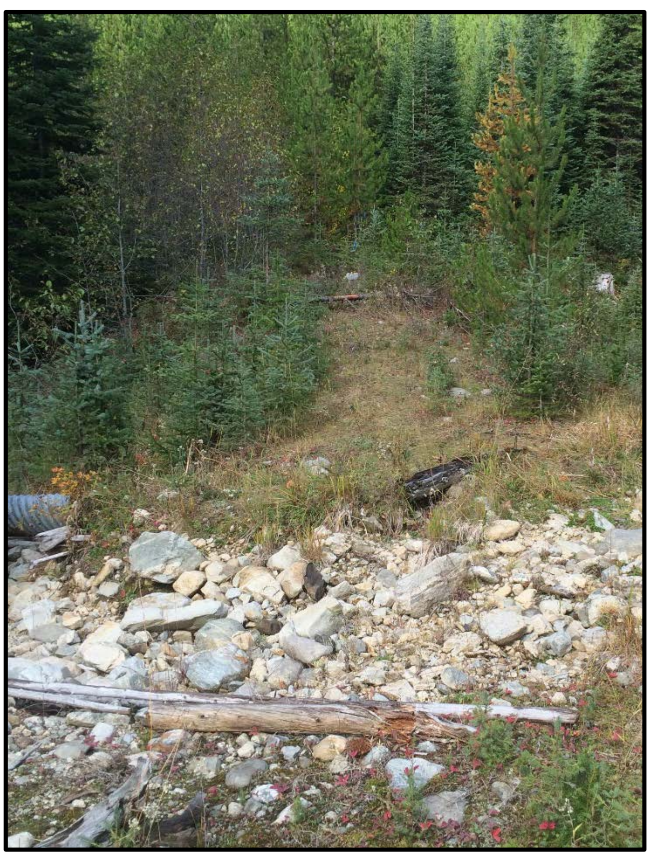
CROSSING REPLACEMENT DESIGN ON DERICKSON ROAD AT TRIBUTARY 3 OF TWO JOHN CREEK



CIEN 240

Clayton Murray

Branden Hoult

Eric Sandberg

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Executive Summary

The following report addresses the need for a replacement crossing for the existing, wash-out of Derickson Rd. at Tributary 3 of Two John Creek. The client requested that four design alternatives be developed with a final alternative recommended that would provide permanent logging access to Cutting Permit 300-1.

The report provides an overview of the existing site conditions, including the hydrology of the watershed area affecting the creek, presence of fish, and soil conditions. Using this data, four designs were developed that include steel and precast bridges along with open bottom and elliptical culverts. These designs include the reconstruction of the streambed, required road upgrades, and BMP's for soil erosion and sediment control. Costs of materials, along with an estimated time of construction are also included.

The advantages and disadvantages of each design are compared and a ratings table was created based on each alternative's cost, suitability, durability, ease of construction, and prospective maintenance. From this table, it is recommended that the open bottom culvert be used due to its site suitability, low cost, high durability, ease of construction, and low future maintenance. Moreover, it was found that the stream has the presence of Rainbow Trout and that in-stream work will be mandatory in order to complete the installation of the open bottom culvert. Finally, the culvert should be installed at the right angle and of an appropriate size to accommodate high peak flows and prevent any future washout.

On top of the recommendation to use an open bottom culvert, the report also recommends that sediment and erosion BMP's be used during and after construction, the stream be diverted temporarily during construction, the streambed be reconstructed in a similar manner to the existing sttreambed, and all work be completed during the appropriate work window of August 7th – October 15th.

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1.0 Introduction

This report, as requested by K. Langedyk, provides the design of a replacement crossing for the existing wash-out of Derickson Rd. at Tributary 3 of Two John Creek. The report includes a brief background of the site and description of the scope of work, followed by an explanation of the steps taken to evaluate the existing stream crossing. The design of four crossing replacements that allow for permanent logging access into Cutting Permit (CP) 300-1 are then described, and an evaluation of each based on a ratings table is included. A final design is proposed based on the criteria in the ratings table, and recommendations based on the construction of the crossing are made.

2.0 Scope of Work

The scope of work for this project included the design of two bridge and two culvert crossing alternatives for the replacement of the current washed-out crossing. The main objective was to explore several crossing design options for the site that would provide permanent logging access over the washout and into CP 300-1. For all the design alternatives, it was also critical to ensure minimal impact to the surrounding environment both during and after construction.

The services that were provided in the analysis of the existing crossing and completion of the design alternatives are as follows:

- Completed a topographic survey of the existing conditions of both Derickson Rd. and Tributary 3 of Two John Creek at the crossing location to be used as a base plan for each design alternative.

- Determined the geotechnical conditions of the site including gradation and soil classification for the purpose of the design of the crossing structure foundations and to be spec'd as a road sub-base.

- Reviewed the hydrological data for the watershed influencing Tributary 3 of Two John Creek in order to ensure the crossing alternatives were adequate for Q100 peak flows.

- Assessed the environmental impact of each crossing design in regards to drainage, sediment, erosion, fish, and in-stream work, and recommended mitigating measures to be used both during and after construction.

- Determined appropriate construction periods based on government fish in-stream work-window regulations.

- Designed four crossing alternatives to replace the current washed-out crossing. The four designs included a steel girder bridge, precast concrete bridge, elliptical culvert, and open bottom culvert.

- Designed the road approaches up to 30m to either side of the crossing, based on the crossing structure recommended.

- Completed cost estimates of materials required for each crossing design.

- Compared all four alternatives based on total cost, site suitability, ease of construction, durability, and maintenance and recommended the design that would be the most appropriate for the site.

3.0 Location and Site Background

3.1 Location

The crossing of Tributary 3 of Two John Creek is located adjacent to the 98km mark of Derickson Rd (approximately 14km North-East of the Big White Road / Hwy 33 junction). The crossing falls in UTM Zone 11 at N 5517943m E 360523m. The watershed influencing Tributary 3 of Two John Creek lies within both the Kootenay Boundary Forestry Region and Okanagan Highland Hydrologic Zone. See the attached Appendix A – Fig. 1 "Crossing Site Map" for more information regarding the crossing's location.

3.2 Site Description

From a site visit, it was determined that the washout of Derickson Rd. occurred due to the original culvert being undersized and installed at the wrong angle to accommodate high peak flows. The poor design of the existing culvert allowed the extreme flow of water to bypass the existing culvert and erode the road to the South of the culvert as shown in Fig. 2.

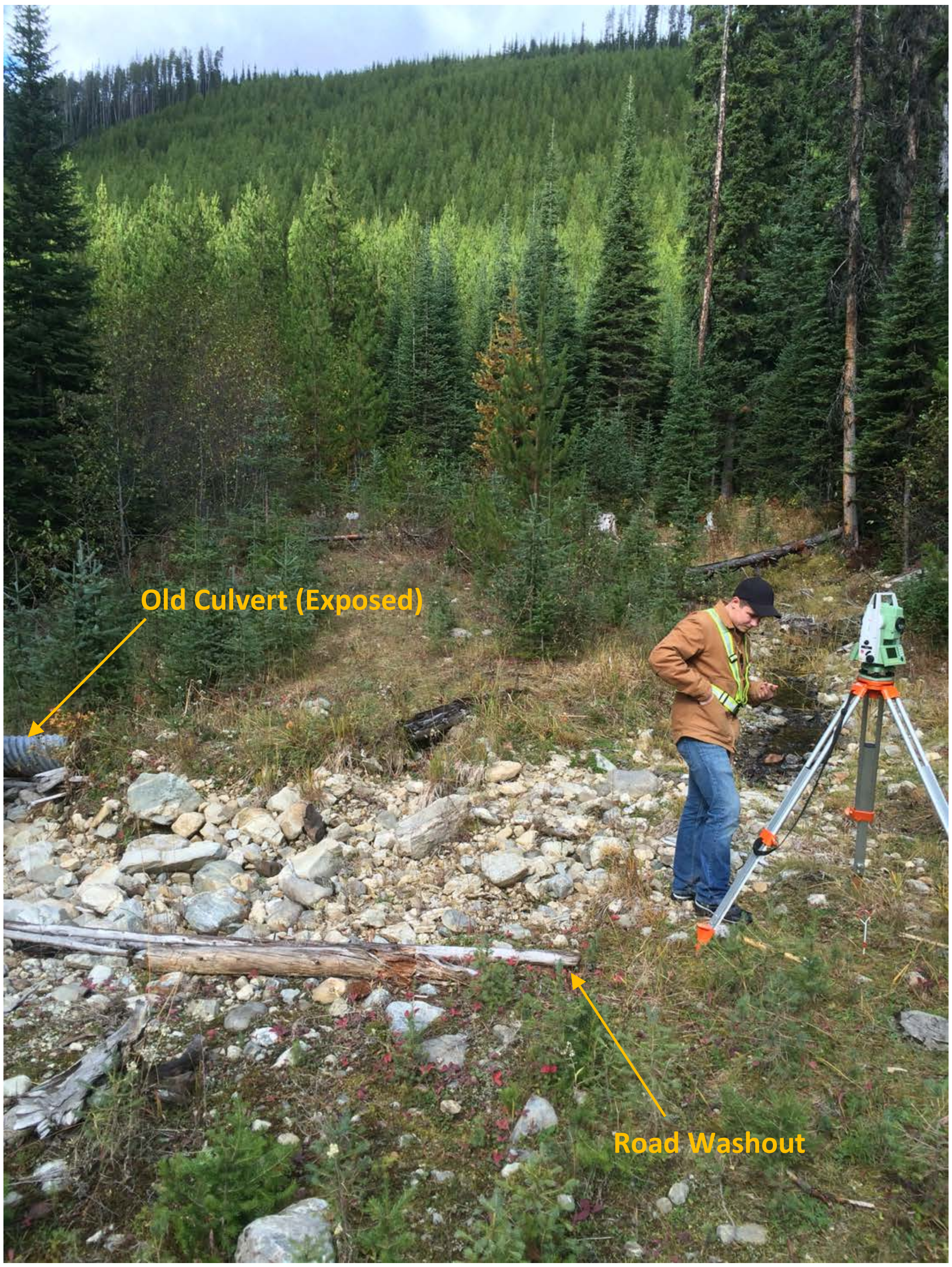

Fig. 2 – Derickson Rd. Washout at Tributary 3. (Taken by Eric)

4.0 Discussion of Work Activities

The following sections detail the design considerations completed in order to design four crossing alternatives for Tributary 3 of Two John Creek. These tasks include a Field Assessment, Geotechnical Analysis, Hydrological Assessment, and an Environmental Analysis with Recommendations.

4.1 Field Assessment

A full site assessment of Tributary 3 was conducted, including the completion of a topographic survey, preliminary onsite geotechnical assessment, and general observations (see Appendix C: C – 14 for field notes). Prior to the site visit a safety meeting was conducted. The record of the safety meeting can be found in Appendix C: C – 13.

The topographic survey included the road prism on either side of the crossing up to 30m, as well as above and below the road right-of-way (see photos from the site visit in Appendix A – Fig. 3 and Fig. 4). The survey was completed according to the guidelines and details in the BC FLNRO Engineering Manual (2013). For a detailed plan view of the existing site conditions and layout see Drawings 101 and 102 in Appendix B.

Other general observations made onsite included the current debris load on either side of the tributary, as shown in Appendix A – Fig. 5 and Fig. 6. From these observations, it was determined that the in-stream debris load will not be an issue as it is not expected to move. Large trees were the only debris noted on site and have been overgrown to become part of the natural environment. Potential waste dump locations were also noted (see Drawings 201,203,205, and 207 in Appendix B) and the condition of the road leading to the crossing in regards to construction equipment accessibility were noted to be more than adequate.

4.2 Geotechnical Analysis

A soil investigation was carried out as instructed by the BC forestry guidelines (BC FLNRO 2013). This examination consisted of the digging of two holes using a spade shovel. Disturbed soil samples collected from the site were subjected to visual inspections and classification. This classification is important in determining the ability of the soil to withstand static and dynamic loading.

After the completion of a mechanical split sieve analysis (Appendix A – Table 1) it was determined that the soil encountered onsite is a granular till material that would be considered an excellent-to-good subgrade material (according to the AASHTO M-145 Classification). It is recommended that material sourced near the site should be used for the road construction and for the crossing structure backfill.

4.3 Hydrological Assessment

The watershed area directly influencing the crossing is approximately 2.19km^2. This area was determined using contours maps on iMapBC, and can be found in Appendix A – Fig. 7. From there, three approaches were taken in order to estimate the Q100 design flow.

The first approach involved the use of isolines provided by iMapBC online software. This estimate is very rough, and is based on an average flow per 100km^2. When adjusted for the actual watershed area (2.19km^2), the flow determined was 0.657 m^3/s.

A second approach consisted of selecting comparison watersheds of similar location, elevation, and size, and collecting their archived annual peak flow data from nearby hydrometric stations. The Weibull Plotting Position Equation was used to determine the return period and exceedance probability data necessary to plot flow vs. return period on gumbel probability paper and get a Q100 estimate. See Appendix A – Table 2 and Table 3 for a summary of the hydrometric data collected and Appendix A – Fig. 8 and Fig. 9 for both gumbel distributions.

Trapping Creek (Station 08NN019) was the first comparison watershed selected based on its location (25km from crossing), and the fact that Two John Creek drains into Trapping Creek. An analysis of the watershed's data and comparison with Tributary 3's watershed produced a Q100 estimate of 0.566m^3/s.

The second comparison watershed chosen was Two Forty-One Creek (Station 08NM241) based on its similar elevation (Tributary = 1518m, Two Forty-One = 1600m) and size (Tributary = 2.19km^2, Two Forty-One = 4.5km^2). Comparison of the data from the creek to the area of the watershed above Tributary 3 gave a Q100 estimate of 1.849m^3/s.

The final approach utilized recommended Q100 design curves provided in the report “Peak Flow – Culvert Design Study: Penticton Forest District” by Summit Environmental Consultants Ltd (2000). Tributary 3 falls in “Zone 4: Upper Kettle River” and the respective design curve can be found in Appendix A – Fig. 10. From this curve, a Q100 flow of 2.6m^3/s was estimated.

Of the four estimated flows above, the 1.849m^3/s determined using Two Forty-One Creek was selected as the Q100 design flow for this crossing. This was in large part due to the data coming from a watershed of both similar size and elevation, as well as the currency of the data and how relevant it was to Tributary 3.

A Q5 level was also estimated to display a level expected at the crossing on a more regular basis. This value was determined with the same gumbel distribution used to estimate the Q100 flow. For consistency, the Q5 associated with Two Forty-One Creek was chosen (0.949m^3/s).

As the crossing requires the streambed to be restored due to the washout of the existing culvert, a representative and relatively undisturbed cross section also had to be selected 25m upstream. This section was taken and modelled in Flowmaster to determine both a Q100 and Q5 water level.

4.4 Environmental Analysis and Recommendations

4.4.1 Fish Stream Work Windows

Tributary 3 of Two John Creek is classified as an S3 Stream due to its width and presence of fish. According to iMapBC, rainbow trout is present at the location of the crossing. The work window that corresponds with the presence of rainbow trout is August 7th – Oct 15th. The purpose of the in-stream work window is to avoid affecting the quality and quantity of water and to limit harm to the fish and wildlife species present.

4.4.2 Diversion of the Stream

In order to complete the installation of a new crossing over the washout, in-stream work must be conducted. This means the stream will need to be diverted to prevent washout, erosion of banks and foundations/abutments, and sediment transfer downstream during construction. Some guidelines recommended by

Culvert BC (2001) have been listed below as general instructions to follow during the installation of the new crossing structure.

- Remove Fish – this is required before in-stream work begins.
- Construct a Downstream Dam – this is primarily used to catch minor sediment or suspended particles in the water. It also provides an added level of comfort for unforeseen circumstances such as hazardous spills from equipment.
- Construct Upstream Dam – it is essential in any flow diversion as it must capture all the water flow. If a "pump-around method" is used, a sufficient number of pumps (including spares) is required. Avoid using pumps if the job cannot be completed in one shift.
- Always have a fully stocked sediment control kit on site to deal with unexpected events. The kit should include silt fences, geotextile tarps, grass seed and hay bales, sand and plastic bags, polyethylene pipe, and volume pumps with the required tools and hoses.

Once the work has been completed:

- Disassemble the Upstream Dam but try to keep the diversion partially functional as long as possible. This allows for the slow release of water from the dam and prevents a surge flow. Maintain the downstream dam while the flows increase into the isolated stream section.
- Disassemble the Downstream Dam when water quantity and quality return to normal levels. Restore the site to its original state.

4.4.3 Erosion and Sediment Control During Construction

During the construction of the new crossing, care must be taken to ensure erosion is kept at a minimum and sediment is not allowed to enter the stream. The following section provides general guidelines that must be followed during construction. For more detailed information on the control of soil erosion and sediment transport, refer to the BC FLNRO Engineering Manual (2013) and the BC Fish Stream Crossing Guidebook (2012).

- Protect any exposed soil surfaces from erosion due to rain with tarps
- Temporarily divert stream flow using diversion ditches, a temporary culvert, or a pump to reduce the exposure of disturbed soil to flowing water.
- Apply permanent cover (vegetation) to slopes as soon they're completed, rather than after the entire project is complete.
- Install silt fencing at the base of the road toe slope on either side of the crossing prior to the installation of the diversion ditches

4.4.4 Erosion and Sediment Control After Construction

The use of erosion and sediment control measures after construction ensures minimal future maintenance and limits the overall environmental impact of the crossing site. For more detailed information on the control of soil erosion and sediment transport, refer to the BC FLNRO Engineering Manual (2013) and the BC Fish Stream Crossing Guidebook (2012).

First off, to prevent future erosion of slopes, it is recommended that vegetation be planted on all exposed areas. This vegetation helps in maintaining surface stability and surface water infiltration.

Grading the road away from the crossing aids in preventing drainage containing sediment from entering the stream; however, drainage will still work its way back to the stream due to the grade of the existing ground at the toe of the road slope. To prevent sediment from entering the stream, it is recommended that ditch flow be diverted into forested area outside of the road prism on both upstream and downstream sides of the crossing. See drawings 201, 203, 205, and 207 in Appendix B for more information.

5.0 Proposed Crossing Designs

Four permanent stream crossing alternatives were designed for the site, including a steel girder bridge, precast concrete bridge, elliptical culvert, and open bottom culvert. Survey data was modelled in CAD software to create existing condition plans. These were then used to create general arrangement, profile, and section view plans for each design. The geometric design of the road approach for each design was also completed.

All alternatives were designed for an L-75 load rating and adhere to all regulations detailed in the BC FLNRO Engineering Manual (2013), the BC Forest Service Bridge Design and Construction Manual (2013), and the BC Fish-Stream Crossing Guidebook (2012). Other resources used in the design process include AASHTO M-145, the Handbook of Steel Drainage and Highway Construction Products (CSPI 2010), and Culvert BC (2001).

The subsections below detail the channel restoration required for all design alternatives (5.1), followed by a detailed description of each alternative (5.2, 5.3) and timeline and cost estimates (5.4, 5.5).

5.1 Channel Restoration

A more natural alignment of the stream was designed, with the crossing of the road occurring further North than the existing culvert. The representative section chosen upstream of the crossing (see Hydrological Assessment Section 4.4) is to be maintained along the restored stream alignment at a 6% grade and must be blended into the existing stream.

The streambed itself should consist of sufficient layers of unconsolidated gravel, sand, cobble, and other sediment lying over the top of the bedrock to allow for proper streambed design. These layers should replicate the upstream and downstream conditions of the stream, and no organic material should be present.

By dividing the Q100 flow of 1.849m^3/s by the stream cross-sectional area of 1m^2, it was determined that the velocity of water passing through the channel will be 1.849m/s. From this velocity, and using the BC Fish-Stream Crossing, a well-graded coarse gravel (75mm) is suggested as it will not wash away until a stream-flow velocity of 2.40m/s is reached. However, due to the adjacent streambed having more cobble present than gravel, and the large streambed width, a mixture of cobble, gravel, and sand is recommended. The streambed material is extremely important as it not only affects the fish passage but also has a major influence on the hydraulic radius of the stream.

For both culvert options, the section inside is to consist of sandy gravel substrate bordered by class 50 riprap for scour protection and must maintain the 3.4m Q100 top water design width. Both culvert options were selected based on their span so that the Q100 level does not come in contact with the culvert itself.

Another way to reduce the washout of fines is to line the streambed with larger material known as "Boulder Lines". Boulder Lines are to consist of large cobbles (300mm or greater) that are to be placed within the streambed every 6m (3m inside the elliptical culvert alternative) to limit the washout of fines. These boulder lines should be placed in a way that does not restrict fish passage while still simulating the natural conditions of the stream (Fig. 11).

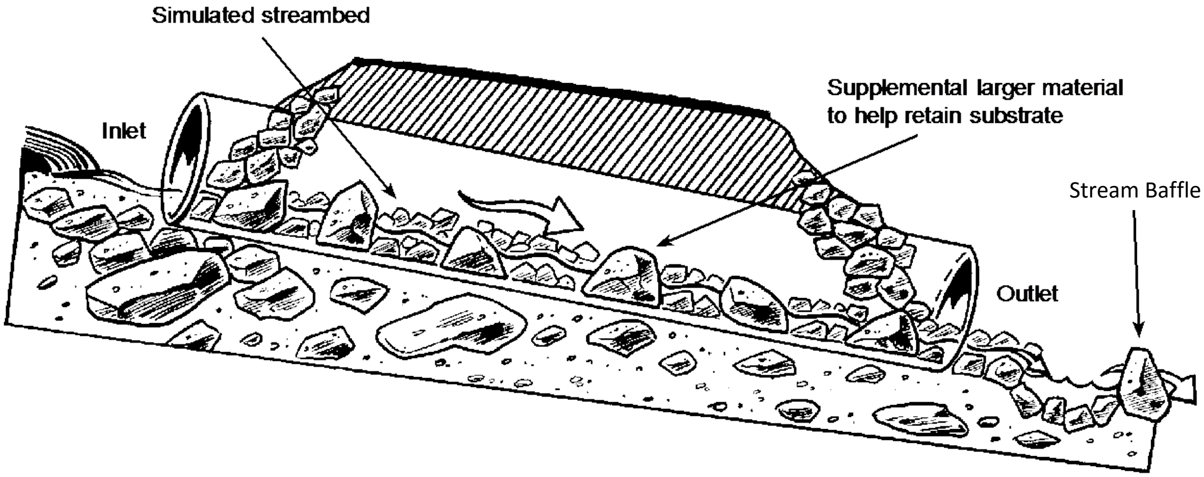

Fig. 11 – Typical Elevation View of Substrate in a Culvert

(BC Fish-Stream Crossing Guidebook (2012) – Figure 5)

Due to the elevation difference at the end of the reconstructed channel and the existing streambed, the installation of a rock baffle is recommended to absorb the flow and provide a resting pool for fish. The height of the baffle must provide fish resting areas during high flows and maintain adequate water depth during lower flow periods. It must not reduce culvert capacity below hydraulic design standards, cause flooding, or capture excessive debris. See the baffle detail on drawings 201, 203, 205, and 207 in Appendix B for more information. As well, typical rock baffle construction is shown in Fig. 12 below.

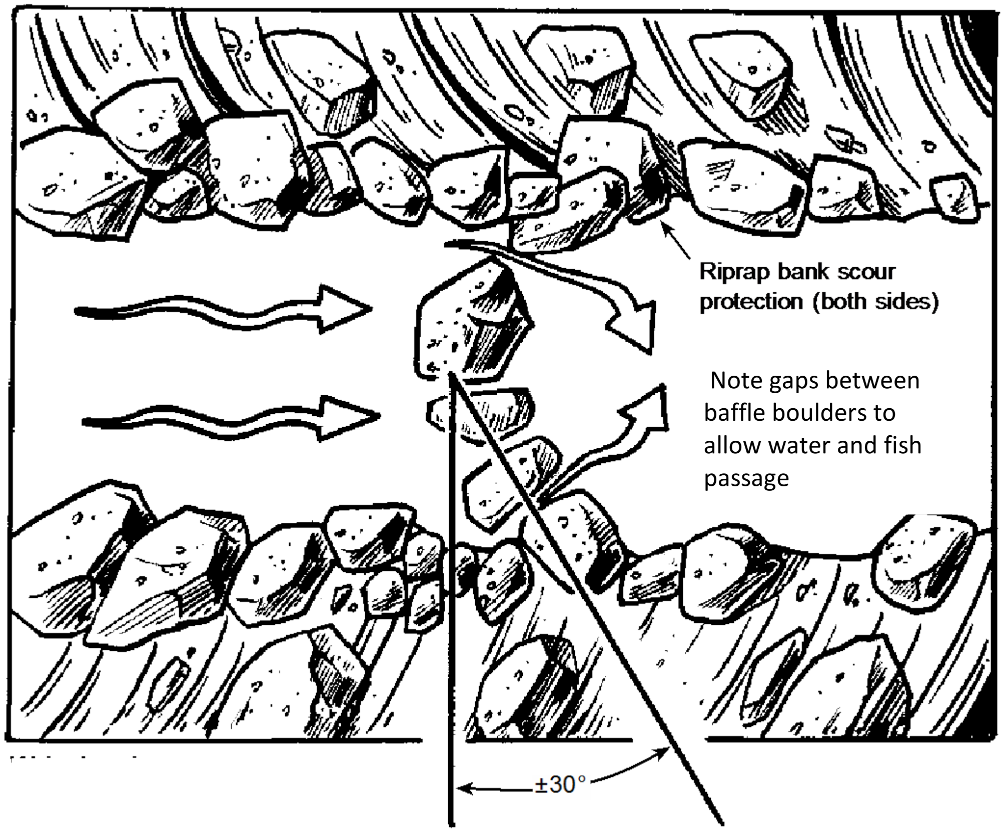

Fig. 12 – Typical Plan View of a Rock Baffle

(BC Fish-Stream Crossing Guidebook (2012) – Figure 8)

5.2 Bridge Design Alternatives

The section below details both bridge alternatives (5.2.1, 5.2.2), and is followed by descriptions of the abutment (5.2.3), road approach (5.2.4) and rip rap design (5.2.5) necessary for both.

5.2.1 Steel Girder Bridge (Drawings 201-202)

The first alternative for the crossing replacement is a steel girder bridge. With a wider width required for clearance on a corner, a 5.846m bridge deck width by 9.144m span bridge is recommended to clear the reconstructed stream and necessary riprap. Steel girders spaced at 4.2m rest on precast cap beams that sit on the lock block abutments. Refer to MOF drawing STD-E-050-30 for more detail on the precast cap beam. Precast ballast walls are specified for either side (MOF STD-E-050-01), and timber guardrails (as detailed in MOF STD-EC-010-01) are recommended. A deck elevation of 100.947m was determined with no grade. This bridge is designed for L-75 loading and is provided as a package delivered to the site.

The benefits to this alternative are:

- Its ease of construction (bridge delivered and placed on pre-constructed abutments by supplier).
- Its wide deck provides the necessary vehicle clearance.
- Its allowance for natural streambed reconstruction below.

The disadvantages to this alternative are:

- The lock block abutments must be designed to take the eccentric loading of a cornering truck, something they are not able to do in their current configuration. Further detailed design is required if this alternative is desired.
- It requires a substantial amount of fill to build the road up to deck level.
- It requires a large amount of erosion protection (riprap) at the abutments.
- It will require future maintenance.

5.2.2 Precast Concrete Bridge (Drawings 203-204)

The second alternative for the crossing is a precast concrete bridge. With a wider width required for clearance on a corner, a 5.846m bridge deck width by a 9.144m span bridge is recommended to clear the reconstructed stream and necessary riprap. The precast concrete deck rests on precast cap beams that sit on the lock block abutments. Refer to MOF drawing STD-E-050-30 for more detail on the precast cap beam. Precast ballast walls are specified for either side (MOF STD-E-050-01), and timber guardrails as detailed in MOF STD-EC-010-01 are recommended. A deck elevation of 100.947m was determined with no grade. This bridge alternative is designed for L75 loading and is provided as a package delivered to the site.

The benefits to this alternative are:

- Its ease of construction (bridge delivered and placed on pre-constructed abutments by supplier).
- Its wide deck provides the necessary vehicle clearance.
- Its allowance for natural streambed reconstruction below.

The disadvantages to this alternative are:

- The lock block abutments must be designed to take the eccentric loading of a cornering truck, something they are not able to do in their current configuration. Further detailed design is required if this alternative is desired.
- It requires a substantial amount of fill to build the road up to deck level.
- It requires a large amount of riprap at the abutments.
- It will require future maintenance.

5.2.3 Abutments:

The abutments specified for both bridge alternatives are comprised of lock blocks due to their relative simplicity, availability, ease of construction, and low maintenance. The base of both abutments must be excavated into existing ground to an elevation of 96.824m. If possible, the excavated material shall be saved for use in the stream reconstruction. 4 layers of lock block is specified to provide necessary clearance for construction purposes. Geogrid must be placed at each layer of lock block and tied back into the abutment backfill 1m. Details of abutment design can be found in MOF drawing STD-E-050-30. Both abutments will be constructed in a similar fashion, with the North side abutment being design slightly shorter on the upstream side to avoid any interference with the reconstructed channel. The main issue with these abutments, is that a detailed anchoring design is required due to the bridge being placed at a corner.

5.2.4 Road Approaches

A typical forestry road cross section was used in the design, with a slightly wider top width of 6m required as the crossing falls on a corner. 1.5:1 side fill slopes were also specified.

Due to the crossing occurring at a corner in the existing road, two 35m radius curves were used to obtain as much tangency to either side of the bridge as possible. In this case, the recommended 10m tangency was only met on the South side of the crossing. To get around this issue, vehicle tracking software was used to determine a width of bridge that would work with the design vehicle (LG3 LLT). The results of the software indicated that a 5.846m bridge deck width would be required. The proposed road alignment is also slightly rotated counterclockwise in comparison to the existing road in order to ensure a perpendicular crossing.

In terms of the road profile, the North approach is graded away from the crossing at a 2% grade until it ties into the existing road, while the south approach is graded away at 8%. Both grades adhere to the maximums laid out for a 5-6m road and 30km/h speed limit in the BC FLNRO Engineering Manual (2013).

5.2.5 Riprap (Erosion Protection)

Due to the realignment of the stream, riprap placement is recommended on the existing banks approaching the bridge on the upstream side. Class 50 riprap was selected based on stream velocity, and typical installation details can be found in Fig. 13 of Appendix A. All riprap installation requires a 0.5m width key in and geotextile underlay. The riprap itself must be "clean, solid, angular, blocky stones; well graded to fill gaps between larger stones, and placed carefully to obtain a well graded blanket of interlocking stones," as per specifications in the BC Fish-Stream Crossing Guidebook (2012). As the makeup of this material is fairly specific, it cannot be taken from the site and must be brought in. A typical detail of installation, design top elevations, and placement locations are all detailed on both bridge alternative's General Arrangements (Drawings 201 and 203) found in Appendix B.

Installation of rip rap at the bridge abutments is also recommended. Riprap must be keyed in and maintain the 3.4m design Q100 top water width while sloping 1.5:1 up to a standard height of 1.5m above the streambed at either abutment. See drawings 202 & 204 in Appendix B for profile views detailing this placement for both bridge alternatives.

5.3 Culvert Design Alternatives

The section below details both culvert alternatives (5.3.1, 5.3.2), and is followed by descriptions of the road approach upgrades (5.3.3) and rip rap design (5.3.4) necessary for both.

5.3.1 Open Bottom Culvert (Drawings 205-206)

A 17.5m structural plate corrugated steel arch with a 5.79m span and 2.79m rise was selected for this design based on the width of the representative stream section selected and the clearance required for stream reconstruction (minimum 2m). The culvert specified has a 152x51mm corrugation profile and rests on 0.6m wide steel footings, embedded 0.3m below the streambed base elevation. 100mm of crush gravel is required below the footings and it is recommended that 1m clearance be provided to either side of the footings when they are excavated. This will provide adequate clearance for backfill compaction during installation. If possible, excavated material shall be saved for use in the stream reconstruction.

The benefits of this alternative are:

- Vehicle clearance and cornering are not an issue.
- It provides adequate width to mimic representative stream section (Q100 will not touch culvert).
- It requires less erosion protection (riprap).
- Little to no future maintenance can be expected.

The disadvantages of this alternative are:

- It requires a substantial amount of fill to build the road up to the necessary cover over the culvert.
- It requires a more labour intensive installation process.

5.3.2 Elliptical Culvert (Drawings 207-208)

A 17.5m structural plate corrugated horizontal ellipse with a 4.42m span and 2.79m rise was selected for this design based on the width of the representative stream section selected and the clearance required for stream reconstruction (minimum 2m). The culvert specified has a 152x51mm corrugation profile and rests on a 300mm nominal thickness layer of bedding sand. The bottom of the culvert must be embedded 0.8m deep. It is recommended that 1m clearance be provided to either side of the footings when they are excavated in order to provide adequate clearance for backfill compaction during installation. If possible, excavated material shall be saved for use in the stream reconstruction.

The benefits of this alternative are:

- Vehicle clearance and cornering are not an issue
- It provides adequate width to mimic representative stream section (Q100 will not touch culvert).
- It requires less erosion protection (riprap)
- Little to no future maintenance can be expected

The disadvantages of this alternative are:

- It requires a substantial amount of fill to build the road up to the necessary cover over the culvert
- It requires a more labour intensive installation process

5.3.3 Road Upgrades

A typical forestry road cross section was used in the design, with a slightly wider top width (6m) to accommodate the turns, and typical 1.5:1 side slopes.

The alignment mirrors the existing road South of the crossing, before curving at a 35m radius. This curve is designed to ensure that the road is perpendicular to the culvert.

In terms of road profile, 1.5m of cover is maintained over the entire culvert length for support (1.68m at centerline). The north approach is graded away from the crossing at a 2% grade until it ties into the existing road, while the south approach is graded away at 7.5%. Both grades adhere to the maximums laid out for a 5-6m road and 30km/h speed limit in the BC FLNRO Engineering Manual (2013).

5.3.4 Riprap (Erosion Protection)

Due to the realignment of the stream, riprap placement is recommended on the existing banks approaching the bridge on the upstream side. Class 50 riprap was selected based on stream velocity, and typical installation details can be found in Fig. 13 of Appendix A. All riprap installation requires a 0.5m width key in and geotextile underlay. The riprap itself must be “clean, solid, angular, blocky stones; well graded to fill gaps between larger stones, and placed carefully to obtain a well graded blanket of interlocking stones," as per specifications in the BC Fish-Stream Crossing Guidebook (2012). As the makeup of this material is fairly specific, it cannot be taken from the site and must be brought in. A typical detail of installation, design top elevations, and location of placement are detailed on both General Arrangements (Drawings 205 and 207) found in Appendix B. It is also recommended that it be placed around the culvert inlet and outlet for protection purposes (0.5m above, 1m either side, 0.55m thick).

5.4 Timeline

The timeline for project completion depends on the contractor chosen to complete the project. However, any and all work must be completed within the fish work window stated in section 4.4.1 of this report. Based on previous projects of this size, a rough estimate of project completion would be approximately one week for bridges, two weeks for the open bottom culvert, and about 2.5 weeks for the elliptical culvert.

5.5 Cost

The costs for the different design alternatives are outlined in Table 4. The table outlines the various materials and quantities needed for construction and the costs for those materials. As seen in the table the most cost efficient option is the elliptical culvert option.

Table 4 – Material Cost Table for all Design Alternatives

Element of Construction	Open Bottom Culvert		Elliptical Culvert		Steel Girder Bridge		Precast Concrete Bridge	
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Culvert	1	$ 47,800.00	1	$ 53,670.00	0		0	
Bridge	0		0		1	$ 54,150.00	1	$ 55,700.00
Lock Blocks	0		0		58	$ 9,320.00	58	$ 9,320.00
Rip Rap (with delivery)	75m^3	$ 3,825.00	45m^3	$ 2,295.00	90m^3	$ 4,590.00	90m^3	$ 4,590.00
3/4" Crush	5	$ 185.00	$ 33.00	$ 1,221.00	2.5	$ 92.50	2.5	$ 92.50
Bedding Sand	0		25m^3	$ 1,330.00	0		0	
Geogrid	1	$ 300.00	0		1	$ 300.00	1	$ 300.00
Geotextile	55m^2	$ 600.00	45m^2	$ 600.00	125m^2	$ 1,200.00	125m^2	$ 1,200.00
Footings	1	$ 10,000.00	0		0		0	
Road Subgrade	1050m^3	On site	1050m^3	On site	600m^3	On site	600m^3	On site
Total Cost	$ 62,710.00		$ 59,116.00		$ 69,652.50		$ 71,202.50	

6.0 Design Alternative Comparison

The table below compares each design alternative based on its total cost, site suitability, durability, ease of construction, and future maintenance.

Table 5 – Design Alternatives Effectiveness Rating Table

Design Consideration	Possible Points	Open Bottom Culvert	Elliptical Culvert	Steel Girder Bridge	Precast Concrete Bridge
Total Cost	50	46	50	42	41
Site Suitability	40	40	33	29	29
Durability	30	25	25	30	30
Ease of Construction	20	16	9	20	20
Maintenance	10	10	8	4	5
	Total Score	**137**	**125**	**125**	**125**

As seen in the above table, the Open Bottom Culvert was determined to be the best crossing alternative for the Derickson Rd. washout. This culvert suits the site the best, and requires the least amount of maintenance. Even though it does not score the best for material costs, it will make up for it in its low labour costs and little maintenance required in the future.

7.0 Conclusion

As requested by the client, four crossing alternatives were designed to replace the washed-out crossing of Derickson Rd. at Tributary 3 of Two John Creek. From the analysis of the existing site conditions, it was determined that the washout occurred due to the culvert being undersized and installed at the wrong to accommodate peak flows. It was also determined that the stream was indeed fish bearing with the presence of Rainbow Trout, and that in-stream work would be mandatory to complete this project. From Table 5 above, the Open Bottom Culvert was determined to be the best crossing alternative to be utilized for the Derickson Rd. crossing.

The Open Bottom Culvert was chosen because it meets the client's needs the best. The Open Bottom Culvert is the most suitable for the site, and requires the least amount of maintenance. Although it does not score the best for material costs, it will make up for it in labour costs and little maintenance required through the years.

8.0 Recommendations

In order to provide a suitable replacement crossing for the existing wash-out of Derickson Rd., the following recommendations must be adhered to:

- Install an Open Bottom Culvert at the appropriate angle, size, and location as specified in Appendix B – Drawing 205 and 206 to prevent any future washout of Derickson Road.
- Construct the road as per the design in Section 5.3.3.
- Follow erosion and sediment BMP's during and after construction as suggested in Section 4.4.
- Divert the stream temporarily during construction using the instructions in Section 4.4.2.
- Ensure the streambed is reconstructed according to the specifications in Section 5.1 and does not differ from the original creek streambed.
- Riprap must be placed according to the specifications in Section 5.3.4.
- All work must be performed within the work window of August 7th – October 15th (Section 4.4.1).

9.0 References

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Appendix A

- Tables and Figures Used in The Derickson Rd. Washed-Out Crossing Design Over Tributary 3

- Photos Taken from The Crossing Site

APPENDIX A

CROSSING SITE MAP

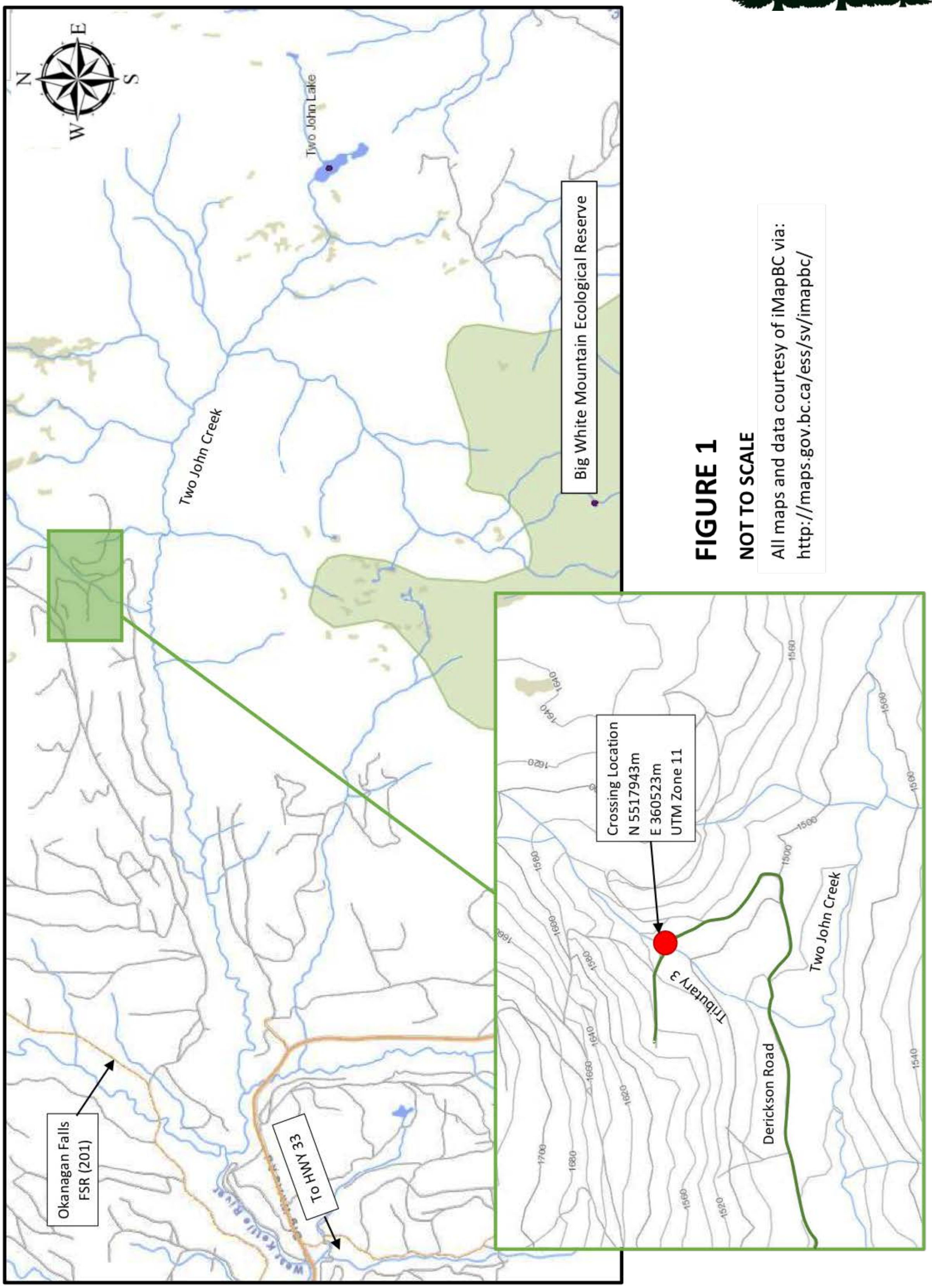


FIGURE 1

NOT TO SCALE

All maps and data courtesy of iMapBC via:
http://maps.gov.bc.ca/ess/sv/imapbc/

APPENDIX A

Fig. 3 – Road Prism South of Crossing (Taken by Eric)

Fig. 4 – Downstream of Crossing/Culvert Washout (Taken by Eric)

Fig. 5 – Upstream Debris Loading and High Water Mark (Taken by Eric)

Fig. 6 – Downstream Debris Loading and Stream Slopes (Taken by Eric)

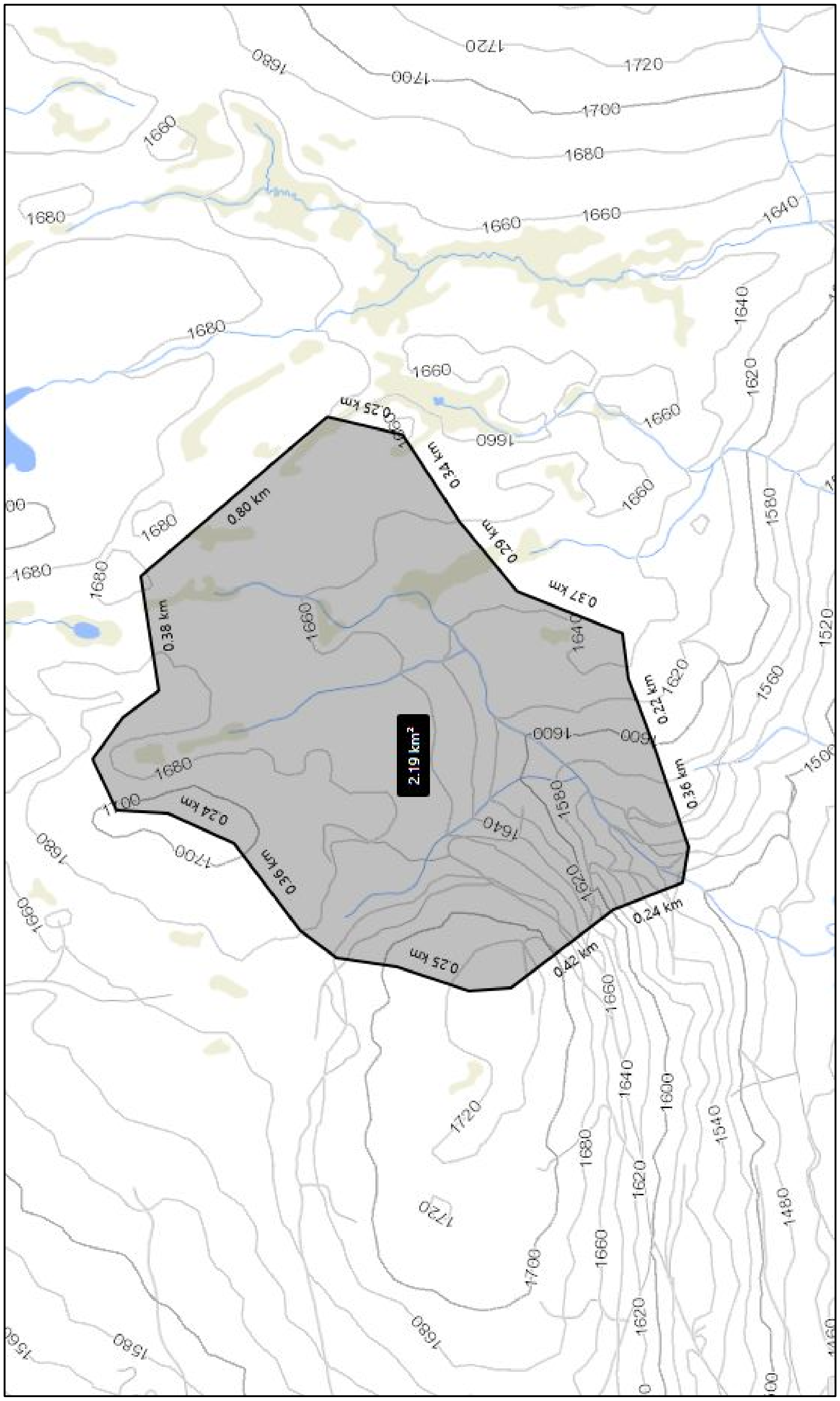


Fig. 7 – Watershed Area Contour Map (Courtesy of iMapBC)

APPENDIX A

Table 1 – Mechanical Split Sieve Analysis

> 9.5mm Sieve Analysis

Mass of Total Test Sample 7388.7 g

Sieve	Individual Mass Retained (g)	Cum. Mass Retained (g)	% Retained (%)	% Passing (%)
50mm	0	0	0.0%	100.0%
25mm	230.1	230.1	3.1%	96.9%
19mm	301.2	531.3	7.2%	92.8%
16mm	167.9	699.2	9.5%	90.5%
12.5mm	276.9	976.1	13.2%	86.8%
9.5mm	315.6	1291.7	17.5%	82.5%
PAN	6099.9	7391.6	100.0%	0.0%

< 9.5mm Sieve Analysis

Mass -9.5mm Sample (Before washing and after Splitting) 1520.39 g

Mass -9.5mm Sample (After washing and Drying) 1153.32 g

Sieve	Cum. Mass Retained (g)	Adjusted Cum. Mass Retained (g)	% Retained (%)	% Passing (%)	% Passing of Total Sample (%)
9.5mm	0.00	0.00	0.0%	100.0%	82.5%
5mm	252.81	252.95	16.6%	83.4%	68.8%
2mm	511.21	511.49	33.6%	66.4%	50.0%
850um	700.79	701.21	46.1%	53.9%	44.4%
425um	842.22	842.77	55.4%	44.6%	36.8%
150um	1039.05	1039.74	68.4%	31.6%	26.1%
75um	1126.10	1126.93	74.1%	25.9%	21.3%
PAN	1152.35	1520.39	100.0%	0.0%	0.0%

<9.5mm Sieving Error 0.97 g

The above soil data shall be classified according to AASHTO as: **A-1-b --> Granular Material (Excellent to good Subbase)**

APPENDIX A

Table 2 – Trapping Creek Annual Peak Discharge Analysis

Trapping Creek

Annual Peak Discharge Analysis

Lat: 49° 33' 52" N   Lon: 119° 03' 8" W

Year	MM--DD	Annual Peak Discharge (m^3/s)	Year	MM--DD	Annual Peak Discharge (m^3/s)	Rank	Return Period	Probability
1966	05–10	7.36	1986	05–26	33.40	1	52.00	1.92
1967	06–04	12.80	1997	05–31	33.10	2	26.00	3.85
1968	06–03	12.70	1987	05–01	28.30	3	17.33	5.77
1969	05–11	16.20	2011	06–08	25.70	4	13.00	7.69
1970	05–23	10.70	2006	05–20	25.00	5	10.40	9.62
1971	05–13	20.30	1979	05–05	24.20	6	8.67	11.54
1972	05–30	19.20	1981	05–25	23.80	7	7.43	13.46
1973	05–17	16.40	1980	05–06	22.70	8	6.50	15.38
1974	06–14	18.40	1993	05–12	22.70	9	5.78	17.31
1975	06–02	17.40	2005	05–16	22.50	10	5.20	19.23
1976	06–16	19.30	1991	05–20	22.00	11	4.73	21.15
1977	05–03	17.20	1988	05–13	20.50	12	4.33	23.08
1978	05–21	14.00	1971	05–13	20.30	13	4.00	25.00
1979	05–05	24.20	1999	05–24	19.60	14	3.71	26.92
1980	05–06	22.70	1976	06–16	19.30	15	3.47	28.85
1981	05–25	23.80	1972	05–30	19.20	16	3.25	30.77
1982	05–25	15.80	1983	05–29	19.10	17	3.06	32.69
1983	05–29	19.10	1985	05–25	18.90	18	2.89	34.62
1984	05–30	15.70	1974	06–14	18.40	19	2.74	36.54
1985	05–25	18.90	2008	05–18	18.40	20	2.60	38.46
1986	05–26	33.40	1990	06–02	17.60	21	2.48	40.38
1987	05–01	28.30	1975	06–02	17.40	22	2.36	42.31
1988	05–13	20.50	1977	05–03	17.20	23	2.26	44.23
1989	05–10	14.80	2010	05–18	17.00	24	2.17	46.15
1990	06–02	17.60	1973	05–17	16.40	25	2.08	48.08
1991	05–20	22.00	2003	05–26	16.30	26	2.00	50.00
1992	05–06	11.20	1969	05–11	16.20	27	1.93	51.92
1993	05–12	22.70	2013	05–07	16.00	28	1.86	53.85
1994	04–22	15.50	2012	06–10	15.80	29	1.79	55.77
1995	05–15	12.90	1982	05–25	15.80	30	1.73	57.69
1996	06–04	13.10	1984	05–30	15.70	31	1.68	59.62
1997	05–31	33.10	1994	04–22	15.50	32	1.63	61.54
1998	05–03	14.10	2002	05–28	15.50	33	1.58	63.46
1999	05–24	19.60	1989	05–10	14.80	34	1.53	65.38
2000	05–21	11.50	1998	05–03	14.10	35	1.49	67.31
2001	05–23	11.40	1978	05–21	14.00	36	1.44	69.23
2002	05–28	15.50	1996	06–04	13.10	37	1.41	71.15
2003	05–26	16.30	1995	05–15	12.90	38	1.37	73.08
2004	06–06	12.20	1967	06–04	12.80	39	1.33	75.00
2005	05–16	22.50	1968	06–03	12.70	40	1.30	76.92
2006	05–20	25.00	2004	06–06	12.20	41	1.27	78.85
2007	05–08	9.59	2000	05–21	11.50	42	1.24	80.77
2008	05–18	18.40	2001	05–23	11.40	43	1.21	82.69
2009	05–30	10.80	1992	05–06	11.20	44	1.18	84.62
2010	05–18	17.00	2009	05–30	10.80	45	1.16	86.54
2011	06–08	25.70	1970	05–23	10.70	46	1.13	88.46
2012	06–10	15.80	2007	05–08	9.59	47	1.11	90.38
2013	05–07	16.00	1966	05–10	7.36	48	1.08	92.31
2011	06–08	1.63	2011	06–08	1.63	49	1.06	94.23
2012	06–10	1.46	2013	05–07	1.47	50	1.04	96.15
2013	05–07	1.47	2012	06–10	1.46	51	1.02	98.08

Data Sourced from Government of Canada Wateroffice Site

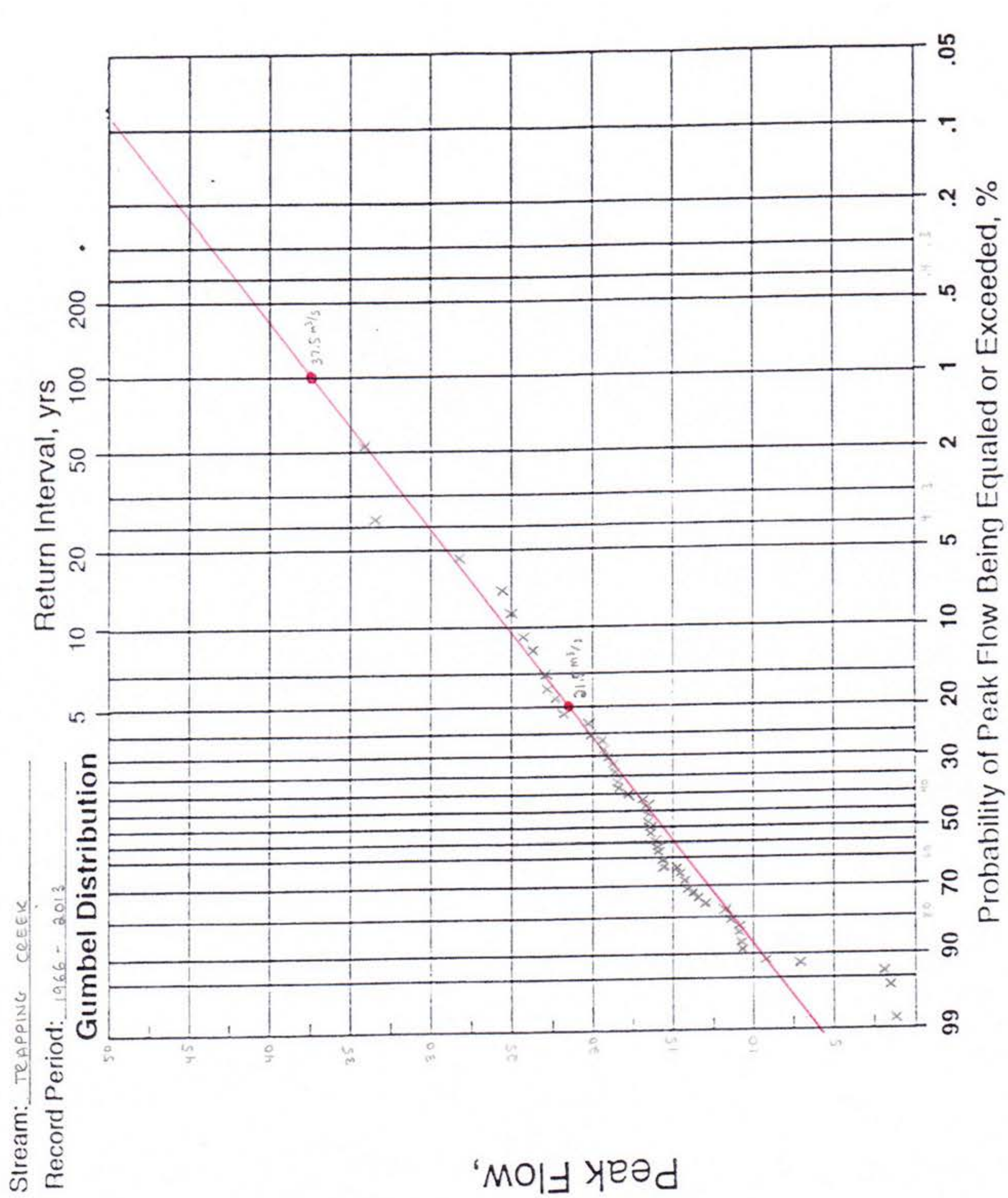


Fig. 8 – Trapping Creek Gumbel Distribution for Q5 and Q100 Flows

APPENDIX A

Table 3 – Two-Forty-One Creek Annual Peak Discharge Analysis

Two Forty-One Creek

Annual Peak Discharge Analysis

Lat: 49° 39' 5" N Lon: 119° 23' 30" W

Year	MM--DD	Annual Peak Discharge (m³/s)	Year	MM--DD	Annual Peak Discharge (m³/s)	Rank	Return Period	Probability
1984	06–14	1.21	1987	04–30	3.39	1	31.00	3.23
1985	05–18	0.97	2006	05–17	2.72	2	15.50	6.45
1986	05–28	1.86	2008	05–17	2.51	3	10.33	9.68
1987	04–30	3.39	1993	05–13	2.09	4	7.75	12.90
1988	05–13	0.94	1986	05–28	1.86	5	6.20	16.13
1989	05–06	0.76	1997	05–15	1.83	6	5.17	19.35
1990	05–29	1.18	2012	05–14	1.66	7	4.43	22.58
1991	05–20	1.20	2010	05–17	1.55	8	3.88	25.81
1992	04–29	0.49	2011	05–22	1.50	9	3.44	29.03
1993	05–13	2.09	2002	05–28	1.37	10	3.10	32.26
1994	05–07	0.86	2009	05–18	1.36	11	2.82	35.48
1995	05–16	1.14	1998	05–03	1.30	12	2.58	38.71
1996	06–03	1.03	1984	06–14	1.21	13	2.38	41.94
1997	05–15	1.83	1991	05–20	1.20	14	2.21	45.16
1998	05–03	1.30	2007	05–08	1.20	15	2.07	48.39
2000	05–21	0.73	1990	05–29	1.18	16	1.94	51.61
2001	05–23	1.17	2001	05–23	1.17	17	1.82	54.84
2002	05–28	1.37	1995	05–16	1.14	18	1.72	58.06
2003	05–24	0.97	1996	06–03	1.03	19	1.63	61.29
2004	05–01	0.86	1985	05–18	0.97	20	1.55	64.52
2005	04–27	0.59	2003	05–24	0.97	21	1.48	67.74
2006	05–17	2.72	1988	05–13	0.94	22	1.41	70.97
2007	05–08	1.20	1994	05–07	0.86	23	1.35	74.19
2008	05–17	2.51	2004	05–01	0.86	24	1.29	77.42
2009	05–18	1.36	1989	05–06	0.76	25	1.24	80.65
2010	05–17	1.55	2000	05–21	0.73	26	1.19	83.87
2011	05–22	1.50	2005	04–27	0.59	27	1.15	87.10
2012	05–14	1.66	2012	04–26	0.58	28	1.11	90.32
2011	05–22	0.51	2011	05–22	0.51	29	1.07	93.55
2012	04–26	0.58	1992	04–29	0.49	30	1.03	96.77

Data Sourced from Government of Canada Wateroffice Site

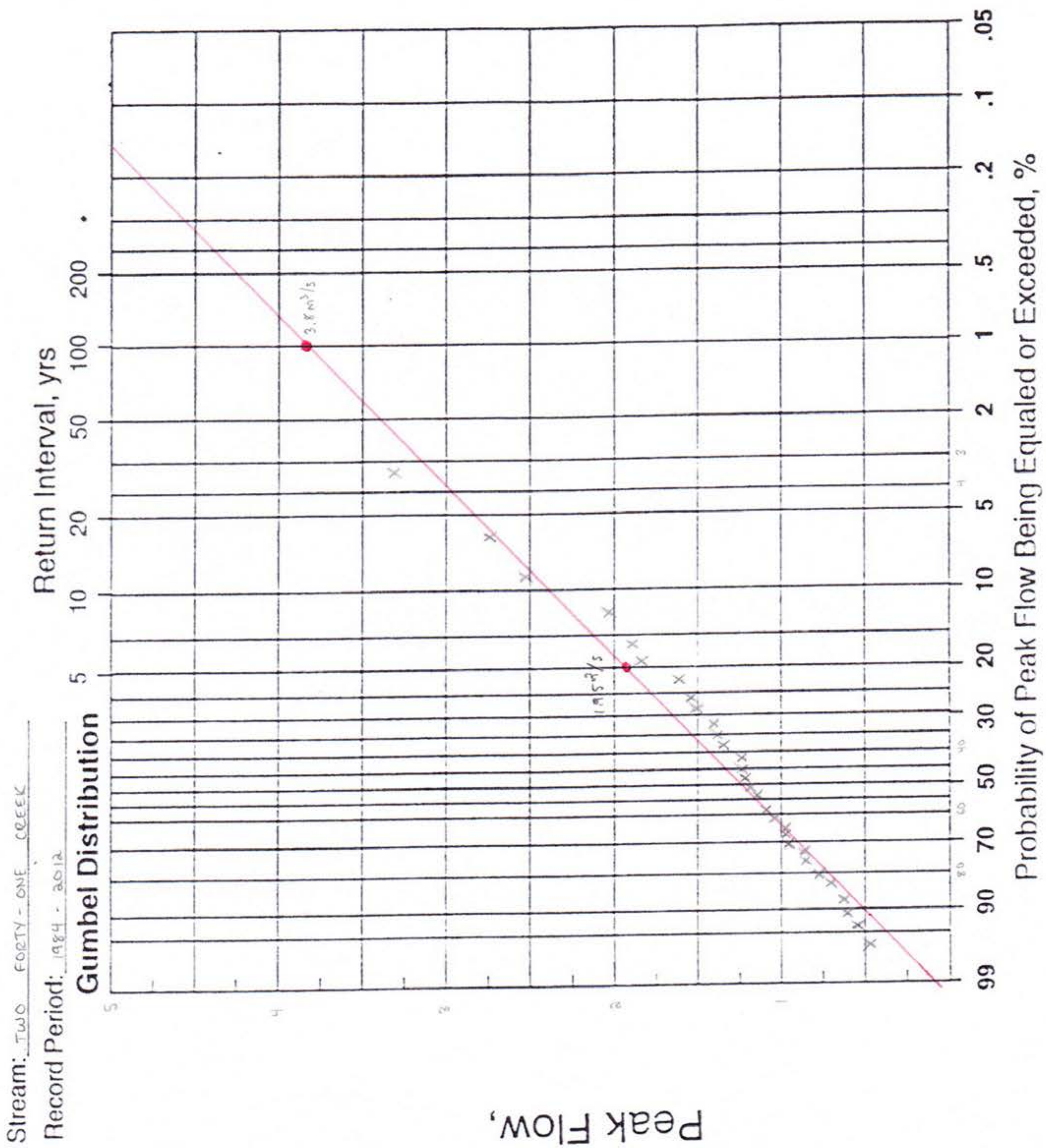


Fig. 9 – Two-Forty-One Creek Gumbel Distribution for Q5 and Q100 Flows

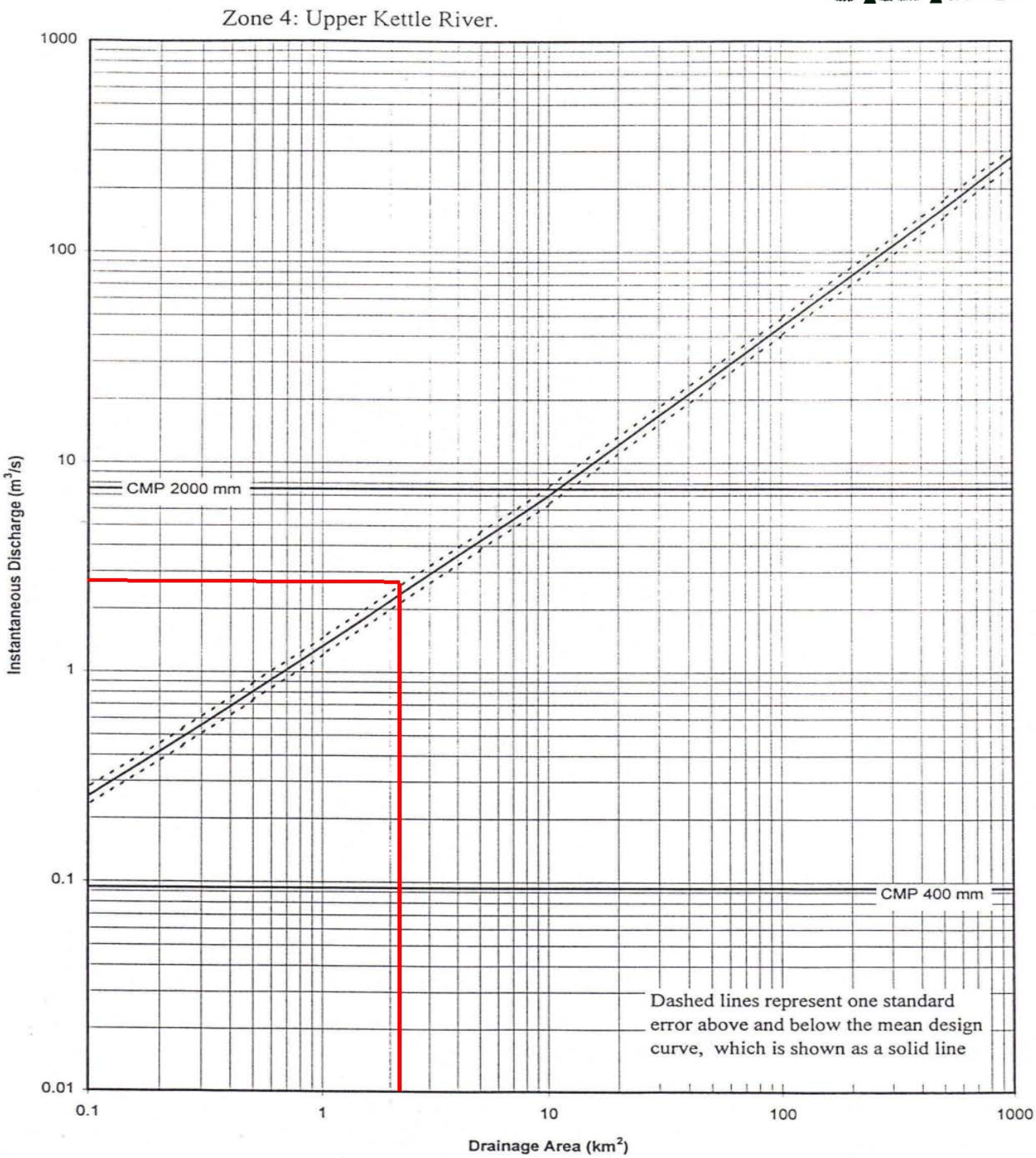


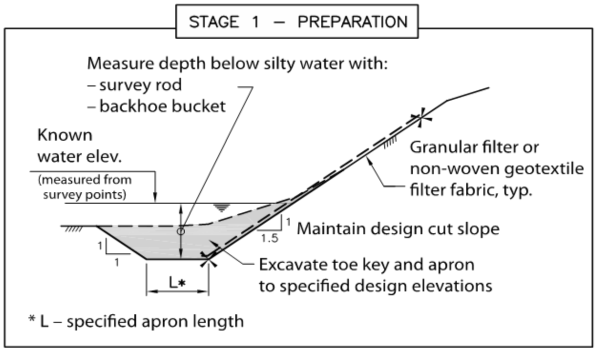
Fig. 10 – Zone 4: Upper Kettle River Design Curve for Q100 Flows

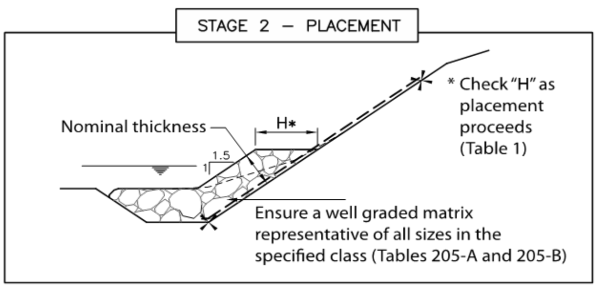
Sourced from Peak Flow-Culvert Design Study: Penticton Forest District (2000) by Summit Environment Consultants Ltd.

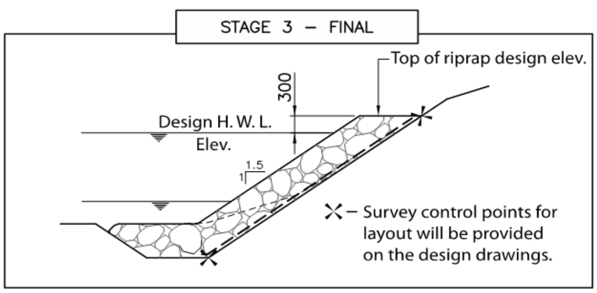
EBC CONSULTANTS LTD.

Riprap Installation Guide – 1

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure







WOLMAN EXAMPLE – CLASS 500 KG

For every 100 rocks set aside in Quarry, you need the following:

- From Table 205-B: 15%=330, 50%=715, 85%=1030mm, 100%=<1220mm
- The riprap has to meet ALL the following conditions

Class 500	330	715	1030	1220
15% (330mm)	15 rocks less than 330mm	85 rocks bigger than 330mm		
50% (715mm)	50 rocks less than 715mm		50 rocks bigger than 715mm	
85% (1030mm)	85 rocks less than 1030mm			15 rocks bigger than 1030mm
100% (<1220mm)	All 100 rocks less than 1220mm			

Table 1: Riprap Horizontal Dimensions

Class of Riprap (kg)	Nominal Riprap Thickness (mm)	Surface Width, H (mm)	
		2H : 1V Slope	1.5H : 1V Slope
10	350	783	631
25	450	1006	811
50	550	1230	992
100	700	1566	1262
250	1000	2236	1803
500	1200	2684	2163
1000	1500	3355	2704
2000	2000	4473	3606
4000	2500	5591	4507

Table 205-A: Gradation of Rock Sizes in Each Class of Riprap – Mass (kg)

Class of Riprap (kg)	Nominal Riprap Thickness (mm)	Rock Gradation Percentage Smaller Than Given Rock Mass (kg)		
		15%	50%	85%
10	350	1	10	30
25	450	2.5	25	75
50	550	5	50	150
100	700	10	100	300
250	1000	25	250	750
500	1200	50	500	1500
1000	1500	100	1000	3000
2000	2000	200	2000	6000
4000	2500	400	4000	12000

Table 205-B: Approximate Average Dimension of Each Specified Rock Class Mass (Sg=2.640) – Equivalent Diameter (mm)

Class of Riprap (kg)	Approximate Average Dimension (mm)			
	15%	50%	85%	<100%
10	90	195	280	330
25	120	260	380	450
50	155	330	475	565
100	195	415	600	715
250	260	565	815	965
500	330	715	1030	1220
1000	415	900	1295	1535
2000	525	1130	1630	1935
4000	660	1425	2055	2440

September 2013

Fig. 13 – Riprap Installation Guide

Sourced from Ministry of Transportation and Infrastructure (2013)

Appendix B

- Existing Site Conditions: Plan & Profile Views

- Steel Girder: General Arrangement, Profile & Section Views

- Precast Concrete: General Arrangement, Profile & Section Views

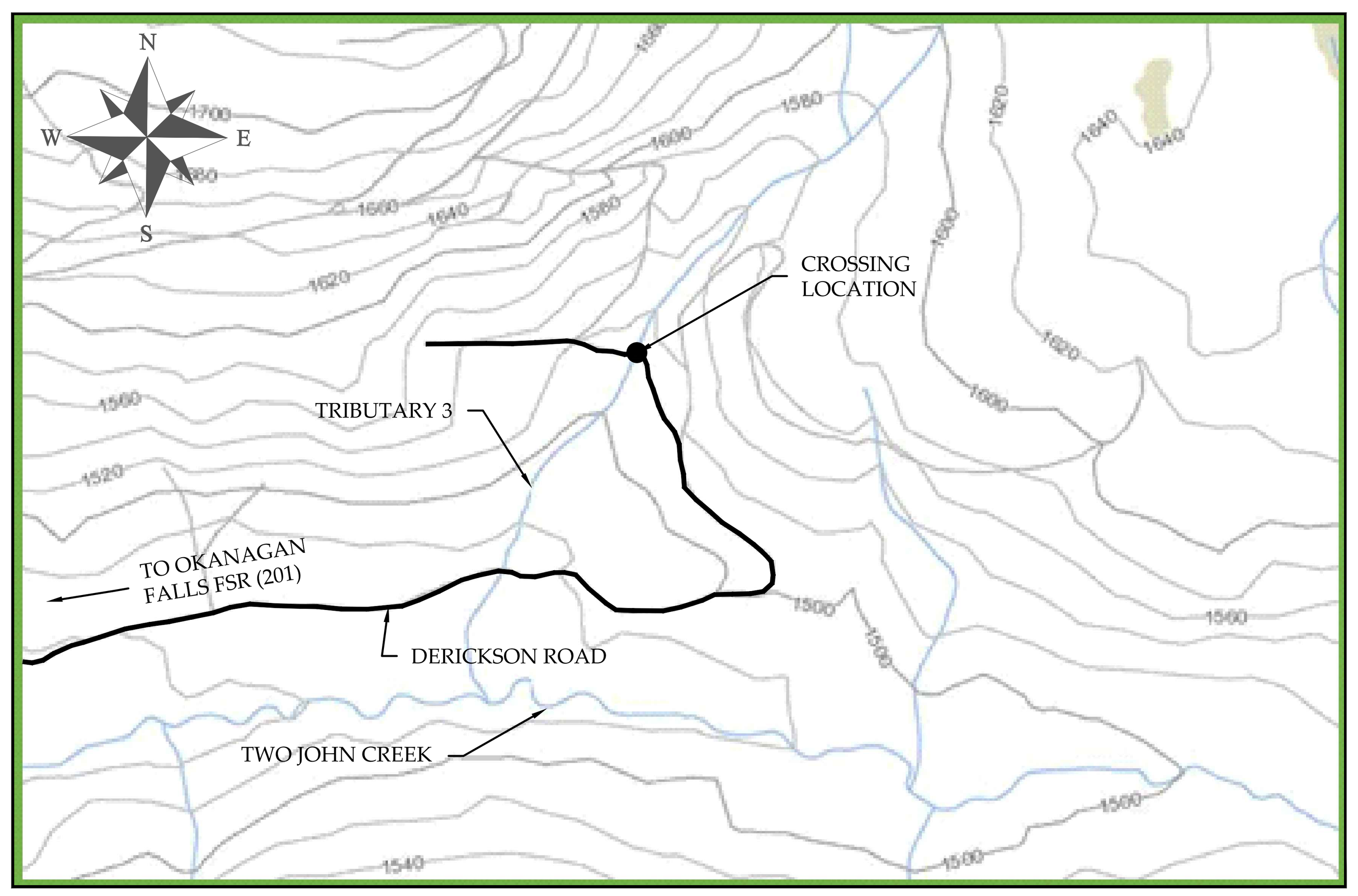
- Open Bottom Culvert: General Arrangement, Profile and Section Views

- Elliptical Culvert: General Arrangement, Profile & Section Views

TRIBUTARY 3 CROSSING
DERICKSON ROAD WASHOUT

EBC CONSULTANTS LTD.

DECEMBER 2015



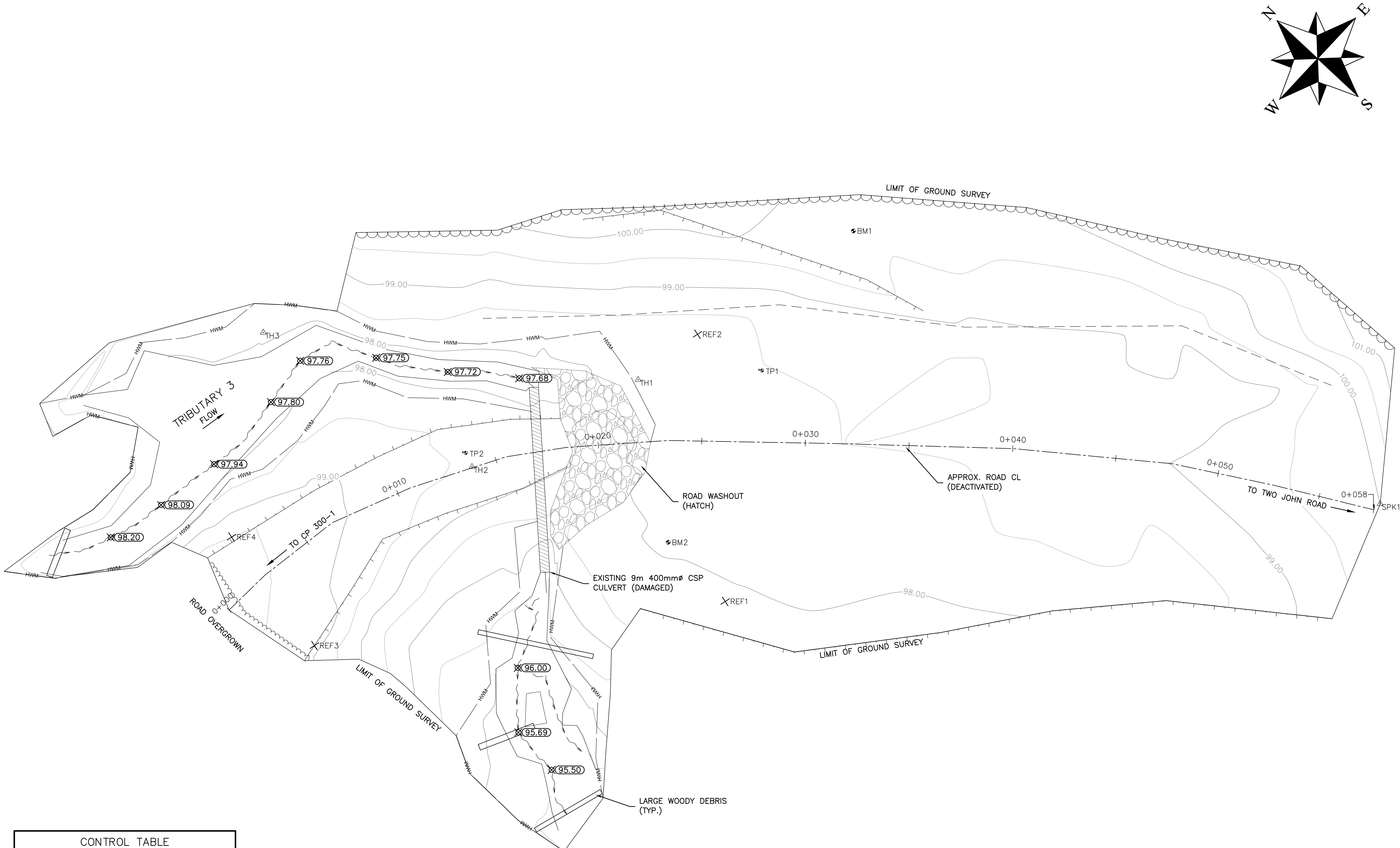
KEY PLAN
NTS

DRAWING LIST

ISSUED FOR REVIEW
2015-12-10

DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001
REV :	0

ORIGINAL SIZE: ARCH D (22"x36")



ORIGINAL SIZE: ARCH D (22"x36")

LEGEND

EXISTING

- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK (HWM)
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB (TH)
- TEST PIT (TP)
- BENCHMARK (BM)
- REFERENCE STAKE (REF)

PROPOSED

- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK (HWM)
- THALWEG
- DITCH

CONTROL TABLE

Name	Northing	Easting	Elevation	Description
BM1	127.59	107.59	99.77	BENCHMARK 1
BM2	133.21	91.05	98.03	BENCHMARK 2
BM3	153.70	85.86	99.68	BENCHMARK 3
REF1	129.92	88.83	97.93	REF STAKE 1
REF2	133.91	101.16	98.29	REF STAKE 2
REF3	148.86	82.63	99.18	REF STAKE 3
REF4	153.86	86.92	99.49	REF STAKE 4
SPK1	100.00	100.00	100.00	NAIL
TH1	136.26	98.41	98.28	TRAVERSE HUB
TH2	143.22	92.64	98.40	TRAVERSE HUB
TH3	154.42	96.88	98.19	TRAVERSE HUB

NOTES:

1. SURVEY COMPLETED BY EBC CONSULTANTS LTD. B. HOULT, E. SANDBERG AND C. MURRAY SEPTEMBER 26, 2015.
2. SURVEY IS IN LOCAL BASED COORDINATES WITH AN ASSUMED DATUM ELEVATION OF 100.000m AT SPK1.
3. HIGH WATER MARK AND PRESENT WATER LEVEL OBSERVED ON SEPTEMBER 26, 2015.
4. ALL BM ARE FLAGGED NAILS IN THE BASE OF BLAZED TREES

ISSUED FOR REVIEW
2015-12-10

NO.	DATE	REVISION	BY	APD

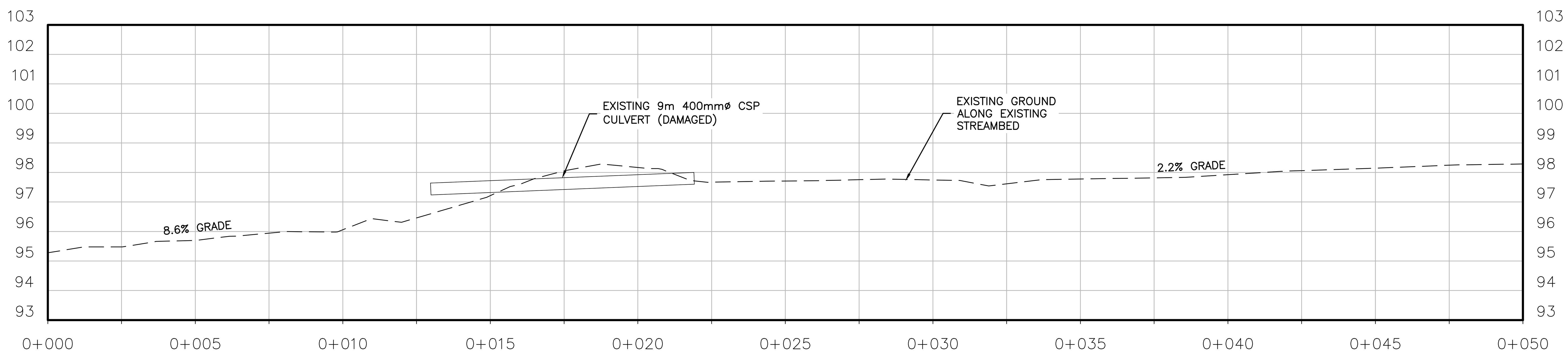
SCALE:	1:100
DATE:	2015-11-03
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

EXISTING CONDITIONS
TRIBUTARY 3 CROSSING - PLAN

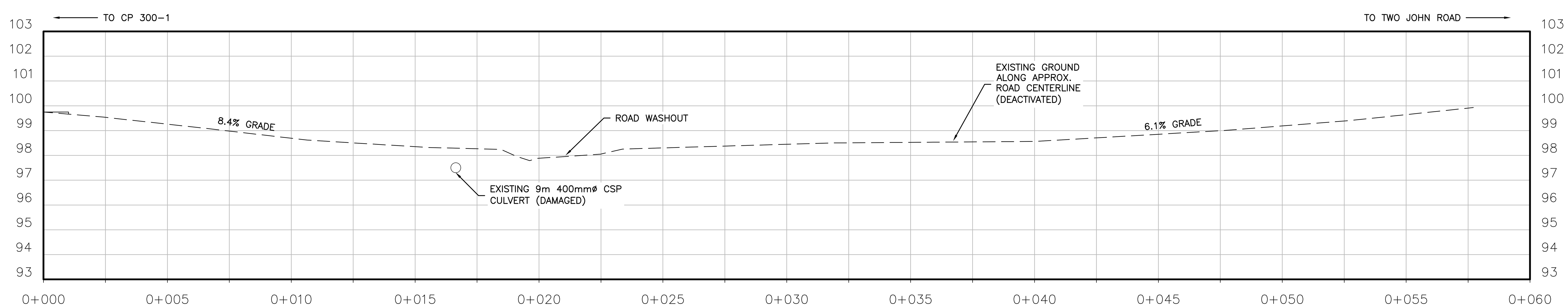
EBC CONSULTANTS LTD.

DRAW NO. 101

REV. 0



EXISTING STREAMBED PROFILE



EXISTING ROAD CENTERLINE PROFILE

NOTES:

1. SURVEY COMPLETED BY EBC CONSULTANTS LTD. B. HOULT, E. SANDBERG AND C. MURRAY SEPTEMBER 26, 2015.
2. SURVEY IS IN LOCAL BASED COORDINATES WITH AN ASSUMED DATUM ELEVATION OF 100.000m AT SPK1.
3. HIGH WATER MARK AND PRESENT WATER LEVEL OBSERVED ON SEPTEMBER 26, 2015.
4. ALL BM ARE FLAGGED NAILS IN THE BASE OF BLAZED TREES

ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING

- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK (HWM)
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB (TH)
- TEST PIT (TP)
- BENCHMARK (BM)
- REFERENCE STAKE (REF)

PROPOSED

- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK (HWM)
- THALWEG
- DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-03
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

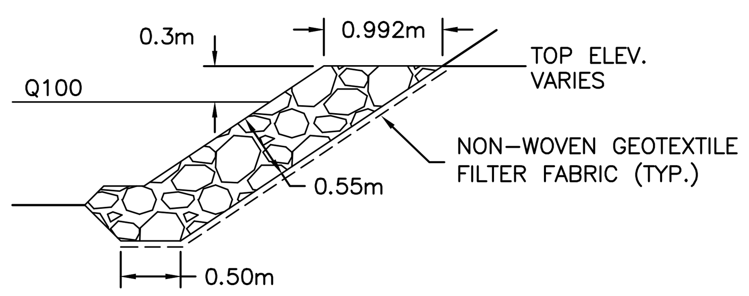
EXISTING CONDITIONS
TRIBUTARY 3 CROSSING - PROFILES

EBC CONSULTANTS LTD.

DRAW NO. 102

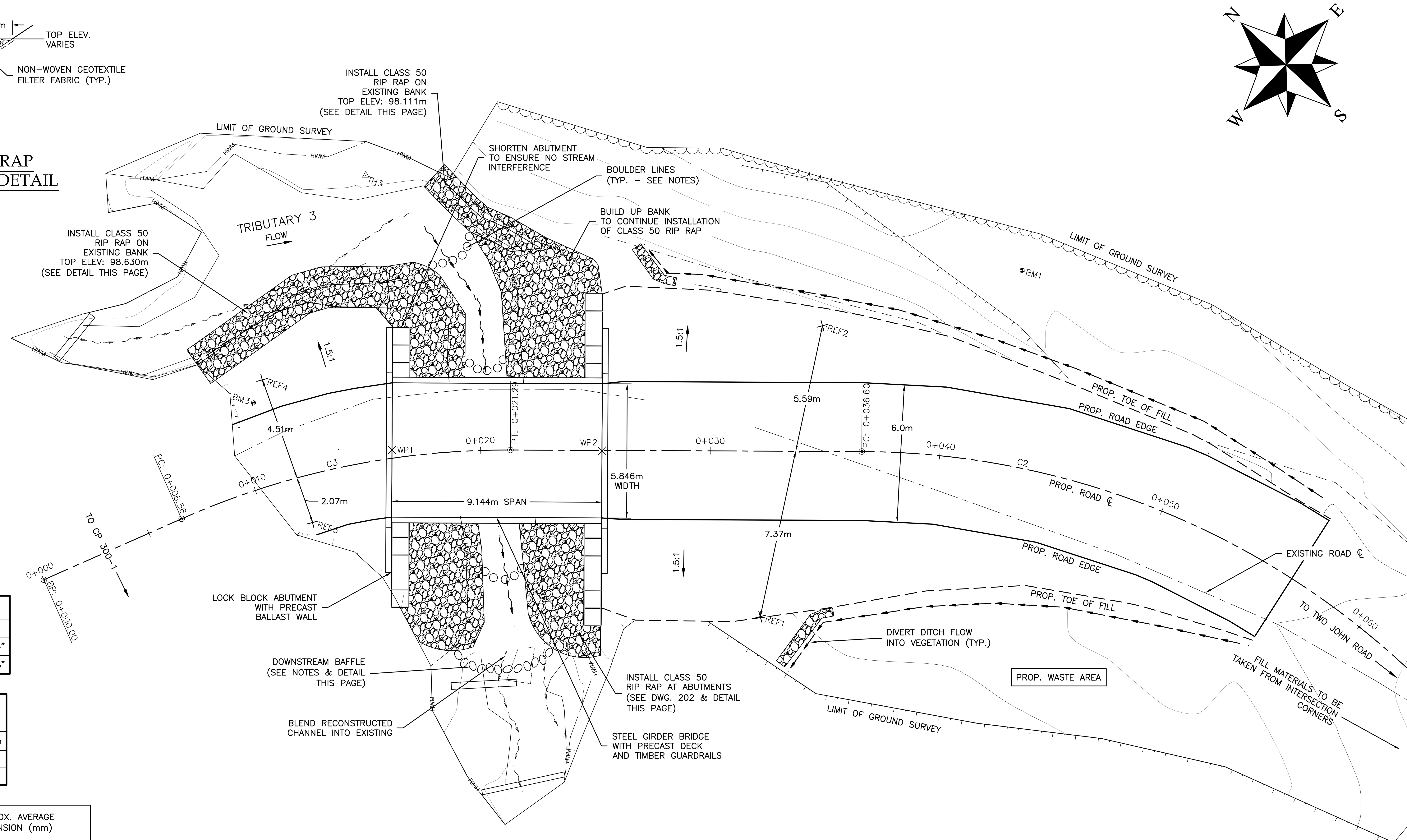
REV. 0

ORIGINAL SIZE: ARCH D (22"x36")



CLASS 50 RIP RAP INSTALLATION DETAIL

SCALE 1:50



CURVE TABLE			
CURVE	RADIUS	LENGTH	DELTA
C2	35.00	28.50	46°39'34"
C3	35.00	14.74	24°07'35"

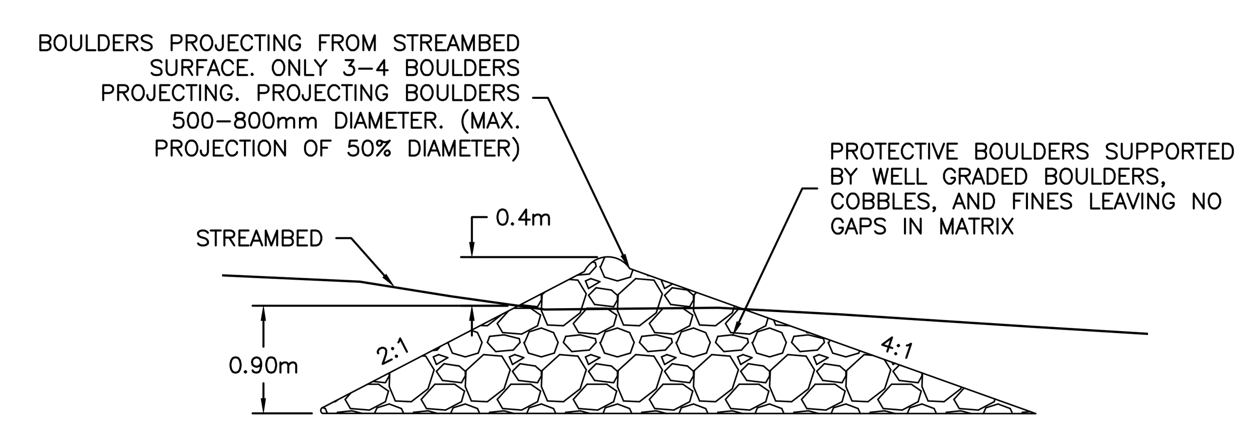
WORKPOINT TABLE			
Name	Northing	Easting	Elevation
WP1	139.50	91.63	99.87
WP2	147.44	87.10	99.87

RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

CONTROL TABLE				
Name	Northing	Easting	Elevation	Description
BM1	127.59	107.59	99.77	BENCHMARK 1
BM2	133.21	91.05	98.03	BENCHMARK 2
BM3	153.70	85.86	99.68	BENCHMARK 3
REF1	129.92	88.83	97.93	REF STAKE 1
REF2	133.91	101.16	98.29	REF STAKE 2
REF3	148.86	82.63	99.18	REF STAKE 3
REF4	153.86	86.92	99.49	REF STAKE 4
SPK1	100.00	100.00	100.00	NAIL
TH1	136.26	98.41	98.28	TRAVERSE HUB
TH2	143.22	92.64	98.40	TRAVERSE HUB
TH3	154.42	96.88	98.19	TRAVERSE HUB

NOTES:

1. STREAM CLASS: S3
2. Q100 DESIGN FLOW: 1.85m3/s
3. DESIGN STREAM Q100 TWL WIDTH: 3.4m
4. DESIGN STREAM SLOPE: 6%
5. GRAVEL & SAND STREAMBED WITH COBBLE BANKS
6. WORKPOINTS REFERENCE TOP OF ABUTMENT AT DECK EDGE
7. REFER TO DWG 202 FOR PROFILE AND SECTION VIEWS
8. L75 DESIGN LOAD (LG3 LLT DESIGN VEHICLE)
9. FOR CAP BEAM DETAILS, SEE MOF STANDARD DRAWING STD-E-050-30
10. FOR TIMBER GUARDRAIL DETAILS, SEE MOF STANDARD DRAWING STD-EC-010-01
11. FOR PRECAST BALLAST WALL DETAIL, SEE MOF STANDARD DRAWING STD-E-050-01
12. FOR FURTHER BAFFLE DETAILS, SEE SECTION 5.1 OF THE REPORT.
13. BOULDER LINES TO BE INSTALLED EVERY 6m ALONG RECONSTRUCTED STREAM.
14. BOULDER LINES TO CONSIST OF LARGER COBBLE (>D90)
15. RIP RAP TO BE INSTALLED TO THE EXTENTS, DEPTHS, AND THICKNESSES NOTED ON THE DRAWINGS.
16. MINIMUM RIP RAP LAYER THICKNESS IS 550mm.
17. RIP RAP TO BE UNDERLAIN WITH NON-WOVEN GEOTEXTILE.
18. RIP RAP TO BE CLEAN (FREE OF FINES), SOLID, ANGULAR, BLOCKY STONES; WELL GRADED TO FILL GAPS BETWEEN LARGER STONES, AND PLACED CAREFULLY TO OBTAIN A WELL GRADED BLANKET OF INTERLOCKING STONES.



TYPICAL BAFFLE INSTALLATION DETAIL

SCALE 1:50

ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING
- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK — HWM
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB — TH
- TEST PIT — TP
- BENCHMARK — BM
- REFERENCE STAKE — REF

PROPOSED
- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK — HWM
- THALWEG
- DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-11
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

GENERAL ARRANGEMENT

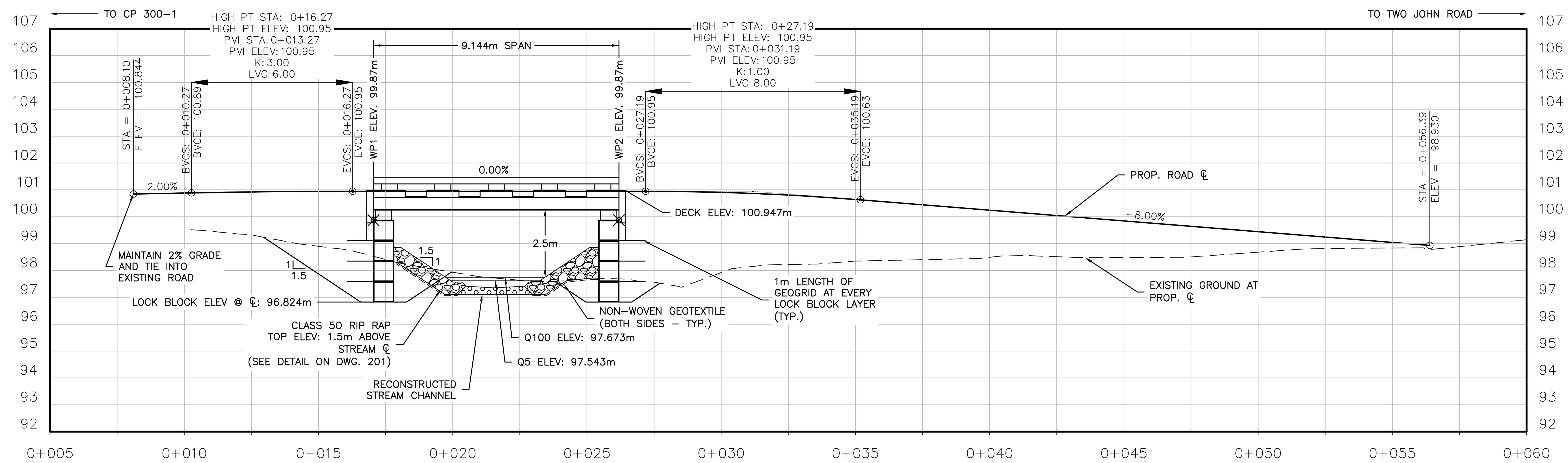
TRIBUTARY 3 CROSSING
STEEL GIRDER BRIDGE
GENERAL ARRANGEMENT

EBC CONSULTANTS LTD.

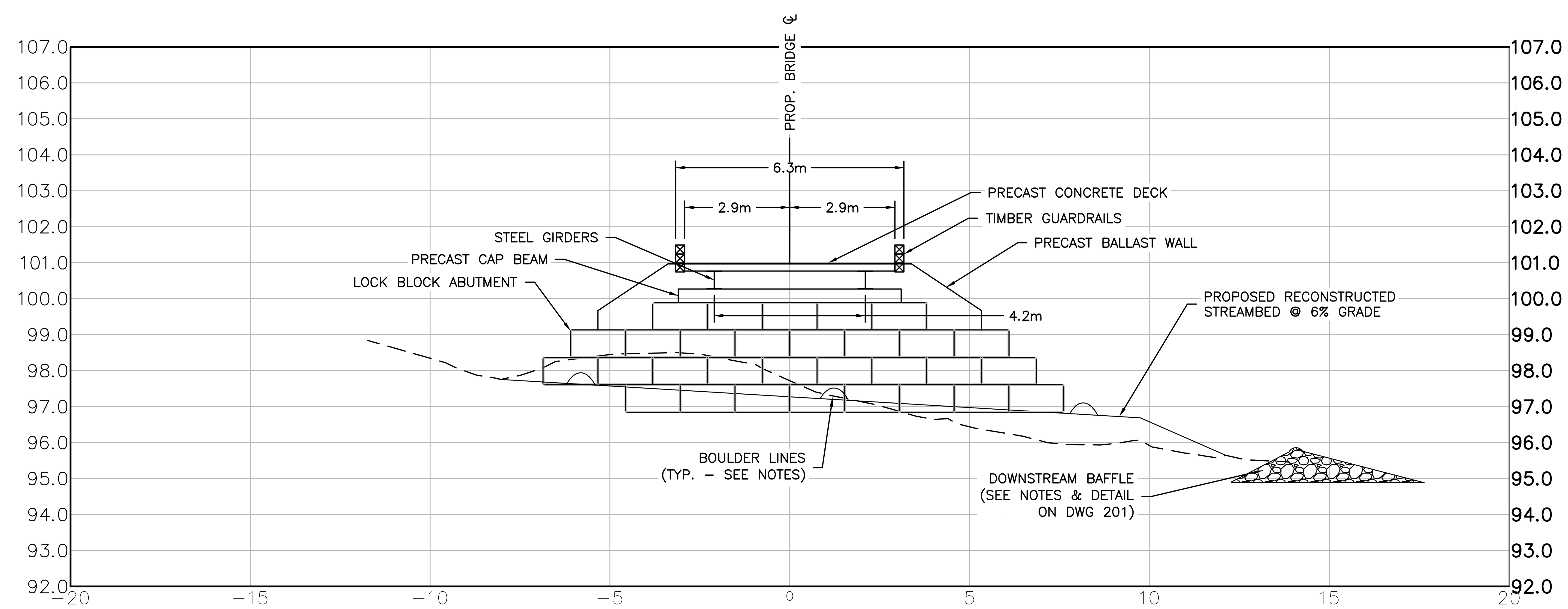
DRAW NO. 201

REV. 0

ORIGINAL SIZE: ARCH D (22"x36")



BRIDGE CENTERLINE ELEVATION



BRIDGE SECTION AT PROPOSED STREAMBED CENTERLINE

RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

NOTES:

1. STREAM CLASS: S3
2. Q100 DESIGN FLOW: 1.85m3/s
3. DESIGN STREAM Q100 TWL WIDTH: 3.4m
4. DESIGN STREAM SLOPE: 6%
5. GRAVEL & SAND STREAMBED WITH COBBLE BANKS
6. WORKPOINTS REFERENCE TOP OF ABUTMENT AT DECK EDGE
7. REFER TO DWG 201 FOR PLAN VIEW
8. L75 DESIGN LOAD (LG3 LLT DESIGN VEHICLE)
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ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING

- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK (HWM)
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB (TH)
- TEST PIT (TP)
- BENCHMARK (BM)
- REFERENCE STAKE (REF)

PROPOSED

- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK (HWM)
- THALWEG
- DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-03
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

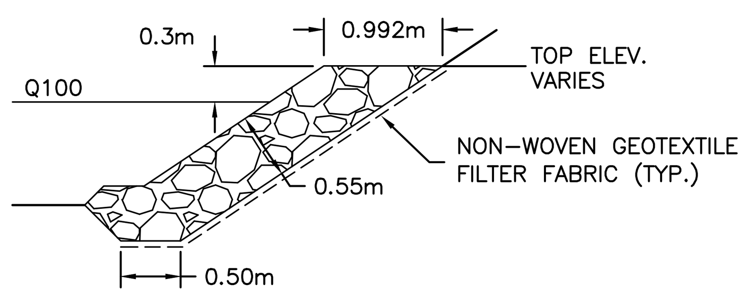
GENERAL ARRANGEMENT
TRIBUTARY 3 CROSSING
STEEL GIRDER BRIDGE
PROFILE & SECTION VIEW

EBC CONSULTANTS LTD.

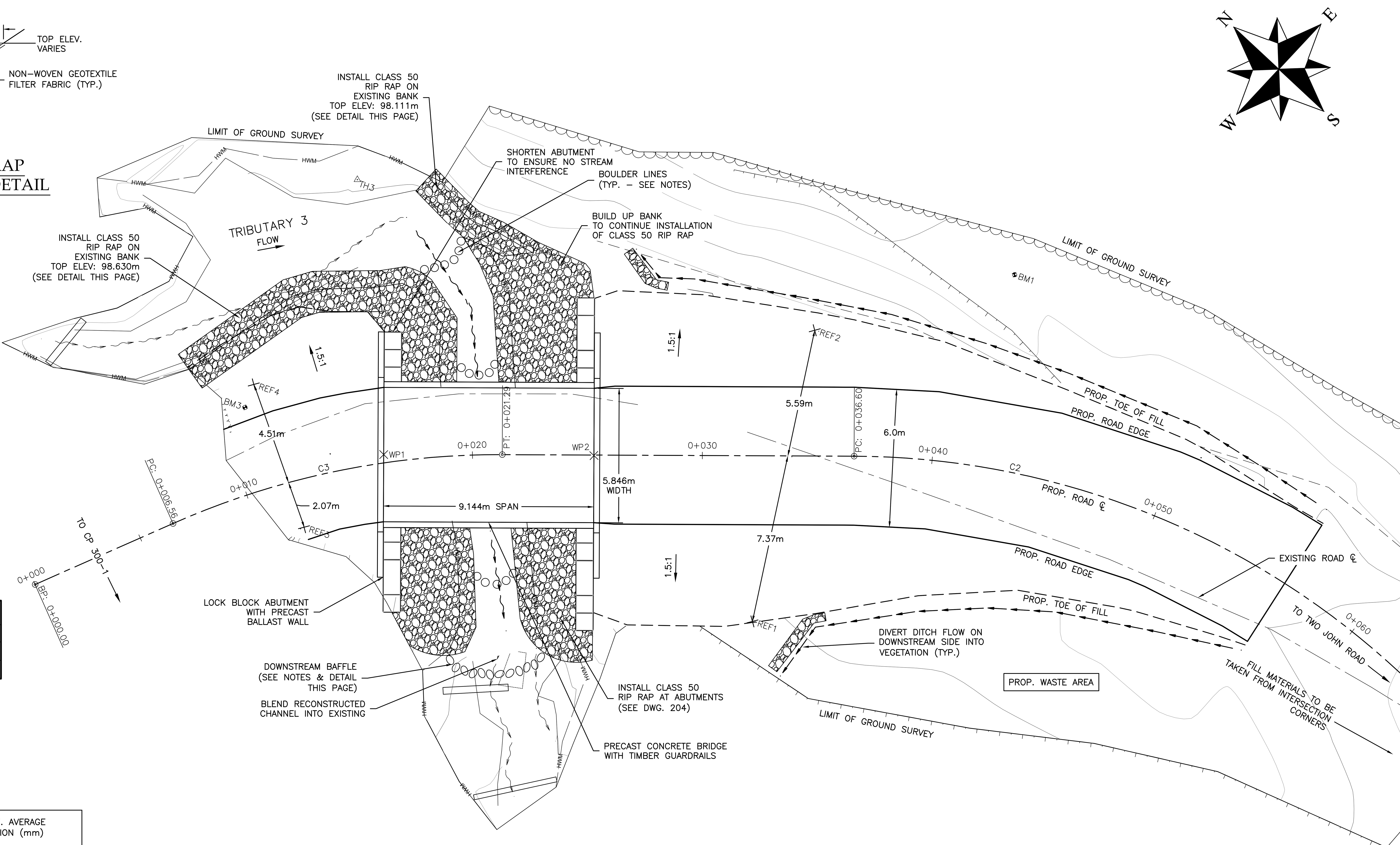
DRAW NO. 202

REV. 0

ORIGINAL SIZE: ARCH D (22"x36")



CLASS 50 RIP RAP INSTALLATION DETAIL
SCALE 1:50



CURVE TABLE			
CURVE	RADIUS	LENGTH	DELTA
C2	35.00	28.50	46°39'34"
C3	35.00	14.74	24°07'35"

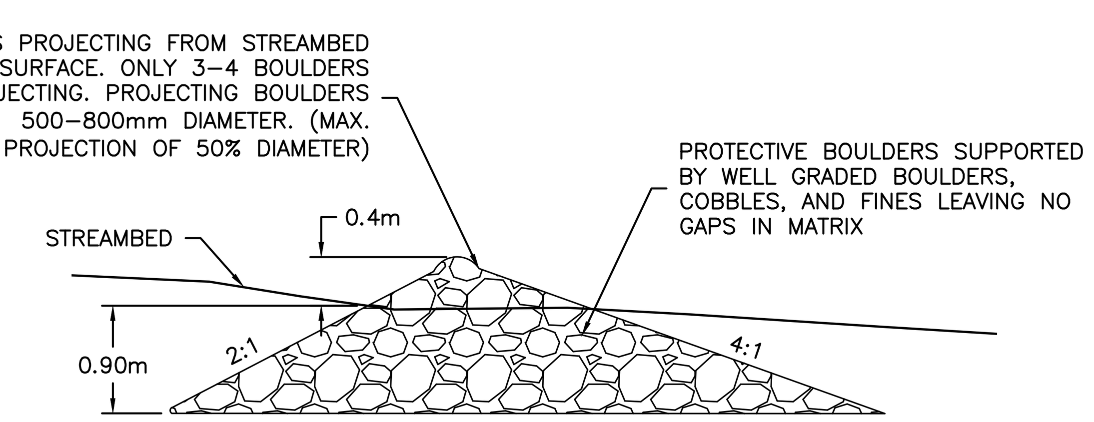
WORKPOINT TABLE			
Name	Northing	Easting	Elevation
WP1	139.50	91.63	99.87
WP2	147.44	87.10	99.87

RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

CONTROL TABLE				
Name	Northing	Easting	Elevation	Description
BM1	127.59	107.59	99.77	BENCHMARK 1
BM2	133.21	91.05	98.03	BENCHMARK 2
BM3	153.70	85.86	99.68	BENCHMARK 3
REF1	129.92	88.83	97.93	REF STAKE 1
REF2	133.91	101.16	98.29	REF STAKE 2
REF3	148.86	82.63	99.18	REF STAKE 3
REF4	153.86	86.92	99.49	REF STAKE 4
SPK1	100.00	100.00	100.00	NAIL
TH1	136.26	98.41	98.28	TRAVERSE HUB
TH2	143.22	92.64	98.40	TRAVERSE HUB
TH3	154.42	96.88	98.19	TRAVERSE HUB

NOTES:

1. STREAM CLASS: S3
2. Q100 DESIGN FLOW: 1.85m3/s
3. DESIGN STREAM Q100 TWL WIDTH: 3.4m
4. DESIGN STREAM SLOPE: 6%
5. GRAVEL & SAND STREAMBED WITH COBBLE BANKS
6. WORKPOINTS REFERENCE TOP OF ABUTMENT AT DECK EDGE
7. REFER TO DWG 204 FOR PROFILE AND SECTION VIEWS
8. L75 DESIGN LOAD (LG3 LLT DESIGN VEHICLE)
9. FOR CAP BEAM DETAILS, SEE MOF STANDARD DRAWING STD-E-050-30
10. FOR TIMBER GUARDRAIL DETAILS, SEE MOF STANDARD DRAWING STD-EC-010-01
11. FOR PRECAST BALLAST WALL DETAIL, SEE MOF STANDARD DRAWING STD-E-050-01
12. FOR FURTHER BAFFLE DETAILS, SEE SECTION 5.1 OF THE REPORT.
13. BOULDER LINES TO BE INSTALLED EVERY 6m ALONG RECONSTRUCTED STREAM.
14. BOULDER LINES TO CONSIST OF LARGER COBBLE (>D90)
15. RIP RAP TO BE INSTALLED TO THE EXTENTS, DEPTHS, AND THICKNESSES NOTED ON THE DRAWINGS.
16. MINIMUM RIP RAP LAYER THICKNESS IS 550mm.
17. RIP RAP TO BE UNDERLAIN WITH NON-WOVEN GEOTEXTILE.
18. RIP RAP TO BE CLEAN (FREE OF FINES), SOLID, ANGULAR, BLOCKY STONES; WELL GRADED TO FILL GAPS BETWEEN LARGER STONES, AND PLACED CAREFULLY TO OBTAIN A WELL GRADED BLANKET OF INTERLOCKING STONES.



TYPICAL BAFFLE INSTALLATION DETAIL
SCALE 1:50

ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING

- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB
- TEST PIT
- BENCHMARK
- REFERENCE STAKE

PROPOSED

- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK
- THALWEG
- DITCH

ORIGINAL SIZE: ARCH D (22"x36")

NO.	DATE	REVISION	BY	APD

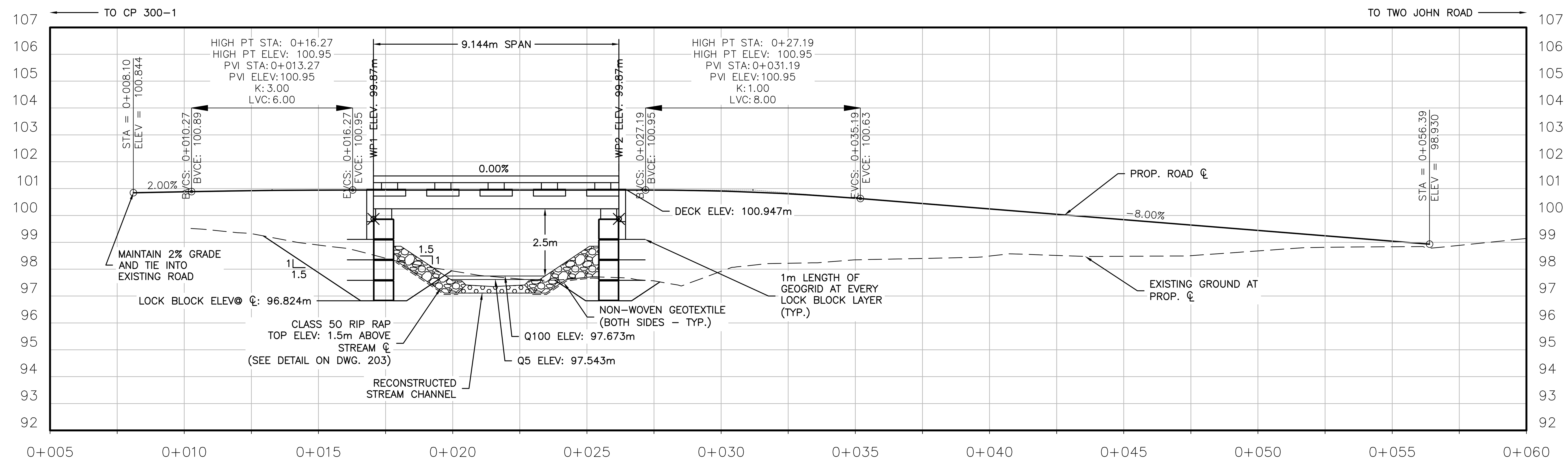
SCALE:	1:100
DATE:	2015-11-11
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

GENERAL ARRANGEMENT
TRIBUTARY 3 CROSSING
PRECAST CONCRETE BRIDGE
GENERAL ARRANGEMENT

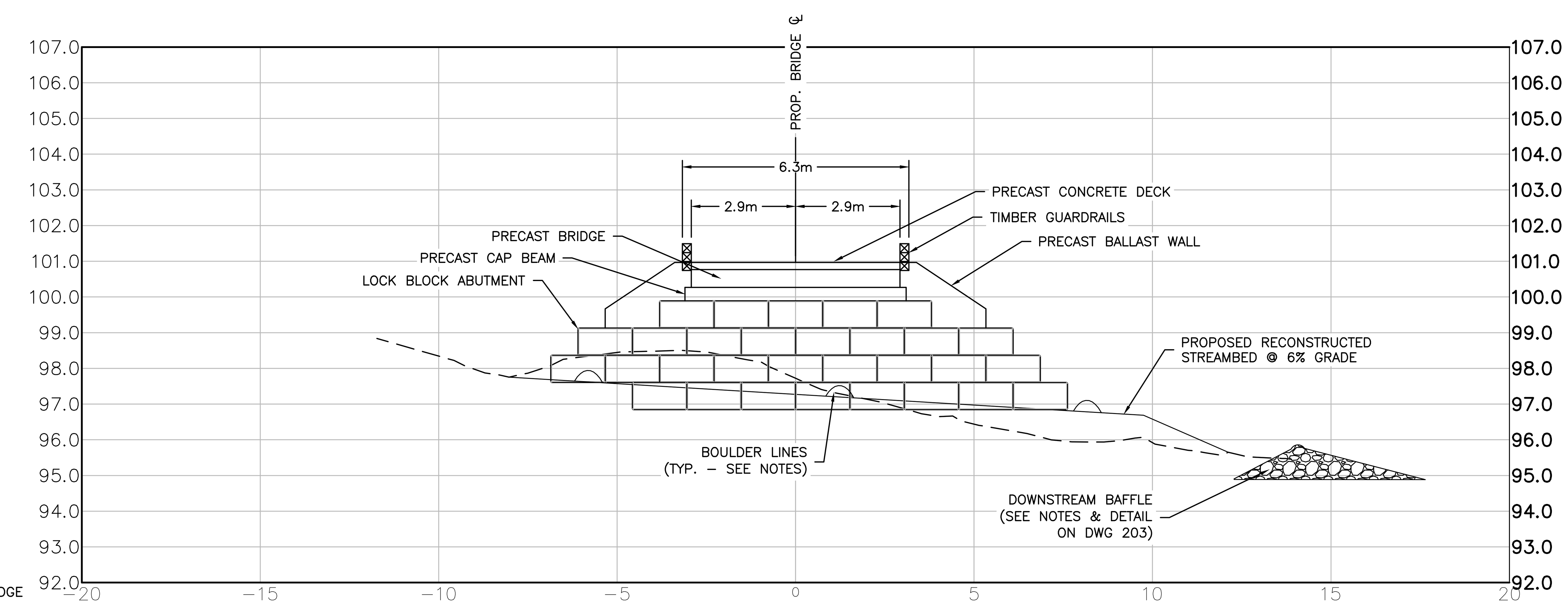
EBC CONSULTANTS LTD.

DRAW NO. 203

REV. 0



BRIDGE CENTERLINE ELEVATION



BRIDGE SECTION AT PROPOSED STREAMBED CENTERLINE

RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

NOTES:

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ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING

ROAD CENTERLINE
BOTTOM OF BANK
TOP OF BANK
HIGH WATER MARK
PRESENT WATER LEVEL
THALWEG
TREELINE
TRAVERSE HUB — TH
TEST PIT — TP
BENCHMARK — BM
REFERENCE STAKE — REF

PROPOSED

ROAD CENTERLINE
ROAD EDGE
TOE OF FILL
HIGH WATER MARK
THALWEG
DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-03
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

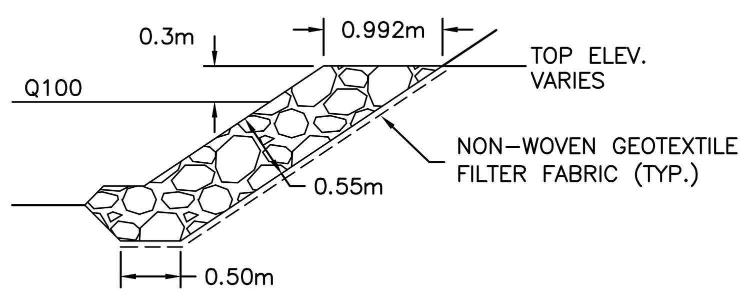
GENERAL ARRANGEMENT
TRIBUTARY 3 CROSSING
PRECAST CONCRETE BRIDGE
PROFILE & SECTION VIEW

EBC CONSULTANTS LTD.

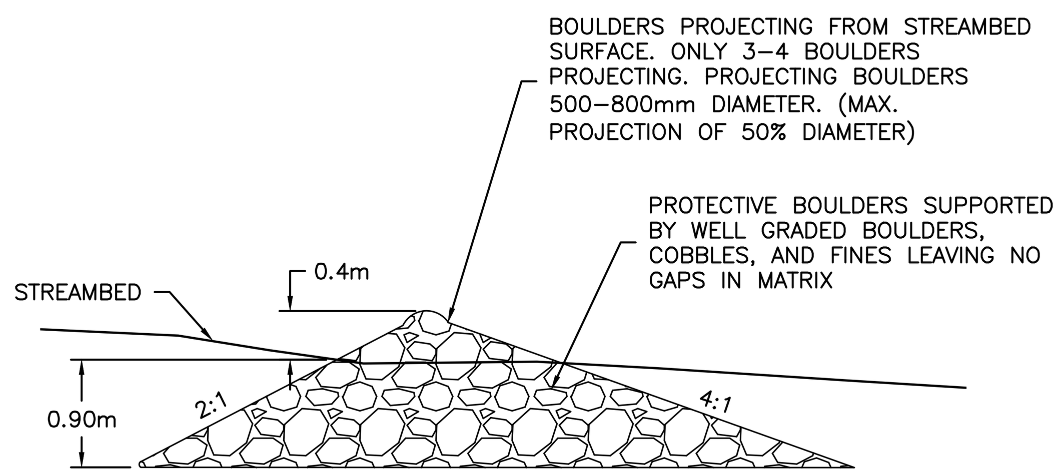
DRAW NO. 204

REV. 0

ORIGINAL SIZE: ARCH D (22"x36")



CLASS 50 RIP RAP
INSTALLATION DETAIL
SCALE 1:50



TYPICAL BAFFLE
INSTALLATION DETAIL
SCALE 1:50

CURVE TABLE			
CURVE	RADIUS	LENGTH	DELTA
C1	35.00	31.49	51°33'14"

WORKPOINT TABLE			
Name	Northing	Easting	Elevation
WP1	148.55	96.22	99.80
WP2	138.15	82.19	98.75

RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

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Name	Northing	Easting	Elevation	Description
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BM3	153.70	85.86	99.68	BENCHMARK 3
REF1	129.92	88.83	97.93	REF STAKE 1
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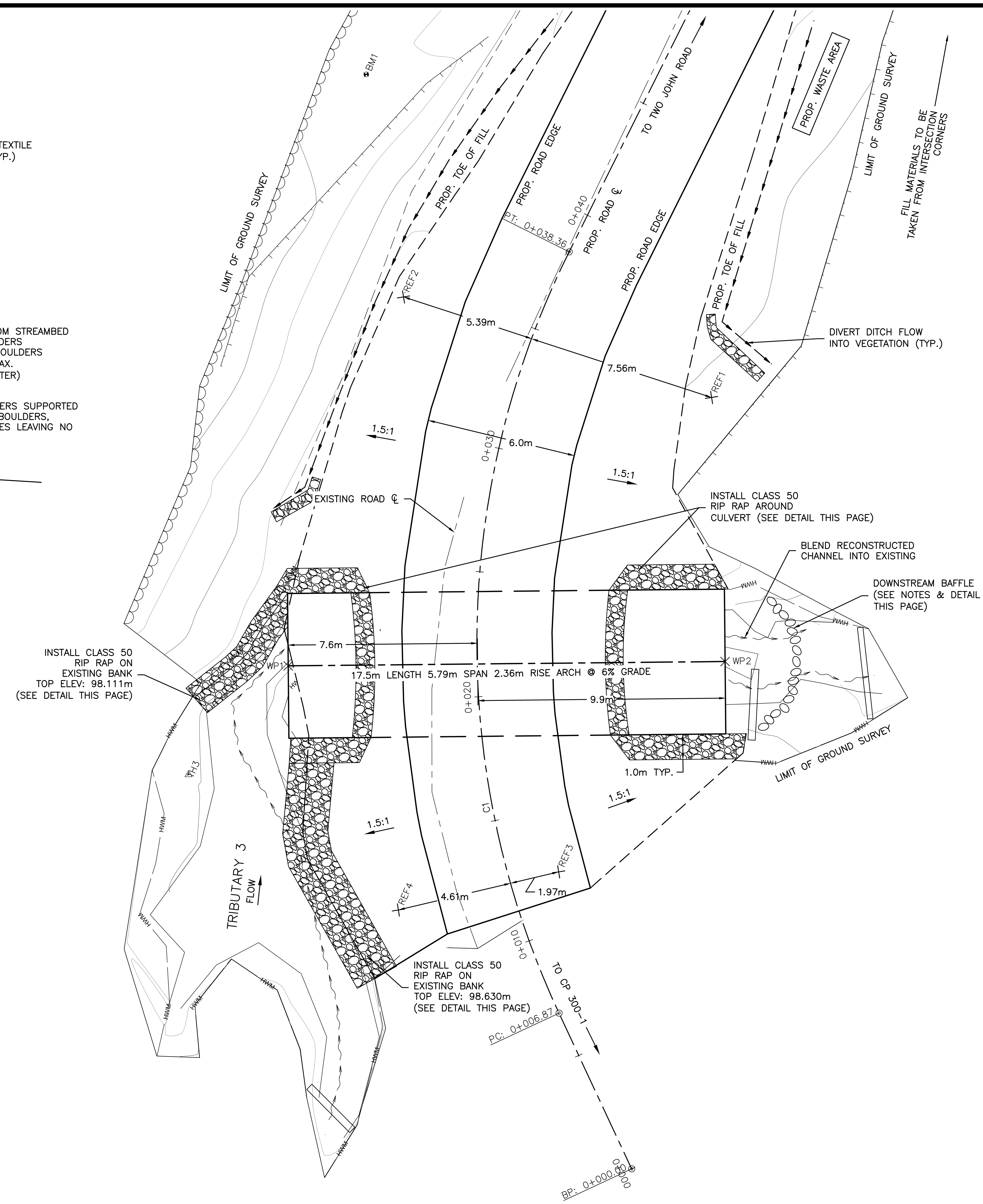

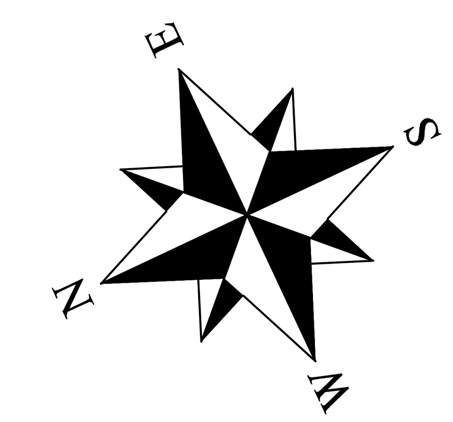

NOTES:

1. WORKPOINTS AT CULVERT OBVERTS
2. STREAM CLASS: S3
3. Q100 DESIGN FLOW: 1.85m3/s
4. DESIGN STREAM Q100 TWL WIDTH: 3.4m
5. DESIGN STREAM SLOPE: 6%
6. GRAVEL & SAND STREAMBED WITH COBBLE BANKS
5. L75 DESIGN LOAD (LG3 LLT DESIGN VEHICLE)
6. REFER TO DWG 206 FOR PROFILE AND SECTION VIEWS
7. FOR FURTHER BAFFLE DETAILS, SEE SECTION 5.1 OF THE REPORT.
8. BOULDER LINES TO BE INSTALLED EVERY 6m ALONG RECONSTRUCTED STREAM.
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10. RIP RAP TO BE INSTALLED TO THE EXTENTS, DEPTHS, AND THICKNESSES NOTED ON THE DRAWINGS.
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ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING

ROAD CENTERLINE
BOTTOM OF BANK
TOP OF BANK
HIGH WATER MARK
PRESENT WATER LEVEL
THALWEG
TREELINE
TRAVERSE HUB
TEST PIT
BENCHMARK
REFERENCE STAKE

PROPOSED

ROAD CENTERLINE
ROAD EDGE
TOE OF FILL
HIGH WATER MARK
THALWEG
DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-11
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

GENERAL ARRANGEMENT
TRIBUTARY 3 CROSSING
OPEN BOTTOM CULVERT
GENERAL ARRANGEMENT

EBC CONSULTANTS LTD.

DRAW NO. 205

REV. 0

ORIGINAL SIZE: ARCH D (22"x36")

RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

NOTES:

1. WORKPOINTS AT CULVERT OBVERTS
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3. Q100 DESIGN FLOW: 1.85m3/s
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5. DESIGN STREAM SLOPE: 6%
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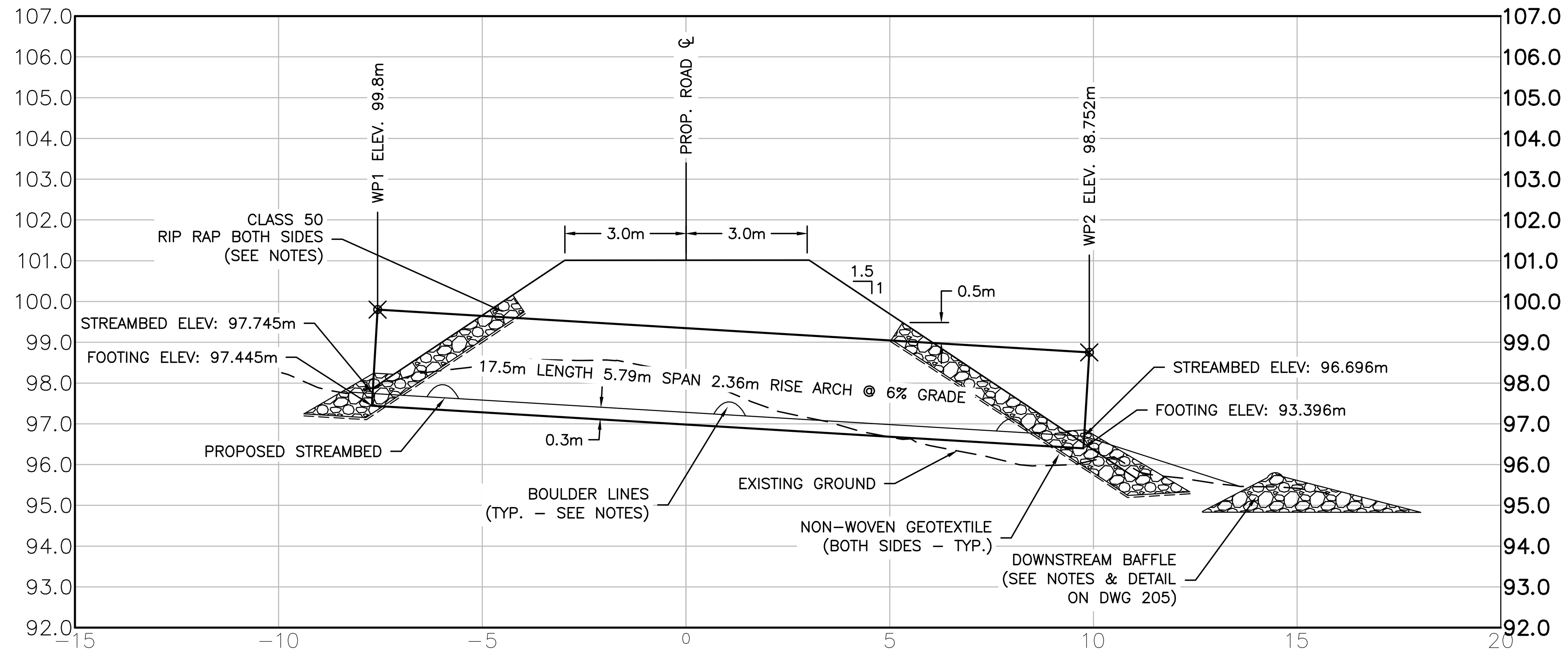
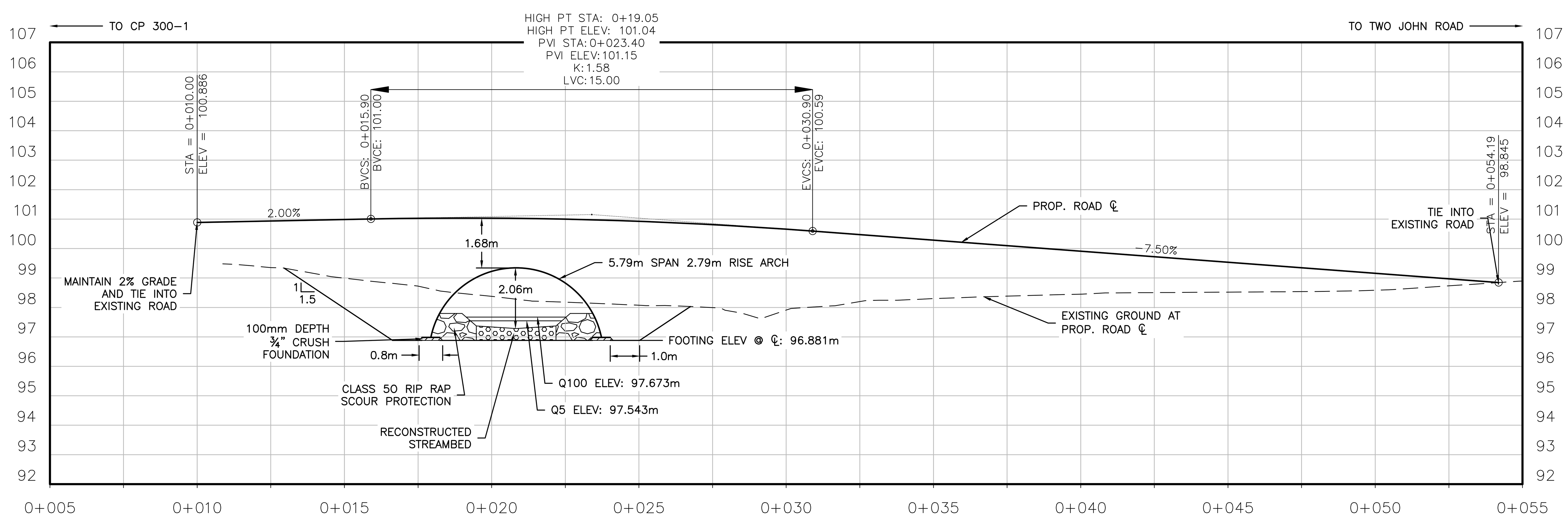


CULVERT CENTERLINE ELEVATION



CULVERT CROSS SECTION AT PROPOSED ROAD CENTERLINE

ISSUED FOR REVIEW
2015-12-10

ORIGINAL SIZE: ARCH D (22"x36")

LEGEND

EXISTING

- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB — TH
- TEST PIT — TP
- BENCHMARK — BM
- REFERENCE STAKE — REF

PROPOSED

- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK
- THALWEG
- DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-03
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

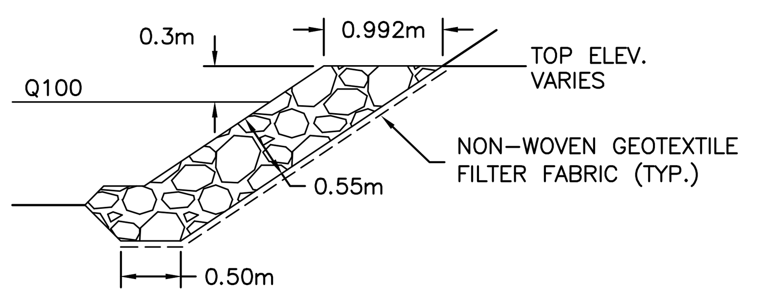
GENERAL ARRANGEMENT

TRIBUTARY 3 CROSSING
OPEN BOTTOM CULVERT
PROFILE & SECTION VIEW

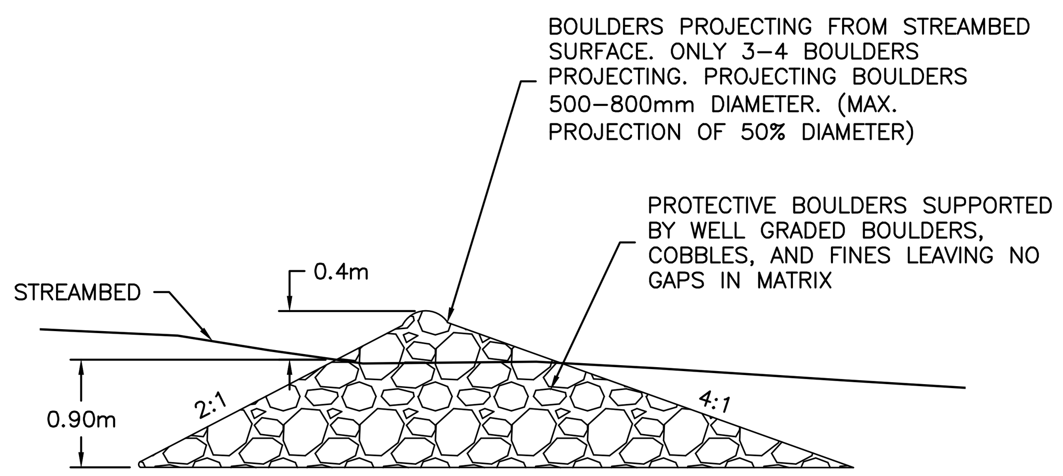
EBC CONSULTANTS LTD.

DRAW NO. 206

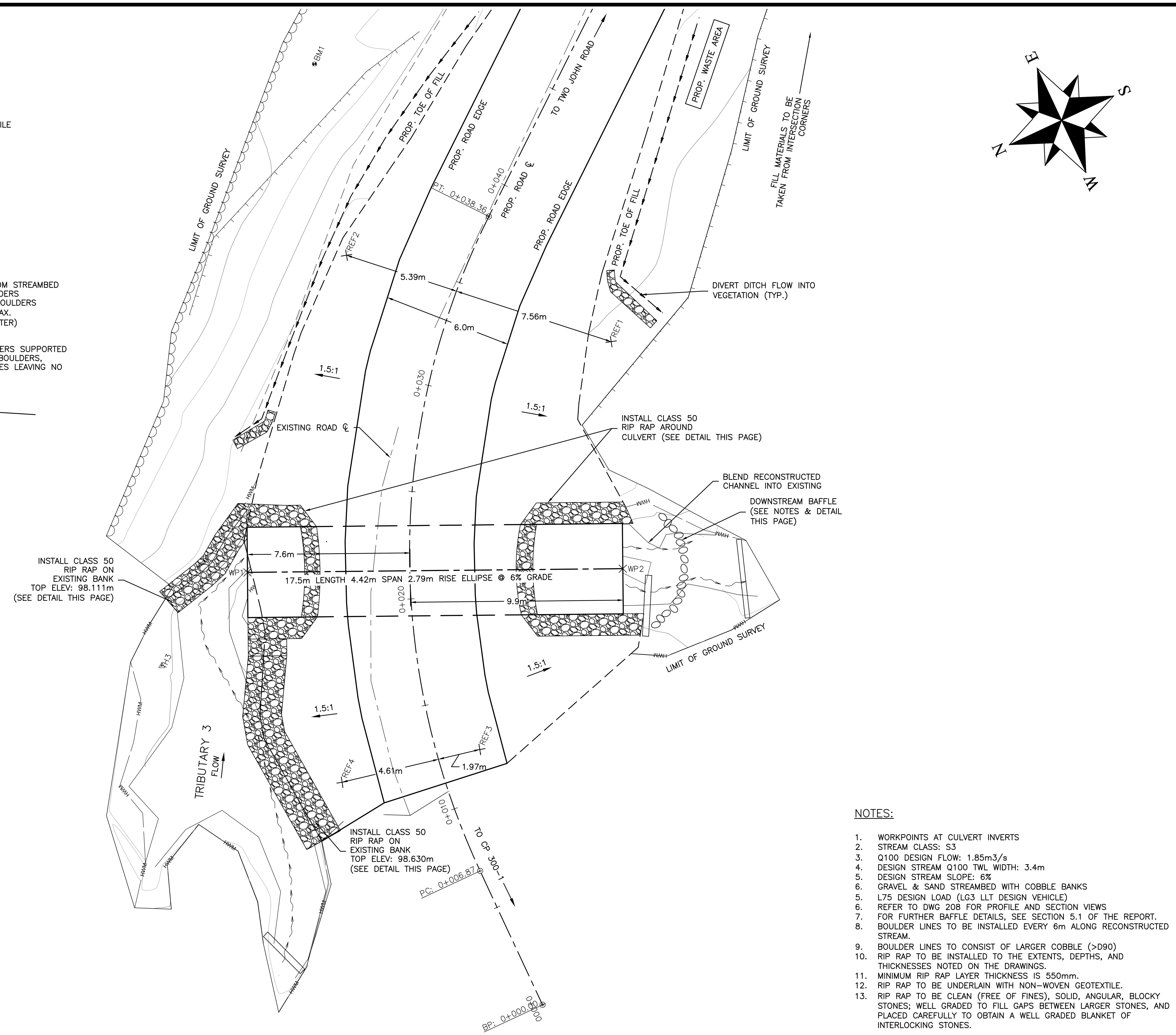
REV. 0



CLASS 50 RIP RAP INSTALLATION DETAIL
SCALE 1:50



TYPICAL BAFFLE INSTALLATION DETAIL
SCALE 1:50



CURVE TABLE			
CURVE	RADIUS	LENGTH	DELTA
C1	35.00	31.49	51°33'14"

WORKPOINT TABLE

Name	Northing	Easting	Elevation
WP1	138.15	82.19	98.87
WP2	148.55	96.22	99.74

RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

CONTROL TABLE

Name	Northing	Easting	Elevation	Description
BM1	127.59	107.59	99.77	BENCHMARK 1
BM2	133.21	91.05	98.03	BENCHMARK 2
BM3	153.70	85.86	99.68	BENCHMARK 3
REF1	129.92	88.83	97.93	REF STAKE 1
REF2	133.91	101.16	98.29	REF STAKE 2
REF3	148.86	82.63	99.18	REF STAKE 3
REF4	153.86	86.92	99.49	REF STAKE 4
SPK1	100.00	100.00	100.00	NAIL
TH1	136.26	98.41	98.28	TRAVERSE HUB
TH2	143.22	92.64	98.40	TRAVERSE HUB
TH3	154.42	96.88	98.19	TRAVERSE HUB

NOTES:

1. WORKPOINTS AT CULVERT INVERTS
2. STREAM CLASS: S3
3. Q100 DESIGN FLOW: 1.85m3/s
4. DESIGN STREAM Q100 TWL WIDTH: 3.4m
5. DESIGN STREAM SLOPE: 6%
5. GRAVEL & SAND STREAMBED WITH COBBLE BANKS
6. L75 DESIGN LOAD (LG3 LLT DESIGN VEHICLE)
6. REFER TO DWG 208 FOR PROFILE AND SECTION VIEWS
7. FOR FURTHER BAFFLE DETAILS, SEE SECTION 5.1 OF THE REPORT.
8. BOULDER LINES TO BE INSTALLED EVERY 6m ALONG RECONSTRUCTED STREAM.
9. BOULDER LINES TO CONSIST OF LARGER COBBLE (>D90)
10. RIP RAP TO BE INSTALLED TO THE EXTENTS, DEPTHS, AND THICKNESSES NOTED ON THE DRAWINGS.
11. MINIMUM RIP RAP LAYER THICKNESS IS 550mm.
12. RIP RAP TO BE UNDERLAIN WITH NON-WOVEN GEOTEXTILE.
13. RIP RAP TO BE CLEAN (FREE OF FINES), SOLID, ANGULAR, BLOCKY STONES; WELL GRADED TO FILL GAPS BETWEEN LARGER STONES, AND PLACED CAREFULLY TO OBTAIN A WELL GRADED BLANKET OF INTERLOCKING STONES.

ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING

- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB — TH
- TEST PIT — TP
- BENCHMARK — BM
- REFERENCE STAKE — REF

PROPOSED

- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK
- THALWEG
- DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-11
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

GENERAL ARRANGEMENT
TRIBUTARY 3 CROSSING
ELLIPTICAL CULVERT
GENERAL ARRANGEMENT

EBC CONSULTANTS LTD.

DRAW NO. 207

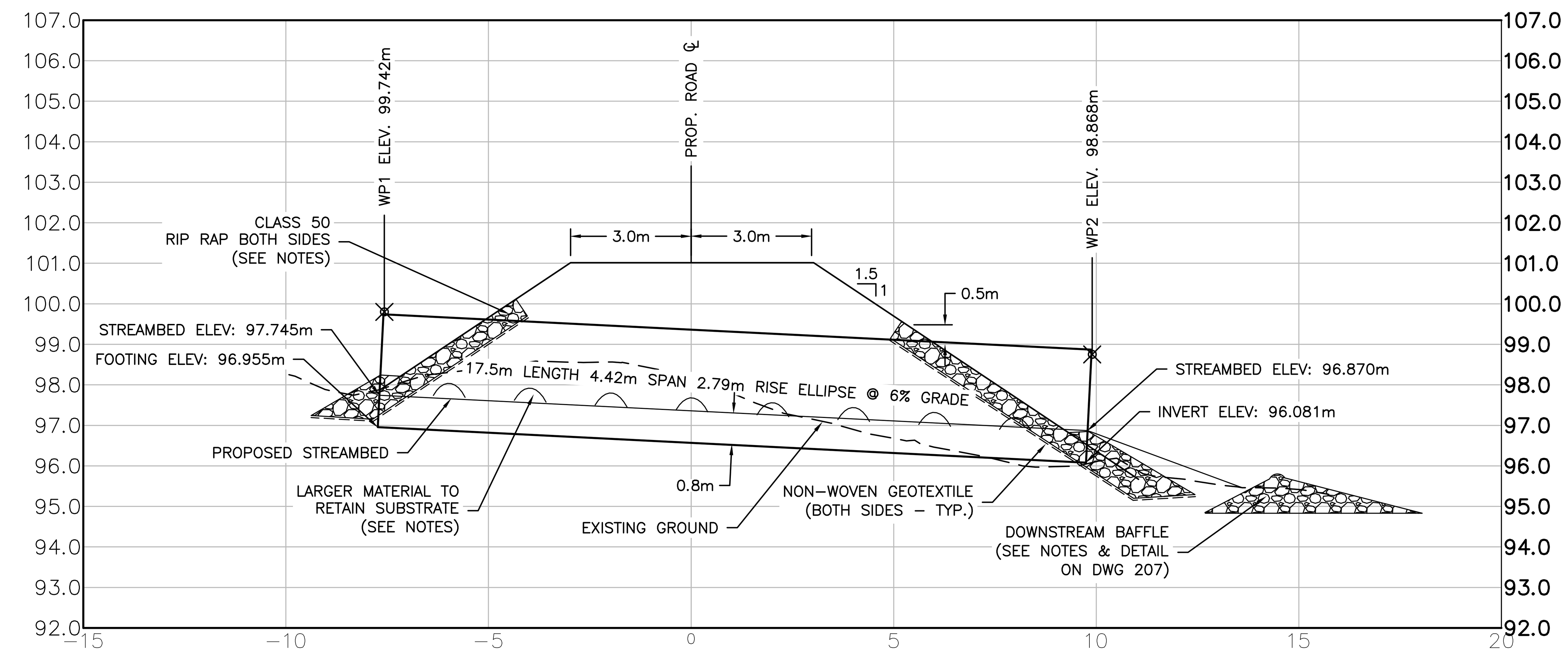
REV. 0

ORIGINAL SIZE: ARCH D (22"x36")

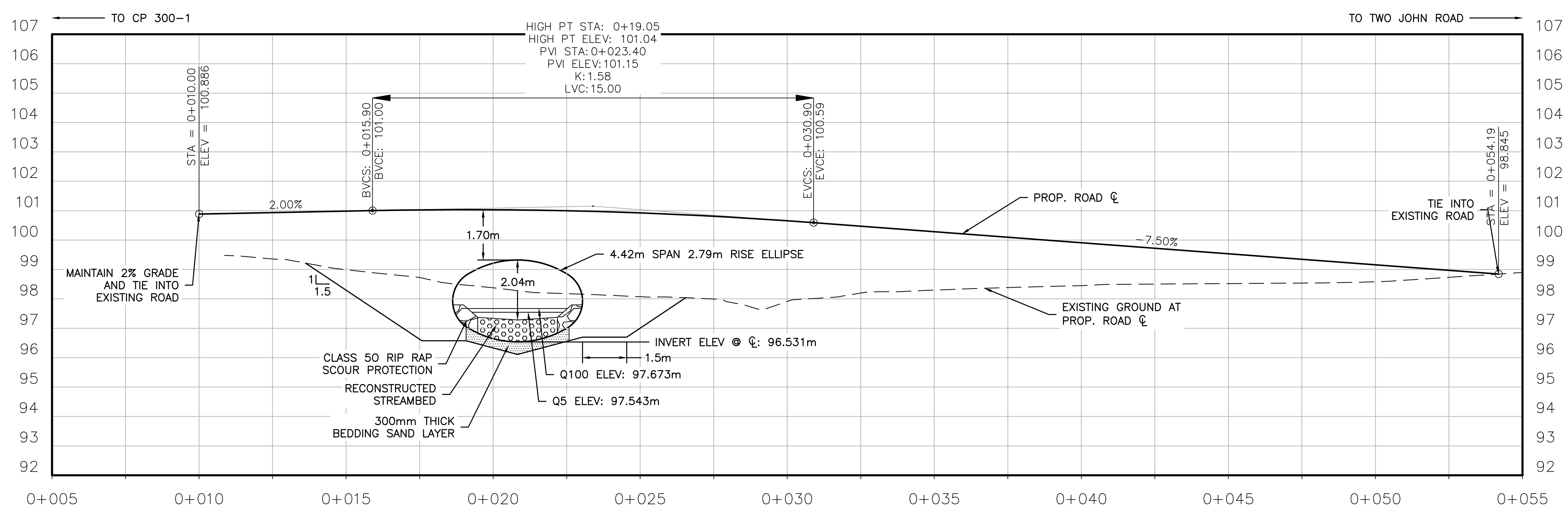
RIP RAP CLASS (kg)	NOMINAL RIP RAP THICKNESS (mm)	APPROX. AVERAGE DIMENSION (mm)		
		15%	50%	85%
50	550	155	330	475

NOTES:

1. CULVERT BACKFILL TO MIMIC NATURAL STREAMBED.
2. IF SUITABLE MATERIALS FOR CULVERT BACKFILL ARE NOT AVAILABLE ON SITE, SUITABLE MATERIALS SHALL BE IMPORTED.
3. BACKFILL IN CULVERT TO BE MIX OF COBBLE, SAND, AND GRAVEL.
4. SUBSTRATE TO BE INSTALLED IN CULVERT TO A NOMINAL DEPTH OF 0.8m
5. LARGER MATERIAL (>D90) TO BE PLACED IN CULVERT TO MAINTAIN SUBSTRATE (3m SPACING)
6. SUBSTRATE MATERIAL MUST BE FREE OF ORGANICS.
7. IF POSSIBLE, EXCAVATED STREAMBED MATERIAL SHALL BE SALVAGED AND SET ASIDE FOR USE DURING INSTALLATION OF THE CULVERT.
8. FOR FURTHER BAFFLE DETAILS, SEE SECTION 5.1 OF THE REPORT.
9. REFER TO DWG 207 FOR PLAN VIEW
10. RIP RAP TO BE INSTALLED TO THE EXTENTS, DEPTHS, AND THICKNESSES NOTED ON THE DRAWINGS.
11. MINIMUM RIP RAP LAYER THICKNESS IS 550mm.
12. RIP RAP TO BE UNDERLAIN WITH NON-WOVEN GEOTEXTILE.
13. RIP RAP TO BE CLEAN (FREE OF FINES), SOLID, ANGULAR, BLOCKY STONES; WELL GRADED TO FILL GAPS BETWEEN LARGER STONES, AND PLACED CAREFULLY TO OBTAIN A WELL GRADED BLANKET OF INTERLOCKING STONES.



CULVERT CENTERLINE ELEVATION



CULVERT CROSS SECTION AT PROPOSED ROAD CENTERLINE

ISSUED FOR REVIEW
2015-12-10

LEGEND

EXISTING

- ROAD CENTERLINE
- BOTTOM OF BANK
- TOP OF BANK
- HIGH WATER MARK
- PRESENT WATER LEVEL
- THALWEG
- TREELINE
- TRAVERSE HUB
- TEST PIT
- BENCHMARK
- REFERENCE STAKE

PROPOSED

- ROAD CENTERLINE
- ROAD EDGE
- TOE OF FILL
- HIGH WATER MARK
- THALWEG
- DITCH

NO.	DATE	REVISION	BY	APD

SCALE:	1:100
DATE:	2015-11-03
DRAWN BY:	ERS
CHECKED BY:	CJM
PROJECT NO. :	2015-001

GENERAL ARRANGEMENT

TRIBUTARY 3 CROSSING
ELLIPTICAL CULVERT
PROFILE & SECTION VIEW

EBC CONSULTANTS LTD.

DRAW NO. 208

REV. 0

ORIGINAL SIZE: ARCH D (22"x36")

Appendix C

- Project Progress (Team Minutes)
    - Arranged by Date

- Project Safety Sheet

- Site Visit Field Notes

- Project Task Management Schedule

APPENDIX C

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Sept. 10, 2015
Time: 11:15am
Location: Member's House
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: none

Agenda

- Determine potential project opportunities
- Discuss preferences of projects
- Contact Sources for industry related projects
- Preparation of Meeting Minutes

Previous action items

- None applicable

Issues

- Limitations of information of projects and contacts
- Deciding on a conceptual project without enough information

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Forestry Project**
Discussion	Contact Ken Langedyk about potential forestry projects
Action Item:	Eric Sandberg – email Ken/set up meeting
Responsible/Date:	Sept. 11, 2015

Item #2	**Meeting with Ken**
Discussion	Invite Rob to meeting with Ken
Action Item:	Branden Hoult – meet with Rob
Responsible/Date:	Sept. 11, 2015

Item #3	**Meeting Minutes**
Discussion	Prepare and print meeting minutes, and setup group template
Action Item:	Clayton Murray – Produce and bring copies of meeting minutes
Responsible/Date:	Sept. 16, 2015

Agenda for Next Meeting

- Confirm project selection, discuss key concepts, and research project
- Begin Letter of Expression

*** Time for next team meeting: Sept. 16, 2015 @ 2:30pm**

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Sept. 16, 2015
Time: 2:16pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: none

Agenda

- Address previous meeting minutes
- Begin LOE
- Work on project scope form
- Preparation of Meeting Minutes

Previous action items

- Had meeting with Ken to discuss project after Eric setup a meeting – September 14, 2015 – Whole team present
- Branden had Rob come to the meeting – September 14, 2015
- Meeting minutes completed and template made by Clayton – September 14, 2015

Issues

- Wait before visiting site → delays surveying
- Need more specific site location from Ken

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**LOE**
Discussion	Format and complete letter head for the LOE
Action Item:	Eric Sandberg – complete LOE
Responsible/Date:	Sept. 17, 2015

Item #2	**Project Scope Form**
Discussion	Complete form and get necessary signatures
Action Item:	Branden Hoult – meet with Rob & Ken to get signatures
Responsible/Date:	Sept. 18, 2015

Item #3	**LOE and Client Meeting**
Discussion	Review completed LOE from Eric as well as set up meeting with Ken
Action Item:	Clayton Murray – Final check of LOE, and email Ken
Responsible/Date:	Sept. 18, 2015

Agenda for Next Meeting

- Begin Proposal Draft
- Discuss Surveying (set up time to practice if deemed necessary)

*** Time for next team meeting: Sept. 23, 2015 @ 1:30pm**

APPENDIX C

Project Progress (Team Minutes)

Group: EBC Consultants Ltd.
Date: Sept. 23, 2015
Time: 2:30pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: none

Agenda

- Address previous meeting minutes
- Review LOE
- Start on Proposal
- Preparation of Meeting Minutes
- Delegate Tasks and begin set up of Task Management Sheet

Previous action items

- LOE completed and submitted – received marked copy back – September 18, 2015 (Eric)
- A couple revisions to Scope of Work Form needed before final signatures can be acquired – September 20, 2015 (Branden)
- LOE was reviewed before being submitted and a meeting was held with client (Ken) – September 17, 2015 (Clayton)

Issues

- Have yet to visit/survey site → Delaying Project

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Research Info necessary for Site Visit, Develop Map**
Discussion	1 - Bring necessary notes needed for site visit & create a detailed map of site location 2 - Revise Work Scope
Action Item:	Eric Sandberg 1 - Research & take notes, Create map for site 2 – Provide detailed scope of work
Responsible/Date:	1 - Sept. 26, 2015 2 - Sept. 28, 2015

Item #2	**Begin Draft of Proposal, Revise Project Scope Form**
Discussion	Acquire & prepare equipment, necessary for site survey, Revise scope of work form
Action Item:	Branden Hoult – Prepare Equipment, complete form
Responsible/Date:	Sept. 25, 2015

Item #3	**Equipment for Surveying / Create Task Management Schedule**
Discussion	1 - Begin Draft of Proposal, bring individual task lists 2 - Create a task schedule outlining responsibilities on excel
Action Item:	Clayton Murray 1 - Draft Proposal 2 - Create Spreadsheet
Responsible/Date:	1 - Sept. 25, 2015 2 - Sept. 28, 2015

Agenda for Next Meeting

- Finish Proposal
- Develop Cost Estimate and Time Schedule

*** Time for next team meeting: Sept. 30, 2015 @ 2:30pm**

APPENDIX C

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Sept. 30, 2015
Time: 2:16pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: none

Agenda

- Address previous meeting minutes
- Complete Presentation for Proposal
- Preparation of Meeting Minutes

Previous action items

- Map was created and site visit was successful – September 26, 2015 (Map – Eric) (Site Visit – Whole Team)
- Equipment was taken out for survey and has already been returned – September 26, 2015 (Branden)
- Proposal was completed and handed in to the client – September 30, 2015 (Clayton)
- Task schedule was completed and everyone has been given copies of deadlines – September 28, 2015 (Clayton)

Issues

- N/A

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Presentation**
Discussion	Complete powerpoint and prepare for presentation
Action Item:	Eric Sandberg – complete PPT, prepare notes for meeting
Responsible/Date:	Oct. 2, 2015

Item #2	**Project Scope Form**
Discussion	Prepare for presentation
Action Item:	Branden Hoult – prepare notes for meeting
Responsible/Date:	Oct. 2, 2015

Item #3	**LOE and Client Meeting**
Discussion	Review powerpoint and prepare for presentation
Action Item:	Clayton Murray – PPT review and preparation
Responsible/Date:	Oct. 2, 2015

Agenda for Next Meeting

- Debrief Presentation
- Discuss order of business and check watershed analysis

*** Time for next team meeting: Oct. 7, 2015 @ 2:20pm**

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Oct. 7, 2015
Time: 1:43pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: none

Agenda

- Address previous meeting minutes
- Debrief Presentation/ Proposal
- Preparation of Meeting Minutes

Previous action items

- Presentation went well, need to be more rehearsed and create better PowerPoint – October 2, 2015 (Whole Team)
- English in proposal was not clear and concise and needs to be revised – October 7, 2015 (Clayton)

Issues

- N/A

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Calculations and determination of flow of Two-Forty Creek**
Discussion	1 – Hydrology analysis of creek to determine flow
Action Item:	Eric Sandberg 1 – Hydrology
Responsible/Date:	1 – Oct. 14, 2015

Item #2	**Fish Bearing Determination and Background info**
Discussion	1 – Fish and Wildlife research
Action Item:	Branden Hoult 1 – Environmental Report
Responsible/Date:	Oct. 21, 2015

Item #3	**Review and Edit Proposal and Review Hydrology**
Discussion	1 – Revise Proposal and Look over hydrology with Eric
Action Item:	Clayton Murray 1 – Revisions
Responsible/Date:	1 - Oct. 14, 2015

Agenda for Next Meeting

- Discuss progress
- Review reports to date

*** Time for next team meeting: Oct. 14, 2015 @ 2:20pm**

APPENDIX C

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Oct. 14, 2015
Time: 2:20pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: none

Agenda

- Address previous meeting minutes
- Look at hydrology
- Review Fish Concerns
- Preparation of Meeting Minutes

Previous action items

- Hydrology report shows a flow of 1.85m^3/s – October 13, 2015 (Eric)
- Fish determination showed the presence of Rainbow Trout – October 12, 2015 (Branden)
- Proposal revised and English made clear Trout – October 10, 2015 (Branden)

Issues

- Complexity of Hydrology – Speak with Ken

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Create Site Base Plan and Model Creek**
Discussion	1 – Create base plan drawing of site
Action Item:	Eric Sandberg 1 – Base plan Drawing/Revise Map
Responsible/Date:	1 – Oct. 21, 2015

Item #2	**Create plan for Erosion and Sediment Control During/After Construction**
Discussion	1 – Start on Erosion & Sediment research
Action Item:	Branden Hoult 1 – Environmental Report
Responsible/Date:	Oct. 21, 2015

Item #3	**Discuss Dates for Soil Testing and Begin Tests**
Discussion	1 – Speak to Henry about soil tests
Action Item:	Clayton Murray 1 – Meet with Henry
Responsible/Date:	1 - Oct. 21, 2015

Agenda for Next Meeting

- Discuss progress
- Review reports to date

*** Time for next team meeting: Oct. 21, 2015 @ 2:00pm**

APPENDIX C

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Oct. 21, 2015
Time: 2:00pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: none

Agenda

- Address previous meeting minutes
- Discuss Progress
- Continue Research on Erosion and Settlement
- Preparation of Meeting Minutes

Previous action items

- Site base plan part way done, needs to be completed (Priority) – Not Complete (Eric)
- Need more Erosion and Sediment research – Not Complete (Branden)
- Soil sample left with Henry, Date to test soil determined October 30, 2015 – October 20, 2015 (Clayton)

Issues

- No deliverables handed in today – Not due until next meeting though

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Create Site Base Plan and Model Creek**
Discussion	1 – Finish base plan drawing of site
Action Item:	Eric Sandberg 1 – Base Plan Drawing
Responsible/Date:	1 – Nov. 4, 2015

Item #2	**Create plan for Erosion and Sediment Control During/After Construction**
Discussion	1 – Finish Erosion & Sediment research
Action Item:	Branden Hoult 1 – Environmental Research
Responsible/Date:	Nov. 4, 2015

Item #3	**Discuss Dates for Soil Testing and Begin Tests**
Discussion	1 – Begin Erosion and Sediment Report
Action Item:	Clayton Murray 1 – Environmental Report
Responsible/Date:	1 – Nov. 4, 2015

Agenda for Next Meeting

- Discuss progress
- Review reports to date

*** Time for next team meeting: Nov. 4, 2015 @ 2:30pm**

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Nov. 4, 2015
Time: 2:00pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: non

Agenda

- Address previous meeting minutes
- Discuss Progress
- Continue Research on Erosion and Settlement
- Preparation of Meeting Minutes

Previous action items

- Site base plan done – Nov. 4, 2015 (Eric)
- Erosion and Sediment research – Nov. 4, 2015 (Branden)
- Sieve report done and erosion and sediment control research done – Nov. 2, 2015 (Clayton)

Issues

- Deadline fast approaching need to push forward with report and have completed within next 2 weeks

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Create Site Base Plan and Model Creek**
Discussion	1 – Plan and Profiles of design concepts
Action Item:	Eric Sandberg 1 – Design concepts Drafted
Responsible/Date:	1 – Nov. 11, 2015

Item #2	**Create plan for Erosion and Sediment Control During/After Construction**
Discussion	1 – Develop BMP for Sediment and Erosion during/after construction
Action Item:	Branden Hoult 1 – Best Management Practices
Responsible/Date:	Nov. 11, 2015

Item #3	**Discuss Dates for Soil Testing and Begin Tests**
Discussion	1 – Soil write up and compile reports to date
Action Item:	Clayton Murray 1 – Compile all finished reports and finish soil report
Responsible/Date:	1 – Nov. 11, 2015

Agenda for Next Meeting

- Discuss progress
- Review reports to date

*** Time for next team meeting: Nov. 12, 2015 @ 2:30pm**

APPENDIX C

PROJECT PROGRESS (TEAM MINUTES)

Group: EBC Consultants Ltd.
Date: Nov. 12, 2015
Time: 2:00pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: non

Agenda

- Address previous meeting minutes
- Discuss Progress
- Continue writing of report
- Preparation of Meeting Minutes

Previous action items

- Drafting or 4 design alternatives – Nov. 11, 2015 (Eric)
- Erosion and Sediment BMP – Nov. 11, 2015 (Branden)
- Report started and soil classification done – Nov. 11, 2015 (Clayton)

Issues

- Would like to have all aspects of report completed and compiled by next week

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Create Site Base Plan and Model Creek**
Discussion	1 – Finalization and write ups of Design Alternatives
Action Item:	Eric Sandberg 1 – Write ups of alternatives
Responsible/Date:	1 – Nov. 18, 2015

Item #2	**Create plan for Erosion and Sediment Control During/After Construction**
Discussion	1 – Write up on site visit and contact suppliers
Action Item:	Branden Hoult 1 – Finish write up and begin PR
Responsible/Date:	Nov. 18, 2015

Item #3	**Discuss Dates for Soil Testing and Begin Tests**
Discussion	1 – Continue write up of report and Appendices
Action Item:	Clayton Murray 1 – Collect all parts of report and compile together
Responsible/Date:	1 – Nov. 18, 2015

Agenda for Next Meeting

- Discuss progress/comparison of 4 designs
- Wrap up report

*** Time for next team meeting: Nov. 18, 2015 @ 2:00pm**

Project Progress (Team Minutes)

Group: EBC Consultants Ltd.
Date: Nov. 18, 2015
Time: 2:00pm
Location: C234 @ Okanagan College
Prepared by: Clayton Murray
Attendees: Clayton Murray, Eric Sandberg, and Branden Hoult
Absent: non

Agenda

- Address previous meeting minutes
- Discuss Progress
- Report Finishing
- Preparation of Meeting Minutes

Previous action items

- 4 design alternatives drafted and written up – Nov. 17, 2015 (Eric) – Completed
- Site Visit – Nov. 18, 2015 (Branden) – Completed
- Report writing – Nov. 18, 2015 (Clayton) – Not Complete, still have 1 week

Issues

- Report needs to be finalized and reviewed ASAP

New Action Items

- Proposed action items for the coming week and name of responsible individual

Item #1	**Create Site Base Plan and Model Creek**
Discussion	1 – Executive Summary, report editing
Action Item:	Eric Sandberg 1 – Write up of executive summary and report editing
Responsible/Date:	1 – Nov. 20, 2015

Item #2	**Create plan for Erosion and Sediment Control During/After Construction**
Discussion	1 – All costs compiled, Completion of Appendix B
Action Item:	Branden Hoult 1 – Get costs and Compile Administrative documents
Responsible/Date:	Nov. 20, 2015

Item #3	**Discuss Dates for Soil Testing and Begin Tests**
Discussion	1 – Continue write up of report and Appendices
Action Item:	Clayton Murray 1 – Finish report
Responsible/Date:	1 – Nov. 20, 2015

Agenda for Next Meeting

- Begin Presentation

*** Time for next team meeting: Nov. 25, 2015 @ 2:00pm**

EBC Consultants Ltd. Field Hazard Assessment

Project Name: Derickson Road Washout

Date of Assesment: Oct. 3, 2015

Location: 98km mark of Derickson Rd.

Conducted by: Clayton Murray

PPE:

Seat Belts	✓	Eye Protection	☐	Ear Protection	☐
Lights/ Alarms work	✓	Bear Spray	✓	Proper Clothing	✓
Gloves	✓	High Visibility Vest	✓	Respirators	☐
Steel Toed Footwear	✓	Hard Hat	☐	Cell Phone/ Radio	✓

Hazards:

- slips, trips, and falls
- wild life
- extreme temps.
- de hydration

Precautions:

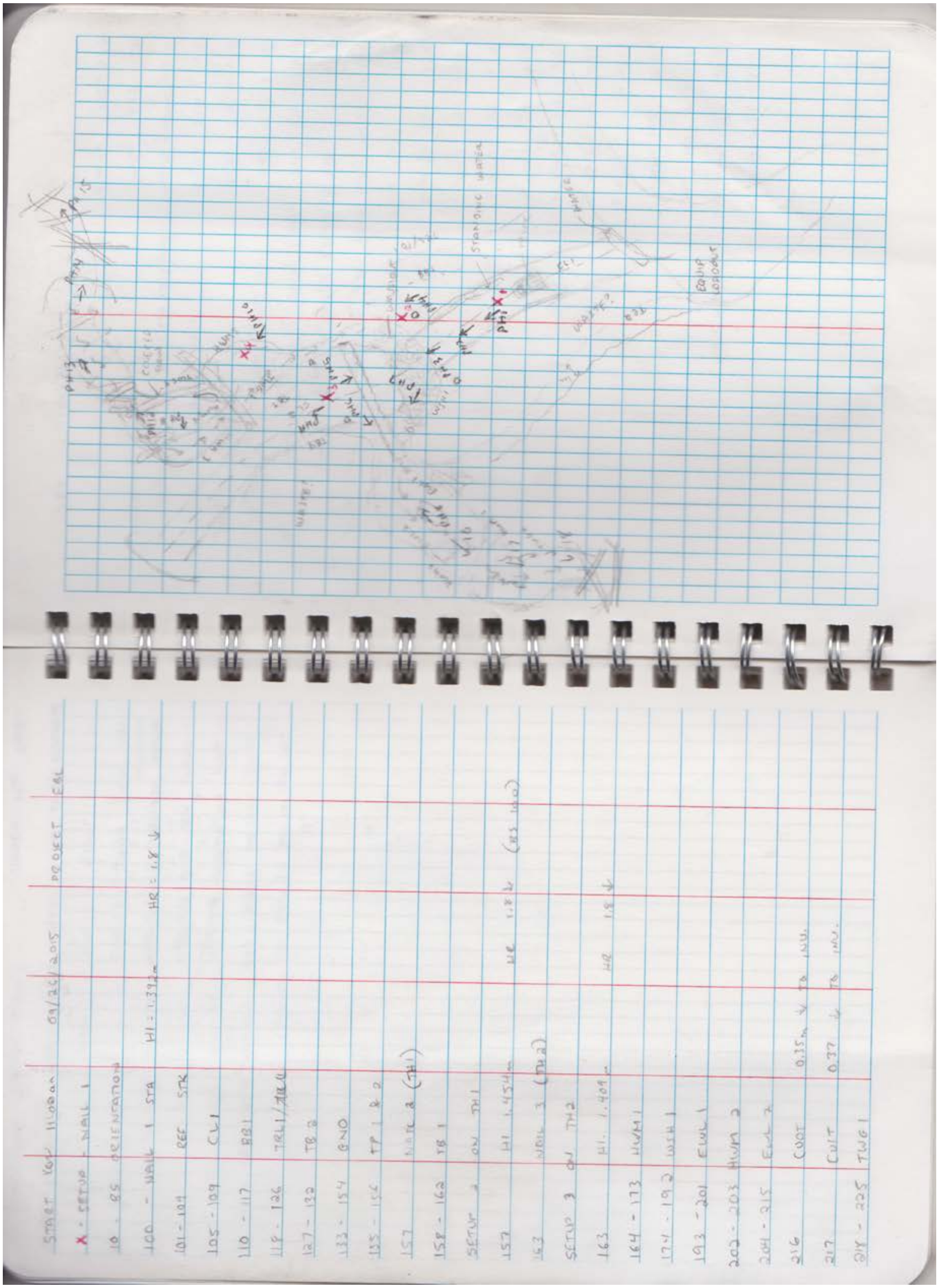
- watch footing while walking
- carry bear spray, keep an eye out on surroundings
- wear appropriate clothing - stay warm
- drink lots of water

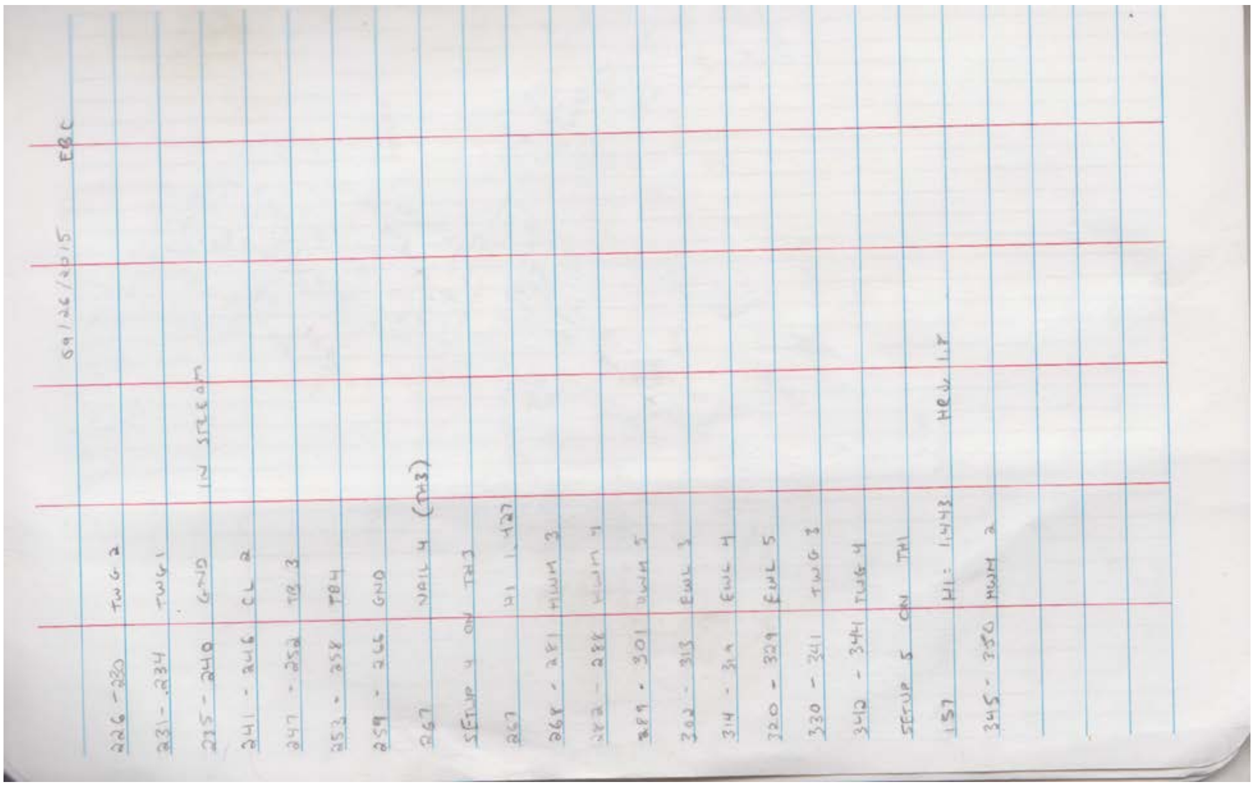
Attendees:

Name	Signature	Date
Clayton Murray		Oct. 3, 2015
Branden Hoult		Oct 3rd, 2015
ERIC SANDBERG		OCT. 3RD, 2015

Reviewed by:

Name Clayton Murray Signature Date Oct 5, 2015


START 11:00am 09/26/2015 PROJECT EBL
X - SETUP - NAIL 1
10 - 85 ORIENTATION
100 - NAIL 1 STA HI = 1.392m HR = 1.8
101 - 104 REF STK
105 - 109 CL1
110 - 117 BB1
118 - 126 TBL1/
127 - 132 TB2
133 - 154 GNO
155 - 156 TP 1 & 2
157 NAIL 2 (TH1)
158 - 162 TB1
SETUP 2 ON TH1
157 HI 1.454m HR 1.8 (BS NAIL)
163 NAIL 3 (TH2)
SETUP 3 ON TH2
163 HI 1.404m HR 1.8
164 - 173 HWM1
174 - 192 WSH1
193 - 201 EWL1
202 - 203 HWM2
204 - 215 EWL2
216 CUOT 0.35m TO INV.
217 CUIT 0.37 TO INV.
218 - 225 TWG1


09/26/2015 EBC
226 - 230 TWG 2
231 - 234 TWG 1
235 - 240 GND IN STREAM
241 - 246 CL 2
247 - 252 TB 3
253 - 258 TB4
259 - 266 GND
267 NAIL 4 (TH3)
SETUP 4 ON TH3
267 HI 1.427
268 - 281 HWM 3
282 - 288 HWM 4
289 - 301 HWM 5
302 - 313 EWL 3
314 - 319 EWL 4
320 - 329 EWL 5
330 - 341 TWG 3
342 - 344 TWG 4
SETUP 5 ON TH1
157 HI: 1.443 HGL 1.8
345 - 350 HWM 2

APPENDIX C

EBC Consultants Ltd. Task Management Schedule

		PERSONNEL	Project Manager	CAD Tech / Head of Research	Survey Tech / PR	Total Hours	Labour Costs
		Person(s) Assigned	Clayton Murray	Eric Sandberg	Branden Hoult		
		Charge Out Rate	$150	$135	$120		
TASK	**ACTIVITY**	**TASK DEADLINE**	**HOURS**	**HOURS**	**HOURS**		
Fee Schedule							
1.1	**Project Initiation / Meetings**	Last one - Dec. 11, 2015	15	15	15	45	$6,075
1.2	**Field Assessment**		7	8	10		$3,330
0.1	Conduct topographic survey of site	Oct. 3, 2015	5	4	8	17	$2,250
0.2	Onsite soil investigation and sampling	Oct. 3, 2015	1		1	2	$270
1.3	Background review and research	Oct. 2, 2015	1	4	1	6	$810
1.4	**Geotechnical Analysis**		4	0	2		
0.1	Sieve analysis	Nov. 6, 2015	2		2	4	$540
0.2	Review of Results	Nov. 11, 2015	2			2	$300
1.5	**Hydrological Assessment**		2	4	2		
0.1	Watershed analysis	Oct. 7, 2015		2		2	$270
0.2	Peak-flow determination	Oct. 14, 2015	2	2		4	$570
0.3	Fish bearing analysis and work preparation	Oct. 7, 2015			2	2	$240
1.6	**Concept Design**		5	23	3		
0.1	Preparation of 4 design concepts	Oct. 7, 2015	3	3	3	9	$1,215
0.2	Model site in C3D for site plan	Oct. 28, 2015		4		4	$540
0.3	Illustrate design concepts on CAD	Nov. 11, 2015		13		13	$1,755
0.4	Ensure designs comply with all regulations	Nov. 11, 2015	2	3		5	$705
1.7	**Environmental Analysis & Reccomendations**		4	0	11		
0.1	Analyze erosion and sediment impacts	Nov. 4, 2015	4		2	6	$840
0.2	Provide plan for fish & wildlife	Oct. 21, 2015			4	4	$480
0.3	Develop BMP plan during/after construction	Nov. 11, 2015			5	5	$600
1.8	**Reporting**		16	13	20		
0.1	Estimate of costs associated with each design	Nov. 22, 2015	3	3	4	10	$1,335
0.2	PR and quote receiving	Nov. 18, 2015			6	6	$720
0.3	Estimate of timelines & recommended work	Nov. 11, 2015	2		4	6	$780
0.4	Finalizing detailed design concepts in C3D	Nov. 18, 2015	1	4		5	$690
0.5	Stream recommendations	Nov. 18, 2015	4	2	2	8	$1,110
0.6	Comparison of 4 design concepts	Nov. 18, 2015	3	3	3	9	$1,215
0.7	Final recommendation for crossing	Nov. 22, 2015	3	1	1	5	$705
1.9	**Deliverables**		45	32	31		
0.1	Preliminary report	Nov. 25, 2015	20	16	14	50	$6,840
0.2	Calculations	Nov. 11, 2015	6	4	4	14	$1,920
0.3	Report editing	Dec. 10, 2015	3			3	$450
0.4	Final Report	Dec. 11, 2015	8	8	8	24	$3,240
0.5	Production	Dec. 10, 2015	3	2	2	7	$960
0.6	Presentation	TBD	5	2	3	10	$1,380
	Completion of Design and Cost Estimate	**Dec. 11, 2015**					
		SUB-TOTAL	**98**	**95**	**94**	**287**	**$ 42,135.00**