



Bridge Standards and Procedures Manual

VOLUME 5

BEST PRACTICES FOR LOW-VOLUME ROAD STRUCTURES

October 2022

BRITISH COLUMBIA
Ministry of Transportation and Infrastructure

Contents

1 Acknowledgements

The following individuals were members of the working group which shaped the direction and core content of the Best Practices Guide:

Carl Lutz	Director, Structural Engineering
Gary Farnden, P.Eng.	Chief Bridge Engineer (former)
Alexandra Marriott, EIT	Structural Engineering
Karen Andrews	Regional Manager Maintenance and Rehabilitation
Mike Frazier	Area Manager, Bridges
Jerry Froese, P.Eng.	Manager, Traffic Engineering Policy and Standards
Eric Constantinescu, P.Eng.	Lead Geotechnical Engineer, Foundations
David Tracz, P.Eng.	Geotechnical Engineer
Theodore Hipol, P.Eng.	District Engineer (former)
Tomas Horalek, P.Eng.	Senior Asset Renewal Engineer (former)
Bill Becker, P.Eng.	Senior Asset Renewal Engineer
Marie Wood, P.Eng.	Asset Renewal Engineer
Khalid Khan, P.Eng.	Manager, Hydrotechnical Engineering
Robbie Kalabis	Regional Project Manager
Lyle Unwin, P.Eng.	Senior Highway Design Engineer
Grant Erickson	Area Manager, Bridges
Kevin Carter	Area Manager, Bridges
Stephanie Rothman	Senior Project Manager
Jonathan Tillie	Manager, Partnerships, Policy and Standards (former)
Marvin Jones	Area Manager, Bridges
John Babineau	Regional Manager Maintenance and Rehabilitation
Mikayla Arkesteyn	Area Manager, Bridges
Scott Hales	Area Manager, Bridges
Ian Baker	Manager, Bridge Construction
Mike Anderson	Bridge Construction Consultant Liaison

2 Forward

Low-Volume Roads (LVRs) and the structures on them form an integral part of the BC Ministry of Transportation and Infrastructure (MoTI) network which serve essential commercial, agricultural, recreational, industrial, and residential needs.

While some jurisdictions in North America maintain only high-volume highways, or alternately low-volume roads, MoTI's mandate extends across the spectrum of highway facilities. A nuanced approach to low-volume roads is required to reflect the differences in needs and scale of these projects in each locale.

A reasonable and economically sustainable approach to LVR structure projects has been developed by MoTI to address the challenges faced by these types of projects.

3 Introduction

The Best Practices for Low-Volume Road Structures was developed to assist project sponsors, professional engineers, Districts and project teams involved in the delivery of new or replacement structures with the primary objective of facilitating the process to determine an appropriate project scope.

MoTI recognizes that a one-size fits all approach to structures is not reflective of the diverse needs and challenges province wide. This document is intended to facilitate a consistent process while allowing flexibility for projects' needs and constraints to build safe and cost-efficient structures on low volume roads. MoTI strives to achieve best value for its projects and the Best Practices for Low-Volume Road Structures Guide will enable different disciplines to find safe and appropriate solutions

There are over 1100 bridges and 130 numbered culverts on low-volume roads. A context sensitive approach demonstrates that solutions different from high and medium-volume routes are appropriate and reasonable due the collective need for investment and attention on LVR structures.

4 Definition of a Low-Volume Road Structure

A Low Volume Road (LVR) structure is defined by BC Supplement to CHBDC S6:19 as a bridge or structure, as designated by the Ministry, on a side road with an average daily traffic ADT (for a period of high use) total in both directions, not exceeding 400. Numbered Routes are not considered as a Low Volume Road unless otherwise Approved.

The BC Supplement to CHBDC S6:19 is applicable to structure which have a span of 3 m or greater, or a height of 2 m or greater and is located on an LVR.

For projects where the traffic volume threshold is exceeded, the use of structural LVR standards may be used if a Design Exception is approved by the Chief Engineer. A Design Exception may be required for related highway design depending on the circumstances or site characteristics.

5 Project Planning, Initiation, Programming and Delivery Models

LVR structure projects typically evolve from the replacement of an existing structure due to service life concerns (e.g., deterioration requiring extensive remediation), or emergencies such as fires, floods and washouts.

Once the need for a project is identified, a project manager should be assigned, and a multi-discipline team formed to assist with project delivery. It is essential to clearly define the scope and extent of a LVR structure project early.

A site visit by all key team members in the early stages of the project (preferably collectively) to assess site-specific challenges and opportunities, is often a key step to the success of these type or projects.

5.1 Key Roles and Partners

The following outlines the roles of different project stakeholders including their focus for LVR projects.

Stakeholder	**LVR Projects Role**
Maintenance Contractor	• Plans and completes maintenance to preserve the life of the structure to prevent deterioration.
Bridge Area Manager (District)	• Collects information on stakeholder use, traffic volumes, environmental constraints, and political interests for consideration in LVR structure replacement options as members of the project team.
Road Area Manager (District)	• Provides local knowledge about stakeholders, conflicting activities, input on signage, pits that can be used for construction etc.
Asset Renewal Engineer (ARE)	• Works directly with the Manager Rehabilitation and Maintenance to develop and prioritize the program based on identified needs and current funding levels. • May act as consultant liaison engineer. • Provides technical support and recommendations on maintenance, rehabilitation, and replacement options.
Consultant Liaison Engineer(s)	• Procures and manages external consultants when required. • Reviews and assesses options and recommendations provided to the project team.
Manager Rehabilitation and Maintenance	• As project sponsor sets the project scope, schedule, budget in consultation with the project team. • In conjunction with the ARE identifies total program needs relative to budgets and provide program insights regarding affordability which will influence project scopes. • As Project Sponsor, works with the team to develop the project scope in advance of assigning a project. • Approves changes.
Project Manager	• Manages the project and the team. • Coordinates meetings to assess site conditions and LVR structure options.

	• Coordinates disciplines, documents LVR structure considerations, risks and options. • Coordinates required design exceptions and approvals with engineering. • Assesses delivery models as well as coordinate and deliver the project.
Professionals of Record	• Provides technical input on LVR structure replacement or alignment options and construction options. • Develops designs and procurement documents. • Provides technical details for design exception requests. • Signs off as EOR
Bridge Construction Supervisor	• Provide feedback on constructability options at options analysis or early design phase that may influence construction methods, improve efficiency, and reduce cost
District Transportation Manager	• Provides leadership to the district operation team • Assigns district resources to projects • Provides guidance for the overall objectives of a LVR structure project and reviews initial scope. • Reviews and provide feedback on proposed solutions and makes decisions related to district operational issues • Applies a lens of reasonableness, practicality and sensitivity to the local project given the social, political and economic impacts
Chief Engineer	• Reviews and approves Design Exceptions for LVR structure projects

5.2 Project Drivers

The following subsection are key project drivers that require consideration in the development of a LVR structure project.

5.2.1 Schedule

LVR structure projects often initiate from a rapid deterioration in condition, or due an emergency event such as flooding or fire. This can lead to and accelerated schedule requirement for design and construction completion. Project teams need to consider their ability to design, solicit, and construct within the schedule constraints of the project, and look for efficiencies through the design and construction process.

5.2.2 Team Resources

Project management, engineering services, district resources, and construction services are all generally fully utilized, and one-off LVR structures projects can be proportionately more time intensive during some stages of a project. In addition, team resources can often be distracted by higher profile or higher budget projects. It may be advantageous to carefully consider the construction schedule, complexity of design, or grouping projects to increase the effectiveness of the project team.

5.2.3 Indigenous Relations

LVR routes can be essential corridors for access to lands and communities or are located within boundaries of indigenous communities.

5.2.4 Properties

While often located in remote rural areas, property ownership and Right-of-Way (ROW) concerns can heavily influence the ability to reconstruct a structure or to realign a roadway. Careful thought must go into balancing any new design against what can be constructed in place without property acquisition, which can lead to unintended long-term challenges for Districts.

5.2.5 Local stakeholders

Projects can have unique needs defined by local stakeholders. For example, agricultural equipment may have unique clearance issues (e.g., very wide equipment is used, and bridge barriers or bridge width need to accommodate this) or the site may be an access to water used by the local community as a swimming/fishing hole.

5.2.6 Seasonality

There can be high variability in the daily or seasonal usage that may require special considerations for construction. Examples including agriculture, resource extraction, summer use cottages or recreation trail access may define when disruptions are not practical. Alternately, there may be extensive periods where there are limited or no need for access, and the road and structure may be able to be closed without the provision of a detour structure. District knowledge of user needs should be identified and shared at the onset of the project.

5.3 Project Requirements

Ministry Standards, Specifications and Policies that influence LVR Structures include:

- Standard Specifications for Highway Construction
- The Canadian Highway Bridge Design Code CSA S6, the Bridge Standards & Procedures Manuals, including the BC Supplement to CHBDC
- TAC Geometric Design Guide for Canadian Roads and the BC Supplement to TAC
- Environmental Best Practices

Provincially, the Water Sustainability Act and Regulations must be followed.

Federal Acts include:

- Species at Risk
- Navigable Waters
- Fisheries Act

These Acts are available online or through the relevant engineering groups. Additionally, engineering projects must follow the Professional Governance Act, and associated Bylaws and Guidelines.

5.4 Delivery models

A variety of delivery models are available for LVR structure projects. The scope, schedule, budget, and available resources will factor into the preferred delivery and procurement method or combination of methods to be utilized. The project team is responsible to ensure projects are delivered in the most efficient method and in accordance with Ministry procurement policies and procedures. For more information see Ministry's procurement and contracts information.

Strategies to combine project development or works to optimize the use of resources should be considered when it can be accommodated in the program.

5.4.1 Day Labor

Day labor projects are managed by a Ministry Representative. They often involve various procurement methods such as use of hired equipment and local minor works and services contracts to obtain materials and services such as traffic control or clear and grubbing advance work.

Pros:

- Can be coordinated relatively quickly
- For smaller scope of work, savings can be realized

Cons:

- Finding available Ministry Representatives can be challenging
- Ministry assumes contracting risk
- Long duration projects may require mid project changes in hired equipment due to utilization rules of day labor lists
- Resource intensive for internal staff for tracking, invoicing etc.

5.4.2 Tender (Minor and Major Works Contracts)

Definition - see procurement manual for current values associated with various contracts.

Pros:

- Competitive process
- Low demand for internal resources once awarded

Cons:

- Timelines need to account to time to tender, award and timelines determined by the contractor for delivery.

5.4.3 Design Build (Major/ Minor)

Contractor provides a detailed design based upon the requirements of a contract and reference design concept.

Pros:

- Less up-front engineering design required prior to tendering

Cons:

- Permitting can be challenging
- Limited ability to influence the design and final product
- Smaller contactors can be unfamiliar with the process, which can lead to higher bid prices and project challenges during delivery

5.4.4 Maintenance Contractor Additional Work

Design or construction activities are undertaken by or through the local Maintenance Contractor.

Pros:

- Can be simpler to initiate work in an expedient manner
- Flexibility in scope and schedule
- Potential lower cost and value added
- Local knowledge of area and community
- Permitting efficiencies that may already be in place with existing maintenance contract

Cons:

- Permitting can be a challenge
- Maintenance contractors may not be familiar with certain types of construction work or the design and approval processes
- Can be challenging to coordinate engineering reviews

5.4.5 ITQ (Purchasing Commission)

Purchase of products and components through a simplified quotation bidding system.

Pros:

- Products and components can be ordered in a reasonably simple process

Cons:

- Can be challenging to manage plant inspection activities
- Risk of fit up is transferred to the Ministry
- Risk of coordination of supply and delivery is transferred to the Ministry

6 Risk Assessment and Acceptance

Conservatism is the application of design standards in excess of those required by actual project warrants or blindly applying standards without consideration of alternatives. Conservatism can have significant implications for LVR structure projects including increase of scope and budget and should be avoided. In addition, LVR structure often have multiple conflicting constraints projects where small changes in standards can have large project implications. Project teams need to be cognizant of these types of constraints and make appropriate risk assessments of them to determine if alternatives or modification should be explored which can achieve project goals more effectively.

6.1 Risks

Project risks, both qualitative and quantitative should be identified for the development, delivery, construction, and operations phases of a LVR structure project. Once identified, a risk analysis should be completed to better understand the consequences of the risks relative to likelihood/probability of occurrence and their overall implications in the project decision and design criteria.

Consequences of risks can include effects related to likelihood of closure, downstream impacts, ability to restore access, alternate routes and maintenance and operations. It is important to understand what tools already exist within the Highway Maintenance Agreement that can help mitigate risks to the public

6.2 Decision Making and Risk Acceptance

Decision making and risk acceptance should be a collaborative effort by the project team, and it is essential that any decision making, and risk acceptance be clearly documented. Depending on the nature of the risks additional approvals may be required.

The District Transportation Manager is the owner designate for the road and therefore may have decision authority on many risk items, particularly with respect to functional, operational and maintenance requirement risks. However, their decision making is influenced by the project team's recommendations and guidance. Other factors can support decisions to deliver a project that does not meet minimum standards. These may include cost, scheduling, resourcing, competing priorities, and external commitments. The project team has an obligation to meet the needs of the owner, make them aware of the risks, so that an informed decisions can be made.

Risk items that involve deviations from design standards and guidelines may require additional approvals through the engineering groups, up to and including a design exception approved by the Chief Engineer due to the requirements of engineering bylaws.

7 Design Considerations

7.1 Hydrotechnical

In general, changes to watercourses can create permitting challenges and an approach which minimizes the disturbance is encouraged.

7.1.1 Design Flow

As described in the Bridge Standards and Procedures Manual – Volume 1, a reduced return period may be used for LVR Structures, however Water Sustainability Act requirements will also need to be considered.

7.1.2 Clearance / Freeboard

A reduced freeboard may be acceptable for structures on LVRs. There are in effect three criteria for defining freeboard, one relating to MOTI requirements for clearance over the design flow, one relating to revetment design (and related inspection clearance) and one related to watercourse navigation. While there is the ability to modify the first two requirements by consent and exception procedures, there is no ability to reduce the clearance/freeboard requirements required by Transport Canada under the Canadian Navigable Waters Act. Navigability assessments and approvals can be time consuming and should be done as soon as possible in a project. It is important to consider the potential for debris, ice and channel aggradation which may require a clearance greater than the minimum identified over the design flow. The consequences elevated approaches, including damming and redirection of drainage along with changes to ROW and property acquisition should be carefully assessed and discussed within the project team and the District.

7.1.3 Channel Protection and Riprap

Riprap supply can be challenging in certain geographic areas of the province and in general may not be readily available near a LVR project site, necessitating high transportation costs. Riprap installations should be optimized to protect the structure, and extensive channel training should be avoided, as the cost of channel work can be significant relative to the whole project and pose additional construction and permitting challenges.

Where appropriate, alternatives to rip rap, such as articulated concrete block mats or proprietary systems such as A-Jacks concrete armor units can be considered.

7.2 Design Life

Reduction in design life relative to typical standards (e.g., 75 years for structures or 100 years for serviceability calculations) do not generally materialize in meaningful cost savings, and have consequential effects on future maintenance and operations, negating the marginal savings that may occur at initial construction and are not recommended.

7.3 Design Loads

Reduction in design loads (e.g., the design truck) relative to CSA S6 and the BC Supplement the CHBDC S6 do not generally materialize in meaningful cost savings and are not recommended. A reduction would require a design exception. The actual/forecast traffic volumes and the related highway class identified in CSA S6 should be considered for items such as fatigue design.

7.4 Types of Structures

7.4.1 Prefabricated Systems

LVR structures generally lend themselves to the advantages of prefabricated systems such as Ministry standard prestressed box girders, precast deck panel and steel I girder systems, precast cap beams and abutments. Such systems avoid issues with long distance concrete haul and generally allow for work to be completed in advance of the site construction windows. The size of components should be assessed with respect to the size of equipment required for installation and for weight and dimension limitations for transportation. Accelerated on-site construction results in site supervision cost savings, decreases road user impacts and increases the likelihood of eliminating the need for a detour bridge.

7.4.2 Two-girder systems

Two-girder systems (like common those used for forestry and industrial bridges) have been utilized on LVRs successfully where there is limited need for deck width. Typically, a 4.88 m clear width is the minimum that can be used for Ministry LVRs, and while slightly wider decks can be accommodated, the precast deck panels can become unwieldly due to size and weight. Note that Consent per the BC Supplement to the CHBDC is required for the typical "cluster" style shear connectors, and for the interconnections between panels.

7.4.3 Traditional cross tie and plank deck systems

Traditional cross tie and plank timber deck systems should be avoided due to their short service life, and issues with premature girder deterioration.

7.4.4 Non-composite deck systems

Composite deck systems are more structural efficient than non-composite decks. If a non-composite deck is used, additional attention should be paid to the connections for the deck systems to ensure long term durability.

7.4.5 Buried Structures

Buried structures, including soil-metal, metal box and reinforced concrete structures, can be viable options for LVR structures, though debris concerns may require increased hydraulic clearance and the use of trash racks.

7.4.5.1 Closed bottom

While closed bottom structures have historically been economical options for replacement of a LVR structure, careful consideration of environmental requirements is required. Recent projects have required additional bury depth for fish passage, on the order of 40%, which significantly increases the amount of site excavation and the overall size of the structure.

7.4.5.2 Open Bottom

Open bottom structures require special consideration primarily around the foundation systems. Spread footing, protected spread footing (using sheet piles for example) or piles foundations are all viable options. Spread footing options will require a design exception, but generally receive favorable reviews when the risks have been identified and mitigated adequately relative to the potential economic advantages of a system.

7.5 Barriers and Approach Flares

Barrier systems and requirement for flares at structures should be per the requirements of the BC Supplement to TAC. Short, paved approaches just for the use of precast barriers should be avoided (if located on a gravel surfaced road) and the use of post and beam barriers are more common on LVRs.

7.6 Foundations & Geotechnical Systems

7.6.1 Embankment Slope Consequence factors

Use of low consequence factors for embankment (side of road) slopes at LVR structures may be appropriate, as regrading activities can address issues that occur in the future, particularly if under 5 m in height. Modifications to the abutment slope consequence factors are generally not advised, unless it can be demonstrated that the damage to the structure can be prevented, and mitigating strategies can be put in place to address issues of slope maintenance and issues related to loss of fill behind an abutment.

7.6.2 Foundation Types

7.6.2.1 Piled

Piled foundations have been used successfully on LVR structures. Designers should consider the use of smaller pipe piles, micro-pile and H-piles where practical as this reduces the size of equipment required on site. Smaller diameter pipe piles also tend to form plugs easier than large ones. Concrete infill should be avoided.

While a minimum of three piles per abutment is desirable from a redundancy basis, two piles have been used on occasion where consideration of the loss of redundancy and challenges with settlement are accounted for and consented to by the Ministry.

Pile design should consider typical pile lengths as splices should be avoided where possible.

7.6.2.2 Spread footing

Spread footing foundations may be used for LVR structures, subject to a Design Exception being accepted. Past design exceptions have been issued for both the use and modifications (reductions) of the bury depth. Note than some projects have determined that the cost of piled foundations were comparable to spread footings. Site specific soil conditions and equipment limitations are factors.

7.6.2.3 Geotextile Reinforced Soil (GRS)

Geotextile Reinforced Soil foundation systems may be considered for the abutments of LVR structures but shall be installed at a depth below scour and shall be adequately protected from flow. Use of GRS for a structure abutment will require a Design Exception. GRS can be used for wall structures (away from a bridge or buried structure) where there is no watercourse without the use of a Design Exception.

7.6.3 Settlement

A significant majority of LVR structures are single span, which are inherently tolerant of relative settlement between abutments. In addition, gravel surfaced roads can be easily regraded when required. Consideration of increased settlement should be a collaborative discussion between the project team

7.7 Roadway Design

7.7.1 Ambient Conditions

When considering the design speed and geometry, consideration should be given to corridor consistency and not for a specific site alone. Improvements to a site out of context with the approach roads, such as defaulting to an 80 kph design speed, may be unwarranted, unless there are foreseeable changes in roadway use.

7.8 Traffic Accommodations/Detours/Closures

Traffic accommodation for LVR structures can add significant cost to a project. Where possible, it is often beneficial to either close the road temporarily (if volumes permit) or reconstruct on a revised alignment rather than using a detour bridge.

7.9 Single Lane Structures

Single lane structures have been used successfully on many LVR structures and should be encouraged where adequate sightlines are available, and the proposed width is appropriate for the corridor use and needs. Winter maintenance requirements should be considered where high accumulations of snow occur as there can be challenges with the wide and oversized equipment on single lane structures.

8 Option Assessment and Multiple Account Evaluation

Options Assessment and Multiple Account Evaluation (MAE) or are exercises for all parties involved to identify all requirements of a project and optimally satisfy all needs. Involved parties typically include the Sponsor, and representatives from Environment, Structures, Hydrotech, Geotech, Highway Design & Geomatics, Traffic, Indigenous Relations, Properties, and District. The project manager is responsible for ensuring the options assessment or MAE is completed with input from project staff. A MAE addresses major project questions early on to avoid major design changes at later stages.

9 Peer Review and Project Validation

Peer reviews are undertaken to assess the appropriateness of a proposed solution, reduce lifecycle costs, enhance constructability, and reduce risks as part the Value Analysis (VA) and Value Engineering (VE) Process. The VA review is an opportunity to analyze and modify the scope or content of the project to ensure its in line with the expectations of a LVR project and the ambient conditions. The VA review will objectively identify the costs and benefits of various planning and design options. The VE is on engineering components and constructability. The VE reviews the costs and benefits of how the project is to be built by obtaining the most cost-effective materials and specifications as well as a review of constructability issues and associated elements such as traffic management. Reviews can be scaled to the complexity of individual components of a project.

While not mandatory for typical LVR structure projects due their value, VA/VE reviews are recommended. A VA review should be initiated by the Project Manager during the planning phase prior to detailed design work. Although the planning phase may be brief in an LVR project, it should occur, nonetheless. The VE review should be initiated by the project manager after concept design (100% preliminary) but prior to 50% detailed design. At this stage, consideration should be given to code compliance and options for Design Exceptions or ministry consent/approval items that could significantly optimize the project. Particularly for LVRs, the ambient condition and future use of the corridor should be considered with early involvement of district staff.

The Project Manager is responsible for mandating that a peer review occurs and is documented. It is recommended that the review receive input from an Engineering Manager or senior engineer with experience in the area and by the local District representative to ensure ambient conditions are considered and the design will meet user needs. LVR structure peer reviews will be smaller, in scale r than a typical highway project often utilizing in-house review by local regional staff. Recommendations should be reviewed by the team, but do not need to be implemented. Documentation must occur and can be in email format using a standard review form and stored in the project folder.

10 Design Exceptions and Consent Items

The Ministry of Transportation and Infrastructure (MoTI) has adopted standards for the design of structures under its jurisdiction, which outline the expectations and minimum requirements for designers for the scope of their work.

Technical Circular T-05/18 – Design Exception Process identified the requirements whereby consent and design exceptions can be sought, which are further clarified in the Guideline for Structural Engineering Design Exceptions and Consent Items

Design Exceptions are intended to document decisions related to risk and capital expenditure and should be assessed on LVR structure projects at an early stage in the project.

11 Construction Considerations

LVR Structures often have additional challenges relative to structures constructed on numbered highways.

11.1 Access & Site Considerations

Material supply and transport can be challenging for many LVR structure projects. Ready mix concrete and/or asphalt mix is often not available and component size may be limited by the roads accessing the site.

Site laydown, storage and working space can be significantly constrained.

11.2 Design Considerations

Design and components should be kept simple. Use of standard component is encouraged, and customization should be avoided. Site work and duration should be kept to a minimum to reduce traffic control, construction, and construction supervision costs. Designs should consider equipment efficiency, where one piece can do multiple tasks. When multiple projects are occurring in the same district, details should be consistent from structure to structure where practicable.

11.3 Contract Considerations

Careful thought should be given to Engineer of Record's hold and witness points and pre-construction meeting(s) for LVR projects due to their typically shorter duration. Understanding that time is of the essence when the contractor is onsite; however, providing a reasonable schedule including milestones is important in developing a contract. Careful assessment of the need and content of Contractor submittals is required, particularly where review cycles are involved such as shop and erection drawings. Traffic Management Plans requirements should be assessed for simplification if possible.

11.4 Supervision Considerations

Fulsome construction supervision is still recommended; however, it is important to look for reduced process tasks. Critical review on a project-by-project basis is recommended, and efficiencies between Ministry Representative and EOR(s) should be identified. If possible, look for opportunities to deliver multiple sites that may be near each other. Post construction documentation should follow typical processes (as identified in the Bridge Standards and Providers Manuals) and be completed in a timely manner.

12 Project Examples

The following projects are some recent examples of LVR structure replacements which have been viewed as being successful by the project team, District and project stakeholders.

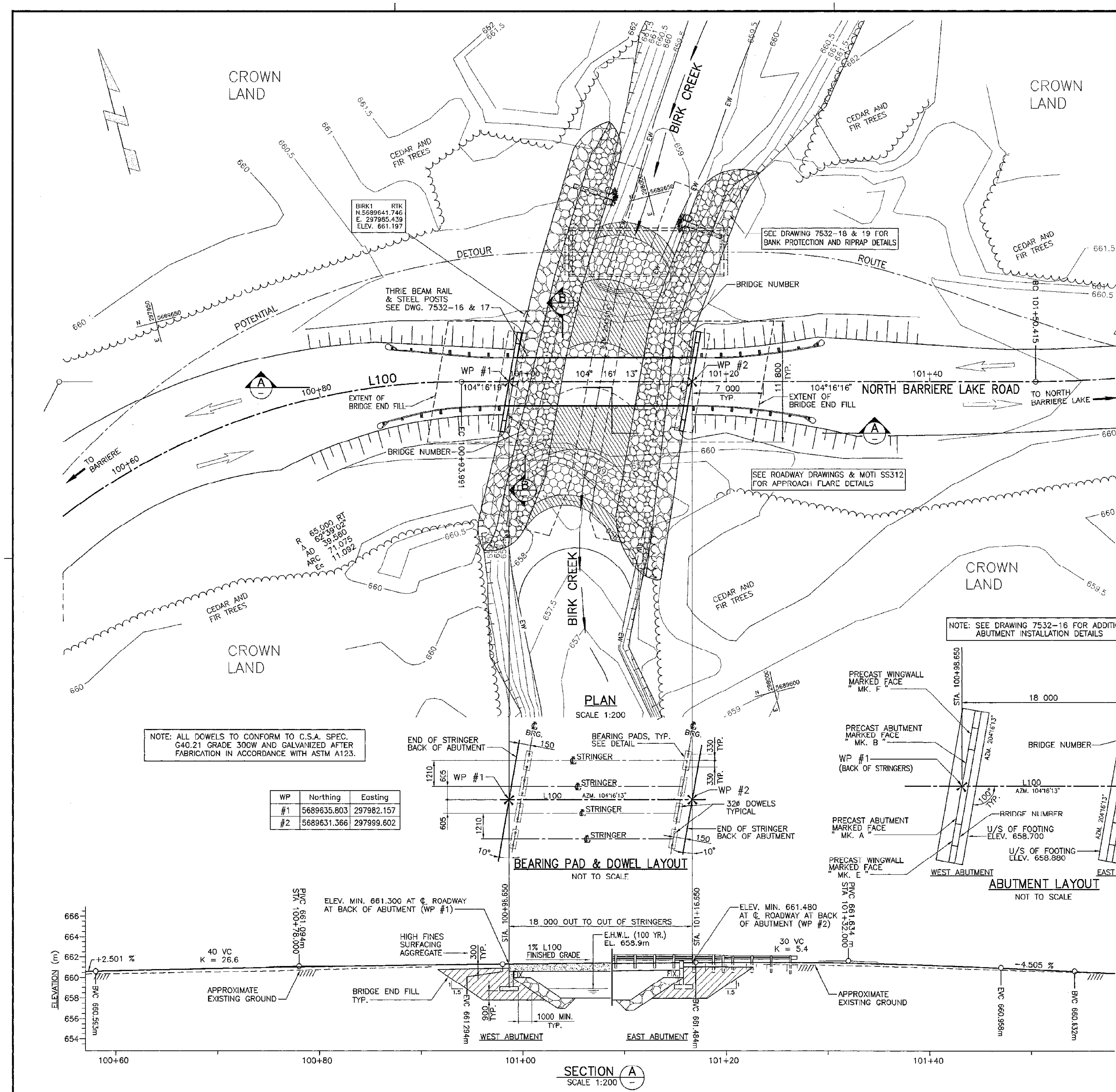
12.1 Birk Creek #7532

Location	Approximately 30 km from the town of Barriere
Road	North Barriere Lake Road
District	Thompson Nicola District
Region	Southern Interior Region
Year of Construction	2019
Construction Cost	Approximately $900,000
Structure Description	Single lane bridge composed of four 18 m long twin-cell box precast prestressed concrete girders supported on precast concrete spread footing abutments. A thrie beam rail was used and the approaches to the bridge are unpaved.
Traffic Management Strategy during construction	Single lane detour bridge
Notes	A design exception was issued for the use of spread footings at an elevation higher than that required by CSA S6

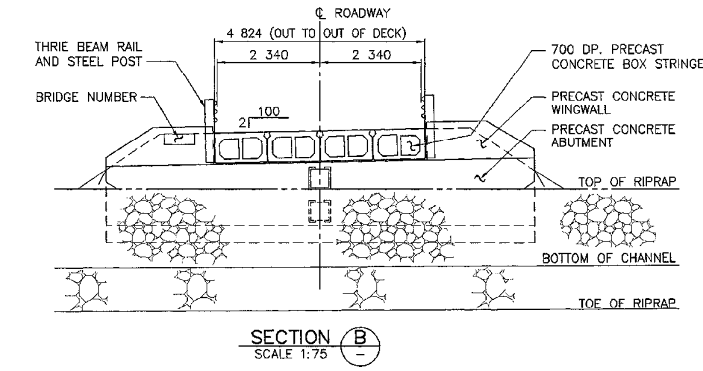
Figure 1- Birk Creek Bridge - Preconstruction

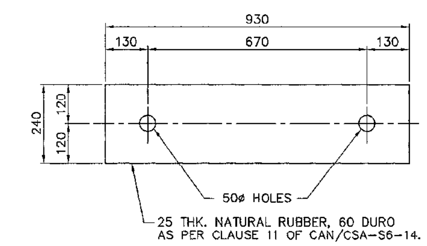
Figure 2 - Birk Creek - Postconstruction - Elevation

Figure 3- Birk Creek - Postconstruction - Approaches



WP	Northing	Easting
#1	5689635.803	297982.157
#2	5689631.366	297999.602





BEARING PADS
8 REQUIRED
SCALE 1:10

NOTES:

1. DESIGN SPECIFICATIONS:
   - CAN/CSA-S6-014
   - BCMOT SUPPLEMENT TO CAN/CSA S6-14
2. DESIGN LOADS:
   - LIVE LOAD: BCL-625
   - DEAD LOAD: INCLUDES 2.4kPa ALLOWANCE FOR FUTURE 100mm THICK CONCRETE OVERLAY
   - DESIGN TEMPERATURE RANGE: MAX. +30°C AND MIN. -27°C
   - RAINFALL: 13mm/15 MINUTES.
   - WIND LOAD: 1/50 YEAR REFERENCE = 0.405kPa
3. DESIGN SPEED: 40 km/h
4. GEOTECHNICAL: SITE CLASS 'D' MATERIAL.
5. EARTHQUAKE:
   - 2015 NBCC SEISMIC HAZARD MAP
   - SITE: 51.3221N , 119.8993W
   - Sn(0.2)=0.132, Sn(0.5)=0.104
   - Sn(1.0)=0.074, PGA(g)=0.059

Rev	Date	Description	Init

REVISIONS

BRITISH COLUMBIA | Ministry of Transportation & Infrastructure
Southern Interior Region

THOMPSON NICOLA HIGHWAY DISTRICT
NORTH BARRIERE LAKE ROAD
BIRK CREEK BRIDGE
GENERAL ARRANGEMENT

PREPARED UNDER THE DIRECTION OF PRERNA SOHAL
ENGINEER OF RECORD
DATE 6th May 2019

PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, P. SOHAL # 42497

DESIGNED	ZS/MCW	DATE	APR. 2019
CHECKED	PS	DATE	MAY. 2019
DRAWN	AJP	DATE	MAY. 2019

SCALE AS NOTED
NEGATIVE No.

FILE No.	PROJECT No.	REG.	DRAWING No.
	23976-0001	2	7532-12

H-308j-10'8JP

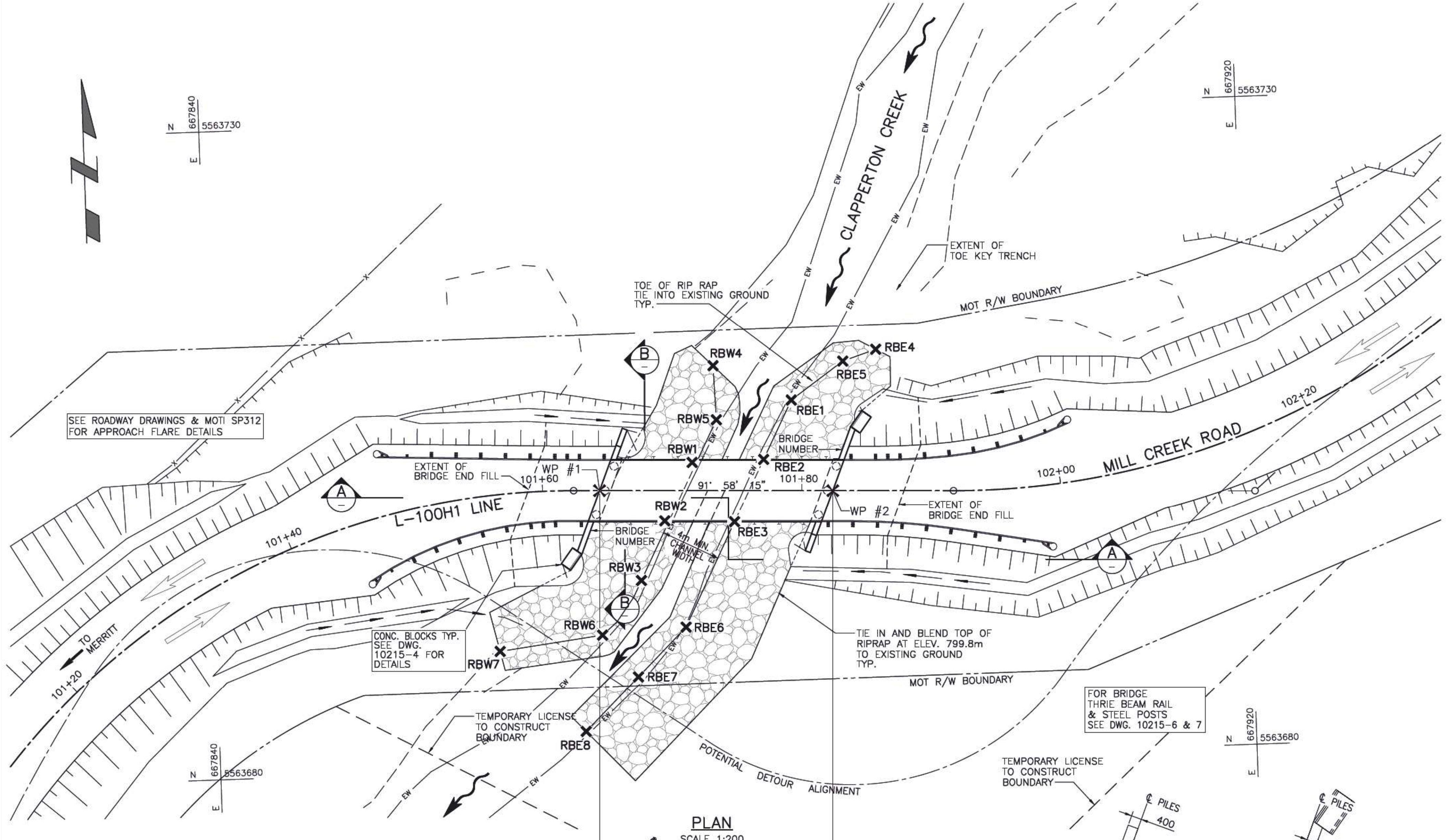
CANCEL PRINTS BEARING PREVIOUS LETTER

12.2 Clapperton Creek 2 #10215

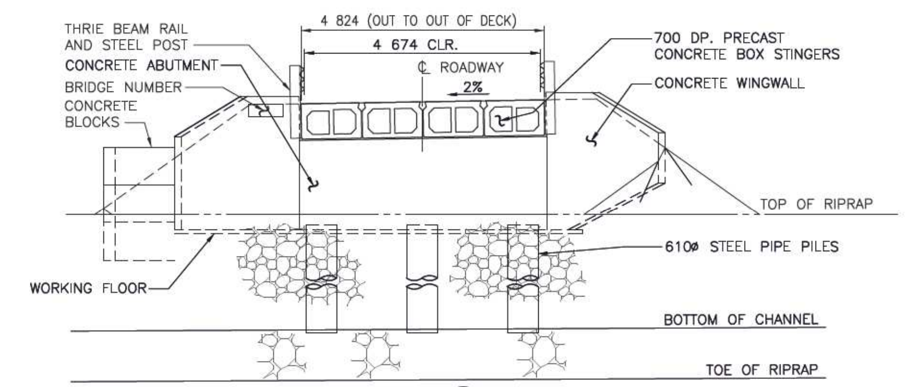
Location	Approximately 16 km from Merritt
Road	Mill Creek Road
District	Thompson Nicola Highway District
Region	Southern Interior Region
Year of Construction	2019
Approximate construction cost	$850,000
Structure Description	Single lane bridge composed of four 18 m long twin-cell box precast prestressed concrete girders supported on piled CIP concrete abutments. A thrie beam rail was used and the approaches to the bridge are unpaved.
Traffic Management Strategy during construction	Single lane detour bridge
Notes	Use of spread footings was assessed but found to be comparable in cost to the piled foundation due to the creek configuration and geotechnical conditions.

Figure 4- Clapperton Creek 2 - Preconstruction

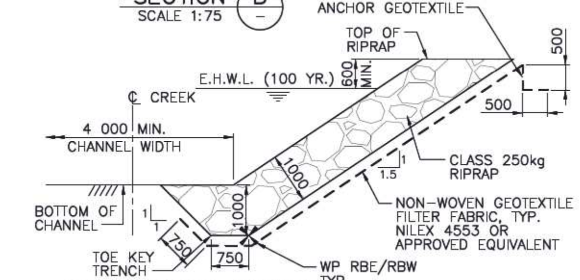
Figure 5- Clapperton Creek 2 - Postconstruction



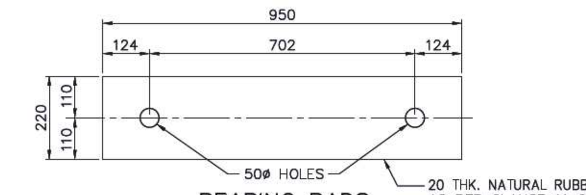
PLAN
SCALE 1:200



SECTION B
SCALE 1:75



TYPICAL RIPRAP SECTION
SCALE 1:75



BEARING PADS
8 REQUIRED
SCALE 1:10

NOTES:

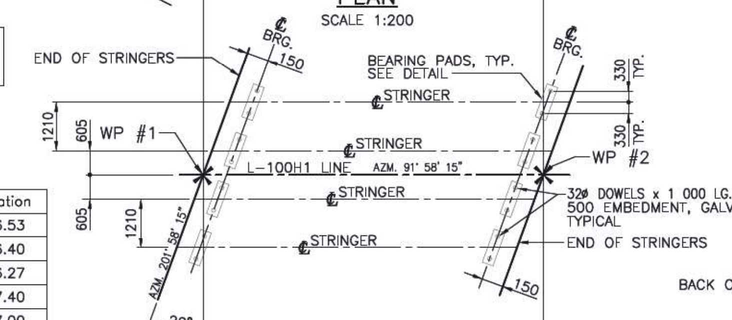
1. DESIGN SPECIFICATIONS: – CAN/CSA-S6-014
   – BCMoT SUPPLEMENT TO CAN/CSA S6-14
2. DESIGN LOADS: – LIVE LOAD: BCL-625
   – DEAD LOAD: INCLUDES 2.4kPa ALLOWANCE FOR FUTURE 100mm THICK CONCRETE OVERLAY
   – DESIGN TEMPERATURE RANGE: MAX. +24°C AND MIN. −44°C
   – RAINFALL: 6.5mm/15 MINUTES.
   – WIND LOAD: 1/50 YEAR REFERENCE = 0.430kPa
3. DESIGN SPEED: 40 km/h
4. GEOTECHNICAL: SITE CLASS 'D' MATERIAL.
5. EARTHQUAKE: – 2015 NBCC SEISMIC HAZARD MAP
   – SITE: 50.2016N , 120.647W
   – Sn(0.2)=0.186, Sn(0.5)=0.158
   – Sn(1.0)=0.114, PGA(g)=0.086
6. HYDROTECHNICAL: – RIPRAP SPECIFICATIONS AND INSTALLATION SHALL BE PER MINISTRY STANDARD SPECIFICATIONS SS 205 AND RIP RAP INSTALLATION GUIDE SEPT. 2013
   – DRAINAGE AREA = 232km²
   – 100-YR PEAK INSTANTANEOUS DESIGN FLOW RATE PLUS CLIMATE CHANGE = 18.2m³/s
   – MAX. DAILY Q200 = 9.0m/s

NOTE: ALL DOWELS TO CONFORM TO C.S.A. SPEC. G40.21 GRADE 300W AND GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH ASTM A123.

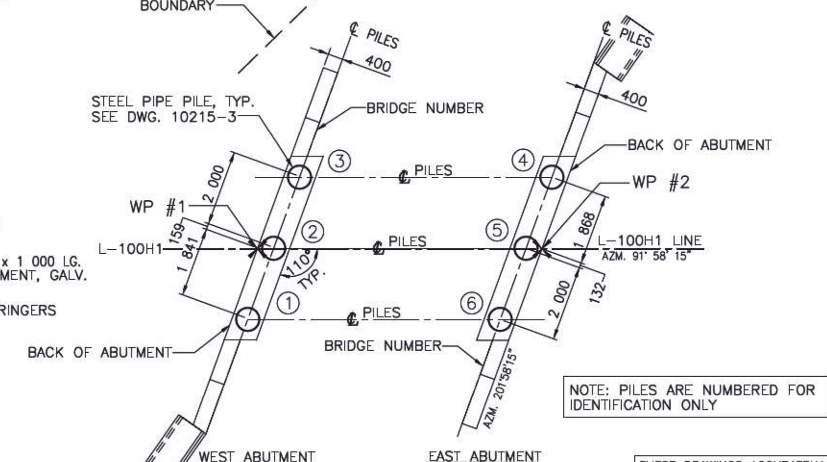
WP	Northing	Easting
#1	5563701.295	667869.962
#2	5563727.795	667887.947

WP	Northing	Easting	Elevation
RBW 1	563703.223	667877.182	796.53
RBW 2	563698.769	667874.915	796.40
RBW 3	563694.345	667872.664	796.27
RBW 4	563710.737	667878.977	797.00
RBW 5	563706.553	667878.879	796.80
RBW 6	563690.251	667869.390	796.38
RBW 7	563689.432	667861.745	797.00

WP	Northing	Easting	Elevation
RBE 1	563707.619	667885.253	796.53
RBE 2	563703.190	667883.000	796.40
RBE 3	563698.736	667880.733	796.27
RBE 4	563711.207	667892.021	797.40
RBE 5	563710.410	667889.144	797.00
RBE 6	563690.303	667876.492	796.27
RBE 7	563686.461	667872.374	796.27
RBE 8	563682.709	667868.352	796.27



BEARING PAD & DOWEL LAYOUT
NOT TO SCALE

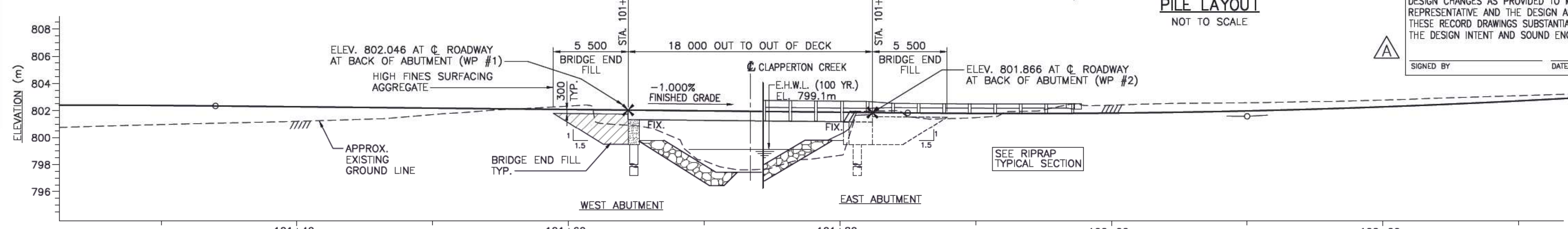


NOTE: PILES ARE NUMBERED FOR IDENTIFICATION ONLY

PILE LAYOUT
NOT TO SCALE

THESE DRAWINGS ACCURATELY RECORD ALL SIGNIFICANT DESIGN CHANGES AS PROVIDED TO ME BY THE MINISTRY REPRESENTATIVE AND THE DESIGN AS REPRESENTED BY THESE RECORD DRAWINGS SUBSTANTIALLY CONFORMS WITH THE DESIGN INTENT AND SOUND ENGINEERING PRACTICE.

SIGNED BY ____ DATE ____



SECTION A
SCALE 1:200

Rev	Date	Description	Init
A	JULY, 2020	RECORD DRAWING	AJP

REVISIONS

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure
Southern Interior Region

THOMPSON NICOLA HIGHWAY DISTRICT
MILL CREEK ROAD WASHOUT

CLAPPERTON CREEK No.2 BRIDGE GENERAL ARRANGEMENT

PREPARED UNDER THE DIRECTION OF
ORIGINAL SIGNED BY
PRERNA SOHAL
ENGINEER OF RECORD
DATE OCT. 17, 2019

DESIGNED MCW DATE SEPT. 2019
CHECKED PS DATE SEPT. 2019
DRAWN DN DATE SEPT. 2019
SCALE AS NOTED
NEGATIVE No.

FILE No.	PROJECT No.	REG.	DRAWING No.
	24239-0001	2	10215-2 A

CANCEL PRINTS BEARING PREVIOUS LETTER

H-308j-1018JP

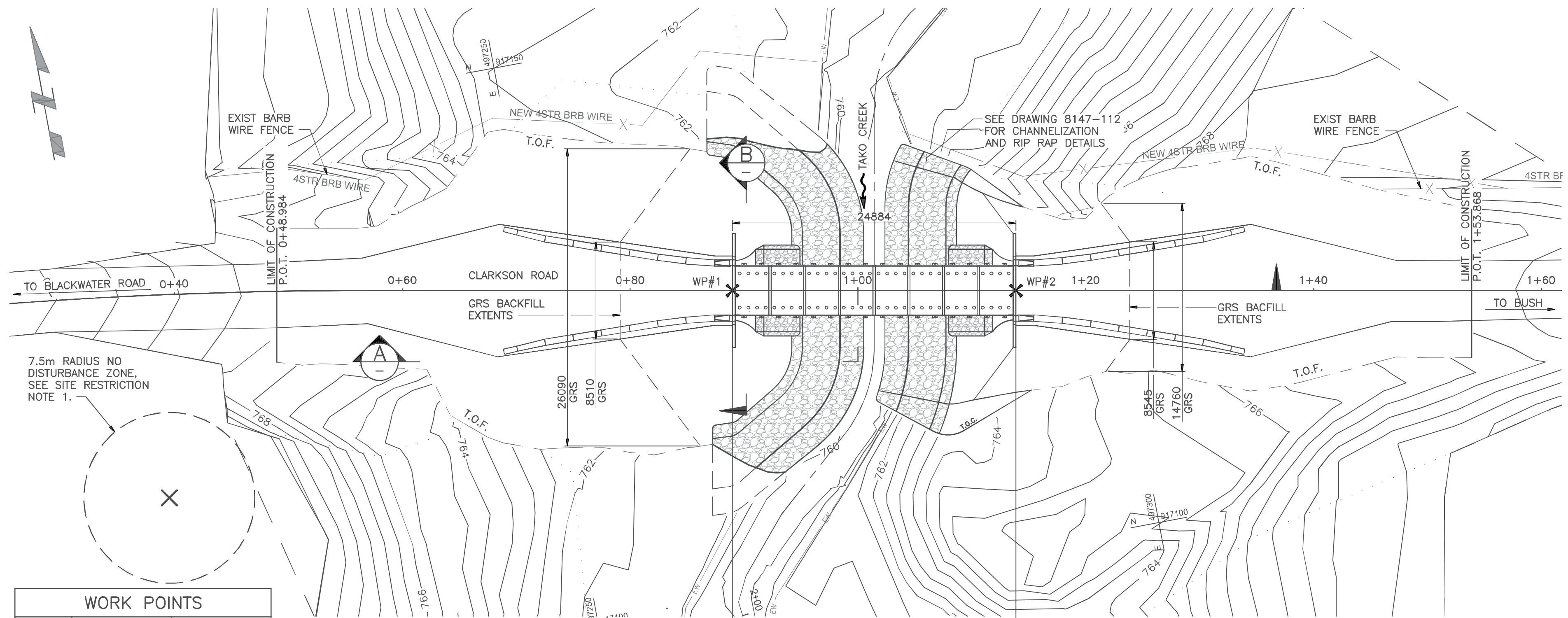
12.3 Tako Creek #8147

Location	Approximately 67 km south of Prince George
Road	Clarkson Road
District	Cariboo District
Region	Southern Interior Region
Year of Construction	2020
Approximate construction cost	$625,000
Structure Description	Single lane bridge composed of 25 m long twin steel I girders with precast concrete deck panels supported by pile pedestal spread footings. A thrie beam rail with concrete approach barriers was used and the approaches to the bridge are unpaved.
Traffic management during construction	Road was closed to vehicular traffic
Notes	A design exception was issued for the use of spread footings at an elevation higher than that required by CSA S6. The bridge reused the girders.

Figure 6- Tako Creek - Preconstruction

Figure 7- Tako Creek - Preconstruction

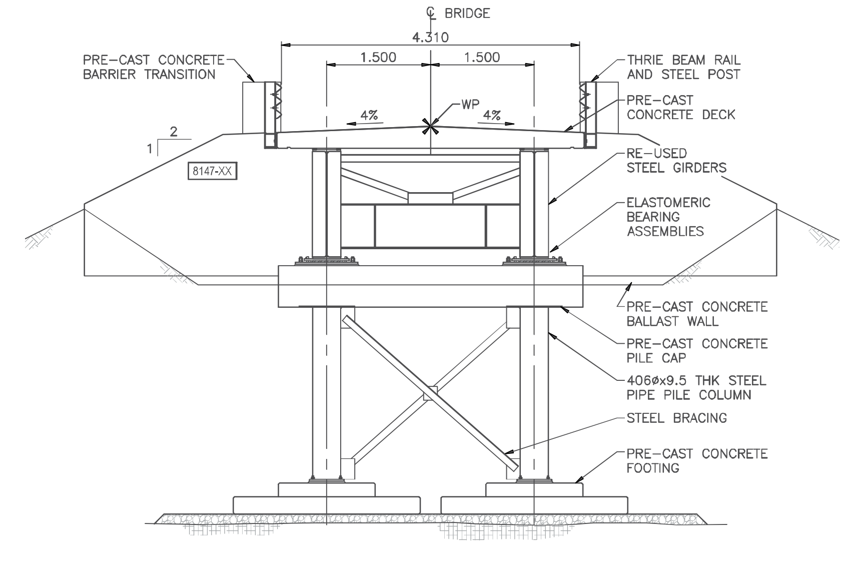
Figure 8 - Tako Creek - Postconstruction



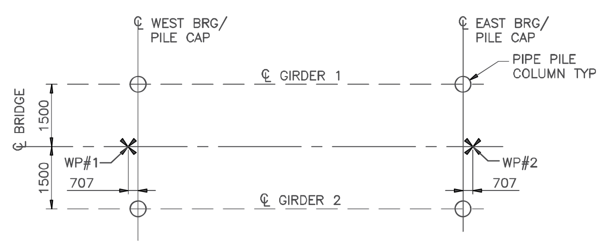
WORK POINTS		
	NORTHING	EASTING
WP 1	917126.868	497266.941
WP 2	917122.390	497291.371

A

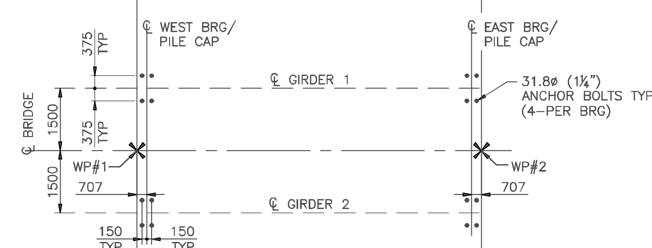
PLAN
SCALE 1:250



SECTION B
SCALE 1:50



PIPE PILE COLUMN LAYOUT
SCALE N.T.S.



ANCHOR BOLT LAYOUT
SCALE N.T.S.

DESIGN SPECIFICATIONS:

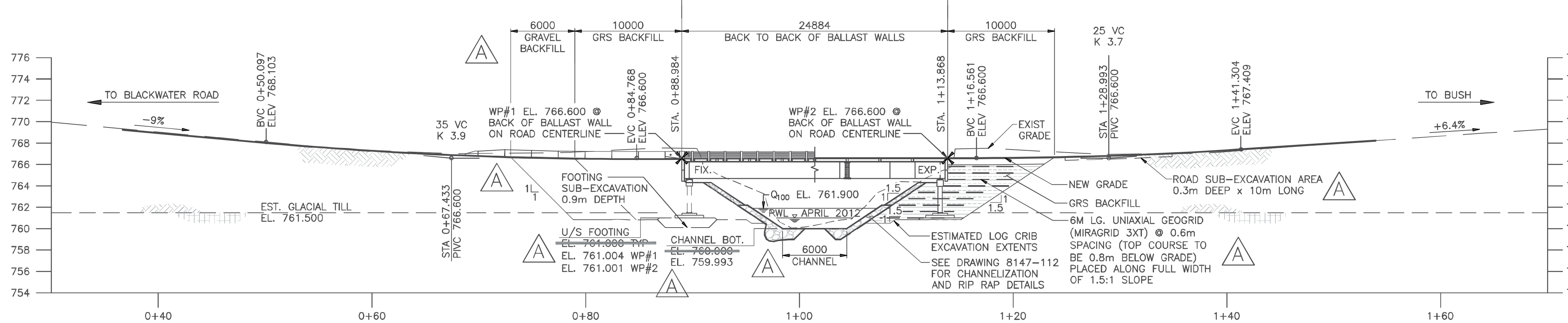
1. DESIGN IN ACCORDANCE WITH CSA-S6-14 & MOTI SUPPLEMENT TO CSA-S6-14.
2. DESIGN LIFE: 75 YEARS
3. DESIGN SPEED 30 km/hr.

DESIGN LOADS:

1. DESIGN LOADS:
   - LIVE LOAD: BCL-625
   - SEISMIC: PERFORMANCE CATEGORY 1, SITE CLASS D, PGA = 0.070g.
   - DESIGN TEMP. RANGE: -36°C TO +28°C
   - WIND LOAD: 1/50 YEAR RETURN = 0.37 kPA
   - FUTURE OVERLAY: 50mm CONCRETE = 1.2 kPA
2. DIMENSIONS SHOWN ARE AT 15°C UNLESS NOTED OTHERWISE.

SITE RESTRICTION NOTES:

1. A 7.5m RADIUS NO DISTURBANCE ZONE IS TO BE OBSERVED AT SITE LOCATION N. 917118.000 E. 497215.000.



SECTION A
SCALE 1:250

I HAVE PROVIDED THE ENGINEER OF RECORD WITH RECORDS OF ALL SIGNIFICANT DESIGN CHANGES KNOWN TO ME, HAVING EXERCISED DUE DILIGENCE IN MONITORING THE CONSTRUCTION OF THE WORK SIGNED BY: DATE:	THESE DRAWINGS ACCURATELY RECORD ALL SIGNIFICANT DESIGN CHANGES AS PROVIDED TO ME BY THE MINISTRY REPRESENTATIVE AND THE DESIGN AS REPRESENTED BY THESE RECORD DRAWINGS SUBSTANTIALLY CONFORMS WITH THE DESIGN INTENT AND SOUND ENGINEERING PRACTICE SIGNED BY: DATE:

Allnorth

Rev	Date	Description	Init
A	2020/09/22	RECORD DRAWING/ REVISED WORK POINTS,	SAP
		FOOTING ELEVATIONS, EXCAVATION EXTENTS,	
		GEOGRID MATERAIL, BACKFILL MATERAILS	

REVISIONS

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure
Southern Interior Region

CARIBOO DISTRICT
CLARKSON ROAD

TAKO CREEK BRIDGE No.8147 REPLACEMENT GENERAL ARRANGEMENT

PREPARED UNDER THE DIRECTION OF
ORIGINAL SIGNED BY
DON WILLIAMS P.Eng
ENGINEER OF RECORD
DATE

DESIGNED S.FIELD	DATE 2019.01.15	
CHECKED D.WILLIAMS	DATE 2019.02.20	
DRAWN S.PEREIRA	DATE 2019.01.15	
SCALE AS NOTED		
NEGATIVE No.		

FILE No.	PROJECT No.	REG.	DRAWING No.
	23541-0000	2	8147-101 A

CANCEL PRINTS BEARING PREVIOUS LETTER

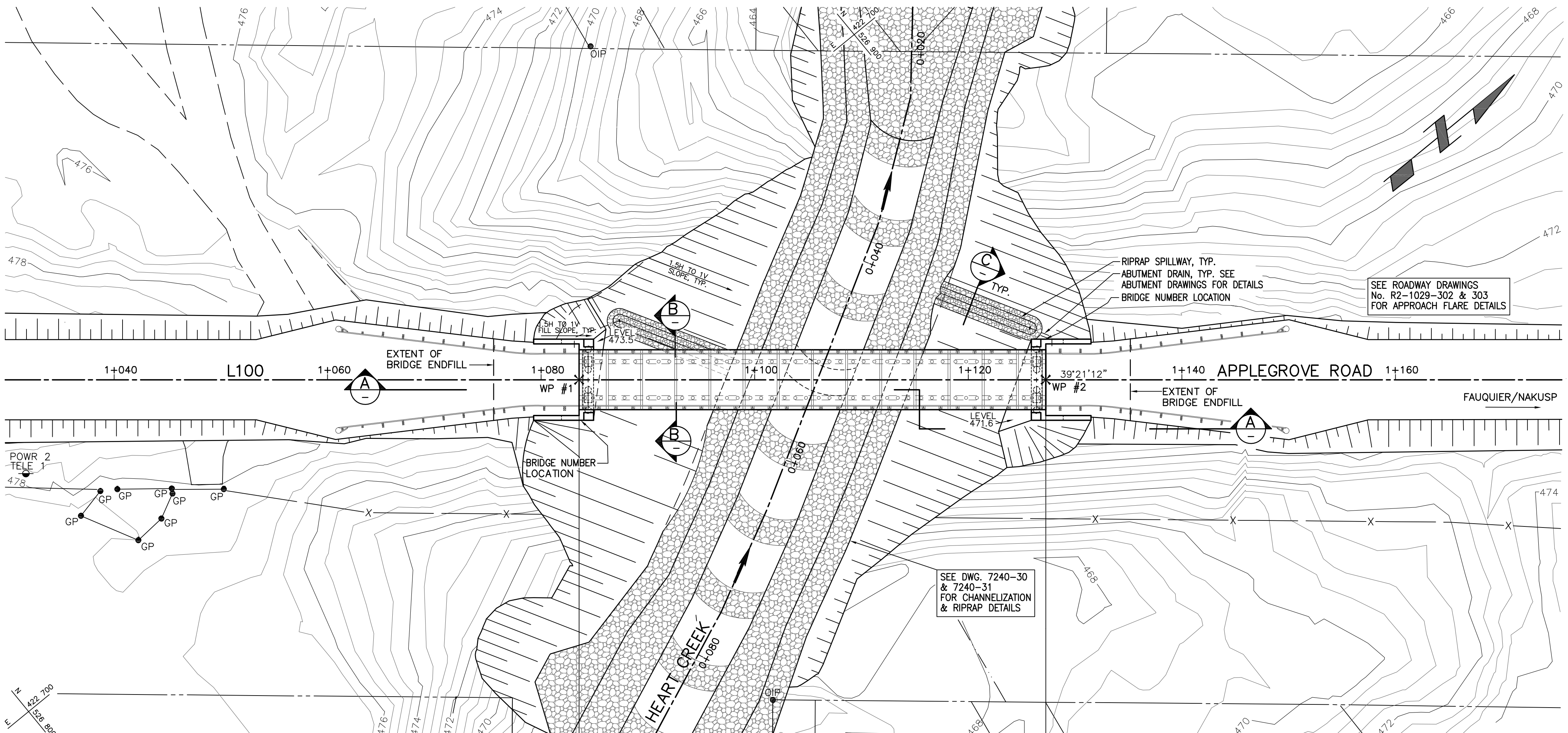
H-308j-r3-c(07-08)

12.4 Heart Creek 2 #7240

Location	57 km southwest of Nakusp
Road	Applegrove Road
District	West Kootenay District
Region	Southern Interior Region
Year of Construction	2018
Approximate construction cost	$2,160,000
Structure Description	Single lane bridge composed of 42 m long twin steel I girders with precast concrete deck panels supported by piled CIP abutments. A thrie beam rail was used and the approaches to the bridge are unpaved.
Traffic Management Strategy during construction	Road was closed to traffic during construction
Notes	Funded significantly through the Ministry environment group as an environmental enhancement project. 18 step pools were included in construction to enhance fishery, as prime spawning habitat was reestablished after the old culvert and 2 m splash pool were reclaimed.

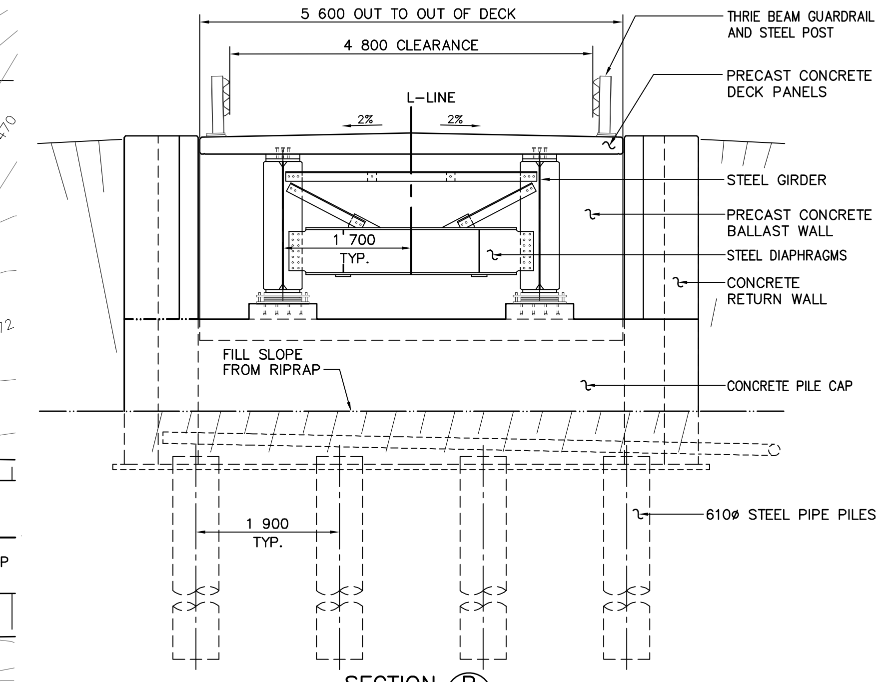
Figure 9- Heart Creek 2 - Preconstruction

Figure 10 - Heart Creek 2 – Postconstruction

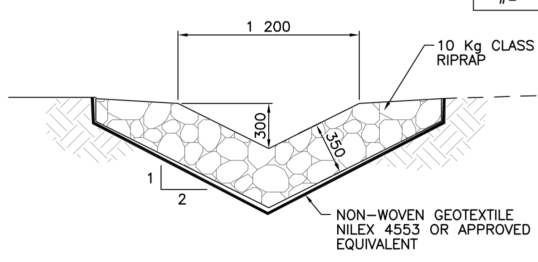


PLAN
SCALE 1:250

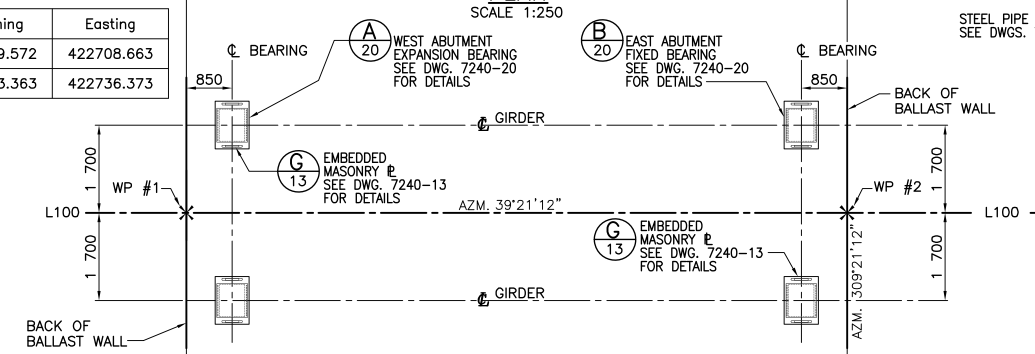
WP	Northing	Easting
#1	526859.572	422708.663
#2	526893.363	422736.373



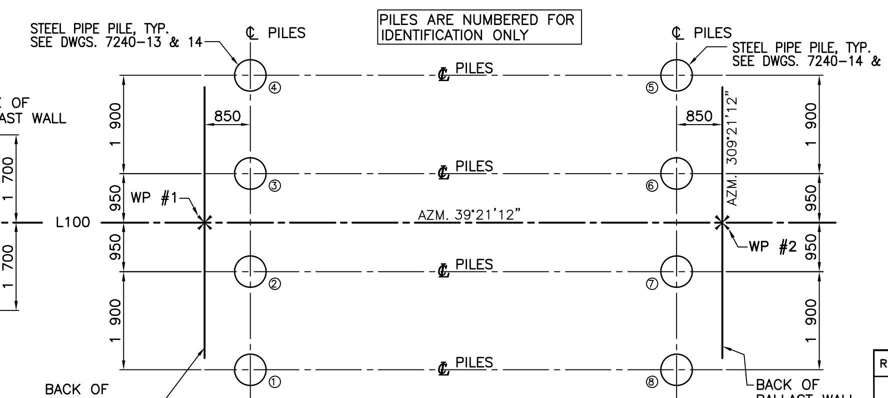
SECTION B
SCALE 1:50



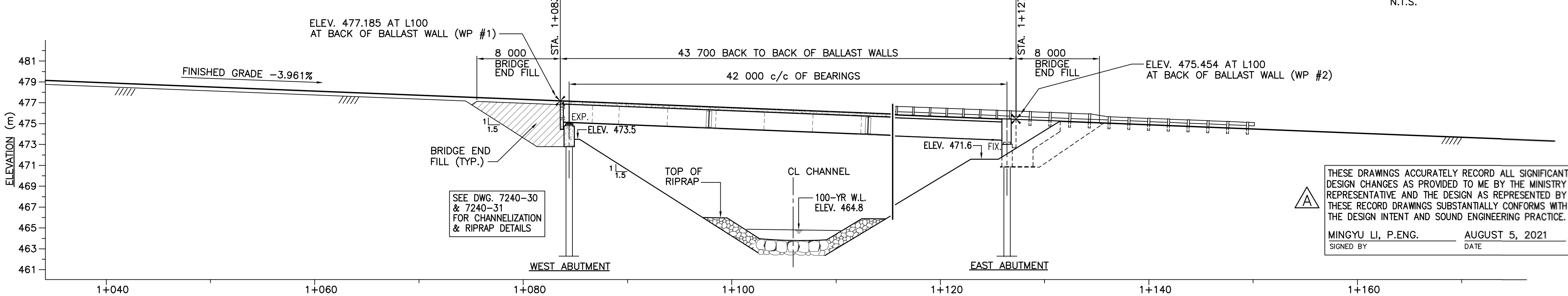
SECTION C
SCALE 1:25



BEARING PAD AND ANCHOR PLATE LAYOUT
N.T.S.



PILE LAYOUT
N.T.S.



SECTION A
SCALE 1:250

NOTES:

1. DESIGN SPECIFICATIONS:
   - CHBDC CAN/CSA-S6-14
   - BC MOTI SUPPLEMENT TO CHBDC CAN/CSA-S6-14
2. DESIGN LOADS:
   - DEAD LOAD: INCLUDES ALLOWANCE FOR FUTURE 50mm ASPHALT OVERLAY
   - LIVE LOAD: BCL-625
   - CLIMATE DATA (FAUQUIER, BC)
     - MAXIMUM DAILY MEAN TEMPERATURE: +28°C
     - MINIMUM DAILY MEAN TEMPERATURE: -32°C
     - HOURLY MEAN WIND PRESSURE: 330 Pa FOR 1/50 YEAR RETURN PERIOD
     - RAINFALL: 6mm/15 MINUTES
   - SEISMIC DESIGN
     - BRIDGE IMPORTANCE CATEGORY: OTHER BRIDGE
     - SITE CLASSIFICATION: E
     - SEISMIC PERFORMANCE CATEGORY: 2
     - 5% DAMPED SPECTRAL ACCELERATION FOR 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS: Sa(0.2)=0.131, Sa(0.5)=0.105, Sa(1.0)=0.078, PGA=0.06g, PGV=0.1m/s
3. DESIGN SPEED: 50 km/h

THESE DRAWINGS ACCURATELY RECORD ALL SIGNIFICANT DESIGN CHANGES AS PROVIDED TO ME BY THE MINISTRY REPRESENTATIVE AND THE DESIGN AS REPRESENTED BY THESE RECORD DRAWINGS SUBSTANTIALLY CONFORMS WITH THE DESIGN INTENT AND SOUND ENGINEERING PRACTICE.

MINGYU LI, P.ENG. — AUGUST 5, 2021
SIGNED BY — DATE

Rev	Date	Description	Init
A	OCT. 2019	RECORD DRAWING	AJP

REVISIONS

BRITISH COLUMBIA
Ministry of Transportation & Infrastructure
Southern Interior Region

WEST KOOTENAY HIGHWAY DISTRICT
APPLEGROVE ROAD

HEART CREEK No.2 BRIDGE
GENERAL ARRANGEMENT

PREPARED UNDER THE DIRECTION OF
ORIGINAL SIGNED BY
MINGYU LI, P.ENG.
ENGINEER OF RECORD
DATE MARCH 22, 2018

DESIGNED ML	DATE MAR. 2018	
CHECKED JB	DATE MAR. 2018	
DRAWN AJP	DATE MAR. 2018	
SCALE AS NOTED		
NEGATIVE No.		

FILE No.	PROJECT No.	REG.	DRAWING No.	
		2	7240-12	A

H-308/-1018.P

CANCEL PRINTS BEARING PREVIOUS LETTER