww.gov.bc.ca/atrisk/red-blue.htm</a>
b) Potential impact of aesthetics (e.g., enrichment of a lake or tainting of food flavor). Is there evidence of aesthetic impact to receiving water bodies? Yes No Do Not Know Is there evidence of olfactory impact (i.e., unpleasant smell)? Yes No Do Not Know Is there evidence of increase in plant growth in the lake or water body? Yes No Do Not Know Is there evidence that fish or meat taken from or adjacent to the site smells or tastes different? Yes No Do Not Know	Do Not Know --- 1 No 0 --- Do Not Know --- 1 Do Not Know --- 1 Ecological Modifying Factors Total - Known Ecological Modifying Factors Total - Potential Raw Ecological Total - Known Raw Ecological Total - Potential Raw Ecological Total Ecological Total (Max 18)	Not investigated  The lagoon has an unpleasant smell from the sewage but not from the contaminants.  Not investigated  Not investigated	Documentation may consist of environmental investigation reports, press articles, petitions or other records.  Examples of olfactory change can include the smell of a COPC or an increase in the rate of decay in an aquatic habitat.  A distinct increase of plant growth in an aquatic environment may suggest enrichment. Nutrients e.g., nitrogen or phosphorous releases to an aquatic body can act as a fertilizer.  Some contaminants can result in a distinctive change in the way food gathered from the site tastes or smells.	This Item will require some level of documentation by user, including contact names, addresses, phone numbers, e-mail addresses. Evidence of changes must be documented, please attach copy of report containing relevant information.
<b>5. Other Potential Contaminant Receptors</b>				
a) Exposure of permafrost (leading to erosion and structural concerns) Are there improvements (roads, buildings) at the site dependant upon the permafrost for structural integrity? Yes No Do Not Know Is there a physical pathway which can transport soils released by damaged permafrost to a nearby aquatic environment? Yes No Do Not Know	No 0 --- No 0 ---	permafrost is not present  permafrost is not present	Consult engineering reports, site plans or air photos of the site. When permafrost melts, the stability of the soil decreases, leading to erosion. Human structures, such as roads and/or buildings are often dependent on the stability that the permafrost provides.  Melting permafrost leads to a decreased stability of underlying soils. Wind or surface run-off erosion can carry soils into nearby aquatic habitats. The increased soil loadings into a river can cause an increase in total dissolved solids and a resulting decrease in aquatic habitat quality. In addition, the erosion can bring contaminants from soils to aquatic environments.	Plants and lichens provide a natural insulating layer which will help prevent thawing of the permafrost during the summer. Plants and lichens may also absorb less solar radiation. Solar radiation is turned into heat which can also cause underlying permafrost to melt.
Other Potential Receptors Total - Known Other Potential Receptors Total - Potential	0 0			
<b>Exposure Total</b>				
Raw Human Health + Ecological Total - Known Raw Human Health + Ecological Total - Potential Raw Total Exposure Total (max 34)	2 34.5 36.5 27.0	Only includes "Allowed potential" - if a "Known" score was supplied under a given category then the "Potential" score was not included.		

**CCME National Classification System (2008, 2010 v 1.2)  
Score Summary**

Scores from individual worksheets are tallied in this worksheet.  
Refer to this sheet after filling out the revised NCS completely.

**I. Contaminant Characteristics**

	Known	Potential
1. Residency Media	8	---
2. Chemical Hazard	8	---
3. Contaminant Exceedance Factor	6	---
4. Contaminant Quantity	6	---
5. Modifying Factors	7	---

**Raw Total Score** 35 0

**Raw Total Score (Known + Potential)** 35

**Adjusted Total Score (Raw Total / 40 \* 33)** 28.9 (max 33)

**II. Migration Potential**

	Known	Potential
1. Groundwater Movement	12	---
2. Surface Water Movement	12	---
3. Soil	12	---
4. Vapour	---	10
5. Sediment Movement	---	4
6. Modifying Factors	---	2

**Raw Total Score** 36 16

**Raw Total Score (Known + Potential)** 52

**Adjusted Total Score (Raw Total / 64 \* 33)** 26.8 (max 33)

**III. Exposure**

	Known	Potential
1. Human Receptors		
A. Known Impact	---	
B. Potential		
a. Land Use		3
b. Accessibility		1
c. Exposure Route		
i. Direct Contact		3
ii. Inhalation		3
iii. Ingestion		4
2. Human Receptors Modifying Factors	0	---
<b>Raw Total Human Score</b>	0	14

Raw Total Human Score (Known + Potential) 14

Adjusted Total Human Score 14.0 (maximum 22)

3. Ecological Receptors

A. Known Impact	---	
B. Potential		
a. Terrestrial		10
b. Aquatic		7.5
4. Ecological Receptors Modifying Factors	2	3
<b>Raw Total Ecological Score</b>	2	20.5

Raw Total Ecological Score (Known + Potential) 22.5

Adjusted Total Ecological Score 18.0 (maximum 18)

5. Other Receptors

	0	0
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Total Other Receptors Score (Known + Potential) 0

**Total Exposure Score (Human + Ecological + Other)** 32.0

**Adjusted Total Exposure Score (Total Exposure / 46 \* 34)** 23.7 (max 34)

**Site Score**

Administration Area Sewage Lagoon Elk Island National Park

**Site Letter Grade** D

**Certainty Percentage** 69%

**% Responses that are "Do Not Know"** 7%

**Total NCS Score for site** 79.3

**Site Classification Category** 1

**Site Classification Categories\*:**

Class 1 - High Priority for Action (Total NCS Score >70)

Class 2 - Medium Priority for Action (Total NCS Score 50 - 69.9)

Class 3 - Low Priority for Action (Total NCS Score 37 - 49.9)

Class N - Not a Priority for Action (Total NCS Score <37)

Class INS - Insufficient Information (>15% of responses are "Do Not Know")

\* NOTE: The term "action" in the above categories does not necessarily refer to remediation, but could also include risk assessment, risk management or further site characterization and data collection.