APPENDIX 6.3.1-B

Conceptual Design of Diffuser Report

29 April 2011
SX0373307

Shore Gold Inc.
300-224 4th Avenue South
Saskatoon, SK S7K 5M5

Attention: Ethan Richardson, M.Sc., P.Eng.
Environmental Manager

Dear Mr. Richardson:

Re: Conceptual Design of a Diffuser on the Saskatchewan River for the Shore Gold Star Diamond Project

1.0 INTRODUCTION

AMEC is pleased to provide Shore Gold with the following conceptual design of a diffuser on the Saskatchewan River for the Star Orion South Diamond Project near Fort à la Corne, SK. The purpose of this report is to outline the major design considerations and provide an initial estimate of materials quantities needed for construction. This initial assessment includes relevant cost factors such as:

- Anticipated project footprint;
- Approximate pipe length, diameter, and number of pipes;
- Construction methods;
- Materials and corrosion protection;
- Necessary erosion and sedimentation protection;
- Mitigation of river ice effects.

The works included in the design are restricted to those in the river and supporting infrastructure on the shore. The supply pipeline, pumps (if any), access road, and other utility connections are not included in this work since designs for these are being prepared by others.

2.0 CONCEPTUAL DESIGN

The diffuser design is based on the following general assumptions:

- Constant effluent discharge rate of 199,000 m^3/d (or 2.3 m^3/s);
- Effluent chloride concentration of 1,725 mg/L;
- Minimum depth of 2 m above the diffuser ports at the 7Q10 (169 m^3/s) low flow under ice-covered conditions (maximum ice thickness is 70 cm).

2.1 Site Plan and Bathymetry

The site proposed previously by AMEC (2010) is shown in **Figure 1**. At this location, the river has a total width of approximately 265 m at the 1:2 year flood level and an average depth (under ice) of just less than 2 m during the 7Q10 low-flow. An approximate representation of the diffuser pipe and coffer dam footprint is indicated on **Figure 1**.

The channel cross section based on the June 2010 bathymetry survey conducted by AMEC and simulated depth under ice at the 7Q10 design discharge is shown in **Figure 2**. The zone which does not meet the minimum depth criteria of at least 2.3 m is shaded on the cross section.

Further review of the bathymetry data indicates that a section approximately 100 m downstream (closer to the FALC Ravine) would provide access to greater depths in the middle of the channel, which would improve mixing performance and reduce the chances of the diffuser being affected by ice forces and sedimentation. AMEC recommends Shore Gold consider siting the diffuser at this downstream location. The primary cost consideration for using the alternate site would be a change in the on land supply pipeline length. Depending on the planned approach route from the mine, this difference may or may not be significant.

2.2 Diffuser Configuration

Considering the design discharge rate, minimum depth criteria, and typical design assumptions for similar structures, the diffuser should have the following principal characteristics:

Number of ports	40
Port diameter	150 mm
Port spacing	1.5 m
Riser height	300 mm above the river bed
Diffuser length	60.0 m
Diffuser pipe diameter	1200 mm

Along the diffuser pipe, risers will extend upwards into the flow, equipped with a 90° elbow and a custom fabricated nozzle oriented horizontally and in-line with the flow (facing downstream) as illustrated in **Figure 3**. The diffuser pipe diameter will be reduced along its length to balance the discharge through each port. It is anticipated that 2 reductions along the diffuser length will be adequate to achieve this. The reduced pipe diameters, their length and the exact specifications for the nozzles will need to be confirmed through numerical hydraulic modeling at the detailed design phase. For the present estimate, a constant diffuser pipe diameter of 1200 mm is assumed.

The diffuser pipe will extend approximately 50 m horizontally into the river bank, where it will intersect a drop shaft. This 1200 mm diameter shaft will be approximately 15 m deep, extending from the invert of the diffuser pipe to the ground surface above. A plunge pool box will likely be necessary at the base of the shaft to dissipate energy before flow enters the diffuser pipe. Since the supply pipe details from the mine site are not known, the details of the drop shaft configuration will need to be determined at a later stage of the design. The preferred installation method (open trench versus trenchless) of the diffuser pipe will also factor into the size of the working shaft (3000 to 4600 mm diameter) that must be excavated for construction.

The above diffuser design parameters are preliminary and will be refined during the detailed design phase. A numerical model such as CORMIX is required to confirm the effluent dispersion into the river water meets target concentration criteria. It is understood that this work will also be completed at a later date.

2.3 Materials and Corrosion Protection

Diffuser structures of this type are generally constructed using steel pipe for its overall strength and workability. It is imperative that the risers and nozzles protruding above the river bed are robust enough to withstand wear and abrasion from debris moving near the bed over the life of the project. On shore components such as manholes and drop shafts may be constructed from concrete.

Corrosion protection should be provided for the diffuser pipe by installing a sacrificial anode on the steel pipe where it enters the base of the drop shaft. Overall considerations for corrosion protection will take into account the service life of the mine and the diffuser.

2.4 Erosion Protection

The diffuser pipe will be positioned close to the existing river bed to minimize the required length of the risers (and head losses). It is anticipated that riprap will be required to armour the existing bed along the segment with risers where the depth of cover is small. Based on previous modeling results (AMEC, 2010), the maximum depth-averaged velocity in the vicinity of the diffuser is 3 m/s at the 1:100 year discharge. Port discharge velocities are approximately 3 m/s as well. Initial estimates suggest that 300 mm nominal diameter riprap, 600 mm thick placed to a width of 3 m on both sides of the diffuser pipe would provide adequate protection along a total length of 75 m.

3.0 CONSTRUCTION METHODS

Construction approach and staging requires some consideration of the river bed material and restrictions on obstruction of flow with coffer dams during construction. Transport Canada requires that at no time during construction should more than 2/3 of the channel be obstructed. For a diffuser to be effective, it must be constructed in the deepest portion of the channel, which is near the middle of the river at this location.

The 190 m long diffuser pipe extending into the river from the drop shaft on shore may be constructed either by open trench method, trenchless methods (e.g. pipe jacking), or a combination thereof. The conceptual design presented in **Figure 1** and quantities listed in **Section 4.0** assume that the main diffuser pipe can be installed using trenchless methods.

For installation by open trench methods, a wider excavation and worksite area would be required to lay the 1200 mm diameter diffuser pipe below the existing river bed in wet sand. It is estimated that the width of the worksite would increase to between 1.5 and 2 times the 20 m width shown in the site concept plan. For an open trench installation of the diffuser pipe between the shoreline and the drop shaft, a shorter drop shaft and sloping diffuser pipe segment below the existing river bank could be considered. The suitability of each method for construction will require more detailed knowledge of the site geotechnical conditions and the preferred construction method should be determined in consultation with potential contractors prior to or during the detailed design phase.

To accommodate work within the channel while minimizing the obstruction to flow, a vertical (sheet pile or caisson) coffer dam, installed by barge, will be required to maximize clearance around the worksite. Also, given that the river bed material in this reach is predominantly sand, isolation and dewatering of an instream worksite enclosed by earthen coffer dam will be difficult or ineffective. The proposed coffer dam and temporary access berm layout shown in **Figure 1** will satisfy restrictions on allowable channel obstruction. It should be noted that an earthen coffer dam segment that is parallel to the flow will connect the access berm to the coffer dam that surrounds the diffuser worksite area. The access berm will be fitted with three 900 mm culverts to reduce upstream afflux against the berm during high flows and maintain circulation of flow on the downstream side of the berm. The crown of the culverts would be set at the 1:2 year water surface elevation.

A typical staging approach for the instream works to construct the diffuser pipe would proceed as follows:

- Construct earthen access berm and coffer dam end wall;
- Install coffer dam in the middle of the river (by barge);
- Install electrical and pump services to worksite area for dewatering;
- Place the 1200 mm diameter diffuser pipe;
- Place riprap armouring around the diffuser pipe and fit crown of pipe with risers and nozzles;
- Remove (vibrate out) sheet pile walls by barge;
- Remove earthen coffer dam and temporary access berm.

It is anticipated that the allowable period for construction activities within the channel authorized by the Department of Fisheries and Oceans (DFO) Canada will be late summer or approximately July 15 through October 1. This period will avoid impacts on spring and fall spawning fish. The coffer dam and temporary access berm should extend up to at least the 1:5 year flood elevation of 352.9 m.

4.0 MATERIALS ESTIMATES

Table 1 summarizes the materials estimates required for construction based on the conceptual diffuser design and proposed construction approach. The quantities and materials specifications will be refined as numerical modeling of the pipe hydraulics and near-field effluent mixing progresses through the detailed design phase to be completed at a later date.

Table 1
Preliminary Materials Estimates for Shore Gold Diffuser Construction

Item No.	Description	Component	Qty	Unit
Diffuser Structure				
1	1200 mm Standard Wall Steel Pipe	Diffuser Pipe	190	m
2	1200 mm End Cap	Diffuser Pipe End	1	unit
3	150 mm Steel Pipe	Port Riser	50	m
4	90° Elbow 150 mm	Port Riser	40	unit
5	Prefabricated Nozzle	Nozzle	40	unit
6	Riprap (300 mm nominal diameter)	Armouring of Diffuser Pipe	500	m^3
7	Concrete Drop Shaft (1200 mm approx. diameter)	Connection to Diffuser Pipe	15	m depth
Construction Materials				
8	Sheet Pile (install, remove, and haul off-site)	Coffer Dam	180	m length
9	Fill (place, remove, and haul off-site)	Access Berm / Coffer Dam	12,000	m^3
10	Gravel (place, remove, and haul off-site)	Gravel Armour for Access Berm	800	m^3
11	900 mm Culvert (Total of 3)	Access Berm	36	m
12	Excavation (remove and haul off-site)	Expose Diffuser Pipe	350	m^3

5.0 RECOMMENDATIONS

AMEC recommends that Shore Gold integrate the following work into their overall mine site development plan and scheduling:

- Detailed design and numerical modeling of diffuser hydraulics and near-field mixing;
- Geotechnical site investigation to confirm subsurface conditions pertinent to placement of the diffuser pipe and construction of the drop shaft;
- Site survey during low-water to confirm bed material composition and channel section bathymetry (adequate observations of the bed material were not possible during the 2010 bathymetry survey by AMEC due to high flows);
- Design of fish habitat compensation and application for regulatory approval from DFO for HADD (Harmful Alteration, Disruption, or Destruction) of fish habitat.

AMEC can provide Shore Gold with assistance through each of these tasks leading up to final design and tendering.

6.0 CLOSURE

This report is based on and limited by the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the report. This report has been prepared for the exclusive use of **Shore Gold Inc.** and their agents for specific application to this project site. The work was conducted in accordance with the scope of work prepared for this project, and no other warranty, expressed or implied, is made.

We trust that the information within this report satisfies your requirements. Should you have any questions or require any additional information, please feel free to contact the undersigned at your earliest convenience.

Yours truly,

AMEC Earth & Environmental

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29-Apr-2011

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Permit to Practice No. P-4546

7.0 REFERENCES

AMEC 2010. “Saskatchewan River Hydrotechnical and Dispersion Modeling Study, Star Diamond Project -2010”, September 2010.

FIGURE 1

SITE PLAN AND ELEVATION

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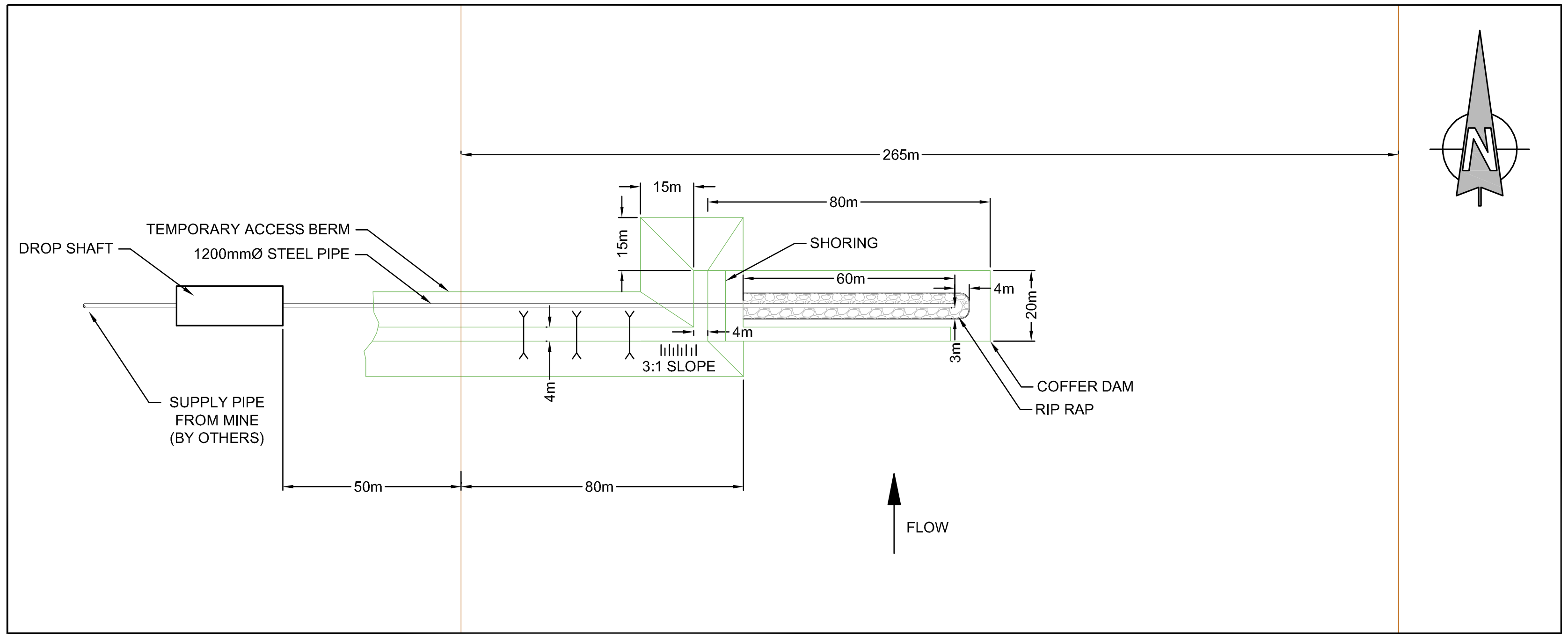
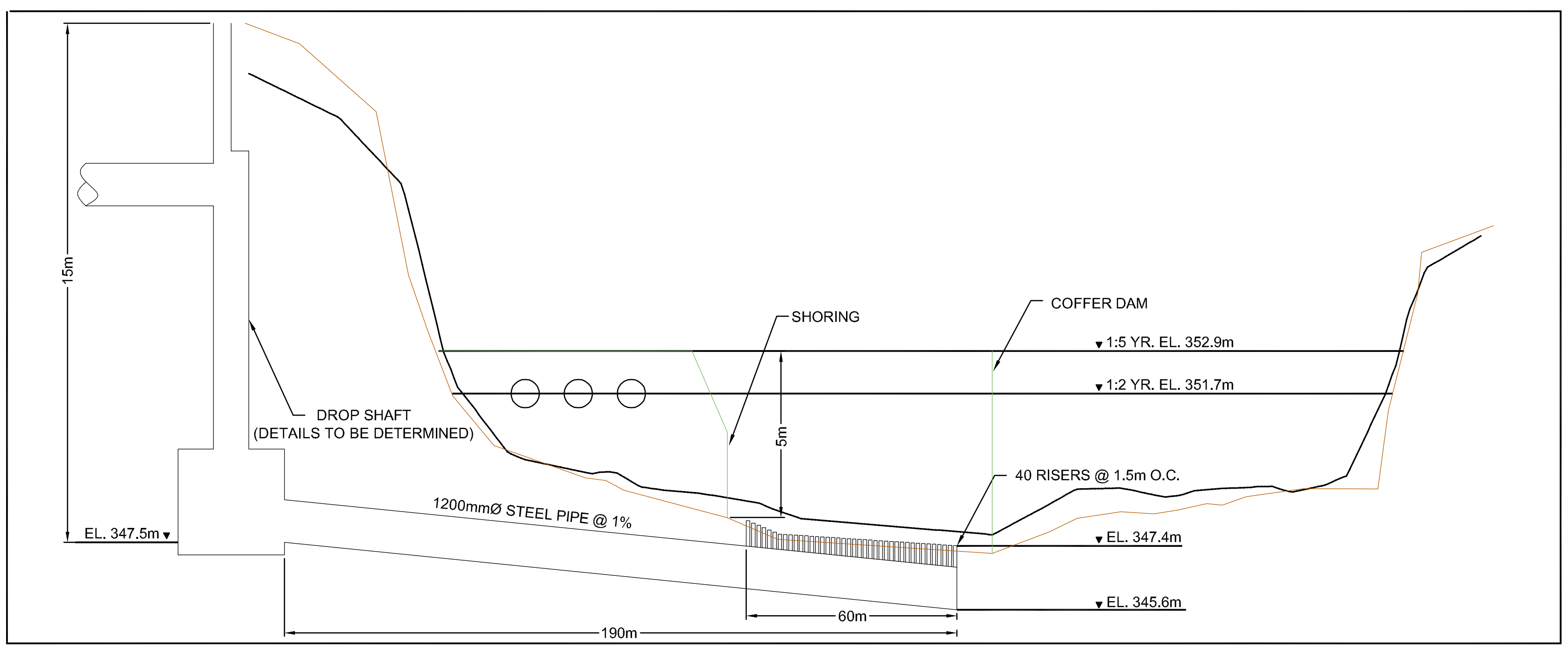
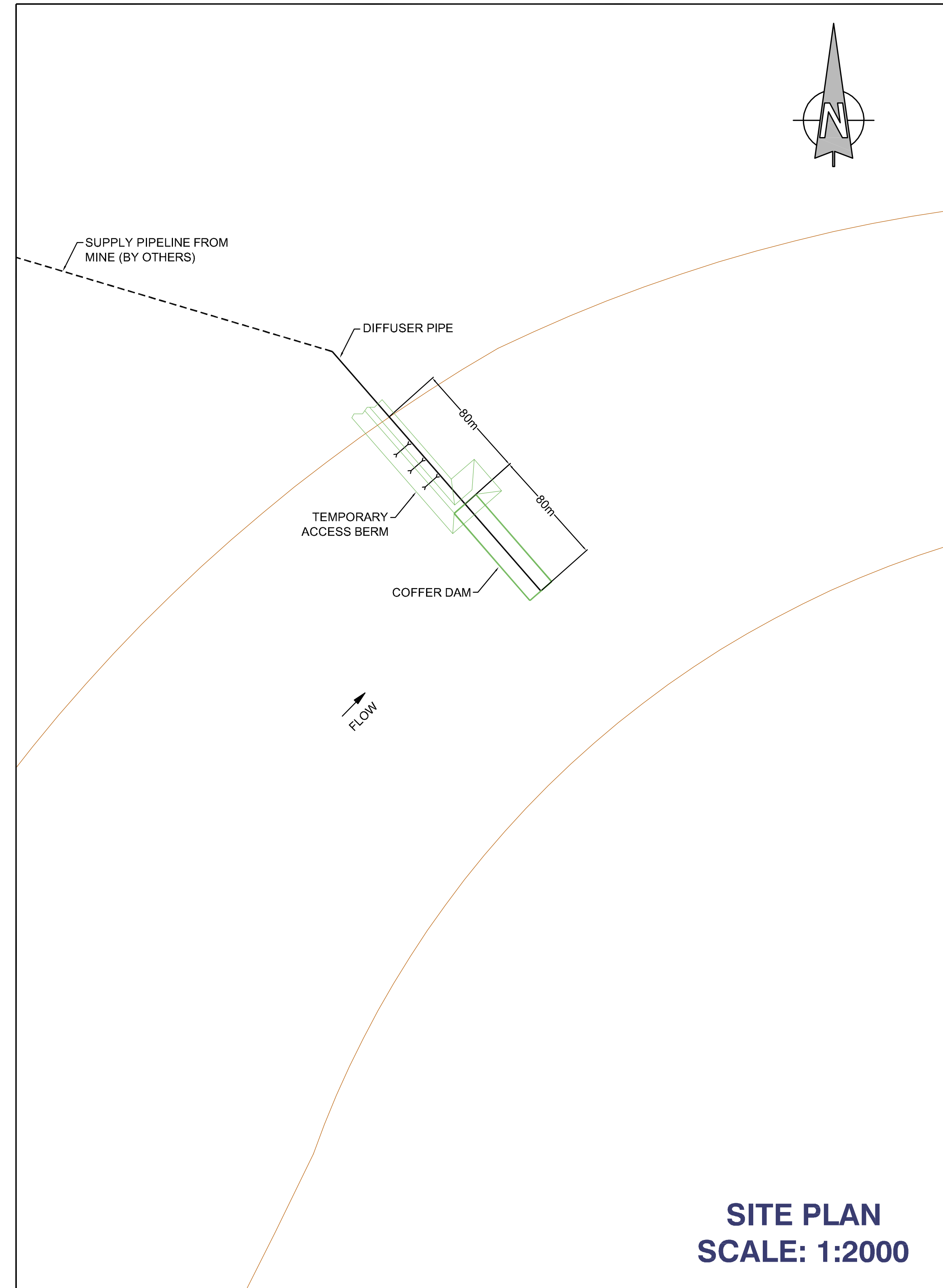


PLAN VIEW
SCALE: 1:1000



ELEVATION VIEW
SCALE: 1:1000

NOTE: CONCEPT DRAWINGS - NOT FOR CONSTRUCTION.
(ALL DIMENSIONS ARE APPROXIMATE)



SITE PLAN
SCALE: 1:2000

Shore Gold Inc.

AMEC Earth and Environmental

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SITE - PLAN & ELEVATION

FIGURE 2

CHANNEL CROSS SECTION AT THE PROPOSED DIFFUSER LOCATION

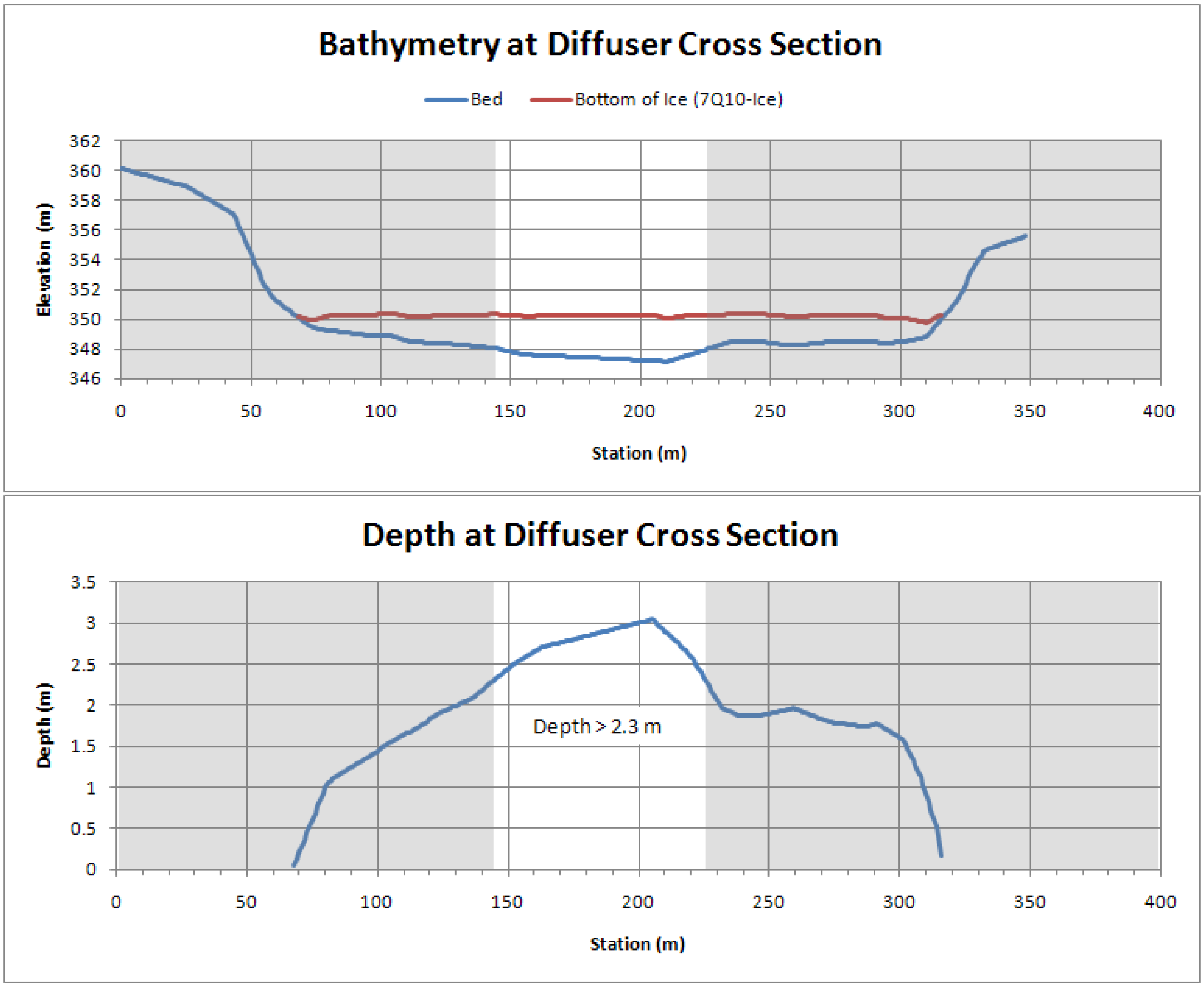
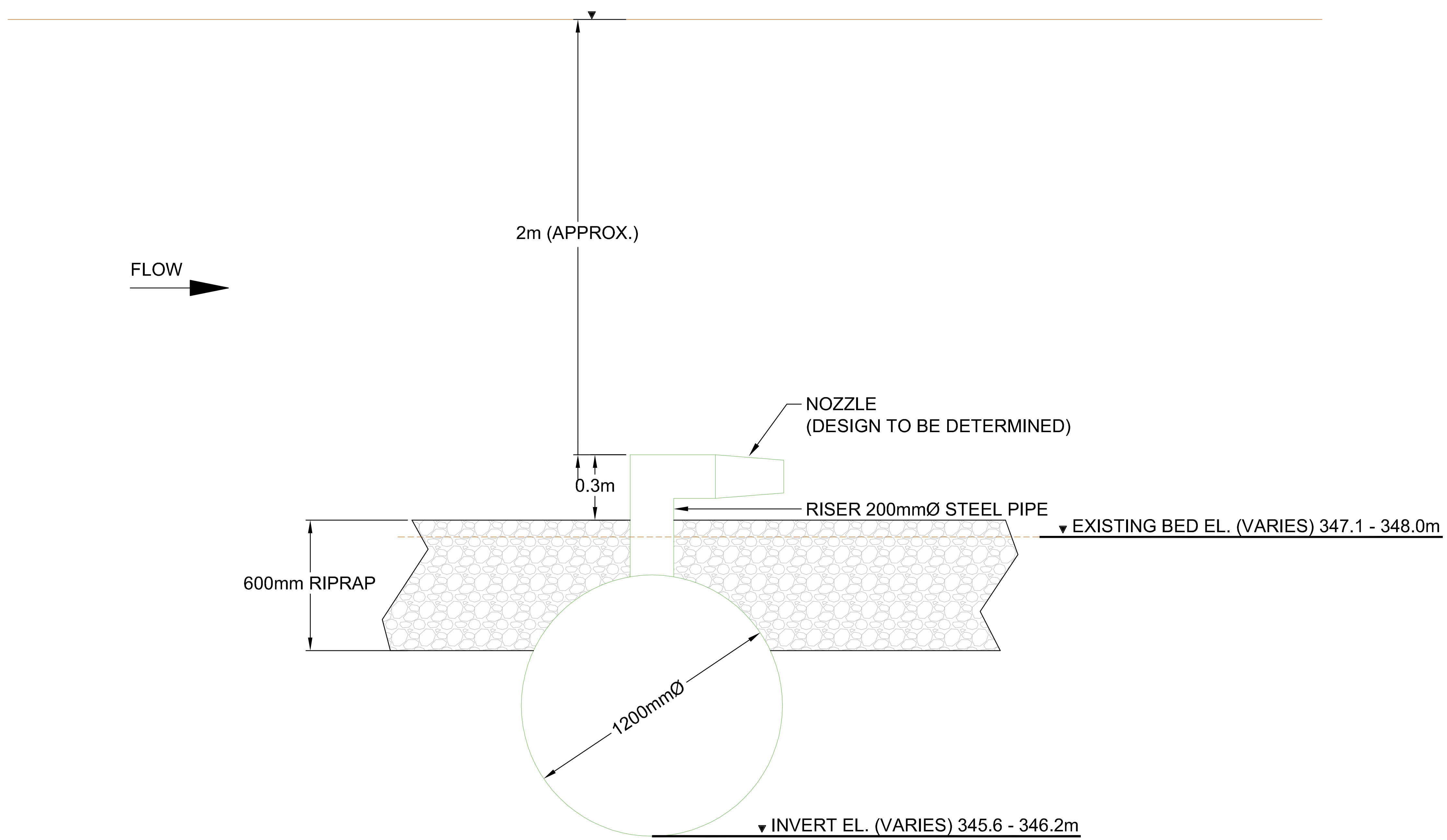


Figure 1 Channel Cross Section at the Proposed Diffuser Location.

FIGURE 3

RISER DETAIL



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RISER DETAIL

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