SUMMARY AS-BUILT PROJECT COMPLETION REPORT

SAANICH AND VIEW ROYAL, BC

DFO Authorization No. 11-HPAC-PA3-00772

Prepared for:

The Corporation of the District of Saanich
770 Vernon Avenue
Victoria, BC V8X 2W7

&

Town of View Royal
45 View Royal Avenue
Victoria, BC V9B 1A6

Prepared by:

Applied Ecological Solutions Corp.
4189 Happy Valley Road
Victoria, BC V9C 3X8

AESC Project No.: 211-018-1

September 3, 2014

EXECUTIVE SUMMARY

The Corporation of the District of Saanich and the Township of View Royal (Owners) jointly initiated the replacement of the pre-existing timber Craigflower Bridge across the Gorge Waterway with a new 4-span bridge. This bridge provides a vital transportation link between the two municipalities.

The combined design and construction phases of the replacement Craigflower Bridge encompassed approximately 30 months. Several key design elements of the replacement bridge were incorporated to address critical environmental issues including (but not limited to) [1] impacts on Olympia Oyster habitat, [2] intertidal Saltmarsh and subtidal eelgrass aquatic habitat, [3] loss of riparian vegetation, and [4] elimination of bird wire strikes on overhead wiring.

Similarly, demolition of the pre-existing 20-span, creosote timber bridge and replacement with the new 4-span structure construction required the Contractors (Ruskin Construction Ltd. and Don Mann Excavating Ltd.) to implement rigorous environmental protection measures throughout the construction phase. This included construction of a temporary work bridge across the Gorge Waterway providing unconstrained access across the Waterway capable of supporting heavy equipment, cranes, pile drivers and materials.

The bridge and road construction Contractors (Ruskin Construction Ltd. and Don Mann Excavating Ltd., respectively), were required to retain the services of a qualified environmental consultant to provide environmental monitoring during construction. Aquaparian Environmental Consulting Ltd. was retained to provide this role. This included the preparation of environmental protection planning documents for use during construction. Similarly, the Owners retained CMS-Focus to provide construction management services. Applied Ecological Solutions Corp. provided the environmental auditing function on behalf of the Owners with the intention of overseeing the environmental performance of the Contractors.

Section 9 of this report summarized the 19 environmental impact mitigation initiatives that were implemented on this Project to eliminate and ameliorate construction-related environmental impacts. Some of these are common to most major construction projects. However, some are unique to this Project. In implementing these initiatives, the Owners, Contractors and their respective representatives on the Project demonstrated a commitment to environmental protection.

Section 11 of this report summarizes environmental compensation initiatives that were implemented as required by the Fisheries and Oceans Canada (DFO) Section 35.2 *Fisheries Act* Authorization (Authorization). Of these, most noteworthy are the efforts to offset unavoidable impacts to Olympia Oysters from habitat areas that were permanently lost due to construction of the bridge footings.

To assist in resolving issues related to environmental compensation as required in the Authorization, the Project retained World Fisheries Trust (recognized experts in Olympia Oyster and their habitat requirements) to develop innovative compensation concepts for Olympia Oyster habitat. This included [1] salvage of approximately 100,000 Olympia Oysters from the three bridge footing locations, [2] construction of two oyster colonization reefs within the Gorge Waterway that provided recipient sites for salvaged oysters and settlements area for future oyster colonization, and [3] installation of settlement panels onto the bridge footing walls to provide vertical habitat for Olympia Oyster colonization.

On completion of bridge construction in May 2014, all of the requirements of the Authorization were completed. There are no outstanding or unresolved environmental issues. The five year post-construction monitoring phase will be initiated in Year 1 following completion (i.e. 2015).

This Project exhibited a level of environmental awareness and stewardship that has become the expectation of the public. As construction of the replacement bridge advanced, environmental consultation by the Owners and their representatives with DFO was ongoing. The Gorge Waterway Initiative steward group was consulted on the status of construction and environmental issues resolutions. The First Nations were consulted regarding archaeological sites. Together, all these activities defined a level of openness and transparency that greatly enhanced the public support for the Project.

Table of Contents

EXECUTIVE SUMMARY I

1. BACKGROUND 1
1.1 INTRODUCTION 1
1.2 PROJECT LOCATION AND EXTENT 1
1.2 REGULATORY AUTHORIZATION 1
1.2.1 REQUEST FOR MARINE TIMING WINDOW EXTENSION 1
1.3 NEED FOR THIS REPORT 2
1.4 REPORT SCOPE 2

2.0 PRE-EXISTING CONDITION 3

3.0 PROJECT ENVIRONMENTAL AND CONSTRUCTION ELEMENTS 4

4.0 EXISTING BRIDGE DEMOLITION AND REPLACEMENT BRIDGE CONSTRUCTION SCHEDULING 4

5.0 CONSTRUCTION CONTRACTORS AND REPRESENTATIVES 5

6.0 TEMPORARY WORK BRIDGE 5

7.0 EXISTING BRIDGE DEMOLITION 6

8.0 REPLACEMENT BRIDGE CONSTRUCTION 7

9.0 ENVIRONMENTAL IMPACT MITIGATION 8
9.1 ENVIRONMENTAL PROTECTION PLANNING DOCUMENTS 8
9.1.1 PREPARATION OF ENVIRONMENTAL MANAGEMENT REPORT (PRE-CONSTRUCTION) 8
9.1.2 PREPARATION OF TEMPORARY WORK BRIDGE ENVIRONMENTAL IMPACT ASSESSMENT (PRE-CONSTRUCTION) 8
9.1.3 PREPARATION OF ENVIRONMENTAL PROTECTION PLAN (CONSTRUCTION) 8
9.2 REGULAR CONSULTATION WITH DFO 8
9.3 REGULAR CONSULTATION WITH ENVIRONMENTAL STAKEHOLDER (GORGE WATERWAY INITIATIVE) 8
9.4 ENVIRONMENTAL SURVEILLANCE MONITOR AND MONITORING LEVEL OF EFFORT 9
9.5 OWNERS' ENVIRONMENTAL AUDITOR 9
9.6 OLYMPIA OYSTER SALVAGE 9
9.7 TEMPORARY TERMINATION OF IN-WATER ACTIVITIES DURING OBSERVED FISH STRESS 10
9.8 FISH SALVAGE DURING PIER CAISSON SHEET PILING INSTALLATION 10
9.9 CREOSOTE TIMBER PILE REMOVAL 10
9.10 VIBRATORY HAMMER PILE DRIVING AND REMOVAL – TURBIDITY AND OVERPRESSURE MONITORING 11
9.11 TEMPORARY WORK BRIDGE 11
9.12 ELIMINATION OF BIRD OVERHEAD WIRE STRIKE RISK 12
9.13 INVASIVE PLANT SPECIES MANAGEMENT 12
9.14 RAINGARDEN AND OIL-GRIT SEPARATOR WATER TREATMENT FACILITIES 12
9.15 USE OF BAFFLED PRIMARY WATER TREATMENT HOPPER 12
9.16 FUEL SPILL RESPONSE 13
9.17 CAST-IN-PLACE CONCRETE POURING AND WASTEWATER MANAGEMENT 13
9.18 IMPLEMENTATION OF WORKER ENVIRONMENTAL ORIENTATION 14
9.19 RESPONSE TO FIRST NATIONS ARCHAEOLOGICAL DEPOSITS AND REMAINS 14

10.0 SUMMARY OF ENVIRONMENTAL CONCERNS AND ISSUES ENCOUNTERED 14
10.1 CONTRACTORS' OVERALL ENVIRONMENTAL PERFORMANCE 14
10.2 SEDIMENT RELEASE DURING PILE DRIVING AND TEMPORARY BRIDGE PILE REMOVAL 14
10.3 SEDIMENT RELEASE DURING TIMBER PILE REMOVAL 15
10.4 WATERLINE BREAKAGE AND RELEASE TO STORM DRAINAGE 15

10.5 LEAKAGE FROM WATER TREATMENT/SETTLEMENT HOPPERS 15
10.6 OIL SHEEN OBSERVED ON GORGE WATERWAY IN VICINITY OF PROJECT 16
10.7 CAISSON FISH SALVAGE 16

11.0 ENVIRONMENTAL IMPACT COMPENSATION 16

11.1 OLYMPIA OYSTER HABITAT REPLACEMENT 16
11.1.1 OLYMPIA OYSTER COLONIZATION REEFS 16
11.1.2 OYSTER COLONIZATION PANELS ON REPLACEMENT BRIDGE PIER FOOTINGS 18
11.2 SALTMARSH RELOCATION 18
11.3 RIPARIAN PLANTING AND INVASIVE PLANT SPECIES REMOVAL 19

12.0 HABITAT BALANCE TABLE 20

13.0 POST-CONSTRUCTION MONITORING PROGRAM 21

13.1 POST-CONSTRUCTION MONITORING SCHEDULE 21
13.2 OWNERS' COMMITMENT TO COMPLETE COMPENSATORY REMEDIAL WORKS 21

14.0 OUTSTANDING ENVIRONMENTAL ISSUES 21

14.1 OUTSTANDING ENVIRONMENTAL ISSUES 21
14.2 UNAVOIDABLE POTENTIAL IMPACTS ON COMPENSATORY HABITAT 21
14.2.1 SEDIMENT DEPOSITION INTO THE GORGE WATERWAY 21
14.2.2 PETROCHEMICAL SPILLS INTO THE GORGE WATERWAY 22

15.0 CONCLUSIONS 22

LIST OF FIGURES

Figure 1 Craigflower Bridge Replacement Project location and scope 1
Figure 2 Temporary work bridge design prepared by Ruskin 11
Figure 3 Olympia Oyster compensation sites in relation to the Craigflower Bridge Replacement Project location 17

LIST OF TABLES

Table 1 Significant Project Dates and Milestones 4
Table 2 Compensation Olympia Oyster Colonization Reef Locations 16
Table 3 Habitat Balance Summary Table 20
Table 4 Post-construction Monitoring Schedule 21

APPENDICES

Appendix 1 Habitat Balance Table 24
Appendix 2 Bridge Design Plan and Profile Record Drawings 27
Appendix 3 Craigflower Bridge – Before and After Photographs 31

REPORT ACKNOWLEDGEMENTS

Specific construction issues, events and monitoring details as reported in Environmental Monitor daily reports prepared by Aquaparian Environmental Consulting Ltd. Bob Chapman was the Environmental Auditor for the Project and prepared field observation Site Visit Reports that were used as references for this report.

Anecdotal and reported details regarding Olympia Oyster compensation, salvage, reef location, and oyster placement provided (in part) by Joachim Carosfeld, Ph.D. (World Fisheries Trust).

Deb Becelaere (Town of View Royal), Jim Hemstock (District of Saanich) and Y. Prudek provided constructive editorial review and comments on the draft and final reports.

PHOTO CREDITS

All photos by AESC (C. Barlow and B. Chapman) in the body of the report unless otherwise credited. All photos are date stamped. Photos presented in Appendix 3 provided by CMS-Focus by way of the Town of View Royal.

1. BACKGROUND

1.1 Introduction

The Corporation of the District of Saanich and the Town of View Royal, collectively referred to as 'Owners', retained the services of Applied Ecological Solutions Corp. (AESC) to prepare a Summary As-built Report (SABR). This SABR outlines the environmental aspects of the construction of the replacement bridge, including the demolition of the pre-existing Craigflower Bridge and the subsequent construction of the replacement Craigflower Bridge (collectively referred to as the 'Project').

1.2 Project Location and Extent

The Project area is on Admirals Road, extending across the Gorge Waterway between Saanich and View Royal. The location and scope of the Project area is shown in Figure 1.

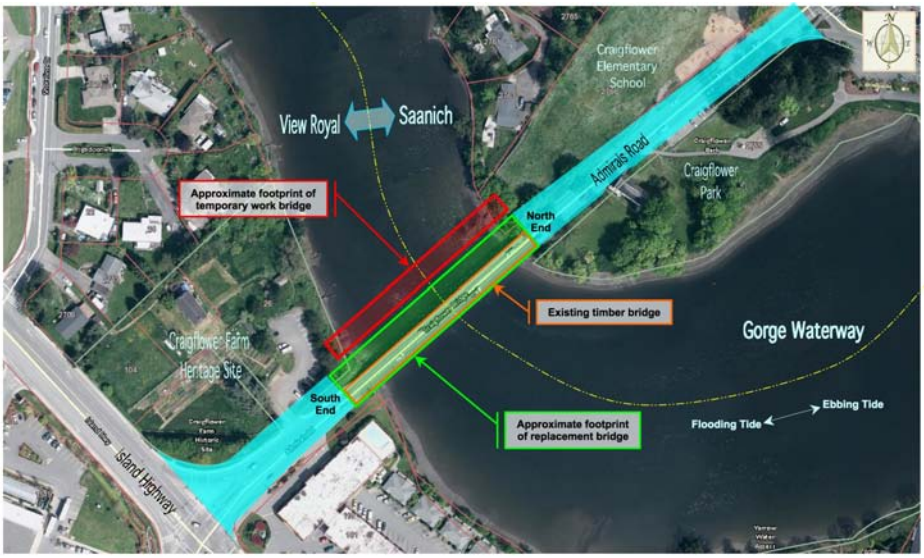


Figure 1 Craigflower Bridge Replacement Project location and scope (CRD Natural Atlas[1]; AESC, 2014).

1.2 Regulatory Authorization

The Project was completed under Fisheries and Oceans Canada (DFO) *Fisheries Act* Authorization No. 11-HPAC-PA3-00772 (Authorization)[2].

1.2.1 Request for Marine Timing Window Extension

Unavoidable construction delays required in-water work outside of the 2014 Marine Timing Winter Window (Window). This included removal of the temporary work bridge. A request for an extension to the Window was submitted to DFO in letter reports entitled:

1. *Craigflower Bridge Replacement Project Update on Bridge Construction and Outstanding In-water Works – Saanich and View Royal, BC.* Prepared by AESC, dated February 4, 2014.
2. *Craigflower Bridge Replacement Project Request for Extension to the Marine Timing Window and Amendment to Fisheries Act Authorization No. 11-HPAC-PA3-00772*. Prepared by AESC, dated September 25, 2013.

---

1 http://viewer.crdatlas.ca/public

2 *Fisheries Act* Subsection 35(2)(b) Authorization for Works, Undertakings or Activities Affecting Fish Habitat – Authorization No. 11-HPAC-PA3-00772. Fisheries and Oceans Canada. Issued February 28, 2013.

A requirement for an extension to the Window was considered by the Project team to accommodate the removal of the temporary work bridge. As recommended by DFO in a letter to the Owners dated February 26, 2014, an online 'DFO Self-Assessment' was completed to determine if removal of the bridge meets DFO criteria and guidance on their website. From this, it was concluded that the work could be undertaken in compliance with the guidelines and would not result in additional serious harm to fish. As such, no further consultation with DFO was required.

1.3 Need for this Report

This SABR has been prepared to fulfill Authorization Condition 5.1, which states:

"5.1. The Proponent will undertake a Monitoring Program during demolition of the existing Craigflower Bridge and construction of the replacement Craigflower Bridge and will provide a summary "As-built" report to DFO after the construction has been completed. An As-built report will be submitted to DFO within 60 days of completion of construction. The As-built report will detail whether the construction was conducted within the schedule of the Proponent's plan and whether the mitigation measures outlined in the proponent's plan and this Authorization were followed, by:

5.1.1. Providing details of the sequence of construction, the quality of construction, and providing "as-built" drawings of the completed works (See Note below).

5.1.2. Providing dated photographs of: 1) the site (pre-construction), 2) the works (in progress), and 3) the completed project.

5.1.3. Providing a description of any contingency measures that were followed in the event that mitigation measures did not function as described in the Proponent Plan."

In addition, the report is to include a Habitat Balance Table (Appendix 1) that confirms what was built (through as-built plans), and if replacement or additional compensation is required. Appendix 2 provides 'Record Drawings' of the bridge design. These drawings include all design changes that were required and constructed following the issue of the Issue for Construction drawings. They represent "as-built drawings" as specified in the Authorization.

1.4 Report Scope

Information in this SABR is based on [1] site reviews, [2] regular environmental monitor reporting (by Aquaparian Environmental Consulting) and auditor reporting (by AESC) throughout construction, [3] information collected in support of the Aquatic Effects Assessment report (AEA), [4] review of available design drawings, and [5] collaboration with the Owners' Construction Site Management Team and the Contractors' field staff.

Specifically, the intent of this report is to:

1. Summarize all environmental concerns and issues encountered throughout construction,
2. Briefly describe environmental best practices and mitigation measures employed during construction,
3. Briefly describe environmental compensation initiatives implemented and the status of these initiatives at the time of writing,
4. Briefly describe any outstanding environmental issues, if any.

This SABR is not intended to be a reiteration of previous assessment and construction environmental reporting. As such, the reader is encouraged to review the environmental reporting (most notably the Aquatic Effects Report[3] prepared by the author in support of

[3] *Craigflower Bridge Replacement Project – Aquatic Effects Assessment – Saanich and View Royal, BC, Final Report*. Prepared for the Corporation of the District of Saanich and the Town of View Royal. Applied Ecological Solutions Corp. March 7, 2012. 66 pages.

the Authorization application), as well as construction monitoring field reports (i.e. Environmental Monitoring Field Reports prepared by Aquaparian and Environmental Auditor Site Visit Reports prepared by AESC).

2.0 PRE-EXISTING CONDITION

The following photos provide an overview of the pre-existing Craigflower Bridge and surrounding features.

Photo 2-1 Pre-existing Craigflower Bridge (Dec. 22, 2011).

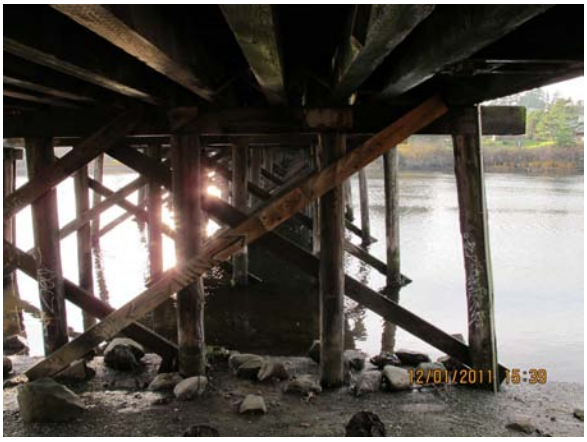


Photo 2-2 Creosote timber pile matrix.

Photo 2-3 Northwest quadrant.

Photo 2-4 Northeast quadrant.

Photo 2-5 Southeast quadrant.

Photo 2-6 Southwest quadrant.

3.0 PROJECT ENVIRONMENTAL AND CONSTRUCTION ELEMENTS

The primary Project environmental elements were:

1. Complete an environmental impact assessment of the Project corridor and issue this Assessment to DFO for regulatory approval,
2. Work with the Owners' design team to provide environmental input on the design of the bridge,
3. Salvage Olympia Oyster in areas where impacts were unavoidable prior to the initiation of in-water work (including pile driving, concrete work and other associated in-water work),
4. Construct compensatory recipient artificial reefs for Olympia Oyster transplant,
5. Salvage Saltmarsh habitat in areas where construction-related impacts were unavoidable,
6. Monitor ongoing construction activities,
7. Complete riparian revegetation initiatives.

The primary Project construction elements were:

1. Construct a temporary work bridge for use throughout existing bridge demolition and replacement bridge construction,
2. Decommissioning and demolition of the existing 20-span timber pile structure,
3. Removal of all remaining creosote timber piles,
4. Construction of the replacement 3-span structure supported on steel piles encased in a concrete pylon,
5. Construct connecting north roadway (to the Gorge Road West intersection) and south roadway (to the Island Highway intersection),
6. Decommissioning and dismantling of the temporary work bridge.

4.0 EXISTING BRIDGE DEMOLITION AND REPLACEMENT BRIDGE CONSTRUCTION SCHEDULING

The following Table summarizes approximate primary milestone dates of the Project.

Table 1 Significant Project Dates and Milestones

Award of environmental contract and initiation of environmental assessment activities	*December 11, 2011*
Submission of environmental Aquatic Effects Assessment Report to DFO for Authorization	*March 7, 2012*
Effective date of *Fisheries Act* Authorization (See Section 1.2 for details regarding the Winter Window extension)	*April 15, 2013 to October 1, 2013 (Marine Summer Window)* *December 1, 2013 to February 15, 2014 (Marine Winter Window)*
Olympia Oyster salvage and relocation to artificial colonization reefs	*February-Spring 2013*
Bridge construction begins	*April 2013*
Decommissioning of the existing Craigflower Bridge	*Summer 2013*
Construction of the temporary work bridge	*July 2013*
Construction of the replacement Craigflower Bridge	*April 2013-April 2014*
Dismantling of the temporary work bridge	*April 2014*
Bridge opens to vehicle traffic	*May 2, 2014*

5.0 CONSTRUCTION CONTRACTORS AND REPRESENTATIVES

The following primary Contractors and Representatives were responsible for all construction and environmental monitoring activities.

Prime Contractor & Road Works	Don Mann Excavating Ltd. (Don Mann)
Bridge Construction	Ruskin Construction Ltd. (Ruskin)
Contractor's Environmental Monitor	Aquaparian Environmental Consulting Ltd. (Aquaparian)
Owners' Construction Management	CMS-Focus
Owners' Environmental Auditor	Applied Ecological Solutions Corp.

6.0 TEMPORARY WORK BRIDGE

Prior to the initiation of replacement bridge construction, a temporary work bridge/pedestrian crossing was installed across the Gorge Waterway. This bridge remained in place for the duration of bridge construction. It was removed when access of all heavy equipment and delivery of other equipment and materials across the Gorge Waterway was no longer required.

Photo 6-1 Work bridge construction.

Photo 6-2 Work bridge construction.

Photo 6-3 Work bridge construction.

Photo 6-4 Work bridge dismantling adjacent to the replacement bridge.

7.0 EXISTING BRIDGE DEMOLITION

Demolition of the existing timber pile bridge was initiated on completion of the temporary work bridge construction. The bridge dismantling was completed in stages to facilitate construction efficiencies. For example, the entire bridge deck was removed and the piles removed within those construction zones that were critical path. That is, because the south pier was the first to be constructed, piles were removed from this zone first. Other sections of piles were removed as replacement bridge construction generally proceeded south to north across the Gorge Waterway.

Photo 7-1 Existing Craigflower Bridge demolition.

Photo 7-2 Creosote timber pile matrix.

Photo 7-3 Existing bridge deck removed and caisson installation initiated.

Photo 7-4 Vibratory hammer used to remove creosote timber piles.

8.0 REPLACEMENT BRIDGE CONSTRUCTION

Similar to the demolition of the pre-existing bridge, construction of the replacement bridge was completed in stages as determined by the Contractor. Once existing bridge piles were removed, this allowed access for caisson construction, pile driving within the caissons for each bridge pier, concrete pouring and bridge erection. In general, bridge construction worked from south to north.

Photo 8-1 Installation of the first and second caissons.

Photo 8-2 Sheet piling around the south caisson.

Photo 8-3 Completed south piers with the sheet piling removed.

Photo 8-4 All three sets of piers complete and ready for bridge erection.

Photo 8-5 Placement of the south girders.

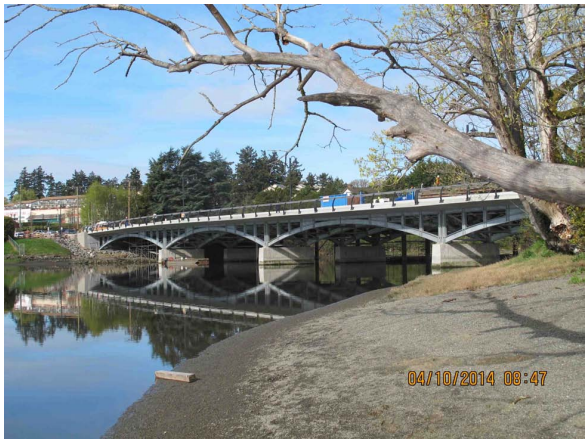


Photo 8-6 Substantially completed bridge approximately one month before opening.

9.0 ENVIRONMENTAL IMPACT MITIGATION

9.1 Environmental Protection Planning Documents

9.1.1 Preparation of Environmental Management Report (pre-construction)

As a pre-construction environmental planning tool for the Owners, an Environmental Management Report[4] was prepared by the author to provide guidance on environmental issues, risk and protection during the demolition of the pre-existing Craigflower Bridge and the subsequent construction of the replacement Craigflower Bridge. Further, the EMR was prepared as a resource tool for joint use specifically by the Owners in ongoing planning of this project (including preparation of construction Tender Documents).

9.1.2 Preparation of Temporary Work Bridge Environmental Impact Assessment (pre-construction)

The Contractor proposed to construct a temporary work bridge to provide unconstrained access along the entire bridge crossing corridor. As this was not factored into the bridge design, the impacts associated with this structure were not accounted for in the Aquatic Effects Assessment Report or the Authorization. As such, the Contractor was required to [1] quantify these impacts, and [2] propose associated mitigation and compensation to offset these permanent and temporal impacts. These impacts were reported in the Temporary Bridge Environmental Impact Assessment[5].

9.1.3 Preparation of Environmental Protection Plan (construction)

Once the construction contract was award to Don Mann, Ruskin was required to submit an Environmental Management Plan[6] to the Owners for review and acceptance. This Plan detailed environmental protection initiatives that would be implemented to address identified, potential and actual environmental risks related to bridge construction.

9.2 Regular Consultation with DFO

DFO was consulted routinely during the planning stages of this Project and in the development of the Authorization. In this regard, DFO was provided with all relevant Project documentation including impact assessment reports and design drawings. DFO conducted pre-construction field reviews of the site with Project team members.

During construction, all environmental monitor field reports were issued to DFO by AESC on receipt from Ruskin. In some instances, delays in distribution occurred. Opportunistic field visits were conducted throughout the construction phase, either at the request of DFO or by invitation from the Owners.

9.3 Regular Consultation with Environmental Stakeholder (Gorge Waterway Initiative)

The Owners (typically the Town of View Royal) and AESC were invited by the Gorge Waterway Initiative (GWI) to present Project updates at several monthly meetings. These informal meetings provided an opportunity for the Owners and AESC to solicit input from this

---

4 *Craigflower Bridge Replacement Project – Environmental Management Report – Final Report – Revision 1*. Prepared for the District of Saanich and Town of View Royal, BC. Applied Ecological Solutions Corp. June 28, 2012. 15 pages.

5 *Craigflower Bridge Replacement Project – Temporary Bridge Environmental Impact Assessment - Draft 4*. Prepared for Ruskin Construction Ltd. Aquaparian Environmental Consulting Ltd. April 17, 2014. 9 pages.

6 *Craigflower Bridge Replacement Project – Environmental Protection Plan – Draft 4*. Prepared for Ruskin Construction Ltd. Aquaparian Environmental Consulting Ltd. April 26, 2014. 21 pages.

environmental stakeholder on what they perceived to be critical environmental design considerations and to update them on the status of construction.

Consultation and collaboration with the GWI provided an important catalyst in resolving some design issues that were outside the domain of the Project. Of note, support from the GWI to place bridge hydro lines within ducts under the bridge to reduce bird wire strikes (a known problem along the Gorge Waterway with Trumpeter Swan and other migratory bird fatalities specifically attributed to wire strikes on bridges), was critical in obtaining acceptance from BC Hydro to implement this recommendation.

9.4 Environmental Surveillance Monitor and Monitoring Level of Effort

Aquaparian was retained by Ruskin to provide ongoing environmental monitoring (primarily) to the bridge construction project. In addition, some roadwork environmental monitoring was integrated into their schedule.

During high-risk activities such as in-water works, pile driving, coffer dam sheet pile installation, fish salvage, etc., Aquaparian attended the site. This typically resulted in weekly and multiple site visits per week to review construction activities during critical times. Aquaparian collaborated with the AESC Environmental Field Auditor.

Thirty six Field Review Reports were generated by the Environmental Monitor during the course of bridge construction.

9.5 Owners' Environmental Auditor

In addition to routine environmental oversight by Aquaparian, AESC was retained to provide environmental auditor services to the Owners. Working in close association with CMS-Focus (Owners' Construction Management Site Representative), the Environmental Field Auditor conducted irregular and opportunistic site reviews to audit environmental performance. This included reviewing the compliance with the Contractors' EMP, effectiveness of environmental mitigation installations, environmental monitor performance and providing recommendations for improvement.

Twenty five Site Visit Reports were generated by the Environmental Auditor (AESC) during the course of bridge construction.

9.6 Olympia Oyster Salvage

World Fisheries Trust (WFT) were retained to complete an impact assessment of the potential impacts of construction on a flourishing local population. WFT is widely recognized within the scientific community as experts in this oyster species. As part of the scope of the WFT assignment, they were to complete the salvage of Olympia Oysters from the impact site and maintain them live in submerged trays nearby until such time they could be transferred to two artificial reefs constructed specifically for this purpose by the Project.

To do this, WFT was required to establish the salvage zones that would coincide with the permanent footprint of the bridge piers. During salvage, oysters were enumerated. A total of approximately 100,000 Olympia Oysters were salvaged (as determined by volume) from the impact zone and transplanted to the artificial reefs constructed of imported Japanese Oyster shell debris (i.e. shell hash). More detailed discussion on the compensation requirements for Olympia Oyster is provided in Section 11.1, below.

Photo 9.6-1 Olympia Oyster shell hash mixed with live Olympia Oysters around pre-existing bridge pile.

Photo 9.6-2 Surveying the footprint of the Olympia Oyster salvage zones/replacement bridge piers.

9.7 Temporary Termination of In-water Activities during Observed Fish Stress

Photo 9.7-1 Threespine Stickleback schooling around worksite.

In the event fish were observed to be impacted by in-water construction activities, those activities would be temporarily terminated until other mitigation efforts could be initiated. There were no instances of observed fish distress (e.g. change in swimming behaviour).

Threespine Stickleback and other fish species were routinely observed schooling around the worksite with no indication of stress or other impact. Coho smolts were periodically observed mid-channel while shiner perch were observed moving with the tide at the north end of the site.

9.8 Fish Salvage during Pier Caisson Sheet Piling Installation

By maintaining an opening at the upstream and downstream end of the caisson sheet piling, it was hoped that fish would be encouraged to move out with the tidal flow such that no fish would be trapped inside the caisson enclosure. To ensure maximum effort was employed to remove as many fish as possible, seine nets were used to sweep fish out of the enclosure prior to the installation of the final sections. This is discussed in more detail in Section 10.7.

9.9 Creosote Timber Pile Removal

The pre-existing Craigflower Bridge consisted of 20 spans and 114 creosote-saturated timber piles constructed in 1933. In consultation with DFO, it was agreed that all piles would be removed to stop the ongoing leaching of creosote into the Gorge Waterway. This requirement is stipulated in Schedule 4 of the Authorization. Piles were pulled using a vibratory hammer (see Section 7.0). In most instances, the residual hole infilled with sediments as the hole collapsed. In most cases, this occurred almost immediately after pile pulling. In relatively few instances, the hole took several days to eventually infill. This infilling effectively capped off any creosote sequestered in the sediments around the pile.

9.10 Vibratory Hammer Pile Driving and Removal – Turbidity and Overpressure Monitoring

Turbidity and overpressure monitoring during pile driving and pile removal were undertaken by Aquaparian. Overpressure monitoring was conducted in a manner consistent with the following guideline:

Best Management Practices for Pile Driving and Related Operations – BC Marine and Pile Driving Contractors Association - March 2003

Numerous overpressure monitoring events did not result in overpressure levels near or in excess of the accepted threshold of 30kPA. The maximum reading achieved was 7.07 kPA on April 24, 2013, as reported by Aquaparian in Environmental Field Report #5.

9.11 Temporary Work Bridge

The temporary work bridge was proposed by Ruskin to provide unconstrained access across the Gorge Waterway. The work bridge was primarily required to facilitate bridge construction in those areas that were inaccessible to heavy equipment such as concrete trucks, pile driving equipment, pipe and sheet piles, materials delivery (e.g. rebar and formwork for caissons) and worker access. The design of the work bridge consisted of a primary crossing. Three fingers extended off the work bridge (Figure 2). The location of each finger coincided with the respective replacement bridge piers. See photos provided in Section 6.0.

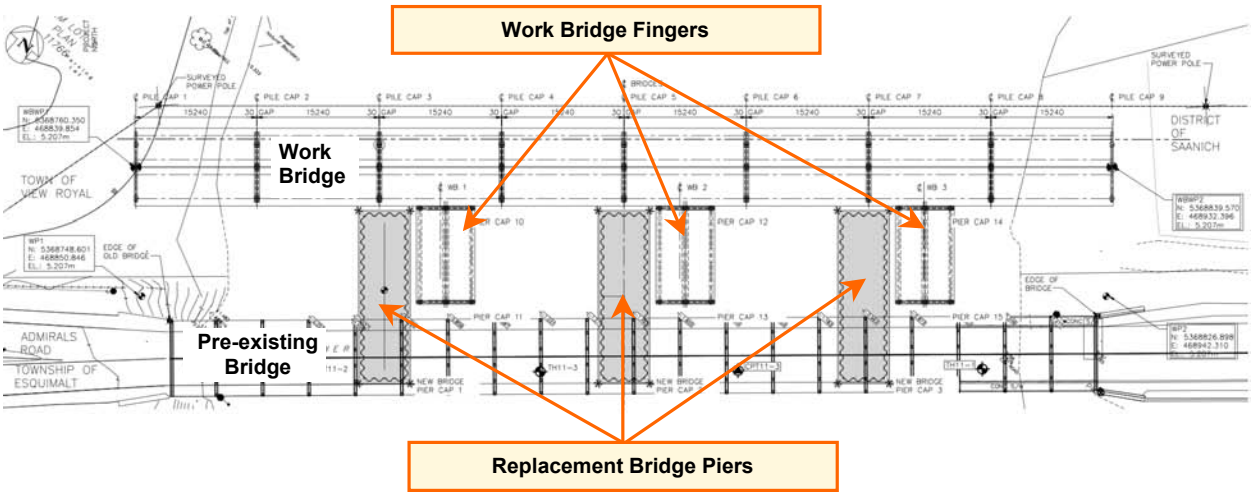


Figure 2 Temporary work bridge design plan view (designed by All-Span[7] for Ruskin).

The 8-span work bridge was not considered or included in the application for Authorization of this Project, nor was it included in the Authorization document. However, DFO was fully consulted on the proposal to install the bridge. Consequently, the Contractor was required to prepare and submit an Environmental Impact Assessment to DFO for review and acceptance prior to initiating the construction of this structure.

Temporal (i.e. Olympia Oyster displacement) and permanent (i.e. loss of riparian vegetation) environmental impacts associated with this structure were in addition to those reported in the Authorization application prepared by AESC. Mitigation and compensation initiatives for the overall Project were upgraded to offset these impacts.

7 *Craigflower Bridge Replacement – Work Deck Arrangement Drawing No. 3, Revision C* – March 25, 2013. All-Span Engineering & Construction Ltd.

9.12 Elimination of Bird Overhead Wire Strike Risk

Photo 9.12-1 Elimination of overhead wiring.

As reported in Section 9.3, wires previously suspended over the pre-existing Craigflower Bridge deck were replaced and conveyed across the Gorge Waterway through ducts under the bridge. This eliminated the issue of bird wire strikes, primarily by migratory birds (including Trumpeter Swans).

9.13 Invasive Plant Species Management

The riparian zones of both the north and south banks were densely colonized with invasive and unwanted plant species. Most notably, English Ivy was well established on the northwest bank while Himalayan Blackberry was established on the southwest bank. These plant colonies were removed from within the Project area prior to the implementation of the riparian planting prescriptions for these zones.

9.14 Raingarden and Oil-Grit Separator Water Treatment Facilities

Photo 9.14-1 Water treatment raingarden.

To address stormwater water quality management, a raingarden was installed on the south bank. It receives road runoff from Admirals Road south of the bridge. This facility provides mechanical treatment (settlement) of runoff water by removing mobilized sediments prior to discharge to the Gorge Waterway. It also allows for infiltration of water into the ground thereby enhancing treatment.

An oil-grit separator has been installed just north of the bridge in the northbound lane. This engineered structure provides a mechanism for trapping oils and other contaminants to prevent them from releasing to the Gorge Waterway.

9.15 Use of Baffled Primary Water Treatment Hopper

There was no opportunity on the Project site to construct water treatment ponds. In response to periods when sediment-laden water was generated, the Contractor employed the use of a mobile water treatment container to provide this function. This multi-cell facility allowed the

Contractor to pump silt-laden water to the container for settlement. As water passed through the cells, additional water settlement was facilitated such that the discharge water was much cleaner.

Photo 9.15-1 Silt-laden water treatment tank prior to filling.

Photo 9.15-2 Operational water treatment tank.

9.16 Fuel Spill Response

The Contractor was required to prepare and maintain on-site a Spill Response Plan for use by all site workers. This Plan included maintaining fully equipped spill kits on-site for use in the event of a fuel spill. The spill kit capacities were able to address volumes that could be expected on the construction site. Also, floating booms around the worksite were deployed to contain any (floating) spilled material for as-required remediation.

In addition to the more comprehensive Spill Response Plan, Aquaparian incorporated summary information on spill identification and response in their Environmental Protection Plan referenced in Section 9.1.3, above.

9.17 Cast-in-Place Concrete Pouring and Wastewater Management

Photo 9.17-1 Contained concrete slurry during construction of the south abutment.

All concrete wastewater was contained to ensure it was not released to the Gorge Waterway. Ruskin maintained a CO_2 diffuser on-site during all concrete pours in the event of accidental release to the Gorge Waterway.

9.18 Implementation of Worker Environmental Orientation

In conjunction with other worker site meetings, the Environmental Monitor attended and/or was aware of the occurrence of these meetings and prepared tailgate sessions on environmental awareness for all site workers.

9.19 Response to First Nations Archaeological Deposits and Remains

Golder Associates Ltd. completed archaeological assessments and consultation with First Nations during the planning and design phases of this Project. This work element was not part of the environmental scope of the overall Project.

Known midden deposits were identified at several locations within the Project site during the initial stages of Project planning and design. Most deposits were at the northwest quadrant of the bridge. In consultation with Esquimalt First Nations (EFN) and Songhees First Nations (SFN), materials excavated from this midden site were relocated to a nearby site acceptable to both First Nations.

A previously unknown First Nations burial site was also uncovered at the northwest quadrant of the bridge during construction. In consultation with EFN and SFN, the remains were fully excavated and relocated to an alternate burial site nearby.

10.0 SUMMARY OF ENVIRONMENTAL CONCERNS AND ISSUES ENCOUNTERED

10.1 Contractors' Overall Environmental Performance

The Contractors were required to adopt and implement the Environmental Protection Plan prepared specifically for this Project. In addition, they were obliged to ensure adequate environmental oversight by their Environmental Monitor (EM) was implemented, which included following the advice and recommendations provided by the EM and Owners' Representative on environmental-related issues.

Overall, there were no significant environmental issues or incidents encountered on this Project. While every large-scale construction project experiences small environmental incidents such as sediment releases, small oil spills, etc, these are typically short-lived and quickly resolved.

On this Project, the Contractors, in consultation with their Environmental Monitor and/or the Owners' Environmental Auditor, were able to proactively deal with potential environmental concerns and issues. Similarly, they were responsive to the environmental requirements of the Project as stipulated in the Authorization and on a day-to-day basis.

The following information summarized environmental issues that required resolution by the Project team regardless of whether the issue was a result of the bridge construction or not.

10.2 Sediment Release during Pile Driving and Temporary Bridge Pile Removal

During pile driving and removal, sediment generation was unavoidable and could not be reasonably contained and removed from the worksite to prevent release to the water column. During pile driving using the vibratory hammer, the vibration mobilized sediments but the sediment-laden slurry was generally contained within the hollow pile. During removal, sediments along the walls of the pile were carried to the surface and released in small amounts into the water column. During slack tide, this suspended sediment remained around the worksite. However, during ebbing and flooding tides, the sediment was quickly carried away and dispersed. There was no significant turbidity associated with these activities.

In some situations, floating booms were utilized to contain any possible petrochemical spills. However, due to tidal activity, it was not possible to effectively contain silt around the pile

installation area with floating curtains that draped for several metres, since the tidal movements carried the floating curtain up against the piles.

Photo 10.2-1 Sediment release during temporary work bridge pile pulling.

Photo 10.2-2 Dissipation of sediment released during temporary work bridge pile pulling.

10.3 Sediment Release during Timber Pile Removal

Pulling the timber piles using the vibratory hammer resulted in minimal release of sediments or creosote. Once the pile was removed, the remnant pile hole collapsed into itself resulting in a small release of sediment. However, it was recognized that this extremely fine-textured (clay-like) sediment release was quickly dispersed by currents within the water column. It was determined that no reasonable action could be implemented and therefore no further action was required.

10.4 Waterline Breakage and Release to Storm Drainage

Photo 10.4-1 Storm outfall containment.

During road works along Gorge Road, construction crews inadvertently fractured a City waterline, which flooded the excavation and released overflow water to a nearby storm drain. This storm drain discharged water directly to the Gorge Waterway by way of a nearby outfall. Crews quickly responded by constructing a sandbag and silt fencing containment around the outfall to ameliorate the situation. The water release was quickly turned off and the break was repaired.

10.5 Leakage from Water Treatment/Settlement Hoppers

The use of settlement hoppers (discussed in Section 9.15, above) was effective in providing mechanical settlement of suspended sediments prior to release to the Gorge Waterway. Some insignificant leakage occurred from these steel containers, as they were not 100% watertight. In response, a combined installation of silt fencing and straw bales was deployed at the discharge point of the leakage to filter as much of the leakage as possible. These releases were considered negligible and no further action was required.

10.6 Oil Sheen Observed on Gorge Waterway in Vicinity of Project

An oil sheen was observed by construction crews and the Owners' Site Supervisor. Crews quickly investigated to ascertain the source of the oil, concerned it might have been from the Project site. On investigation, it was determined it was not a result of site works but originated from a spill somewhere upstream. A spill into the vicinity of Colquitz Creek occurred around the time of this observation and may have been attributable to the site observations. The wide dispersal of the oil sheen did not allow for a reasonable response from the Project. As such, no further action was taken.

10.7 Caisson Fish Salvage

Ruskin was required by DFO to salvage fish potentially trapped inside the caisson enclosures prior to dewatering and pouring of the pier footings. This was done using seine nets prior to the installation of the final sheet piles. In discussion with the Owners' Site Supervisor and environmental team, it was decided that maintaining an upstream and downstream opening in the sheet piling would encourage fish to move out with the current. Seine nets were deployed and swept through the caisson enclosure to further encourage remaining fish to move out.

In reality, very few marine fish species (including Threespine Stickleback and Pipefish) were captured during four passes of the seine net through the caisson enclosure. No salmonids were salvaged. It's unlikely Coho Salmon smolts or other salmonids would remain in the caisson with the installation of the sheet piling using a vibratory hammer. Rather, the significant disturbance associated with pile driving would likely cause fish to quickly evacuate the site.

11.0 ENVIRONMENTAL IMPACT COMPENSATION

11.1 Olympia Oyster Habitat Replacement

11.1.1 Olympia Oyster Colonization Reefs

WFT identified in their compensation assessment study two candidate sites where Olympia Oyster compensation sites could be established. These sites were selected as they exhibited conditions that were suitable for establishing colonization reefs. These reefs were constructed specifically for transplanting salvaged oysters to re-establish populations elsewhere in the Gorge Waterway. These sites are generally shown in Figure 3.

Site 1 (= Authorization Site A-2) is located at Christie Point. Site 2 (= Authorization Site F) is located adjacent to Esquimalt-Gorge Park.

General details of the reef sites are provided in Table 2, below for information.

Table 2 Compensation Olympia Oyster Colonization Reef Locations

Reef Element	Site 1 – Christie Point	Site 2 – Esquimalt-Gorge Park
Location Coordinates (Lat.-Long.)	48° 27' 27.05" 123° 25' 25.20"	48° 26' 50.12" 123° 24' 25.23"
Pea gravel base used	None	~15,000 kg
Oyster shell hash used	~11m^3	~11m^3
Reef dimensions	Numerous – 2m diameter x 0.3m deep	Numerous – 2m diameter x 0.3m deep
Oyster placement	1/2 of total volume of salvaged oysters (~5,800 litres); scattered randomly	1/2 of total volume of salvaged oysters (~5,800 litres); scattered randomly

Information presented in Table 2 provided by WFT.

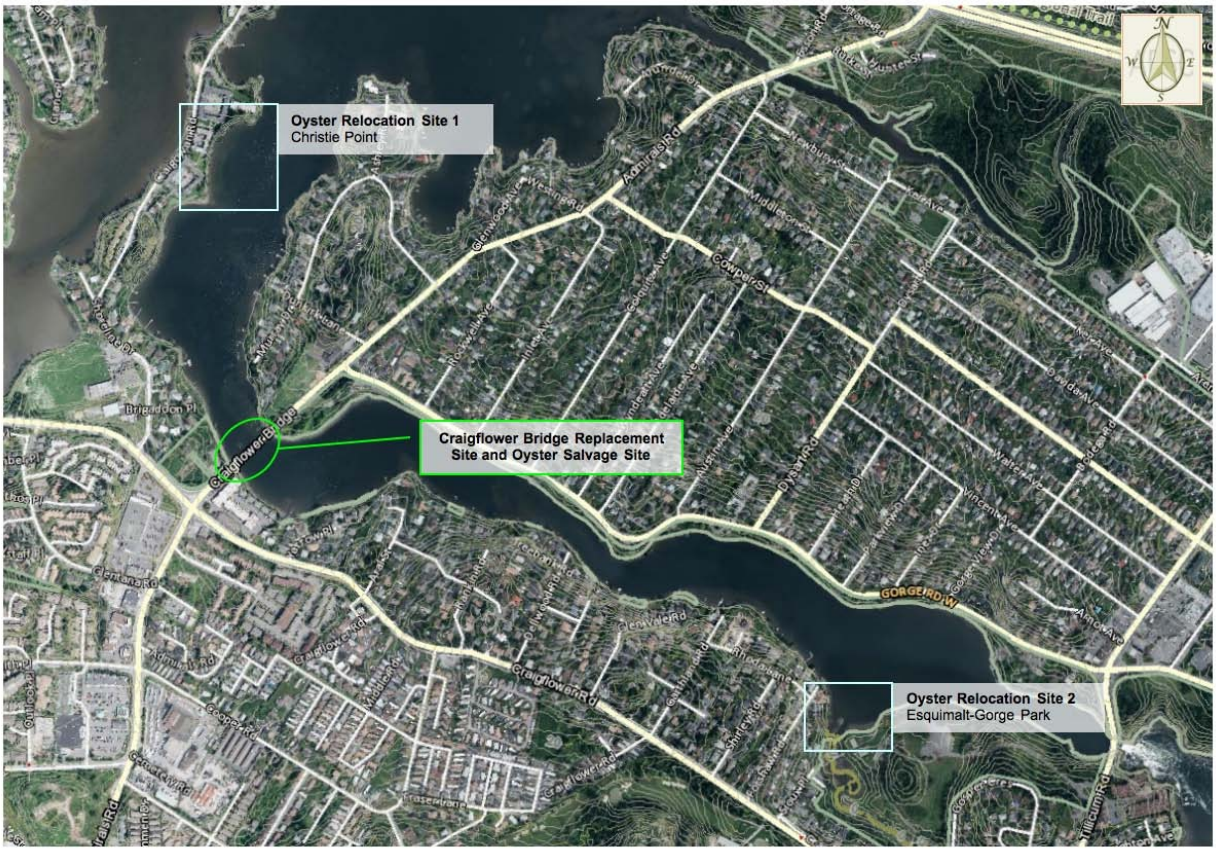


Figure 3 Olympia Oyster compensation site locations in relation to the Craigflower Bridge Replacement Project location (AESC 2014[3]).

Photo 11.1.1-1 Pressure washing oyster shell hash for use as colonization reefs.

Waste Japanese Oyster hash was obtained from Fanny Bay Oysters in Fanny Bay, BC. This material was trucked to a staging site near the Project site that was isolated from any hydraulic connection to the marine environment.

At this staging location, shell hash was pressure washed to remove undesirable organisms and to eliminate the likelihood of transfer of organisms to the Gorge Waterway. Following pressure washing, shell hash was sterilized with bleach to kill any remaining organisms and spread at the cleaning site to sun dry.

Once all preparations were made for the Olympia Oyster transplant (including all salvage initiatives), shell hash was transported by truck and skiff to the colonization reef sites and placed by hand. These reefs provided the growing medium for the transplanted oysters and a settlement habitat for colonization of Olympia Oyster larvae carried through the Gorge Waterway. All salvaged Olympia Oysters were accommodated on the colonization reefs.

11.1.2 Oyster Colonization Panels on Replacement Bridge Pier Footings

WFT determined that the pre-existing bridge provided vertical habitat for Olympia Oyster colonization totaling ~9m^2 on the creosote-coated timber bridge piles. This habitat within the water column provided oyster attachment areas that were off the bed of Gorge Waterway and thereby less susceptible to impacts from siltation.

To replace this loss of habitat, WFT recommended that horizontally corrugated panels be incorporated into the replacement bridge pier design. Originally, these panels were to be attached directly on the portion of the bridge pier footings, which extend above the bed of the Gorge Waterway. Horizontal corrugations were specifically recommended as it was concluded by WFT that this orientation provided a better attachment medium for Olympia Oyster than vertical corrugations. Further, it was concluded that competing species such as mussels preferred vertical corrugations. Ultimately, these corrugations were formed directly onto all four walls of each of the six pier footings, providing a total of 180m^2 of replacement vertical habitat.

Photo 11.1.2-1 Forming the corrugated oyster colonization panels.

Photo 11.1.2-2 Exposed corrugated oyster colonization panels.

11.2 Saltmarsh Relocation

Less than 3m^2 of Saltmarsh (intertidal marsh habitat) was impacted by encroachment of construction. This Saltmarsh habitat was removed by hand and transplanted at a location immediately east (downstream) of the bridge. While not shown in Photo 11.2-2, the Saltmarsh relocation site is fenced to prevent trampling by beachcombers and pets.

Photo 11.2-1 Saltmarsh habitat to be salvaged.

Photo 11.2-2 Highlighted Saltmarsh habitat relocation site.

Photo 11.2-3 Saltmarsh buds in spring 2014.

11.3 Riparian Planting and Invasive Plant Species Removal

All four quadrants of the bridge crossing site were impacted by the design and construction of the replacement bridge and the temporary work bridge. These impacts were primarily associated with the upstream banks (i.e. northwest and southwest quadrants), as the replacement bridge and work bridge extended upstream of the pre-existing bridge. Riparian impacts on the downstream side of the bridge (i.e. northeast and southeast quadrants) were less severely impacted. This was because the east edge of the replacement bridge generally aligned with the pre-existing bridge such that encroachment was minimized.

An intensive riparian planting initiative was undertaken on the upstream banks. Plants were installed at approximately 1m spacing using a native plant species prescription comprising trees and shrubs developed in consideration of pre-existing conditions and accepted guidelines. Riprap bank armouring around the abutments extended into the downstream bank areas. It is difficult to plant these areas. However, to provide a nominal amount of riparian replacement, planting wells using vertical pipes were installed within the riprap. This is rarely done. Shrub plants were installed into these wells as a measure that over time will establish localized vegetated cover.

Photo 11.3-1 Preparation of the northwest quadrant bank for riparian planting.

Photo 11.3-2 Prepared northwest quadrant with topsoil and temporary irrigation.

Photo 11.3-3 Planted northwest quadrant.

Photo 11.3-4 Prepared southwest quadrant with topsoil and temporary irrigation.

Photo 11.3-5 Planted southwest quadrant.

Photo 11.3-6 Planting wells in riprap on southeast quadrant.

12.0 Habitat Balance Table

A detailed Habitat Balance Table for the Project is provided in Appendix 1. This table quantifies pre- and post-construction anticipated (estimated) impact and compensation vs. actual (constructed) constructed impacts and confirmation. Further, this table confirms what was built (through as-built plans), and if replacement or additional compensation is required. Additional details on the compensation habitat construction are provided in the Notes page following the Habitat Balance Table. Table 3 summarizes the overall habitat balance.

Table 3 Habitat Balance Summary Table

Habitat Type	Total Actual Harm	Total Compensation	Habitat Balance	Comment
Subtidal Substrate	94	0	-94	Compensation at off-site location
Aquatic (Olympia Oyster Habitat)	410	787	377	Combined compensation – vertical habitat + colonization reefs
Shade	0	0	Neutral	-
Saltmarsh	2	10	8	-
Riparian	112	125	13	Additional riparian impacts associated with temporary work bridge

13.0 Post-construction Monitoring Program

13.1 Post-construction Monitoring Schedule

The post-construction monitoring program (PCMP) as described in Sections 4.4 and 5.2 of the Authorization has not yet been initiated as the Project is at Year 0+ of completion. The PCMP program will be undertaken based on the following schedule provided in Table 4.

Table 4 Post-construction Monitoring Schedule

Post-construction Monitoring Element	Authorization Reference	Monitoring Years	Monitoring Dates
Providing a written description of the condition of the compensatory habitat and its ancillary components	Condition 5.2.1	1, 3 & 5	December 31, 2015, 2017 & 2019
Providing dated photographs of the compensatory habitat and its ancillary components	Condition 5.2.2	1, 3 & 5	December 31, 2015, 2017 & 2019
Verify that the Olympia Oyster density when extrapolated over each recipient site [referenced as Authorization Site A2 (= Site 1 in this report and Authorization Site F (= Site 2 in this report)] of relocated Olympia Oyster is maintained relative to the baseline densities of each site documented at the time of relocation.	Condition 4.4.1	5	December 31, 2019
Verify that compensatory riparian habitat demonstrates 90% survival of planted native vegetation for each year of monitoring (conducted in the spring).	Condition 4.4.2	1, 3 & 5	Spring 2015, 2017 & 2019
Verify that created intertidal marsh (i.e. Saltmarsh) habitat will be considered established if the planted area demonstrates at least 75% areal coverage with healthy plants for each year of monitoring (conducted in the spring) of the target Saltmarsh species (*Salacornia viginica*).	4.4.3	1, 3 & 5	Spring 2015, 2017 & 2019
Submission of post-construction monitoring reports.	Condition 5.2	1, 3 & 5	December 31 of each monitoring year (2015, 2017 & 2019)

13.2 Owners' Commitment to Complete Compensatory Remedial Works

The Owners commit to completing remedial works on any aspect of the compensatory habitat (i.e. Olympia Oyster colonization reefs, Saltmarsh replacement habitat and riparian revegetation) if determined through the PCMP to be deficient. The schedule to complete these remedial works (if required) will be in the year of the identification of the deficiency. Replacement planting of the riparian and Saltmarsh zones must occur prior to June of the Monitoring Year.

14.0 OUTSTANDING ENVIRONMENTAL ISSUES

14.1 Outstanding Environmental Issues

There are no identified outstanding Project-related issues associated with the replacement bridge design, construction and commissioning.

14.2 Unavoidable Potential Impacts on Compensatory Habitat

14.2.1 Sediment Deposition into the Gorge Waterway

It is unlikely that most small sediment-release events into the Gorge Waterway will impact colonization of the vertical habitat on the replacement bridge piers as suspended sediments will be flushed through. However, it is possible that a severe event consisting of particulates that

are able to settle onto a colonization reef can impact Olympia Oyster survival. For example, there have been recent environmental impacts (i.e. winter 2013-14) on the Gorge Waterway unrelated to this Project that have the potential to impact the functionality of the in-water compensatory works. Specifically, WFT has identified excessive sediment deposition on the Site 2 oyster colonization reef such that transplanted oysters and potentially newly colonizing oyster larvae may have been adversely impacted.

The Project has no ability to address these urban occurrences. The findings of the PCMP may identify and report on lack of functionality, which cannot be mitigated or addressed through remedial measures.

14.2.2 Petrochemical Spills into the Gorge Waterway

A recent oil spill in the Gorge Waterway resulted in an impact on several waterfowl. Response by the BCSPCA Oil Spill Response Team recovered approximately six impacted birds. It is unclear how many unrecovered birds and mammals might have been impacted. Further, it is not known if dissolved petrochemicals from this and other future spills will adversely affect the viability of the compensatory oyster colonization areas. It is likely that the impacts will be negligible considering Olympia Oysters appear to thrive at the bridge site despite the regular occurrences of urban impacts on the Gorge Waterway.

15.0 CONCLUSIONS

This report summarizes the demolition of the pre-existing Craigflower Bridge and the subsequent construction of the replacement Craigflower Bridge. Further, details are provided regarding the environmental protection mitigation measures implemented during construction, compensation initiatives constructed to offset unavoidable environmental impacts and requirements for post-construction monitoring as required by the *Fisheries Act* Authorization.

Overall, the construction project was undertaken in an environmentally responsible way that was consistent with the requirements of the Owners, the Owners' field representatives, the construction Contractors, and the Authorization.

All compensatory habitat, including [1] riparian planting, [2] Saltmarsh relocation, [3] Olympia Oyster salvage, [4] construction of two Olympia Oyster colonization reefs, [5] transplantation of salvaged Olympia Oysters to the reefs, and [6] incorporation of vertical corrugated Olympia Oyster colonization habitat panels onto the bridge footing walls were completed as required by the Authorization.

There are no outstanding environmental works required to fulfill the Terms and Conditions of the Authorization.

Prepared by
Craig Barlow, R.P.Bio., QEP

cb/

Distribution: Michelle Bigg, Habitat Biologist (Fisheries and Oceans Canada)
Jim Hemstock, Manager of Transportation (Corporation of the District of Saanich)
Deb Becelaere, Superintendent of Engineering (Town of View Royal)
Troy McKay, Project Manager (Corporation of the District of Saanich)
Don Couch, Owners' Site Representative (CMS-Focus)
Rob Waters, R.P.Bio. (Castor Consultants Ltd.)
Joachim Carosfeld, Ph.D. (World Fisheries Trust)
Bob Chapman, RChapman Environmental Monitoring Services (for AESC)

<><><><><><><><><><><><><><><>

APPENDIX 1

HABITAT BALANCE TABLE

Habitat Balance Table (Table notes provided on next page)

Feature Type and Activity	Authorized Harm (m^2) Column A (as per Auth)	Authorized Compensation (m^2) Column B (as per Auth)	Estimated Compensation and Ratio (m^2)	Actual Harm (m^2) Column C (as-built)	Actual Compensation (m^2) Column D (as-built)	Net Habitat Balance (m^2) Column E (D-C)	Replacement or Additional Compensation Column F
	Pre-construction (Areas as reported in the Authorization)			**Post-construction**			
Subtidal Substrate (Notes 1 & 2)	141 (new pylons) (minus 47 (old piles)	0	Compensation -94 / Ratio - 3:1 (loss)	-94 (new pylons)	0	-94	None (Compensation gain at off-site locations)
Aquatic (Olympia Oyster Habitat) Pylon construction (Note 2)	410 (Note 2a)	877 (683+14+180)	Compensation +467 / Ratio + 2.1:1 (gain)	410	787 (683+14+90) (Notes 2b & 2c)	377 (Note 2d)	None
Shade	-	-	-	-	-	-	Neutral
Saltmarsh (Note 3)	4	8	Compensation +4 / Ratio +2:1 (gain)	2	10	8	None
Riparian – Shoreline Vegetation (Notes 4-6)	72	125	Compensation +53 / Ratio +1.7 :1 (gain)	112	125	13	None
Riparian South Bank Riprap (Above HWM) (Note 5)	70	70	Compensation 0 / Ratio 1:1	-	-	-	Neutral

Habitat Balance Table Notes

1. The pre-construction Aquatic Effects Report did not factor in the construction of the temporary work bridge. This work bridge was proposed by the contractor and approved in consultation with DFO following an impact assessment completed by Aquaparian in which the impact was determined to be approximately **14m^2**. As the aquatic impact associated with the work bridge was temporal (i.e. not a permanent loss) and mitigated through additional oyster salvage and relocation, it is not factored into this Habitat Balance Table.
2. a) **410m^2** represents World Fisheries Trust estimate of the total area of Olympia Oyster salvage (240m^2 from pre-existing bridge timber piles and area under the pre-existing bridge + 170m^2 from the area of the footprint of the new bridge footings).

   b) Compensation for permanent loss of substrate habitat has (in part) been provided at two off-site locations (see Section 11.1.1 of this Report). The total area required for this off-site compensatory habitat was estimated to be approximately **683m^2**. WFT estimates that approximately 5,800 litres (5.8m^3) of salvaged shell hash with Olympia Oysters attached were salvaged (representing approximately 100,000 Olympia Oysters). During oyster relocation, WFT constructed sufficient reef habitat to accommodate all of the salvaged oysters as well as providing colonization habitat for new oysters. These reefs were placed in two approximately equal size artificial colonization reefs (i.e. total of approximate 215m^2 of reef habitat comprising 2,900 litres of salvaged oysters per site) to dimensions determined appropriate by WFT during the transplant phase. These reefs supplement existing natural substrate (i.e. coarse, granular substrate and not mud) in the vicinity of the reef sites.

   c) 180m^2 of vertical habitat on corrugated panels on the replacement bridge abutment wall (see Section 11.1.2 of this Report) provides additional onsite habitat replacement[8]. DFO credited the Project with 0.5:1 ratio for this vertical habitat (i.e. 180m^2; as shown in the 'Authorized Compensation' areas reported in the table). The Actual Compensation shown in Column D of the Habitat Table (i.e. **90m^2**) represents one half of the 180m^2 actual total compensation area associated with the vertical habitat.

   d) The total area of off-site and onsite habitat is approximately 877m^2 (actual area not considering the reduced 0.5:1 ratio credit for the vertical habitat). Accounting for the reduced credit, the total compensation area is **787m^2** for a net habitat balance of **377m^2**. WFT has advised that the total area of the reefs is still approximately as originally estimated because the reefs were required to elevate Olympia Oysters off the mud bottom. The hash was placed heterogeneously to improve theoretical survival, improve settlement opportunities by creating more backwater eddies around the patches, and enhance habitat for fish – in particular, out-migrating juvenile salmonids. Oysters were placed in smaller densities than those encountered at the salvage site to improve survival.
3. The relocation of salvaged Saltmarsh was placed in an area approximately 1m wide X 10m long as shown in Photo 11.2-2.
4. Riparian loss reported in the post-construction component of the Habitat Balance Sheet reflects an increase in riparian impact associated with the temporary work bridge. Aquaparian estimated this additional impact to be approximately 20m^2 on each bank (north and south). This impact area was factored in the original riparian revegetation proposal as described in the Authorization, which included invasive species removal and infill revegetation. The total impact is the sum of the impacts reported in the Authorization (72m^2) plus the 40m^2 estimated by Aquaparian for a total of 112m^2.
5. In addition to compensatory planting on the north and south banks, three riparian planting wells (consisting of a vertically placed 1m diameter PVC pipe) were installed within the south bank riprap and two within the north bank riprap (see Section 11.3 of this Report). This represents a total additional planting area 3.95m^2.
6. Riparian revegetation included a combination of planting native plant shrub and tree species and the removal of pervasive invasive plants (predominately English Ivy and Himalayan Blackberry). The compensatory ratio is less than the ratio reported in the Authorization, but still greater than the accepted 1:1 ratio. For this reason, the benefit of invasive plant removal and infill planting is still considered a reasonable offset to impacts at the site.

---

[8] Authorization Schedule 4 – Project Note 5 incorrectly reports that the pylons provide 360m^2 of vertical habitat for Olympia Oyster colonization. The as-built pylons provide 180m^2 of vertical habitat.

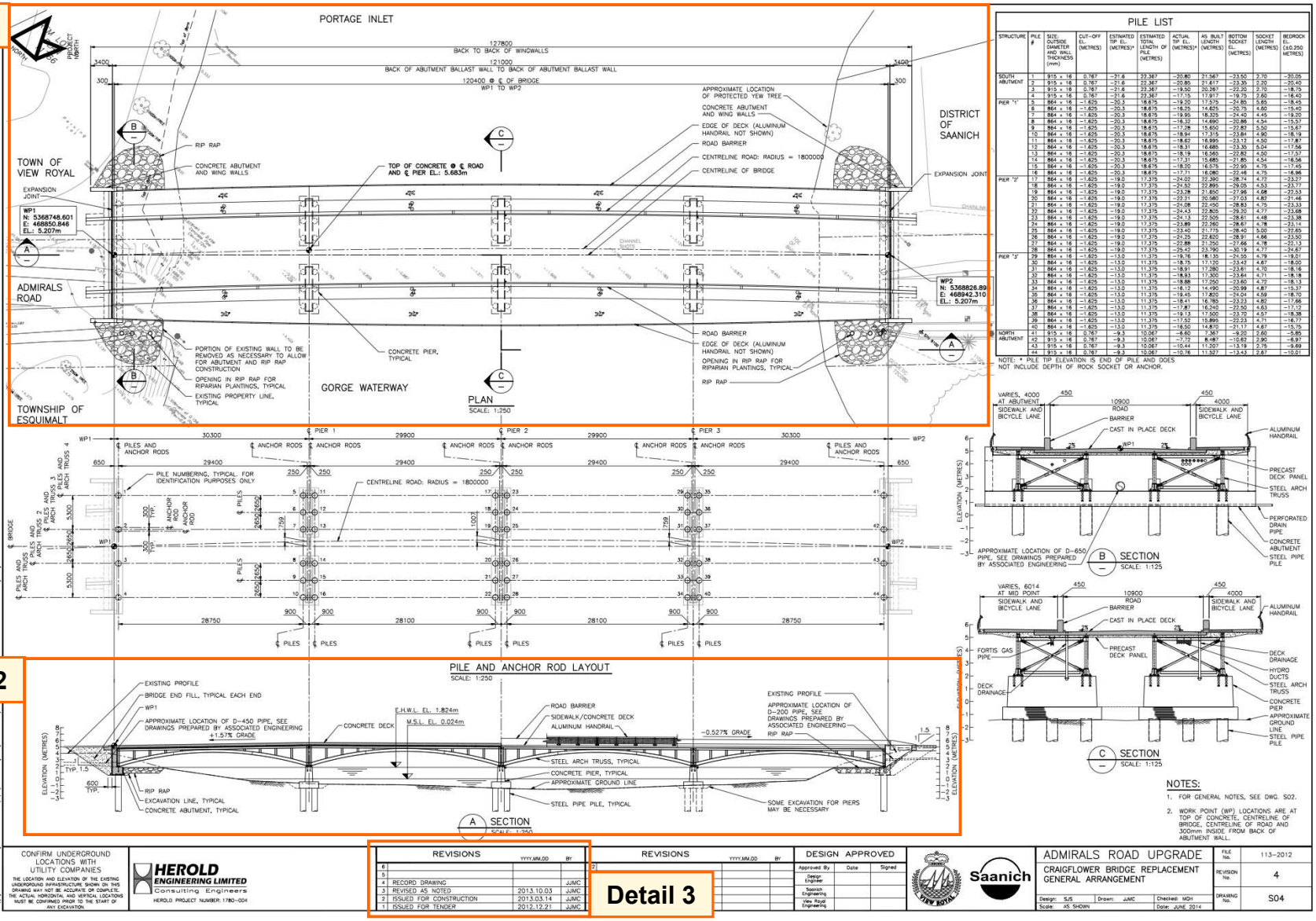
APPENDIX 2

BRIDGE DESIGN PLAN AND PROFILE RECORD DRAWINGS

(Prepared and provided by Herold Engineering Ltd.)

PLAN AND PROFILE RECORD DRAWING (Drawing No. S04 – Revision No. 4)

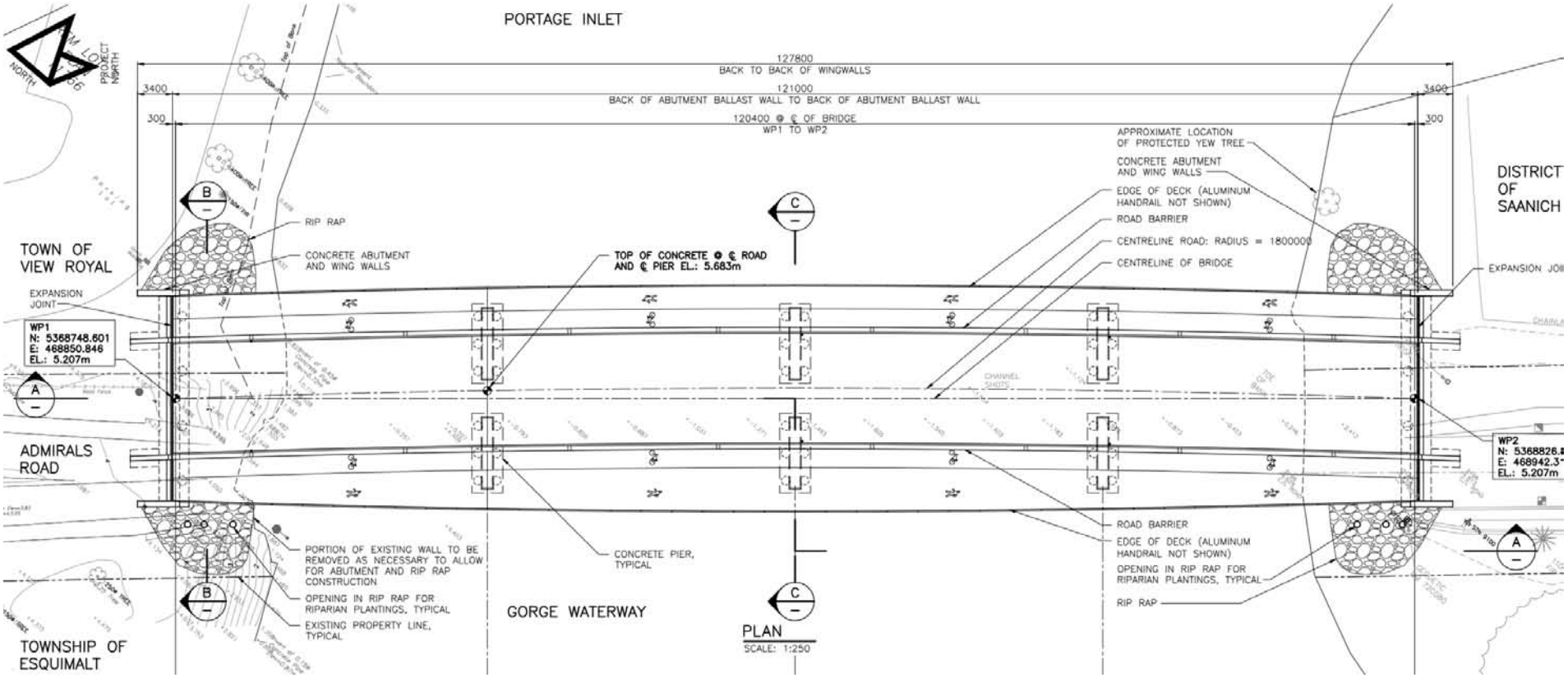
Detail 1



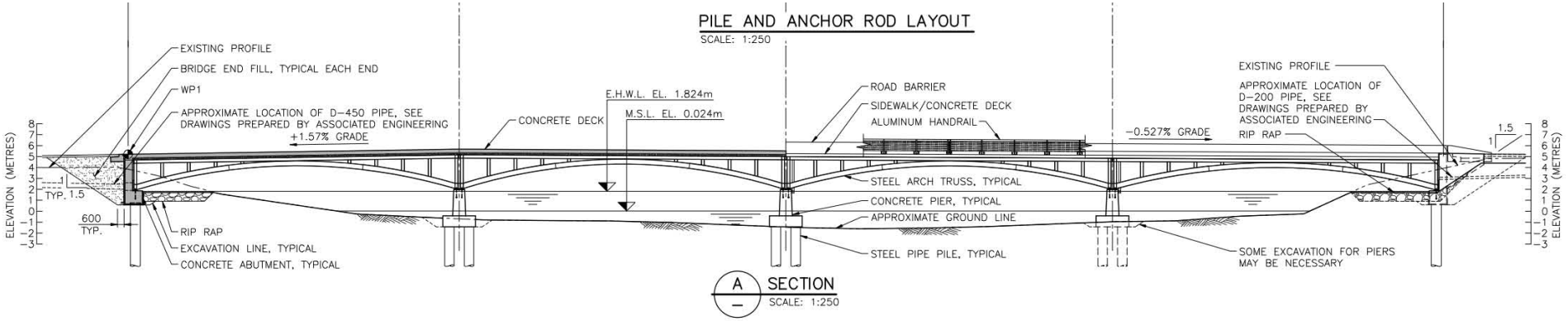
Detail 2

Detail 3

DETAIL 1 PLAN VIEW DETAIL



DETAIL 2 PROFILE VIEW DETAIL



DETAIL 3 TITLE BLOCK REVISION LOG

	REVISIONS	YYYY.MM.DD	BY
6			
5			
4	RECORD DRAWING		JJMC
3	REVISED AS NOTED	2013.10.03	JJMC
2	ISSUED FOR CONSTRUCTION	2013.03.14	JJMC
1	ISSUED FOR TENDER	2012.12.21	JJMC

APPENDIX 3

CRAIGFLOWER BRIDGE – BEFORE AND AFTER PHOTOGRAPHS (PROVIDED BY CMS-FOCUS)

Fall 2012

Spring 2014