PINE POINT MINING LIMITED

Confirmation and Exploration Program
Water Licence and Land Use Permit Application
Comments on Information Request Responses
April 2021

Source:	Comments on Technical Session Information Request (IR) Responses
Topic:	Groundwater Management Plan Framework and Approach for Compatibility
Comment Numbers:	GNWT-1 to GNWT-5, GNWT-7 and GNWT-8, MVLWB-2 to MVLWB-5, and MVLWB-6

1.0 Background

On 27 November 2020, Pine Point Mining Ltd. (PPML) submitted applications to the Mackenzie Valley Land and Water Board (MVLWB) for the Confirmation and Exploration Program (CEP) at Pine Point, Northwest Territories (NWT). Groundwater tests are proposed as part of the CEP (Section 9 of the Project Description) to provide information required for developing the water management plan for the proposed mining project. As part of these groundwater tests, water from an existing open pit will be pumped to another pit. Similarly, water from a groundwater well will be pumped and reinjected into another well within the same aquifer. There may also be an opportunity to transfer water from an existing open pit to an injection well. Locations are still to be selected, but the source and receiving locations will be close enough to minimize pipeline and pumping distances while not unduly impacting the results from groundwater re-circulation.

A Groundwater Management Plan Framework was submitted as part of the application, with the recognition that a final plan would be submitted to the MVLWB for approval prior to conducting the groundwater testing program. During the technical sessions on 24 and 25 February, PPML agreed to provide additional information on the criteria that may be used to determine compatibility for the water transfers. The response to Information Request (IR) #2 provided PPML's initial thoughts on the process for determining compatibility. PPML received follow-up comments on the IRs, including IRs #1, #2, and #3. The following provides additional information to address comments from the Government of the Northwest Territories (GNWT) and the MVLWB on the IRs, including GNWT-1 to GNWT-5, GNWT-7, GNWT-8, and MVLWB-2 to MVLWB-6.

2.0 Spatial Analysis (GNWT-1, GNWT-2, GNWT-3, and GNWT-4)

The following provides a review of the spatial variability of the available water quality data in the pits located within the historical Pine Point Mine site to address comments from GNWT, including GNWT-1, GNWT-2, GNWT-3, and GNWT-4.

2.1 Methods

2.1.1 Available Water Quality Data

Data from 13 pits located within the historical Pine Point Mine were used to demonstrate the spatial variability of water quality conditions (Figure 1). The data were collected as part of various programs in 2005 (EBA 2005), 2017 (non-reported data collected by PPML), 2018 (Maskwa 2018; non-reported data collected by PPML), and 2020 (Golder 2021). These data (provided in Appendix A) represent water samples generally collected at the surface; however, additional samples collected at the mid-depth of the water column or at the depth of maximum specific conductivity were collected as part of the 2020 program (Golder 2021). Water column profile in situ physico-chemical water quality field measurements of temperature, dissolved oxygen (DO), specific conductivity, and pH are also included, which were collected as part of the 2018 and 2020 sampling programs (Maskwa 2018; Golder 2021). The suite of analyzed parameters varied between programs, but generally consisted of the following:

- conventional parameters — pH, specific conductivity, hardness, acidity, total alkalinity, total dissolved solids (TDS), total suspended solids, turbidity, and colour
- major ions — bicarbonate, bromide, calcium, carbonate, chloride, fluoride, magnesium, potassium, sodium, and sulphate
- nutrients — nitrate, nitrite, total ammonia, total nitrogen, total Kjeldahl nitrogen, total and dissolved phosphorus, orthophosphate, and total and dissolved organic carbon
- total and dissolved metals — aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silicon, silver, strontium, sulphur, thallium, tin, titanium, uranium, vanadium, and zinc

Figure 1 – Historical Pine Point Mine Pit Locations with Available Water Quality Data

2.1.2 Spatial Analysis and Pit Compatibility for Water Transfers

PPML has proposed a multi-step decision tree for determining the compatibility for pit water transfers during mine operations (Appendix B). Prior to any activation of water transfer, field data and water samples will be collected in the source pit and the receiving pit for detailed chemical analysis (refer to the response to GNWT-8). Briefly, if the concentration of TDS in the source pit selected for transfer is within 30% of the concentration of TDS in the pit identified to receive the water transfer, then the pit water quality is considered compatible. However, before the transfer between pits can be initiated, a secondary screening step has been included to account for parameters that have the potential to occur in concentrations considered anomalous based on the range of available data for the majority of the pits, which could potentially limit the water transfer (see Section 2.2.2).

To support this compatibility decision for the mine water management plan, all available pit water quality data were reviewed to demonstrate the validity of this approach and to identify any spatial variability of water quality conditions in the pits that may require a modification to this approach. To facilitate this assessment, the pits were grouped according to the spatial zones presented in the PPML Project Description (PPML 2020). Following, a series of figures are presented focusing on TDS and parameters with concentrations measured above water quality chronic guidelines for the protection of aquatic life (CCME 1999; BC ENV 2019).

2.2 Results

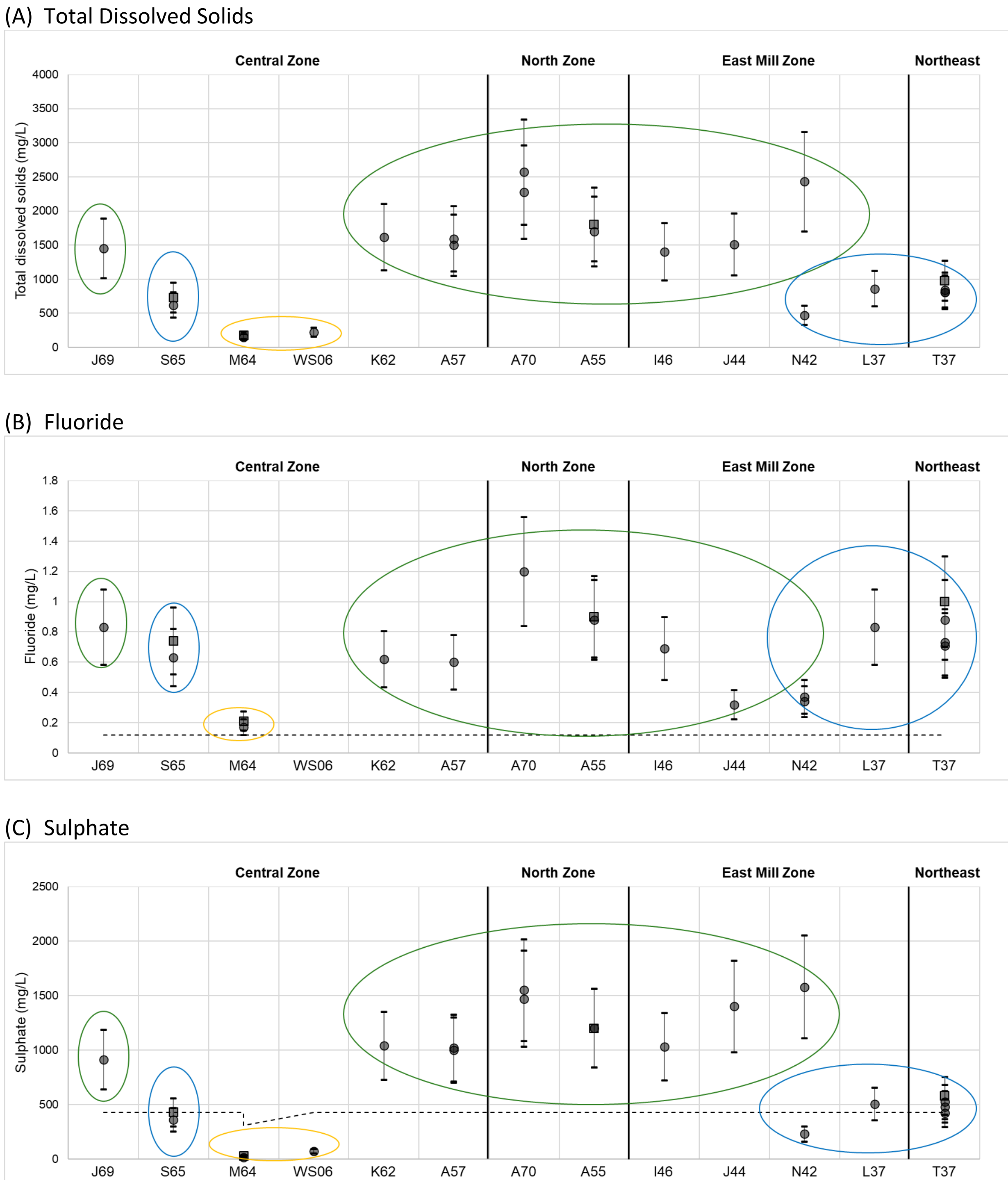
The water quality data included in the review are presented in Appendix A, Table A-1.

2.2.1 TDS and Major Ions

Concentrations of TDS (specifically calculated TDS) and major ions varied across the pits, with concentrations of TDS ranging from 150 mg/L to 2,570 mg/L (Table A-1 and Figure 2A). However, when considering the proposed threshold for compatibility of plus or minus (±) 30% in the concentration of TDS, the pits fall within one of three groups based on TDS concentrations, as indicated by the yellow, blue, and green coloured circles on Figure 2A. These groups approximate less than 500 mg/L, 500 to 1,500 mg/L, and greater than 1,500 mg/L. Concentrations of the major ions, particularly fluoride and sulphate, which are measured above CCME (1999) and BC ENV (2019) protection of aquatic life guidelines, respectively, follow the same spatial pattern as TDS, supporting the spatial grouping of the pits (Figures 2B and 2C).

2.2.1 Metals

Concentrations of nine metals (i.e., aluminum, cadmium, chromium, copper, iron, lead, thallium, uranium, and dissolved zinc) were measured above the Canadian Council of Ministers of the Environment (CCME) chronic guidelines (CCME 1999) in one or more of the pit samples (Figure 3) and thus, along with TDS, fluoride, and sulphate, were also a focus of the data review. Concentrations of these metals in most pits fell within the pit water quality grouping identified using TDS as an indicator of compatibility (Figure 3). However, anomalous concentrations, indicated by red circles in Figure 3, were identified in one to two pits for most of these focus metals, indicating the potential for a compatibility issue simply based using the TDS groupings. As a result, a secondary screening step was included in the decision tree (Appendix B) to evaluate the potential for water transfer if anomalous results are encountered during the data review process.

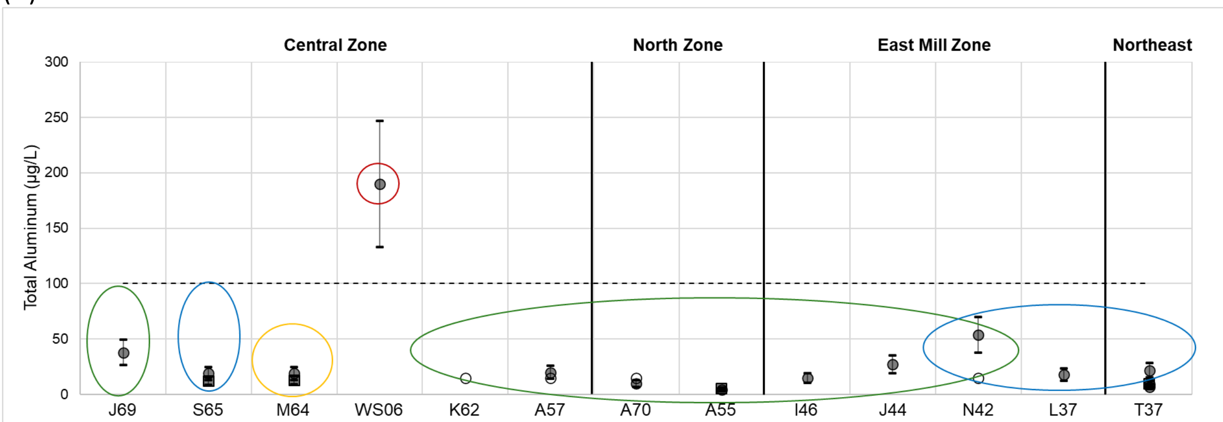


Notes: Surface sample results are represented by the circle markers and sample results collected at mid-depth or the depth of maximum conductivity are represented by the square markers. The dashed line represents the interim CCME (1999) fluoride and BC ENV (2019) sulphate chronic guidelines for the protection of aquatic life. The black bars represent ±30% of the measured concentrations. The green, blue, and yellow circles represent groups of pits with compatible water quality.

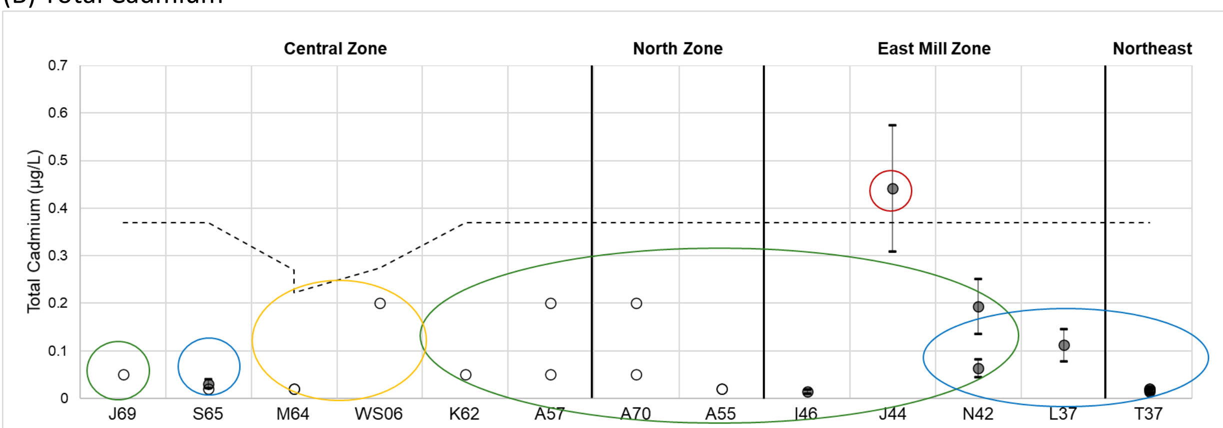
CCME = Canadian Council of Ministers of the Environment; BC ENV = British Columbia Ministry of Environment and Climate Change Strategy.

Figure 2 – Concentrations of Total Dissolved Solids, Fluoride, and Sulphate in Pits Located within the Historical Pine Point Mine Site

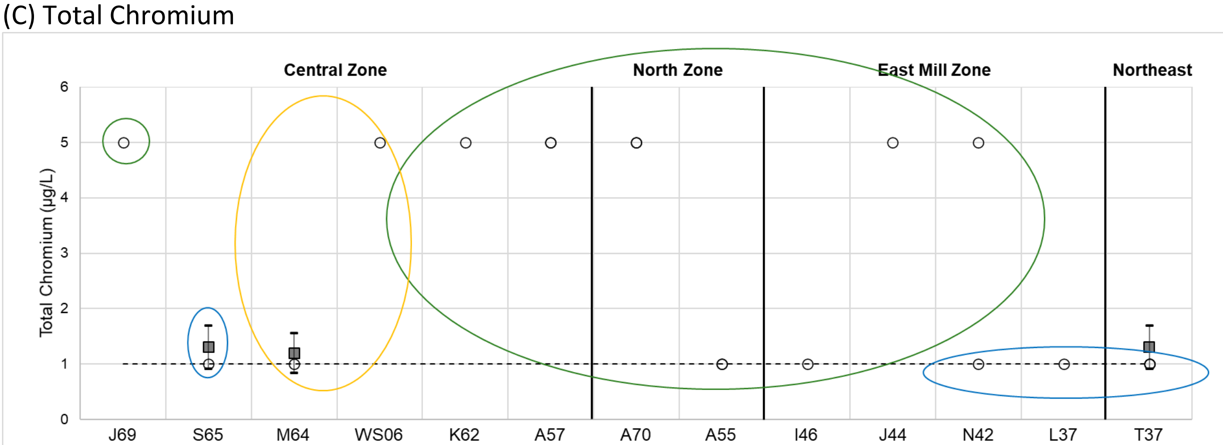
(A) Total Aluminum



(B) Total Cadmium



(C) Total Chromium

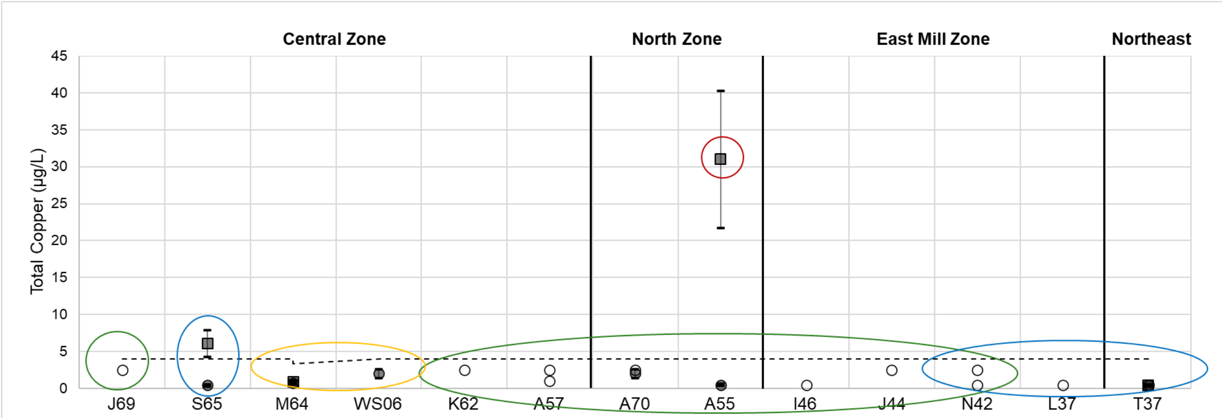


Notes: Surface sample results are represented by the circle markers and sample results collected at mid-depth or the depth of maximum conductivity are represented by the square markers. The dashed line represents the CCME (1999) chronic guidelines for the protection of aquatic life. The black bars represent ± 30% of the measured concentrations. The green, blue, and yellow circles represent groups of pits with compatible water quality. Red circles indicate concentrations greater than 30% of concentrations within the pit grouping.

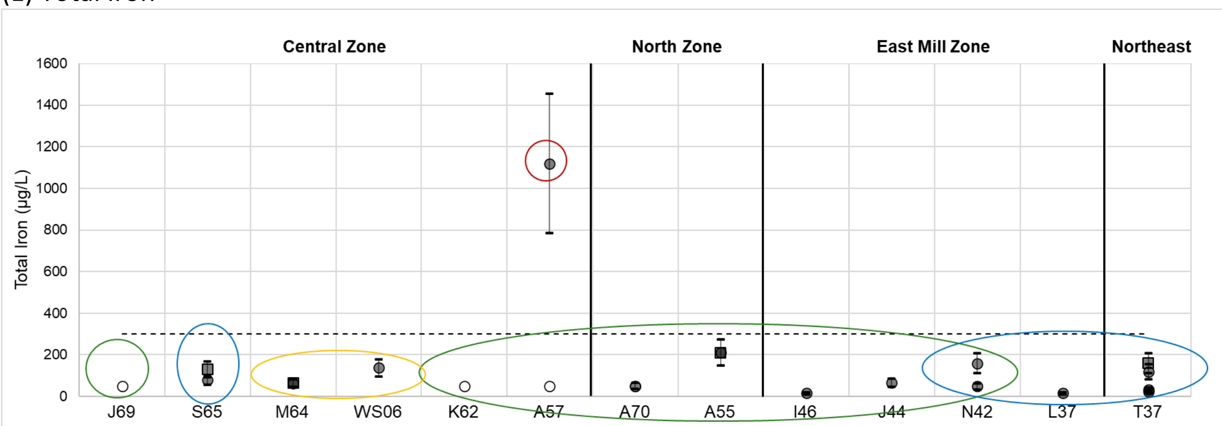
CCME = Canadian Council of Ministers of the Environment.

Figure 3 – Concentrations of Select Metals in Pits Located within the Historical Pine Point Mine Site

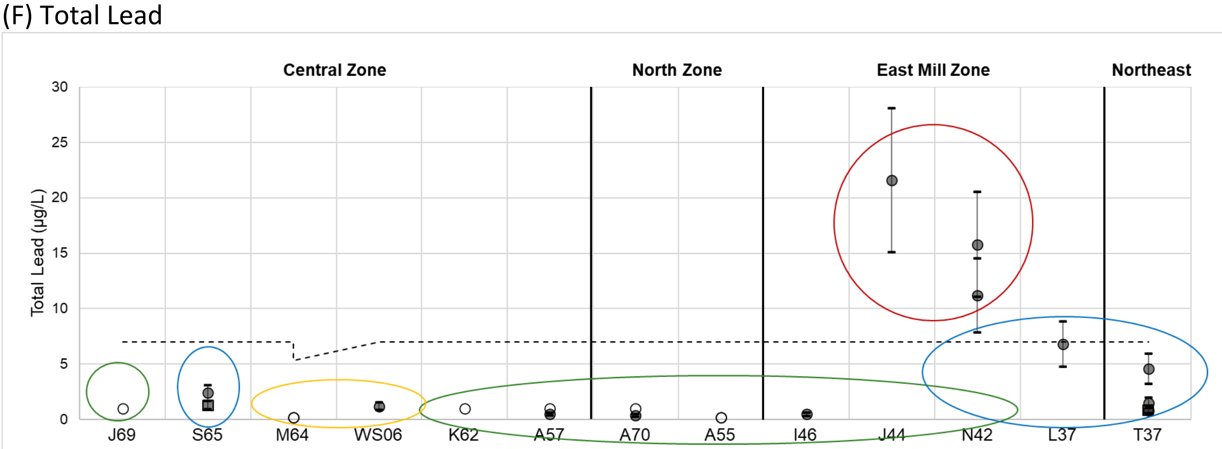
(D) Total Copper



(E) Total Iron



(F) Total Lead

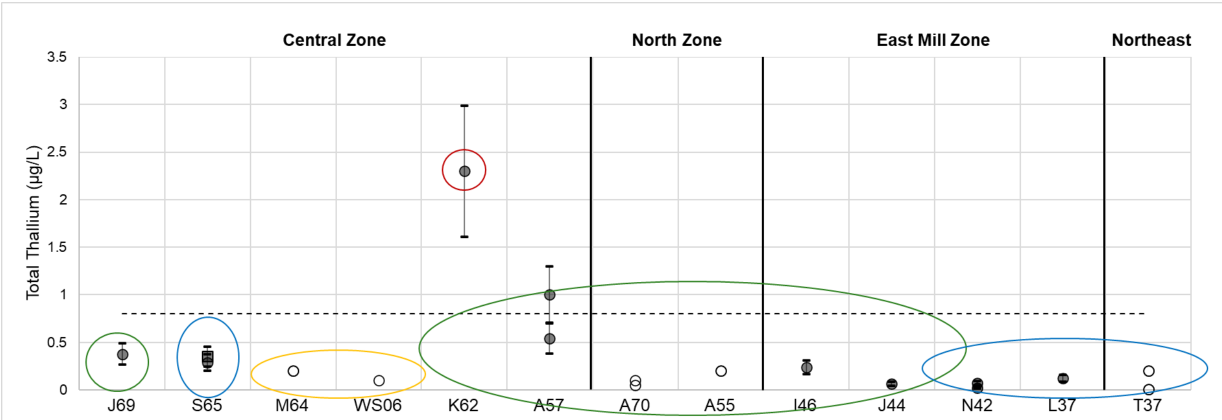


Notes: Surface sample results are represented by the circle markers and sample results collected at mid-depth or the depth of maximum conductivity are represented by the square markers. The dashed line represents the CCME (1999) chronic guidelines for the protection of aquatic life. The black bars represent ±30% of the measured concentrations. The green, blue, and yellow circles represent groups of pits with compatible water quality. Red circles indicate concentrations greater than 30% of concentrations within the pit grouping.

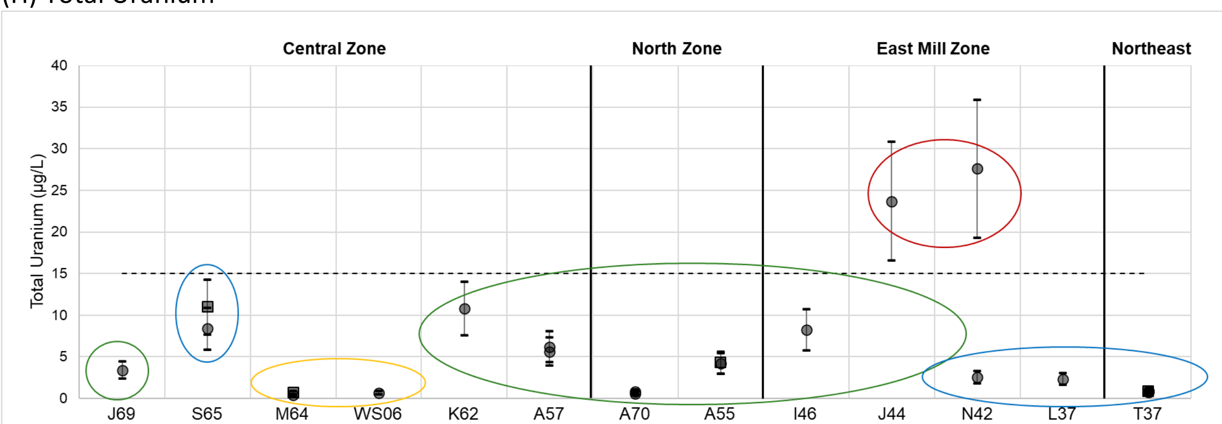
CCME = Canadian Council of Ministers of the Environment.

Figure 3 – Concentrations of Select Metals in Pits Located within the Historical Pine Point Mine Site

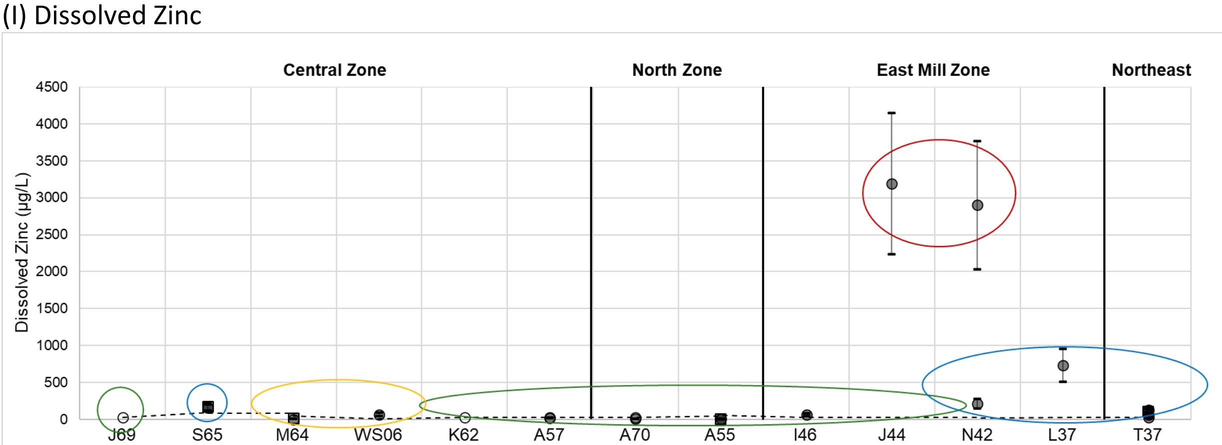
(G) Total Thallium



(H) Total Uranium



(I) Dissolved Zinc



Notes: Surface sample results are represented by the circle markers and sample results collected at mid-depth or the depth of maximum conductivity are represented by the square markers. The dashed line represents the CCME (1999) chronic guidelines for the protection of aquatic life. The black bars represent ±30% of the measured concentrations. The green, blue, and yellow circles represent groups of pits with compatible water quality. Red circles indicate concentrations greater than 30% of concentrations within the pit grouping.

CCME = Canadian Council of Ministers of the Environment.

Figure 3 – Concentrations of Select Metals in Pits Located within the Historical Pine Point Mine Site

3.0 Conclusion

In summary, the pit water grouping using three ranges of TDS concentrations from available data provides the primary basis for activating pit water transfers. For the other focus parameters (i.e., fluoride, sulphate, aluminum, cadmium, chromium, copper, iron, lead, thallium, uranium, and dissolved zinc), their concentrations in the pits either mostly align with the TDS grouping or are very consistent across all TDS groupings. However, the available data show that there may be occasions were some of these focus metals concentrations may be measured outside of expected ranges, which do not align with other pits data or the TDS groupings. The activation of any transfer, therefore, will be based on confirmation through field physico-chemical measurements and an analysis of samples from source and receiving pits. Emphasis will be placed on TDS to initially confirm the receiving pit, with a secondary screening step of the focus parameters before water transfer is activated, or to trigger mitigation or to seek an alternate receiving pit.

4.0 Sampling Methods for Pit and Well Transfers (GNWT-8)

The following provides additional information on sampling methods for source and receiving pits and wells prior to conducting the groundwater tests to address GNWT-8.

Prior to initiating groundwater tests in the pits or transferring water between pits, physico-chemical water column profile measurements (i.e., specific conductivity, dissolved oxygen, pH, and temperature) and a water sample will be collected from the pumping source pit or well and from the receiving pit or well for detailed chemical analysis. If a discernible chemocline in a pit is present where a deeper portion of the pit possesses a higher TDS compared to the surface waters (where the deeper zone possesses >20% higher TDS), then two samples will be collected: a surface sample and a sample from the deeper zone. The analytical testing of samples will include a full suite of water quality parameters:

- Physical parameters – total suspended solids and turbidity
- Major ions – total alkalinity, bicarbonate/carbonate, calcium, chloride, fluoride, hardness, magnesium, potassium, reactive silica, sodium, sulphate, and calculated TDS
- Nutrients – total phosphorus, total dissolved phosphorus, orthophosphate/filterable reactive phosphorus, total nitrogen, nitrate, nitrite, total ammonia, and dissolved and total organic carbon
- Total and dissolved metals – aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, cesium, cobalt, copper, chromium, hexavalent chromium, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, selenium, silver, strontium, thallium, titanium, uranium, vanadium, zinc
- Radionuclides – Radium 226

Data from water column profile measurements will be used initially to determine the compatibility of the water sources through an evaluation of the depth-averaged TDS concentration. A specific conductivity to TDS (calculated) relationship can be developed from available data to rapidly transform water column specific conductivity data to TDS estimates in the field. If waters are determined to be compatible based on this field comparison, the laboratory results from the water sample collection will then be reviewed once available to confirm that there are no anomalous parameter results that may exclude water transfer.

To calculate the depth-averaged TDS concentration, the calculated TDS: field specific conductivity relationship will be established for the pit waters across the site. This relationship can initially be established for all pit waters in the project area, and if the coefficient of correlation is less than 0.8, it can be further assessed at the TDS grouping level to identify if there is a better relationship at the grouping level. The relationship (or relationships) can also be updated as new data are collected over time. Using this approach, an estimate of depth-averaged TDS concentration can be provided as soon as specific conductivity field data are collected from each depth interval through the water column. As shown in Golder (2020, 2021), some pits possess a chemocline, where a lower specific conductivity surface water zone overlies a deeper higher specific conductivity zone. Similarly, a depth averaged TDS concentration in the receiving pit would appropriately be used to assess its compatibility, as the receiving pit water would be expected to mix with the pumped pit inflow. The depth-averaged TDS concentration would be the average estimated TDS with depth determined from the specific conductivity measurements.

A similar approach would be developed for the source and injection wells.

5.0 Compatibility Testing/Screening Approach (GNWT-5, GNWT-7, MVLWB-2 to MVLWB-5)

The following provides information related to the compatibility testing and screening approach, the use of TDS for determining compatibility, and that the approach is protective.

The spatial review of available data indicates that using ±30% of TDS concentrations as an indicator of pit water quality compatibility is applicable for grouping the pits for water transfer. Three ranges of TDS concentrations were initially defined based on the general characteristics of the pit waters and, based on the results of the spatial review, have been refined on a spatial basis (Figures 2 and 3). These groupings also apply to major ions and most metals, with occasional anomalous concentrations of select metals identified. PPML has applied a similar compatibility approach for water transfers to well to well transfers, and pit to well transfers (Appendix B).

To address the identification of the occasional anomalously high focus parameter concentrations identified in the pit waters (Figures 2 and 3), the compatibility decision trees developed for pit to pit, well to well, and pit to well transfers (Appendix B) have incorporated a secondary screening step to guide decision making for pit transfers where parameters fall outside of their concentration range in the three TDS groupings. This screening complies with GNWT’s request (GNWT-5) for an additional screening step in the decision-making process and involves an initial additional sampling to confirm these parameter concentrations are anomalous (i.e., more than 30% higher than concentrations within the pit grouping or the pit/well identified to receive the water transfer). If the concentrations are confirmed to be greater than 30% higher than concentrations in the pit identified to receive the water transfer, other mitigation options would be considered. These include limiting water transfer between pits so that water is only transferred from pits with lower concentrations of TDS and/or metals to pits with higher concentrations, identifying a new pit or well to receive the water transfer, or not transferring the pit or well water. The development of TDS-based and the secondary screening steps applied to focus parameters for a compatibility assessment are designed to limit the potential for broad water quality changes in the receiving pits and wells as a result of pit water transfers, and specifically for the receiving pits if applicable, any potential for risk to aquatic life.

PPML selected the pit groupings based on the three ranges of TDS measurements associated with a ±30% threshold. This grouping and threshold were not developed primarily with aquatic life ‘protection’ at the forefront, but to limit water transfers based on three types of pit waters characterized by ranges of TDS concentrations. This approach would make sure that the mixing of waters from any pit transfer would not result in a resulting water quality in the receiving pit being substantially different from its initial existing state (i.e., not substantially modifying the pit waters), thus exerting some degree of water quality management. The inclusion of the secondary screening step, however, accounts for focus parameters as identified above (mostly metals) that have occasionally been measured in anomalous concentrations relative to the pit groupings or relative concentrations across the area of the project. Therefore, there is an aquatic protection aspect in the secondary screening step to limit any potential for aquatic risk in the event there are some aquatic species in the receiving pits that could be affected should water quality change by more than the threshold margin.

6.0 Receiving Environment (MVLWB-6)

A few of the MVLWB comments, and specifically MVLWB-6, were related to the “receiving environment" associated with the groundwater tests. The following provides additional information related to PPML’s thoughts about the use of the existing pits at the historical mine site versus the receiving environment.

The existing pits were created during previous mining by Cominco Ltd. in the 1960s to 1980s. Since mining stopped in 1987, many of these pits have become filled or partially filled with water, which is a combination of groundwater inflows from the bottom of the pit and surface water inflows from precipitation, runoff, and snowmelt. Some of these pits have connections to surface drainage channels that were built by Cominco to manage water at the site. This system of pits and drainage channels is human-made and is not a natural aquatic environment. It is therefore PPML’s opinion that this system should not be considered the receiving environment. The receiving environment that should be protected is the natural aquatic environment that sits outside of the project area boundary, such as the Paulette Creek, Little Buffalo River, Buffalo River, Twin Creek, and Great Slave Lake. It is recognized that the drainage network at the historical Pine Point Mine site may connect with the natural aquatic environment; as such, this is the point that PPML considers to be the ‘receiving environment’ for the CEP. This is consistent with the definition of receiving environment in PPML’s Type B Water Licence (MV2020L2-0008), which states that the receiving environment is the aquatic environment that received any water or waste released from the undertaking. This definition is also consistent with Water Licences for other mining operations in the NWT (e.g., Gahcho Kué Diamond Mine, Ekati Diamond Mine) which also specify that the receiving environment is the “natural aquatic environment”. As such, PPML believes that the receiving environment for the CEP is the natural aquatic environment outside of the area of the historical Pine Point Mine site where water would need to be managed by PPML if these natural waterbodies were to receive any deposit or discharge of waste, including seepage, runoff or wastewater, from the Project.

This being said, PPML believe that the incorporation of the pit and well compatibility decision trees will minimize the extent of change in pits and well water resulting from water transfers, and limit any potential for risk to aquatic life by identifying focus parameters that fall outside of expectations based on available data. Therefore, the movement of pit water or groundwater within the area of the Project as part of the groundwater testing program is anticipated to have negligible effects to the receiving waters outside of the area of the Project.

7.0 References

BC ENV (British Columbia Ministry of Environment and Climate Change Strategy). 2019. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Available at https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines. Accessed: April 2021.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (Updated 2019). Available at: https://ccme.ca/en/summary-table. Accessed April 2021.

EBA (EBA Engineering Consultants Ltd). 2005. Tamerlane Pine Point Project: Water Quality and Stream Assessment Baseline Studies. Report prepared by EBA Consultants Ltd. for Tamerlane Ventures Inc.

Maskwa (Maskwa Engineering Ltd.). 2018. Full Pit, Bathymetric Survey and Water Sampling for Pits N31-EXT, N32, L37, N38, N42, J44, I46, and Natural Lake at Pine Point Site. Prepared for Pine Point Mining Limited. Fort Smith, Northwest Territories.

Golder (Golder Associates Ltd.). 2021. Field memo for pit waterbody reconnaissance for fish, fish habitat, and water quality at the historical Pine Point Mine Site. April 2021.

PPML (Pine Point Mining Ltd.). 2020. Project Description for the Pine Point Project. December 2020. Available at: https://reviewboard.ca/upload/project_document/Volume%201%20-%20Project%20Description.pdf

APPENDIX A - Available Water Quality Data for Pits Located within the Historical Pine Point Mine

Table A-1: Available Water Quality Data for Pits Located within the Historical Pine Point Mine

Parameter	Unit	J69	S65	S65	M64	M64	WS06	K62	A57	A57	A70	A70	A55	A55	I46	J44	N42	N42	L37	T37	T37	T37	T37
		Surface	5 m	Surface	8 m	Surface	Surface	Surface	Surface	Surface	Surface	Surface	4 m	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	7 m	Surface
		24-Oct-17	19-Aug-20	19-Aug-20	25-Aug-20	25-Aug-20	22-Sep-05	24-Oct-17	24-Oct-17	22-Sep-05	24-Oct-17	22-Sep-05	26-Aug-20	26-Aug-20	17-Jul-18	11-Jul-18	24-Oct-17	11-Jul-18	11-Jul-18	30-Jun-18	17-Jul-18	21-Aug-20	21-Aug-20
Field Measured																							
pH	-	-	7.9	8.3	7.6	8.4	-	-	-	-	-	-	8.3	8.3	8.2	8.2	-	8.0	8.3	-	8.1	8.0	8.3
Specific conductivity	µS/cm	-	1,432	1,144	449	342	-	-	-	-	-	-	2,375	2,331	1,649	1,235	-	2,326	613	-	1,114	1,885	1,507
Temperature	°C	-	9.4	23.7	4.1	16.9	-	-	-	-	-	-	16.1	16.1	18.9	18.7	-	19.9	19.4	-	19.5	9.0	17.1
Dissolved oxygen	mg/L	-	10.4	9.2	5.4	9.3	-	-	-	-	-	-	9.8	9.7	8.6	8.3	-	6.7	9.4	-	8.9	12.2	9.6
Dissolved oxygen	%	-	93.7	102.8	42.6	99.5	-	-	-	-	-	-		102.4	93.1	89.5	-	74.3	102.4	-	97.2	108.0	101.3
Turbidity	NTU	-	1.8	1.5	0.7	0.9	-	-	-	-	-	-	0.7	0.6	-	-	-	-	-	-	-	0.3	0.5
Conventional Parameters																							
pH	-	8.1	8.1	8.2	7.9	8.2	8.3	8.1	7.9	8.1	8.2	8.1	8.1	8.1	8.1	8.1	8.0	8.0	8.0	8.2	8.2	8.1	8.2
Specific conductivity	µS/cm	1,760	1,000	900	320	280	380	1,930	1,900	1,950	2,780	2,820	2,100	2,100	1,640	2,280	2,590	596	1,130	1,050	1,110	1,400	1,200
Hardness, as $CaCO_3$	mg/L	1,060	580	490	190	150	194	1,170	1,160	1,150	1,720	1,700	1,200	1,200	986	1,510	1,810	315	615	595	637	820	670
Total alkalinity, as $CaCO_3$	mg/L	157	140	120	130	120	125	133	129	138	204	213	110	110	105	142	159	97.7	113	142	144	170	150
Total dissolved solids	mg/L	1,450	730	620	180	150	220	1,620	1,590	1,500	2,570	2,280	1,800	1,700	1,400	1,510	2,430	468	860	806	842	980	810
TDS (Calculated)	mg/L	1,478	812	693	261	226	296	1,626	1,605	1,590	2,479	2,413	1,825	1,838	1,518	2,104	2,405	467	875	805	927	1,075	896
Total suspended solids	mg/L	<4	<1	1.3	1	<1	-	<4	<4	-	<4	-	3.6	<1	<4	5.5	<4	<4	<4	5	<4	<1	<1
Total organic carbon	mg/L	3.72	5	5.8	13	15	15	1.4	2.7	2	2.48	3	1.6	1.5	1.5	<0.5	<0.5	<0.5	<0.5	5.74	5.3	3.9	4.9
Dissolved organic carbon	mg/L	-	5.2	6.3	14	16	-	-	-	-	-	-	1.9	2.1	-	-	-	-	-	-	-	3.4	4.9
Colour	TCU	<5	3.3	5.8	43	50	-	<5	<5	-	<5	-	<2	2.4	<5	<5	<5	<5	<5	11.3	26.8	3.2	4.6
Turbidity	NTU	0.98	0.86	0.59	0.61	0.64	-	0.45	0.51	-	0.33	-	0.23	0.2	0.95	0.7	1.5	1.4	0.69	3.4	3.5	0.7	0.18
Major Ions																							
Bicarbonate, as $CaCO_3$	mg/L	192	170	150	160	150	152	162	157	168	249	260	140	140	128	173	194	119	138	173	175	210	180
Bromide	mg/L	<0.05	0.094	0.072	<0.01	<0.01	-	<0.05	<0.05	-	<0.05	-	0.14	0.13	0.21	0.3	0.078	0.048	0.1	0.095	0.097	0.14	0.11
Calcium	mg/L	229	160	140	52	42	57.3	266	275	262	416	395	250	260	264	378	440	88.6	154	133	147	180	150
Carbonate, as $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<5	<1	<1	<5	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	11	2.2	2	2.9	3.8	2	14	16	18	55	64	56	56	6.4	9.5	11	2.6	9.5	4.5	4.7	6.3	4.7
Fluoride	mg/L	0.83	0.74	0.63	0.21	0.17	-	0.62	0.6	-	1.2	-	0.9	0.88	0.69	0.32	0.34	0.37	0.83	0.73	0.71	1	0.88
Hydroxide, as $CaCO_3$	mg/L	<1	<1	<1	<1	<1	<5	<1	<1	<5	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium	mg/L	118	41	34	14	11	12.3	123	116	120	166	173	130	130	79.5	137	172	22.7	56.2	63.7	65.8	86	71
Potassium	mg/L	3	2.5	2.1	1.3	1.1	1	3.76	3.56	3.9	3.45	4	5	5.3	3.52	2.2	2.29	1.31	2.31	2.27	2.42	2.7	2.3
Sodium	mg/L	10.7	5.4	4.4	2.3	2.2	1	16.9	16.9	18	38.8	47	43	46	5.64	4.4	5.22	1.14	9.42	6.68	6.67	9	7.4
Sulphate	mg/L	913	430	360	28	16	70.7	1040	1020	1000	1550	1470	1200	1200	1030	1400	1580	231	505	421	525	580	480
Nutrients																							
Nitrate	mg-N/L	<0.02	<0.05	<0.05	0.056	<0.01	0.13	<0.02	<0.02	<0.006	<0.02	<0.006	<0.01	<0.01	<0.02	0.023	<0.02	<0.02	<0.02	0.068	<0.02	<0.01	<0.05
Nitrite	mg-N/L	<0.005	<0.01	<0.01	<0.01	<0.01	<0.002	<0.005	<0.005	<0.002	<0.005	<0.002	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Nitrate + nitrite	mg-N/L	<0.02	<0.05	<0.05	0.056	<0.014	0.13	<0.02	<0.02	<0.006	<0.02	<0.006	<0.014	<0.014	<0.02	0.023	<0.02	<0.02	<0.02	0.068	<0.02	<0.01	<0.05
Total ammonia	mg-N/L	<0.02	<0.015	<0.015	<0.015	<0.015	0.019	0.03	<0.02	<0.005	0.04	<0.005	0.046	<0.015	0.029	<0.02	<0.02	<0.02	0.033	0.035	0.029	<0.015	<0.015
Total Kjeldahl nitrogen	mg-N/L	0.219	0.21	0.42	0.6	0.77	-	0.194	0.207	-	0.328	-	0.12	0.11	0.124	0.06	0.182	0.066	0.07	0.227	0.281	0.22	0.22
Total nitrogen	mg-N/L	0.219	0.21	0.42	0.66	0.77	-	0.194	0.207	-	0.328	-	0.12	0.11	0.124	0.083	0.182	0.066	0.07	0.295	0.281	0.22	0.22
Total phosphorus	mg-P/L	-	<0.003	<0.003	<0.003	<0.003	0.006	-	-	0.003	-	0.008	<0.003	<0.003	-	-	-	-	-	-	-	<0.003	<0.003
Dissolved phosphorus	mg-P/L	-	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-	<0.1	<0.1	-	-	-	-	-	-	-	<0.1	<0.1
Orthophosphate	mg-P/L	<0.005	<0.003	<0.003	<0.003	<0.003	-	<0.005	<0.005	-	<0.005	-	<0.003	<0.003	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.003	0.0037
Total Metals																							
Aluminum	µg/L	38	12	19	13	19	190	<15	<15	20	<15	10	5	4.3	14.8	27	<15	53.7	18	9.5	21.8	9.6	7
Antimony	µg/L	<2.5	<0.6	<0.6	<0.6	<0.6	<0.4	<2.5	<2.5	<0.4	<2.5	<0.4	<0.6	<0.6	<0.5	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.6	<0.6
Arsenic	µg/L	<0.5	0.21	0.33	0.49	0.52	<0.4	<0.5	<0.5	<0.4	<0.5	<0.4	<0.2	0.2	0.19	<0.5	<0.5	0.2	<0.1	0.24	0.24	0.32	0.32
Barium	µg/L	25.4	41	40	48	39	43	29.9	29.6	31	6.1	7	10	11	32.6	13.1	12	78.7	32.3	20.8	19.1	21	21
Beryllium	µg/L	<0.5	<1	<1	<1	<1	<1	<0.5	<0.5	<1	<0.5	<1	<1	<1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	<1	<1
Bismuth	µg/L	<5	-	-	-	-	-	<5	<5	-	<5	-	-	-	<1	<5	<5	<1	<1	<1	<1	-	-
Boron	µg/L	<250	150	140	<20	<20	<50	<250	<250	180	388	390	520	530	52	<250	<250	<50	105	107	116	150	120

Table A-1: Available Water Quality Data for Pits Located within the Historical Pine Point Mine

Parameter	Unit	J69	S65	S65	M64	M64	WS06	K62	A57	A57	A70	A70	A55	A55	I46	J44	N42	N42	L37	T37	T37	T37	T37
		Surface	5 m	Surface	8 m	Surface	Surface	Surface	Surface	Surface	Surface	Surface	4 m	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	7 m	Surface
		24-Oct-17	19-Aug-20	19-Aug-20	25-Aug-20	25-Aug-20	22-Sep-05	24-Oct-17	24-Oct-17	22-Sep-05	24-Oct-17	22-Sep-05	26-Aug-20	26-Aug-20	17-Jul-18	11-Jul-18	24-Oct-17	11-Jul-18	11-Jul-18	30-Jun-18	17-Jul-18	21-Aug-20	21-Aug-20
Cadmium	µg/L	<0.05	<0.02	0.031	<0.02	<0.02	<0.2	<0.05	<0.05	<0.2	<0.05	<0.2	<0.02	<0.02	0.015	0.442	0.193	0.063	0.112	0.018	0.014	<0.02	<0.02
Chromium	µg/L	<5	1.3	<1	1.2	<1	<5	<5	<5	<5	<5	<5	<1	<1	<1	<5	<5	<1	<1	<1	<1	1.3	<1
Cobalt	µg/L	<1	<0.3	<0.3	<0.3	<0.3	<2	<1	<1	<2	<1	<2	<0.3	<0.3	<0.2	<1	<1	<0.2	<0.2	<0.2	<0.2	<0.3	<0.3
Copper	µg/L	<2.5	6.1	0.43	0.87	0.74	2	<2.5	<2.5	<1	<2.5	2	31	0.47	<0.5	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	0.39	0.43
Iron	µg/L	<50	130	80	66	63	138	<50	<50	1120	<50	51	210	210	15	65	159	48	15	22	34	160	120
Lead	µg/L	<1	1.3	2.4	<0.2	<0.2	1.2	<1	<1	0.5	<1	0.4	<0.2	<0.2	0.48	21.6	11.2	15.8	6.8	1.51	4.56	0.81	0.8
Lithium	µg/L	35	21	<20	<20	<20	<10	36	36	40	36	40	51	52	35.2	13	13	3.6	21.2	14.9	16.6	<20	<20
Manganese	µg/L	<5	<4	4	<4	<4	4	<5	<5	3	25.2	19	<4	<4	3.3	41.7	27.9	4.3	2.6	6.8	5.5	5.7	4.5
Mercury	µg/L	<0.01	<0.0019	<0.0019	<0.0019	<0.0019	<0.2	<0.01	<0.01	<0.2	<0.01	<0.2	<0.0019	<0.0019	<0.002	<0.002	<0.01	<0.002	<0.002	-	<0.002	<0.0019	<0.0019
Molybdenum	µg/L	<5	1.1	1	0.47	0.32	<5	<5	<5	<5	<5	<5	3.5	3.3	3.3	<5	<5	1.8	3.4	<1	<1	0.8	0.64
Nickel	µg/L	<5	2.5	2.4	0.73	<0.5	<2	<5	<5	7	<5	<2	4.2	4.1	5.5	11.3	12.3	<1	3.1	1.1	1.2	1.5	1
Selenium	µg/L	<0.5	<0.2	<0.2	<0.2	<0.2	<0.4	<0.5	<0.5	1	<0.5	0.6	<0.2	<0.2	0.18	<0.5	<0.5	0.18	0.22	<0.1	<0.1	0.33	0.2
Silicon	µg/L	4560	1800	1600	2500	2200	-	3440	2230	-	4580	-	2800	2800	870	1800	2030	1340	2770	2740	2730	3400	3000
Silver	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.4	<0.1	<0.1	<0.4	<0.1	<0.4	<0.1	<0.1	<0.02	<0.1	<0.1	<0.02	<0.02	<0.02	<0.02	<0.1	<0.1
Strontium	µg/L	3,180	1,000	780	110	99	-	4,200	2,950	-	9,610	-	5,900	5,900	1,360	236	267	140	3,050	1,520	1,640	2,000	1,700
Sulphur	µg/L	307,000	140,000	120,000	9,200	4,900	-	380,000	373,000	-	546,000	-	360,000	360,000	293,000	475,000	558,000	72,200	175,000	153,000	156,000	210,000	170,000
Thallium	µg/L	0.379	0.35	0.29	<0.2	<0.2	<0.1	2.3	0.543	1	<0.05	<0.1	<0.2	<0.2	0.238	0.065	0.073	0.021	0.121	<0.01	<0.01	<0.2	<0.2
Tin	µg/L	<25	<1	<1	<1	<1	<50	<25	<25	<50	<25	<50	<1	<1	<5	<25	<25	<5	<5	<5	<5	<1	<1
Titanium	µg/L	<25	<1	1.1	1.1	1.5	6	<25	<25	1	<25	1	1.2	1.2	<5	<25	<25	<5	<5	<5	<5	1.6	1
Uranium	µg/L	3.42	11	8.4	0.67	0.41	0.7	10.8	5.63	6.2	0.61	0.8	4.3	4.2	8.26	23.7	27.6	2.55	2.35	0.94	0.91	0.85	0.76
Vanadium	µg/L	<25	<1	<1	<1	<1	<1	<25	<25	<1	<25	<1	<1	<1	<5	<25	<25	<5	<5	<5	<5	<1	<1
Zinc	µg/L	26	150	160	16	<3	71	<25	<25	18	<25	8	4.8	4.3	92.2	3280	3130	241	702	124	91	130	43
Zirconium	µg/L	<0.5	-	-	-	-	-	<0.5	<0.5	-	<0.5	-	-	-	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	-	-
Dissolved Metals																							
Aluminum	µg/L	<15	<3	5.3	<3	<3	70	<15	<15	<10	<15	<10	<3	<3	12.5	<75	<15	<3	6.4	14.6	25.9	<3	<3
Antimony	µg/L	<2.5	<0.6	<0.6	<0.6	<0.6	0.8	<2.5	<2.5	<0.4	<2.5	<0.4	<0.6	<0.6	<0.5	<13	<2.5	<0.5	<0.5	<0.5	<0.5	<0.6	<0.6
Arsenic	µg/L	<0.5	<0.2	0.3	0.4	0.48	<0.4	<0.5	<0.5	<0.4	<0.5	<0.4	0.21	<0.2	0.18	<2.5	<0.5	0.19	<0.1	0.27	0.24	0.22	0.29
Barium	µg/L	25.1	41	40	43	34	40	30.5	30.8	28	5.9	6	<10	<10	34.6	<25	12.4	83.3	36	19.2	21.4	19	19
Beryllium	µg/L	<0.5	<1	<1	<1	<1	<1	<0.5	<0.5	<1	<0.5	<1	<1	<1	<0.1	<2.5	<0.5	<0.1	<0.1	<0.1	<0.1	<1	<1
Bismuth	µg/L	<5	-	-	-	-	-	<5	<5	-	<5	-	-	-	<1	<25	<5	<1	<1	<1	<1	-	-
Boron	µg/L	<250	60	49	<20	<20	<50	<250	<250	200	415	510	460	480	52	<1300	<250	<50	104	103	114	150	130
Cadmium	µg/L	<0.05	<0.02	0.026	<0.02	<0.02	<0.1	<0.05	<0.05	<0.1	<0.05	<0.1	<0.02	<0.02	<0.01	0.37	0.196	0.034	0.105	0.02	<0.01	<0.02	<0.02
Chromium	µg/L	<5	<1	<1	<1	<1	<5	<5	<5	<5	<5	<5	<1	<1	<1	<25	<5	<1	<1	<1	<1	<1	<1
Cobalt	µg/L	<1	<0.3	<0.3	<0.3	<0.3	<2	<1	<1	<2	<1	<2	<0.3	<0.3	<0.2	<5	<1	<0.2	<0.2	<0.2	<0.2	<0.3	<0.3
Copper	µg/L	<1	0.4	<0.2	0.73	0.64	1	<1	<1	<1	<1	1	<0.2	<0.2	0.45	<5	<1	0.26	0.36	0.37	0.45	<0.2	<0.2
Iron	µg/L	<25	<60	<60	<60	<60	79	<25	<25	<5	<25	<5	180	190	<5	<130	<25	<5	<5	18.8	<5	<60	<60
Lead	µg/L	<1	0.48	1.2	<0.2	<0.2	1.3	<1	<1	0.3	<1	<0.1	<0.2	<0.2	<0.2	12.9	2.6	10.1	6.07	1.39	4.66	0.26	0.32
Lithium	µg/L	34	<20	<20	<20	<20	<3	42	42	36	39	33	47	47	34.5	<50	16	3.4	20.4	13.4	15.3	21	<20
Manganese	µg/L	7	<4	<4	<4	<4	5	<5	<5	1	21.5	14	<4	<4	2.8	38	28.3	2.3	2.2	7.5	<1	<4	<4
Mercury	µg/L	<0.01	<0.0019	<0.0019	<0.0019	<0.0019	<0.1	<0.01	<0.01	<0.1	<0.01	<0.1	<0.0019	<0.0019	<0.002	<0.002	<0.01	<0.002	<0.002	-	<0.002	<0.0019	<0.0019
Molybdenum	µg/L	<5	0.97	1	0.38	0.29	<5	<5	<5	<5	<5	<5	3.5	3.4	3	<25	<5	1.8	3.6	<1	<1	0.73	0.66
Nickel	µg/L	<5	2.2	1.9	0.62	<0.5	<2	<5	<5	8	<5	<2	5.2	4	4.8	<25	12.1	<1	3	1.3	1	0.93	2
Selenium	µg/L	<0.5	<0.2	<0.2	0.23	<0.2	<0.4	<0.5	<0.5	0.6	<0.5	0.6	<0.2	0.28	0.15	<2.5	<0.5	0.16	0.18	<0.1	<0.1	<0.2	<0.2
Silicon	µg/L	5,540	1,500	1,300	2,400	2,100	-	3,120	2,000	-	5,120	-	2,600	2,700	888	<2500	1,800	1,250	2,720	2,670	2,820	3,100	2,900
Silver	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.02	<0.5	<0.1	<0.02	<0.02	<0.02	<0.02	<0.1	<0.1
Strontium	µg/L	3,310	960	770	100	89	-	4,430	2,950	-	8,930	-	5,600	5,500	1,320	239	263	138	3,020	1,550	1,600	1,800	1,500
Sulphur	µg/L	323,000	140,000	120,000	8,700	4,700	-	372,000	360,000	-	515,000	-	330,000	350,000	316,000	488,000	546,000	68,400	178,000	159,000	173,000	220,000	180,000
Thallium	µg/L	0.366	0.26	0.21	<0.2	<0.2	<0.1	2.32	0.572	0.9	<0.05	<0.1	<0.2	<0.2	0.22	<0.25	0.067	0.021	0.143	<0.01	<0.01	<0.2	<0.2
Tin	µg/L	<25	<1	<1	<1	<1	<50	<25	<25	<50	<25	<50	<1	<1	<5	<130	<25	<5	<5	<5	<5	<1	<1

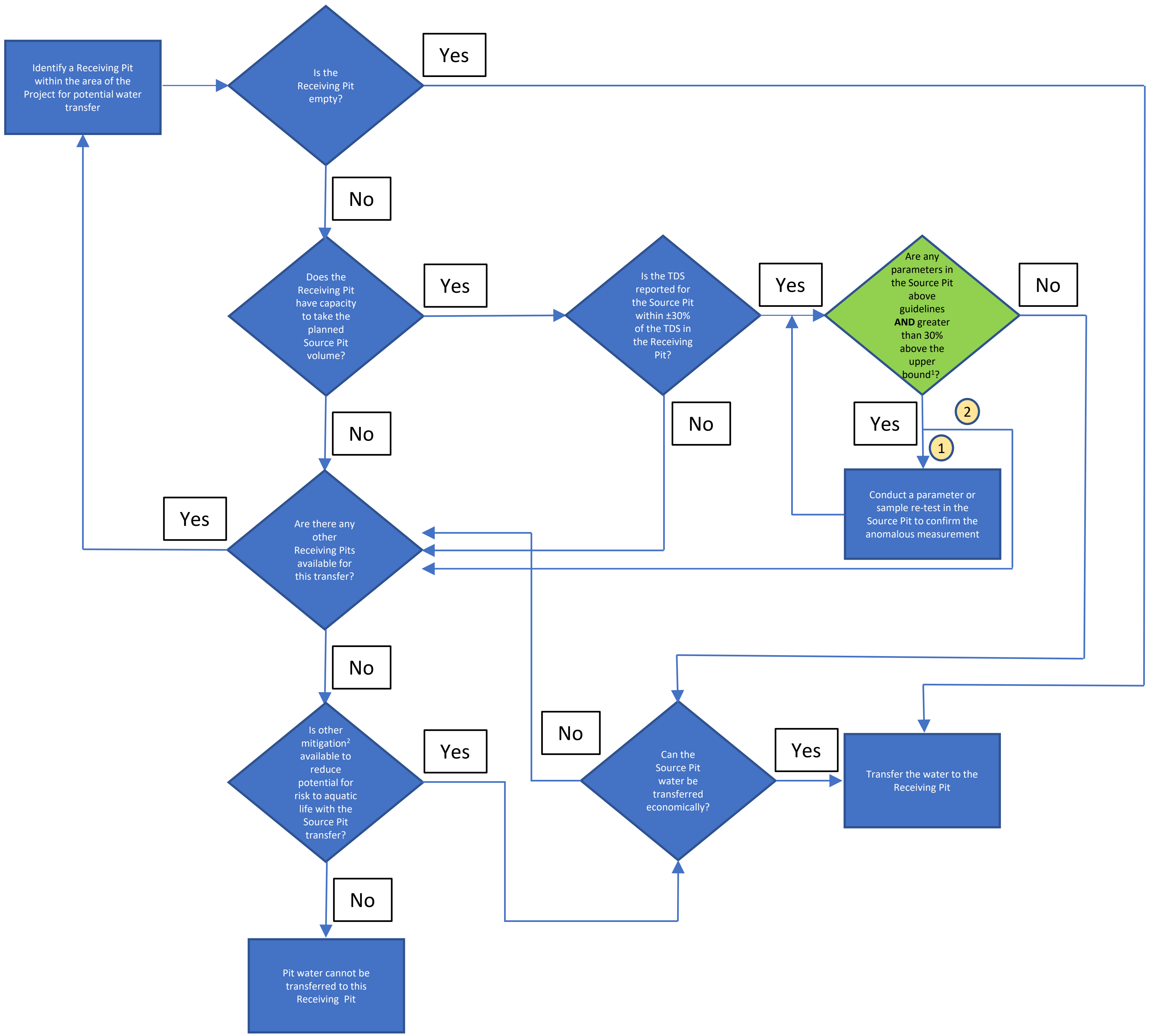
Table A-1: Available Water Quality Data for Pits Located within the Historical Pine Point Mine

Parameter	Unit	J69	S65	S65	M64	M64	WS06	K62	A57	A57	A70	A70	A55	A55	I46	J44	N42	N42	L37	T37	T37	T37	T37
		Surface	5 m	Surface	8 m	Surface	Surface	Surface	Surface	Surface	Surface	Surface	4 m	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	7 m	Surface
		24-Oct-17	19-Aug-20	19-Aug-20	25-Aug-20	25-Aug-20	22-Sep-05	24-Oct-17	24-Oct-17	22-Sep-05	24-Oct-17	22-Sep-05	26-Aug-20	26-Aug-20	17-Jul-18	11-Jul-18	24-Oct-17	11-Jul-18	11-Jul-18	30-Jun-18	17-Jul-18	21-Aug-20	21-Aug-20
Titanium	µg/L	<25	<1	<1	<1	<1	3	<25	<25	<1	<25	<1	1.1	<1	<5	<130	<25	<5	<5	<5	<5	<1	<1
Uranium	µg/L	3.43	10	8.4	0.64	0.31	0.7	11.2	6.21	5.6	0.6	0.8	3.8	3.6	8.04	22.9	29.9	2.53	2.44	0.83	0.9	0.97	0.84
Vanadium	µg/L	<25	<1	<1	<1	<1	<1	<25	<25	<1	<25	<1	<1	<1	<5	<130	<25	<5	<5	<5	<5	<1	<1
Zinc	µg/L	<25	170	160	11	<3	69	<25	<25	23	<25	10	6.6	7.4	64.1	3190	2900	216	732	132	63.3	110	29
Zirconium	µg/L	<0.5	-	-	-	-	-	<0.5	<0.5	-	<0.5	-	-	-	<0.1	<2.5	<0.5	<0.1	<0.1	<0.1	<0.1	-	-

- = no data; µS/cm = microsiemens per centimetre; NTU = nephelometric turbidity units; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µg/L = micrograms per litre; $CaCO_3$ = calcium carbonate.

APPENDIX B - CEP Groundwater Testing - Decision Trees for Pit to Pit, Well to Well, and Pit to Well Compatibility for Water Transfers

Figure B1: Pine Point – CEP Groundwater Testing Pit to Pit Compatibility for Water Transfers



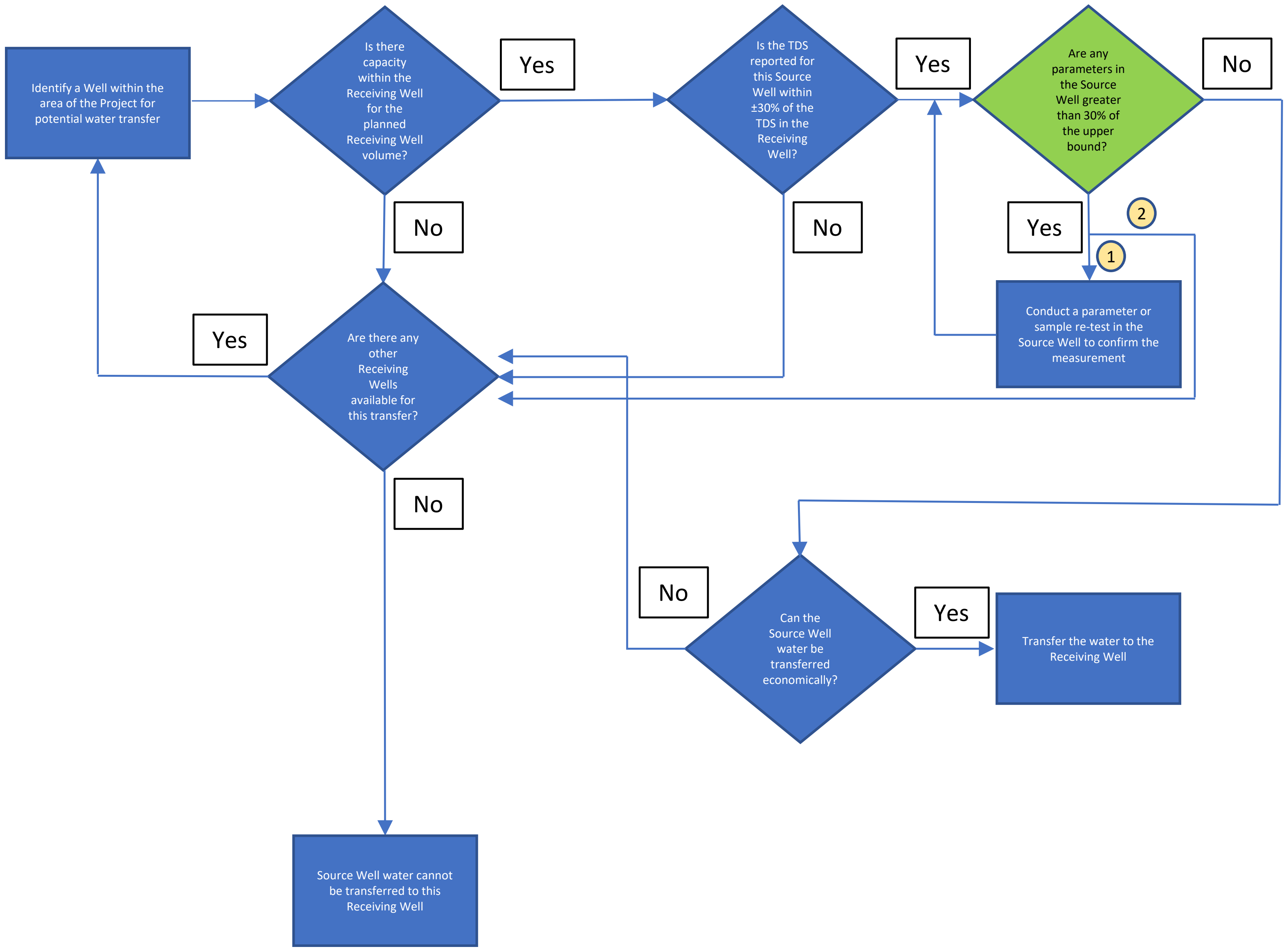
Green - This is an iterative query:

1. If the initial answer to the query is yes, confirmation testing is required
2. Is the follow-up response to the query remains as yes, this path is followed

[1] Based on our current knowledge, available data for most major ions and metals are below guidelines, and where not, generally remain similar for pits across the area of the project, or one of the three specific TDS groupings. Exceptions include copper, lead, thallium, and uranium, which based on measured concentrations may trigger a secondary screening step and follow-up mitigation or result in exclusion.

[2] Mitigation may include limiting water transfers between pits that pump “better” (lower TDS and/or other parameter concentrations) to “poorer” (higher TDS and/or other parameter concentrations) conditions.

Figure B2: Pine Point – CEP Groundwater Testing Well to Well Compatibility for Water Transfers



Green - This is an iterative query:

1. If the initial answer to the query is yes, confirmation testing is required
2. Is the follow-up response to the query remains as yes, this path is followed

Figure B3: Pine Point – CEP Groundwater Testing Pit to Well Compatibility for Water Transfers