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CONSULTING

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May 11, 2009

Mr. Ron Martel
Environmental Superintendent
Mount Polley Mining Corporation
P.O. Box 12
Likely, BC V0L 1N0

Dear Ron,

Re: SEDIMENT / POLISHING RETENTION POND DOWNSTREAM OF THE PERIMETER EMBANKMENT

Knight Piésold Ltd. (KPL) has been retained to design a sediment / polishing retention pond downstream of the Perimeter Embankment for the purpose of discharging excess water into Hazeltine Creek.

SUPPORTING STUDIES

KP has completed a closure water balance study that predicts various discharge rates to Hazeltine Creek. The design discharge rate for this sediment pond design has been selected based on the predicted maximum 1 in 10 year wet discharge rate from the Passive Treatment System (VA09-00298, April 2009). This scenario (Case 7) conservatively assumes the toe drains are clogged and this additional flow is directed into the Passive Treatment System.

SITE DESCRIPTION

Hazeltine Creek flows in the southeast direction from Polley Lake. Edney Creek confluences with Hazeltine Creek prior to Hazeltine Creek discharging into Quesnel Lake. The proposed point of effluent discharge into Hazeltine Creek is located approximately 1200 m downstream of Polley Lake and 1500 m upstream of Water Quality Station W7. This general arrangement is shown on Figure 1.

The effluent will originate from a sediment / polishing retention pond located downstream of the Perimeter Embankment. Water will be transferred from the Perimeter Embankment seepage collection pond to the proposed sediment / polishing retention pond, from which effluent will flow by gravity, pass through a weir box (to monitor flow rates) and then discharged through a 150 mm (6 inch) diameter HDPE pipe into Hazeltine Creek. The overall plan and cross sections are shown on Figures 2 and 3, respectively. The source (influent) will originate from the Tailings Storage Facility (TSF) supernatant either through direct transfer or through seepage collection and recycle systems, including the tailings impoundment foundation, toe and chimney drain system, outfall; and related appurtances. Effluent will also be derived from the NEZ Dump collection ditch.

Given the available data and operating experience with the existing TSF, it is fully anticipated that contingency measures for a more effective system will not be required. However, if metal concentrations are of concern or if discharge rates exceed the design, the following two contingency measures would be available for use at the site:

BSI
ISO 9001:2000
FS 64925

- Return the effluent back to the TSF via the existing Perimeter Embankment Seepage Collection Pond pumping system; and/or
- Addition of lime/coagulating/flocculating agents to assist with heavy metal precipitate formation and settling.

DESIGN CONSIDERATIONS

Length to width ratio – Maximizing the distance between the pond inlet and outlet, and thereby increasing the length to width ratio, increases the likelihood of removing solids (Shammaa et al., 2002). The recommended ratio is between 4:1 and 5:1 (AEP, 1999; Barr Engineering, 2001). Length is defined by the distance from the inflow to outflow point, and width is typically defined as the pond surface area divided by length (Novotny, 1995).

Pond depth – Live storage in a settling pond is generally kept between 2.0 m to 3.0 m (Shammaa et al., 2002), measured from the invert elevation of the outlet device. Pond depths beyond this range make effective settling difficult, as the time required for the particles to settle is greater. This pond is designed to have 2.5 m of live storage. The discharge device is a floating culvert, which will remain at this elevation during normal operating conditions.

Bottom grading – Sedimentation is facilitated with a level pond bottom. The bottom elevation is 925.0 m for the span of the pond.

Side slopes – The clayey till material which will be excavated is quite strong and cohesive, and side slopes of 2H:1V were deemed appropriate for this pond, for both the interior and exterior sides of the embankment surrounding the pond.

Freeboard – Although runoff from the catchment area above the pond will be diverted, a freeboard is still required. The sides of the pond provide for 1.0 m freeboard, as water must be allowed to rise to such a level as to be able to flow back into the seepage pond to be pumped into the TSF, if the need arises.

POND SIZE

The *B.C. Guidelines for Assessing the Design, Size, and Operation of Sedimentation Ponds used in Mining* (1996) was used to determine the required pond size of the sediment / polishing retention pond. The pond size is based on the minimum particle size that must be settled out and the desired discharge rate. Stokes' Law Formula was used to estimate the particle setting velocity based on the minimum particle diameter. The particle settling velocity was then used to estimate the minimum pond surface area based on the desired discharge rate.

Stokes' Law Formula is as follows:

$$Vs = g/18\mu * (S-1) D^2$$

Where:

Vs = spherical particle terminal settling velocity, cm/s
G = acceleration of gravity, 981 cm/s^2
μ = kinematic viscosity of water, cm^2/s
S = specific gravity of the particle
D = diameter of a non-interacting particle.

The kinematic viscosity is dependent on temperature. Lower temperatures increase the kinematic viscosity, thus decreasing the settling velocity and increasing the required surface area. Discharge will primarily occur from early spring to late fall; the recorded temperatures during these months were analyzed. The lower bound of the temperatures (approximately $0^{o}C$) was conservatively used to estimate a kinematic viscosity of 0.0179 cm^2/s, based on *Fundamentals of Hydraulic Engineering Systems* (Hwang, N and Houghtalen, R, 1996).

Specific gravity of the particles was assumed to be 2.7, as suggested in the *B.C. Guidelines for Assessing the Design, Size, and Operation of Sedimentation Ponds used in Mining* (Ministry of Environment, 1996).

Typically the smallest suspended sediment particle that can be removed by plain sedimentation (i.e., no added settling aids) is 5 microns in diameter (0.005 mm), which is namely fine silt (Ministry of Environment, 1996). This design assumes that the pond will be managed without added settling aids; however, should the suspended solids in the discharge exceed the maximum permitted or regulated discharge quality, then settling aids would need to be added upstream of the pond (Ministry of Environment, 1996). Therefore, this pond is designed to settle out particles down to 5 microns in diameter (fine silt).

Incorporating all the stated assumptions, the settling velocity was calculated to be 1.29×10^{-5} m/s. The minimum pond surface area required to remove the smallest suspended sediment (0.005 mm diameter) must be greater than the estimated discharge rate divided by the estimated settling velocity, as shown below (Ministry of Environment, 1996):

$$A > Q/ Vs$$

Where:

Vs = spherical particle terminal settling velocity, m/s
Q = pond discharge rate, m^3/s
A = surface area of pond, m^2

The estimated discharge rate is 0.146 m^3/s based on the predicted maximum 1 in 10 year wet discharge rate; this scenario conservatively assumes that the toe drains are clogged and that additional flow is directed into the sediment control pond (VA09-00298, April 2009).

With this flow, the minimum surface area required is:

$$A_{min} = 0.146\ m^3/s\ /\ (1.29 \times 10^{-5}\ m/s)$$
$$= 11{,}300\ m^2$$

Stokes' Law Formula is based on spherical particles; the non-spherical shape of most mineral particles necessitates the application of a correction factor of 1.18 to 2.0 if applied to the sedimentation pond area, based on the *B.C. Guidelines for Assessing the Design, Size, and Operation of Sedimentation Ponds used in Mining* (1996). A conservative correction factor of 2.0 was applied to the surface area, increasing the surface area to 22,600 m^2. This surface area can be achieved with dimensions of 330 m x 69 m, which result in a length to width ration of 4.8.

The pond surface area dimensions were increased to 350 m x 74 m to account for the volume of baffles, described in more detail below. This increased pond surface area maintains a length to width ratio of 4.7. This surface area applies to the water surface elevation. As there is 1 m of freeboard above the water

surface (with 2H:1V side slopes), the dimensions to begin the excavation are: 354 m x 80 m, such that the dimensions of 350 m x 74 m will be achieved one metre down the slope.

POND LOCATION

The pond location can be seen in Figure 2. The location was chosen based on several factors, namely: The proximity to the seepage pond, as this will allow water to flow back through the ditch to the seepage pond to be pumped into the TSF, if deemed necessary. Other considerations included: minimizing the area of trees that needed to be cut, finding the flattest area so as to minimize the excavation requirements and aligning the pond so that it does not interfere with the powerline alignment.

CUT / FILL VOLUMES

Due to the natural contours, the pond can be entirely excavated, with no fill necessary. A total of 144,000 m^3 of material is to be excavated. Approximately 8,500 m^3 of this material is expected to be topsoil, assuming a depth of 0.3 m. The remaining excavated material, approximately 135,500 m^3, is expected to be glacial till, to be used for construction of the tailings dam or any other requirements around the minesite.

BAFFLES

A system of baffles is included in the design to ensure that the surface area of the pond is used to its capacity. Even with the recommended length to width ratio, the flow pattern will often not make use of the entire surface area for settling, and instead will just take the shortest route from the inlet to the outlet. A baffle system will create a longer, more meandering flow path for settling.

Till material will be left in the pond to create these baffles, with the following dimensions:

- 2H:1V side slopes.
- 1 m crest.
- 3.5 m in height, matching the anticipated pond depth and 1 m of freeboard.
- Extends 50 m across the width of the pond.
- Baffle spacing along the length of the pond is approximately 50 m.

There will be 6 baffles in all. The original pond design dimensions (without the baffles) were extended to account for the volume that these baffles take up in the pond, from 330 m x 69 m to 350 m x 74 m.

OUTLET DESIGN

The settling velocity is dependent on the outflow rate (as opposed to the inflow rate). The outlet must be situated high enough to avoid taking in sediment, while not being too high that dead storage occurs during slightly lower than expected flows. These requirements are satisfied by using a floating culvert, which is hinged to a 150 mm HDPE outlet pipe located near the bottom of the pond. The floating culvert stays on the surface of the water, thus only skimming the clean water; however, dead storage will not be an issue as the floating culvert will rise and fall with the water level (Figure 3, Section 5).

RETENTION TIME

Retention time is most commonly defined as the sedimentation pond depth divided by the settling velocity, or

$$T = D / Vs$$

For a pond of depth 2.5 m, and settling velocity of 1.29×10^{-5} m/s, the retention time is approximately:

$$T = 2.5 \text{ m} / (1.29 \times 10^{-5} \text{ m/s}) = 194{,}000 \text{ s} = 2.24 \text{ days}$$

DIVERSION DITCHES

A diversion ditch will be excavated around the settling pond. This will capture any runoff, ensuring that only minesite water will enter into the pond, minimizing retention time.

WEIR BOX

A weir box will be constructed near the outlet section of the settling pond to measure the discharge rates. This weir box is located at the outlet of the settling pond for convenient monitoring. A previous weir box design for the Main Embankment Seepage Collection Pond will be used as the basis for this design, with modifications due to differing flows, inlets and downstream configurations. The weir box will receive flows from the setting pond outlet culvert and flow over a v-notch weir into a collection box. From the collection box, the water will flow into a 150 mm HPDE pipe leading to Hazeltine Creek (Figure 3, Section 5).

RIPRAP DESIGN

Water flow from the 150 mm HDPE pipe will be discharged at a reasonable rate in Hazeltine Creek; therefore, effort must be taken to protect the natural ground surface from eroding. A section between the pipe and the creek will be lined with properly graded riprap. Large boulders (greater than 0.6 m diameter) will be utilized where the discharge leaves the pipe while the remaining riprap size will be determined on site by the engineer. The pipe will exit the ground so that it is elevated slightly above the boulders. The riprap channel will have a width of approximately 1.0 m. The riprap will be tied into the bank of Hazeltine Creek at an angle of about 45 degrees, in a location away from any sensitive reaches (Figure 3, Section 5).

CONCLUSIONS

The pond size is based on the minimum particle size that must be settled out and the desired discharge rate. This design for the sediment / polishing retention pond downstream of the Perimeter Embankment is on a discharge rate of 0.146 m^3/s based on the recent closure water balance study. The minimum particle diameter was assumed to be 5 microns (fine silt), which is typically the finest particle size that can be settled out without the addition of settling aids. The resulting total surface area of the pond is 355 m x 80 m and the retention time is estimated at about 2 days.

REFERENCES

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Novotny, V. 1995. Nonpoint pollution and urban stormwater management. Technomic, Lancaster, Pa. Chapter 6, pp. 193-292.

Shammaa, Y., Zhu, D.Z., Gyurek, L.L., Labatiuk, C.W. 2002. Effectiveness of dry ponds for stormwater total suspended solids removal. Canadian Journal of Civil Engineering, 29: 316-324.

We trust that this letter provides the necessary details you require. If you have any questions or comments, please contact Greg Smyth at your convenience.

Yours truly,
KNIGHT PIESOLD LTD.

Prepared:	Reviewed:	Approved:
Amanda Strouth, EIT	Greg Smyth	Ken Brouwer, P.Eng.
Staff Engineer	Senior Scientist	Managing Director

Attachments:
Figure 1 Rev 0 Sediment / Polishing Pond – General Arrangement
Figure 2 Rev 0 Sediment / Polishing Pond – Plan View Details
Figure 3 Rev 0 Sediment / Polishing Pond – Sections & Details

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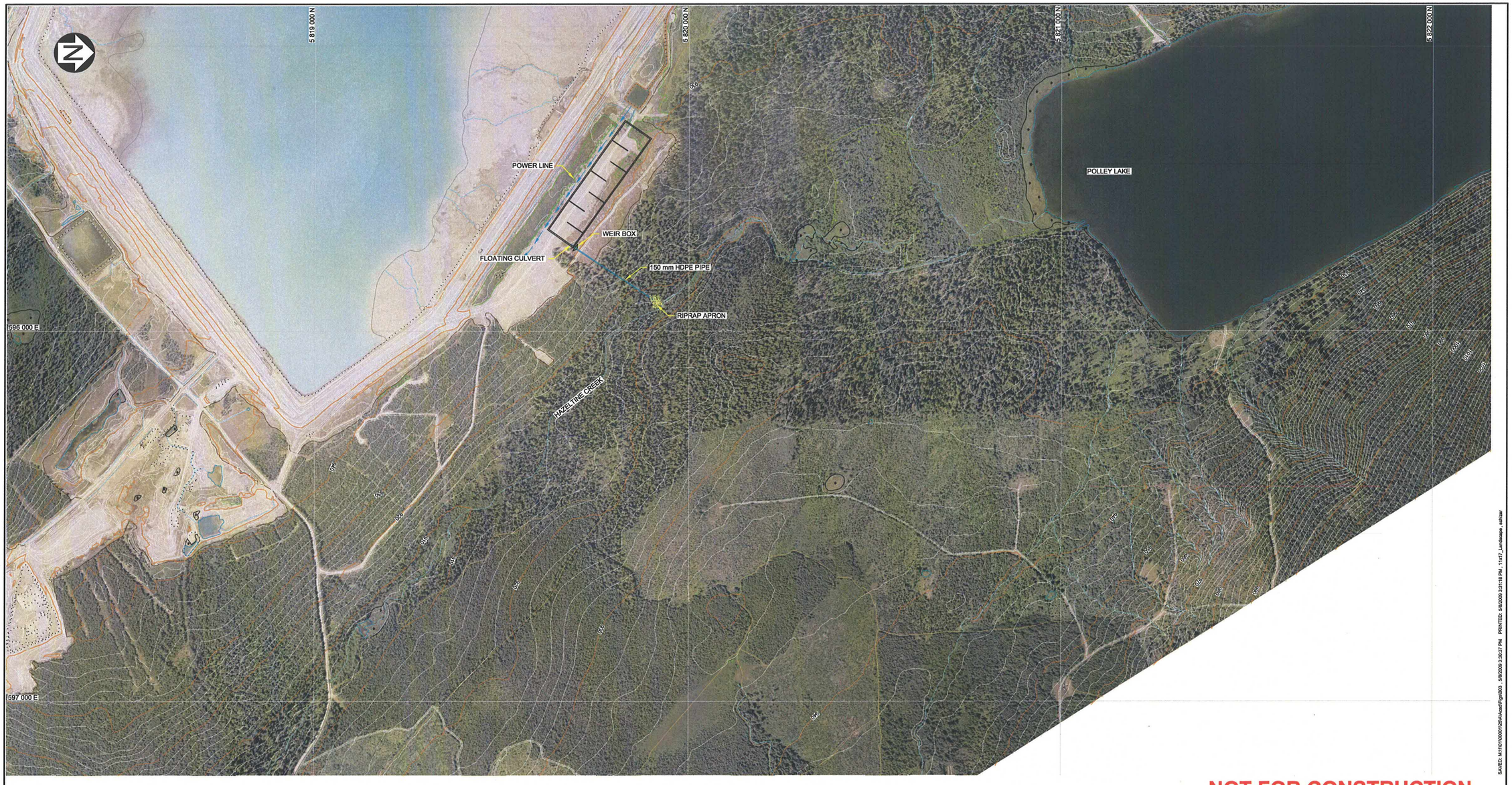

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

SEDIMENT / POLISHING POND GENERAL ARRANGEMENT

Knight Piésold CONSULTING

P/A NO. VA101-1/25 | REF NO. VA09-00617

FIGURE 1 | REV 0

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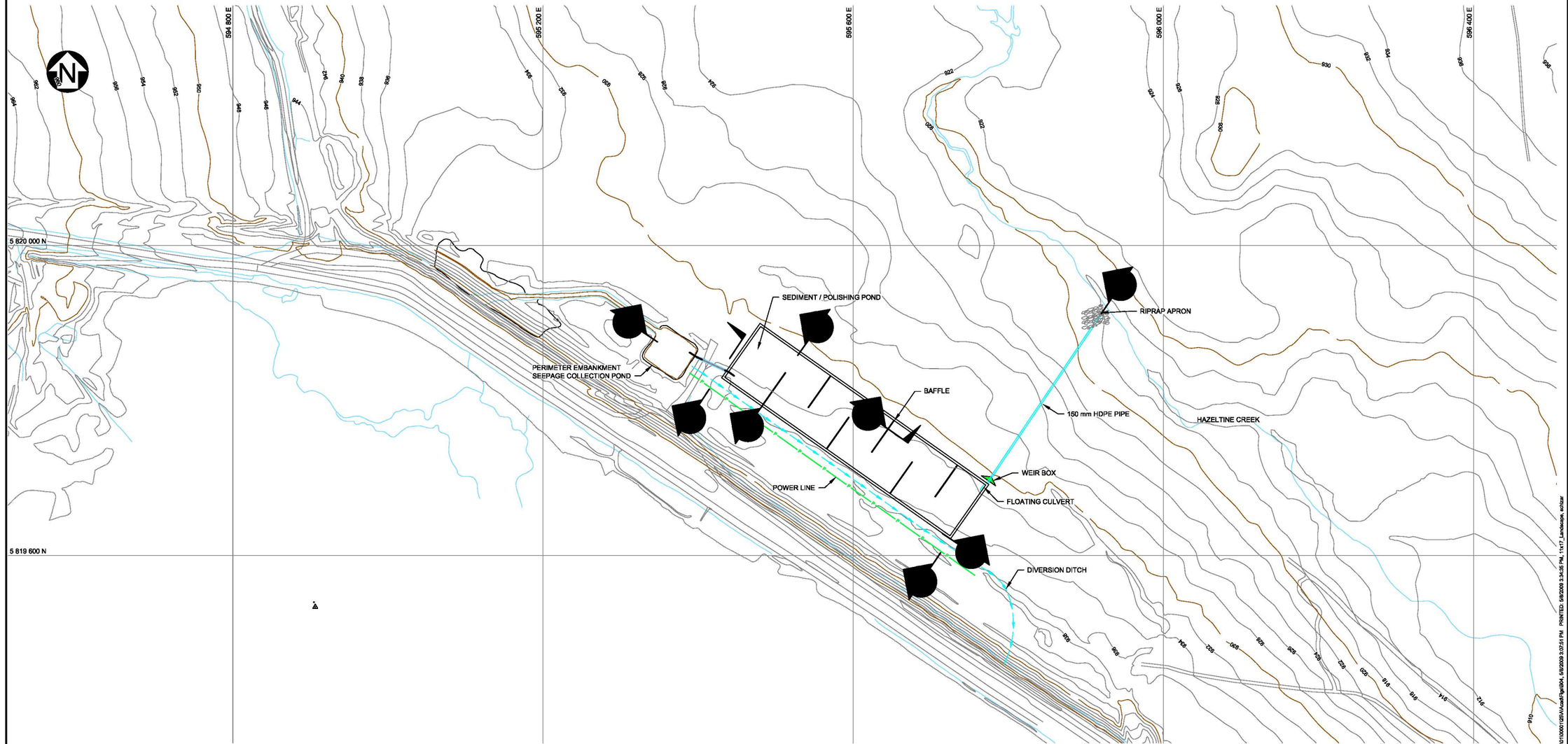

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

SEDIMENT / POLISHING POND
PLAN VIEW DETAILS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-1/25	VA09-00617

FIGURE 2 REV 0

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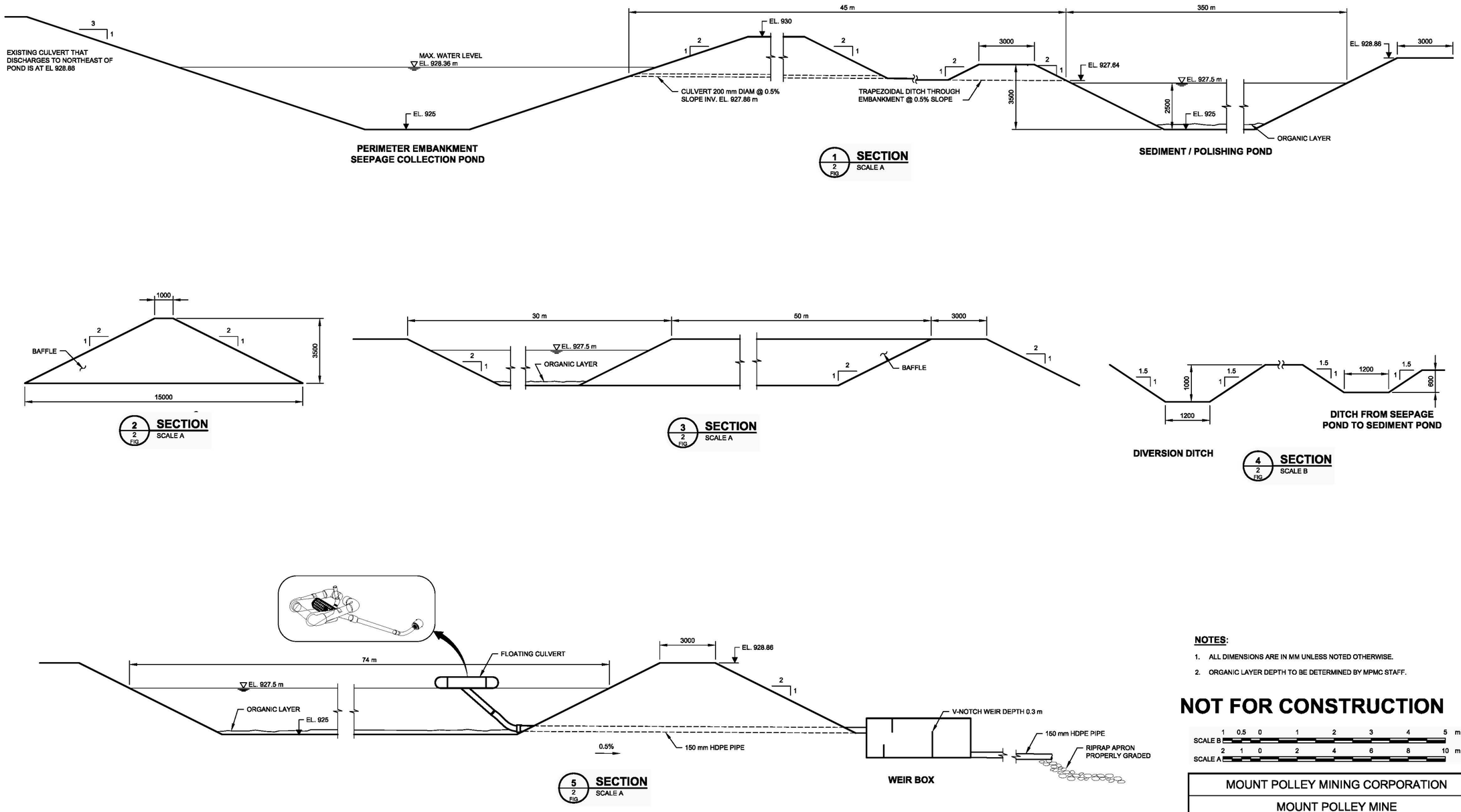

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. ORGANIC LAYER DEPTH TO BE DETERMINED BY MPMC STAFF.

NOT FOR CONSTRUCTION

SCALE B: 1 0.5 0 1 2 3 4 5 m

SCALE A: 2 1 0 2 4 6 8 10 m

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

SEDIMENT / POLISHING POND SECTIONS & DETAILS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-1/25	VA09-00617

FIGURE 3 REV 0

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