PARKLAND COUNTY
REPORT NUMBER: 221-06005-00

BRIDGE FILE 74978 FEASIBILITY STUDY

JUNE 22, 2022

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FEASIBILITY STUDY

PARKLAND COUNTY

FEASIBILITY REPORT (REV.0)
CONFIDENTIAL

PROJECT NO.: OUR REF. NO. 221-06005-00
DATE: JUNE 22, 2022

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SIGNATURES

PREPARED BY

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June 22, 2022

PERMIT TO PRACTICE
WSP CANADA INC.

RM SIGNATURE:

RM APEGA ID #: 72423

DATE: 2022-06-27

PERMIT NUMBER: P007641
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Samuel Tekle, P. Eng.

APPROVER[1] (To be reviewed for technical accuracy prior to approval)

Sameul Teklé, MScE, P.Eng.
Director

June 22, 2022

[1] Approval of this document is an administrative function indicating readiness for release and does not impart legal liability on to the Approver for any technical content contained herein. Technical accuracy and fit-for-purpose of this content is obtained through the review process. The Approver shall ensure the applicable review process has occurred prior to signing the document.

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INTRODUCTION

The existing bridges (BF74978-1, BF74978-2) on the Yellowhead Trail (Hwy 16) located just west of the Wabamun interchange are slated to be decommissioned and removed by Alberta Transportation (AT) in the near future. It is expected that the abandoned mine haul road cut over which the bridges cross will be filled in and a full highway cross-section with barrier-free sideslopes, shoulders, lanes, and median will be constructed, thereby blocking off crossing access beneath the highway and negatively impacting the existing active wildlife corridor and recreationist trail.

Parkland County (County) engaged WSP Canada Inc. (WSP) to investigate the feasibility of maintaining wildlife connectivity and providing access for recreationists once the bridges have been removed. It is believed that accommodating area drainage through the site is part of AT's scope of work for removal of the bridges, although the County should confirm this.

The crossing solution needs to be context specific and customized to the local ecological conditions, broader land use planning objectives, stakeholder interests, and available funding. The intent is to utilize a buried structure or series of structures for the crossing to minimize future maintenance and repair costs and avoid inconvenience to the traveling public during inspections and future interventions.

In addition to wildlife, the crossing is to accommodate hikers and motorized recreational vehicles (ATV's, snowmobiles). There is no requirement to separate the different user types. For recreationists, the interior of the underpass is to remain unobstructed (barrier-free).

Due to the significant difference in height between the overpassing highway and the existing ground beneath the bridges, roadway users will need to be protected from the severe drop at the wildlife crossing by some form of guardrail or barriers along the sides of the road.

For wildlife, the underpass concept needs to consider species-specific requirements related to sightlines and light penetration (openness ratios) and cover or terrain features that can attract wildlife to the crossing site and encourage crossing. Landscaping should encourage the use of the structure, guide animals towards the entrances, and help minimize disturbance effects from traffic. Fencing is often needed to direct animals toward structures and prevent them from crossing in other (less safe) locations, although there is a practical limit to the affordable extent of fencing for this purpose.

Scope of Work & Deliverables:

WSP was tasked with exploring specific scenarios (see below) and conceptualizing up to three (3) feasible structure types based on drainage needs, the target species, recreational use, and the local topography.

The scope of work did not extend to identifying species of interest, so the study is based on anecdotal accounts that large ungulates such as deer/moose/elk have been seen in the area. It is unknown whether amphibians and reptiles are also present.

Also excluded from the scope of work is any geotechnical or drainage assessment and any existing problems related to area drainage or embankment instability.

WSP visited the site to observe the surroundings to visually identify any obvious existing drainage paths, drainage inlets/outlets, geographical features, and possible constraints. The County provided LiDAR survey data for use in developing the scenario layouts.

Specific scenarios:

a. A drainage only / do nothing option (Option 1)
b. A drainage and wildlife connection option (Option 2)
c. A drainage, wildlife, and recreationist access option (Option 3)

Deliverables:

a. A concept planning study report and associated drawings for up to three (3) feasible structure types, based on available and visually gathered information.
b. Cost estimates for the presented scenarios with as much detail as reasonable at the conceptual planning stage (Level A).

2 SITE DESCRIPTION

Hwy 16 (Yellowhead Trail) is a four-lane divided highway at the location of the BF74978 bridges, with two lanes in each direction that are offset 19.2 m (63 ft) each way from the median centreline to the centreline of lanes. The westbound and eastbound lanes are crowned at their centrelines and cross a pair of abandoned gravel and mine haul roads on three-span and four-span bridges, respectively. The roadway sits on a 3-4% longitudinal grade from west to east, and the bridge approaches are protected by a combination of straight and flared W-beam guardrails that range in length from about 90 m to 140 m. There is evidence of localized failures in the roadway side slopes and median ditch.

The bridges are about 73 m (240 ft) long measured along the roadway alignment and they sit on an approximately 20-degree right-hand forward skew relative to the haul road.

The haul road cut is approximately 69 m (226 ft) wide measured square from abutment to abutment of the bridges. The ground line consists of a 2:1 head-slope on the west side that drops the ground about 5 m (16 ft) to the elevation of the 6.7 m (22 ft) wide gravel haul road and then drops the elevation by about 3.4 m (11 ft) more via another 2:1 slope and some ditching to the elevation of the 12.2 m (40 ft) wide mine haul road at the bottom of the cut. The ground rises back to grade via some ditching and a 2:1 headslope on the east side. See attached record drawing 830-1.

Original bridge construction record drawing 830-1 shows a 1.2 m diameter drainage culvert running north-south along the middle of the mine haul road, buried approximately 3.8 m below grade. At some time in the past a 1.2 m diameter culvert has been installed along the middle and just below the surface of the mine haul road. The haul roads have a longitudinal grade of approximately 2% from north to south.

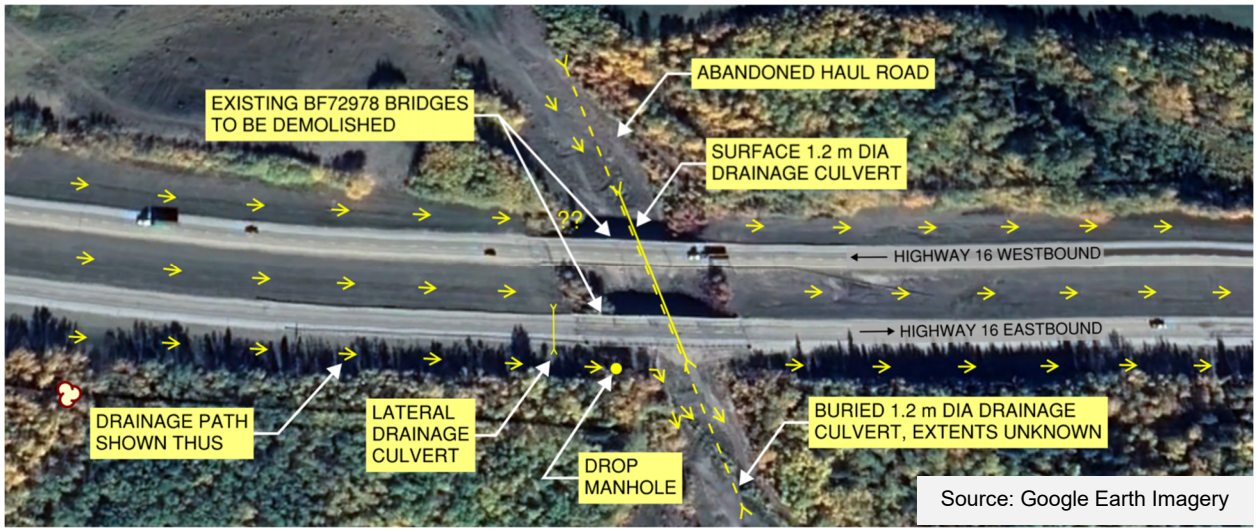


Figure 1: Aerial View of the Bridge Site

Reference record drawings of the existing bridges are attached in ***Appendix A.***

3 AREA DRAINAGE CONCERNS

Rainfall discharges off both sides of the crowned Hwy 16 roadways into the median and outside ditches and is conveyed eastwards towards the west end of the bridges where special drainage infrastructure has been installed, as described below. The runoff at the east end of the bridges drains harmlessly away from the end of the bridges.

A cut-off wall intercepts the water collected in the Hwy 16 median ditch and diverts it into a lateral culvert that discharges to the south outside ditch on Hwy 16 where it is again diverted into drainage infrastructure (including a drop manhole) that discharges into the deep buried 1.2 m diameter culvert that runs along the middle of the haul road alignment. The drainage infrastructure at this corner of the site no longer functions as intended, with parts missing and significant scour in the area caused by overland flow.

It is not clear where the Hwy 16 drainage from the north outside ditch on the west end of the bridges goes after it is intercepted by the cut-off wall shown on record drawing 7189-C 1. It is possible the water gets picked up and conveyed by buried drainage infrastructure to the deep buried 1.2 m diameter culvert that runs along the middle of the haul road alignment, similar to that for the south outside ditch, but there is no mention of this on the record drawings and no evidence was seen on site due to fairly heavy ground cover.

The abandoned haul road forms an integral part of the area drainage system and water from the catchment area north of the highway also needs to be accommodated through the new infill embankment. The volume of this additional water needs to be determined through an area drainage assessment. The drainage solution will consist of appropriately sized CSP culverts set along the sides of the haul road(s), constructed in accordance with AT Standard Drawing S-1418.

It is reasonable to expect that this drainage accommodation is part of AT's scope of work, but it will be necessary for the County to hold discussions with AT to identify their plans for the new infill embankment and drainage system and confirm responsibility for the area drainage assessment.

The existing semi-buried 1.2 m diameter culvert that runs along the middle of the haul road will likely need to be reconstructed/reprofiled to account for the settlement that will be caused by the infill embankment, and it will likely need to be relocated if a wildlife underpass is installed.

The significant scour along the haul road drainage margins that has resulted from the deterioration of AT's drainage system should be addressed in AT's scope of work. This should be confirmed by the County in its discussions with AT. Haul road ownership and easement agreements will be an influencing factor in the discussions.

Drainage in the median at the west end of the bridges could be problematic if the existing lateral culvert connection to the south drainage ditch cannot be retained. This could result in the need to construct a new drop manhole system draining to the buried 1.2 m diameter culvert, similar to the existing arrangement at the south ditch. Costs for a new manhole and connection are not included in this report.

The following photos are taken from various 2015-2017 bridge inspection reports prepared by Bow Valley Bridge Services Ltd and MPA Engineering Ltd, and the 2022 site visit by WSP:

Figure 2: Looking north, drainage ditch check dams

Figure 3: Looking south, drainage path & scour

Figure 4: Looking south, drainage culvert inlet

Figure 5: Looking north, scour at mine haul road

4 TARGET SPECIES

In the absence of data related to the species of interest at the crossing, this study has relied on anecdotal accounts that large ungulates such as deer/moose/elk have been seen in the area. Along with minimum height requirements, the target species informs the proportioning of the underpass structure based on generally recognized openness ratios. The minimum height requirement for large ungulates is 4.0 m.

Openness ratios approximate the amount of light that can be seen at the end of a wildlife passage and are species-specific. They are determined as the “height x width / length” of the crossing structure. Large ungulates will be reluctant to use the underpass if the openness ratio is too low.

A continuous underpass structure would be too long to meet reasonable openness ratio requirements and would present significant challenges for fire and life safety and wildlife-human and human-human interaction given the proposed mixed use of the installation.

While it is unknown whether amphibians and reptiles are present, it is reasonable to assume that they will be accommodated by the combination of wet drainage culverts and the dry underpass structure.

Figure 6: Looking north between the bridges, multiple animal tracks and skidoo tracks in the snow

5 UNDERPASS SCENARIOS

Different scenarios exist for the underpass depending on the desired level of wildlife connectivity and access for recreationists.

Based on direction from the County, the following scenarios have been considered:

a. **Scenario 1**: Drainage only / do nothing.

   Under this scenario, the existing wildlife connectivity and access for recreationists would be cut off.

   AT would accommodate the drainage needs of the area in their scope of work, although it is not known if an area drainage assessment of the catchment area to the north of the site is included in that scope.

   This scenario represents the least ecologically friendly option and will lead to an increase in wildlife-vehicle collisions as wildlife will inevitably try to cross the highway at grade. Some of the wildlife-vehicle collisions will result in wildlife and human injuries and possible fatalities, and major vehicle damage.

b. **Scenario 2**: Drainage and wildlife connectivity.

   Under this scenario, the existing wildlife connectivity would be maintained.

   AT would accommodate the drainage needs of the area in their scope of work, although it is not known if an area drainage assessment of the catchment area to the north of the site is included in that scope.

   This scenario jointly represents the most ecologically friendly option along with Scenario 3 and will maintain the status quo for wildlife-vehicle collisions at the site.

c. **Scenario 3**: Drainage, wildlife connectivity, and recreationist access.

   Under this scenario, the existing wildlife connectivity and recreationist access would be maintained.

   AT would accommodate the drainage needs of the area in their scope of work, although it is not known if that scope includes an area drainage assessment of the catchment area to the north of the site.

   Due to the compatibility of the size of structure required to accommodate large ungulates and the size of structure required to accommodate recreationists, there is no difference in the scope of work between this scenario and Scenario 2.

   This scenario jointly represents the most ecologically friendly option along with Scenario 2 and will maintain the status quo for wildlife-vehicle collisions at the site.

The layout and configuration for Scenario 1 is the responsibility of AT and is not included in this report.

The layout and configuration for Scenarios 2 and 3 are the same as each other and are shown conceptually as part of the feasible structure types on drawings SK-1, SK-2, and SK-3 that are attached in ***Appendix B.***

6 UNDERPASS STRUCTURE OPTIONS

The County's stated intent to utilize a low maintenance buried structure for the crossing informs the structure type as being a culvert.

While several culvert shape and size options are available in both steel and concrete, experience suggests that:

a. Closed-bottom culverts are more cost effective than open bottom culverts that require concrete spread footings or, in some cases, piled foundations.

b. Structural plate corrugated steel pipe (SPCSP) culverts are typically more cost effective than concrete arches and boxes for the size of structure that is contemplated for this site, typically require less lead time for fabrication and delivery, and are typically simpler to install. Cost differentiators include the extent and nature of site preparation, the size and type of equipment needed for installation, and the complexities related to loading, unloading, and transporting the individual structural components.

Large multi-lane highways with relatively wide medians, as is the case here, are well suited to separate underpass structures under each half of the highway. Based on the record drawings for the site, the overall width at the top of embankment is about 56 m. The overall distance between the toes of slope for the new infill embankment will depend on the sideslopes and ditching arrangements selected by the roadway designer. For the purposes of this study, 4:1 sideslopes have been assumed, with no mid-height ditching.

A geotechnical investigation will be required to confirm soil conditions and determine bedding needs for the culverts. The County should check with AT to see if they are prepared to share the results of the geotechnical investigation being carried out under their scope of work.

The vertical clearance beneath the existing bridges is posted at 6.9 m, which provides a lot of available space for a large size culvert for the wildlife crossing.

It is noted that Parks Canada uses elliptical SPCSP culverts to provide wildlife connectivity beneath roadways in the National Parks in Alberta and BC.

Figure 7: Looking north, vertical clearance beneath the existing bridges posted at 6.9 m

The following structural options have been investigated for maintaining wildlife connectivity and providing access for recreationists following removal of the existing bridges:

a. **Option 1**: Elliptical SPCSP closed-bottom culverts set under each half of the highway with a light well at the median to increase the openness ratio and make the underpass more appealing to wildlife.

   The light well will be created by continuing the bottom half of the culverts through the median and using retaining walls set into the median slopes to bring the ground back to grade.

   The ends of the culvert at the outside of the highway are beveled to avoid the need for retaining walls, and those at the median are vertical to maximize the size of the light well.

   Design life for SPCSP culverts in dry applications is 50 years.

b. **Option 2**: Elliptical SPCSP closed-bottom culverts set under each half of the highway with a light well at the median to increase the openness ratio and make the underpass more appealing to wildlife.

   The light well will be created by continuing the bottom half of the culverts through the median and using retaining walls set into the median slopes to bring the ground back to grade.

   The ends of the culvert at the outside of the highway are vertical and will require gabion headwalls and flared gabion wingwalls, and those at the median are also vertical to maximize the size of the light well.

   Design life for SPCSP culverts in dry applications is 50 years.

c. **Option 3**: Segmental precast concrete box culverts set under each half of the highway with a light well at the median to increase the openness ratio and make the underpass more appealing to wildlife.

   The precast boxes will be fabricated in two pieces (top and bottom) due to transportation constraints related to weight and dimensions.

   The light well will be created by continuing the bottom half of the boxes through the median and using retaining walls set into the median slopes to bring the ground back to grade.

   The ends of the culvert at the outside of the highway are vertical and will require gabion headwalls and flared gabion wingwalls, and those at the median are also vertical to maximize the size of the light well.

   The precast units could be procured as a design and supply item in the construction contract to leverage formwork and detailing efficiencies from the fabricator.

   Design life for concrete box culverts in dry applications is 75 years.

Each side of the highway will need guardrail or barrier protection at the wildlife underpass and the light well in the median will require 1.8 m high fencing to prevent wildlife from escaping from the underpass.

The three (3) options are shown conceptually on drawings SK-1, SK-2, and SK-3 that are attached in ***Appendix B.***

Examples of bear and large ungulate wildlife underpasses with similar layout and aesthetic features are shown on the next page. The culverts are in Banff National Park and the bridge crossing is located approximately half-way between Canmore and Dead Man's Flats on the TransCanada Highway. The grade difference at BF 74978 is greater than it is at these locations.

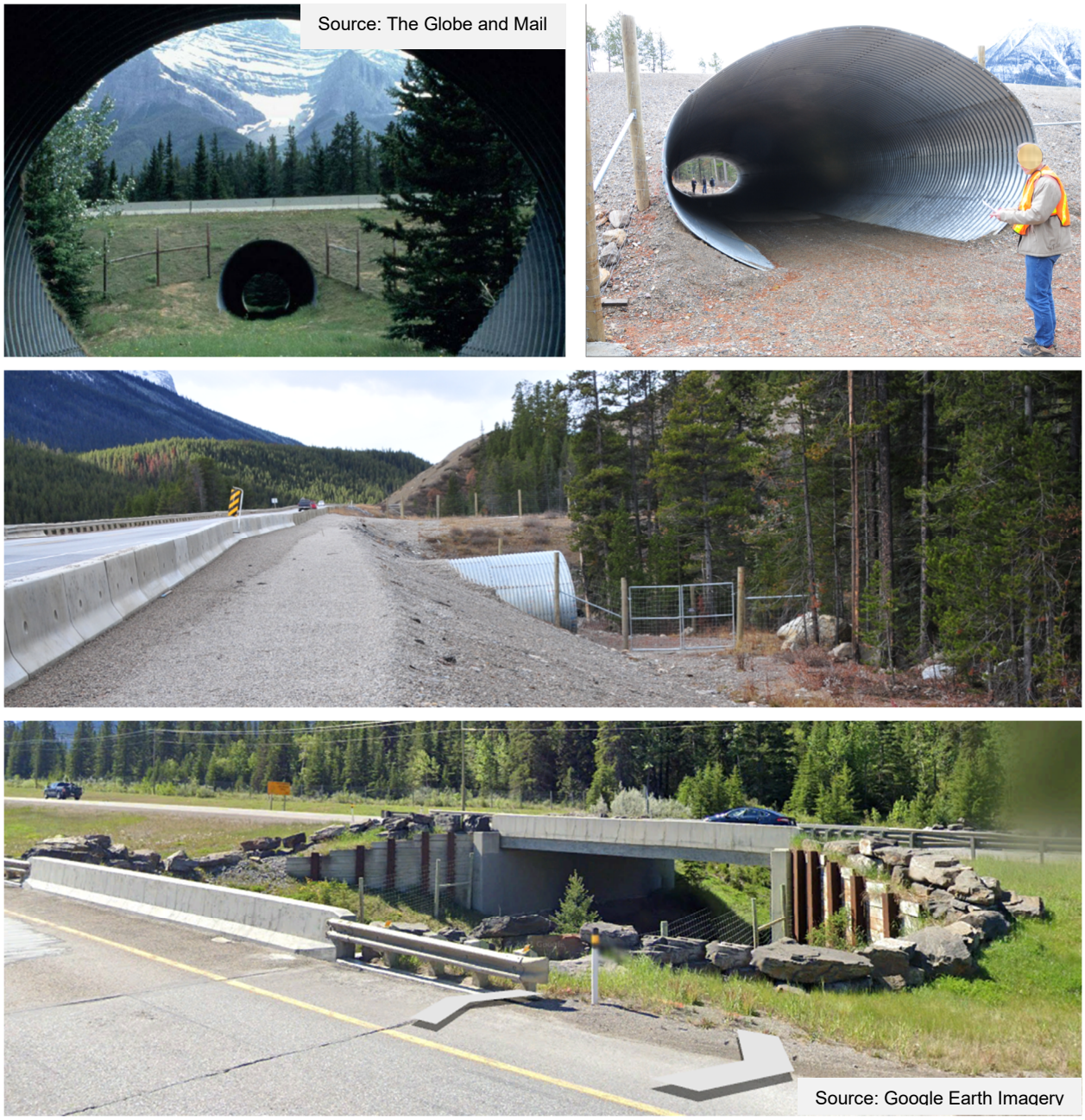


Figure 8: Examples of wildlife underpasses with similar layout and aesthetic features.

7 CONSTRUCTION COST ESTIMATES

Construction cost estimates have been assembled for the underpass structure options discussed above, with as much detail as is reasonable at the conceptual planning stage. The cost estimates are relatively high level and are intended for the purpose of comparing the construction costs for the respective scopes of work.

In summary, the estimated construction costs for the feasible underpass structure types presented above, including 10% contingency but exclusive of allowances for engineering and construction support, are:

a. **Option 1**: Elliptical SPCSP closed-bottom culverts with bevel ends $3.8M

b. **Option 2**: Elliptical SPCSP closed-bottom culverts with vertical ends $3.6M

c. **Option 3**: Segmental precast concrete box culverts $4.2M

The construction cost estimates are presented in greater detail in ***Appendix C***.

Since there are no 'moving parts' in buried underpass structures, not much is expected in the way of life cycle costs.

Regular maintenance and repair items typically include the highway guardrail or barrier which is the most vulnerable part of the installation needing regular or on-call attention, and the fencing around the light well will need to be kept intact and secure.

The wildlife corridor surface will also need to be regularly maintained to address any excessive internal ponding or detrimental build-up/loss of material resulting from the passage of motorized recreational vehicles.

8 CONCLUSION

Three feasible structural options have been investigated for maintaining wildlife connectivity and providing access for recreationists following removal of the existing bridges on Hwy 16 and filling of the abandoned mine haul road cut under a separate AT project.

The County should confirm the extent to which the concerns surrounding drainage in the overall area are being addressed by AT as part of their scope of work for removal of the bridges.

The context specific crossing concepts presented in this report consider the local ecological conditions, broader land use planning objectives, and the County's interests related to utilizing a buried structure for the crossing to minimize future maintenance and repair costs and avoid inconvenience to the travelling public during inspections and future interventions.

The culverts have been sized based on the concept of openness ratio for the target species of large ungulates (moose/elk/deer).

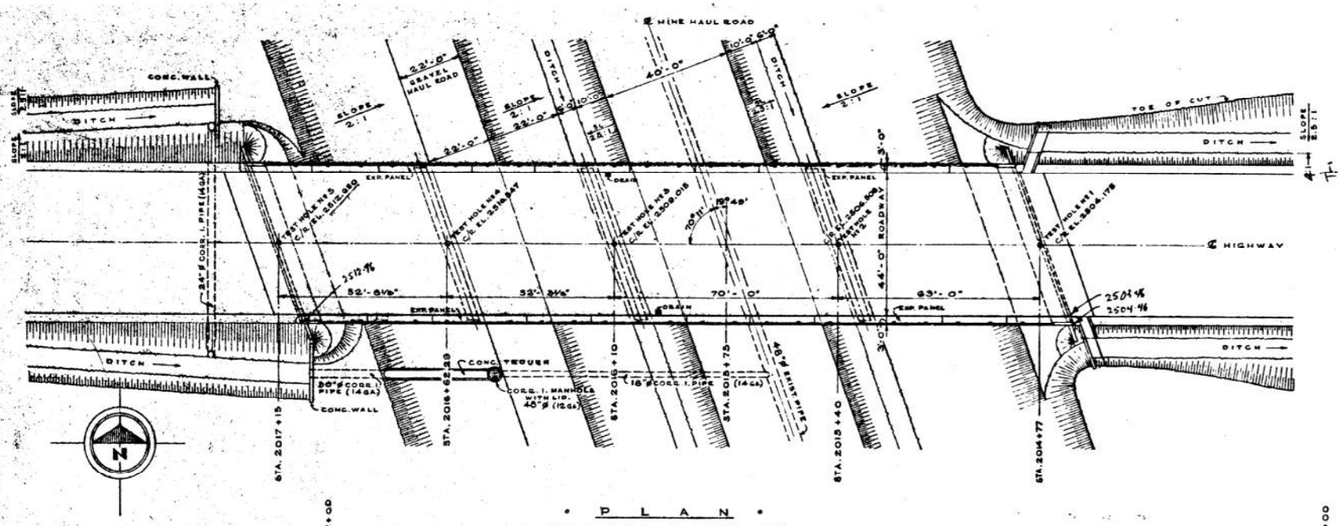
Feasible structure types include closed bottom SPCSP culverts and precast concrete box culverts for which high level pricing has been developed for the purpose of comparing the relative costs, exclusive of allowances for engineering and construction support.

Based on the concept costing exercise, the marginally least cost option for scenarios that include a wildlife underpass is Option 2 which consists of elliptical SPCSP closed-bottom culverts with vertical ends, set under each half of the highway, with a light well at the median to increase the openness ratio and make the underpass more appealing to wildlife. The other SPCSP option (Option 1) is similar in cost and the concrete box option (Option 3) is 10-15% more expensive.

APPENDIX

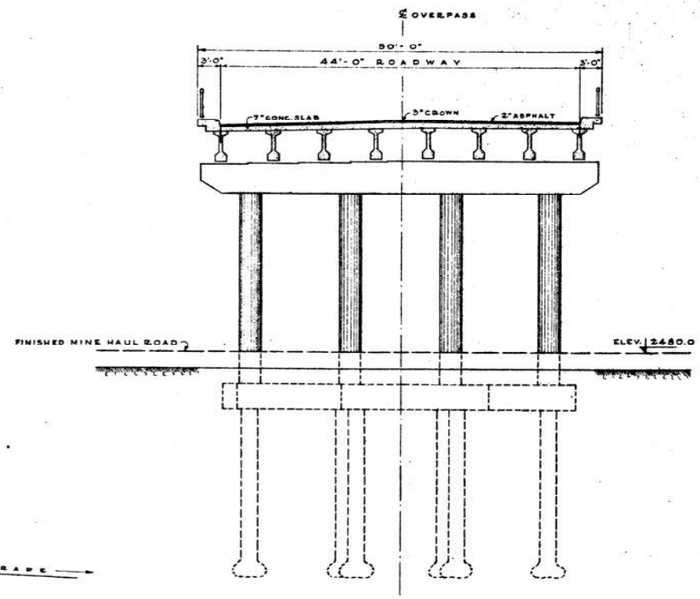
A

REFERENCE RECORD DRAWINGS



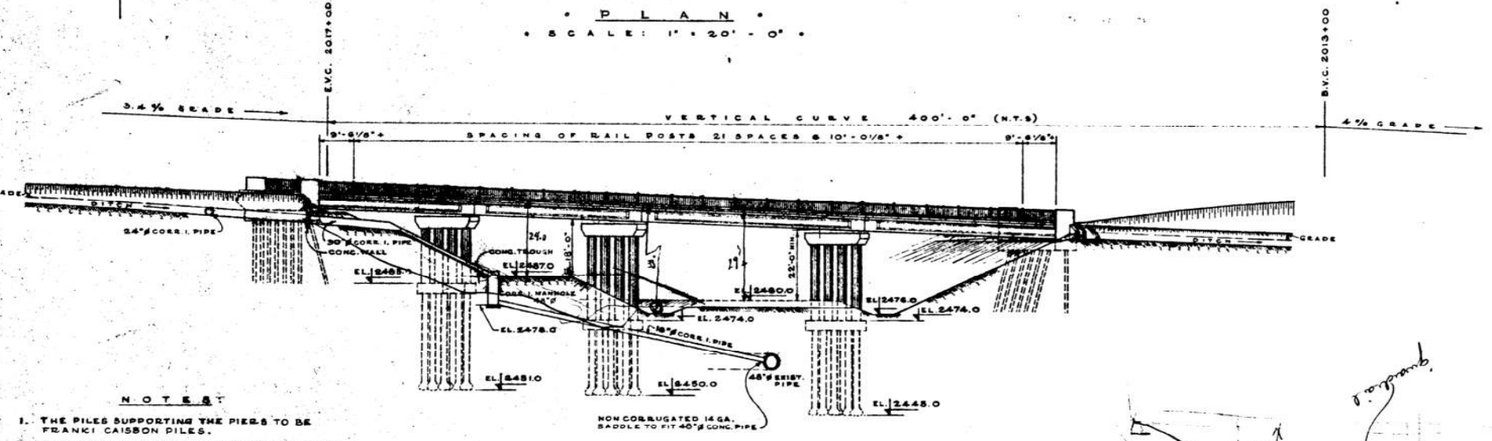
• P L A N •

• S C A L E : 1" • 20' - 0" •



• C R O S S S E C T I O N •

• S C A L E : 1/8" = 1' - 0" •

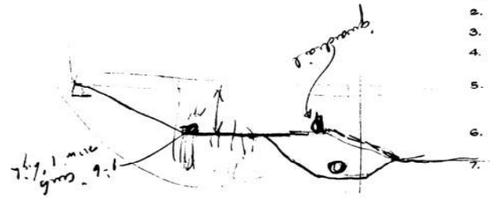


• E L E V A T I O N •

• S C A L E : 1" • 20' - 0" •

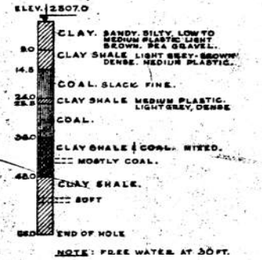
N O T E S :

1. THE PILES SUPPORTING THE PIERS TO BE FRANKI CAISSON PILES.
2. THE BOTTOM OF THE PILES IS THREE FEET BELOW THE TOP OF THE LOWER CLAY SHALE STRATUM.
3. THE ABUTMENT PILES ARE STEEL (10 BP 42) DRIVEN TO PRACTICAL REFUSAL.



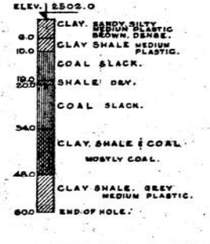
• G E N E R A L N O T E S •

1. SPECIFICATIONS A.A.S.H.O. SPEC'S 1957.
2. DESIGN LIVE LOAD H20 - S16 - 44.
3. DISTRIBUTION OF LOADS IN ACCORDANCE WITH A.A.S.H.O. SPEC'S 1957.
4. PRESTRESS DESIGN IN ACCORDANCE WITH "CRITERIA FOR PRESTRESSED CONCRETE BRIDGES" U.S.-DEPT. OF COMMERCE B.P.R. 1954.
5. DETAILING OF REINFORCED CONCRETE TO BE IN ACCORDANCE WITH THE "MANUAL OF RECOMMENDED PRACTICE FOR DETAILING REINFORCED CONCRETE HIGHWAY STRUCTURES A.A.S.H.O. AND C.R.S.I. 1950.
6. CONSTRUCTION JOINTS OTHER THAN THOSE SHOWN ON THE DWG'S MUST BE APPROVED BY THE ENGINEER.
7. ELEVATIONS TO C.N.R. DATUM. C.N.R. + 4.80 • DEPT. HIGHWAYS DATUM.



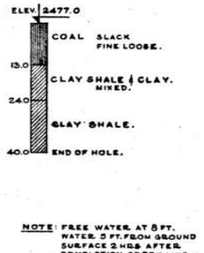
NOTE: FREE WATER AT 30 FT.

• T E S T H O L E N º 5 •



NOTE: FREE WATER AT 28 FT.

• T E S T H O L E N º 4 •

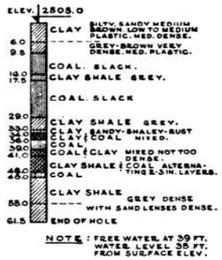


NOTE: FREE WATER AT 8 FT. WATER 5 FT. FROM GROUND SURFACE 2 HRS. AFTER COMPLETION OF DRILLING.

• T E S T H O L E N º 3 •

NOTE: FREE WATER AT 12 FT.

• T E S T H O L E N º 2 •



NOTE: FREE WATER AT 39 FT. WATER LEVEL 35 FT. FROM SURFACE ELEV.

• T E S T H O L E N º 1 •

7477P.

CB 9-1

APPROVED..... CHIEF BRIDGE ENGINEER. CB 9

• MONTREAL ENGINEERING COMPANY LIMITED •

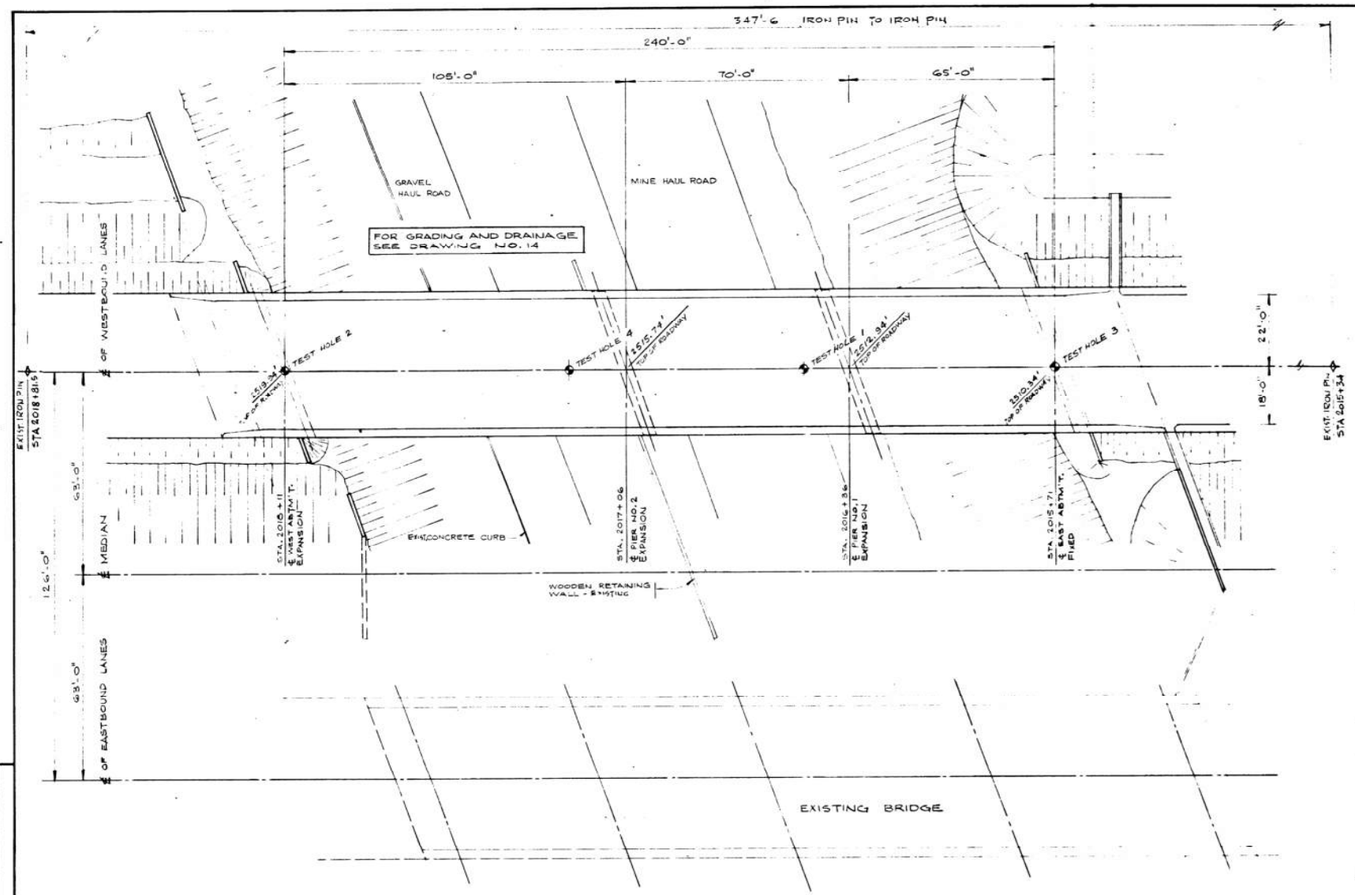
• HIGHWAY OVERPASS • FOR MINE HAUL ROAD WABAMUN COAL MINE

PLAN, ELEVATION, CROSS SECTION, TEST HOLES AND GENERAL NOTES.

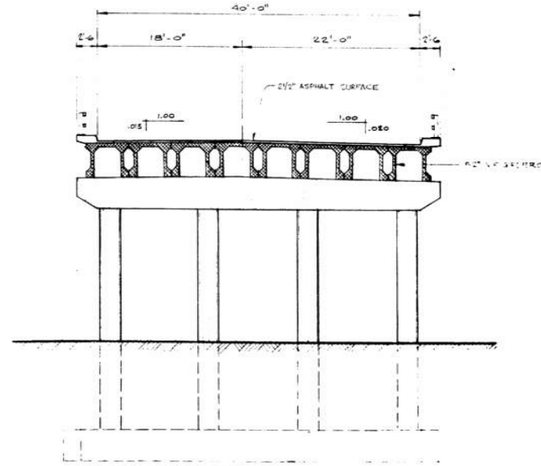
PROFESSIONAL ENGINEER D. A. DEWOLFE ALBERTA

STRUCTURAL ENGINEERING SERVICES LTD.
CONSULTING ENGINEERS
EDMONTON CALGARY

DWN. A.V.S.	SCALE AS NOTED.		FILE NO. 830		
CHKD G.D.A.	APPD.	DATE APRIL. 1959	DWG. NO. 830-1		



PLAN OF BRIDGE
SCALE : 1" = 20'-0"



TYPICAL CROSS SECTION
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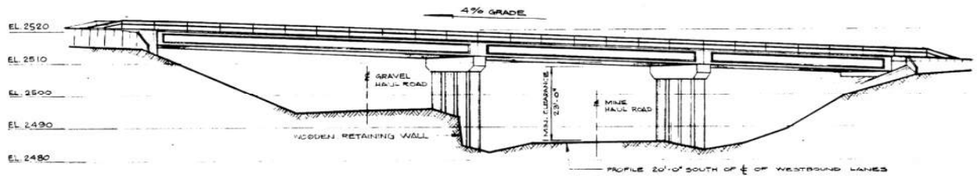

ELEVATION
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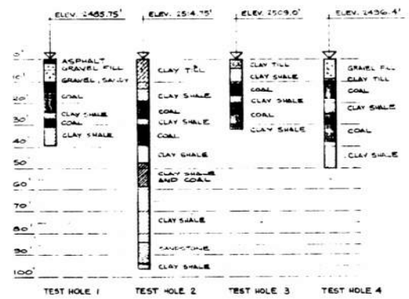


TEST HOLE DATA

DESIGN:

DESIGN IN ACCORDANCE WITH AASHO STANDARD SPECIFICATION FOR HIGHWAY BRIDGES - 1969 AND CSA STANDARD S-6-1966.

DESIGN LIVE LOAD — HS 25 PLUS IMPACT.

ELEVATIONS - ALL ELEVATIONS ARE GEODETIC AND REFERENCED TO GEODETIC BENCH MARK NO. 71-A-207 ON THE NORTHEAST CORNER OF THE EXISTING BRIDGE. ELEVATION OF BENCH MARK = 2507.33'.

ABUTMENTS:

PILING - PILES SHALL BE DRIVEN TO THE DEPTH OF PENETRATION INDICATED, OR PRACTICAL REFUSAL.

CONCRETE - ALL CONCRETE SHALL BE CLASS B.
- ALL CORNERS SHALL HAVE 3/4" (INCH) CHAMFERS.
- ALL REINFORCING TO HAVE 2" CLEAR COVER.
- THE TOP AND INSIDE FACE OF CURBS AND THE PAVING LIP TO BE GIVEN A CLASS 2 RUBBED FINISH. THE APPROACH SLAB AND ABUTMENT DECK SLAB SHALL BE GIVEN A CLASS G FLOAT FINISH. THE EXPOSED FACE OF ABUTMENT WING WALLS AND THE FRONT FACE OF THE ABUTMENT TO BE GIVEN A CLASS 5 BONDED SURFACE FINISH.

PIERS:

FOUNDATIONS - THE DESIGN BEARING VALUE ON THE UNDISTURBED COAL IS 10 KSF.

INVESTIGATION AFTER THE FOOTING EXCAVATION INTO THE UNDERLYING COAL SEAM IS COMPLETED, THE BASE OF THE EXCAVATION SHALL BE PROTECTED BY A 3" CONCRETE SKIN SLAB. THE FOOTING SHALL BE POURED NEAT AGAINST THE COAL FACE, AND SHALL BE COMPLETED WITHIN 48 HOURS (MAXIMUM) FROM THE TIME EXCAVATION IS COMPLETED. CONT'D.

SHOULD IT BECOME NECESSARY FOR THE EXCAVATION TO BE LEFT OPEN FOR MORE THAN 48 HOURS, THE SIDE WALLS SHALL BE PROTECTED BY A SHOTCRETE COATING.

CONCRETE - CONCRETE IN FOOTING TO BE CLASS C
- CONCRETE IN COLUMNS AND RAMPS TO BE CLASS B.
- ALL REINFORCING TO HAVE 2" CLEAR COVER ON SHAFT AND CAP, 3" ON PAD FOOTING.
- CIRCULAR COLUMNS SHALL BE FORMED USING SEAMLESS FIBRE TUBE FORMS.
- ALL CORNERS OF PIER CAPS TO HAVE 3/4" (INCH.) CHAMFERS.
- THE BOTTOM, SIDES AND END OF PIER CAP AND SURFACE OF CIRCULAR COLUMNS TO A POINT 12" (INCHES) BELOW GRADE SHALL BE GIVEN A CLASS 5 BONDED SURFACE FINISH.

PRECAST CONCRETE GIRDERS:

FOR GENERAL NOTES REGARDING PRECAST CONCRETE GIRDERS, REFER TO DRAWING NO. 6.

CAST-IN-PLACE CONCRETE CURBS:
- CONCRETE IN CURBS AND PAVING LIP TO BE CLASS D.
- FORM LINES FOR CURBS AND PAVING LIP SHALL BE SET WITH PROPER ALLOWANCE FOR ACTUAL CAMBER OF PRECAST GIRDERS AND CALCULATED SUPERIMPOSED DEAD LOAD DEFLECTION.
- THE OUTSIDE FACE OF CURBS AND EXTERIOR FACE OF PRECAST GIRDERS TO HAVE A CLASS 5 BONDED FINISH APPLIED AS A ONE-STAGE OPERATION.

ISSUED FOR	DATE	DESIGN	CHECKED	DRAWN	CHECKED
TENDER	JUNE 6, 1974	R.M.M.	R.M.M.	D.G.A.	W.L.D.

MK	DATE	REVISIONS
		Y.G. DUNIT

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF ALBERTA
PERMIT NUMBER P128
T. LAMB, McMANUS & ASSOCIATES LTD.

PROFESSIONAL ENGINEER R. M. MORISON ALBERTA

FILE 73-135
SCALE AS SHOWN
DATE JUNE 6, 1974
APPROVED

CALGARY POWER LTD.

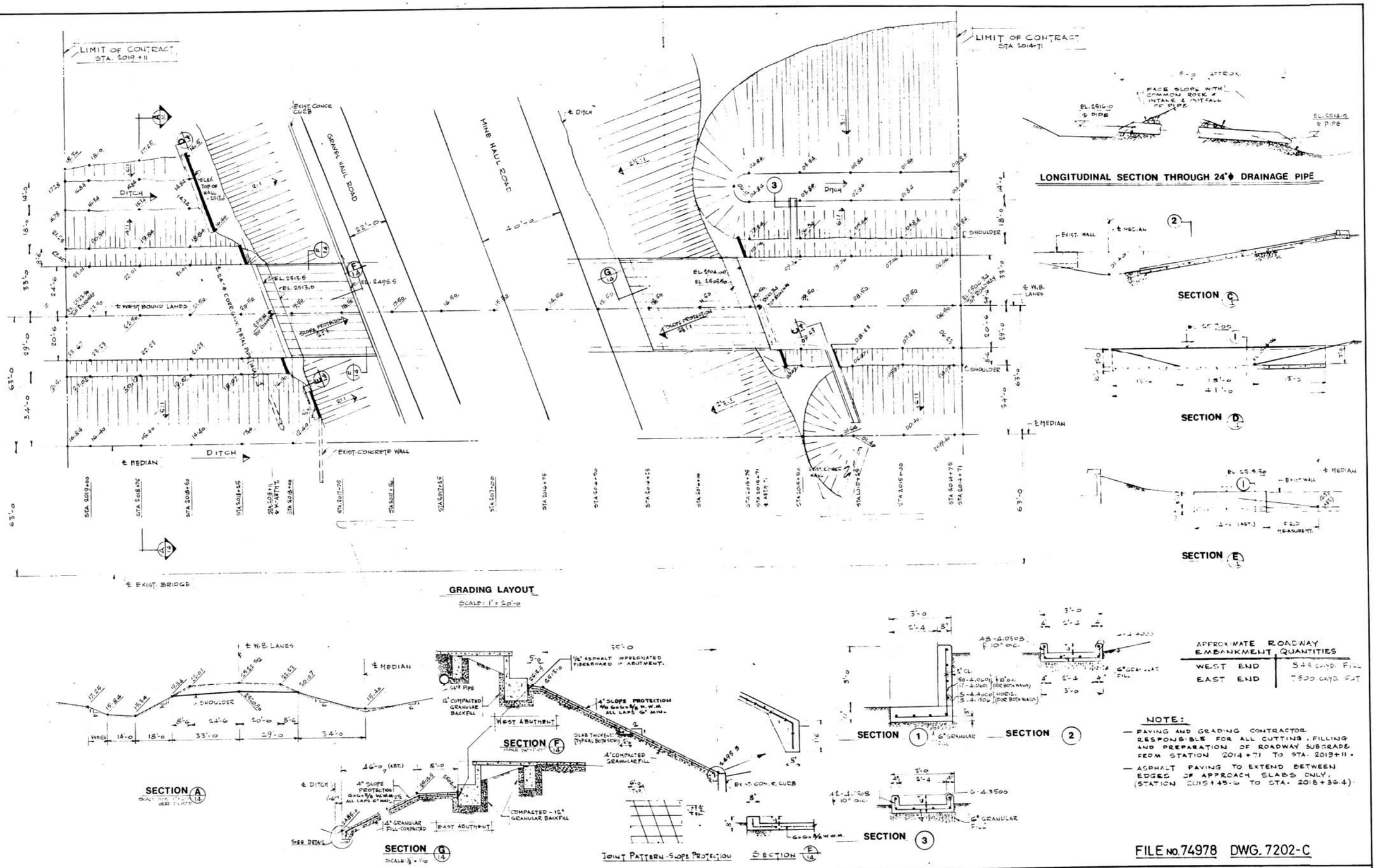
HIGHWAY 16 GRADE SEPARATION WEST OF WABAMUN

T. LAMB, McMANUS & ASSOCIATES LTD.
CONSULTING ENGINEERS
EDMONTON CALGARY WINNIPEG

DWG TITLE: GENERAL LAYOUT

DWG. NO. 1

FILE NO. 74978 DWG. 7189-C



ISSUED FOR	DATE	DESIGN	CHECKED	DRAWN	CHECKED
TENDER	JUNE 6, 1974	R.M.M.	R.M.M.	W.L.D.	W.L.D.

MK	DATE	REVISIONS
		— AS BUILT

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CALGARY POWER LTD.

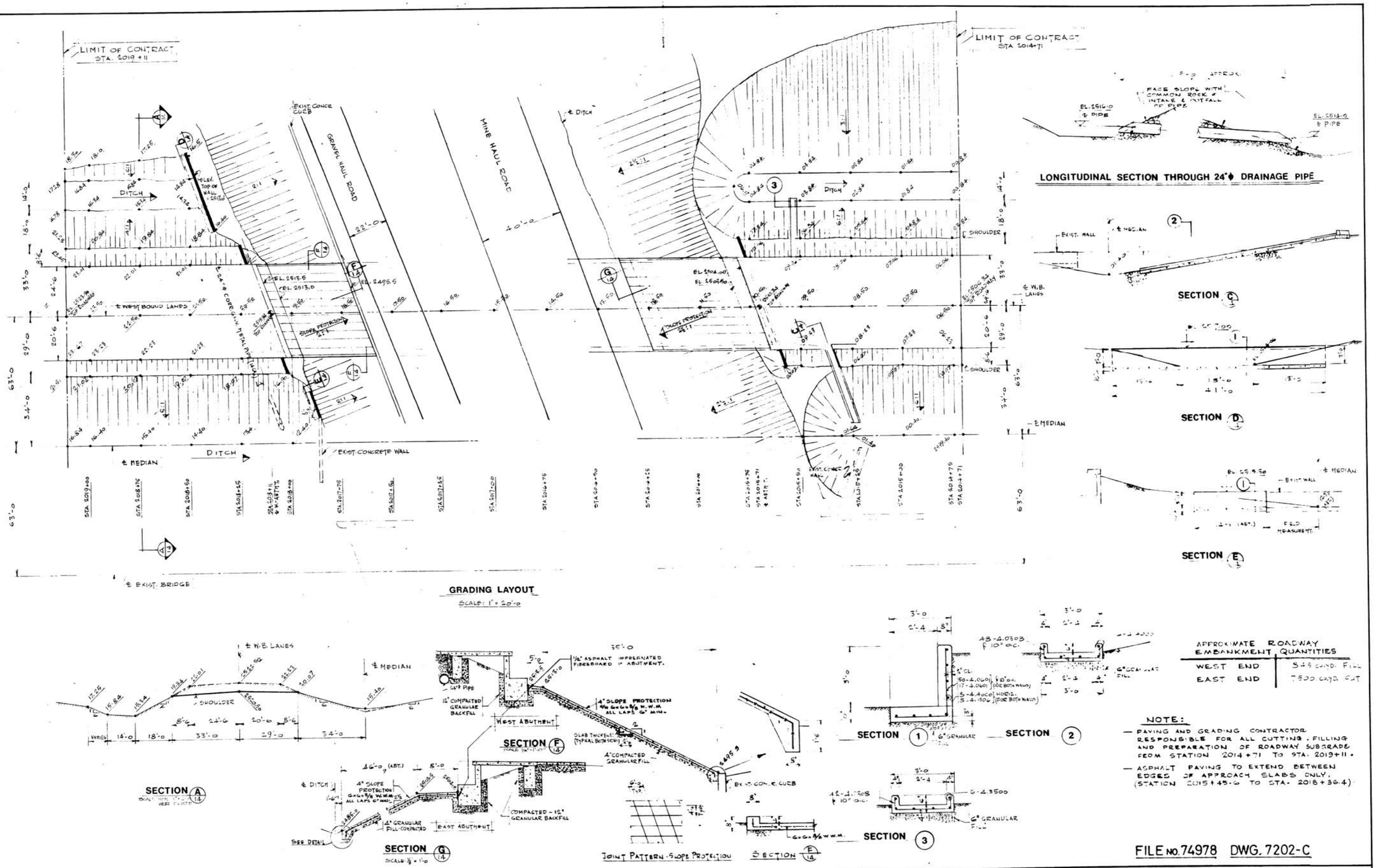
HIGHWAY 16 GRADE SEPARATION WEST OF WABAMUN

T. LAMB, McMANUS & ASSOCIATES LTD.
CONSULTING ENGINEERS
EDMONTON CALGARY WINNIPEG

DWG TITLE: GRADING, DRAINAGE, SLOPE PROTECTION

DWG. NO. 14

FILE NO. 74978 DWG. 7202-C



ISSUED FOR	DATE	DESIGN	CHECKED	DRAWN	CHECKED
TENDER	JUNE 6, 1974	R.M.M.	R.M.M.	W.L.D.	W.L.D.

MK	DATE	REVISIONS
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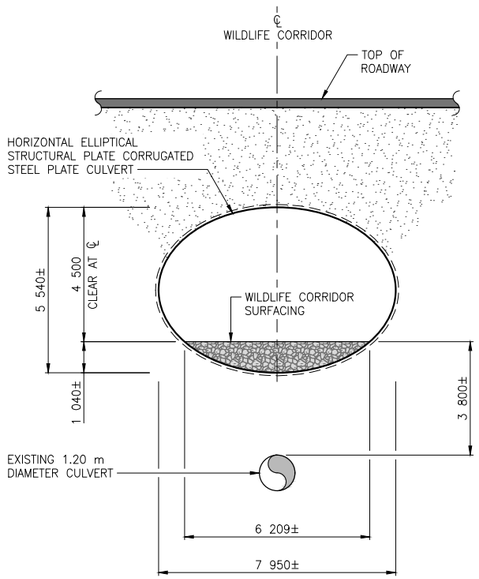
DWG. NO. 14

FILE NO. 74978 DWG. 7202-C

APPENDIX

B UNDERPASS CONCEPT SKETCHES



TYPICAL SECTION

(SECTION SHOWN AT ℄ WB HWY 16)
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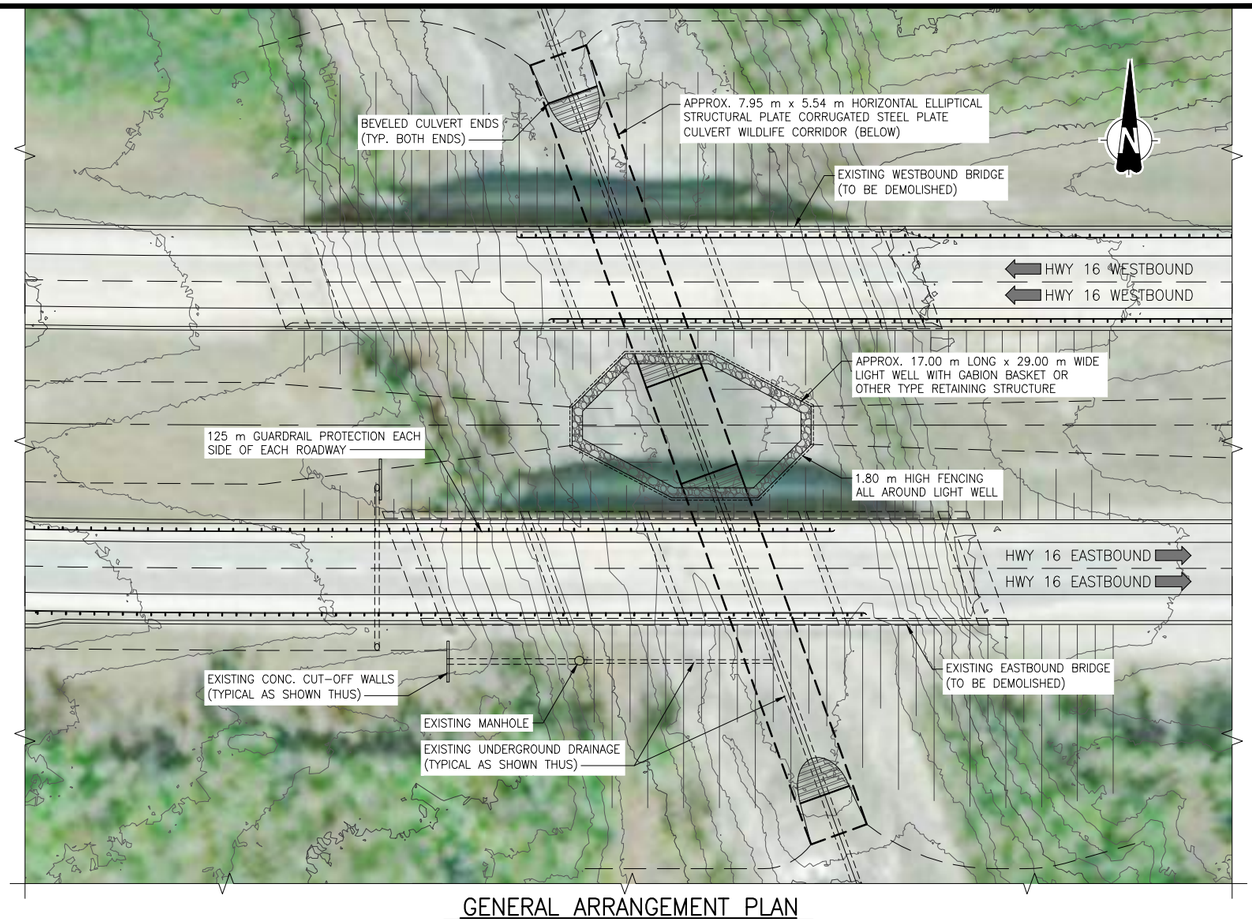
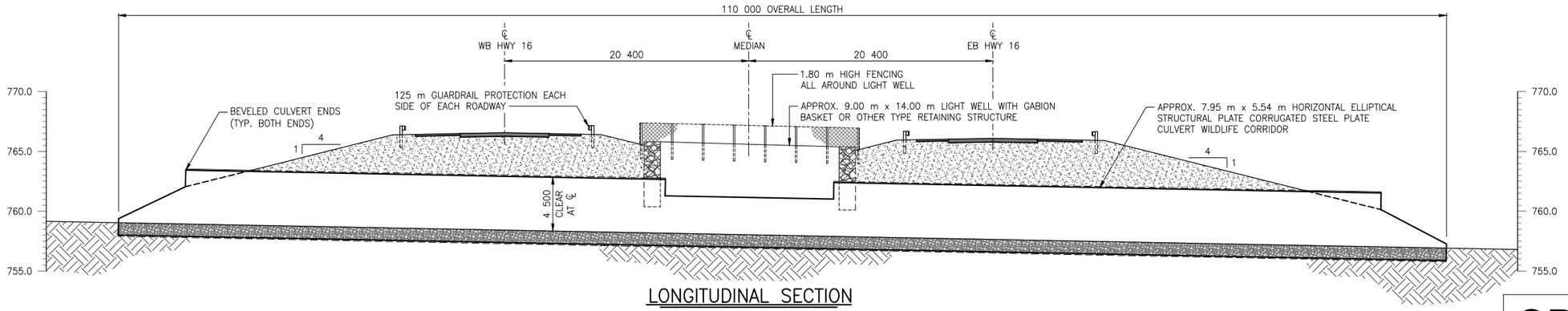


GENERAL ARRANGEMENT PLAN

SCALE 1:800



LONGITUDINAL SECTION

(SECTION SHOWN AT ℄ OF CULVERT)
SCALE 1:400

OPTION 1

PRELIMINARY
NOT FOR CONSTRUCTION

FOR DISCUSSION ONLY
JUNE 22, 2022

NOTE:
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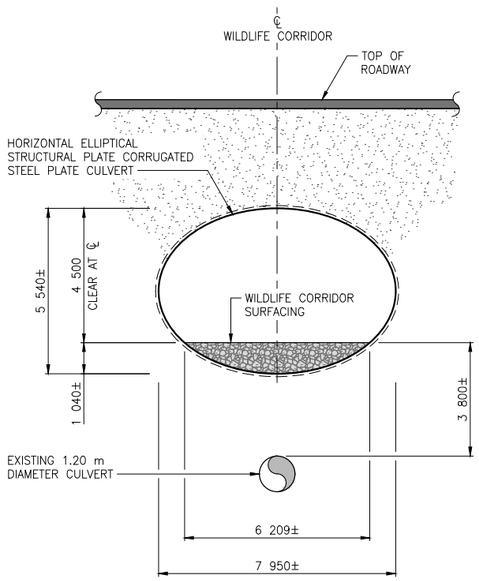
www.wsp.com

PARKLAND COUNTY

YELLOWHEAD TRAIL (HWY 16) WILDLIFE CROSSING

CONCEPTUAL ELEVATION AND TYPICAL SECTION

SCALE:	DATE:	PROJECT No:	DRAWING No:
AS SHOWN	2022-06-22	221-06005-00	SK-1



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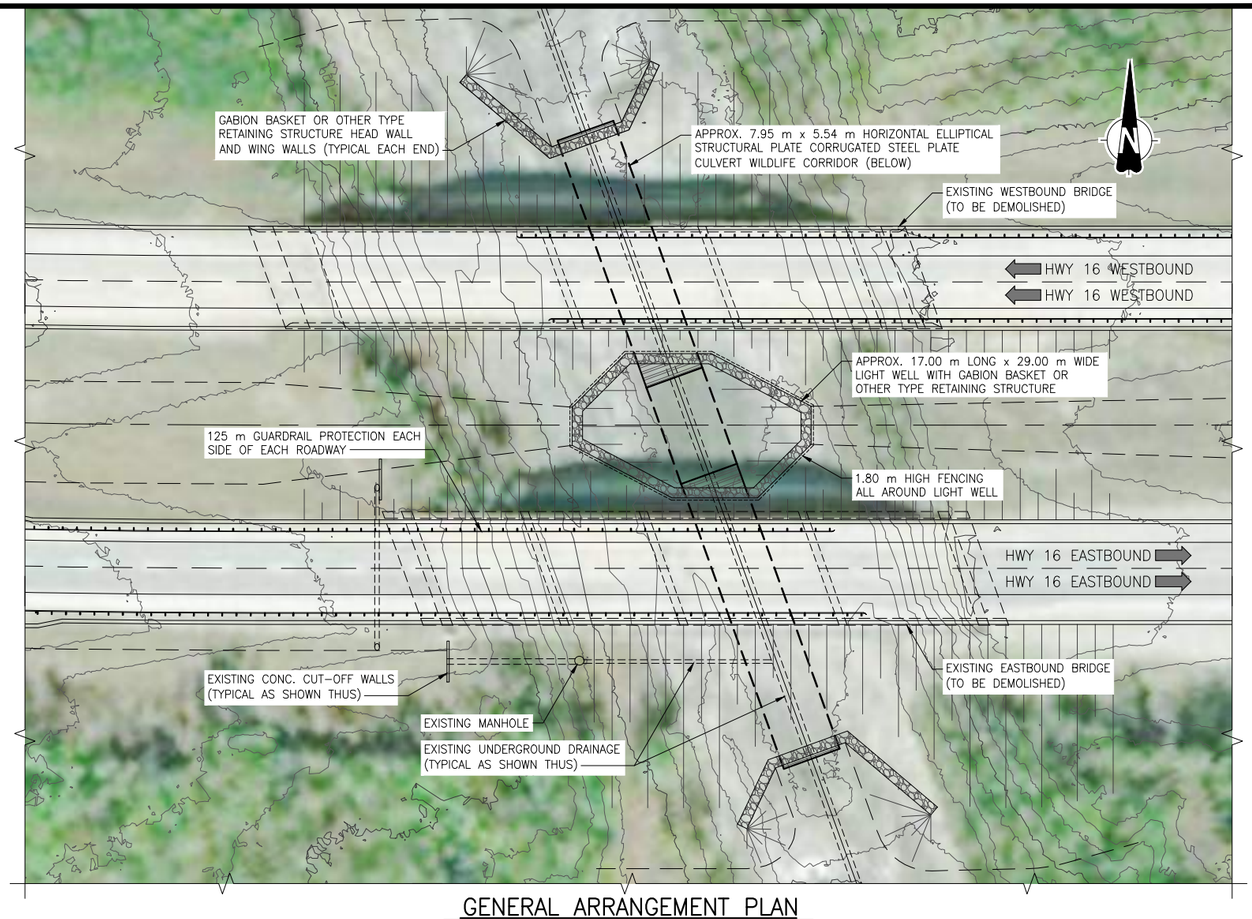
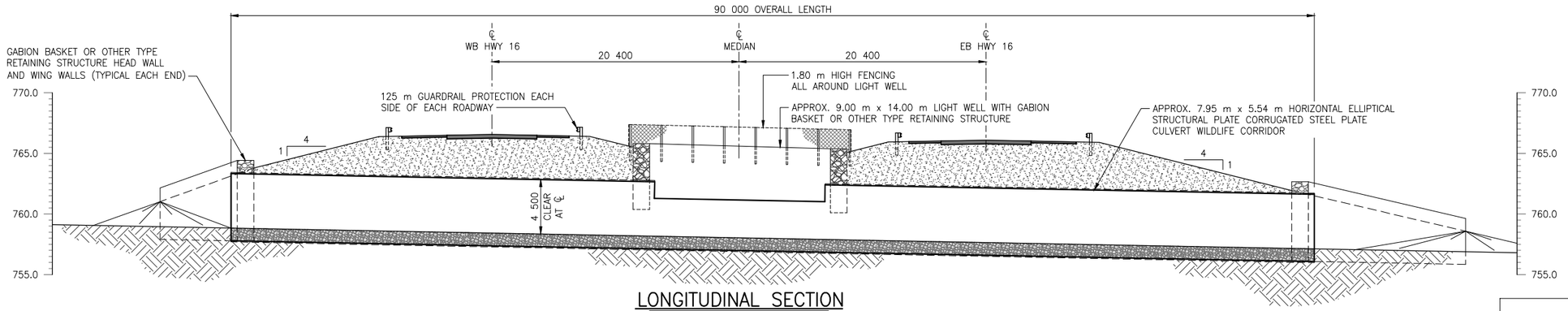


GENERAL ARRANGEMENT PLAN

SCALE 1:800



LONGITUDINAL SECTION

(SECTION SHOWN AT ℄ OF CULVERT)
SCALE 1:400

OPTION 2

PRELIMINARY
NOT FOR CONSTRUCTION

FOR DISCUSSION ONLY
JUNE 22, 2022

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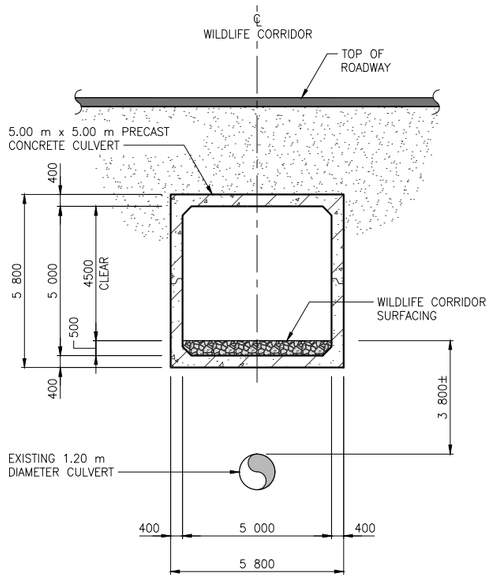
PARKLAND COUNTY

YELLOWHEAD TRAIL (HWY 16) WILDLIFE CROSSING

CONCEPTUAL ELEVATION AND TYPICAL SECTION

SCALE:	DATE:	PROJECT No:	DRAWING No:
AS SHOWN	2022-06-22	221-06005-00	SK-2



TYPICAL SECTION

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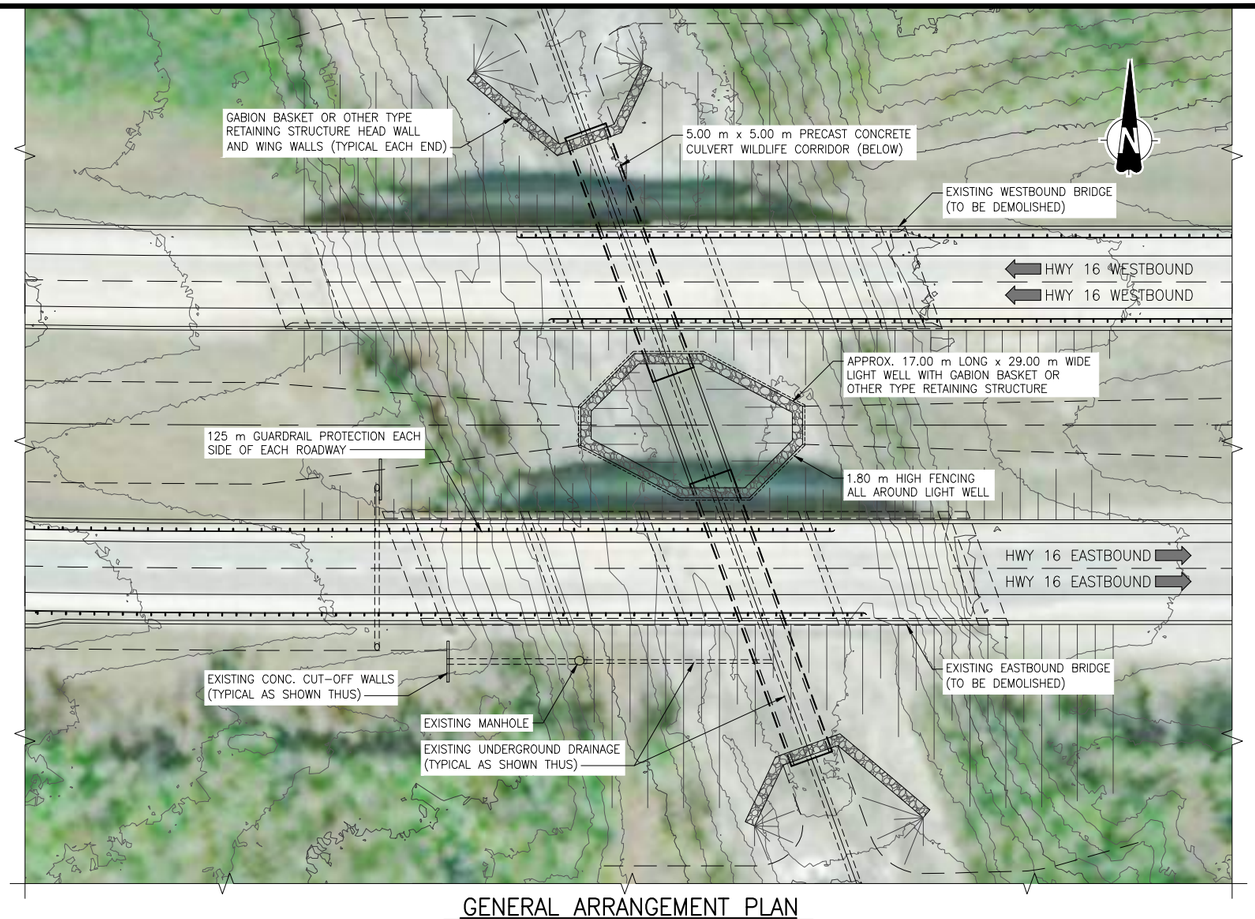
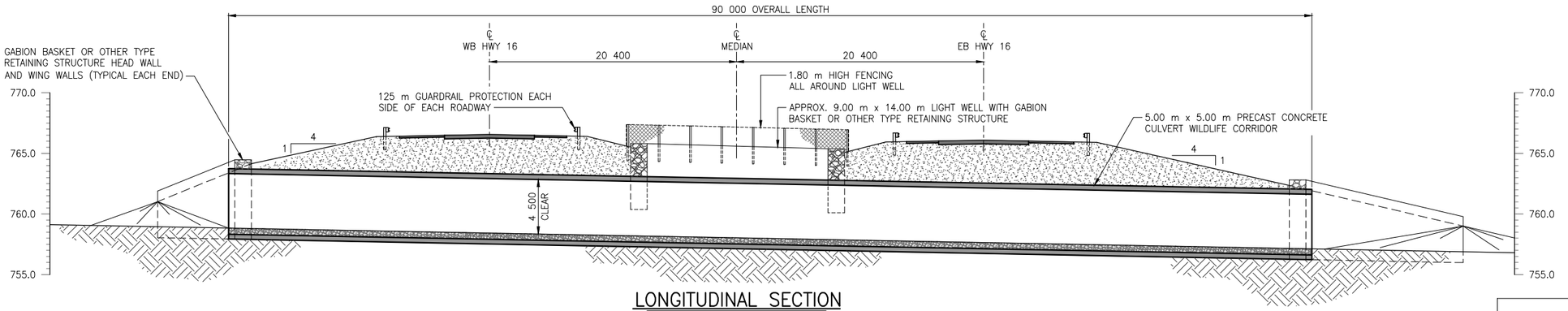


GENERAL ARRANGEMENT PLAN

SCALE 1:800



LONGITUDINAL SECTION

(SECTION SHOWN AT ℄ OF CULVERT)
SCALE 1:400

OPTION 3

PRELIMINARY
NOT FOR CONSTRUCTION

FOR DISCUSSION ONLY
JUNE 22, 2022

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PARKLAND COUNTY

YELLOWHEAD TRAIL (HWY 16) WILDLIFE CROSSING

CONCEPTUAL ELEVATION AND TYPICAL SECTION

SCALE:	DATE:	PROJECT No:	DRAWING No:
AS SHOWN	2022-06-22	221-06005-00	SK-3

APPENDIX

C CONSTRUCTION COST ESTIMATES

Parkland Underpass Study

June 23, 2022

Shihang (Kevin) Zhao

CONCEPT DESIGN COST ESTIMATE "A"
Option 1
221-06005-00 - Bridge Culvert Installation and Other Work
Wabamun Underpass, Wildlife and Pedestrian Crossing
Parkland County

2 - 7.95 m Span x 5.54 m Rise Inside Dia. SPCSP Culvert, 55.0 m Invert Length, 5 mm Thickness
152 mm x 51 mm Corrugation Profile, 915 g/m2 Galvanized Coating, Beveled Ends, Gabion Light Well

Design Items	Units	Quantity	Unit Price	Contract Amount
Mobilization	Lump Sum			$ 342,000.00
Excavation - Structural	m³	400	$ 50.00	$ 20,000.00
SPCSP - Supply	m	110.0	$ 13,000.00	$ 1,430,000.00
SPCSP - Assembly	m	110.0	$ 3,000.00	$ 330,000.00
Backfill - Granular	m³	7200	$ 90.00	$ 648,000.00
Concrete End Treatment	Collars	4	$ 35,000.00	$ 140,000.00
Gabion Light Well	Each	2	$ 155,000.00	$ 310,000.00
Guardrail Protection (Strong Post W-Beam)	m	500	$ 110.00	$ 55,000.00
Chain Link Fence (1.8 m)	m	150	$ 650.00	$ 97,500.00
Corridor Surfacing	m³	570	$ 90.00	$ 51,300.00
			CONTRACT COST	**$ 3,423,800.00**
OTHER COSTS		Contingency	10%	$ 342,380.00
			TOTAL CONSTRUCTION COST	**$ 3,766,180.00**

Parkland Underpass Study

June 23, 2022

Shihang (Kevin) Zhao

CONCEPT DESIGN COST ESTIMATE "A"
Option 2
221-06005-00 - Bridge Culvert Installation and Other Work
Wabamun Underpass, Wildlife and Pedestrian Crossing
Parkland County

2 - 7.95 m Span x 5.54 m Rise Inside Dia. SPCSP Culvert, 40.0 m Invert Length, 5 mm Thickness
152 mm x 51 mm Corrugation Profile, 915 g/m2 Galvanized Coating, Vertical Ends with Gabion Light Well

Design Items	Units	Quantity	Unit Price	Contract Amount
Mobilization	Lump Sum			$ 311,000.00
Excavation - Structural	m³	400	$ 50.00	$ 20,000.00
SPCSP - Supply	m	80.0	$ 13,000.00	$ 1,040,000.00
SPCSP - Assembly	m	80.0	$ 3,000.00	$ 240,000.00
Backfill - Granular	m³	7200	$ 90.00	$ 648,000.00
Gabion End Treatments - Supply and Install	Each	2	$ 178,000.00	$ 356,000.00
Gabion Light Well - Supply and Install	Each	2	$ 155,000.00	$ 310,000.00
Guardrail Protection (Strong Post W-Beam)	m	500	$ 110.00	$ 55,000.00
Chain Link Fence (1.8 m)	m	150	$ 650.00	$ 97,500.00
Corridor Surfacing	m³	420	$ 90.00	$ 37,800.00
			CONTRACT COST	**$ 3,115,300.00**
OTHER COSTS		Contingency	10%	$ 311,530.00
			TOTAL CONSTRUCTION COST	**$ 3,426,830.00**

Parkland Underpass Study

June 23, 2022

Shihang (Kevin) Zhao

CONCEPT DESIGN COST ESTIMATE "A"
Option 3
221-06005-00 - Bridge Culvert Installation and Other Work
Wabamun Underpass, Wildlife and Pedestrian Crossing
Parkland County

2 - 5.0 m Inside Square Concrete Precast Box Culvert, 45.0 m Invert Length, 400 mm Thickness Vertical Ends With Concrete Wingwalls, Gabion Light Well

Design Items	Units	Quantity	Unit Price	Contract Amount
Mobilization	Lump Sum			$ 378,000.00
Excavation - Structural	m³	400	$ 50.00	$ 20,000.00
Concrete Precast Box Culvert - Supply	m	90.0	$ 20,000.00	$ 1,800,000.00
Concrete Precast Box Culvert - Assembly	m	90.0	$ 5,000.00	$ 450,000.00
Backfill - Granular	m³	3700	$ 90.00	$ 333,000.00
Gabion End Treatments - Supply and Install	Each	2	$ 160,000.00	$ 320,000.00
Gabion Light Well	Each	2	$ 155,000.00	$ 310,000.00
Guardrail Protection (Strong Post W-Beam)	m	500	$ 110.00	$ 55,000.00
Chain Link Fence (1.8 m)	m	150	$ 650.00	$ 97,500.00
Corridor Surfacing	m³	250	$ 90.00	$ 22,500.00
			CONTRACT COST	**$ 3,786,000.00**
OTHER COSTS		Contingency	10%	$ 378,600.00
			TOTAL CONSTRUCTION COST	**$ 4,164,600.00**