Nova Pacific Environmental

Environmental monitor's Post-Construction Report

2024 VEDDER RIVER SEDIMENT REMOVAL PROJECT
CHILLIWACK & ABBOTSFORD, BC

Version 1.0 – Mar 24, 2025

File No. 1629

Prepared for:

BC Ministry of Lands, Water and Resource Stewardship &
Fisheries and Oceans Canada

On behalf of:

BC Ministry of Environment and Climate Change Strategy

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EXECUTIVE SUMMARY

As described in the Project Plan, the 2024 Vedder River Sediment Removal Project aimed to remove 243,500 m^3 of sediment from naturally dewatered sediment bars between Vedder Crossing Bridge and Highway 1 Bridge on the Vedder River to restore flood protection. The Project Plan identified twelve bars and provided pit excavation designs consistent with established guidelines for the protection and enhancement of fish and fish habitat (TetraTech 2015, NPE 1999). The Fisheries Act Authorization #24-HPAC-00190 Water Sustainability Act Change Approval #2010455 for the project, authorized the removal of 243,000 m^3 of sediment during the permitted work window from S45, Giesbrecht, Peach, Lickman, Brown, Bergman, Railway, Greendale, Salad, Powerline, and Chadsey Bars. The total authorized area of habitat alteration or disturbance was 72,300 m^2 and the required area for habitat enhancement within the same timeframe was 19,040 m^2.

This report has been prepared to satisfy the reporting requirements of the *Fisheries Act* Authorization and *Water Sustainability Act* Change Approval for the 2024 Vedder River Sediment Removal Project. This report describes the observations and activities of full-time environmental monitors, including project activities, field fitting of excavation designs, excavation and offsetting works completed, water quality data, application and effectiveness of mitigation measures, challenges and contingency measures implemented, lessons learned and recommendations for future sediment removals on the Vedder River. This report also provides recommendations for updates to the Site Selection and Design Guidelines for Sediment Removal (TetraTech 2015).

In summary, project works completed in 2024 involved ten pit excavations with a total disturbance area of 55,052 m^2 (76% of the proposed area; NPE 2024b) and 15 offsetting activities with an enhancement area of 17,069 m^2 (89% of the proposed area; NPE 2024b). Eight offsetting activities were part of the original design and seven were added by the Qualified Environmental Professional (QEP) during the construction phase. Major field fit changes include: (i) cancellation of Salad Bar excavation and offsets owing to river configuration changes; (ii) conversion of Brown Bar A pit to a bar top removal owing to river configuration changes; (iii) cancellation of nine offsetting activities owing to invasive knotweed at Peach, Brown, and Bergman; and (iv) addition and expansion of seven offsets at Campground and Powerline Bars. All works below the high-water mark were completed over a five-week period, from Aug 27 to Sep 28, 2024. Notable challenges encountered during the project included navigation of trucks on the trails and subsurface percolation to/from pits at Peach, Railway and Greendale.

This report accompanies a technical memo prepared by KWL (2025).

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1 INTRODUCTION

Nova Pacific Environmental Ltd (NPE) was retained to provide environmental services for the Construction Phase of the 2024 Vedder River Sediment Removal Project (the "Project") by Kerr Wood Leidal Associates Ltd (KWL), the prime consultant to the Ministry of Environment and Climate Change Strategy (ENV). The purpose of the Project was to remove 243,500 m^3 of sediment from naturally dewatered sediment bars for the purpose of flood mitigation. The submitted Project Plan (NPE 2024b) proposed a total disturbance area of 72,300 m^2 across twelve excavation pits (Figure 1) and a total habitat enhancement area of 19,040 m^2 across 17 offsetting activities. Project activities included: field fitting and layout of excavation footprints by the QEP; establishing access routes, including bridges and ramps to facilitate equipment access; excavating sand and sediment from exposed bars, isolated from flowing water, with excavators; hauling and stockpiling material with dump trucks and rock trucks; managing stockpiles with bulldozers and loading highway trucks with front loaders; offsetting activities, including large woody debris (LWD) placement, flow enhancement and excavation of microchannels; environmental and cultural heritage monitoring, including erosion and sediment control (ESC), fencing sensitive areas; and site restoration. The proposed work was authorized by the Fisheries Act Authorization #24-HPAC-00190 issued by DFO on Jul 3, 2024, and Water Sustainability Act Change Approval #2010455 issued by the Ministry of Water, Lands, and Resources Stewardship (WLRS) on Aug 2, 2024, and associated amendments.

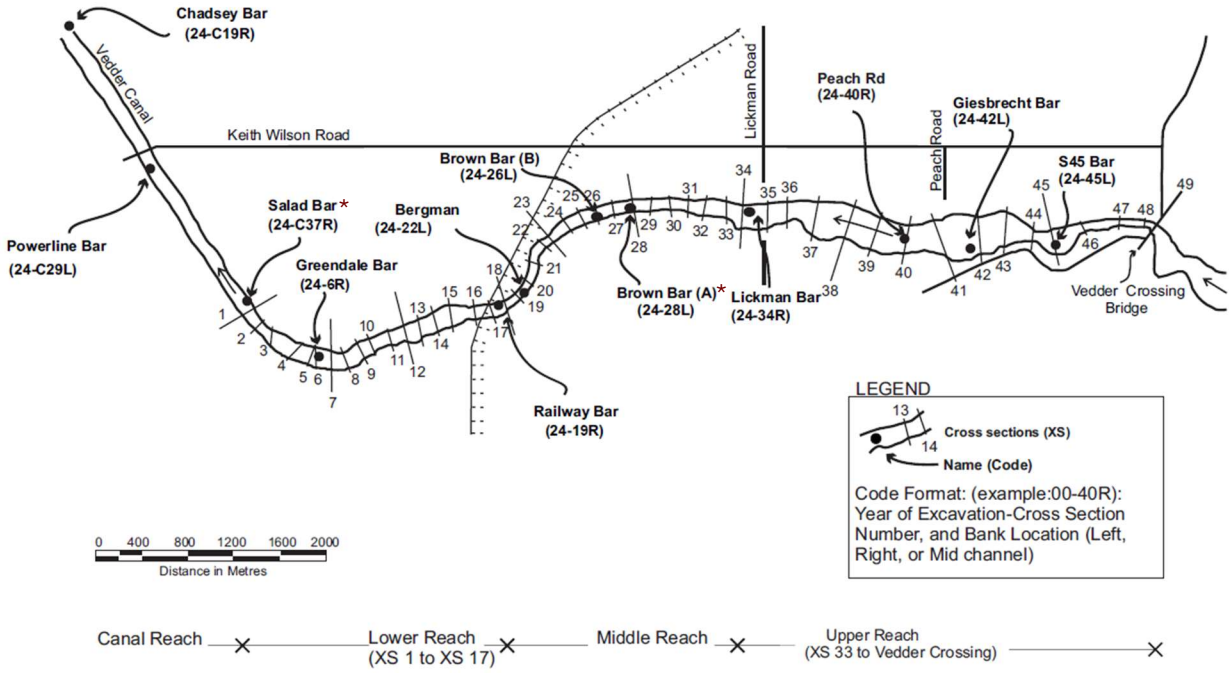

Figure 1. Map of the twelve proposed pit excavation sites for the 2024 Vedder River Sediment Removal Project. The two pits excluded or modified are indicated with an asterisk.

This report has been prepared by the environmental supervisors on the Project to satisfy permit reporting requirements. It provides an overview of project activities that took place between August 16, 2024 to October 18, 2024. On August 16, the construction contract was awarded and pre-mobilization surveys and field fitting activities commenced. As of Oct 18, all work below the high water mark

(HWM) and site and riparian area restoration by the contractor was completed. Detailed descriptions of activities, events and outcomes related to environmental permit conditions are provided in this report, including:

- Descriptions of environmental factors influencing the timing of mobilization, instream works, timing of daily operations, work stoppages, and pit settling durations;
- Descriptions of pre-mobilization surveys, fish salvages, knotweed management activities, and off-channel habitat monitoring;
- Descriptions of the field fitting process;
- Site reports summarizing daily environmental monitoring reports, water quality data collected during excavation works and pit openings, mitigation measures implemented, site restoration, as well as contingency measures implemented and non-reportable incidents;
- Comparison of excavation designs proposed in the Project Plan based on river conditions in Fall 2023, field fit designs based on river conditions Aug-Sep 2024 and the implemented design for each site;
- Review of the total disturbance area and total habitat improvement area (offsetting areas); and,
- Recommendation and lessons learned from the 2024 sediment removal project.

This report is accompanied by shapefiles for the pit excavations and an excel spreadsheet with sediment removal volumes, disturbance and offsetting areas, and geographic coordinates of the completed works. This submission package is expected to satisfy conditions 3.1 and 5.2.1 of the *Fisheries Act* Authorization and condition (dd) of the *Water Sustainability Act* Change Approval for construction phase summary reporting. Other reporting requirements related to the annual post-construction mitigation and offsetting effectiveness monitoring will be addressed in annual reports submitted to regulators in December 2025, 2026 and 2027.

1.1 BACKGROUND

Sediment removal has been implemented as a flood mitigation strategy on Vedder River since the early 1990's. The deep pit excavation strategy was formally described by Bruce Wright in *Site Selection and Excavation Design Guidelines for Sediment Removal* (NPE 1999) following a series of excavation projects between 1994 and 1999. The deep pit methodology for removing this sediment prioritizes the protection of fish and maintenance of existing fish habitat and also applies habitat restoration techniques to those areas where the aggrading sediment has filled in shallow habitats salmonids use for rearing and spawning. When the guidelines are followed, pits can refill or naturalize and still provide the highest possible fish habitat value while meeting flood reduction objectives. From 2000 to 2016, sediment removal on Vedder River adhered to this design strategy to remove the estimated long term average input of 110,000 m^3 per two years. Lessons learned and outside review have contributed to the evolution of this strategy as described in the Vedder River Management Area Plan Update (TetraTech 2015). Sediment removal projects were cancelled in 2018 and 2020 owing to below average inputs. In November 2021, an Atmospheric River Event (ARE) caused an estimated 440,700 m^3 of sediment to be deposited in the active channel of the Vedder River (KWL 2021). In 2022, under an emergency authorization (22-HPAC-00675) and change approval (file 2009684), 35,000 m^3 of sediment was removed using the same design strategy (TetraTech 2015; NPE 2024b).

Ministry of Environment and Climate Change Strategy (ENV) has sponsored the 2024 Vedder River Sediment Removal Project to restore flood protection to pre-ARE conditions. NPE was retained by KWL to provide environmental services for the permitting and planning phase of the Project, between August 2023 to July 2024, which included providing expertise and recommendations for site selection and design, participation in Taskforce meetings and submitting applications for environmental permits on behalf of the project sponsor.

NPE applied the same design strategy in Fall 2023 to identify and develop excavation plans for the twelve proposed sites for 2024. Although the target volume was in excess of the annual removal target established by the Vedder River Management Area Committee (110,000 m^3; TetraTech 2015) for the routine maintenance of dike freeboard, this volume was below the total aggraded volume in the river since the 2021 ARE (KWL 2024). It was also the largest volume possible given river conditions in 2023 and design constraints for

the protection of fish and fish habitat, i.e. the *Site Selection and Excavation Design Guidelines for Sediment Removal* (NPE 2024b, TetraTech 2015, NPE 1999).

1.2 PERMITTED TIMELINE & ENVIRONMENTAL CONDITIONS

1.2.1 WORK WINDOW

The least risk fish window for the Vedder River is August 1 to Sep 15 of any given year and these dates were reflected in the original Authorization and Change Approval for the Project. Immediately following award of the construction contract, NPE initiated pre-mobilization surveys, knotweed management, and field fitting on Aug 16. Fish salvages were also completed for access ramps and crossings, as needed. Salvages were authorized by federal (#XHAB 296 2024) and provincial fish collection (#SU24-861156) permits issued to NPE on Jun 10, 2024, and Aug 1, 2024, respectively.

Construction crews mobilized at several sites on Aug 27 and the first pit excavation was initiated on Aug 27 at Brown Bar. In an Authorization Amendment issued on Aug 28 and a Section 28 Order issued on Aug 23, temporary bridges were incorporated as an authorized alternative to culvert crossings. Regulators made a visit to the site on Sep 3, 2024.

The request for a work window extension from Sep 15 to Sep 30 was granted by regulators in an Authorization Amendment issued by DFO on Aug 28, 2024, and a WSA Section 28 Order issued by WLRS on Sep 11, 2024. Project activities completed during this period include the pit opening at Peach Bar and Railway Bar, pit excavation and opening at Chadsey and Lickman Bar, as well as offsetting activities at Campground Bar. The last pit opening occurred on Sep 27 and all works below the high-water mark were completed by Sep 28, 2024.

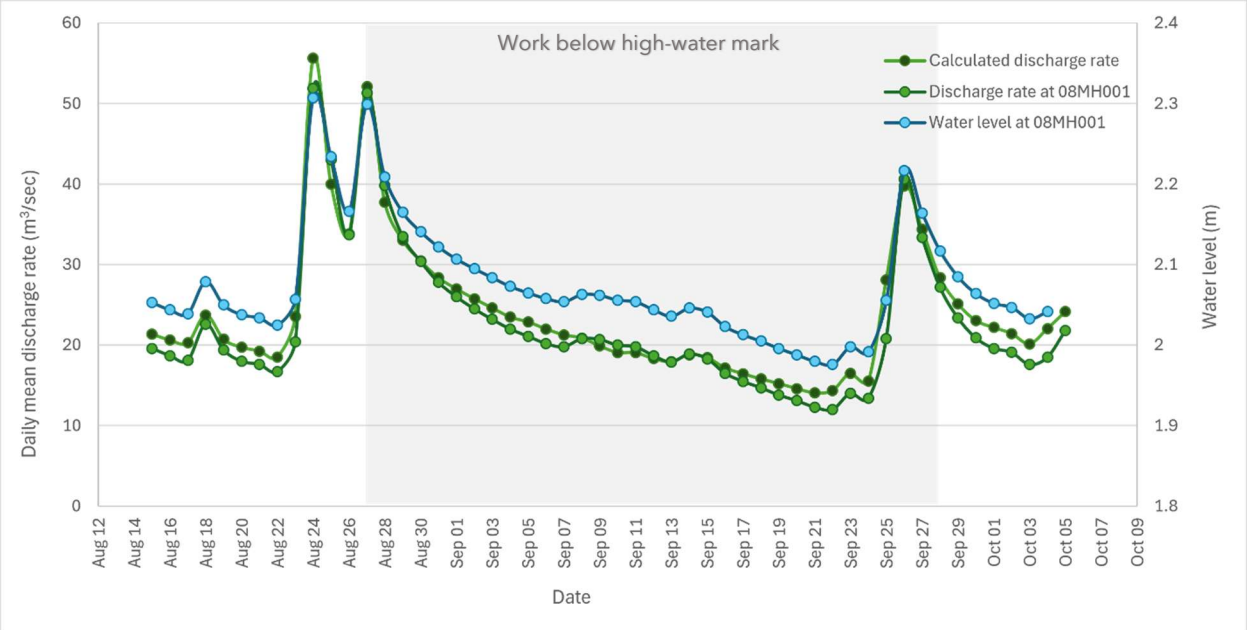

Figure 2. Estimated daily mean discharge rates for Vedder River, Chilliwack, BC from Aug 15 to Oct 5, 2024. Work below the high-water mark extended from Aug 27, 2024 to Sep 28, 2024.

1.2.1 WEATHER AND RIVER CONDITIONS

In the week prior to mobilization, the drought classification for the Vedder River area was *D1*, and dropped to D0 by Aug 22. According to the Chilliwack South weather station #1108530 (49°06'22.0"N, 121°58'12.003"W), daily high temperatures averaged 25.8°C in August with a maximum of 31.3°C, and averaged 15.4°C in September with a maximum of 21.9°C (Figure 3). Total precipitation was 93.4 mm in August and 259.3 mm in September.

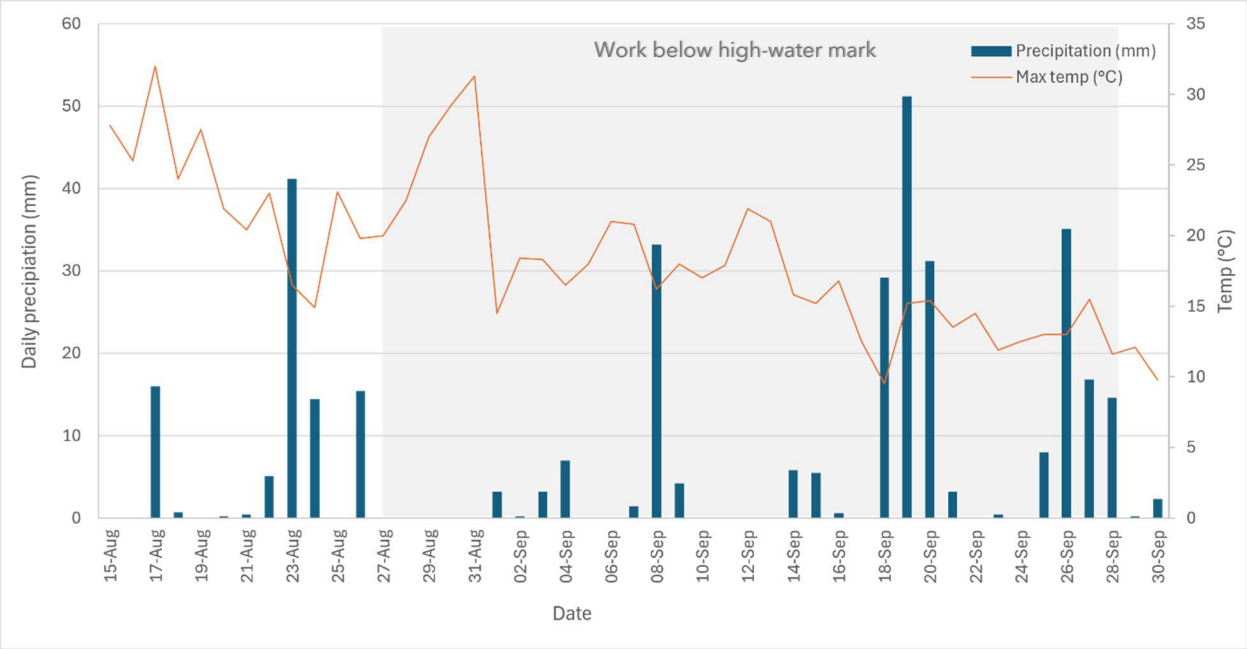

Figure 3. Daily max temperature and daily precipitation measured at Chilliwack South weather station #1108530 during the work window.

On Aug 24, the discharge rate peaked at 65.5 m^3/s and it rose again to 62.5 m^3/s on Aug 27. This impacted the location and size of bridges for side channel crossings in the upstream reach, the setback of pit footprints from the main channel. This and other subsequent rain impacted the timing of mobilization for some bars, such as Railway Bar and Chadsey Bar. The first heavy rain event (i.e. over 25 mm in 24 hours) occurred overnight on Sep 25 with discharge rates peaking at 52.5 m^3/s on Sep 26. Despite preparations, containment at the Campground site and Chadsey pit was lost. Both sites were completed shortly thereafter.

1.2.1 SITE SEQUENCING & DISCHARGE RATES

Typically, the upstream excavations are completed first, as the downstream excavations are flatter and the area of exposed bar increases as water levels drop in August. The upstream bars often have steeper slopes around their edges as well as greater depth of gravel to be removed. For 2024, mobilizations at Railway, Powerline and Chadsey Bars were limited by water levels and therefore were initiated later in the work window.

Given concerns about the accuracy of this gauge for flows below 50 m^3/s, a secondary measure of flow established in 2014 has been provided in Figure 2 This secondary measure is calculated by adding flow estimates from the two upstream WSC gauges, Chilliwack River above Slesse Creek (08MH103) and Slesse Creek near Vedder Crossing (06MH056) and applying a scaling factor of 1.5 (L. Flint-Petersen, MFLNRO, pers. comm., January 2014). In a comparison of values between Aug 27 and Sep 28, the 08MH001 values were

105% of the calculated values, on average, with a range of 95% to135%. In the following section of this report, discharge values refer to those measured at station 08MH001. The hydrograph in Figure 2 illustrates flow conditions during the 2024 excavations.

1.2.2 DAYLIGHT

Instream works were to be conducted during daylight hours to ensure that EMs could perform monitoring tasks effectively. When instream work commenced on Aug 26, daylength was 13 hours and 44 minutes (Table 1). When instream works concluded on Sep 28, daylength was 11 hours 37 minutes. Construction crews spent the first 30 to 45 min of every 12-hour shift completing a tailgate meeting and warming up machinery. The last 30 min of every day were spent moving equipment to overnight parking locations, typically at the stockpile area, and turning in slips to the site supervisor. EMs collected water quality measurements and surveying for salmon at these times. Contractors shifted operational hours later in mid-Sep to accommodate changing light conditions over the course of the Project.

Table 1. Daylight conditions and typical daily work hours at the beginning (Aug 27), middle (Sep 9), and end (Sep 28) of instream works for the project.

Date	Civil twilight start	Sunrise	Sunset	Civil twilight end	Daily start time*	Daily finish time*
Aug 27	5:42	6:16	20:01	20:34	6:00	18:00
Sep 9	6:14	6:46	19:17	19:48	6:00 -7:00	18:00 - 19:00
Sep 28	6:32	7:04	18:51	19:22	6:00 - 7:00	18:00 - 19:00

** Note that instream works occurred at least 30 min after the shift start time and 30 min before finish time.*

1.3 SEDIMENT REMOVAL PRACTICE AND PROCEDURES

Key measures to avoid and mitigate impacts to fish habitat are incorporated into a comprehensive set of Site Selection and Excavation Design Guidelines developed for the Vedder River (NPE 1999; TetraTech 2015). As in past removal cycles, site plans for 2024 were field fit by the QEP to ensure these measures remain effective given the river conditions at the time of construction. Additional information pertaining to other environmental elements were also managed and incorporated into the field fitting process, such as presence of Japanese knotweed. Full-time monitoring by environmental monitors (EMs) was required by environmental permits. Monitoring focused on prevention and mitigation of sediment release into fish-bearing water, riparian habitat disturbance/alteration, as well as spill preparedness and monitoring for migrating salmon. Full-time cultural heritage and archaeological monitoring (CHAM) was planned to ensure that indigenous values were preserved during the works. This work was fulfilled to the extent possible and to the extent required by rights holders (SFN).

1.3.1 SITE DESIGN & FIELD FITTING

The Project Plan (NPE 2024b) was developed based on river conditions in Fall 2023 and submitted to regulators in Winter 2024. This timing allows for the application of Site Selection and Excavation Design Guidelines to on-the-ground observations of river conditions, hydraulic analysis by engineers, a thorough review of the project proposal and consultation with Indigenous groups by regulators, and finally, a competitive contract tendering process. As Vedder River is a dynamic system, all sites must be re-evaluated against the guidelines based on actual river conditions immediately prior to mobilization to ensure mitigation measures are implemented effectively. In 2024, the QEP both field-fit and laid out each excavation footprint based on river conditions as well as additional survey data.

The final design was laid out by the QEP at each site in one to seven days leading up to mobilization of the site. Layouts accommodated setbacks determined from pre-mobilization surveys as well as present river conditions. With the raise in water levels Aug 25 to 27, these field fits were adjusted again immediately prior to pit excavation, as needed. All sites were consistent with the original designs in this regard except Brown Bar pit A and Salad Bar. Brown Bar pit A was converted to a bar top removal and Salad Bar was cancelled

because a re-design that adhered to the guidelines was not possible with the river conditions at the time. Adherence of the field fit layouts to each design guideline in the *Site Selection and Design Guidelines for Sediment Removal* (NPE 1999, TetraTech 2015) are presented in (Table 2).

Prior to mobilization at each site, the contractor's site foreman or general superintendent(s) completed a walk-though with the QEP, or their designate, to discuss the plan and any site-specific environmental considerations such as trees to be felled, knotweed, access route across the bar, crossings, excavation details and timing of activities.

Pre-mobilization surveys

Surveys completed by NPE and its subconsultants before, or concurrent with, the field fitting process included: breeding bird nest and raptor nest surveys, invasive species surveys, sensitive habitat surveys and river conditions surveys. These surveys informed the field fitting of pit excavations, offsets, flagging/fencing, and access routes.

Breeding bird and raptor nest surveys were completed for all proposed sites by NPE on August 18 and 19, 2024. No breeding bird nests or raptors nests were identified in proximity to the sites except one possible Pileated woodpecker cavity. Two eagle nests were known to occur approximately 200 m east of the Vedder canal, which have been present for past sediment removal cycles. During the works at Lickman Bar, EMs observed eagles flying in the area on several occasions; however, no nest was observed. Additional nest surveys were completed by the QEP for individual trees that were felled for access.

Knotweed management

In July of 2024, NPE consulted with an Invasive Plant Specialist with the B.C. Ministry of Forests (MoF) to develop the Knotweed Management Plan for the Project. Based on information from a similar project in BC, best practices and specific knowledge of the Vedder River, a class system and management strategies appropriate for each class were defined (see Appendix A). In August 2024, NPE conducted surveys for Japanese knotweed complex on all sediment bars to be excavated and along access routes. As recent reporting had indicated, significantly more knotweed was observed in Summer 2024 than in previous years. This may be related to the large amount of woody debris that entered the system during the 2021 ARE and continues to move downstream from infestations above Vedder Crossing Bridge.

Generally, individual and small clumps of Japanese knotweed clones were identified near the main channel and other recently flowing areas of sediment bars, and larger, more established clones were observed in riparian areas usually above the top of bank. Based on survey data, excavation footprints modifications were noted for field fitting purposes. Where knotweed buffers would significantly impact planned excavation footprints or access routes, knotweed that met specific size and substrate requirements of the Knotweed Management Plan (Appendix A) were eligible for mechanical removal. Through the removal of 16 clones and adjustment of excavation footprints, interactions with knotweed were largely avoided and any uncontrolled excavation and removal of contaminated material was prevented. Procedures for removal were developed to ensure that all plant parts with vegetative, reproductive potential were removed, bagged, and disposed of appropriately. For detailed information please see Appendix A.

During field fitting, where mechanical removal was not an option or unnecessary, knotweed setbacks were measured as a 20 m radius from the stems and marked with water-soluble paint. No ground disturbance was permitted within these setbacks. Knotweed clones were fenced off or flagged depending upon proximity to access routes and likelihood of interaction with equipment or crew members.

At Bergman Bar, stands of knotweed occurred along the top of bank, however the sediment bar itself was almost entirely bare of any vegetation. A test trench was excavated parallel to the bank and setback by 10 m. The side wall of the 1.5 m deep trench and the windrow of excavated material were screened by hand for organic material. With no evidence of roots, the remaining area of the bar beyond the test trench was considered to be non-contaminated and the excavation proceeded.

Table 2. Adherence of actual pit excavations to NPE's Site Selection and Design Guidelines criteria (TetraTech 2015) for the ten pit excavations completed in 2024 as well as the pits modified (Brown Bar pit A) and cancelled (Salad Bar pit).

Guidelines and constraints	S45	Giesbrecht	Peach	Lickman	Brown Pit B	Bergman	Railway	Greendale	Powerline	Chadsey	Brown Pit A*	Salad*	NON-ADHERENCE
Program guidelines													
1. No excavations in pink spawning years in the reach where most pink salmon spawn.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
3. Work only in isolation from flowing water.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
5. Adherence to the least-risk fish windows.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
9. Avoid excavating in areas adjacent to sensitive habitat.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
Site location													
2. Avoid excavating in areas of sub-gravel percolation as this may impact chum salmon spawning and water levels in enhanced off-channel habitat.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
4. Leave the upstream third of bars.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	3
6. Avoid digging consecutive bars because of potential interaction between them.	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	2
7. Excavate channels to replicate natural streambed shape to minimize post-excavation changes.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
8. Protect areas adjacent to points where secondary channels branch off from the main flow.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
Site design													
10. Avoid digging long pits associated with elevation drops or which can affect long sections of the river.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
11. Leave gently sloped inside edges on the upper end of cuts to prevent head cutting and to leave stable habitat for chum salmon spawners.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
12. Open the upstream end of deep sediment pits so that head-cutting can occur, and encourage sediment flow into the pits.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
13. Construct internal, cross channel berms in long pits or where there is a significant elevation drop.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	Yes	0
14. Leave the downstream ends of bars, since this will preserve tailouts which provide rearing and spawning opportunities.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
15. Ensure riffles are not bypassed by excavation.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes*	Yes*	0
16. Adjacent dry channels should be deepened and stabilized with flow control structures such as large woody debris complexes.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
17. Leave pits with large head differences closed to prevent chum spawning within them or fish trapping.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
18. Open excavations thoroughly to avoid creating fish traps. Two deep openings adjacent to the main channel should prevent this problem.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0
19. Use caution when designing excavation where the thalweg approaches the pit at an angle of more than a few degrees, e.g. reduce the opening or move the excavation or the opening downstream when this condition is encountered.	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	0
NON-ADHERENCE	0	0	1	0	0	0	1	0	1	1	1	0	

** Pit excavation that was cancelled or converted to an enhancement design.*

1.3.1 ENVIRONMENTAL MONITORING

NPE provided the QEP to supervise sensitive works, oversee the response to environmental incidents, and generally provided oversight to the team of environmental, archaeological, and cultural heritage monitors (Table 3). As such, NPE provided the QEP to review site conditions, field fit the excavation designs and oversee the implementation of design-related measures for fish and fish habitat protection, directed pit openings, and directed offsetting activities. NPE also provided the on-site Environmental Supervisor (ES) who was responsible for training, coordinating and providing oversight for all environmental monitors (EMs) on the project, completing pre-mobilization walkthroughs of each site with the Contractor, coordinating with cultural heritage and archaeological monitors (CHAMs) and engineers, responding to environmental issues, and preparing the environmental monitor's post-construction report.

For all sensitive works, including all work below the highwater mark, full-time environmental monitoring was required by the authorization and change approval for this project. Archaeological and cultural heritage monitoring was also to be conducted to the satisfaction of SFN. Initially, to accommodate the Contractor's construction schedule, seven environmental monitors and seven archaeological monitors were anticipated to be on site for twelve-hour days, six days per week. Appropriately trained personnel for the environmental monitoring, cultural heritage monitoring and archaeological monitoring were provided by SFN per the subcontract agreement with NPE dated Aug 29, 2024.

Each environmental monitor (EM) reviewed the project Environmental Management Plan (NPE 2024a) and participated in a project orientation prior to mobilization, or on their first day on-site. The orientation emphasized erosion and sediment control (ESC) measures, water quality monitoring, site isolation, knotweed identification, salmon in the river, and completing the daily monitoring form. EMs typically worked on-site for twelve hours per day, six days per week to match the contractors schedule and they were assigned to the same site as continuously as possible. EMs also provided fish salvage and surveys, as needed. Pit openings involved more thorough water quality monitoring, which often involved the QEP and two to four EMs. EMs were equipped with turbidity meters to monitor activities with potential for aquatic guidelines exceedances and propose corrective actions. At active sites, daily measurements of turbidity were taken in the main channel, any side channels, and inside pits using Lamotte 2020i turbidity meters and one Apera TN400 meter. However, owing to limited equipment availability early in the construction phase, visual interpretation of turbidity was occasionally necessary. As turbidity in the pits was often in excess of 100 Nephelometric units (NTUs), Radiometric units (FNUs) were used for all measurements from Sep 5 and onwards. Both methods measure scattered light from a sample at a 90 angle from incident light, but a different calibration curve is applied allowing a readable range up to 1000 FNUs. Meters were calibrated daily and triplicate samples were taken where possible. Averages are reported in this document.

Table 3. Environmental construction monitoring team members

Role	Name	Company	Start date	Finish date
QEP & Environmental Supervisor (ES)	Bruce Wright, BSc, MBA, RPBio	NPE	Aug 16	Oct 18
Environmental coordinator	Karen Frazer, MSc, BIT	NPE	Aug 16	Oct 18
Environmental monitor (EM)	Donovan Toews, BA	SFN	Aug 23	Sep 28
	Carley Simpson, BSc	SFN	Aug 27	Sep 27
	Nick Ng	SFN	Sep 2	Sep 27
	Bryghton Home	SFN	Sep 5	Sep 21
	Samantha Mitchell	SFN	Aug 30	Aug 30
	Kelsey Smith, BSc	NPE	Aug 16	Sep 17
	Icaro Novo de Olivieira, BSc	NPE	Aug 16	Sep 26
	Florian Rossmann, PhD, RPBio	NPE	Aug 16	Oct 18
Cultural Heritage & Archaeological Monitor	Joachim Pierre	SFN	Aug 23	Sep 20
	Dave Tom	SFN	Sep 23	Sep 27

Cultural heritage/archaeological monitors provided by SFN visited all sites at least once with an EM. NPE facilitated the CHM in deciding which active sites to monitor. Typically, the CHM monitored the mobilization of sites where plant varieties of interest were known to occur (e.g. snowberry at Brown Bar) and the excavation of sites that were most likely to encounter older, native sediment (e.g. S45 Bar and Chadsey Bar).

Environmental, cultural heritage and archaeological monitors were provided by SFN as much as their capacity allowed, and NPE provided additional environmental monitors, as needed. A complete list of individuals that participated in monitoring during the construction phase is included Table 3.

1.3.2 GENERAL MITIGATION MEASURES

Erosion and sediment control

At all sites, "double handling" of excavated material was practiced. Excavators made stockpiles within the pit footprint to allow wet material to drain and then a second excavator loaded trucks with the drained material. All sites had at least two excavators; typically, one would focus on excavating and the other on loading trucks. In some cases, a front-end loader was used for loading the trucks. This strategy was effective in minimizing sediment-laden water spilling out of the truck on access routes. Typically, as the pit neared completion, only one excavator was used to dig and to load trucks. To prevent runoff from the stockpiles on the bar, the bar top was levelled prior to digging below water level. Also, the perimeter nearest the mainstem was generally excavated first so that any stockpile runoff was entering the pit rather than the watercourse. This strategy appeared to be very effective as runoff from excavated material was not an issue over the course of this project.

Routine turbidity monitoring was conducted daily by EMs at all active sites (Appendix B). Turbidity readings were taken during the excavations, primarily near the downstream pit openings. Measurements included the background conditions in the river, the standing water in the excavations and downstream during and after the opening of the excavations to flowing water. Some locations and times were not measured when the attention of the monitors was required elsewhere and due to other practical concerns. However, a representative sample of turbidity conditions has been provided. Turbidity readings are supplemented with visual observations where appropriate. The results of these readings are discussed in the conclusion section.

Pit openings were scheduled in advance to ensure >12 hour settling period. The QEP provided direction to the foreman and excavator operator, and three to four EMs participated in collecting water quality data multiple locations before, during and after (see Sections below). Typically, the EMs took measurements in the pit, and in the channel, 10 to 20 m upstream, adjacent to pit, 10 to 20 m downstream, and at the upstream end of the next bar downstream. Monitoring continued to determine the intensity and duration of turbidity plumes released as the pit flushed. Efforts were taken to capture the peak, decline of below 8 FNUs, and background levels, where possible. All excavated material from the openings was hauled away, with a few exceptions described in the Site Reports.

Salmon monitoring

Environmental monitors performed daily checks for adult salmon in the river and specifically salmon displaying spawning behaviour or moving in large groups, i.e. twelve fish per 10 m^2. The frequency of salmon surveys increased mid-September. During the Project, individual salmon were observed swimming, jumping, or were caught by fishers. Some salmon were holding in pools, e.g. the pool downstream of Keith Wilson Bridge and the pool adjacent to the vegetated island on Lickman Bar. During one-hour lunch breaks, there was no evidence of fish attempting to move upstream from these pools. Running densities of salmon were not detected until after the heavy rain event on Sep 26. These salmon were moving upstream in groups of six to twelve in the canal.

Fish salvage

Fish salvage was required at most sites prior to installation of culverted ramps or bridges for access. For channel crossings, sites were isolated using stop nets and/or silt curtains, ensuring that flow was not obstructed. Salvages were performed and any salvaged fish were moved to suitable, nearby habitat.

The following sub-sections describe (i) the works completed compared to the Project Plan (NPE 2024b), including side-by-side maps and rationale for field fitting changes, (ii) challenges encountered and contingency measures applied, and (iii) water quality monitoring results, including from pit openings.

2 SITE REPORTS – UPPER REACH

This section provides an overview of the construction activities and environmental monitoring completed at each site in the Upper Reach, including pit opening data and side-by-side comparisons of proposed design, field fit design and actual completed excavations. The Upper Reach extends from cross-section (XS)-47 at Vedder Crossing Bridge downstream to XS-35 near Lickman Road. This reach is approximately 3 km long, relatively steep and wide with large gravel bars and tall riprapped bank slopes on the right side. Excavations in this reach were designed to increase overall capacity and reduce gravel transport downstream. In the upper reach, all three proposed pit excavation (S45, Giesbrecht and Peach Road Bars) and three of the four proposed enhancement (offsetting) activities were completed. These three sites were mobilized in the first week of construction and all work below the high-water mark (HWM) was completed by Sep 17.

2.1 S45 BAR (24-45L)

PLAN

Access route

The proposed access route from the Municipal Quarry Stockpile site travelled along Vedder Mountain Road, approximately 100 m east and onto the South Rotary Trail which descends along the road embankment to the floodplain. A wooden footbridge that crossed a riprapped outfall from a culvert needed to be removed as it was impassible for trucks. The route then veers north off the trail for 150 m and then out onto the unvegetated gravel bar. It was expected that one wildlife tree (snag) would need to be felled for ramp construction and some three-year-old cottonwoods bordering the footpath would need to be removed for the excavator to access sediment to construct the ramp. The excavation site was a further 20 m over unvegetated gravel bar.

Pit excavation

The proposed excavation at S45 Bar consisted of a single pit. The main purpose of this excavation was to intercept sediment upstream of the freeboard limited area. The bar was estimated to be 1.5 m in height above low water levels resulting in a 4.5 m excavation depth and higher yield of sediment. A 5:1 slope at the upstream edge of the excavation was prescribed to provide stability during higher flows and to prevent erosion of the head of the bar. All other slopes were designed at 1.5:1. Two openings, 20 m wide, were prescribed to permit flow in and out of the excavation and to allow fish to move freely through the site. The dimensions were limited by the location of the riffles upstream and downstream, flowing water and pit proportions. To ensure that the pit would fill without creating isolated pools, the width of the excavation was kept narrower than the length.

Offsetting

One habitat enhancement excavation and one LWD placement was proposed for S45 Bar. A habitat opening on the south perimeter of the pit would provide flow to a microchannel along the toe of the bank. At the time of construction, this area consisted of several isolated pools, and a channel open at the downstream end and fed by subsurface flows. The additional flows would increase the wetted area,

increasing pool and riffle habitat. The LWD in the side channel would create cover and potential feeding opportunity, increasing habitat quality.

IMPLEMENTATION

Access route

On August 27 and 28, the access route between Vedder Mountain Road and the pit footprint was completed as originally proposed in the Project Plan (NPE 2024b). A culvert was installed in place of the existing wooden pedestrian bridge. The bridge was detached, lifted out and stored temporarily further east on the rotary trail. No water flowed through this culvert for the duration of the project. A ramp was constructed with sediment from the bar below the culvert to address the steepness of the access route along the embankment. As proposed, the snag located within the footprint of this ramp was felled. The snag was approximately 11 inches diameter at breast height (DBH), non-living and missing the top. The footpath down to the bar top was widened. This was considered maintenance as the trail had become overgrown by pioneering species of plants, e.g. cottonwood. No additional culvert crossing or fish salvage was needed to access the bar top at this site owing to the high elevation of the bar.

To maintain the access route, a street sweeper travelled along Vedder Mountain Road daily to clean up any egress. On a few occasions, ramp material sloughing on the sides was pulled back by an excavator at the end of the day. Two knotweed clones identified on the bar near the access route were flagged to prevent contact with equipment and were monitored by EMs.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on August 16. The field fit layout was consistent with the proposed layout in the Project Plan (NPE 2024b), except the south perimeter was adjusted to accommodate setbacks from knotweed. These knotweed clones could not be removed as they did not meet maximum size requirements (Appendix A).

The pit was excavated from Aug 28 to Sep 11 with an EM on-site for all work below the HWM. Equipment at this site included two excavators, two rock trucks hauling material, and one bulldozer managing the stockpile site. Sediment from the entire footprint down to approximately 0.5 m above water level was removed first. Then the pit was excavated from the downstream end to the upstream end. Wooden triangles were used by the Contractor to confirm the correct slopes. Turbidity in the mainstem was unaffected by pit excavation until the pit was opened to flowing water.

Two pit openings were excavated on Sep 12 at the direction of the QEP. The pit was undisturbed for approximately 14 hrs. A standard 20 m wide by 1 m deep opening was created at the downstream end. This opening was constructed slowly to allow water levels to equalize without local erosion material entering the pit. The excavator completed the offsetting activities before moving on to the upstream opening. The upstream pit opening was made slightly narrower (~15 m wide) and shallower (~ 0.5 m), because water velocity was high in this area and the channel was relatively shallow. The opening was configured as a riffle to ensure good flow and a modest increase in habitat value at that location. With moderate flow through the pit, the outflow of turbid water stayed in a narrow stream until flowing over the next riffle. Turbidity in the main channel approximately 20 m downstream of the opening peaked at 82 FNU at 11:50 am (Figure 4). Turbidity at this location declined to 6.94 by 3:20 pm on the same day.

Offsetting

At S45 Bar, the proposed habitat opening and one LWD installation were completed in between pit openings on Sep 12. The habitat opening was field fit to create a 5 m wide and 20 m long channel cut just below the water level in the pit. The bank across from this elongated opening was exposed bedrock. A berm along the edge of the pit was left until the pit openings were complete. One piece of LWD located high on the bar was selected and placed in a pre-excavated trench and buried at the edge of a small existing pool. The root wad was left exposed while approximately 12 m of the trunk was buried 1.5 m below surface. The excavator returned to breach the berm in the afternoon, which allowed water from the pit to flow into the side channel and raised the water level by approximately

0.5 m. A series of small pools along the bank became connected, including one that had been heated by many hours of direct sun each day. Large cobble was added for complexity.

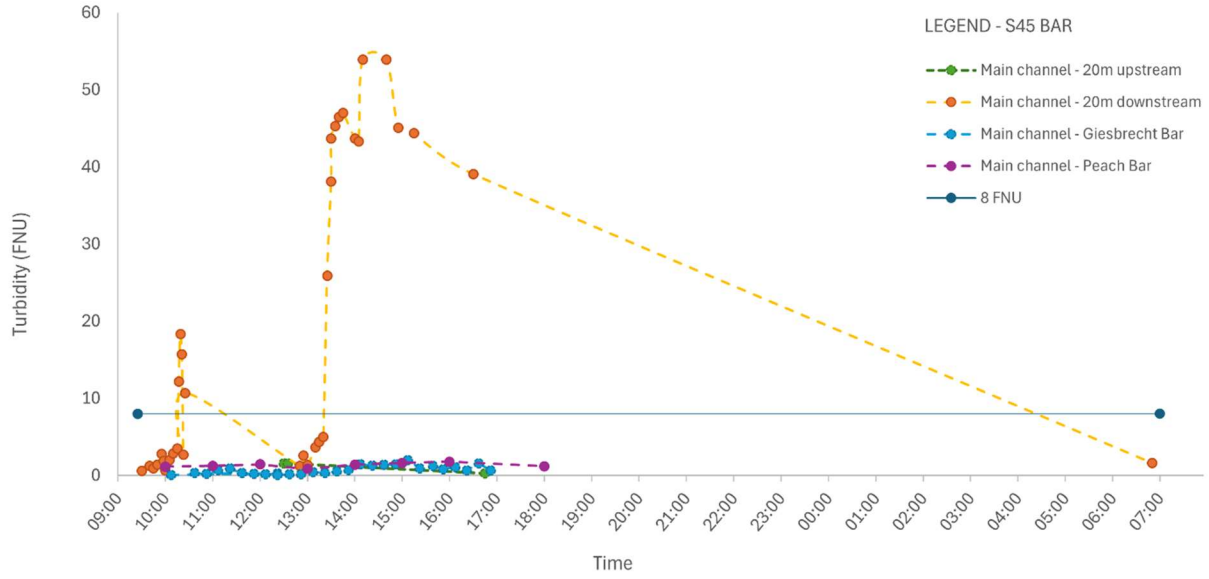

Figure 4. Turbidity (FNU) measurements during S45 Pit openings on Sep 12, 2024.

Restoration

The contours of the bar were reestablished as machinery pulled back. Material from the ramp was hauled to the stockpile. At the rip rap crossing, excess sediment and the culvert were removed. The footbridge was placed in its original position and new supports were used to anchor it in place.

Two knotweed clones were located directly ahead of the ramp onto the bar. Trucks had difficulty consistently maneuvering around them. Windthrows built up over time, covering the plants that were marked with paint and flagging tape. A pylon was placed next to it when it became difficult to see. Restoration was difficult with the knotweed plant buried. One was damaged in the process and the other was unburied by hand. During mitigation effectiveness monitoring, this location should be monitored for emergent clones.

SUMMARY

The S45 Bar pit excavation was undertaken from Aug 28 to Sep 12, 2024, and was the fourth largest pit completed as part of the 2024 project. The total footprint of the excavation, including the pit openings, was 6,571 m^2, which is 83% of the proposed disturbance area. No reportable incidents occurred at the site. The shortfall is attributed to the field fit design incorporating knotweed setbacks along the south perimeter. The completed excavation had slow and steady flow through the pit. The shallow upstream opening effectively controlled flow in this steep section of the river.

The habitat opening directs flow to the rocky bank slope on the left side of the river. The area previously consisted of some disconnected pools, one of which had long hours of sun exposure, and a groundwater fed microchannel. The habitat opening has increased the water level and created consistent flow and connectivity of all wetted habitat in this area. The installed LWD is located in a pool, half submerged and providing immediate benefits.

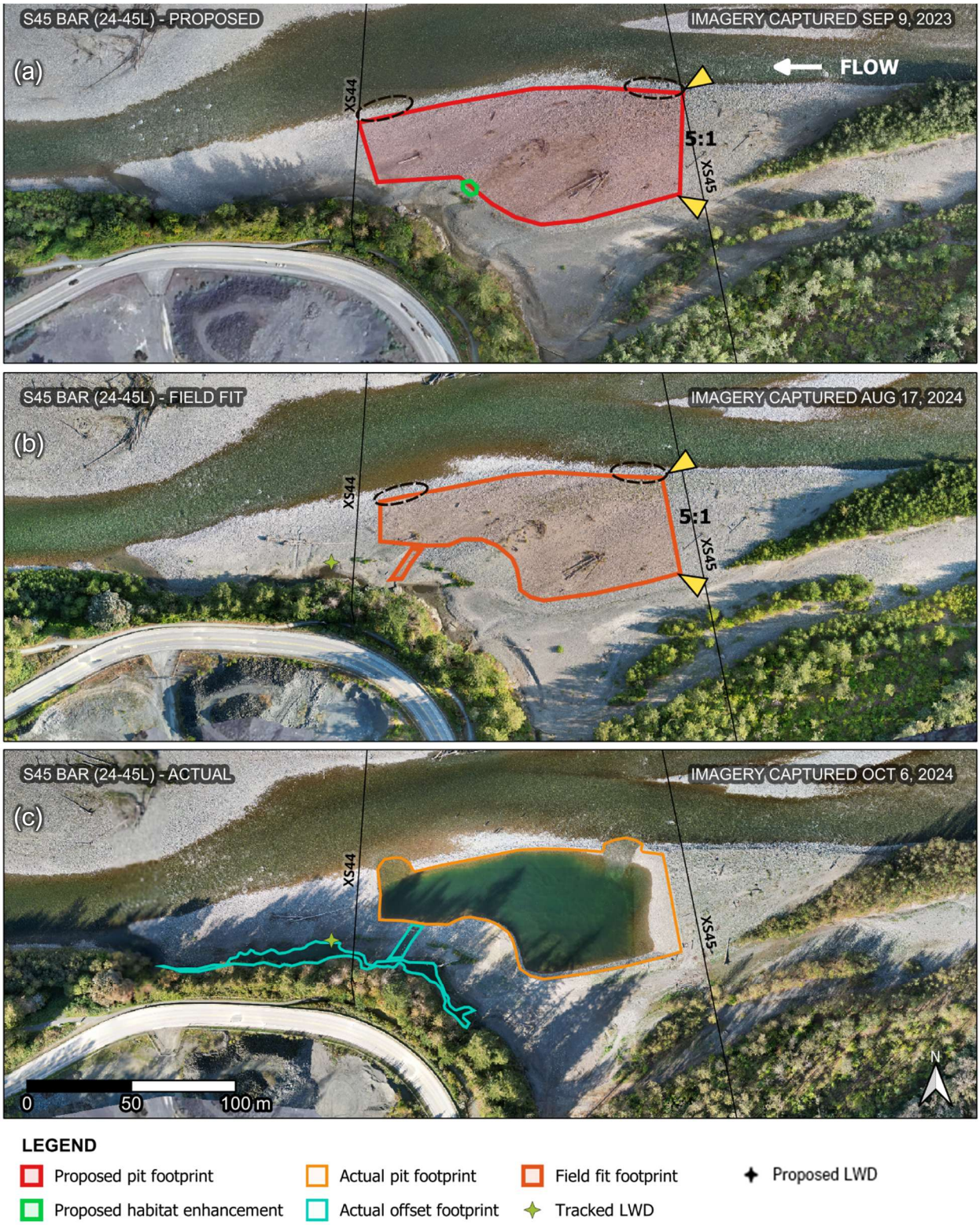

Figure 5. Orthomaps of S45 Bar with (a) planned excavations and offsets based on 2023 river conditions, (b) field fit excavations and offsets based on current river conditions on Aug 17, 2024, and (c) actual excavation and offsets completed in 2024.

Figure 6. Photos of the works at S45 Bar by environmental monitors. (a) Access route along Rotary trail and culvert crossing (taken Aug 30 2024); (b) Access route where the access route departs from the Rotary Trail, looking toward the gravel bar (taken Aug 28, 2024); (c) Spill kit located on the gravel bar next to the access route (taken Aug 30 2024); (d) culvert under Vedder Mountain Road with no flow during rainy conditions (taken Sep 13).(e) Pit excavation at the downstream end (Aug 30, 2024). (f) Water flows into the pit during the downstream pit opening as water levels equalize (Sep 12, 2024).

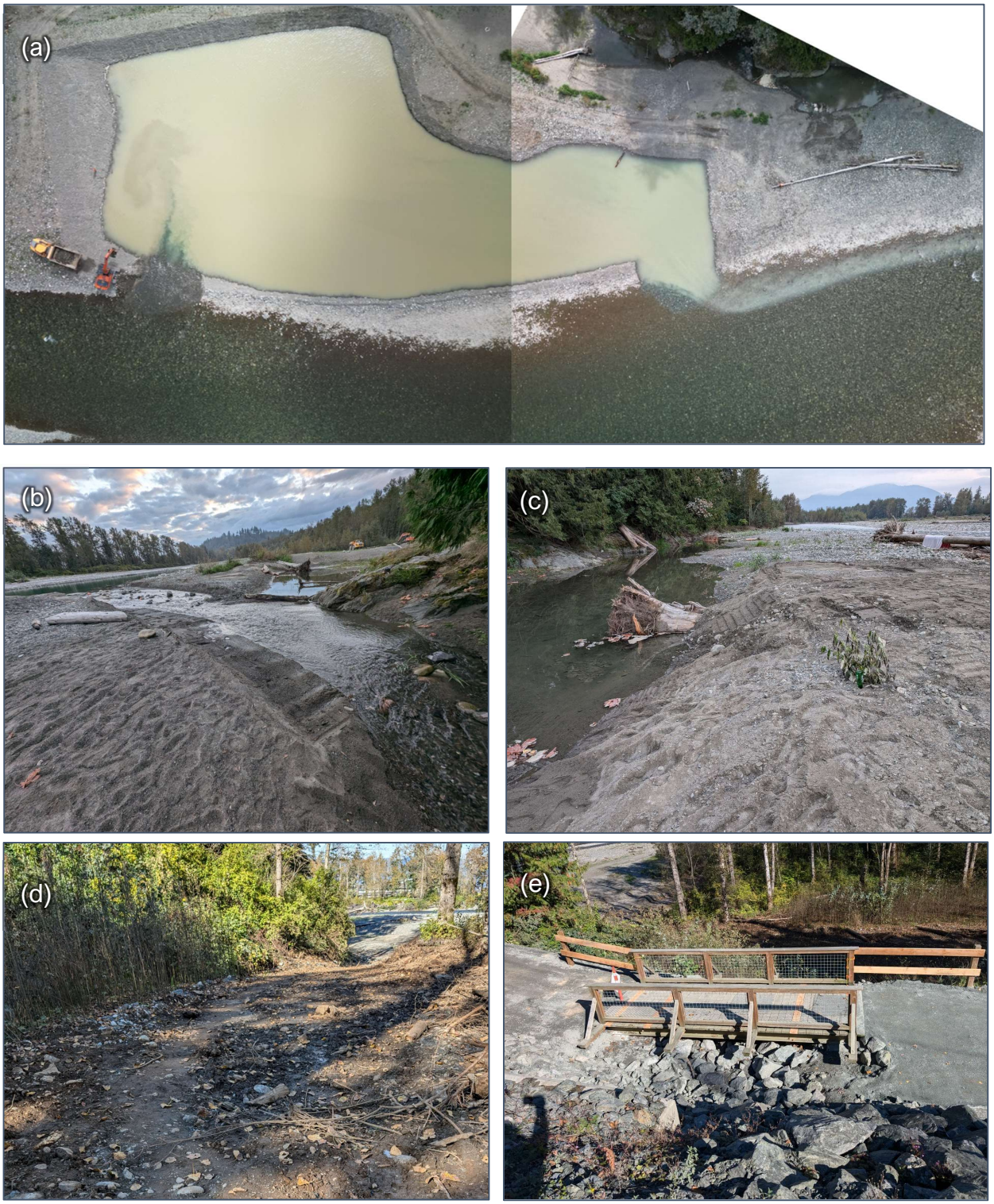

Figure 7. Photos taken by environmental monitors at S45 Bar. (a) Aerial image of S45 with turbid water slowly flushing out of the pit (Sep 12, 2024). (b) Restored trail following removal of access ramp (taken Oct 11, 2024).(c) Wood footbridge replaced on Oct 11. (d) Completed flow enhancement (Sep 12, 2024). (e) Completed LWD installation on Sep 12, 2024.

2.2 GIESBRECHT BAR (24-42L)

PLAN

Access route

The proposed access route from Giesbrecht Stockpile A to the pit excavation site followed an existing access road through the riparian area and involved one secondary channel crossing. The existing road could be followed for approximately 440 m to the top of bank, with some sections needing widening. Approximately 375 m east along the unvegetated gravel bar, one channel crossing was needed, and then equipment tracked over unvegetated gravel bar for approximately 375 m to the excavation site.

Pit excavation

The proposed 2024 excavation at Giesbrecht consisted of a single pit. The main purpose of this excavation was to trap sediment upstream of the freeboard limited area. The bar was estimated to be 1.5 m in height above low water levels resulting in a 4.5 m total excavation depth. A 5:1 slope at the upstream edge of the excavation was prescribed to provide stability during higher flows and to prevent erosion of the head of the bar. All other slopes were designed at 1.5:1. Two openings, 20 m wide, were prescribed to permit flow in and out of the excavation and to allow fish to move freely through the site. The dimensions were limited by the location of the riffles upstream and downstream, flowing water and vegetated bar.

No offsetting work was planned for this location.

IMPLEMENTATION

Access route

Between August 26 and 29, the access route was established under the supervision of EMs. The trail had been used as an access route earlier and was very wide through the first two forested sections of the route. A low-lying area between these sections was overgrown with canary grass and needed to be widened to accommodate the trucks. The last 90m through the tree was narrow and needed to be widened to allow passage for excavators and rock trucks. Knotweed clones on the edge were covered with geotextile and labelled *knotweed*. No trees were felled. Some bar material was later added to the access route in the riparian area.

Recent rain caused water levels to rise such that two channels were flowing initially. Two bridges were installed to allow machinery to cross these side channels. An airbridge was brought in by two excavators and placed across the first stream, which was approximately 3m wide and very shallow. The second crossing involved the installation of an abutment on one side and the placement of a 20 ft bridge. The location was moved upstream closer to the inside bend of the side channel. The area for the abutment on the left bank was isolated and a fish salvage was conducted. Initially, bar material was used, however, relatively high-water velocity led to high turbidity and movement of this material. The QEP halted works. Rip rap was requested and used to create a solid base sitting a few inches above water level. Geotextile was laid down and then bar material and four lock blocks were used to create the abutment. One excavator completed one wet crossing, carrying four lock blocks. This excavator constructed the ramp on the opposite side using material from a borrow pit. While positioned on the ramps, the excavators lifted the bridge into position and then completed the ramps up to the bridge level. An EM monitored the installation of each bridge from approximately 20 m downstream. Borrow pits were refilled with bar material once hauling began.

The route on the bar was chosen and marked to avoid knotweed among the LWD. A bulldozer and excavators were used to create a level driving surface and move LWD aside. At one location, an 8’ by 10’ wooden board was placed over a small knotweed clone.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on August 16. The field fit layout was consistent with the proposed layout in the Project Plan, except the south perimeter was adjusted to accommodate setbacks from knotweed in the center of the bar that could not be removed. After the rise in water levels over the weekend, the north permitter of the pit was adjusted slightly to maintain a 5 m leave strip (berm) to isolate the pit from flowing water. In the end, the field fit footprint was slightly smaller than originally proposed. Pit slope at the leading edge was field fit to 7:1 to maintain the stability of the upstream section of the bar, as the thalweg is concentrated at this location, has a high velocity and is relatively steep.

Two excavators and up to four rock trucks were used at this site. The bar top was removed from the pit footprint first and then deep excavation began at the downstream end on Aug 31. A strip was dug along the north perimeter (i.e. adjacent to the main channel), and material was stockpiled in windrows. The second excavator typically loaded trucks with material from the windrows. The excavation was completed in strips moving downstream to upstream and then back downstream, until the entire pit was completed. Slopes were checked using custom made wooden triangles produced by the Contractor for each crew. Pit excavation was completed on September 11. During excavation of the pit, an EM measured turbidity in the channel, upstream to downstream of the pit, before and after works began each day. Measurements ranged from 0.0 to 1.5 FNU, with the exception of Sep 12 when S45 was opened.

On Sep 13, the pit was opened to the main channel. After settling for approximately 36 hours, turbidity in the pit at 7 am was 48 FNU. At 10 am, an 18 m wide by 1 m deep opening was excavated at the downstream end. At 11 am, the upstream pit opening was excavated. As water velocity was high in this area, the opening was configured as a riffle, kept shallow (~ 0.5 m) and setback from the corner by ~15 m. Throughout the day, turbidity was measured by EMs inside the pit, 20 m upstream of the pit, 20 m downstream of the pit, at the upstream end of Peach Bar and upstream end of Lickman Bar. Turbidity 20 m downstream of the pit peaked at 89.9 FNU at 11:05 am. Turbidity in the main channel dropped below 8 FNU by 4 pm on Sep 13.

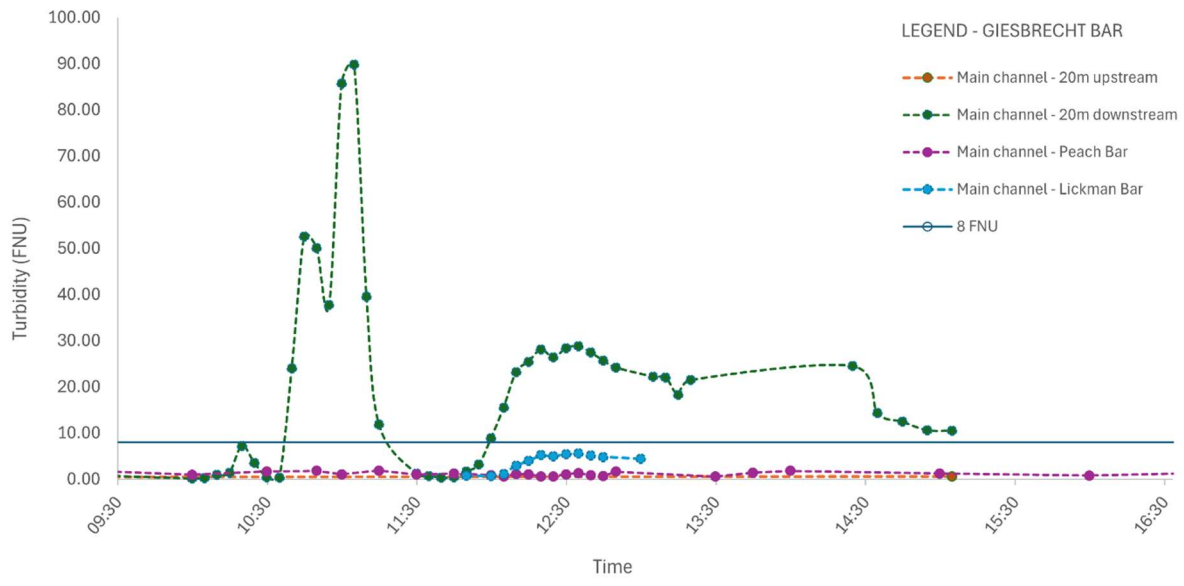

Figure 8. Turbidity during pit opening at Giesbrecht Bar on Sep 13th, 2024.

Restoration

On Sep 13, restoration of the bar was initiated after the pit opening was complete. The access route across the bar was scarified and LWD were redistributed. On Sep 14, the large bridge was uninstalled under the supervision of an EM. One wet crossing of an excavator carrying four lock blocks was completed at 9:03 am. Turbidity peaked at 765 FNU immediately and dropped to 13.38 FNU within 5 minutes. Removal of the abutment commenced at 10:20 am and was completed by 11:25 am. Turbidity was monitored 20 m downstream at 5.4 FNU prior to the works, peaked at 106 FNUs at 11:10 am and returned to 5.3 FNU by 11:45 am. The ramp material was hauled to the stockpile. The second side channel was dry at the time of bridge removal.

Restoration of the access route through the riparian area and the Rotary Trail was completed mostly between Sep 14 and 16. Excess sediment was removed and hauled to the stockpile. LWD was redistributed along the trail. Finally, the Rotary Trail was graded and topped with crusher dust, the granular product typically used on these trails.

SUMMARY

The Giesbrecht Bar pit was undertaken from Aug 30 to Sep 13, 2024. The area of disturbance was 5,829 m^2, which was 85% of the proposed disturbance area. The smaller area is mainly attributable to the accommodation for knotweed with some reduction due to the field fit change to the upstream slope from 5:1 to 7:1. The excavation is expected to refill and habitat values before and after are expected to be similar.

In general, knotweed disturbance was a challenge to monitor as they occurred in many locations near this long access route. Mitigation effectiveness monitoring should include surveys for emergent knotweed on the Giesbrecht access route.

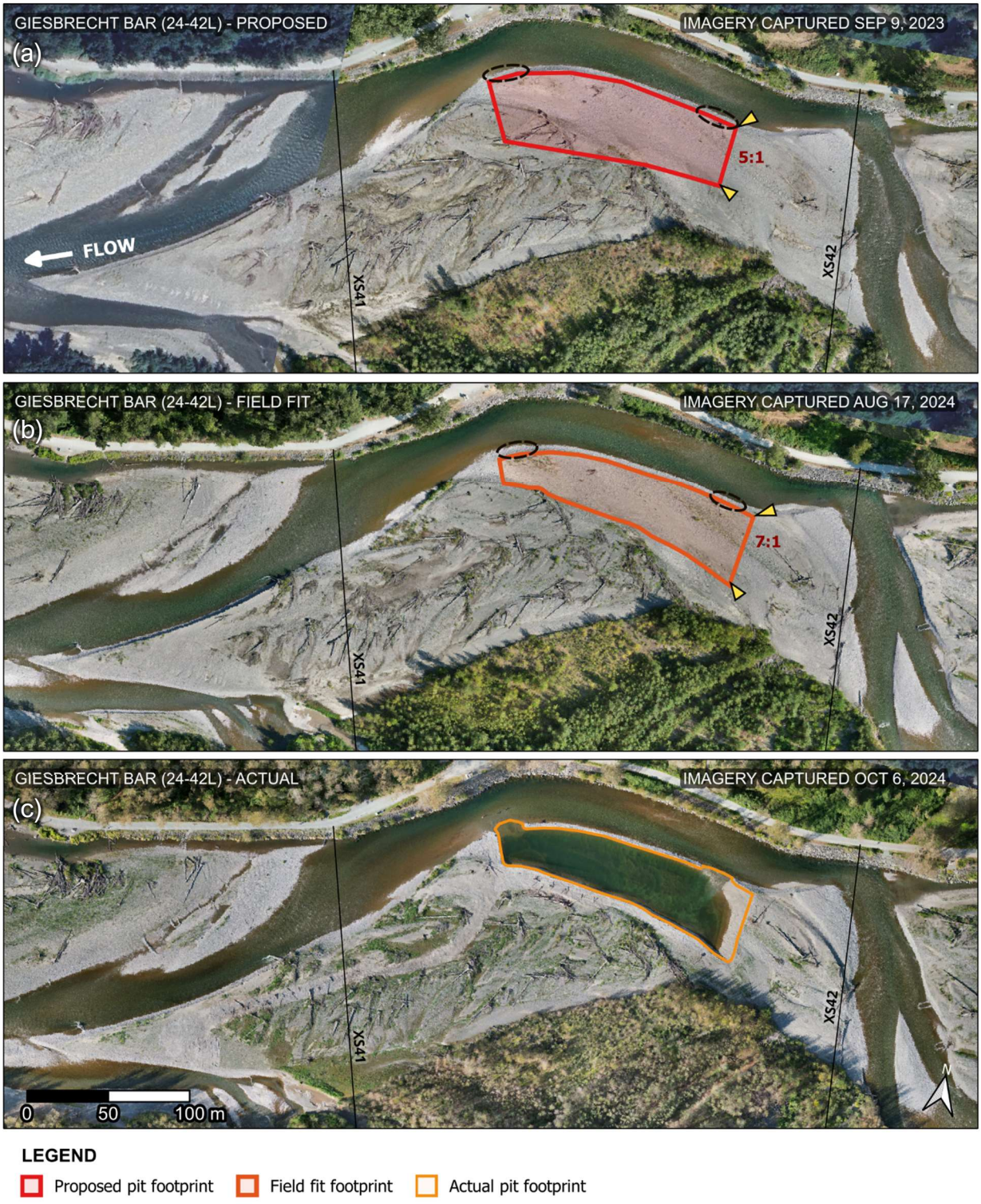

Figure 9. Orthomaps of Giesbrecht Bar with (a) planned excavations based on 2023 river conditions, (b) field fit excavations and offsets based on river conditions on Aug 17, 2024, and (c) the actual excavation completed in 2024.

Figure 10. Photos taken at Giesbrecht Bar by environmental monitors. (a) Excavators carrying bridge to the river bank via the existing trail (taken Aug 27, 2024). (b) Side channel running dry after the installation of airbridge (taken Aug 28 2024). (c) An excavator completed one wet crossing to construct the side channel crossing (taken Aug 29 2024); (d) Bridge was moved into place by excavators positioned on land (taken Aug 29 2024). (e) Access route established along the bar top (taken Aug 30 2024); (f) Pit excavation was completed in lengthwise stripes and briefly stockpiled in windrows behind the excavator within the pit footprint (taken Aug 30 2024).

Figure 11. Photos taken at Giesbrecht Bar by environmental monitors.(a) Excavator pausing at downstream end to allow pit to fill and water levels to equalize (Sep 13, 2024). (b) Flow of turbid water from the pit following pit openings on Sep 13, 2024. (c) Bridge removal during light rain on Sep 13. (d) Restoration of pre-existing access road through the riparian area (Oct 11, 2024). (e) Site of first bridge crossing after restoration was completed (taken Oct 11, 2024).

2.3 PEACH ROAD BAR (24-40R)

Peach Bar is large in area and elevation, i.e. approximately 90,000 m^2 and 4 m above water level at low flow in 2024. Although the Peach pit excavation was the largest proposed for 2024 at 8,830 m^2, the proposed footprint was less than 10% of the bar.

PLAN

Access route

The proposed access route from the Lickman Hayfield Stockpile Site to the pit excavation site followed the existing North Rotary Trail for the majority of the distance, approximately 1,000 m eastwards. A ramp from the top of bank onto the gravel bar would be needed and possibly a culvert. The route then extended across 130 m unvegetated bar to the site. No vegetation removal was expected, although some relocation of LWD to adjacent areas was expected.

Pit excavation

The proposed 2024 excavation at Peach Road Bar consisted of a single pit. The purpose of this excavation was to trap sediment upstream of the freeboard limited area and to limit erosion on the left bank. Excavation of the bar takes some of the pressure off this bank and helps to maintain the integrity of the bank without the requirement of armoring. A 5:1 slope at the upstream edge of the excavation was prescribed to provide stability during higher flows, and to prevent erosion of the head of the bar. All other slopes were designed at 1.5:1. Two openings, 20 m wide, were prescribed to permit flow in and out of the pit and to allow fish to move freely through the site. The dimensions were limited by the location of the riffles upstream and downstream, vegetation on the bar, and flowing water.

Offsetting

One habitat enhancement excavation was proposed at the downstream end of Peach Road Bar (Figure 14). This excavation was intended to provide a channel fed by sub-gravel percolation during low flows for rearing and potentially some spawning. However, if sub-gravel flows were less than anticipated, the resultant backwater would still contribute to habitat value.

IMPLEMENTATION

Access route

During the pre-mobilization meeting a location for the ramp was identified ~75 m west of the proposed location. A large enough gap in the trees along the top of bank and unvegetated area on the adjacent gravel bar was available at this location and there was no side channel to cross. After the rise in water level over the weekend, a section of a temporary side channel along the toe of the bank became wetted. Site isolation and fish salvage was completed for a ~20 m long area on Aug 26 and 27. EMs walked and flagged a route across the bar that was free of native and invasive plants. Any knotweed in areas adjacent to the access route were flagged and/or fenced off.

On August 27, two culverts were installed and the ramp was constructed. Culverts were installed and confirmed to be sufficient to accommodate flows and for fish passage. The excavator walked down the rip rapped bank slope at the location for ramp construction. Material from the bar was used to construct the ramp and it was completed in one day.

Pit excavation

The design laid out by the QEP on Aug 19 was similar to the proposed design, except the north perimeter was shifted to accommodate setbacks from knotweed clones located among the LWD in the middle of the bar. These clones were too large or difficult to access for removal and therefore a 20 m meter setback was applied, per the Knotweed Management Plan.

Pit excavation began on Aug 28. Two excavators and four trucks were used at this site. First, the bar top within the pit footprint was excavated to near the waterlevel. When deep excavation was underway, EMs observed that water level equalization between the main channel and pit was much slower than expected, such that water level was over one meter lower inside the pit. Wave action midway on the pit wall led to sloughing and there were concerns about over-steepening of the inside slopes. The Contractor left berms every ~50 m to create cells to limit the wave action. The slope of the perimeter adjacent to the mainstem was changed from 1.5:1 to 2:1 and continued monitoring was prescribed. On Aug 30, water was observed seeping into the pit from the mainstem just above water level in the pit. Following discussions between the engineering team and environmental team, including the QEP, it was determined that the chance of berm failure was low, but that the following measures should nevertheless be followed: (i) ensure that water level in the pit was within one meter of the water level in the river, (ii) both excavators would load trucks to allow time for equalization, as needed, (iii) mid-pit berms would continue to be used, and (iv) the sub gravel percolating water and inner slopes would be closely monitored by EMs for any changes.

On Sep 3, 2024 at 11:35 am, a truck hauling sediment along the North Rotary Trail from the excavation site to the stockpile at Lickman Parking Lot slid off the edge of the trail and tipped toward the north side. Three mature trees along the trail prevented the truck from sliding further down. The EM and site supervisor responded to the incident, monitored the righting of the truck by an excavator at 12:30 pm, checked for vehicle damage, checked for fluid spills, and assessed environmental damage. The top of the vehicles cab was damaged and the three trees had some scarring. Some sediment spilled onto the riparian vegetation but none entered Peach Creek. A small hydraulic leak was observed on the truck and had dripped onto some leaf litter and vegetation. Aborbant pads and shovels were used to clean and dig up all contaminated material, which was bagged separately for proper disposal. Speed limit signs and a pylon indicating the edge of the trail at this bend were added, the hydraulic line was repaired and work resumed. On Sep 7, 2024 at 8:30 am, a hauling truck travelling along the North Rotary Trail went off the shoulder and tipped. Again, the trees lining the trail held the truck up and were scarred. Approximately two cubic meters of sediment poured onto the bank slope of the Peach Creek Spawning Channels. The truck was out of operation until it was repaired. For the remainder of the project, enforcement of the posted speed limits was increased and pylons marking curves in the trail were added to the access route.

Figure 12. Photos taken by EM. (a) Bar material spilled between Rotary Trail and Peach Creek (Sep 7, 2024); (b) Tree damage caused by truck (Sep 7, 2024); (c) Pylon at location of truck tipping (Sep 10, 2024).

During excavation of the pit, an EM measured channel turbidity upstream to downstream of the pit before and after works began each day. Measurements ranged from 0.0 to 1.5 FNU, with the exception of Sep 12 when S45 was opened. Turbidity in the mainstem was unaffected by pit excavation until the pit was opened to flowing water. EMs observed fish jumping across from Peach Bar, but no runs of salmon. Trucks travelling across Peach Bar generated a significant amount of dust. A water truck was deployed approximately every 1.5 to 2 hours for dust suppression, except during rain events. Excavation of the pit was completed on Sep 15.

Pit openings occurred on Monday Sep 16 between 8 am and 11:30 am. The openings were directed by the QEP and two additional EMs were on-site taking turbidity measurements, monitoring for fish, and operating the aerial drone. The downstream end was opened first

and was 20 m wide. The upstream opening was 19 m wide. Together, the openings involved the disturbance of approximately 100 m^2 of wetted area.

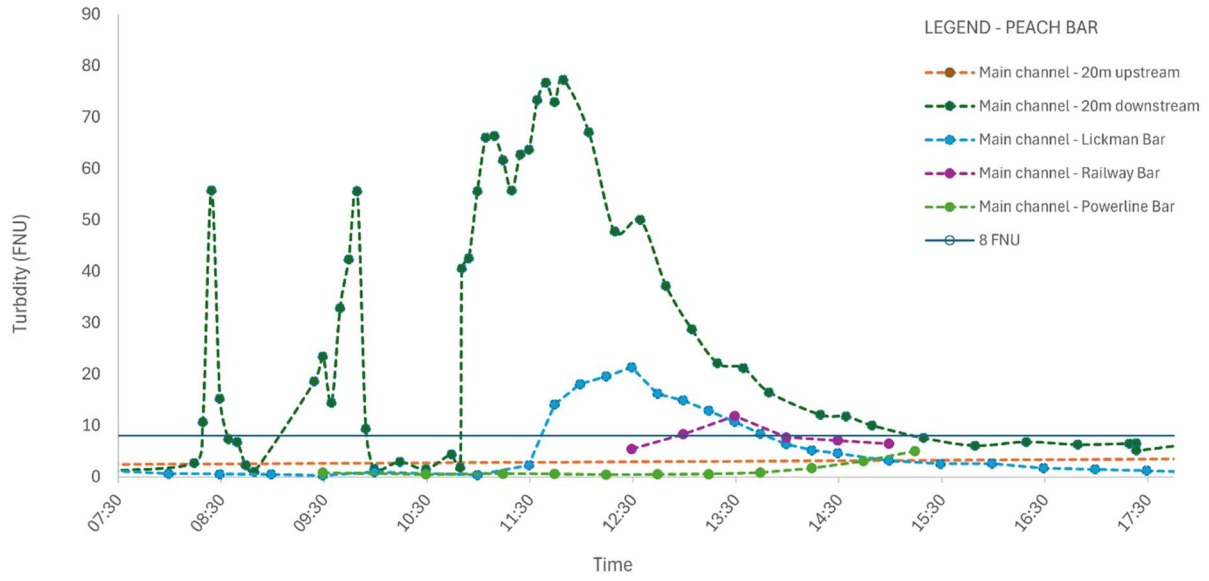

Figure 13. Water quality measured at several locations during the pit opening at Peach Bar on Sep 16, 2024.

Offsetting

The backchannel excavation planned for Peach Bar was cancelled owing to several irremediable knotweed clones along the edge of vegetated island. Despite extensive evaluation of alternative offsetting options on Peach Bar further downstream (between XS39 and XS38), irremediable knotweed clones present in the area rendered all the options infeasible.

Restoration

After the pit was complete and opened to flowing water, the stockpiles were removed completely, LWD was redistributed and the surface of the bar was roughened. Ramp material was hauled to the stockpile, the bed contours were re-established, and rip rap was replaced. The Rotary Trail was graded and topped with crushed gravel (crusher dust), per the City's request.

SUMMARY

The Peach Road pit excavation was completed between Aug 27 and Sep 16. It was the second largest excavation with a disturbance area of 8,452 m^2, which was 96% of the proposed disturbance area. Challenges with water level equalization, dust suppression and trucks tipping on the Rotary Trail were addressed by the EM and QEP. No reportable incidents occurred at this site. Overall impacts to habitat values are expected to be neutral.

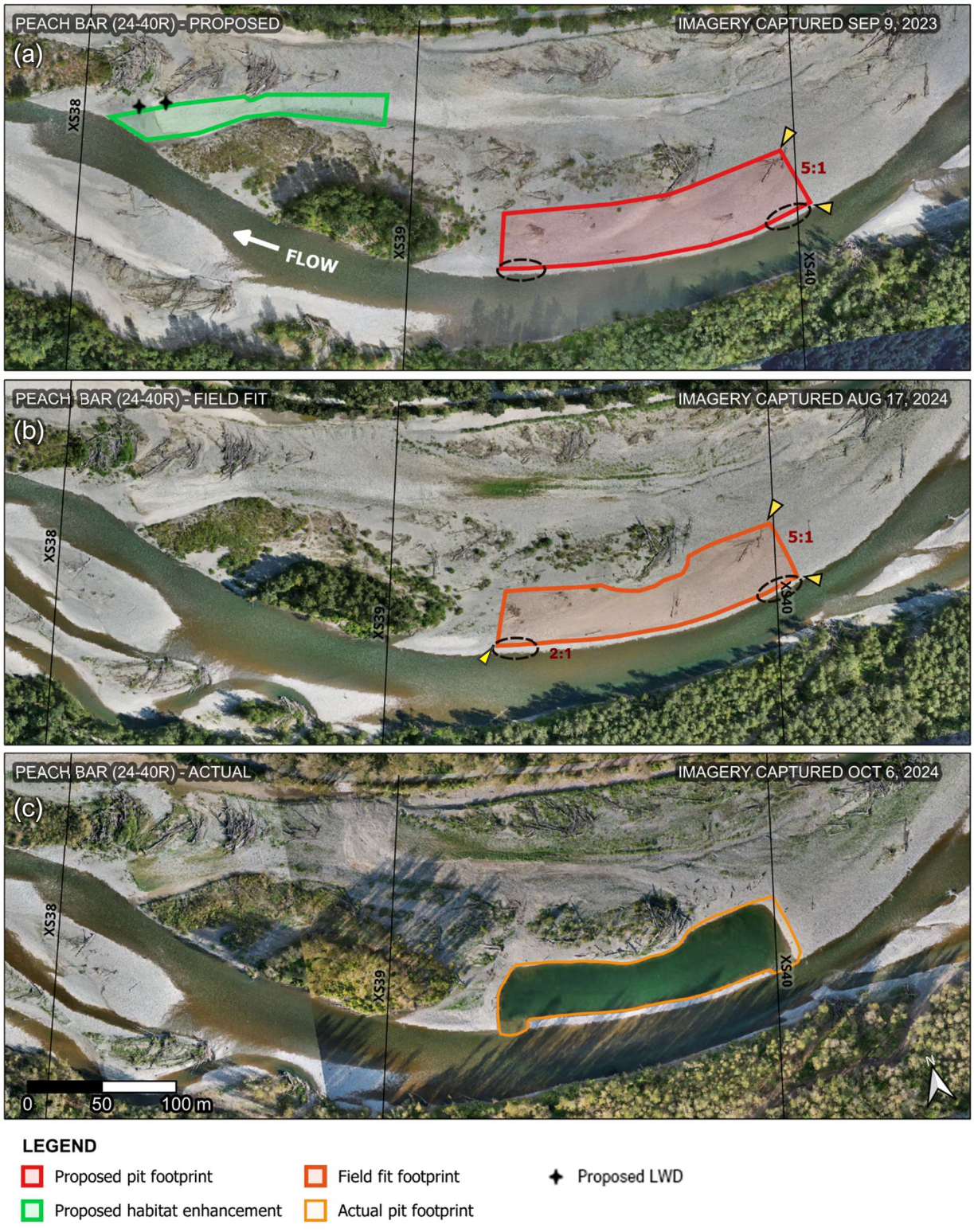

Figure 14. Orthomaps of Peach Road Bar with (a) planned excavation and offsets based on 2023 river conditions, (b) field fit excavation based on river conditions on Aug 17, 2024, and (c) the actual excavation completed in 2024.

Figure 15. Photos taken by environmental monitors at Peach Road Bar. (a) Culverts placed at the toe of the bank within an isolated and salvaged area prior to ramp construction (Aug 27, 2024). (b) Access ramp nearly complete (Aug 27, 2024). (c) Stockpiling of bar top material prior to deep excavation at Peach Bar (Aug 28, 2024). (d) Pit is slow to fill with water once deep excavation begins (Aug 29, 2024). (e) Spring of water from main channel causing some erosion (Aug 30, 2024). (f) Tree found next to Rotary Trail along the access route appeared to have been felled by a beaver (Sep 11, 2024).

Figure 16. Photos taken by environmental monitors at Peach Road Bar. (a) No runoff issues along the hauling route near the Peach Creek Spawning Channels during rain on Sep 11, 2024. (b) Stockpile and machinery at the Lickman parking lot (taken Sep 10, 2024). (c) Downstream pit opening on Sep 16, 2024. (d) Turbid water travelling along bar edge 20 m downstream during pit opening (Sep 16, 2024). (e) No impacts to water levels detected at temporary staff gauge installed in Peach Creek Spawning Channel on Sep 17, 2024. (f) Restored bar top (Sep 19, 2024).

3 SITE REPORTS – MIDDLE REACH

This section provides an overview of the construction activities and environmental monitoring completed at each site in the Middle Reach. The Middle Reach of Vedder River extends from XS-34 near Lickman Road downstream to XS-17-2 near the BC Southern Railway Bridge. This reach is approximately 2.5 km long, and compared to the Upper Reach it is narrower and less steep. Excavations in this reach were designed to restore some channel capacity in freeboard limited zones and reduce the volume of sediment moving into the Lower Reach. In the Middle Read, all four proposed pit excavations were completed (Lickman, Brown, Bergman, and Railway Bars). Although Bergman and Railway Bars are consecutive, both were completed because they are highly unlikely to interact given the distance between them and the right-hand bend in the in the river upstream of Railway Bar. Offsetting activities were only completed at Campground Bar. All work below the HWM in this reach was completed between Aug 27 and Sep 27.

3.1 LICKMAN BAR (24-34R)

Lickman Bar is located on the right side of the mainstem with a well-established secondary channel flowing along the right bank. Flow splits across a large log jam at the upstream end of the bar, maintaining flow to a side channel on the right. Vegetation on the bar is becoming more established at the upstream end and in patches at higher elevation areas on the bar.

PLAN

Access route

The proposed access from the Lickman Hayfield stockpile site was 150 m east along the Rotary Trail and then a constructed ramp with a culvert crossing to get down to the bar. From the ramp, the machinery would track over unvegetated gravel bar, with contractors limited to a single track with a pullout. Installation of the culvert will be completed using appropriate BMP's that most effectively limit impacts on fish in that channel. If the hayfield site was not available, the material could have been transported down the Rotary Trail to Hooge Stockpile or transported directly off-site.

Pit excavation

The proposed excavation at Lickman Bar consisted of one pit, intended to trap sediment upstream of the freeboard limited area and to limit erosion on the left bank. A 5:1 slope at the upstream edge of the excavation was prescribed to provide stability during higher flows and to prevent erosion of the head of the bar. All other slopes were designed at 1.5:1. Two openings, 20 m wide, were prescribed to permit flow in and out of the excavation and to allow fish to move freely through the site. The dimensions were limited by the location of the riffles upstream and downstream, flowing water, and vegetation in the center of the bar.

Offsetting

The proposed riffle excavation was a wide, shallow, gently sloped excavation that would be left dry by leaving a slight berm at the upstream end. The objective was to provide a channel, fed by sub-gravel percolation during low flows, for rearing and potentially some spawning and then allow a natural riffle shape to form during higher flows. If flows were less than anticipated, the resultant intermittent riffle would also contribute to habitat values. LWD from within the excavation footprint were to be keyed in at strategic locations along the bank and channel.

IMPLEMENTATION

The access route was moved to align with the Lickman parking lot gate and a direct path from the Lickman stockpile to the bar top. From there, an 80 ft bridge was installed to allow for a steady grade down from the Rotary Trail to the top of the bar. At this location,

two trees along the trail were topped, a layer of geotextile was laid over the existing pedestrian trail down to the bar. Then sediment from the stockpile and lock blocks were layered on top to construct the bridge abutments. Rip rap was placed along the base and where the abutment extended into the water. A layer of geotextile was placed on top of the rip rap to prevent sediment from dropping between the rocks. Sediment from the stockpile (shared with Peach Bar) and lock blocks were added. One wet crossing of an excavator carrying four lock blocks was completed to establish the ramp on the other side and assist in pulling the bridge into place on the abutments. The bridge installation was completed on Sep 8.

On the bar, a small gully with vegetation needed to be crossed to gain access to the pit footprint. At the direction of the EM, geotextile was laid over the vegetation and sediment from the bar was placed on top. The geotextile was wrapped around the side and held up with T-bars to prevent sloughing. Some individual pieces of LWD in the middle of the bar were picked up and moved to the side to create a clear path for the remaining 60 m to the pit footprint.

Pit excavation

Design layout was completed by the QEP on Aug 16 after site conditions were reviewed. Excavations were completed between Sep 13 and Sep 23, 2024. Once access was established, the bar top within the footprint was excavated to near the water level. Then the deep pit was excavated from downstream to upstream, allowing trucks to turn and be loaded within the footprint.

On Sep 18 at 6:30 am, the EM observed fluid under the tire of a rock truck that had been parked overnight. The fluid was identified as Powertran Fluid XP brake fluid. An estimated 1.5 L had leaked from a broken o-ring on the brake cooling system. The affected area was estimated to be 0.1 m^2. As this was not a reportable quantity, the EM monitored the clean up. The contaminated gravel was shovelled into a bag for separate disposal, spill pads were placed under the wheel, and the truck was not used until the o-ring was replaced and the truck was confirmed to be in good working order by the mechanic three hours later.

Figure 17. Spill of a non-reportable quantity of brake fluid on land. (a) Brake fluid leak (Sep 18, 2024). (b) After clean-up, a spill pad placed under truck while awaiting repair (Sep 18, 2024).

On Sep 18, the slope at the upstream end of the pit was adjusted by the QEP. Flow in the main channel coming off of a riffle upstream was directed towards the original location for the upstream opening. To maintain stability, the opening was moved 30 m downstream and the slope along the upstream edge, around the corner and 30 m of the river side of the pit was converted to a 7:1 slope.

Excavation of the pit was completed on Sep 19, 2024. On Sep 20, the pit was opened to flowing water under the direction of the QEP. The downstream opening was 23 m across with a standard 1 m depth in the center. The upstream opening was 19 m wide and shallow, approximately 0.5 m deep.

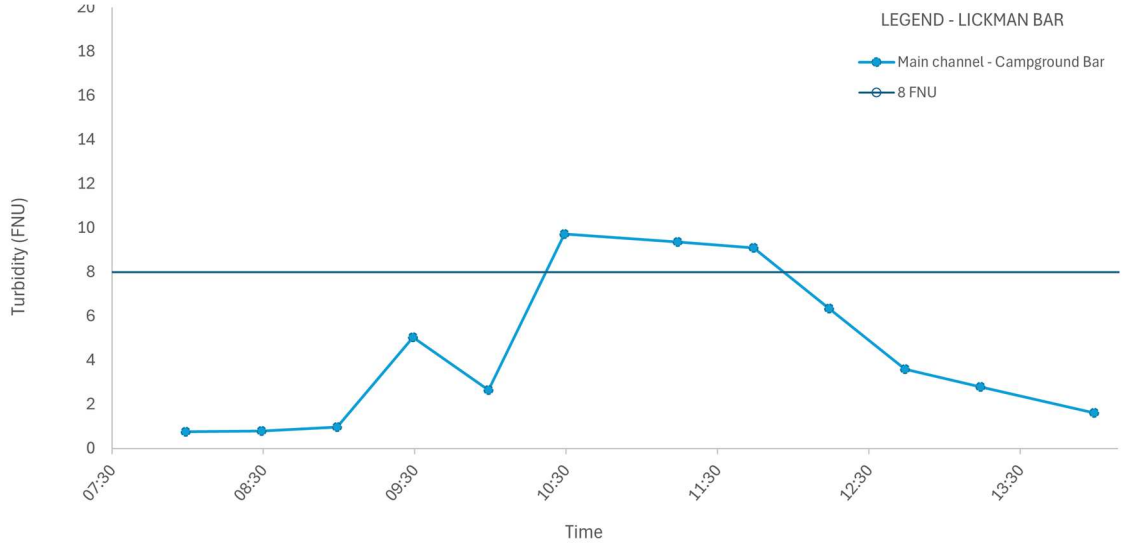

Figure 18. Turbidity (FNU) measured during the pit opening at Lickman Bar on Sep 20, 2024.

Offsetting

The riffle excavation was also laid out by the QEP on Aug 16. When excavation of the riffle began, the cut at the upstream end was below water level at the prescribed grade. The grade on the riffle excavation was adjusted mid-way to ensure the cut at the downstream end was above water level. Excavation of the riffle was completed between Sep 10 and Sep 22.

On Sep 23, the berm was removed at the upstream end of the riffle. To access this site, the excavator walked upstream along the unvegetated bar from the area of the pit to the berm. The berm was excavated to just below current water level in the main channel, opening this riffle area to the flowing water. Berm material was placed in a pre-excavated receiving pit at a higher elevation on the bar nearby, because trucks could not access the area. Some turbidity was released, which peaked at 53 FNU at 9:30 am and had returned to 1.3 FNU by 11:30am. The excavator crossed the newly excavated riffle at the downstream end and then finished removing the bridge.

Restoration

Restoration was completed in several stages at this bar. On Sep 20 to 23 remaining stockpiles on the bar were hauled to the parking lot and tracked areas of the bar top were scarified as needed. LWD was redistributed, the cover for the infilled vegetated gully crossing was removed, and the ramp on the bar was removed. After opening the riffle on Sep 23, the excavator assisted with moving the bridge back to the bank and carried the lock blocks across the side channel. On Sep 24 and 25, the abutment and ramp on the bank side were removed and the pedestrian ramp was re-established. All material at the Lickman parking lot was hauled off site by highway trucks and the site was restored to previous condition by October 17, 2024.

SUMMARY

All work at Lickman Bar was completed between Sep 12th and Sep 23. The disturbance footprint was 3,360 m^2, which is 89% of the proposed disturbance area. The shortfall is attributable to small changes to the north perimeter and downstream end to accommodate knotweed and the downstream riffle, respectively. This excavation may lessen the eroding force of the mainstem on the left bank. This pit is expected to refill and return to its original configuration over time. The riffle excavation was completed between Sep 18 and Sep 22 was 3,855 m^2 and is expected to provide shallow rearing habitat and spawning habitat. Habitat values are expected to increase with the riffle enhancement.

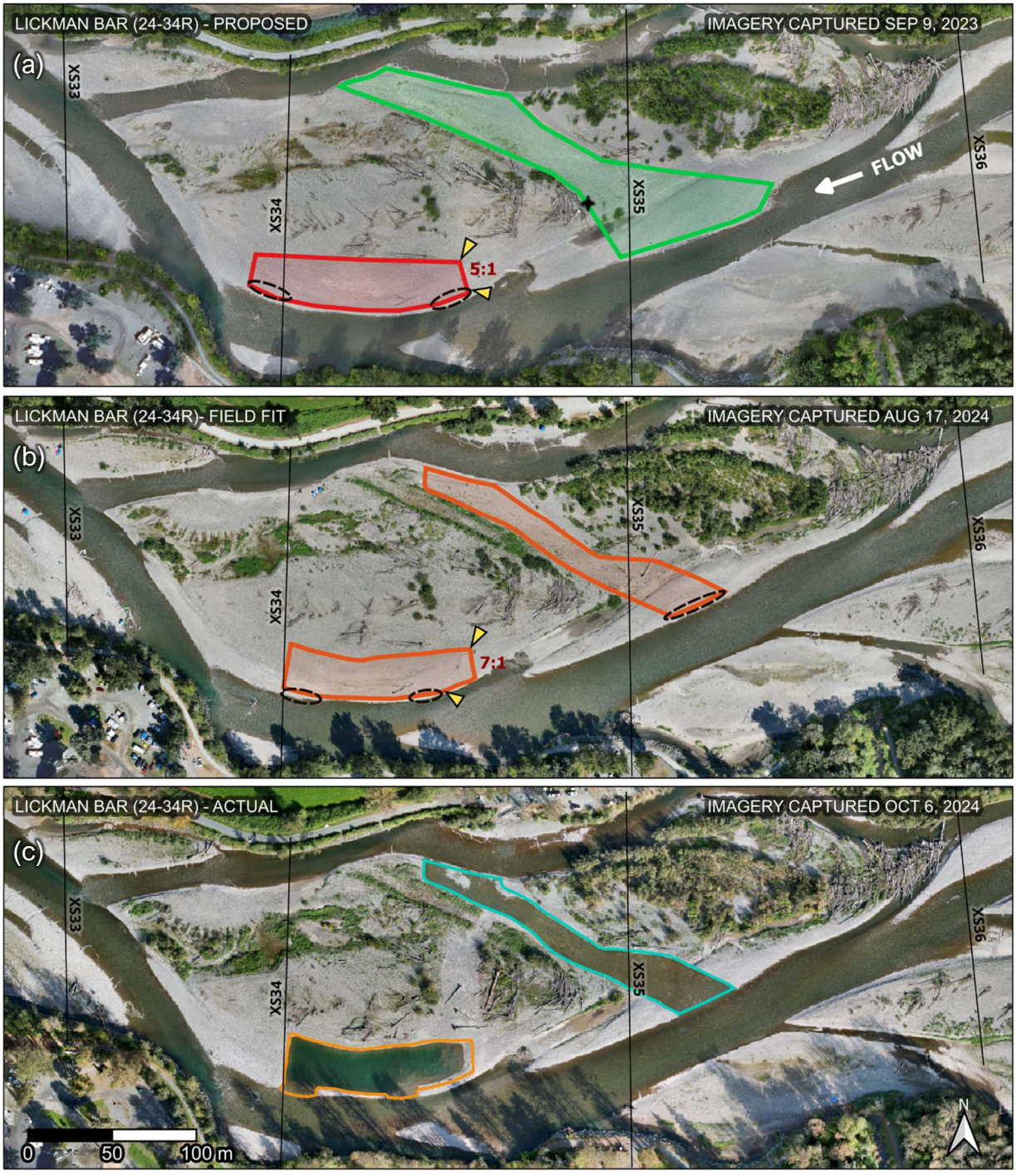

Figure 19. Orthomaps of Lickman Bar with (a) planned excavations and offsets based on 2023 river conditions, (b) field fit excavations and offsets based on river conditions on Aug 17, 2024, and (c) actual excavations and offsets completed in 2024.

Figure 20. Photos of the works at Lickman Bar were taken by the environmental monitors. (a) Isolated and salvaged area for bridge abutment installation (Sep 6, 2024). (b) Completed bridge across from Lickman parking lot (Sep 9, 2024); (c) Geotextile and sediment was used to fill in a vegetated contour on the bar to allow access to the excavation site (Sep 13, 2024). (d) Downstream end of pit excavation (Sep 11, 2024). (e) Excavation of the upstream end of riffle excavation (Sep 18, 2024).(f) Downstream end of riffle excavation (Sep 17, 2024).

Figure 21. Photos taken at Lickman Bar by environmental monitors. (a) Excavation of upstream pit opening (Sep 20, 2024). (b) Outflow of turbid water from the downstream opening during the upstream opening (Sep 20, 2024). (c) Completed pit at Lickman Bar on Sep 23, 2024. (d) Opening of riffle enhancement area on Sep 23, 2024. (e) Restoration of the pedestrian ramp from the Rotary Trail to the bar top where the bridge had been installed (Sep 25, 2024). (f) Topping parking lot with crushed gravel after stockpiled material was removed (Oct 16, 2024).

3.1 CAMPGROUND BAR

At Campground Bar, only offsetting activities were planned. Campground Bar is located in a sensitive area where groundwater discharges from the Sardis Aquifer. This groundwater contributes to aquatic habitat in the Browne Creek Wetland on the south side of Vedder River and Great Blue Heron Reserve on the north side as well as within the active channel. In the 2010's, DFO installed a 60 m pipe on the left bank with a sluice valve to provide supplemental flow to Browne Creek Wetland during dry summer months. However, around 2020 the thalweg shifted to the right side, burying the intake in gravel and limiting its functioning. The purpose of the proposed offsetting activity was to restore the function of this pipe and protect the wetland against dewatering under drought conditions. The outlet of the pipe is located at the upstream end of a 300 m extension to the groundwater fed Brown Creek wetland which has been enhanced in sections by DFO.

PLAN

The Campground Bar site was to be accessed from the Giesbrecht stockpile via the South Rotary Trail and a small ramp down to the bar. The proposed enhancement excavation at Campground Bar would create a microchannel along the bank for approximately 200 m and restore flow across the intake of the pipe. The wetland is a large area with a number of pools, but a conservative estimate of 2,100 m^2 of improved habitat was provided in the Project Plan because habitat gains would be most significant during drought conditions and because deposition could potentially fill in the excavation. The enhancement excavation would provide 500 m^2 of improved in-channel habitat. Flows were expected to spill over from the pool at the intake and flow along the bank for 200 m and then rejoin the mainstem at the downstream end of the bar.

IMPLEMENTATION

The stockpile location and access route were changed to minimize disruption to the Vedder River Campground. To accomplish this, the hauling route headed from the excavation site west along the South Rotary Trail to Browne Road, then to the setback dike road and east along the setback dike to the Giesbrecht Stockpile. The total distance was 2,300 m. The Browne Road Stockpile site was considered but did not have enough capacity for the expected volume post-field fitting.

Field fitting of the enhancement excavation and preparation of an engineering drawing was completed between Sep 2 and Sep 15. The excavation design was field fit to accommodate setbacks from knotweed located at the top of bank. The length of the excavation was extended to ensure adequate spill over at the downstream end. One tree was felled for access.

On Sep 16, the access ramp was constructed. On Sep 17, the intake structure was excavated to determine its depth, angle, and condition. It was discovered that the sluice gate, located at the wetland end of the pipe, had an incomplete seal and when the pipe intake was excavated, some turbid water leaked through. To stop movement of turbid water through the pipe, a submerged pump was placed in the excavation to move turbid water to an adjacent settling area. The turbid water was left to settle in an area more than 30 m from flowing water. With the water level lowered, no further movement of turbid water was observed at the sluice gate. With the water level now lower on the river side of the pipe, water level in the headwater was monitored. Staff gauges were installed in the headwater and 120 m downstream in the wetland to establish two permanent sampling locations. It appeared to have dropped by less than 1 cm by the end of the day when the pump was turned off. An EM remained onsite for two hours to ensure turbidity levels did not increase. This pit was left undisturbed until the infiltration gallery was to be installed on the final day and immediately prior to opening the enhancement excavation to flowing water. To further mitigate potential leakage of turbid water, meter bags and a poly lining were installed around the sluice gate. Prior to installation, the immediate area was isolated using a net and fish within the area were salvaged. During enhancement excavations, the EM and/or QEP monitored the works and regularly checked water level and turbidity at the outflow of the pipe. The enhancement excavation was completed in sections with berms left every ~200 m. One piece of LWD was added to each of the three pools by the QEP.

With a large amount of sand and gravel observed within the pipe, it was evident that the pipe needed to be flushed to restore functioning. The infiltration gallery would limit the accumulation of fines in the pipe and increase the likelihood of functioning even with some infilling of the enhancement excavation on the bar. On Sep 25, the pipe was flushed for several hours with high pressure water. A significant amount of fines was removed from the pipe on the river side. An EM monitored the sluice gate for turbid water. A small hole was cut in the end of the pipe for City of Chilliwack to send a CCTV up the pipe to assess the condition of the pipe and the amount of fines and debris. Once the pipe was deemed to be sufficiently flushed, the hole was welded shut.

On Sep 26, the berms in the habitat excavation had been breached as a result of a heavy rain event. Although the berms were intact, sections of the enhancement excavation were salvaged using a seine net out of an abundance of caution. Since the hole at the intake was over 2 meters deep, the pool was drawn down using a large pump fitted with fish exclusion screens to approximately 0.7 m depth. No fish were caught in either the newly excavated channel sections or the intake excavation, and no signs of fish were observed. Once the excavations were confirmed to be non-fish bearing, the infiltration gallery was created by addition of two layers of rinsed and sorted cobble and one layer of sediment excavated on site. To prevent fines filling the interstitial spaces within the infiltration gallery or passing through to the wetland habitat, geotextile fabric was added between the cobbles and gravel layers.

Construction of the infiltration gallery followed engineered drawings provided by KWL. A deep layer of large cobble was placed first, then two large sheets of geotextile were placed over top and held in place with the last of the cobble. Excavators then infilled the remaining portion of the intake area, leaving an adjacent pool that connected with the rest of the habitat excavation. The berms were removed in a downstream to upstream direction and immediately delivered a substantial increase in flow to the backchannel/wetland habitat. The ramp was removed at the end of the day, which initiated flow through the entire enhancement excavation. The access ramp material was hauled to the stockpile. All work below the high water mark was completed by Sep 27 with restoration of the South Rotary Trail completed shortly after.

SUMMARY

The Campground enhancement work was completed between Sep 16 and Sep 27, 2024. The sluice gate on the pipe remained closed throughout all works and following completion. The infiltration gallery and enhancement excavation appeared to be highly successful in providing supplemental flow to Browne Creek Wetlands upon the completion of this work. The immediate effects on functionality are likely attributable to flushing of the pipe given that a large volume of sand was removed, the provision of channels for groundwater and surface water through the cobble of the infiltration gallery, as well as the excavation of the side channel. The infiltration gallery is expected to significantly increase the likelihood of continued functioning of the pipe if the side channel fills with gravel in the future. This will be monitored during the three-year effectiveness monitoring period.

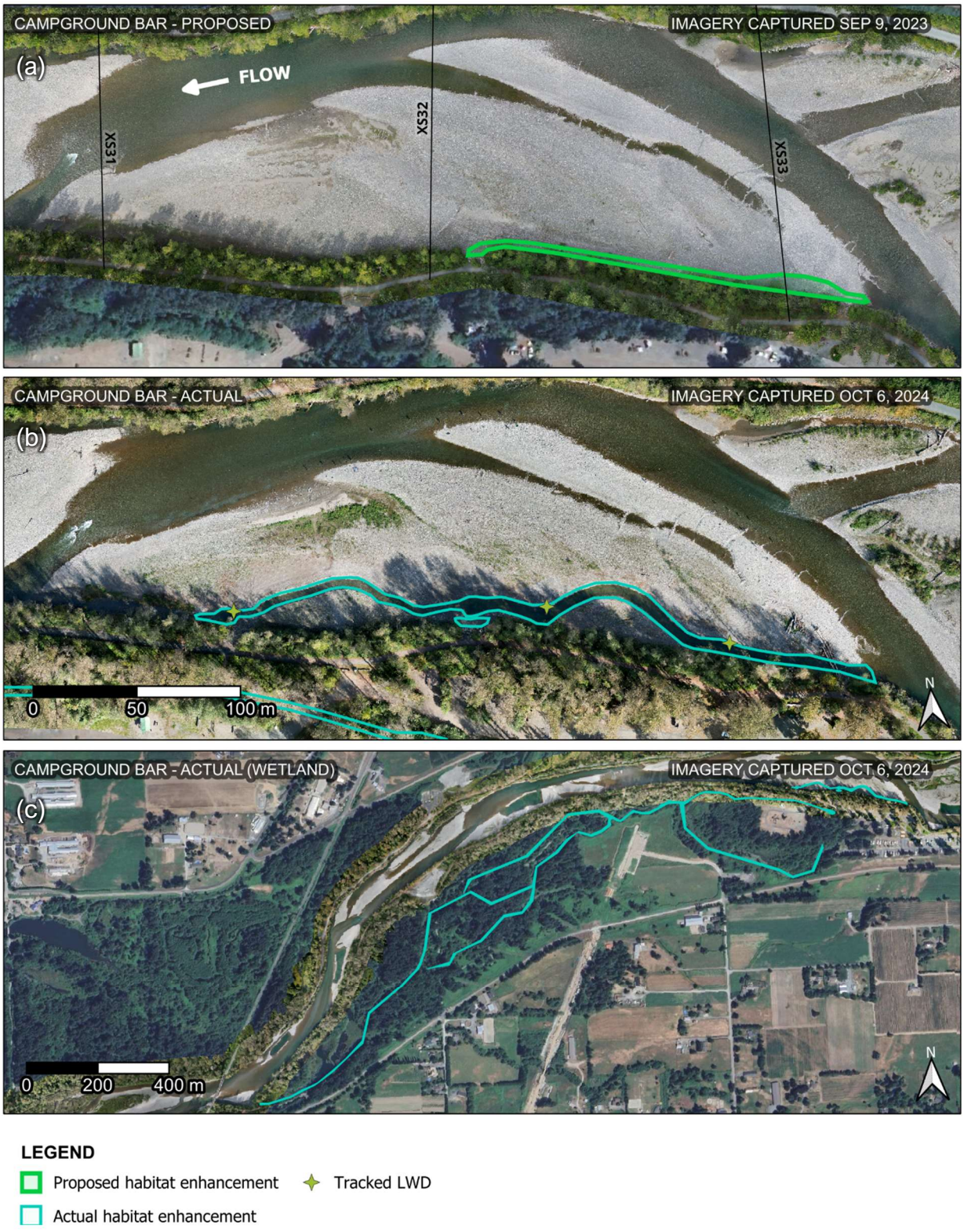

Figure 22. Orthomaps of Campground Bar with (a) planned offset based on 2023 river conditions, and (b) the completed offsets in 2024 in Vedder River and (c) the Browne Creek Wetland from the headwaters next to Campground Bar to the outflow near CN Rail.

Figure 23. Photos taken at Campground Bar by environmental monitors. (a) Access ramp onto the bar (taken Sep 17, 2024). (b) Small pit was excavated at the pipe intake on Sep 16, 2024, and a small water pump controlled the water level. (c) Staff gauge marking the upstream monitoring location for wetland enhancement (Sep 17, 2024). (d) Staff gauge marking the second monitoring location 120 m downstream (Sept 17, 2024). (e) Excavation at upstream end where water is seeping in prior to removing the berm at the upstream end (Sep 19, 2024).(f) Aerial drone image of habitat enhancement channel and access ramp (Sep 21, 2024).

Figure 24. Photos taken at Campground Bar by environmental monitors. (a) Two berms at the upstream end of the enhancement excavation (Sep 26 2024); (b) LWD placement within one of the pools in the habitat enhancement excavation (Sep 24, 2024). (c) CCTV inspection of the pipe on Sep 25 2024; (d) geotextile laid over large cobble during construction of the infiltration gallery (Sep 26, 2024); (e) excavator packing the finer sediment over the infiltration gallery. (f) Aerial photo of completed habitat enhancement excavation connected to the main channel at the upstream and downstream end of Campground Bar (Sep 28, 2024).

3.2 BROWN BAR (24-26L)

Brown Bar is a long, narrow bar with a microchannel that flows along the left bank and then across the center of the bar. This microchannel has been a persistent feature despite other changes in bar configuration, so buffers were applied to preserve this feature. There is also a persistent pattern of left to right cross channel riffles in this section of the river.

PLAN

Access route

The proposed access route to Brown Bar involved construction of a small ramp near the downstream end of the bar. If there was potential for flow, the side channel would require a culvert crossing at the toe of the bank. Access to pit A from pit B may have also required a culvert crossing. The hauling route from the ramp followed the South Rotary Trail for 200 m eastward to the Bergman Stockpile site.

Pit excavation

The Brown Bar site consisted of two pit excavations, pit A at the upstream end and pit B downstream of the microchannel. Pit A was to be excavated first so trucks could limit their tracks to the footprint of pit B. The dimensions of pit A were constrained by bar surface area and the microchannel that flows along the left bank and then crosses the bar as well as the change of slope induced by the riffle upstream. A buffer was to be left between the microchannel and pit A.

The dimensions of pit B were constrained by a riffle at the downstream end and the microchannel at the upstream end. Pit B was to be excavated close to the bank to provide wetted habitat edge and potentially extend the microchannel habitat as the bar refilled.

Offsetting

One habitat opening was planned for this site at the downstream end of pit B. This opening would allow overflow from the pit to travel along the bank to create more rearing and spawning opportunities. If advantageous, the entrance to the microchannel was to be deepened. While not included in the offset calculation, this deepening would result in habitat enhancement.

IMPLEMENTATION

Access route

On Sep 27, the access route was established as proposed in the Project Plan (NPE 2024b), except the access point was moved upstream approximately 20 m owing to knotweed next to the footpath at the proposed location. One alder was felled and some shrubs were cut back along the top of bank (TOB) for the access ramp.

On Aug 28, a clear span bridge was placed over the microchannel where it flowed across the center of the bar for access to Brown Bar A. Some gravel was redistributed at either end for smoother transitions from and to the bar. Three stickleback were salvaged from a nearby pool and were transferred to the main channel.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on August 20. The available area of dry bar for excavation of pit A was much smaller in 2024 compared to 2023 as a cross-channel riffle feature had developed further downstream. With insufficient space for a pit excavation Brown Bar A was converted to a bar top removal. This field fit change fully mitigated the potential impacts to the high value habitat surrounding the area. (It should be noted that in all analyses of disturbance and offsetting footprints, this bar top removal is presented with no offsetting value and also no disturbance value as the effects of disturbance are considered fully mitigated.)

Although not included in the offsetting calculations, the bar top removal was designed to maintain or increase riffle habitat by improving the pattern of cross channel riffles in this area.

Compared to the Project Plan, the pit footprint for Brown Bar B was narrower and tapered at the downstream end owing to knotweed setbacks. Also, the riffle at the downstream end appeared to be slightly further upstream and relatively aggressive so the downstream extent was moved upstream ~18 m. Moving the excavation upstream also allowed for part of the downstream edge to be left perpendicular to the direction of the flow to preserve the tailout at the downstream end of the bar (guideline 14).

On Aug 27, pit excavation was initiated. Brown Bar B was the first site to begin pit excavation on the Project. At this time, water levels had increased since the layout was completed. Conditions were reviewed and although the setback of pit B from the main channel had decreased from 5 m to ~2.5 m, no changes were made to the layout as water levels were anticipated to continue dropping. Two excavators and three rock trucks were deployed at this location. The bar top was removed from the pit footprint first. Deep excavation of the pit proceeded in an upstream to downstream direction.

On Aug 28, drips of oil were observed on along the hauling route. Upon investigation, the EM observed one of the rock trucks had a slow leak from the engine. The truck was parked at the stockpile for repairs while the access route was examined for traces of engine oil. Approximately 2 to 5 ml of fluid was found on rocks on the access route. None entered a water course, as such this was a non-reportable event. The material was bagged for separate disposal. The rock truck returned to haul sediment after it was repaired. However, on Aug 29 another slow leak was detected. The rock truck was parked at the stockpile and the same clean-up procedure was followed. Another truck was brought in to replace the one with the issue.

When pit B was nearly complete, work on the bar top removal began. All excavation work at Brown Bar was completed by 1 pm on Sep 2. On Sep 5, pit B was opened to the main channel after a settling period of two and a half days. Turbidity inside the pit at 6:30 am on Sep 5 was 93.7 FNRUs at the upstream end and 67.3 FNUs at the downstream end. At 9:10 am, excavation of the downstream opening began. The opening was wide and shallow at 26 m width and 0.75 m deep. At 11:15 am, excavation of the upstream opening began and flow through the pit created a temporary plume of turbid water. The opening was 13 m wide, 1 m deep and took 15 min to excavate. Turbidity peaked 20 m downstream at 76.8 FNUs and dropped below 8 FNUs around 1 pm. No opening was needed for the bar top excavation.

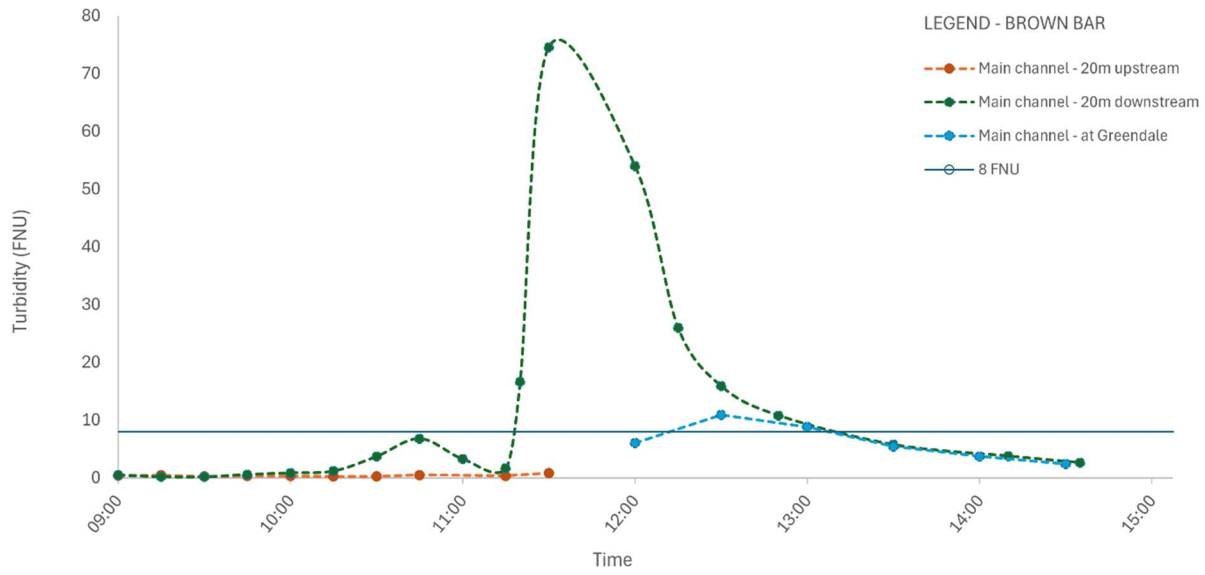

Figure 25. Turbidity (FNU) measurements during the Brown Bar pit openings on Sep 5, 2024.

Offsetting

The habitat opening was cancelled for this site because the field fit pit design was not conducive to directing flow to the bank. Increasing the length of the excavation to achieve this objective was precluded by the presence of knotweed along the bank at the downstream end.

Restoration

Site restoration was completed on Sep 5. The bar was scarified, ramp material was hauled to the stockpile and small woody debris was redistributed on the bank slope to allow natural regrowth. The ramp location was not replanted as there was interest in retaining this as a permanent access point. Shrubs are expected to regrow, and a tree and 2 shrubs will be planted at another location to replace the felled alder.

Report investigation: "Sheen" near Hooge

On Sep 10, a report was made to DFO that a "mystery sheen" was observed on an excavated gravel bar near the Hooge parking lot. All EMs were instructed to survey the active bars for any sign of an oil or oil-like substance. When nothing was found at the active bars, the QEP and EM surveyed completed bars and bars not yet mobilized. At Brown Bar, a mineral sheen was observed in some small rain puddles on the bar. Suspended by surface tension and with a slight silvery sheen, this was the only observation that fit the description in the report. Although efforts were made to follow-up with the person who made the report, the phone number provided was not in service. The sheen was attributed to naturally occurring fines where bar sediment was disturbed.

Figure 26. Metallic sheen on puddles near former ramp location at Brown Bar on Sep 13. Coordinates: 49.097778 N, 122.026483 W.

SUMMARY

The Brown Bar pit excavation was undertaken between Aug 27 and Sep 5. The area of disturbance was zero for pit A, and 4,232 m^2 for pit B, which was 57% of the proposed disturbance area. Pit A was converted to a 1,060 m^2 bar top removal due changes in bar configuration. The excavation design followed natural contours of the riverbed and is expected to increase shallow, gravel habitat. The reduction of pit B is attributed to multiple occurrences of knotweed along the edge of the riparian zone. The completed excavation flushed quickly from both the top and bottom opening. In future assessments of habitat values in the vicinity of this site a neutral or slightly positive outcome is expected. Evaluation of the downstream edge of the excavation to confirm that the tapered section and shorter perpendicular section did not interfere with the configuration of the tailout at his location.

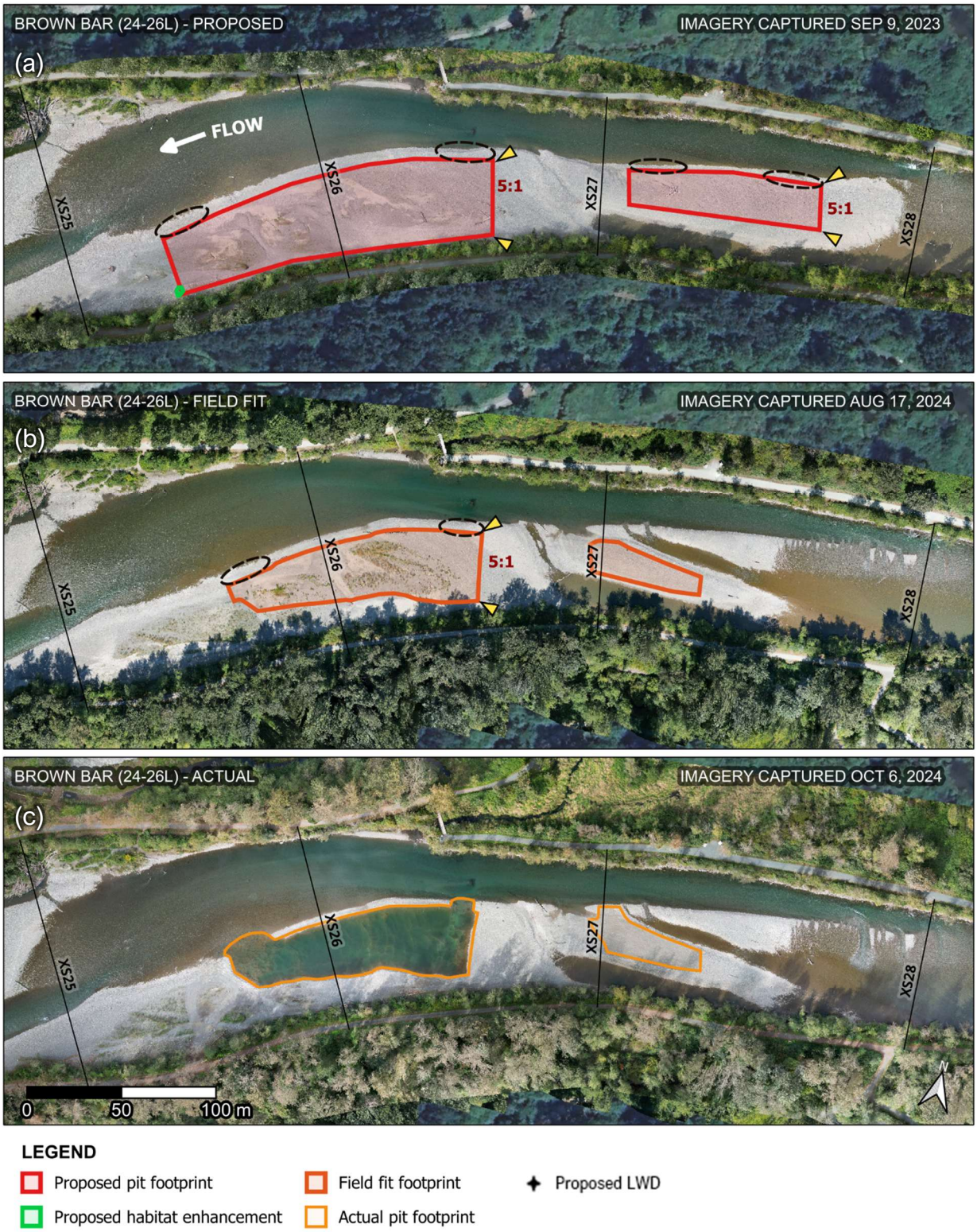

Figure 27. Orthomaps of Brown Bar with (a) planned excavation and offsets based on 2023 river conditions, (b) field fit excavations based on river conditions on Aug 17, 2024, and (c) the actual excavation completed in 2024.

Figure 28. Photos taken at Brown Bar by environmental monitors. (a) Constructed access ramp (taken Aug 28, 2024). (b) Knotweed fenced off next to access ramp was undisturbed (Sep 5, 2024). (c) South Rotary Trail on Aug 28 2024. (d) Spill kit onsite next to excavation footprint (Aug 28, 2024). (e) Removal of top layer of gravel from pit footprint (taken Aug 28, 2024). (f) Pit excavation (Aug 29, 2024).

Figure 29. Photos taken at Brown Bar by environmental monitors. (a) Downstream pit opening at Brown Bar on Sep 5, 2024. (b) Aerial photo of pit and bar top removal after openings were completed (taken Sep 5 2024). (c) Access ramp area restored (Sep 6, 2024). (d) Bergman stockpile (Oct 4, 2024).

3.3 BERGMAN BAR (24-22L)

Bergman Bar is located in a narrow section of Vedder River on the left side. In 2024, a 60 m^2 pool had formed approximately 65 m from the upstream end of the bar. The bar is highest in the center and lower along the bank although it does not flow at low water levels.

PLAN

Access route

The proposed access route for the Bergman Bar site followed the South Rotary Trail 250 m from the Bergman Stockpile site. Access to the bar top was expected to require only a small ramp at most. A culvert was not expected to be required.

Pit excavation

The proposed excavation at Bergman Bar consisted of one pit with a footprint of 3,950 m^2. The upstream boundary was approximately 70 m downstream from the head of the bar. A 5:1 slope was prescribed for the upstream edge to ensure slope stability. The outer berm was designed with a 1.5:1 slope. A 20 m wide inflow was located at the upstream end to permit flow into the excavated area, and a corresponding 20 m outflow opening was located at the downstream end.

Offsetting

A small habitat excavation was planned along the bank at the upstream end and a habitat opening was planned at the downstream end to direct some flow along the bank at the downstream end.

IMPLEMENTATION

Access route

The access route was established according to the plan, however a ramp was not needed. An existing footpath between blackberry plants was widened. Where knotweed occurred close to the Rotary Trail, geotextile was draped over it and the EM monitored the area for disturbance each day.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on August 21. A groundwater-fed, salmon-bearing microchannel had formed on the bar and thus constituted high value fish bearing habitat. The upstream edge of the excavation was moved downstream so this feature could be left undisturbed.

A 20 m setback for knotweed identified along the edge of the riparian area could not be accommodated as this bar was only approximately 40 m wide at the upstream end and 30 m wide at the downstream end. Given the lack of vegetation of any kind on the bar, the potential for a reduced setback was evaluated. On Sep 2, a small excavator dug a 1.5 m deep trench, 10 m from the riparian edge under the supervision of the QEP and an EM. Windrows of sediment and 2 to 4 cm of sediment on the inner wall of the trench was examined by hand for signs of any roots. Sections of ~20 m lengths were completed at a time until the entire length of the pit footprint was completed. Once satisfied that no root material was encountered during the excavation of the trench, the windrow of sediment was considered non-contaminated and was hauled to the stockpile. The trench became the southeast side of the pit. Two excavators and two rock trucks deployed at the site removed the bar top, then began deep excavation in a downstream to upstream direction. The pit was completed on Sep 4.

Pit opening occurred on the afternoon of Sep 5, 2024 at the direction of the QEP. Turbidity in the pit was 235.7 FNUs at 11:50 am. At the downstream end, a 9 m wide opening was excavated at 12:15 pm. At the upstream end, a 21 m wide opening was excavated at 12:55 pm. Turbidity peaked at 31.5 FNUs at 1 pm and dropped below 8 FNUs by 5 pm on the same day.

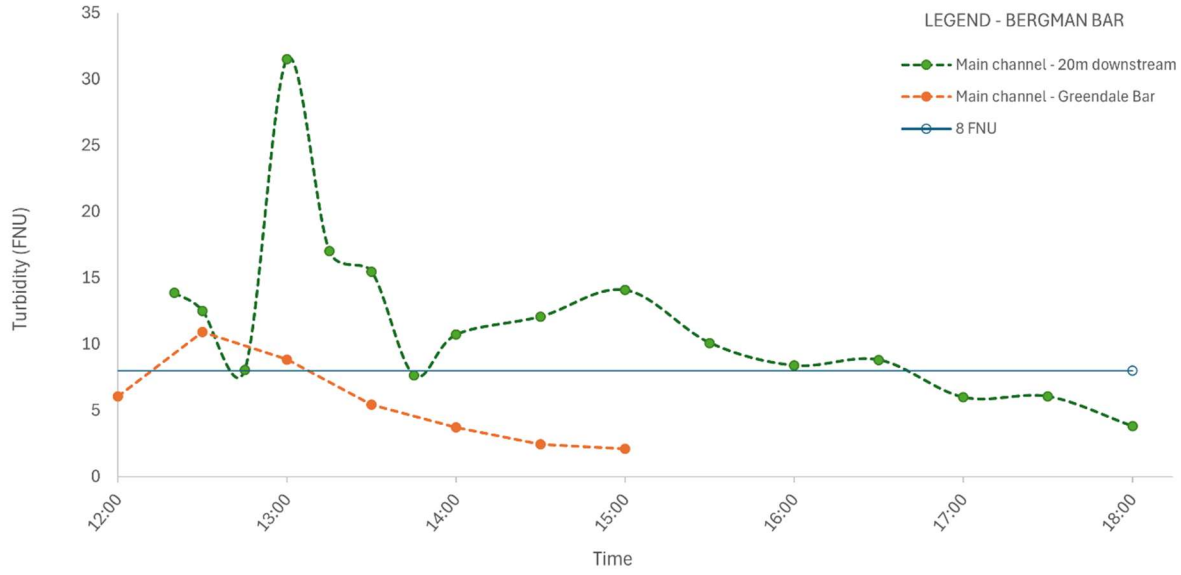

Figure 30. Turbidity (FNU) measured during the pit opening at Bergman Bar on Sep 5.

Offsetting

The offsets at this bar were cancelled to avoid excavating within the setback area required for the large stands of knotweed along the bank.

Restoration

Site restoration on the bar was completed on Sep 5. The bar was scarified. The Rotary Trail was graded and topped with crushed gravel and geotextile was carefully removed from riparian areas before reopening to the public.

SUMMARY

The Bergman Bar excavations was completed between Sep 2 and 5, 2024. The total disturbance footprint was 2,722 m^2, which was 58% of the proposed disturbance area. The reduction is attributed to changes to the permitter adjacent to the bank owing to knotweed, adjacent to the main channel owing to erosion of the bar at the downstream end, and at the upstream end to preserve the groundwater fed microchannel habitat. The completed excavation had slow and steady flow through the pit. In future assessments of habitat values in the vicinity of this site a neutral outcome is expected.

Figure 31. Orthomaps of Bergman Bar with (a) planned excavation and offset based on 2023 river conditions, (b) field fit excavation based on current river conditions on Aug 17, 2024, and (c) actual excavation completed in 2024.

Figure 32. Photos taken at Bergman Bar by environmental monitors. (a) Preparing to dig a test trench for knotweed root search (Sep 2, 2024). (b) Inside wall of excavated trench (Sep 2, 2024).(c) Trench material was replaced and bar top material within the marked footprint was removed (Sep 2, 2024). (d) Bergman pit excavation (Sep 2, 2024).

Figure 33. Photos taken at Bergman Bar by environmental monitors. (a) Aerial photo of Bergman Bar after pit opening was completed (Sep 5, 2024). (b) Aerial photo of Bergman Bar one week after pit opening was completed (taken Sep 17, 2024). (c) Access to Bergman bar top from South Rotary Trail (Sep 5, 2024).

3.4 RAILWAY BAR (24-19R)

Railway Bar is a narrow point bar located on the right bank on an inside bend of the river, upstream of the BC Southern Railway Bridge. This bar was excavated in 2022 and was expected to be filled by 2024, but it was still only partially filled by summer of 2024. North of the Rotary Trail in this area is sensitive wetland habitat. Outflow from a section of this the wetland passes through a culvert (installed by DFO) beneath the trail and flows along the bank. Railway Bar has been the most frequently excavated bar over the years because it fills in a predictable manner, generally within a year. Although this bar is consecutive with Bergman Bar, interaction between these bars was less a concern, given the bend in the river, the distance between the bars and the lower gradient in this area.

PLAN

Access route

The proposed access route from Hooge Stockpile to the bar top at Railway Bar was through the Hooge parking lot and southwest on the North Rotary Trail for 780 m. No ramp would be needed.

Pit excavation

One pit excavation was planned for Railway Bar with an area of 3,020 m^2. The inclusion of this bar was contingent on sufficient refilling of the 2022 pit. A 5:1 slope was prescribed for the upstream edge to ensure slope stability with all other slopes designed at 1.5:1. Two 20 m wide openings were prescribed to allow good flow through and passage of fish in and out of the pit.

No offsets were proposed for Railway Bar.

IMPLEMENTATION

Access route

Site access was established as proposed in the Project Plan with the addition of a clear span bridge for bar access. Since the 2022 pit had not fully refilled and was providing fish habitat, this 110 m long microchannel was preserved. The upstream half of the microchannel was salvaged on Sep 11 due to the concern that this area would dewater when the pit was excavated. A clear span airbridge was allowed to be placed after the first set of passes and then additional passes were completed on Sept 12.

To prevent equipment from encroaching on sensitive habitat, snow fencing was installed along the north side of the Rotary Trail where there was an opening in the vegetation as well as around the DFO culvert.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on Sep 7 when water levels were lower. Since the remnant of the 2022 pit was providing fish habitat, the excavation layout was reduced to fit the available area of dry bar and to adhere to design guidelines. The configuration at the head of the bar also contributed to reducing the footprint. A 2 m buffer was applied along the northwest perimeter of the pit. Pit slopes and depth were unchanged.

Two excavators and two trucks were deployed at this site. A thin layer of the bar top was removed from the pit footprint on Sep 11. Towards the end of the day, turbid water was observed seeping into the microchannel. The bar material appeared to be unconsolidated and compression by excavators next to the footprint boundary was causing the seepage. The excavators were moved to the center of the bar, and work was halted until the issue was discussed with the QEP. Silt cloth was placed in the microchannel along the side of the bar, and the excavators were kept away from the bar edge. Thereafter, only one excavator worked on the bar at the site at a time and the truck backed over the ramp to limit driving on the bar. A silt curtain had also been installed at the downstream end of the excavation to maintain fish exclusion. The area along the bank where the culvert discharged was at a higher elevation than the pit remnant so there was always a flow of clean water along the bank to the confluence with the main channel.

In spite of these precautions, chronic low-level seepage of turbid water from this excavation was an ongoing issue. Generally, both the pit and the microchannel were continuously exceeding the rate at which material was baled from the pit resulting in continuous water pressure forcing sediment through the relatively unconsolidated sediments. The EM worked with the crew to mitigate the seepage and turbidity issues, keeping most of the turbidity within the area that had been salvaged and isolate. With a constant flow of water from the head of the channel, turbidity would flush out overnight and it was always running clear by the next morning. Occasionally, the EM would direct machinery to take breaks or relocate on the bar to allow turbidity to clear. Beyond these efforts, the best approach was to complete the work as efficiently as possible. Before completing the pit on Sep 16, a pocket was pre-excavated in the downstream end to receive material from the downstream opening. Hauling the opening material was not possible as the gravel bar remaining was too narrow to allow trucks to pass without tracking through wetted areas.

On Sep 17, the pit was opened to the main channel. After a settling period of approximately 18 hours, the turbidity in the pit was 64.5 FNUs. The bridge was removed for the excavator to travel along the berm within the isolated area. A 19 m wide and 0.75 m deep opening was excavated at the downstream end at 10:10 am. Excavated material was piled on the edge of the pit and then pushed into the pit with minimal resuspension of fines. This material served to flatten the downstream excavation edge and better align it to be perpendicular to flow. Where a small section of the berm was compressed by the excavator's tracks, water began to overtop the berm and some scouring created a very shallow, 10 m wide opening on the bank side, similar to a typical habitat enhancement opening.

The excavator completed one wet crossing to leave the bar, then travelled 65 m up the Rotary Trail and approached the upstream opening location via the temporary access established in 2022. One truck followed onto the bar to haul away the opening material. The upstream opening was excavated at 11:30 am.

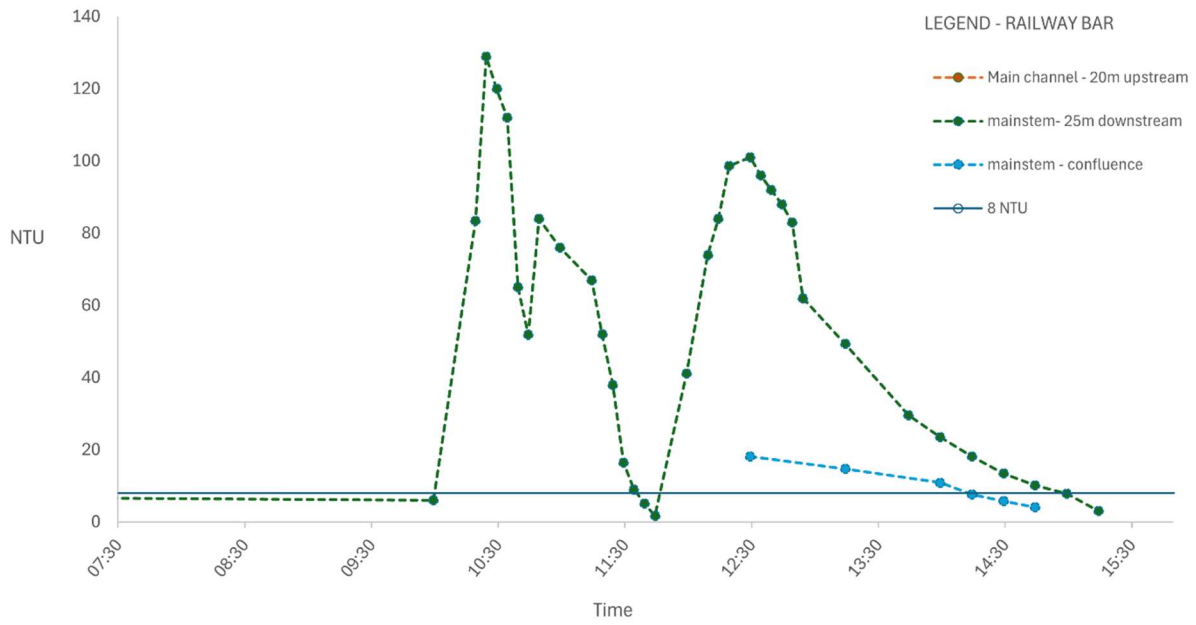

Figure 34. Turbidity (FNUs) during pit opening at Railway Bar on Sep 17, 2024.

Restoration

The bridge and snow fencing were removed on Sep 17. Some additional sediment was removed along the bank where it was over-steepened. The Rotary Trail was later restored by grading and topping with crushed gravel.

SUMMARY

Railway Bar excavations proceed from Sep 11 to Sep 17, 2024. The disturbance footprint was 1,724 m^2, which was 57% of the proposed footprint. The reduction in size is attributed to the erosion at the upstream end of the bar and persistence of a pit remnant that was providing fish habitat. Sensitive habitat on the north side of the Rotary Trail was not disturbed during the works. Challenges with turbidity at this site were managed but it is recommended that partially filled sites be omitted in future excavations, in part due to the relatively smaller available footprints but also due to the risk that the materials will be poorly consolidated and subject to excessive sub-gravel seepage. This issue may also have arisen because the river was still in a transitional stage of sediment distribution following the large deposition of sediment in 2021.

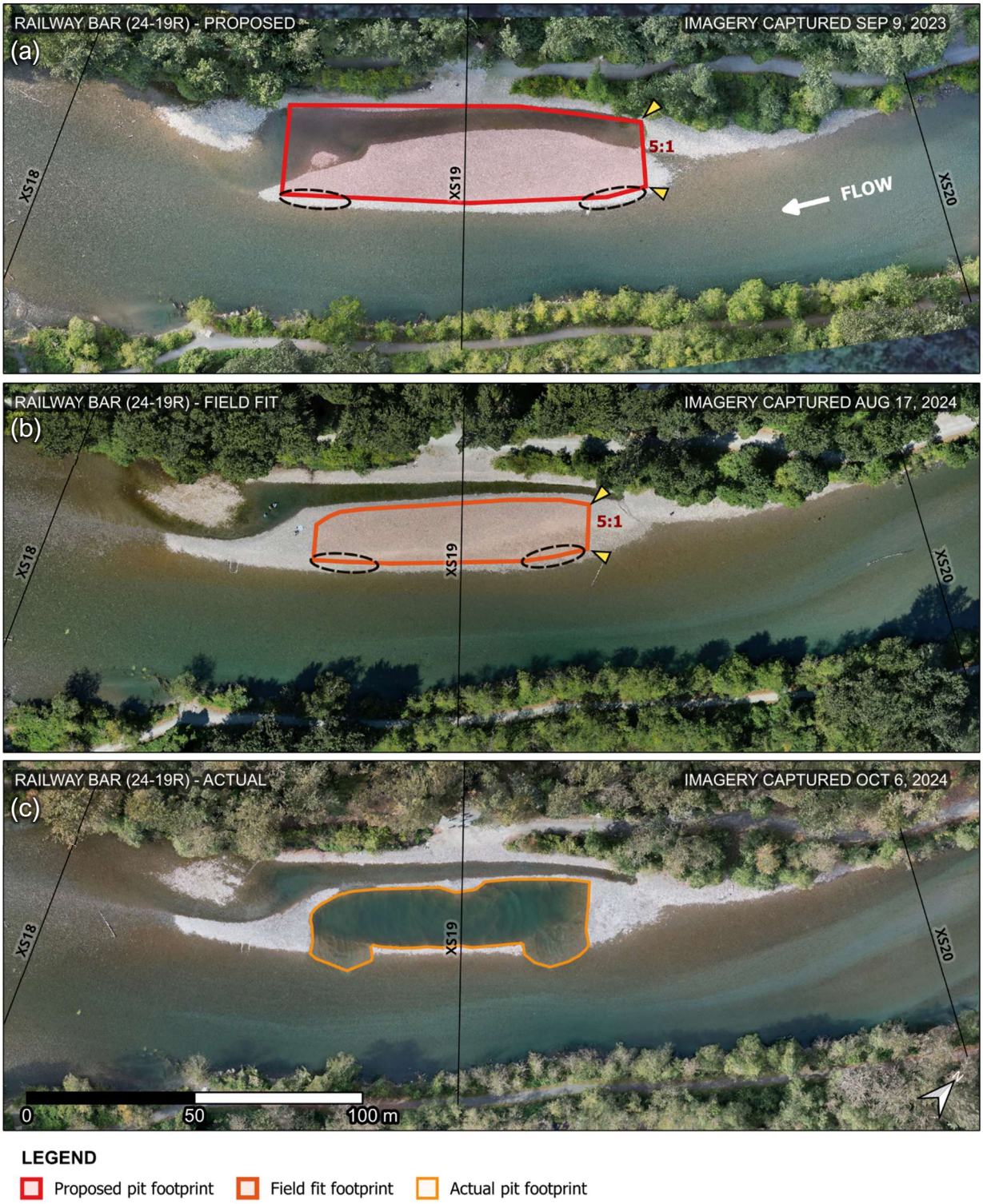

Figure 35. Orthomaps of Railway Bar with (a) planned excavation based on 2023 river conditions, (b) field fit excavation based on current river conditions on Aug 17, 2024, and (c) actual excavation completed in 2024.

Figure 36. Photos taken at Railway Bar by environmental monitors. (a) Snow fencing placed around culvert and knotweed and spill kit (Sep 11, 2024). (b) Airbridge installed over backwater for site access (Sep 11, 2024). (c) The berm started to breach as the excavator accessed the bar to complete the downstream opening (Sep 17, 2024). (d) Completed upstream opening at 12:20 pm on Sep 17, 2024; (e) Aerial photo of pit following completion of both openings on Sep 17, 2024. (f) No turbidity reached culvert outflow (Sep 17, 2024).

4 SITE REPORTS – LOWER REACH

This section provides an overview of the construction activities and environmental monitoring completed at each site in the Lower Reach. The Lower Reach of Vedder River extends from XS-17-1 at the BC Southern Railway Crossing downstream to the XS-C1 at the Vedder River Canal. This reach is 2.2 km long and the river is less steep. Greendale Bar was the only bar from the Lower Reach included in the 2024 project. One site, Greendale Bar, was selected for sediment removal in this reach with a planned volume of 9,600 m^3 and total disturbance footprint of 7,000 m^2. The surrounding area includes sensitive wildlife and fish habitat. The proposed pit excavation and offsetting activities at Greendale Bar were all completed between Aug 27 and Sep 11.

4.1 GREENDALE BAR (24-45L)

Greendale Bar is a large bar extending from XS-59 to XS-52, with a large, vegetated island at the downstream end. The site is located on the right side of the river, on lands administered by the City of Chilliwack. Sensitive habitat occurs on the north side of the North Rotary Trail.

PLAN

Access route

The Greendale Stockpile site was made available for the material from Greendale Bar. The proposed access route from Greendale Stockpile to the top of bank followed the North Rotary Trail for a distance of 210 m. An existing bridge along the trail crossed over a dry area of the wetland 80 m from the top of bank. One possible culvert crossing was anticipated on the bar to access the pit footprint.

Pit excavation

One pit excavation was planned for Greendale Bar. The proposed disturbance footprint was 7,000 m^2. A 5:1 slope was prescribed for the upstream edge to ensure slope stability with all other slopes designed at 1.5:1. Two 20 m wide openings were prescribed to allow good flow through and passage of fish in and out of the pit.

Offsetting

Two habitat enhancement excavations and one ballasted LWD complex was proposed for Greendale Bar. The downstream enhancement excavation was a large bar top removal intended to restore flows to the secondary channel north of the vegetated island. This would increase the contribution of riparian habitat and increase the availability aquatic habitats in this secondary channel. The upstream enhancement excavation involved deepening and widening an existing microchannel to maintain connectivity with the main channel at low flows. The LWD complex was intended to maintain the opening of this side channel.

IMPLEMENTATION

Access route

Between Aug 27 and 29, site access route was established according to the original plan, however it involved the placement of additional airbridges. To reinforce the existing, permanent bridge on the Rotary Trail, an airbridge was installed overtop. To bar material from falling into the vegetation below, the geotextile was laid over the bridge and fastened to the railings.

Near the access point from the Rotary Trail onto the bar, a clear span bridge was installed. No fish salvage was required as the wetted area was narrow and very shallow and could be easily bridged without disturbance.

As proposed, a side channel near the pit footprint required a crossing. Site isolation and salvage was completed prior to the installation of an airbridge. A ramp was constructed out of bar sediment on either side for smoother transitions on and off the bridge. One wet crossing was necessary.

As expected, the small channel that flowed across the bar upstream of the pit into the microchannel was dry, allowing access to the upstream enhancement without requiring a bridge or salvage.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on August 20. The excavation was laid out as originally planned. Pit excavation began on Aug 29. Three excavators and three rock trucks were deployed at this site. The bar top was removed from the pit footprint first. Pit excavation proceeded in an upstream to downstream direction. Wet material was stockpiled on the bar and then loaded onto trucks and hauled to the Greendale Stockpile. A high proportion of fines mixed with gravel appeared to be a factor in excessive erosion at pit walls. Sloughing of the north perimeter wall was addressed by laying geotextile over top and pinning with stakes on Aug 30.

The EM detected a small amount of turbid water seeping into the main channel on Aug 30. There was no machinery operating in proximity to the area and the amount of turbid water being released was quite small. The area was monitored closely and appeared to stop around 6 pm. The seep was managed by hand-placing sediment along the inside of the berm within the pit and by confining the sediment leaking from the area using silt cloth. As the excavation continued, the point of seepage moved downstream requiring the silt cloth to be repositioned. This was effective in keeping most of the leaking turbid water out of the main flow.

On Sep 3, a non-reportable quantity of hydraulic fluid leaked from one of the excavators on top of a stockpile. The excavator was moved to the bar top 30 away from water and turned off. Hydraulic fluid on the machine was cleaned up using spill pads. Approximately four cubic meters of contaminated (and potentially contaminated) material was moved to a separate location at the Greendale Stockpile site for proper disposal. The excavator was repaired by a mechanic before the machine returned to work.

Pit openings were completed on Sep 10. Turbidity in the mainstem upstream of the pit was 0.84 FNU and inside the pit was 80.7 FNU. The QEP directed the openings, and environmental monitors were positioned downstream to monitor water quality. A 20 m wide, 1 m deep opening was excavated at 12:30 pm. A 19 m wide, 1 m deep opening at the upstream end was excavated at 1:30 pm. Turbidity peaked at 470 FNUs at 2:30pm.

Offsetting

The bar top removal proposed for the downstream end of Greendale Bar was completed, but the perimeter was modified to allow for setbacks from knotweed identified along the right bank and the vegetated island on the bar. This offset was initiated on Aug 28 prior to the pit excavation and finished on Sep 11 as the access route was restored.

The upstream enhancements were completed on Sep 10. An LWD complex was established at the inlet of the enhanced channel to help keep the inlet open and ensure that fines did not accumulate at that location. Initially planned for the point of the bar, it was installed on the bank instead as the bar point already significant accumulations of LWD. The LWD was weighed down by several boulders and then sediment was used to infill and cover the boulders. A microchannel along the right bank was excavated in a downstream to upstream direction. Two pools were created with one piece of LWD installed in each. When the microchannel was opened to flowing water on Sep 10, no visible increase in turbidity occurred in the downstream sections.

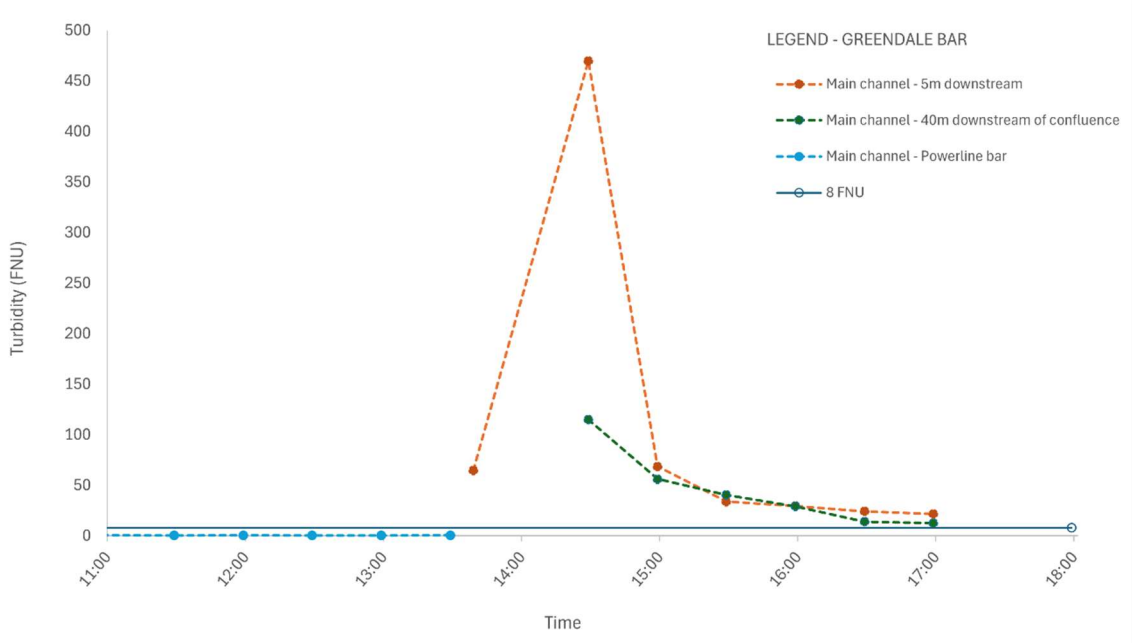

Figure 37. Turbidity (FNUs) measured during the pit opening at Greendale Bar on Sep 10, 2024.

Restoration

The airbridges were removed and the sediment used to ramp up to the bridge was hauled to the stockpile. No wet crossings were required for the removal of these small, clear span bridges. Removal of the airbridge overlaid on the permanent bridge on the trail as well as the restoration of the trail were completed in October.

SUMMARY

Works at Greendale Bar were undertaken Aug 27 to Sep 11. The area of disturbance was 7,379 m^2, which was 105% of the proposed disturbance area. The excess is attributed to a small increase in the available area of unvegetated gravel bar in 2024. It is expected that the bar will refill with a potentially persistent riffle habitat feature into the secondary channel. With a substantial deepening and structured intake for the upstream microchannel enhancement, it is anticipated that the feature will provide aquatic habitat during lower flows and increase habitat values in future habitat assessments. The addition of LWDs in the upstream section adds further enhancement.

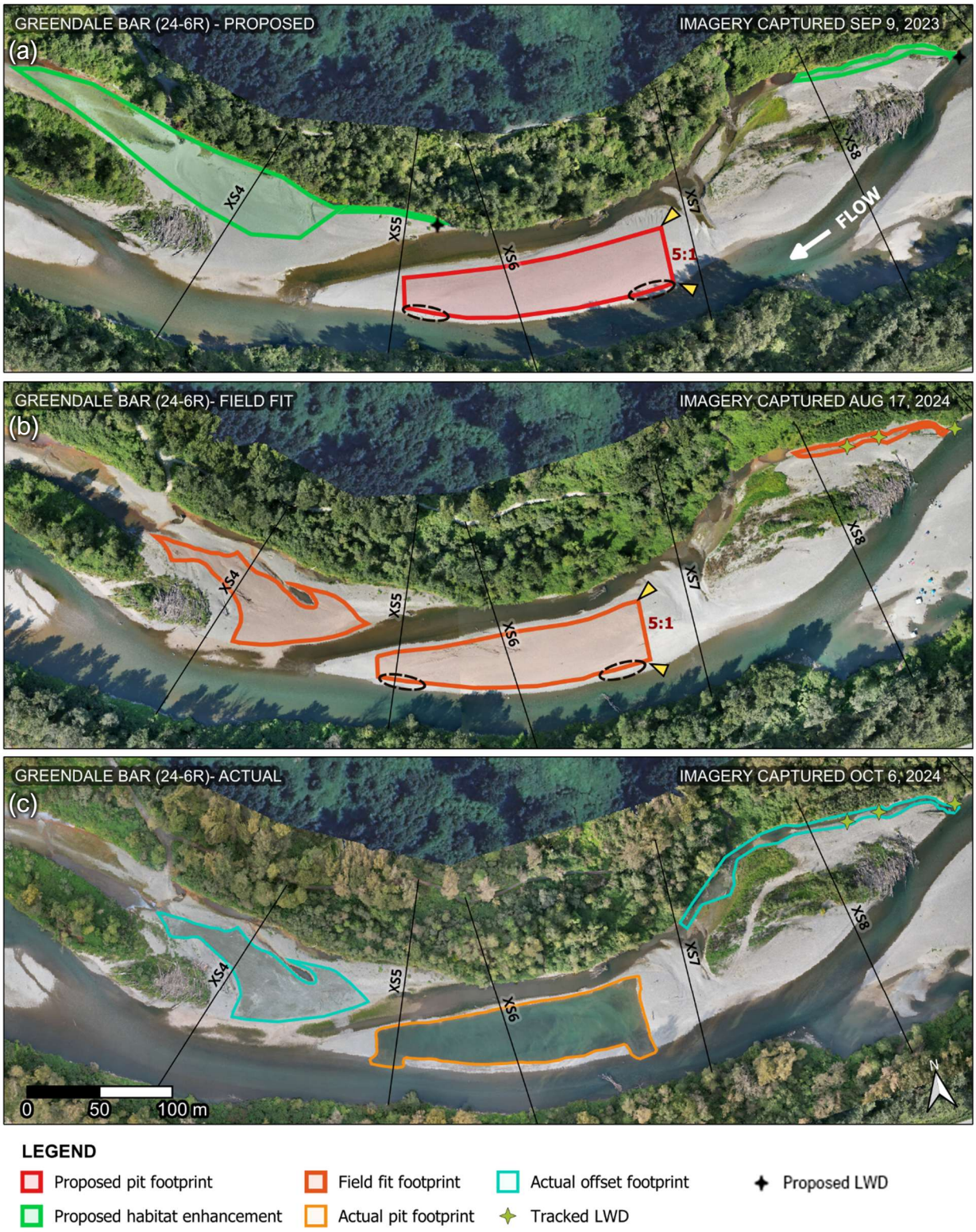

Figure 38. Orthomaps of Greendale Bar with (a) planned excavation and offsets based on 2023 river conditions, (b) field fit excavation and offsets based on current river conditions on Aug 17, 2024, and (c) actual excavation and offsets completed in 2024.

Figure 39. Photos taken at Greendale Bar by environmental monitors. (a) Completed base of sediment for side channel crossing within isolated area lined with silt curtain at upstream and downstream ends (taken Aug 28, 2024); (b) Main channel during pit excavation (taken Aug 30, 2024). (e) Spill kit onsite during excavations (taken Aug 31, 2024) . (e) Bar top removal did not disturb the remnant pool in the center of the bar (taken Sep 12, 2024). (f) Side channel crossing location after airbridge was removed (taken Sep 12, 2024).

Figure 40. Photos of habitat enhancements at Greendale Bar. (a) Airbridge, geotextile and sediment placed overtop of a permanent bridge on the North Rotary Trail for bar access (Sep 12, 2024); (b) Airbridge removed from side channel crossing location (Sep 18, 2024). (c) Completed microchannel excavation and LWD installations at upstream end of Greendale Bar (Sep 18, 2024). (d) Completed bar top removal at downstream end of Greendale Bar (Sep 18, 2024).

5 SITE REPORTS – CANAL REACH

This section provides an overview of the construction activities and environmental monitoring completed at each site in the Canal Reach. The Canal Reach extends from XS-1 near Salad Bar downstream to XS-C10 at the Highway 1 Bridge. The Canal Reach is a linear 4 kms with tall dikes on either side. Two of the three proposed sites (Salad, Powerline and Chadsey Bars) were completed; Salad Bar pit and offsets were excluded. Additional offsetting activities, i.e. a microchannel enhancement and LWD placement, were incorporated at Powerline Bar. All works in the Canal reach were completed between Sep 6 and Sep 28. Chadsey Bar was the last site to be completed and instream works over the last two days consisted of the final pit opening and restoration of the bank slope.

Salmon were observed in the canal in low numbers during excavations at Powerline and Chadsey Bar. Salmon were typically holding in pools or deep areas of the mainstem. Following the heavy rain on Sep 26, larger groups of salmon were beginning to migrate upstream.

5.1 SALAD BAR

THE PLAN & FIELD FITTING

The proposed 2024 excavation consisted of one pit and one habitat enhancement excavation along the right bank. This would have been very similar to the 2022 excavation. In 2023, it was expected that the pit and side channel would continue to fill in, however the long narrow remnant of the 2022 pit turned into a side channel with a large riffle at the top and bottom the bar. The smaller side channel along the bank also persisted. The QEP determined that Salad Bar no longer met site selection guidelines for two reasons: (i) access required crossing two side channels of high value to fish, and (ii) a pit excavation under the modified conditions risked capturing the thalweg, bypassing riffles and devaluing riffle habitat, and more importantly could significantly damage a large area of important pink spawning habitat. As a result, the Salad Bar pit and offset were cancelled by the QEP on Aug 21, before construction began.

Figure 41. Orthomaps of Salad Bar with (a) the planned excavation and offset based on 2023 river conditions, and (b) river conditions on Aug 17, 2024.

Figure 42. Photos taken at Salad Bar by NPE on July 28, 2024. (a) Pit remnant that had naturalized into a side channel with a large riffle at the upstream end. (b) View of two side channels to be crossed for access from the trail to the excavation footprint. (c) Smaller side channel running along the bank in an area of moderate cover and woody debris. (d) Photo location map (aerial imagery collected on Aug 17, 2024).

5.2 POWERLINE BAR (24-C29L)

Powerline Bar is located on the left side of the Vedder Canal, approximately 50 m upstream of Keith Wilson Bridge. This site was excavated in 2022 and its inclusion in the 2024 project was contingent upon sufficient refilling. This bar naturally becomes dewatered later in the work window because, like most of the bars in the canal reach, it has a flat and low profile.

PLAN

Access

The proposed access route from the No 2 Road Stockpile site travelled up the dike slope to Dike Crest Road for about 100 m, then down the other side via existing ramps, under Kieth Wilson Bridge on the bench and then down to the bar via a constructed ramp. A culvert would possibly be needed.

Pit excavation

The proposed excavation at Powerline Bar consisted of a single pit. The excavation was designed to be 105 m long, 31 m wide and 3 m deep from the surface of the bar with anticipated removal volume of 7,500 m^3.

No offsetting was proposed for this site in the Project Plan (NPE 2024b).

IMPLEMENTATION

Access route

The proposed access route was at Powerline Bar. Construction of the access ramp began on Sep 6, following site isolation and salvage of fish from the crossing point of the microchannel along the left bank. Two culverts were installed at the base and then sediment excavated from a borrow pit on the bar was used to build the ramp. A silt curtain was installed downstream of the ramp to limit the movement of turbid water during ramp construction. The borrow pit was filled once hauling from the pit footprint began. The hauling route from the top of the ramp went under the Keith Wilson Bridge, up an existing ramp to Dike Crest Road, and then down another ramp to No 2 Road Stockpile site outside of the floodplain.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on Sep 5 because water levels were still dropping in the canal. Pit excavation began on Sep 6. On Sep 6, one of the trucks got stuck on the bar and needed to be pulled out by an excavator, requiring additional preparation prior to full scale excavation. Excavated material was used to build up a road for trucks to drive on from the ramp to the pit. The pit was completed from upstream to downstream in two strips, starting with the one closer to the left bank. Due to the low profile and unconsolidated substrate, the upstream end was also left. As water continued to drop, conditions improved. A second access upstream was established by travelling along the bench and building a ramp down from the top. No culverts were needed and no riparian shrubs or trees were affected.

Along the left bank, a 5 m buffer was left between the pit and the microchannel and sediment was added to some areas that would interconnect the pit and the microchannel during even a very slight increase in water level. As the second strip was excavated, a berm was built up adjacent to the main channel to maintain isolation. At the downstream end, the ramp was within the pit footprint. As a result, the ramp was removed with the last of the pit excavation and the material for the opening had to be side cast and groomed into the surface of the bar. With the added offset and higher than usual water levels, it was necessary to construct a second ramp at the upstream end on Sep 16 for machinery to complete the offsetting works and the pit opening at the upstream end.

Two pit openings were excavated on Sep 18 at the direction of the QEP. The pit was undisturbed for approximately 16 hrs. A standard 20 m wide by 1 m deep opening was created at the downstream end and then the upstream end.

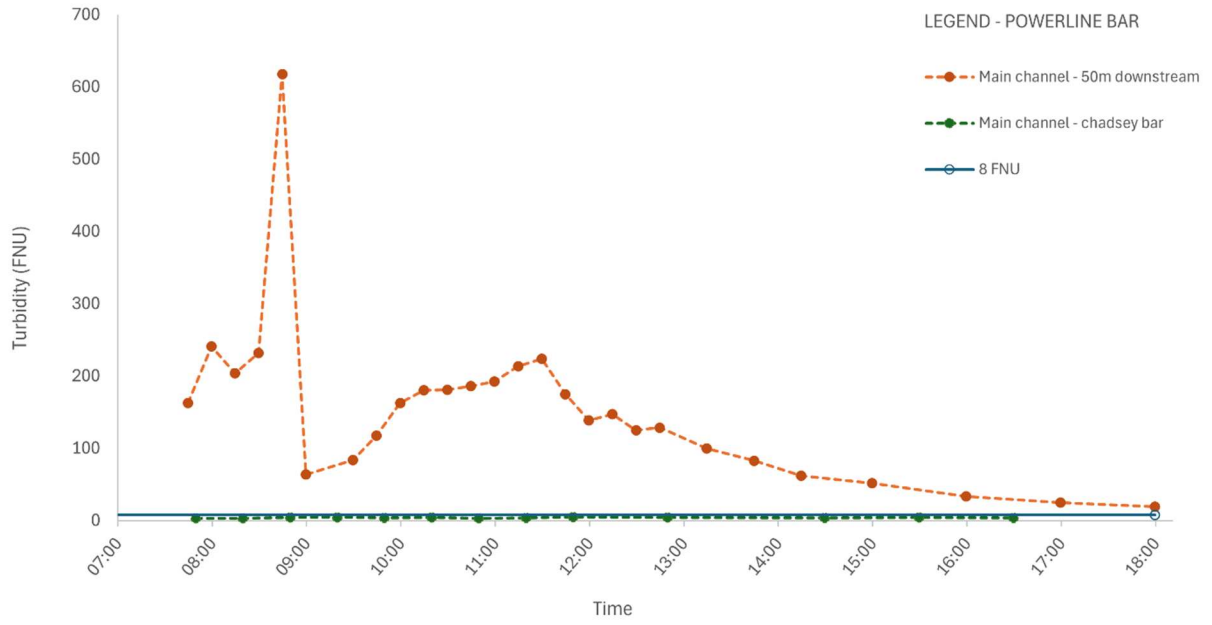

Figure 43. Turbidity (FNU) during pit openings at Powerline Bar on Sep 18, 2024.

Offsetting

Upon review of the conditions in the microchannel, which contained predominantly dry or standing water only, the QEP added an enhancement plan to replace the offsets that were cancelled at other bars. The approach was consistent with mitigation strategies followed at other sites and was very similar to the offsets that had been cancelled due to the presence of knotweed. The offset involved excavation near the toe of the bank slope for 300 m to create a deeper microchannel with continuous flow in low water conditions. The purpose of this offset was to improve flow and connectivity of a microchannel flowing along the vegetated bank between the excavation site and the bank.

On Sep 13, the offsetting work began under the direction of the QEP. Excavated sediment was cast on the bar between the microchannel and pit to further improve the definition of the microchannel. A pool was added at the mouth and another at the upstream end to mitigate deposition of sediment that could reduce flow. Three pieces of LWD were also placed along this channel to provide additional cover, food, and complexity.

Restoration

The two ramps were removed as soon as bar access was no longer needed. The sediment was hauled to the stockpile. The bank slope is expected to regrow naturally as the area was already dominated by reed canary grass, other grasses and shrubs.

SUMMARY

The Powerline Bar pit excavation was undertaken from Sep 6 to Sep 18, 2024. The total footprint of the excavation, including the pit openings, was 6,634 m^2, which is 94% of the proposed disturbance area. This minor shortfall is attributed to changes in bar shape since 2023. The completed excavation had slow and steady flow through the pit. The enhancement excavation had steady flow, some overhanging vegetation and lots of woody debris.

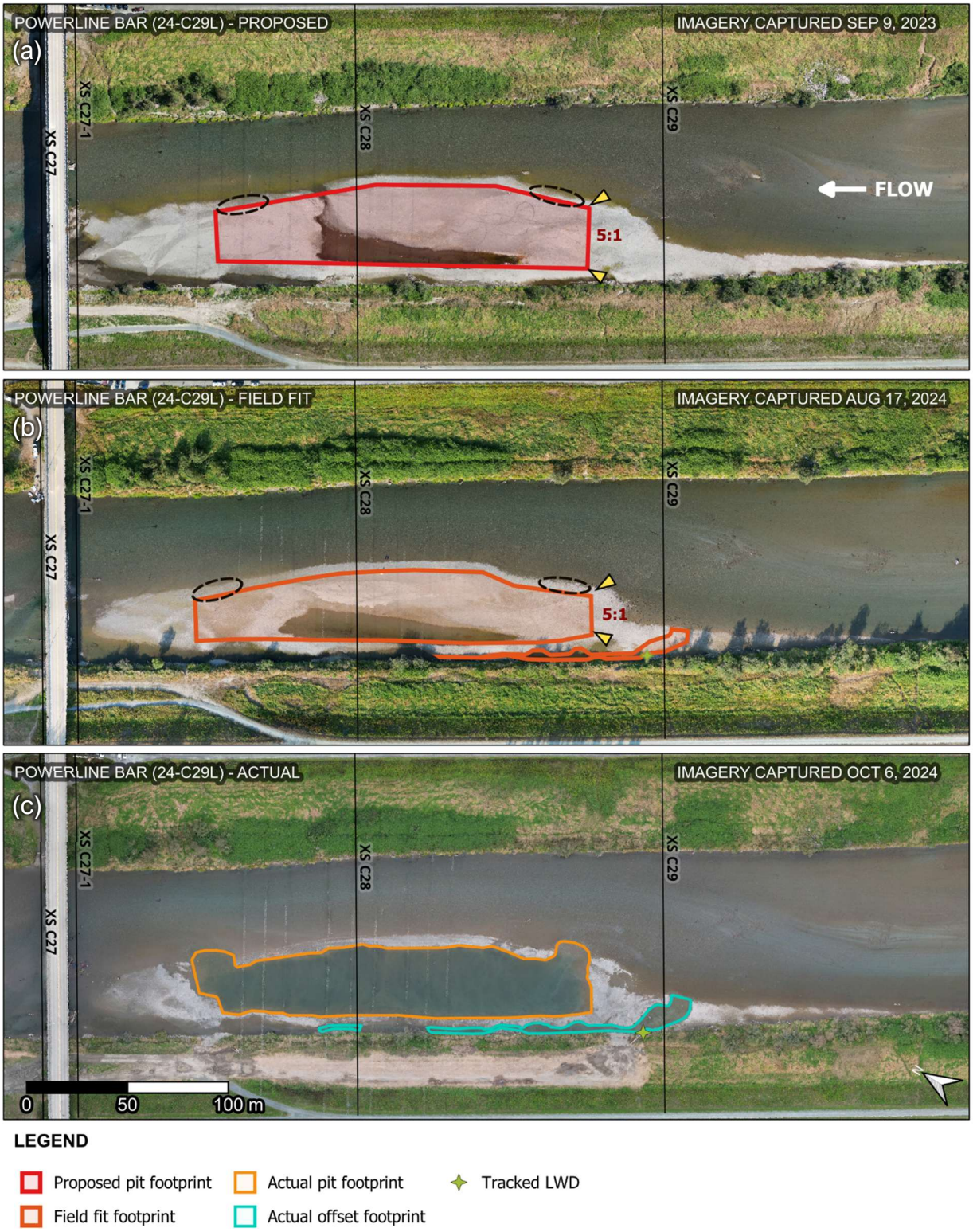

Figure 44. Orthomaps of Powerline Bar with (a) planned excavation based on 2023 river conditions, (b) field fit excavations and added offsets based on current river conditions on Aug 17, 2024, and (c) actual excavation and offsets completed in 2024.

Figure 45. Photos taken by environmental monitors at Powerline Bar. (a) Silt curtain downstream of the access ramp and within the salvages area (Sep 6, 2024). (b) Pit excavation began on Sep 6, 2024. (c) Piece of LWD recovered during pit excavation (Sep 7, 2024). (d) Berm around pit (Sep 13, 2024). (e) Pit excavation at upstream end of the bar (taken Sep 10, 2024). (f) Sediment added to the berm between the pit and side channel along the left bank (taken Sep 10).

Figure 46. Photos of the works at Powerline Bar by environmental monitors. (a) Completed microchannel at upstream end (Sep 16, 2024). (b) Turbid water from Powerline Bar pit opening moving along the left bank on Sep 17, 2024.

5.3 CHADSEY BAR (24-C19R)

Chadsey Bar is a large bar of relatively fine substrate located 1.25 km downstream of the Keith Wilson Bridge. The bar has low elevation and was not dry enough to begin excavations until mid-Sept.

PLAN

Access route

The proposed access route involved the construction of one ramp from the North Dike Crest Road down to the bench and another from the bench down to the bar top. Dike Crest Road and the road along the base of the dike were available for hauling. Contractors had the option of using No 2 Road Stockpile, Keith Wilson Stockpile (later cancelled), or the Greendale Stockpile.

Pit excavation

The proposed excavation at Chadsey Bar consisted of a single pit. The primary objective of this excavation was to improve the backwater curve, reducing the risk of dike overtopping upstream in the freeboard limited section of the Vedder River. The bar was estimated to sit just above water level at low flows, resulting in a 3 m excavation depth. Where no edge features were available, the excavation was to be extended to the bank with a shelf left to support reformation of habitat edge or microchannel habitat.

No specific offsetting activities were proposed for this bar.

IMPLEMENTATION

Access route

The proposed access point from Dike Crest Road to the bar top was followed, however material from this site was hauled away rather than using one of the provided stockpiling sites. The Contractor obtained a *Dike Management Act* Permit allowing them to temporarily stockpile bar sediment on the slope of the dike. Large sheets of geotextile laid on the dike slope and bench were pinned down over the vegetation. Highway trucks travelling northwest on Dike Crest Road from Keith Wilson Road were loaded by excavators adjacent to the site and continued along the dike crest and then under the Highway 1 Bridge, onto Yale Road and then onto Highway 1.

Starting on Sep 17, the ramp from the bench to the bar top was constructed between the willows such that no native shrubs or trees were removed. A layer of geotextile was laid over the area and then sediment from within the pit footprint was used to build the ramp located near the upstream end. For trucks hauling on the bar, sediment was excavated from a strip along the bar to create an elevated road. As a result, despite the wet conditions and finer material, no trucks got stuck on Chadsey Bar.

Pit excavation

The QEP reviewed site conditions and field fit the pit excavation footprint on Sep 16. The field fit layout was consistent with the proposed layout in the Project Plan (NPE 2024b). Instead of excavating a bench along the edge, a setback was left to accommodate some standing water ponds, emergent vegetation and small pieces of LWD.

Pit excavation began on Sep 18. On the bar, one or two excavators worked the pit from downstream to upstream, creating small stockpiles or windrows. These excavators would also load trucks, as needed. Two trucks worked on the bar, hauling material from small stockpiles next to the excavators to the upstream end, travelling up the ramp and stockpiling material on the dike slope. Another excavator located on the bench managed the stockpile and loaded the highway trucks. All material was kept on the area that had been covered in geotextile fabric. A berm was constructed along the river edge of the site by piling sediment along the marked perimeter and compressing with the excavators' bucket. During excavations, some clay was identified by the QEP, suggesting that the material may not have been disturbed either during canal construction or previous sediment removal excavations. The CHAM was notified and relocated to Chadsey to monitor the excavation work. After the first day, little clay and no archaeological discoveries were observed.

On Sep 19, an unexpected drop in water level in the canal lead to the dewatering of several pools along the bank. A buffer of two to four meters had been left between the pools and the pit excavation. Although the pit was only excavated at the downstream end, all pools across the length of the bar appeared to be affected. All pools were immediately salvaged, even though the area was not included in the footprint. No salmon were identified among the fish carcases recovered or the fish salvaged from the ponds. Salvaged fish included stickleback (*Gasterosteus aculeatus*), peamouth chub (*Mylocheilus caurinus*), and one yellow bullhead *(Ameiurus natalis).* The bullhead, an invasive element was disposed of humanely. All salvaged fish were released along the bank upstream of Chadsey Bar.

On Sep 20, a 1.5 m wide section of the berm spilled over near the center of the pit when water levels raised. The site supervisor found it at 6:30 am and notified the EM. The pit was considered non-fish bearing given the location, limited depth and duration of the opening in the berm. The berm was repaired and excavation works continued.

Prior to the forecasted rain event, Contractors added material to the berm, constructed a retention pond at the base of the ramp, and removed stockpiled material from the bar. Despite efforts, sections of the berm had failed at the upstream end and downstream end of Chadsey Bar on Sep 26. Only a 20 m wide section of the pit footprint adjacent to the ramp remained unexcavated at the time. Since the pit was now considered fish-bearing, berms were left on either side and the remaining section was excavated as an isolated cell. Later on Sep 26, openings were excavated, in the two berms remaining after excavating a cell in the last section of the pit, two were near the main channel, and two near the bank. The downstream opening was excavated to prevent fish trapping. An excavator walked down at a location identified by the QEP. The location minimized the distance travelled on the bar as most of the bar was at, or just below, water level. The upstream end of the pit was opened to flowing water on Sep 27. A similar approach was used for the upstream opening, however, due to the high water levels it was necessary to travel into the water over the recently dry bar to the opening site. All of the disturbed sediments flowed into the pit and due to the mixing already in the pit did not significantly impact turbidity outside of the footprint. The decision to proceed into the flowing water to achieve this opening was based on the imminent expectation of chum spawners in the immediate vicinity and the very real risk of stranding these spawners within the unopened pit when water levels dropped.

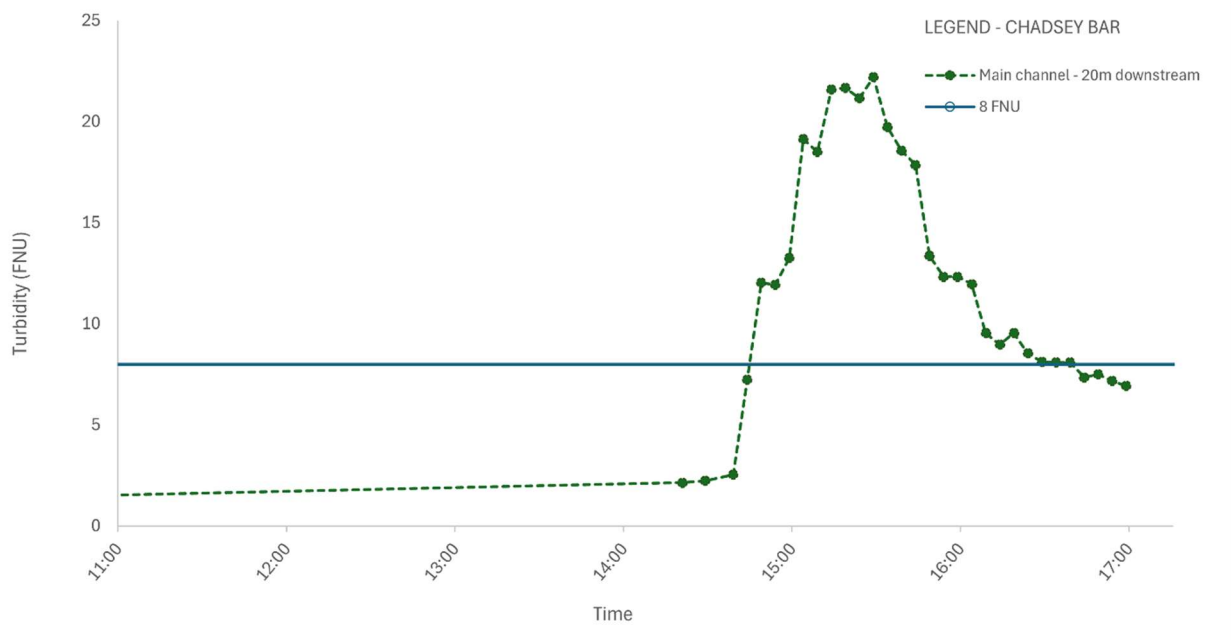

Figure 47. Turbidity (FNUs) during pit opening at Chadsey Bar on Sep 27, 2024.

Restoration

Work below the high water mark on Sep 28 only involved removal of geotextile and some ramp material on the bank slope. Subsequently, the stockpiled material on the bench and the geotextile fabric were removed. The grass beneath the geotextile had withered, however a full recovery of existing vegetation is expected for this area. Where the excavators walked down the bank slope at the upstream end and downstream end, the vegetation is expected to fully recover in the next growing season.

SUMMARY

The Chadsey Bar pit excavation was undertaken from Sep 17 to 28, 2024. The total footprint of the excavation, including the pit openings, was 8,699 m^2, which is 96% of the proposed disturbance area. This minor shortfall is attributed to the small amount of material unexcavated from the pit footprint due to the strip left to accommodate the loss of isolation on Sep 26. Water levels fluctuated by an estimated 20-30 mm in the canal over the course of the works. Tidal influence and/or other hydrological events in the Fraser likely contributed to this. While the finished excavation was not as planned, the six openings are expected to provide sufficient flow through to mitigate any potential refilling issues.

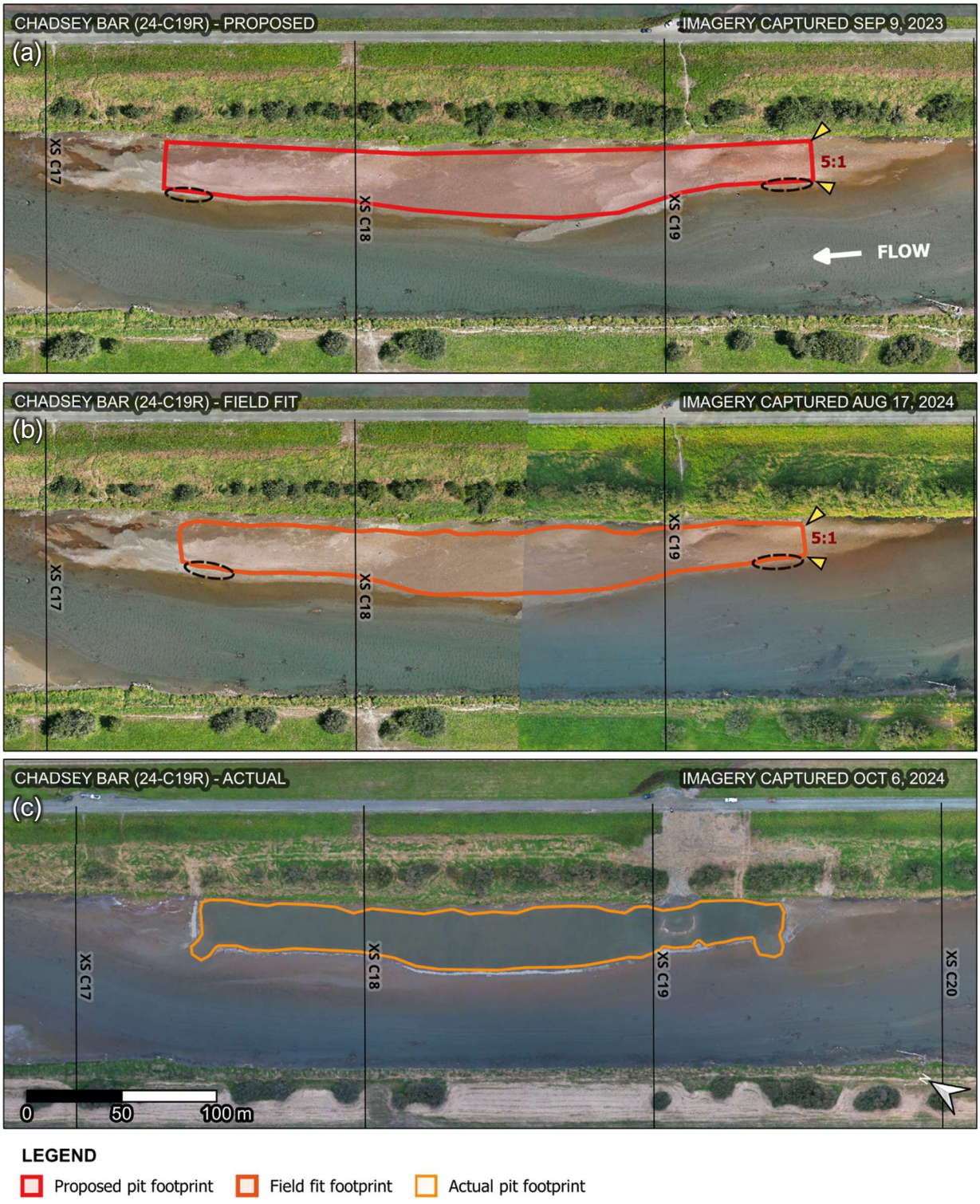

Figure 48. Orthomaps of Chadsey Bar with (a) planned excavation based on 2023 river conditions, (b) field fit excavation based on current river conditions on Aug 17, 2024, and (c) actual excavation completed in 2024. Note the crescent of unexcavated sediment, that is the remains of the isolated cell, after four openings were made. The upstream and downstream openings can be seen as small patches of green outside of the footprint.

Figure 49. Photos taken by environmental monitors at Chadsey Bar. (a) Sheen caused by bacteria found in several small pools before the site was mobilized (taken Sep 12, 2024). (b) Geotextile laid on slope of the dike, per the Dike Management Act permit, to allow stockpiling (Sep 17 2024). (c) Bar sediment was used to create a road for trucks (Sep 20, 2024). (d) Clay found during excavation (Sep 18, 2024). (e) Stockpiling sediment on bench and dike slope (Sep 18, 2024). (f) Recovered LWD were placed on the leave strip next to the berm (Sep 23, 2024).

Figure 50. Photos taken at Chadsey Bar by environmental monitors. (a) Berm has been added around the full perimeter of the pit and stockpiled material at the access ramp was being removed on Sep 25, 2024. (b) Berm overtopped on the morning of Sep 26, 2024. (c) Excavation of the middle cell of the pit on Sep 26, 2024. (d) Aerial photo of the upstream end of Chadsey Bar after all openings were complete (Sept 27, 2024). (e) Dike slope and bench after geotextile was removed and site was fully decommissioned (Oct 4, 2024).

6 CULTURAL HERITAGE MONITORING

A CHAM provided by SFN completed a walkthrough of each site over the course of the Project, monitored the construction of site access, monitored the construction of groundworks on the bar and was available to implement the Chance Find Procedure if an artifact or remains were found. The CHAM observed most sites prior to mobilization of any sites to identify any vegetation or other culturally significant feature(s) of the environment that might influence field fitting of the access route. In the Brown Bar area, it was requested that snowberry be kept intact. The CHAM monitored excavation work at Brown Bar, Bergman Bar, S45, Railway and Chadsey Bar, in this order. S45 and Chadsey Bars had the greatest potential for excavation activity to disturb native sediments as these sites had not been excavated in previous sediment removal cycles. The first CHAM finished on Sep 20 and a subsequent CHAM joined the project on Sep 23 and remained until Sep 27, 2024.

On Sep 18, the QEP observed clay during excavations at the downstream end approximately 3 m below water level at Chadsey Bar. Deposited fines into Sumas Lake may have created this clay layer. The CHAM was relocated to monitor excavations at this location. According to the CHAM, no clay was observed after the first day. This may have been a result of excavators adjusting the depth slightly or a natural grade in the clay layer.

7 COMPLEMENTARY OFFSETTING

A fish behaviour and survivorship study championed by the Conservation and Guardianship of Semá:th S'ólh téméxw was completed as complementary offsetting measure, per the project Authorization and Approval. To gather data on the cumulative effects of the multiple anthropogenic stressors on salmonids migrating up the Sumas/Chilliwack River (Vedder River and Canal), including this large-scale sediment removal project, fish were tagged at the downstream end of the Project Area, near Keith Wilson Bridge, and detected by arrays deployed in the upper reach near Vedder Crossing Bridge.

Between July 31 and August 26, adult migrating chinook were caught using (i) a picket-style weir spanning 70% of the channel and trap box below the Keith Wilson Bridge. Following implantation of a radiotelemetry tag, fish were released at the same location. Underwater cameras captured video footage of tagged and untagged Chinook bypassing the weir. The Weir was manned 24/7 by Semá:th staff and community members. Demobilization on the Aug 26 was due damage caused by an increase in flows following a rain event.

Following the removal of the weir, the program resumed by deploying beach seines at the same location downstream of Keith Wilson Bridge to capture migrating salmonids. Seining by three to six personnel outfitted in dry suits and personal floatation devices would complete five sets in the morning and evening (when temperatures did not exceed 20C).

All Chinook, adipose-clipped coho and ~90% of chum salmon captured by seine net were measured and tagged. A mixed tagging approach was used with fish travelling to the hatchery. Adipose-clipped Chinook and coho over 50 cm POFL received a gastrically-implanted radio tag. Non-adipose clipped Chinook and chum that may not have been heading to the hatchery received a dorsally-implanted PIT. Post-orbital fork length, sex, injuries, and reflexes were recorded for all fish.

Four radio telemetry stations were placed at roughly equal intervals from 1 km downstream of the tagging site to the Chilliwack River hatchery. This aligned with the study designs from previous work in the system (the original design included five detection sites, but equipment was stolen from one of the sites). PIT arrays were also installed approximately 1km downstream of the tagging site and at the hatchery (operated by the Lower Fraser Fisheries Alliance).

8 CONCLUSIONS & RECOMMENDATIONS

Overall, project objectives for timing, volume removed, and offsetting were met. The instream work for this project (i.e. below the high-water mark) was completed between Aug 27 and Sep 28, which was within the approved work window of Aug 1 to Sep 30. Runs of chum salmon were not observed in the canal reach until after the final pit excavation was completed. All sites were fully excavated, per the field fit designs, except for a small area below the Chadsey access ramp area (see KWL 2025 for volumes based on truck counts). Although seven offsetting activities were cancelled owing to changes in river conditions and knotweed presence (Appendix A), eight offsetting activities were added or expanded by the QEP to meet quantitative offsetting requirements of the FA Authorization. Recommendations for effectiveness monitoring, contingency offsetting, and lessons learned from the implementation of the 2024 project are provided in the subsections below.

8.1 RECOMMENDATIONS FOR OFFSETTING

The need for additional offsetting was evaluated based on the percentage of proposed area impact by pit excavation completed relative to the percentage of the proposed area of wetted habitat gains by offsetting activities. Table 4 presents the proposed and actual disturbance area, based on the high water mark of Vedder River, for each bar. The actual disturbance area 76% of the proposed area for each bar.

Table 4 . Comparison of pit excavation footprints proposed and completed in 2024, and start and completion dates for instream works at each bar In Vedder River.

			PROPOSED	ACTUAL			
Reach	Pit location	Pit ID#	Proposed pit footprint (m^2)	Actual pit footprint (m^2)	Date Initiated	Date completed	Percent disturbance area
Upper	S45 bar	24-45L	7,880	6,571	Aug 27	Sep 14	83%
	Giesbrecht bar	24-42L	6,880	5,829	Aug 27	Sep 13	85%
	Peach Road bar	24-40R	8,830	8,452	Aug 27	Sep 17	96%
Middle	Lickman bar	24-34R	3,780	3,360	Sep 7	Sep 26	89%
	Brown bar pit A	n/a	2,550	0	n/a	n/a	0%
	Brown bar pit B	24-26L	7,390	4,232	Aug 27	Sep 5	57%
	Bergman bar	24-22L	3,940	2,272	Sep 2	Sep 5	58%
	Railway bar	24-19R	3,020	1,724	Sep 11	Sep 17	57%
Lower	Greendale bar	24-6R	7,000	7,379	Aug 27	Sep 11	105%
Canal	Salad bar	n/a	5,040	0	n/a	n/a	-
	Powerline bar	24-C29L	6,950	6,534	Sep 6	Sep 18	94%
	Chadsey bar	24-C19R	9,040	8,699	Sep 17	Sep 28	96%
		TOTAL	72,300	55,052			76%

Table 5 presents the proposed and actual areas of habitat gains from habitat enhancement activities (offsetting activities). Overall, the enhanced area was 89% of the proposed area. This was possible because the cancelled offsetting activities at Peach, Lickman, Brown, Bergman, and Salad Bar where compensated for by added and significantly (>50%) expanded offsets at Campground, Greendale, and

Powerline Bars. As such, no further offsetting is need to meet permit requirements at this time. During the annual monitoring program, habitat values will be assessed and guide any future recommendations, as per permits

Table 5. Offsetting activities proposed in Table 8 of the Project Plan (NPE 2024b) and completed in 2024.

		PROPOSED		ACTUAL			
Reach	Site	Proposed offsetting activity	Proposed enhancement footprint (m^2)	Actual offsetting activities	Actual enhancement footprint (m^2)	Date Initiated	Date completed
Upper	S45 Bar	Habitat opening	520	Habitat opening	1,002	Sep 12	Sep 12
		LWD placement (1)	50	LWD placement (1)	^	Sep 12	Sep 12
	Peach Road Bar	LWD placement (1)	50	-	0	-	-
		Habitat excavation	3,070	-	0	-	-
Middle	Lickman Bar	LWD placement (1)	50	-	0	-	-
		Riffle excavation	8,300*	Riffle excavation	3,855	Sep 17	Sep 23
	Campground Bar	Habitat excavation - river	500	Habitat excavation	2,436	Sep 17	Sep 26
				LWD (3)*	^	-	-
		Habitat excavation - wetland	2,100	Infiltration gallery	2,600	Sep 17	Sep 26
	Brown Bar	LWD placement (1)	50	-	0	-	-
		Habitat opening	1,220	-	0	-	-
	Bergman Bar	LWD placement (1)	50	-	0	-	-
		Habitat enhancement	490	-	0	-	-
Lower	Greendale Bar	Habitat excavation upstream	8,200	Habitat excavation upstream	6,370*	Sep 10	Sep 10
		LWD complex (1)	100	LWD installations (3)	^	Sep 10	Sep 10
		Habitat excavation downstream	^	Habitat excavation downstream	^	Aug 28	Sep 11
Canal	Salad Bar	LWD placement (1)	50	-	0	-	-
		Habitat excavation	560	-	0	-	-
	Powerline Bar	-	-	Habitat excavation *	756	Sep 13	Sep 18
				LWD (3)*	^	-	-
		TOTAL PROPOSED	19,040	TOTAL COMPLETED	17,069	89%	

** Activity was added by QEP during the constructions phase.*
^ Total area has been incorporated into the value above.

Offsetting for riparian disturbance was not proposed as machinery used municipal trails and existing access routes to the top of bank and, in some cases, the bar top. At Greendale and Railway, machinery could access the bar top using only existing trails. A Peach, Lickman, Campground, Brown, Bergman, Powerline and Chadsey, a ramp was constructed on the inner bank slope for access. In river reaches, these banks were often riprapped along the bottom half with some shrubs along top. With ramps removed, riprap replaced, and shrubs are expected to regrow, impacts to riparian areas are considered fully mitigated. Monitoring during the three-year post-construction/mitigation effectiveness monitoring program will determine if any additional planting is needed. Trees and one snag were

removed at S45, Lickman, Brown and Campground owing to small field fit adjustments to the ramp location. These trees are scheduled to be replaced in spring 2025. See the Planting Plan in Appendix C for details.

8.2 RECOMMENDATIONS FOR EFFECTIVENESS MONITORING

The three-year, annual post-construction monitoring (i.e. mitigation effectiveness monitoring) program required by regulatory approvals is described in the Project Plan. In addition, it is recommended that knotweed removal sites be revisited to confirm the effectiveness of the removal strategy.

8.3 RECOMMENDATIONS FOR PROGRAM GUIDELINES

This section provides recommendation for (i) updates to program and site selection guidelines in the *Site Selection and Design Guidelines for Sediment Removal* (TetraTech 2015), (ii) project planning, and (iii) additional mitigation measures for the Environmental Management Plan of any future sediment removal project on the Vedder River.

PROGRAM AND SITE SELECTION GUIDELINES

Ordering of bars: While the sequencing of sites to be initiated has always been influenced by water levels, this implementation strategy should be formalized as a program guideline.

Exclude sites where a pit has not refilled from a previous year: Seepage of turbid water into flowing water was observed Railway and trucks got stuck on the bar at Powerline Bar. Both issues are likely attributable to the incomplete filling of these bars since 2022 and perhaps in part due to the continued readjusting of the river to the very large sediment influx from the ARE in 2021. Given the pattern of refilling, it is preferable to wait another two-year cycle before excavating at that site. In the future, candidate bars should be excluded if the pit remains unfilled one year prior to the works. As the leaching issue was also observed at Peach and Greendale Bars, future Environmental Management Plans for the project should include measures to (i) install a silt curtain to contain turbid water seeping from localized spots on the bar and (ii) assess "softness" and salvage any nearby pools or backwaters in the event of turbid water seepage. If the bar is largely gravel, compression of the ground over the area may have some mitigate effect.

Pit dimensions: To ensure that the pit fills without creating isolated pools, the width of any excavation is kept narrower than the length. This concept has not been formalized within the guidelines as it has rarely been an issue; however, it should be added to the guidelines going forward, as part of an overall updating that is proposed in the recommendations section.

PROJECT PLANNING

Knotweed Management: Presence of knotweed in the Vedder River was more common than previous years. Mitigation strategies will be needed as knotweed is expected to impact candidacy of sites for sediment removal in future channel capacity maintenance projects on the Vedder River. Knotweed appeared to be most prevalent in the river reaches, with none observed below the bench in the canal reach. It is the opinion of NPE that the recent influx of clones is potentially associated with the 2021 ARE and continued downstream movement of associated woody debris from above the Vedder Crossing Bridge. Small clones (approximately one month of growth) located close to the main channel likely emerged from woody debris since the last freshet. Larger clones among the LWD piles and higher on bank slopes and in riparian areas may have been introduced since the 2021 ARE. Assuming post-construction monitoring confirms the effectiveness of this approach, mechanical removal should continue to be implemented, but as a last resort and only for clones meeting criteria in the Knotweed Management Plan (Appendix A). Beyond this, the recommended strategy is targeted herbicide application. This would require a Pesticide Use Permit (PUP) under the *Integrated Pest Management Act* to treat knotweed clones below the highwater mark using HabitatAqua. To be effective, herbicide treatment in the Fall and Spring preceding the sediment removal works

for all clones on the bar and river-side of the Rotary Trail would be needed. Without a treatment strategy in place, locating large enough knotweed-free areas will significantly constrain the number of bars eligible for sediment removal and removal volumes at individual bars in the upper and middle reaches. If left unabated, knotweed will spread in riparian areas and impact fish habitat by reducing quality of stream-side vegetation and by increasing bank erosion.

RECOMMENDATIONS FOR EMP

Working within an extended window, Sep 15 to 30: If a heavy rain event is forecasted for the Chilliwack River Valley (Vedder South climate station), it is recommended that instream works be adjusted, if needed, to finish ahead of the rain event. This could be accomplished by immediately cutting the gentler slope at the upstream end or narrowing the excavation if proceeding upstream to downstream. Strategies to deal with forecast rain events as well as those that may be larger than anticipated or compound to yield higher water levels should be outlined in the EMP. For example, if the weather pattern is questionable, it would be better to proceed with an excavation in the canal earlier and leave a bar with more profile to the end. The likelihood of migrating salmon moving into the Vedder increases with rises in water levels in this period.

Field fit access routes based on potential water levels: For sites in river reaches, it is recommended that access routes be reviewed in early or mid-August (when discharge rates at station 08MH001 are approximately 50 m^3/s). This will reduce the probability of issues arising with access and fish trapping if a heavy rain event were to occur later on. Rip rap is recommended for the base of any part of a ramp or abutment that may be inundated in a heavy rain event. (See below for specific recommendations for sites in the canal).

Maintaining pit isolation in the canal: It is recommended that future excavations in the canal take into consideration the potential influence of tides. Tide charts should be checked and a staff gauge should be installed in advance to ensure the field fitting accounts for anticipated water level changes. Berms should be constructed to accommodate anticipated water level plus a buffer of 20 mm, as needed.

Maintaining pit isolation when water level is slow to equalize: If the water level in the pit is more than one meter below the main channel, the following measures can be implemented to mitigate risk of berm failure: (i) smoother enter/exit of bucket in the water to reduce wave action, (ii) slow down sediment removal from the pit, (iii) leave berms to create cells in the pit, (iv) compression using an excavator bucket on the berm or inside the pit, and possible (v) silt curtains pinned down to moderate wave action.

Surveys for identifying runs of salmon: Conducting salmon surveys from gravel bars can be difficult. The aerial drone was useful for observing fish in the canal. For better visibility, it is recommended that surveys for runs of salmon be completed by aerial drone, if available, in the canal and downstream of active sites every other day after Sept 15. This would provide a more reliable and repeatable method for assessing the beginning of a salmon run.

Surveys for holding behaviour in salmon: Mid-day breaks are the best opportunity to observe evidence of salmon deterred from migrating past an active site. EMs should be scheduled to allow for 30 min of observation at the downstream end of the pit when contractors break for lunch. This would be a precautionary approach since no evidence of holding behaviour was observed during the 2024 project.

Hauling on the Rotary Trail: The edge of the Rotary Trail can be difficult to navigate at times. It is recommended that max 30 km/hr speed limits be enforced and pylons be used to mark edges on inside bends where vegetation could obscure the truck driver's view.

Monitoring of isolated pools in on bars in canal: Excavation of pits in the canal may increase the tidal effect on naturally isolated pools on the bar. These pools should be monitored, particularly at lowest low tide, to determine if there is a risk of stranding when the excavation of the pit is initiated and as it progresses. If there is a perceived risk, these pools should be salvaged.

9 SUMMARY STATEMENT FROM QEP

We trust that this report provides sufficient information on the completed works and impacts to the environment. Please feel free to contact us if you have any further questions or comments.

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APPENDICES

A. KNOTWEED MANAGEMENT PLAN & IMPLEMENTATION

B. WATER QUALITY MONITORING DATA

C. PLANTING PLAN

APPENDIX A
KNOTWEED MANAGEMENT PLAN

Environmental Monitor's Post-Construction Report
2024 VEDDER RIVER SEDIMENT REMOVAL PROJECT

BC Ministry of Environmental and Climate Change Strategy

Mar 24, 2025

Knotweed Management Plan & Implementation

1.0 INTRODUCTION

Knotweed negatively impacts aquatic ecosystems, including fish and wildlife habitat and bank stability. Knotweed can also impact the structural integrity of infrastructure, such as bridge abutments, roads and pumps. Knotweed is commonly found in riparian areas. Knotweed propagules can survive in dormancy for long periods of time and can grow aggressivley. It grows up to 3 m in height and can shade out native species. Once established, knotweed is difficult to control. Its presence in Vedder River has been low, but slowly increasing in past decades. Recently, since the atmospheric river event (ARE), it appears to be spreading more rapidly, particularly within the active channel. With excavators and trucks accessing and removing sediment from bars the in Vedder River for the 2024 Sediment Rmoval Project, it was necessary to identify all knotweed plants prior to mobliization at the site and implement measures to prevent contact with knotweed plants found along access roads and trails, in riparian areas and below the high water mark of the Vedder River.

Wthin the Project Area, a number of invasive plant occurences had been documented on the *Invasives BC* website as of July 2024. NPE completed groundtruthing and additional surveys to identify invasive plants, particulaly knotweed, at all twelve bars and associated access routes and stockpiles in July and August 2024. Section 2.0 describes survey results and other documented occurences.

The Knotweed Management Plan is presented in Section 3.0. The primary object of this plan is to prevent the disturbance of knotweed and ensure knotweed contaminated materials do not leave the site. The plan descibes the class system used to identify plants elibigible for removal and recommended implementation strategies. The class system and strategies described in this plan considers input provided by Invasive Specialists with BC Ministry of Forests (MoF) in July 2024, best practices, and specific knowledge of the Vedder River. Areas of concern are largely below the high water make of Vedder River, and since no Pesticide Use Permit is in place for this area, management strategies were limited to isolation and disposal of knotweed and knotweed contaminated materials. Section 4.0 provides an overview of excavation field fit changes made to accommodate knotweed buffers and knotweed removals.

2.0 INVASIVE PLANT OCCURENCES

Desktop Assessment

Previously report occurences were retrieved from the InvasivesBC website in July 2024. Invasive plants recorded within the Project Area included primarily Japanese knotweed (*Reynoutria japonica*), as well as a few occurences of Bohemian knotweed (Reynoutria x bohemica), Giant Hogweed and Spurge Laurel. Most occurrences were located in or adjacent to the upper, middle and lower river reaches, which are approximately 7.5 km long. Previously reported occurances of invasive plants are mapped in Figures A-1 to A-4.

Invasive Plant Surveys

For four days between July 27 to Aug 1, NPE biologists undertook to groundtruth the documented occurences from *Invasives BC*, and identify any new occurences at all twelve sediment bars, associated access routes, and stockpiles. This was the earliest time in the summer to access the bars in the river as the water levels were dropping. Biologists were trained and/or had extensive previous experience with knotweed identification prior to completing surveys. Transect surveys were completed for proposed footprint and bar top access routes and the surrounding 50 m. Survey areas for access routes along established trails and roads extended 5 to 10 m from the edge on either side. Occurances identified in summer 2024 during field surveys are mapped in Figures A-1 to A-4 as blue and green points. A total of 226 knotweed occurences were documented during in the summer of 2024 within the Vedder River project area (Table A-1). Groundtruthing results for documented occurences from *Invasives BC* are not provided, as most of the documented occurences could not be positively identified. A number of these occurences were located in submerged areas and it is likely that these have been washed downstream during high flows or river configuration changes. The acuracy of GPS coordinates are also uncertain as even long established stands were not clearly associated with reported occurences. Overall, survey results suggest colonization is proceeding from upstream to downstream with limited evidence of progression past Salad Bar, which is consistent with previous data.

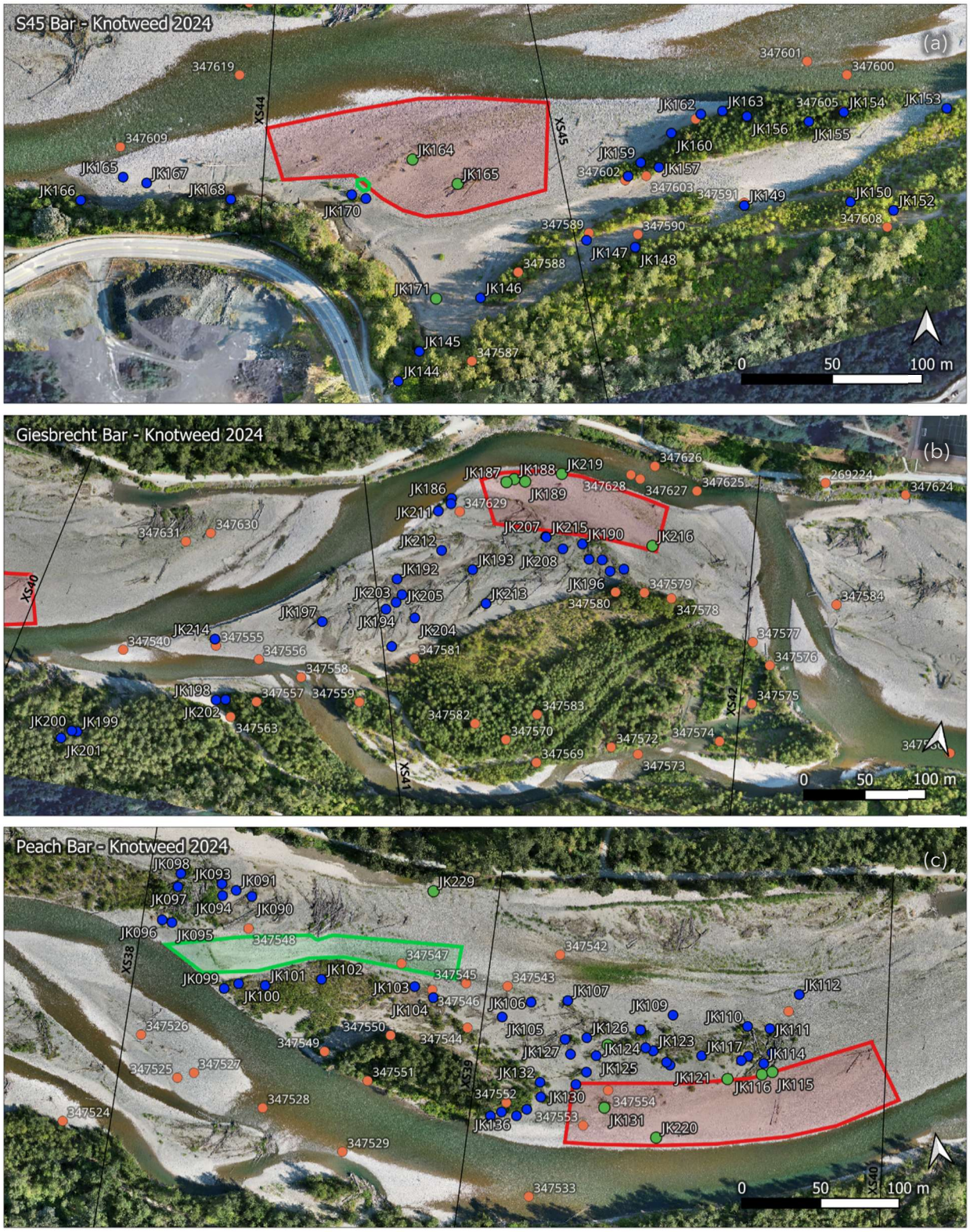

Figure A-1. Knotweed occurrences observed during the 2024 surveys (blue), those removed in 2024 (green) at the (a) S45, (b) Giesbrecht, and (c) Peach Bar sites in the Vedder River, as well as previously documented occurrences on *Invasives BC* (orange).

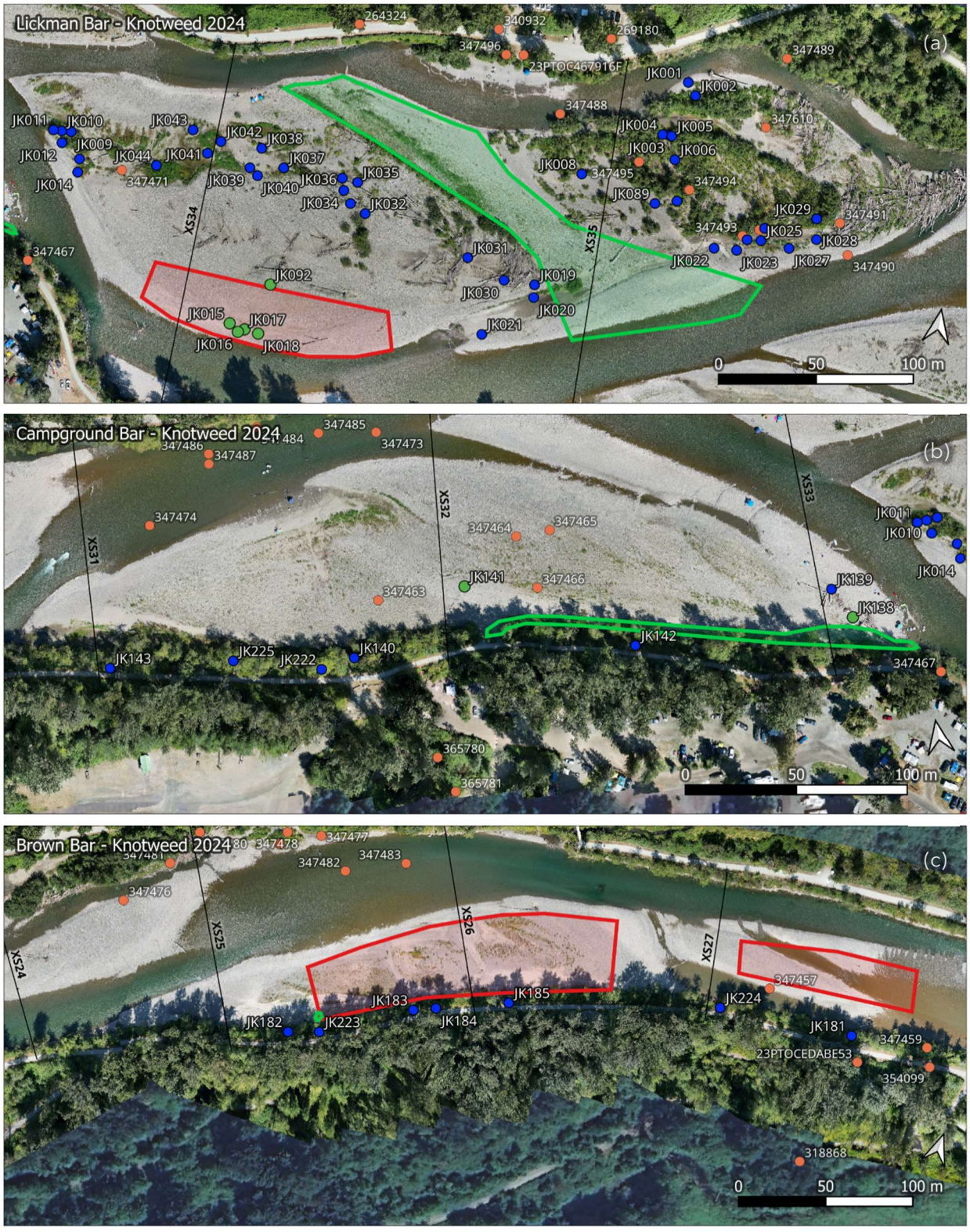

Figure A-2. Knotweed occurrences observed during the 2024 surveys (blue), those removed in 2024 (green) at the (a) Lickman, (b) Campground, and (c) Brown Bar sites in the Vedder River, as well as previously documented occurrences on *Invasives BC* (orange).

Figure A-3. Knotweed occurrences observed during the 2024 surveys (blue), those removed in 2024 (green) at the (a) Bergman, (b) Railway, and (c) Greendale Bar sites in the Vedder River, as well as previously documented occurrences on *Invasives BC* (orange).

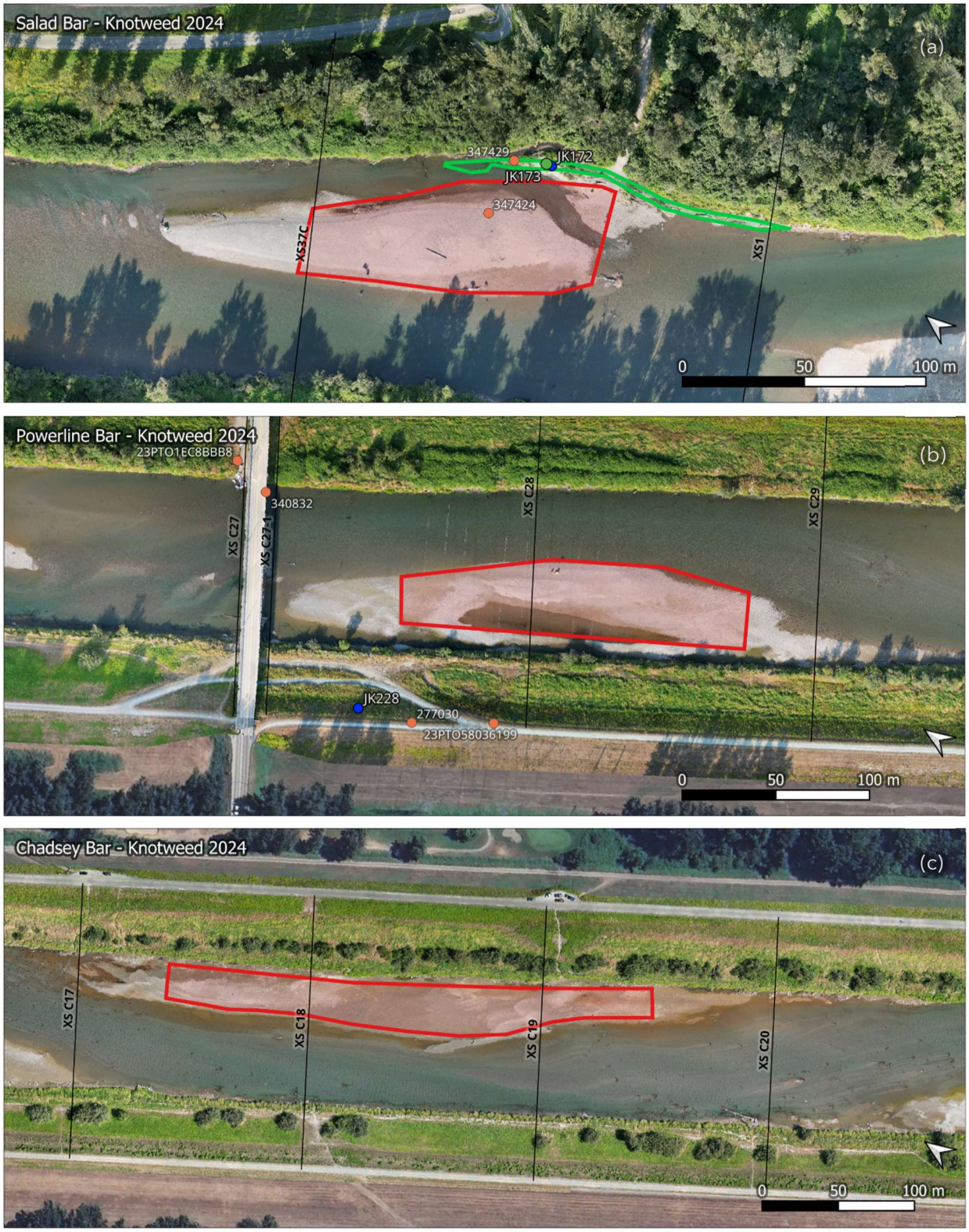

Figure A-4. Knotweed occurrences observed during the 2024 surveys (blue), those removed in 2024 (green) at the (a) Salad, (b) Powerline, and (c) Chadsey Bar sites in the Vedder River, as well as previously documented occurrences on *Invasives BC* (orange).

Figure A-5. Knotweed occurrence photos taken during summer 2024 surveys on sediment bars within Vedder River. Photo (a) represents a Class A knotweed clone eligible for mechanical removal. Knotweed clones in photo (b) would not be considered for removal because it has secondary emergent shoots, (c) is too mature, and (d) is too entangled.

3.0 KNOTWEED MANAGEMENT PLAN

Disturbance and excavation of knotweed and knotweed contaminated material was to be avoided during the Construction Phase through the implementation of mitigation measures in this Knotweed Management Plan. Avoidance through exclusion area fencing, modification of access routes and excavation footprints to accommodate 20 m setbacks was the preferred option. Where disturbance is unavoidable, knotweed contaminated sediments will require mechanical removal with small hand tools and proper disposal at a designated facility. This was considered the most appropiate strategy as *in situ* chemical treatments were not possible below high water mark at the time and removal using heavy equipment would have required the disposal of an enormous volume of material given the scale of the project.

Buffers & Guidance by Clone Class

For situations were knotweed buffers could not be accomodated, mechanical removal was considered. Knotweed plants within 20 m of an excavation footprint was evaluated against the Clone Class System, which was developed to ensure that only newly established plants with small root systems and occuring in sand or gravel substrates were removed these areas.

Class A – Single stem, new plant (distribution: individual stem <30cm height, density: stem/5m^2, area: <2cm^2)

Guidance: Carefully excavate 30cm circumference around stem using hand shovel. Locate the entire root system within excavated material, bag and stockpile in dryland location on top of sediment barrier until long term suitable knotweed disposal location is determined. If roots are intercepted during excavation, expand the excavation circumference by an additional 30cm.

Care should be taken to prevent fragmenting the stem and roots, as <2cm of rhizome or stem fragment is capable of regenerating into a new plant. Where suitable, the excavated sediment would be disposed of with the plant material.

Class B – All other knotweed size classes occurring within a planned sediment removal area.

Guidance: Soil occurring within a 20 m circumference and 2 m depth of surface knotweed clones, is considered contaminated with viable knotweed propagules and requires excavation and deep burial at a suitable location.

Class C – Knotweed clones occurring above the High Water Mark with the root crown at an elevation 2m higher than the elevation of a planned sediment removal area, with no visible surface or subsurface knotweed growth on the river bank between.

Guidance: The sediment may be excavated up to, but not including the toe of the riverbank slope without disturbing the bank, and will be considered free of knotweed propagules (reproductive plant parts).

Class D – Knotweed clones occurring on large woody debris with roots clearly isolated to that debris.

Guidance: The knotweed and large woody debris should be picked up and relocated on the bar. Where clones are growing on large woody debris with roots clearly penetrating adjacent sediment the 20 m buffer will apply.

Sanitation, Transport & Disposal

- All knotweed and knotweed contaminated sediments will require proper disposal at a designated facility. Designated facilities will be contacted in advance to ensure capacity for the amount of material to be disposed.
- Prevent vehicles and equipment from driving on known knotweed occurrences. Exclusion zone fencing should be used to prevent distubance of knotweed by equipment, as needed.
- Equipment and vehicle cleaning should be repeated prior to leaving the permanent disposal location.
- Clones eligible for excavation by hand, will be deposited in buckets lined with two heavy duty garbage bags. Bags will be filled to 50% capacity and zip-tied closed to prevent spillage. The bagged material will be transferred by truck to the designated landfill. Trucks will not enter knotweed infested areas. Bagged material will be carried in buckets to the truck above the high water mark on the Rotary Trail or parking lot.

- Before leaving a site, remove all visible plant parts and soil from vehicles, equipment, tools, and footwear (especially those involved in sediment removal). All vehicles, equipment, and tools that may have come in contact with knotweed should be cleaned.
- No contaminated material will be permitted to be stockpiled in the Project Area. If temporary storage is necessary prior to transport to the disposal facility, all bagged material will be placed on an impermeable surface and covered. All bags will be inspected for holes prior to movement if removed from the bucket.

Monitoring & Management

- All survey, treatment, and monitoring records should be entered into the provincial invasive plant database (*Invasives BC*).
- Removal sites should be assessed annually for three years during low summer flows to confirm no emergent clones are present. Observations will be reported in the annual assessment report required per the *Fisheries Act* Authorization and *Water Sustainability Act* Change Approval for the Project.

4.0 MITIGATION IMPLEMENTATION

Since excavation footprints are located over unvegetated gravel bar and log jams are avoided, as per the Design Guidelines, there were relatively few occurrences with impacts on pit excavations. Where knotweed did occur within pit footprints, the plant tended to be in recently inundated gravel areas and their small size suggested they were newly emergent. Generally, these met the criteria for mechanical removal and were relatively easy to remove.

Knotweed clones were more prevalent in vegetated areas and log jams. Despite being labour intensive, selective removals from these areas were very effective in maintaining the scale and functionality of the excavations beyond what would have occurred relying on setbacks alone to manage knotweed. The design for seven pit excavations had to be modified to accommodate knotweed setbacks.

The habitat enhancement excavations that are often along the riverbank were more impacted. Enhancement excavations planned for Peach, Brown and Bergman were cancelled and replaced with alternatives. Other enhancement excavations, such as S45, Campground, Greendale, and Lickman, were modified to accommodate knotweed setbacks.

Table A-1. Overview of knotweed occurrences and mitigation measures implemented by bar.

Bar	Survey date(s)	Surveyed area (m^2)	No. knotweed occurrences documented	Knotweed buffer accommodation needed for pit (1=Yes; 0=No)	Knotweed buffer accommodation needed for enhancement excavation (1=Yes; 0=No)	No. knotweed removed
S45	July 29	36,000	27	1	1	3
Giesbrecht	Aug 1	47,000	32	1	n/a	5
Peach	July 29	80,000	50	1	1	8
Lickman	July 29	50,000	45	1	1	4
Campground	Aug 1	25,000	7	1	1	2
Brown	July 28	26,000	8+	1	1	0
Bergman	July 28	11,000	6+	1	1	0
Railway	July 28	10,000	3	0	n/a	2
Greendale	July 29	65,000	45	0	1	2
Salad	July 28	3,000	2	0	n/a	1
Powerline	July 28	15,000	1	0	0	0
Chadsey	Aug	13,000	0	0	0	0
	TOTAL	381,000	226	7		27

References

Ministry of Transportation and Infrastructure (MoTI). 2024. Knotweed Best Management Practices for BC Highway Right of Ways and Gravel Pits: Learn to Identify Knotweed. Retrieved from https://www2.gov.bc.ca/assets/gov/driving-and-transportation/environment/invasive-species/knotweed-bmp-poster-generic.pdf

MetroVancouver (MetroVan). 2024. Best Management Practices for Knotweed Species in Metro Vancouver Region. Retrieved from https://metrovancouver.org/services/regional-planning/Documents/knotweeds-best-management-practices.pdf

APPENDIX B
WATER QUALITY RESULTS

Environmental Monitor's Post-Construction Report
2024 VEDDER RIVER SEDIMENT REMOVAL PROJECT

BC Ministry of Environmental and Climate Change Strategy

Mar 24, 2025

Routine Water Quality Monitoring

Daily water quality monitoring in the main channel was completed by environmental monitors during pit excavation works at all nine bars (Figure B-1, B-2). At each site, turbidity measurements (FNUs) were taken between 6:30pm and 7:30am before instream work began, between 12:00pm to 14:00pm, and between 5:00pm to 6:30pm during the last 30min of instream works. At each site, measurements were taken 10 to 20m upstream of the pit (U/S), adjacent to the middle of the pit (ADJ) and 10 to 20m downstream of the pit (D/S). Environmental monitors used Lamotte turbidity meters and obtained triplicate samples. Averaged are presented in the table below. In some instances, water quality was assessed visually. Only routine monitoring of the main channel is presented here. For more information on turbidity during pit openings, please see the main document.

Figure B-1. Turbidity (FNUs) measured in the main channel upstream (U/S), adjacent (ADJ) and downstream (D/S) of the pit before, during and towards the end of pit excavation works each day at S45, Giesbrecht, Peach, Brown, Bergman, and Railway.

Date	Timing	S45			Giesbrecht			Peach			Brown			Bergman			Greendale		
		U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S	U/P	ADJ	D/S	U/P	ADJ	D/S
Aug 28	Before	-	-	-				-	-	-	-	-	-						
	During	NC	NC	NC				NC	NC	NC	NC	NC	NC						
	After	NC	NC	NC				NC	NC	NC	NC	NC	NC						
Aug 29	Before	-	-	-				-	-	-	-	-	-				-	-	-
	During	NC	NC	NC				NC	NC	NC	NC	NC	NC				NC	NC	NC
	After	NC	NC	NC				NC	NC	NC	NC	NC	NC				NC	NC	NC
Aug 30	Before	-	-	-				-	-	-	-	-	-				-	-	-
	During	NC	NC	NC				NC	NC	NC	NC	NC	NC				NC	NC	NC
	After	NC	NC	NC				NC	NC	NC	NC	NC	NC				NC	NC	NC
Aug 31	Before	-	-	-	-	-	-	-	-	-	1.82	1.64	1.69				-	-	-
	During	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.66	1.64	1.45				0.33	-	0.98
	After	NC	NC	NC	NC	NC	NC	NC	NC	NC	1.70	1.58	1.54				-	-	-
Sep 2	Before	-	-	-	-	-	-	-	-	-	1.32	1.47	1.51				0.49		2.22
	During	NC	NC	NC	NC	NC	NC	NC	NC	NC				-	-	1.35	0.08	-	0
	After	NC	NC	NC	NC	NC	NC	NC	NC	NC				1.73	1.28	1.47	0	-	0
Sep 3	Before	-	-	-	-	-	-	0	-	1.57				1.37	1.45	1.53	0	-	0.73
	During	NC	NC	NC	NC	NC	NC	-	-	-				1.43	1.38	1.45	0	-	0.77
	After	NC	NC	NC	NC	NC	NC	1.46	-	2.80				1.49	1.49	1.36	0	-	0.40
Sep 4	Before	-	-	-	0.67	-	0.17	9.31	-	1.62				2.15	1.56	1.32	0	-	0.33
	During	NC	NC	NC	-	-	-	-	-	-				1.76	1.56	1.32	0.21	-	0.58
	After	NC	NC	NC	0	0.17	0	1.46	-	2.80							0.26	-	0.80
Sep 5	Before	NC	NC	NC	6.00	-	0.19	1.01	-	0.81	0.42	-	0.54	0.51	0.44	1.06	0.36	-	1.44
	During	NC	NC	NC	-	-	-	-	-	-		open			open		3.72	-	6.25
	After	NC	NC	NC	5.06	-	1.22	1.21	-	0.65							1.39	-	1.11

Date	Timing	S45			Giesbrecht			Peach			Brown			Bergman			Greendale		
		U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S	U/P	ADJ	D/S	U/P	ADJ	D/S
Sep 6	Before	-	-	-	0	-	0	1.85	1.51	1.37	0.43	0.70	0.81	0.51	0.61	2.71	0.52	0.58	1.90
	During	NC	NC	NC	0.07	-	0.41	-	0.52	1.57							0.56	-	0.91
	After	NC	NC	NC	0.04	0	0.35	1.16	0.47	0.38							-	-	-
Sep 7	Before	-	-	-	-	-	-	0.30	0.40	0.30							-	0.67	-
	During	NC	NC	NC	-	-	-	0.54	0.45	0.94							0.65	-	1.32
	After	NC	NC	NC	-	-	-	0.77	1.71	0.61							-	-	-
Sep 9	Before	-	-	-	0.12	0.16	0.05	0.56	0.33	0.46							-	-	-
	During	NC	NC	NC	0.28	-	1.02	1.01	1.14	0.76							NC	NC	NC
	After	NC	NC	NC	0.52	0.73	0.34	0.46	0.43	0.47							-	-	-
Sep 10	Before	-	-	-	0.34	-	0.12	1.48	0.36	0.75							1.02	-	1.40
	During	NC	NC	NC	0.69	-	0.14	0.48	1.50	0.52								open	
	After	NC	NC	NC	0.56	1.54	0.59	0.54	1.02	0.83									
Sep 11	Before	-	-	-	0.35	0.11	0.21	0.62	0.80	0.33									
	During	NC	NC	NC	0.23	-	0.11	0.61	1.03	0.51									
	After	NC	NC	NC	0	-	0	0.94	1.10	0.32	0.80	-	1.52	0.74	-	1.74			
Sep 12	Before	1.57	-	0.62	0.37	1.81	0.92	1.04	0.71	0.96									
	During		open		0.16	-	-	0.86	0.59	1.02									
	After				0.67	-	0.24	1.20	1.44	1.20									
Sep 13	Before	-	-	-	0.49	0.47	0.27	1.07	0.66	0.90									
	During	-	-	-		open		0.34	0.72	1.13									
	After	0.44	2.16	2.69				1.22	0.88	0.84									
Sep 14	Before							0.92	0.64	0.70									
	During							0.90	-	0.79									
	After							-	-	-									
Sep 16	Before							2.42	-	0.99									
	During								open										
	After																		
Sep 17	Before							3.08	0	3.25									
	During																		

*NC – No change from background levels during visual check

Figure B-2. Turbidity (FNUs) measured in the main channel upstream (U/S), adjacent (ADJ) and downstream (D/S) of the pit before, during and towards the end of pit excavation works each day at Lickman, Railway, Powerline, and Chadsey.

Date	Timing	Lickman			Railway			Powerline			Chadsey		
		U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S
Sep 6	Before							0.79	0.65	0.71			
	During							0.45	0.50	0.70			
	After							0.30	0.57	0.92			
Sep 7	Before							0.58	0.72	0.61			
	During							0.80	0.57	0.44			
	After							-	-	-			
Sep 9	Before							0.59	0.89	0.92			
	During							1.10	0.66	0.50			
	After							-	-	-			
Sep 10	Before							0.56	0.63	0.92			
	During							-	-	-			
	After							-	-	-			
Sep 11	Before							0.76	0.67	0.91			
	During							-	-	-			
	After							0.78	0.61	0.91			
Sep 12	Before	-	-	-	-	-	-	0.52	1.37	1.16			
	During	NC	NC	NC	NC	NC	NC	-	-	-			
	After	NC	NC	NC	NC	NC	NC	-	-	-			
Sep 13	Before	-	-	-	-	-	-	0.90	1.06	0.72			
	During	NC	NC	NC	0.83	-	0.49	-	-	-			
	After	NC	NC	NC	-	-	-	0.96	1.15	0.80			
Sep 14	Before	0.38	-	0.66	-	1.23	1.23	0.93	-	1.63			
	During	0.60	-	-	-	-	-	-	-	-			
	After	1.32	-	0.51	-	-	1.13	-	-	-			
Sep 16	Before	1.37	-	0.94	1.75	1.75	2.35	0.78	0.94	0.60			
	During	6.39	-	6.08	1.10	-	29.7	-	-	-			
	After	0.94	-	1.12	-	-	-	-	-	-			
Sep 17	Before	0.61	-	0.83	1.03	1.88	6.72	0.80	1.63	0.81			
	During	0.78	-	0.64		open		1.84	1.87	1.82			
	After	1.10	-	1.27				-	-	-			
Sep 18	Before	1.50	-	1.29				0.78	0.72	0.68	5.78	-	4.5
	During	0.93	-	1.30					open		-	-	-
	After	1.31	-	2.66							4.11	-	4.77
Sep 19	Before	-	-	-				0.93	-	1.63	3.94	-	2.38
	During	NC	NC	NC							-	-	-
	After	NC	NC	NC							3.82	-	3.45

Date	Timing	Lickman			Railway			Powerline			Chadsey		
		U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S	U/S	ADJ	D/S
Sep 20	Before	-	-	-							3.15	5.17	7.25
	During		open								5.69	-	6.39
	After										3.75	-	5.62
Sep 21	Before	-	2.4	-							0.92	0.93	0.94
	During										-	-	-
	After										0.54	0.45	0.67
Sep 23	Before										6.39	4.13	3.68
	During										-	-	-
	After										3.20	-	4.18
Sep 24	Before										3.54	3.19	2.64
	During										-	-	-
	After										3.94	-	5.80
Sep 25	Before										3.04	3.87	3.95
	During										-	-	-
	After										5.19	-	6.15
Sep 26	Before										12.0	18.7	22.4
	During											open	
	After												
Sep 27	Before										4.71	-	4.65
	During										1.63	-	2.15
	After										-	-	-
Sep 28	Before										2.38	-	2.33
	During												
	After												

*NC – No change from background levels during visual check

APPENDIX C
PLANTING PLAN

Environmental Monitor's Post-Construction Report
2024 VEDDER RIVER SEDIMENT REMOVAL PROJECT

BC Ministry of Environmental and Climate Change Strategy

Mar 24, 2025

REPLANTING PLAN

A total of three live trees and one snag were downed to allow bar access for equipment. One snag at S45 was expected to be removed. The removal of one tree at campground and one at Brown were necessary owing to the presence of knotweed at planned access ramps to the bar top. One small tree at Lickman was topped to allow for the bridge crossing, however the regrowth of this tree is unlikely. Tree species removed included black cottonwood (*Populus balsamifera*) and red alder (*Alnus rubra*), which are both early-colonizers. The 36 cm DBH tree will be replaced by one tree and four shrubs, the 28 cm DBH tree will be replaced with one tree and two shrubs. The smaller alder will be replaced with four shrubs. Shrubs have been selected to provide groundcover, food for wildlife, and may out-complete invasives found in the area. Also, shrubs are less likely to impact maintenance of the Rotary Trail in areas where only a narrow strip adjacent to the trail is available for planting. Species to be planted include red alder, big leaf maple (*Acer macrophyllum*), vine maple (*Acer circinatum*), red flowering currant (*Ribes sanguineum*), nootka rose (*Rosa nutkana*), Salmonberry (*Rubus spectabilis*), snowberry (*Symphoricarpus albus*), and red-osier dogwood (*Cornus stolonifera*).

In addition, native willow (*Salix sp.*) cuttings will be planted at machine access locations along the bank slope at Chadsey and Powerline. Black cottonwood cuttings may also be planted along the access route at S45 if natural regrowth is insufficient.

An all-native seed mix will be applied, as needed.

Table C-1. Trees felled for site access and replanting completed to offset for tree removal.

	TREES REMOVED		PLANTS TO BE PLANTED		
Site	Species	DBH	Species	Size	Number
S45	(snag only)		Big leaf maple	3 gallon pot	1
			Vine maple	2 gallon pot	1
Peach	n/a		Nootka rose	4 gallon pot	3
			Red flowering current	2 gallon pot	2
Lickman	Red alder	10 cm	Red osier dogwood	2 gallon pot	2
Campground	Red alder	28 cm	Red alder	2 gallon pot	1
			Salmonberry	2 gallon pot	1
			Snowberry	2 gallon pot	1
Brown	Red alder	34 cm	n/a		
Powerline	n/a		Willow	whips	8
Chadsey	n/a		Willow	whips	8

Methodology

Plants will be obtained from a nursery and planted at fours sites in the upper and middle reaches of Vedder River (Figure C-1). At these sites, all plantings will be completed at least one meter from the edge of the Rotary Trail, per the City's request. For each potted plant, a hole will be dug deep enough for the root wad to be at or below the surface. The hole will be filled with a mixture of topsoil and undyed bark mulch where drought is a concern. Any weeds found in close proximity to planting locations will bull pulled. Placement of plants will be consistent with Figures C-2 to C-5, unless conditions have changed. The total number of plants will not be less than 12 (Table C-1).

Beavers occur in areas between Peach Rd and Hooge Rd. A textual repellant will be applied to the lower 3 ft of stem of any red osier dogwood, cottonwood, or willows planted in this area. The textual repellant is created by mixing 1.5 cups of course sand and 1 litre light grey latex paint. The mixture is applied after planting using a rag and with a drop cloth to catch drips. If needed, vinyl tree protectors may also be used to prevent herbivory.

As needed, whips will be harvested from willows in in the Vedder canal area. Whips will be installed on the bank slope approximately 1-4 feet from the top of bank (TOB). Whips will be planted where excavators disturbed vegetation to complete the pit openings at the upstream and downstream end of Chadsey and Powerline Bars. Rebar will be used to create a hole at least 1 m deep to install the whip.

Some sites may require reseeding (Table C-2). An all-native seed mix will be applied to areas where topsoil has been added, such as Peach and Lickman Bars. be removed prior to adding seed, with the exception of knotweed. A thin layer of topsoil will be applied on top of seeds.

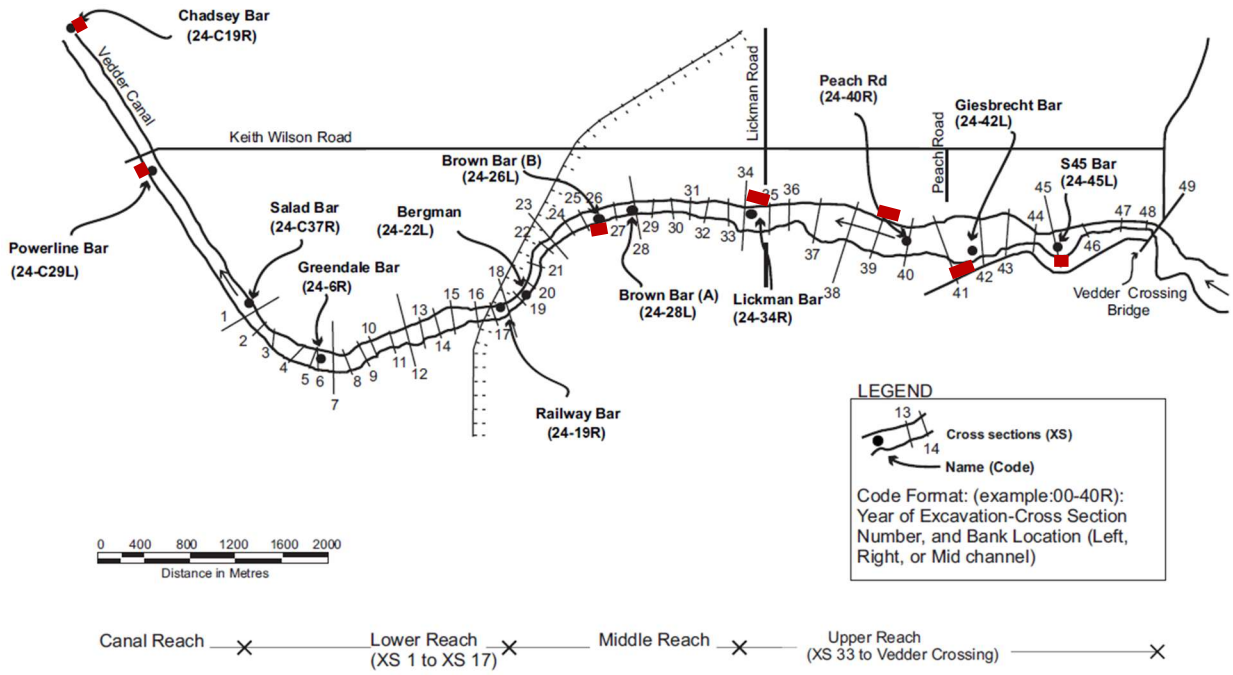

Figure C-1. Location of replanting and seeding to be completed within the Project Area on Vedder River, Chilliwack, BC.

Survivorship Monitoring

To evaluate the success of riparian replanting efforts, all planted shrubs and trees will be assessed in summer 2025, 2026 and 2027. Before and after photos will be taken to confirm both trees and shrubs achieve at least an 80% survival rate each year. Ground cover and natural recruitment will also be documented.

Figure C-2. Planting plan for S45 access route between the South Rotary Trail and Vedder River. One big leaf maple (BLM), pot size #3 and one vine maple (VM) pot size #2 will be planted to add diversity to this area.

Figure C-3. Planting plan for the Peach Bar access route between the North Rotary Trail and Vedder River. Three Nootka rose (NR), pot size #4 and two red flowering current (RFC) pot size #2 will be planted. These shrubs were selected to create a barrier for trail users and allow this access point to be used again in the future. This area will also be reseeded.

Figure C-4. Planting plan for Lickman access ramp area between the North Rotary Trail and Vedder River. Two red osier-dogwood (ROD) pot size #2 will be planted. Two small areas along the south edge of the Rotary Trail will be reseeded.

Figure C-5. Planting plan for Campground Bar access ramp area between the South Rotary Trail and Vedder River. One red alder (RA) pot size #2, salmonberry (SLB) pot size #2 and snowberry (SWB) pot size #2 will be planted.