Peace River Project Water Use Plan

Peace River Side Channel Response

Implementation Year 1

Reference: GMSMON-8

Study Period: 2012

NHC and Mainstream Aquatics Ltd.

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GMSMON-8 Peace River Side Channel Response

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Executive Summary

The Peace River Water Use Plan Consultative Committee (WUP CC) recognized that the changes in river morphology due to reduced peak flows were creating loss and continued degradation of fish habitat in side channels, and identified that controlled and uncontrolled spill events could potentially restore side channel function and value.

The terms of reference for the work under GMSMON-8 Peace River Side Channel Response were provided as one element of a comprehensive spill monitoring program prepared by BC Hydro (2008). The terms of reference were intended to address key issues identified by the WUP CC, and were approved by the Comptroller of Water Right under an order issued to BC Hydro. The specific scope items for GMSMON-8 were, as stated:

1. Assess the changes to channel morphology and physical dimensions of the side channels.
2. Assess the textural changes to the bed.
3. Determine abundance and distribution of fish species, and relative importance of fish species life stage use within side channels.
4. Assess changes relative to pre-spill conditions in the side channels.

GMSMON-8 was activated when BC Hydro implemented a spill in excess of normal operational flows at GMS and PCN over a certain magnitude and duration. The dates and timing of the spill exceeding the 2,500 m^3/s trigger ($\geq$ 2 days duration) were from June 27 to July 9 in 2012, and peak hourly flows ranged between 2,605 and 3,289 m^3/s. These flows resulted in a mean daily average flow between 2,600 to 2,800 m^3/s.

In the accepted scope of work for this monitor, two key side channels (32L and 102.5R) were identified for air photo analysis to determine geomorphic change. Side Channel 32L is located on the mainstem Peace River midway between Farrell Creek and the Halfway River. Side Channel 102.5R is located immediately below the confluence of the Pine River and the Peace River. These same two side channels were identified to monitor pre- and post-spill fish use and habitats. NHC and Mainstream field crews were mobilized and data were collected. Field data extents and coverage were limited pre and post-spill due to inundation.

The side channels examined under this monitor exhibited little morphological change for the 2012 spill flow magnitude and duration in relation to pre-spill conditions. Analyses of grain size distributions (GSD) indicated that side channel sediment textures were coarsened by spill flows, mobilizing finer sediments eroded from overtop of existing cobbles and gravels. No changes to the underlying armour layer were noted at the sample sites.

Biological changes indicated changes in fish community structure with relatively minor changes in physical habitats and cover elements for the spill magnitude and duration in 2012 in comparison to pre-spill conditions. Both Side Channel 32L and 102.5R had lower relative abundance and changes in community structure that may reflect spill effects on fish health. Physical cover and measures of habitat type extracted using GIS differed little pre to post-spill at both sites. Changes in GSD and embeddedness are one noted physical change that was consistent between both the biological and morphological components of the monitor, although the changes were less distinct at 102.5R.

The monitor was not able to discern the cause of the fish community changes, whether they due to changes in habitat suitability, water quality or temperature, primary and secondary productivity, or some combination of these key factors. Understanding the primary factors related to changes in fish communities would also help explain the resilience and longevity of these ecological changes in a post spill environment.

For example, if sediment flushing and changes to GSD are important factors, then the time frame in which side channel habitats infill with sediment and revert to a fine textured substrate may be critical. In terms of the PFPP, more frequent spill flows in excess of 2,500 m^3/s may mitigate infilling and influence fish community structure and utilization.

Significantly higher flows – likely from 4,000 to 6,000 m^3/s for a period of weeks – are required for morphological change in the side channels that would affect channel structure. If changes in habitat and hydraulics rely on these long term morphological changes, then lasting biological changes are unlikely to occur. These higher flow magnitudes are uncommon in the regulated Peace River and occur very infrequently.

All reviewed data suggests that larger, longer duration spill flows are likely required to effect significant changes by natural scour and erosion processes in side channel sections, planforms and profiles. Fish sampling conducted to date also suggests that extensive physical and hydraulic changes would have corresponding biological changes in fish utilization, habitats and community structure.

It is critical to adequately monitor the biological and physical effects of all future spill events for the both the PSP and the PFPP. The following recommendations are provided for future biological, sediment and geomorphological monitoring under these programs:

1. Both the PSP and the PFPP should incorporate additional detail in the timing, magnitude, and duration metrics to trigger changes in monitor(s) application, scope and tasks. Pre-spill hydrological and hydraulic modelling information should be able to estimate magnitude and duration of spill inundation and guide the scope of work for field monitors.

2. The data collected under GMSMON-8 suggest that limited geomorphic changes are experienced at spill flows of similar magnitude and duration as the 2012 event. A higher spill flow magnitude and duration (or combination of both) trigger level could be used in future PSP monitors. Only spill duration is used as a modifying factor in the current PSP. For example, the following table could be used as an interim guide for planning future GMSMON-8 work. Any spill-duration combination less than the criteria would default to the row above.

Suggested Interim GMSMON-8 Spill Triggers.

Spill Flow mean daily (m^3/s) and duration[1]	GSD	Fish/Habitat	Orthophotos	Physical Surveys
> 2,000 for < 7 d	X	X		
2,000 – 3,500 for >7 d	X	X	X	
> 3,500 for > 7 d	X	X	X	X

[1.] As measured at PCN as mean daily flow over 24 hour period.

3. This spill monitor requires spatial assessments of relatively larger areas. Additional side channel baseline maps could be produced using existing low water orthophotos produced under existing monitors or works (i.e., GMSWORKS-4 Peace River Hydraulic Habitat Study for flows less than 2,000 m^3/s). These data sets could then be compared to the next available orthophoto mosaic collected during other water levels to illustrate the morphologic effects of or future spills.
4. Physical effects cannot be determined by LiDAR as the vertical resolution will be unable to quantify changes in the side channels. Both air photo and topographic surveys are likely required in order to quantify potential morphological effects when they occur. The large spatial extent should use pre-identified index sites, similar to what is used under the GMSMON-8 Peace River Side Channel Response and GMSMON-7 Peace River Side Channel Fisheries studies.
5. Any proposed index sites should be pre-selected for long-term monitoring with baseline surveys and benchmarks installed to facilitate rapid post-spill assessment. Cross sections at critical side channel features (i.e., bars, inlet channels and riffles) and long profile data may be useful measurements in a structured assessment program. GMSMON-7 is expected to include similar physical data collection on both study and index sites. GMSMON-8 should include sites other than those included under GMSMON-7 so larger sample of side channel types below PCN can be monitored effectively.
6. Biological data collection can be improved for the benefit of long-term assessment. Pre-determined fixed index sites for fish and habitat transects should be used, based on the existing database of available sites. Multi-event datasets would allow statistical evaluation of potential spill effects on species diversity, relative abundance and age class structure.
7. The monitor should consider use of whole side channel estimates of fish abundance as a metric to measure potential spill effects. Biological sampling should occur at the same Peace River flow, and monitoring should include seasonal assessments in order to address natural variation in fish use of side channels that are not associated with potential spill effects. GMSMON-7 is expected to provide an improved estimate of fish community abundance and diversity and it is expected to commence in spring 2013.
8. Synoptic, repeat sampling at periodic intervals at index locations and sample sites should be considered in order to evaluate the time frame for change or reversion to a pre-spill state for both biological and physical elements under this GMSMON-8 as part of the PSP. These data will help determine the frequency and magnitude of spill events required to modify the morphology, habitats and fish communities in Peace River side channels.

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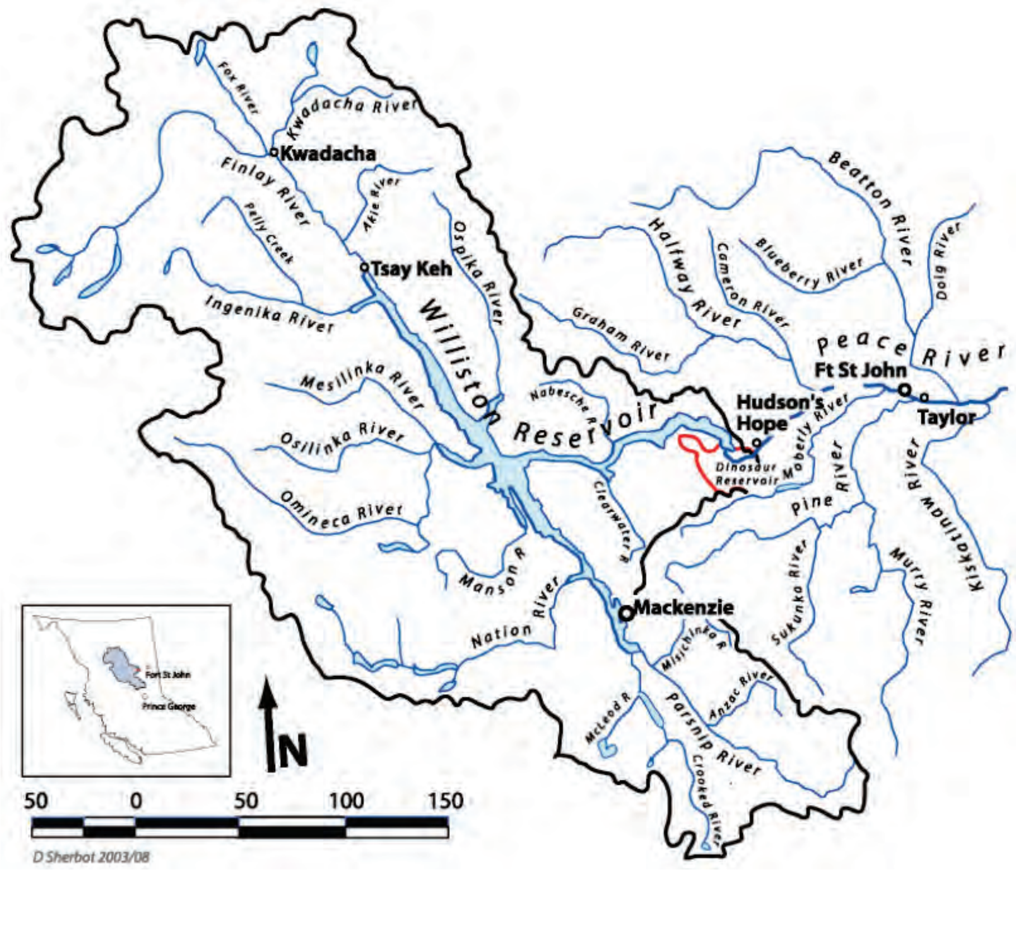
1 Introduction

1.1 Background

The headwaters of Peace River, a tributary of the Mackenzie River, are located in northeastern British Columbia (BC) (**Figure 1.1**). It flows east out of Williston Reservoir and is the only river to cut through the Rocky Mountains. Once out of the Peace Canyon the river maintains an easterly direction, crossing the BC-Alberta border, draining into Great Slave Lake and the Mackenzie River before it enters the Arctic Ocean.

The Peace Project includes the Williston Project (GMS) and the Peace Canyon (PCN) Project. GMS consists of the Williston Reservoir, W.A.C. Bennett Dam, and the G.M. Shrum Generating Station, while PCN consists of Dinosaur Reservoir, Peace Canyon Dam, and the Peace Canyon Generating Station. Flows in the Peace River are regulated by BC Hydro's Williston Reservoir with power generation occurring at the G.M. Shrum Generating Station (GMS) and Peace Canyon Dam (PCN).

Figure 1-1 Peace Project location and place names (BC Hydro 2008).



1.2 Effects on Hydrology, Sediment and Side Channels

Regulation of the Peace River (PCR) has resulted in changes to flow, specifically the timing and magnitude of annual (and larger) floods, and the transport of sediment (Church 2005). Primary hydrological effects include a reduction of the mean annual flood peak flow by 70%, an increase in winter flows for power generation and ice control, and reduced daily variability in seasonal flows by 30 to 50 percent. The current operational flow regime does not have the stream power required to move the pre-existing bed sediments consisting of gravels and cobbles. Fine sediments and suspended loads are carried downstream of the Pine River by the current flow regime.

Long term storage provided by Williston Reservoir and regulation of the Peace River has impacted side channel habitat by reducing large flood flows that control vegetation establishment and transport fine sediments from the secondary channels along the mainstem (Church 1995, 2005). Similar impacts have been observed on the Nechako River above Fort Fraser (Rood and Neill 1987, NHC and MMA 2008) where river regulation has reduced both the number and area of side or secondary channels. NHC *et al*. (2010) identifies a number of factors that lead to side channel morphological changes.

The regulated flow regime reduces natural water levels that would occur during the spring and summer, decreasing both the wetted area and side channel connectivity to the mainstem river, which effects the side channel's utility and value as fish habitat. These changes, in concert with morphological and water quality changes, have instigated fish population and community changes in Peace River above the Pine River.

1.3 Peace River Water Use Plan

The Peace River Water Use Plan Consultative Committee (WUP CC) recognized that the changes in river morphology due to reduced peak flows were creating losses and continued degradation of fish habitat in side channels. The WUP CC identified that controlled and uncontrolled spill events could potentially restore side channel function and value as productive fish habitat. The Water Use Plan (WUP) identified monitors and works to address the loss of side channel habitat in lieu of large flow releases from PCN intended to restore the natural annual flood hydrology and processes.

The Peace Spill Protocol (PSP) was established by the Peace WUP Committee to formalize agency notification and to identify monitoring programs that quantify the environmental effects of a spill. There was insufficient time and data during the Water Use Planning process to properly scope and investigate the influence of spill events on the environment of the Peace River.

The alternative, recommended by the WUP Committee, was a plan to manage and monitor spill events at PCN and GMS to acquire the information necessary to develop more refined operational procedures for spilling. If a spill occurs within the 10 year scope of the PSP monitoring programs that were initiated in August 2007, then the information gained from these studies will assist in future decision-making related to spill risk strategies and environmental audit procedures (BC Hydro 2007).

PSP is integral to the Peace Flood Pulse Plan (PFPP), which was developed by the WUP Committee to improve fisheries productivity and riparian habitat. The PFPP considers the feasibility of periodic flood pulse events to maintain side channel and riparian habitat downstream of Peace Canyon Dam (PCN).

Monitoring programs under both of these management plans (e.g., PSP and PFPP) would be conducted opportunistically as no planned spill releases were proposed. A potential issue is that PSP monitoring programs may identify adverse effects related to uncontrolled spills that conflict with the restoration objectives of the periodic flood pulse events considered under PFPP.

1.3.1 Management Questions

The Committee, through its conclusions contained in the WUP, the PSP and the PFPP, proposed several key management questions with respect to the impacts of spills at BC Hydro operations on the Peace River:

1. What is the effect of a spill on the physical state of the side channels? In particular, what processes occur, what changes are evident, and are the changes beneficial to fish?
2. What changes occur in fish use of side channels as a result of a spill?

1.3.2 Primary Hypotheses

The Fisheries Technical Committee developed detailed hypotheses regarding fisheries, ecological, geomorphic and wildlife impacts. This monitor specifically addresses fish, fish communities and side channel geomorphology, primarily through the following hypotheses:

- H_1: Morphology of side channels before a spill event is different than after a spill event.
- H_2: Bed-material armouring as measured by the median particle size in side channels before a spill event is different than after a spill event.
- H_3: The relative abundance of fish species, age class structure, fish numbers, and species present in side channels before a spill event is different than after a spill event.

The activation and testing of this and other spill monitors was dependent on the occurrence of a spill during the 10-year WUP monitoring period. Data collected in previous monitors and works were used to guide the implementation of GMSMON-8, along with the availability of critical information for assessment. The third hypothesis of fish use may only be testable if the spill occurs in a similar sampling season as the baseline monitoring; otherwise temporal variation of fish use in side channels may be a confounding variable.

1.3.3 Key Water Use Decision Affected

The key water use decision affected by the results of GMSMON-8 is a revision of future spill operational strategies and monitoring, with the potential to develop an improved program. This could include recommendations with respect to this or other spill monitors. Improved knowledge and information gained in this study may also help better understand the current and future role of spill flows on side channels in the lower Peace River below PCN.

1.4 Scope of Work

The Terms of Reference for the work under this monitor were provided as one element of a comprehensive spill monitoring program prepared by BC Hydro (2008). The terms of reference were intended to address key issues identified by the WUP CC, and were approved by the Comptroller of Water Rights. The specific scope items for GMSMON-8 were, as stated:

5. Assess the changes to channel morphology and physical dimensions of the side channels.
6. Assess the textural changes to the bed materials in side channels.
7. Determine abundance and distribution of fish species, and relative importance of fish species life stage use within side channels.
8. Assess changes relative to pre-spill conditions in the side channels.

Additional ancillary conditions were also included:

5. This monitoring program will characterize the side channels of the Peace River in terms of morphology, fish presence, and fish distribution following a spill event.
6. Changes to the side channels will be quantified by comparing this data to baseline data collected as part of the PCR Side Channel Fisheries monitoring program. Note that the PCR Side Channel Fisheries monitoring program (GMSMON-7) has not been initiated at the time of the study, and comparisons were made to data collected by Site C Peace River baseline fisheries inventory program.
7. Evaluation of impacts to fish populations should be made where possible, using both the fish survey data and observed changes in the physical state of the habitat. Field and office methodologies will be consistent with those established in the GMSMON-7 Side Channel Fisheries monitoring program.
8. The study area identified in the ToR included the Peace River from Peace Canyon Dam to the confluence with the Pine River. The study sites will be the same: two trial side channels restoration sites and the two control side channels.
9. Implementation of this monitoring program is conditional on a spill event occurring where total discharge (Q_{out}) from Peace Canyon Dam exceeds 88,287 cfs (2,500 m^3/s) for two or more days. It will be implemented following each spill that meets this criterion during the 10-year study period.

1.5 Work Summary

NHC and Mainstream provided separate scopes of work to BC Hydro that were consolidated, and NHC provided an scope of work approved on July 10 2012.

Sediment samples were collected at various spatial locations at 12 side channels for pre-spill (June 25-26) and post-spill (August 1) conditions in 2012 (**Table 3-1**). Six of the twelve sampling locations are coincident with the side channels identified in GMSWORKS-3 Peace River Side Channel Restoration (NHC *et al.*, 2010). The sampling locations were chosen prior to the spill based on the assessment of having a higher chance of undergoing morphologic or sediment changes due to a spill event.

Side Channels 32L and 102.5R were identified for air photo analysis to determine geomorphic change, as well as to monitor pre- and post-spill fish use and habitats. Baseline morphologic maps were prepared for both sites using available orthophotography taken during minimum flows. Orthophotos produced from imagery collected during pre- and post-spill conditions in 2012 capture the channel at relatively high flows that obscure most details of side channel morphology, which limits the utility of these data for this study.

1.5.1 Involvement with other GMSMON Studies

As prescribed under the Peace Spill Protocol (PSP) (BC Hydro 2003), the magnitude and duration of a spill event defines the monitors and programs triggered to assess its potential effects. The PSP has both Conditional (**Table 1-1**) and Required (Table 1-2) Monitoring criteria. Table 1 in NHC (2012) provides a summary of monitors implemented as a result of the magnitude and duration of the 2012 spill. The dates and timing of the spill meeting the 2,500 m^3/s trigger ($\geq$ 2 days duration) was from June 27 to July 9 in 2012, and peak hourly flows ranged between 2,605 and 3,289 m^3/s.

Table 1-1 PSP Conditional Monitoring Components.

Monitoring Program	PCN Q_{OUT}		GMS Q_{SDI}	Q_{SDI} PCN	
	> 2500 (2d)	> 2000 (2d)	> 205 (2d)	> 1500(2d) > 500(7d)	> 2000 (2d) > 500 (7d)
GMSMON-3		X			
GMSMON-4			X		
GMSMON-6	X				
GMSMON-8	X				
GMSMON-9	X	X	X		X
GMSMON-10		X			
GMSMON-11		X	X	X	
GMSMON-12		X			
GMSMON-13				Note [A]	

[A] GMSMON-13 was originally a conditional PSP monitoring program (BC Hydro 2007) with the initiation criteria above, but was modified to be a one-time study. Total project discharge (Q_{OUT}) and spill discharge (Q_{SDI}) are listed in m^3/s with the minimum required duration in days

Table 1-2 PSP Required Monitoring Components.

Required Monitoring Programs
GMSWORKS-1 [A]
GMSWORKS-2
GMSWORKS-4
GMSWORKS-6
GMSWORKS-7
GMSMON-7

[A] GMSWORKS-1 was not included in the needs assessment as the program identifies and maps areas of flood plain and side channel inundation at PCN Q_{OUT} < 2,000 m^3/s. GMSMON-10 addresses aerial photo documentation for spill discharge (**Table 1.1**).

2 Pre-Spill Information

2.1 PCR Spill Operations and Hydrology

Within the BC Hydro system there are three classes of spills: system spills, project spills and selective spills. System spills are required when projected inflows exceed the capacity of the entire BC Hydro system because the system may be operating at reduced capacity, due to maintenance or demand. Spilling in such case is necessary, but the spills can be transferred between projects, and the transfer almost always targets the project where the cost of the spill, in economic, environmental and infrastructure terms, is minimized.

Project spills, on the other hand, are project-specific and cannot be transferred. They arise when inflows to the project exceed the ability of the project to store and/or discharge the inflow through normal operations. Project spills may also arise in order to test spillway or emergency discharge infrastructure. Some projects within the system spill on an annual basis, due largely to an inability to store inflows related to substantial precipitation or freshet.

Selective spills are project spills that are undertaken for non-hydraulic or hydrologic reasons, typically due to negative pricing of energy. In these cases, the large supply of energy on the open market reduces power values to near zero which, combined with green credit pricing of generated power, results in a cost to generate. To avoid the monetary losses, power flows are spilled instead of generated through the project.

Williston Reservoir has a very large storage capacity, which substantially reduces the likelihood of project spills on the Peace Project. Spill events on the Peace Project (exceeding the available generation capacity) are uncommon, with only eight spills occurring since the completion of the W.A.C. Bennett Dam (1967). Based on historical operations (1967-2003), the average annual spill risk for the Peace Project is estimated to be 15% ± 5%, or a 65-89% chance of occurring within 10 years.

BC Hydro can model the magnitude and duration of spill event using hydrological and hydraulic modelling. For future events, it will be critical to monitor the effects of spill events meeting the Peace Spill Protocol criteria (2,500 m^3/s for $\geq$ 2 days in duration) and assess differences in timing, magnitude, and duration of spill event along the Peace River. These criteria may be used in a more detailed assessment protocol, or to determine the scale and extent of future studies and monitors.

2.2 Morphological Data

The pre-spill morphology of side channels can be examined from a variety of data sources, including available aerial photographs / orthophotos, LiDAR and topographic surveys. Sediment texture is also an important indicator of morphologic character and habitat quality, but can only be obtained from *in-situ* measurements, such as substrate photographs, surface pebble counts, or by directly sampling and sieving surface or subsurface sediments.

As part of the Peace River Water Use Project, BC Hydro collects 1:5000 scale aerial photographs of the channel between Peace Canyon Dam and Pine river confluence when controlled water releases or 'spills' exceed 2,000 m^3/s for two consecutive days. On July 9 2012, one set of aerial photographs was collected prior to the spill, but flows were 2,500 m^3/s. At these flows, most side channels were completely inundated and pre-spill morphology could not be adequately assessed.

In addition, there are several sets of pre-spill orthophotos taken at low discharge that can be used to assess pre-spill side channel morphology. Low flow imagery is ideal for this analysis as it reveals details on the extent of bars, vegetation cover, permanently wetted channels and pools, and wetted channel connectivity - these are the morphologic characteristics most likely to respond (change) following a spill. The earliest available low flow orthophotos were collected June 12 to 13, 2007, extending from WAC Bennett Dam downstream to more than 7 km past Moberly River (roughly 10 km upstream of Side Channel 102.5R).

Flows on these dates ranged from 451 m^3/s at Hudson's Hope to 2,160 m^3/s at Taylor. Although these photos were collected 5 years before the 2012 spill, they represent an analogue of contemporary baseline conditions. These orthophotos were used to map baseline (pre-spill) morphology at Side Channel 32L.

Since the 2007 imagery did not extend to Side Channel 102.5R, baseline mapping for this location was completed using September 12 to 13, 2009 imagery that was obtained[1] subsequent to completion of mapping at Side Channel 32L. Average flows on this date were 304 m^3/s immediately below PCN, increasing to 400 m^3/s at the Taylor gauge. The only other available set of low water photography was collected in September 2010 with flow conditions nearly identical to those in 2009. The 2007 mapping was compared to the 2009 orthophotos at Side Channel 32L and no differences could be observed, so the baseline mapping was not updated. The 2010 orthophotography was not acquired or reviewed as part of this monitor.

LiDAR data was also collected in 2007, roughly covering the same spatial extent as the 2007 orthophotography (but including more floodplain and upland areas). Additional side channel baseline maps could be produced using existing low water orthophotos which could then be compared to the next available orthophoto mosaic collected during low water to illustrate the morphologic effects of the 2012 (or future) spills.

The LiDAR data and orthophotography are used to map side channel baseline topography, and post-spill orthophotography and LiDAR surveys are used to map and analyze potential morphological changes. This methods is best suited for identifying changes in riparian vegetation, channel planform and characteristics over a large spatial extent (i.e., channel width, bed forms and sinuosity).

Typically LiDAR and topographic surveys would be likely required to quantify potential morphological effects related to scour and erosion within the channel (i.e., change in channel slope and profile, depth of changes in channel sections, etc.). Elevation changes would reveal whether the spill caused previously deposited sediments to erode, whether there was subsequent deposition during receding flows, and confirm lateral channel shifting.

Orthophotos, LiDAR and topographic surveys are require to quantify physical changes in side channels along the Peace River. These data are likely required to develop a sufficiently detailed digital elevation model (DEM) to measure both lateral (x and y-axis) and elevation changes (z-axis) over large spatial area, and interpret the morphological changes.

[1] The 2009 orthophotos were originally collected for the Peace River Hydraulic Habitat Program (GSMWORKS-4), and were provided to NHC by Mainstream Aquatics. NHC also provided 2012 pre- and post-spill orthophotos to Mainstream as part of this monitor.

Spill flows can also potential modify the characteristics of the sediments within the side channels, as well as the physical characteristics and morphology. Pre-spill sediment textures within the side channels was recorded by taking scaled photographs of the substrate within the open channel area of side channels. The data were collected at locations expected to experience change due to a spill event (see Section 4). Several photos were taken at an individual site, and the grain size of surface sediments were measured and pooled to determine a complete grain size distribution (GSD).

The GSD is a qualitative measure of surface sediment texture but is limited to classifying larger sized sediments (e.g., b-axis diameter > 2 mm). Silt and sand can be identified in the photographs, but the size of individual particles cannot be determined, but coverage can be estimated. Assessing the changes in GSD and fine sediment coverage in conjunction with the physical surveying can determine whether erosion or deposition has occurred. The size of materials on the channel bed provides an indication of water velocities during a spill, that in turn can be used to assess flows which modify the GSD.

2.3 Fish Communities and Habitat Studies

Pre-spill fish and habitat data was extracted from databases generated during Site C Peace River baseline fish inventories conducted in 2009, 2010, and 2011 (Mainstream 2010, 2011, and 2012). The studies used several fish capture methods in a variety of fish habitats during three seasons (Table 1; Appendix A). The intent of the pre-spill inventories was to describe the Peace River fish community. The number of samples collected and the methods used within each of the two target side channels (i.e., 32L and 102.5R) was dependent on flow-related conditions at the time of sampling (**Table 2-1**).

Table 2-1 Number of sites by method and sample year in Side Channels 32L and 102.5R.

Side Channel	Year	Method and Number of Sites					
		Gill Net	Minnow Trap	Boat Electrofisher	Backpack Electrofisher	Beach Seine	Total
32L	2009	3	1	2	3	3	12
	2010	0	0	0	2	7	9
	2011	0	0	0	0	9	9
	Sub-Total	*3*	*1*	*2*	*5*	*19*	*30*
102.5R	2009	0	6	1	0	6	15
	2010	0	0	1	0	5	6
	2011	0	0	3	0	0	3
	Sub-Total	*0*	*6*	*7*	*0*	*11*	*24*
Total		**3**	**7**	**9**	**5**	**30**	**54**

Fish related parameters measured during pre-spill inventories were as follows:

- Species presence/absence.
- Life stage presence/absence.
- Fish size structure.
- Fish catch rate..

In addition to fish data collections, general environmental conditions and habitat characteristics were measured at each site. Parameters measured by pre-spill inventories were as follows (see Appendix B for definitions):

- Water temperature (^{o}C).
- Substrate type (%).
- Water conductivity (µS/cm).
- Available fish cover (%).
- Water depth (m) and velocity (m/s).
- D_{90} (cm).
- Instream habitat type.
- Substrate embeddedness (low, moderate, high).
- Bank habitat type.
- Substrate compaction (low, moderate, high).

Mainstream *et al.* (2012) quantified fish habitats based on visual interpretation of orthophotos collected at several steady state discharges. The study area was a 105 km long section of the Peace River between the Peace Canyon Dam and the Highway 97 Taylor Bridge, and encompassed main channel, side channel, and tributary confluence areas. Side channels 32L and 102.5R studied under both GMSWORKS-3 and GMSMON-8 are included within this study area.

The habitat classification system was based on the physical characteristics of the active channel bed and adjacent riverbanks. The habitat classification system utilized three levels of characterization – channel type, bank type, and physical characteristics. Parameters used by the third level of classification (physical characteristics) are potentially sensitive to effects of elevated river discharge. These parameters are as follows:

- Bed material type.
- Nearshore slope.
- Bank irregularities.
- Physical cover.

3 Field Studies and Data Collection

3.1 Sediment Surveys and Data

3.1.1 Survey Sites

In order to quantify changes to the sediment texture of the bed material of the Peace River side channels, a selective sampling methodology using photogrammetric techniques was conducted to characterize the sediments. Site selection began by examining airphotos of the Peace River in ArcGIS, including all side channel areas identified under GMSWORKS-3. A sub-set of twelve of the side channels were selected for sampling with an emphasis on areas that were likely to be significantly inundated by the anticipated spill level.

Within each side channel, two to four locations for sediment sampling were selected depending on the morphology and type of the side channel (**Table 3.1**). At a minimum, the inlet and outlet of the side channel were sampled, and mid-channel locations were sampled where there were more complex morphologies.

UTM coordinates for each of these locations were loaded into a handheld GPS to allow for proper locating in the field. Site photos looking upstream, downstream and towards both banks were also taken at each location.

Table 3-1 Grain size sampling locations and site conditions pre and post spill.

Site	UTM Coordinates (Easting, Northing)	Pre-Spill Visit	Post Spill Visit
8.1R-A	10 V 568661 6209840	Sediment Visible	Partially Submerged
8.1R-B	10 V 570323 6211456	Sediment Visible	Partially Submerged
8.1R-C	10 V 571213 6212476	Sediment Visible	Partially Submerged
8.1R-D	10 V 571673 6212796	Sediment Visible	Sediment Visible
32.0L-A	10 V 586089 6223211	Sediment Visible	Sediment Visible
32.0L-B	10 V 587252 6224472	Sediment Visible	Sediment Visible
32.0L-C	10 V 587257 6224671	Sediment Visible	Sediment Visible
32.0L-D	10 V 587681 6225134	Fines	Fines
40.5L-A	10 V 592692 6228408	Fines	Sediment Visible
40.5L-B	10 V 593991 6228949	Sediment Visible	Sediment Visible
40.5L-C	10 V 594120 6228981	Sediment Visible	Sediment Visible
40.5L-D	10 V 594561 6229811	Sediment Visible	Partially Submerged
49.9L-A	10 V 599823 6233406	Sediment Visible	Sediment Visible
49.9L-B	10 V 600316 6233711	Sediment Visible	Sediment Visible
49.9L-C	10 V 602007 6233928	Sediment Visible	Sediment Visible
49.9L-D	10 V 603045 6233777	Fines	Sediment Visible

Site	UTM Coordinates (Easting, Northing)	Pre-Spill Visit	Post Spill Visit
58.8R-A	10 V 608196 6235246	Sediment Visible	Sediment Visible
58.8R-B	10 V 608238 6235582	Sediment Visible	Sediment Visible
65.0L-A	10 V 612992 6236461	Sediment Visible	Sediment Visible
65.0L-B	10 V 613428 6235796	Sediment Visible	Sediment Visible
65.0L-C	10 V 614273 6235196	Fines	Sediment Visible
65.0L-D	10 V 614564 6235310	Fines	Fines
69.1L-A	10 V 616057 6233637	Sediment Visible	Sediment Visible
69.1L-B	10 V 617283 6232954	Fines	Fines
73.0L-A	10 V 619758 6232246	Submerged	Submerged
73.0L-B	10 V 620193 6232048	Submerged	Submerged
73.0L-C	10 V 620432 6231992	Sediment Visible	Submerged
73.0L-D	10 V 620836 6231972	Submerged	Submerged
83.3L-A	10 V 628601 6230867	Submerged	Submerged
83.3L-B	10 V 629376 6230108	Submerged	Submerged
83.3L-C	10 V 629893 6229622	Submerged	Submerged
83.3L-D	10 V 630473 6229562	Submerged	Submerged
88.7L-A	10 V 632663 6229755	Submerged	Submerged
88.7L-B	10 V 633887 6229975	Submerged	Submerged
88.7L-C	10 V 634535 6230556	Submerged	Submerged
98.2R-A	10 V 639753 6225961	Submerged	Submerged
98.2R-B	10 V 642200 6223928	Sediment Visible	Submerged
102.5R-A	10 V 642885 6224081	Sediment Visible	Submerged
102.5R-B	10 V 643009 6224132	Submerged	Submerged
102.5R-C	10 V 643507 6223992	Submerged	Submerged
102.5R-D	10 V 644413 6223509	Submerged	Submerged
Note: sediment refers to clasts larger than 2 mm.			

3.1.2 Field Visits

A field visit to the sites was conducted before the spill from June 25 to 26, 2012 and again after the spill on August 1, 2012. During the June visit, flows were moderately high, ranging from 1,400 to 2,000 m^3/s as measured at the *WSC 07FA004* above the Pine River, so overall bed exposure of the river channel was not ideal for detecting changes at lower elevations. Of the twelve selected sites, five were indudated such that there was no visible bed exposed.

Where possible, new locations were selected in the field, however, this was not possible at all sites. Side Channel 102.5R was under a considerable amount of water during the June trip. The only exposed sediment was on a bar near the mouth of the side channel in the main channel of the Peace River. A substrate photograph was taken at this location, however, it is expected to be considerabley coarser than the material in the side channel.

On the second trip on August 1, the same sites were revisited and another set of substrate photographs was taken. Discharge ranged from 1,000 to 2,000 m^3/s during the day as measured at *WSC 07FA004*. Again, photographing the bed was hindered by high water levels.

Field observations indicated that very little sediment textural change had occured during the spill. The one noticeable difference was that a blanket of silt, likely deposited during the 2012 spring freshet, had been washed away during the spill (Photo 1 to Photo 3) at the lower end of Side Channel 32L. This observation was confirmed by the GSD results which showed a coarsening trend at many of the sites.

PHOTO 1 LOOKING UPSTREAM AT SIDE CHANNEL 32.0L-B PRE-SPILL.

PHOTO 2 LOOKING UPSTREAM AT SIDE CHANNEL 32.0L-B POST-SPILL

PHOTO 3 CLOSE-UP PHOTOGRAPHS FROM SIDE CHANNEL 32.0L-B. TOP: PRE-SPILL. BOTTOM: POST-SPILL.

3.2 LiDAR and Photogrammetric Data

Available LiDAR data (collected in 2007) was not used in the assessment of morphologic changes because there is no post-spill LiDAR for which to base a comparison. Alternatively, terrestrial topographic surveys could be used to compare to the LiDAR elevations but it is also not known if post-spill topographic surveying was completed.

Given the known accuracy of LiDAR, vertical changes greater than ± 15-20 cm would be required in order to interpret any change as real. Minor changes, such as deposition or removal of silt lenses, could not be assessed using LiDAR comparisons. However, a comparison of pre- and post-spill LiDAR would help confirm the results of the morphologic mapping exercise. In addition, the LiDAR comparison could easily be completed for all side channels downstream of Peace Canyon Dam and would show if all side channels behave the same, or some are more sensitive / susceptible to change. Future monitoring could then be revised to complete morphologic change mapping and sediment texture analysis at the most sensitive sites.

The pre- and post-spill 2012 orthophotography provided by BC Hydro was collected when flows were high (2500 m^3/s below Peace Canyon) at full discharge under the current regulated flow regime. Baseline (pre-spill) morphology was alternatively mapped from orthophotos taken during low flow conditions in 2007 and 2009.

Morphologic features that can be mapped from orthophotos are limited to features that can be interpreted in a 1-dimensional view, including open water, channel bars and channel islands. Bars and islands can be further subdivided into different age classes (young or mature). The interpretations are partly subjective which can make it difficult to definitively place a mapped feature into a given category, and the boundary between features is not always clear, especially for vegetation.

The procedures used in this study for mapping were designed to minimize these problems. The analyses are also conditional on similar flows for pre- and post-spill photography, or measured changes could be spurious. For example, if exposed bars on the pre-spill photos were partly inundated on the post-spill photos, it would appear that there has been erosion even if there has not actually been any change. Pre- and post-spill photos should also be collected during the same season if possible, as weathering from snow, ice and precipitation and vegetation regrowth may alter the actual geomorphic effects.

The morphologic mapping is limited to changes that can be observed in planform only. Aggradation or degradation of a bar surface, for example, cannot be determined by this approach. The types of changes that can be observed also limit this approach, which is related to the resolution of the imagery (typically 15 cm). Therefore, it is not possible to determine if there have been changes to substrate, and subtle changes such as stripping of emergent vegetation on part of a bar may not be observable.

3.3 Aquatic Surveys and Data

The post-spill study area included the two target side channels. The first, Side Channel 32L, is located approximately 10 km downstream of Farrell Creek (**Figure 3-1**). For the purposes of this study, Side Channel 32L includes two distinct areas due to differences in fish habitat type. Side Channel 32LA (Channel) is connected directly to and under the immediate influence of the Peace River. Side Channel 32LB (Pond) is connected to 32LA via a small channel and is not affected by the Peace River under normal flows.

The second, Side Channel 102.5R, is located 1 km upstream of the Taylor Bridge (**Figure 3-2**). For the purposes of this study, Side Channel 102.5R includes two distinct areas due to differences in fish habitat types. Side Channel 102.5RA (Channel) is connected directly to and under the immediate influence of the Peace River. Side Channel 102.5RB (Pond) is connected to 102.5RA via a small channel and is not strongly affected by the Peace River under normal flows.

Data summaries presented in this report focus on the riverine habitats: Side Channel 32LA and Side Channel 102.5RA, because these are fish habitats utilized by Peace River fish communities under normal flow regimes. For the purposes of this report, these locations are simply referenced as Side Channel 32L and 102.5R.

Figure 3-1 Side Channel 32L Overview.

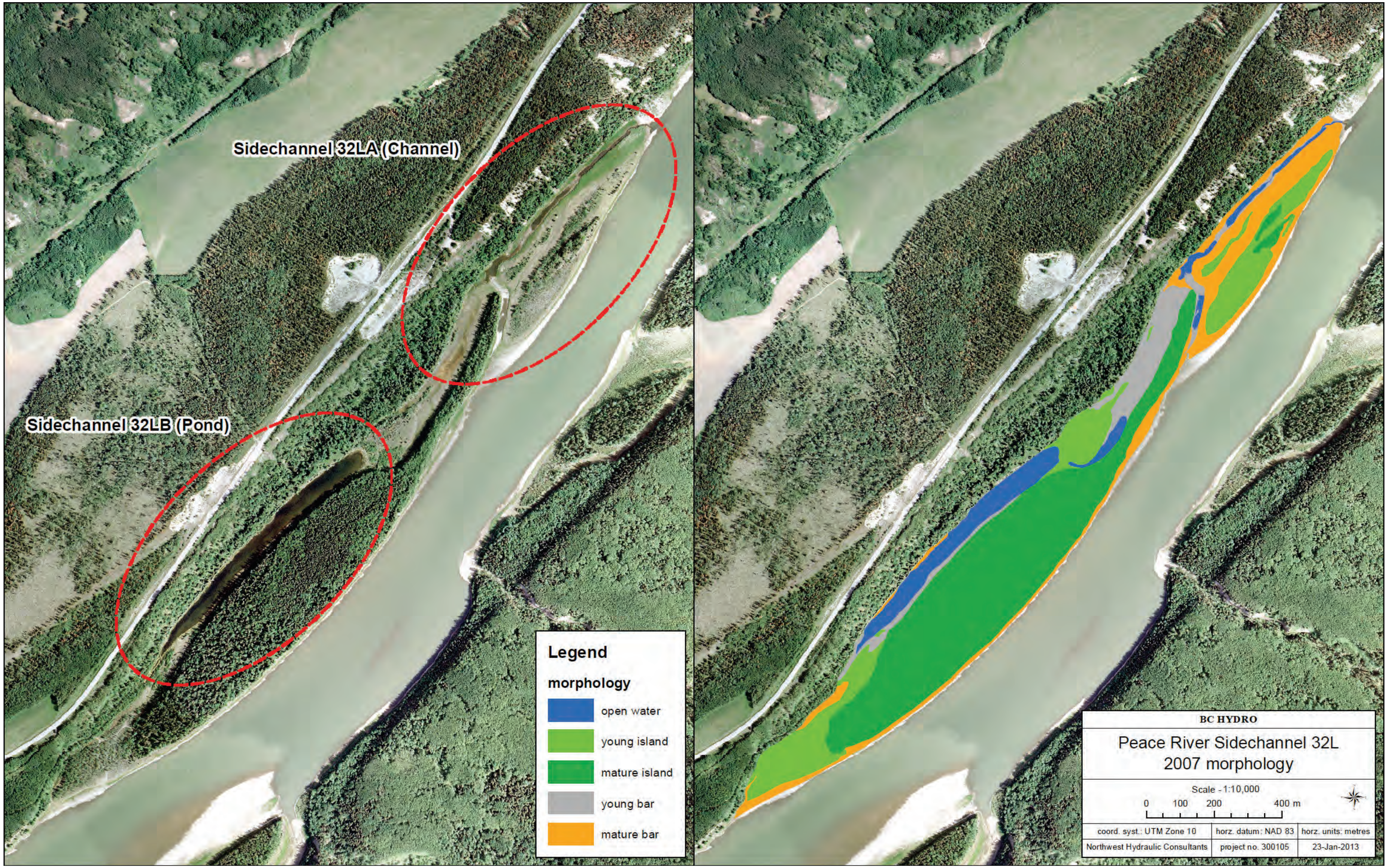
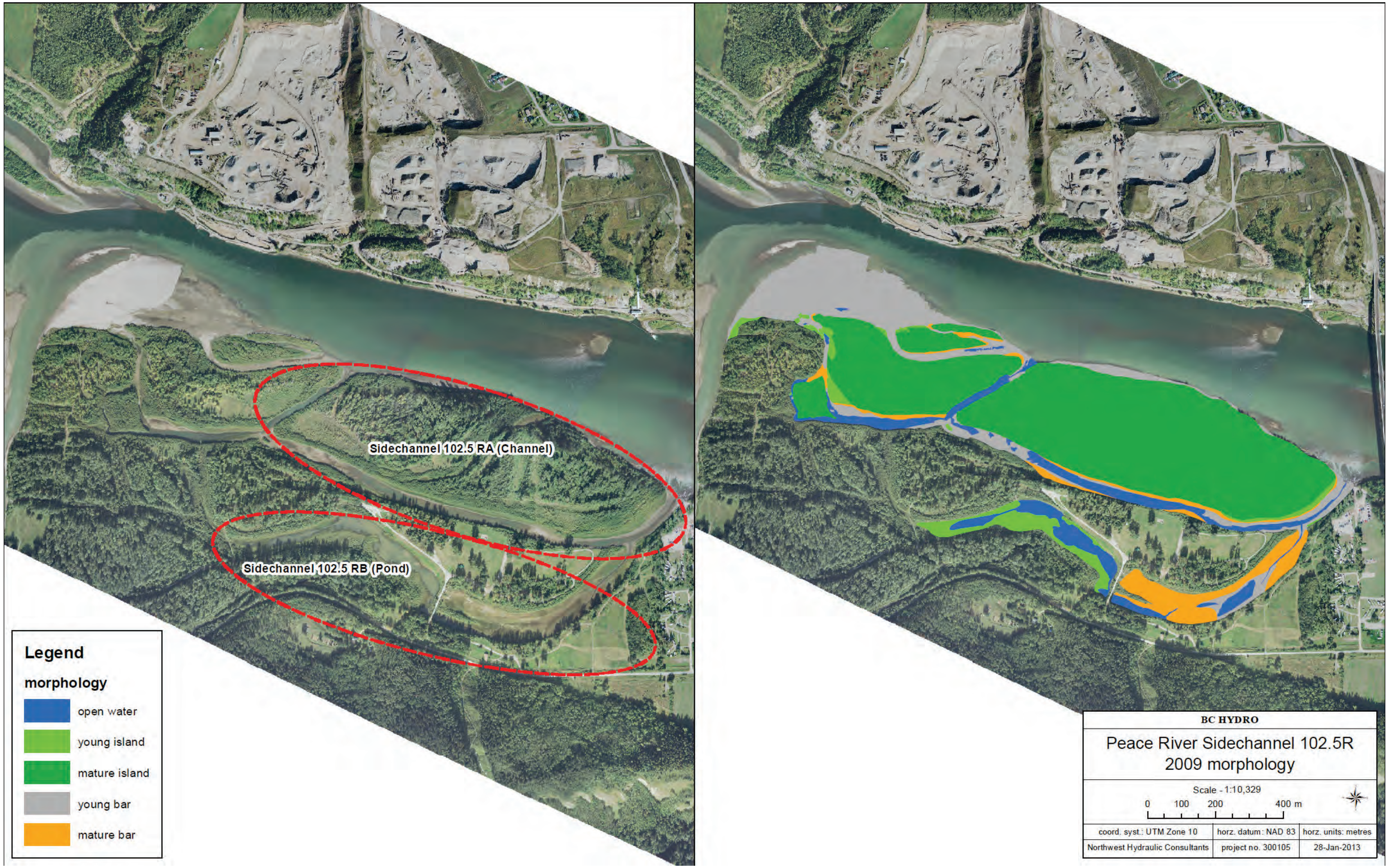


Figure 3-2 **Side Channel 102.5R Overview**.



Data from all locations sampled in 2012 (includes 32LA, 32LB, 102.5RA, and 102.5RB, are presented in report Appendices C, D, E, F, G, and H. Sampling occurred post-spill in 2012. Side Channel 32L was sampled between August 19 and 21. Side Channel 102.5R was sampled between August 24 and 25).

To facilitate comparisons to pre-spill information, site locations and methods used by the present study were based on protocols of previous investigations (i.e., sample methods and site locations). However, the specific location of sites and methods used were largely dependent on water levels at the time of sampling.

Fish collection methods followed standard protocols (Bonar *et al.* 2009, RISC 2001). A variety of fish collection methods were used in an attempt sample all fish habitats, species and life stages present in the side channels. The physical characteristics of fish habitats were measured using protocols described by RISC (2001).

3.3.1 Fish Collection and Processing

The intent of the biological sampling was to collect information to describe the fish community species composition and relative abundance. Three fish collection methods were used, including boat electrofisher, backpack electrofisher, and beach seine. Sampling occurred during daytime hours, and both juvenile and adult fish were targeted. The method used was dependent on the physical characteristics of the area to be sampled and the life stage targeted. Boat electrofishing was used to sample un-wadeable areas, and was effective for collection of large-sized fish (>150 mm fork length). Parameters measured at each site included date and time, geodetic location, method settings, and effort (i.e., seconds, length [m], and/or width [m^2]).

Beach seine was used to sample wadeable areas containing fine substrates and still or low velocity water. Backpack electrofishing was used to sample wadeable areas containing rock substrates and flowing water. Beach seine and backpack electrofisher methods targeted smaller-sized fish (≤ 150 mm fork length).

Boat Electrofisher

The boat electrofisher consisted of a double-bowed, inflatable drift boat equipped with a Smith-Root Type VI electrofisher system, two fixed boom anodes on the bow and a cathode wire array on the stern. Electrofisher settings were maintained at an amperage output of 3.0 to 4.0 A pulsed DC current and a frequency of 60 or 120 Hz. Voltage frequency was adjusted based on conductivity and sampling effectiveness. The sampling procedure involved an operator positioning the boat perpendicular to the channel margin while drifting downstream, using a continuous current of electricity.

The boat electrofisher position alternated between banks in order to sample shallow water habitats frequented by small fish and to avoid navigation hazards. A single netter positioned at the bow of the boat captured the temporarily immobilized fish and placed them in a 30 L live well. The netter was equipped with a net with a mesh size of 0.5 cm. The netter was instructed not to bias their catch towards a particular species in order to provide a representative sample of the fish community. The sampled length of each site consisted of a single pass of approximately 500 m.

Backpack Electrofisher

A Smith-Root LR24 high output backpack electrofisher was used when conditions were suitable. Settings were maintained at an output of 250 – 300 VDC, 4.3 ms, and a frequency of 60 Hz. The backpack electrofisher operator waded upstream along the channel margin and sampled suspected fish holding areas. The netter, who was positioned in close proximity to the electrofisher operator, collected immobilized fish and placed them in a holding bucket. A single pass was used at each site and the sampled length or river bank was approximately 100 m.

Beach Seine

A beach seine was used in low velocity wadeable areas not effectively sampled with a backpack electrofisher. The beach seine was 4.5 m wide and 1.5 m high with a stretched mesh size of 5.0 mm (the depth of the capture bag was 1.4 m). A two-person crew sampled parallel to the channel margin for a predetermined distance (usually 25 m) before turning into shore. Depending on the habitat area available, one to three discrete hauls were conducted with the distance of each haul being at least 25 m, where possible. Captured fish were placed in a holding bucket for processing.

The number of fish collection sites by method is summarized in **Table 3-2** (site details provided in Appendix A).

Table 3-2 Number of fish collection sites by method in Side Channels 32L and 102.5R.

Side Channel	Method and Number of Sites			
	Backpack Electrofisher	Beach Seine	Boat Electrofisher	Total
32LA	2	3	4	9
32LB	1	0	2	3
102.5RA	0	3	3	6
102.5RB	0	4	2	6
Total	**3**	**10**	**11**	**24**

Processing

All captured fish were held in a holding tank/bucket prior to processing. Data recorded for fish included species (**Table 3-3**) and fork length (to the nearest 1 mm). Total lengths were measured for sculpin species. When the catch at a site exceeded 20 individuals per species a subsample was measured. The first 20 individuals of each species were measured, while the remaining fish were identified and enumerated before release. Very small suckers and sculpins that could not be identified to species were categorized as 'SUCK' and 'SCUL', respectively.

Table 3-3 Nomenclature and abbreviations used for fish species recorded in Side Channels 32L and 102.5R.

Group	Common Name	Scientific Name	Species Label
Sportfish	Bull Trout	*Salvenlinus confluentus*	BT
	Goldeye	*Hiodon alosoides*	GE
	Kokanee	*Oncorhynchus nerka*	KO
	Mountain Whitefish	*Prosopium williamsoni*	MW
	Northern Pike	*Esox lucius*	NP
	Walleye	*Stizostedion vitreum*	WP
	Yellow Perch	*Perca flavescens*	YP
Sucker	Sucker species	*Catostomus spp.*	SUCK
	Largescale Sucker	*Catostomus macrocheilus*	CSU
	Longnose Sucker	*Catostomus catostomus*	LSU
	White Sucker	*Catostomus commersoni*	WSU
Minnow/ Trout Perch	Flathead Chub	*Platygobio gracilis*	FHC
	Lake Chub	*Couesius plumbeus*	LKC
	Longnose Dace	*Rhinichthys cataractae*	LNC
	Northern Pikeminnow	*Ptychocheilus oregonensis*	NSC
	Redside Shiner	*Richardsonius balteatus*	RSC
	Spottail Shiner	*Notropis hudsonius*	STC
	Trout-perch	*Percopis omiscomaycus*	TP
Sculpin	Sculpin species	*Cottus spp.*	SCUL
	Prickly Sculpin	*Cottus asper*	CAS
	Slimy Sculpin	*Cottus cognatus*	CCG

3.3.2 Fish Habitat

Fish Sample Sites

Habitat types at each fish sampling site were classified according to O'Neil and Hildebrand (1986), which conforms to classifications described in RISC (2001). The differences include the separation of grouped habitat complexes (i.e., riffle-pool, cascade-pool, and step-pool) into riffle or pool or cascade. Fish habitat assessment procedures followed those described in RISC (2001).

At each backpack electrofisher and beach seine site, physical characteristics of a discrete habitat were measured along a transect perpendicular to the length of the sampled habitat. Note that habitat specific parameters (e.g., water depth, water velocity, and D_{90}) were not recorded at boat electrofisher sites due to variable characteristics (i.e., multiple habitats were present within one fish sample site). Habitat parameters measured (definitions presented in Appendix B) at backpack electrofisher and beach seine sites were as follows:

- Date and time.
- Geodetic location.
- Water temperature (± 0.1°C).
- Water conductivity (± 2% full scale.
- Water clarity (cm).
- Water depth (cm) and velocity (m/s).
- Substrate compaction (low, moderate, high).
- Instream habitat type.
- Bank habitat type.
- Substrate type (%).
- Available fish cover (%).
- D_{90} (cm).
- Substrate embeddedness (low, moderate, high).

Habitat parameters measured (definitions presented in Appendix B) at boat electrofisher sites were as follows:

- Date and time.
- Upstream and downstream geodetic location.
- Dominant bank habitat type.
- Dominant instream habitat type.
- Dominant substrate type.

Water depth and water velocity were measured at ¼, ½, and ¾ the sampled width using a Swoffer Model 2100 velocity meter and staff rod. Percent substrate composition was visually estimated using a classification system based on the Modified Wentworth Scale (Cummins 1962). D_{90} represented the average size of substrate particle that was in the 90th percentile, and classified using procedures outlined in MOE (1995).

Embeddedness refers to the amount of fine particles (sand, silt, and clay) present within the substrate. Compaction evaluates the density or looseness of the substrate within the channel. Compaction and embeddedness were evaluated as low (1), moderate (2), or high (3). The percent cover was visually estimated for overhead cover, rock cover, large organic debris, submergent vegetation, emergent vegetation, and terrestrial vegetation. Finally, digital photographs were taken of representative habitat types in sampled sites.

Habitat Transects

In addition to habitat characteristics measured at each fish collection site, transects uniformly spaced at 100 m intervals were used to sample physical features of each side channel. Habitat parameters (definitions presented in Appendix B) measured at each transect included:

- Date and time.
- Geodetic location.
- Instream habitat type.
- Wetted width (m).
- Channel width (m).
- Presence of LOD .
- Substrate type (%).
- Available fish cover (%).
- D_{90} (cm).
- Substrate embeddedness (low, moderate, high).
- Bank erosion (%).
- Substrate compaction (low, moderate, high).

Digital photographs were taken at each transect.

Mesohabitat Maps

Mesohabitats in each side channel were typed and mapped on field orthophotos for comparison to results generated by Mainstream *et al.* (2012). The habitat classification system used was identical to that used by Mainstream *et al.* (2012) and is presented in **Table 3-4**.

3.3.3 Data Processing and Analysis

Fish and habitat characteristics data collected in the field were recorded on standardized forms. Forms were checked daily for errors or omissions. Data were entered into standardized data entry spreadsheets using Microsoft Excel™. These data were visually compared to the field forms for errors and subjected to several summary analyses including graphical examination to identify errors and outliers.

The checked data were then imported into a single Microsoft Access™ data management file for data management and storage. Water temperature and discharge data were stored in Microsoft Excel™. Geodetic location information (UTM coordinates) was tabulated and plotted onto geo-referenced base maps using MapInfo Professional™.

The pre-spill baseline fish data were compared with data collected by the present study at each side channel. Depending on the particular study, the pre-spill baseline data included seasonal sampling (spring, summer, and fall), whereas sampling in 2012 occurred in summer (August). To avoid season-related biases, pre and post-spill comparisons were restricted to data collected during summer unless indicated otherwise.

The analyses included pre and post-spill comparisons of the following:

1. Fish community structure
    a. Species presence/absence
    b. Life stage presence/absence
2. Fish size structure (restricted to large fish species)
3. Fish catch rate.

Table 3-4 Peace River habitat classification system.

Level	Physical Characteristic	Code	Type
Channel		M	Main channel
		S	Side channel - open
		C	Side channel - closed
		T	Tributary confluence
Bank		A	Anthropogenic
		F	Fluvial or terrace bank
		M	Mass wasting deposit
		R	Bedrock wall
		V	Valley wall bank
Habitat	Bed Material	R	Bedrock
		B	Boulders
		C	Coarse (gravel and cobbles)
		F	Fine (>50% sand or finer)
	Near shore slope	L	Low
		M	Moderate
		H	Steep
	Bank Irregularities	I	Irregular bank
		R	Rough bank
		S	Smooth bank
	Cover	B	Backwater
		R	Rock
		W	Woody debris
		V	Non wood vegetation
Isolated Habitat Type		POND	Isolated

Fish life stage was examined for large fish species (sportfish, suckers, and Northern Pikeminnow). Life stage categories included young-of-the-year, juvenile, and adult. Life stage categories were assigned to each fish based on fork length at the time of capture using protocols and age-at-length data presented in Mainstream (2010, 2011 and 2012). **Table 3-5** summarizes the data used for life stage category designations.

Table 3-5 Life stage category designations of large-fish species based on fork length in summer, Side Channel 32L.

Group	Common Name	YOY			Juvenile			Adult		
		n	Median	Range	n	Median	Range	n	Median	Range
Sportfish	Bull Trout[a]				3	285	180 - 387	1	534	
	Goldeye							1	404	
	Kokanee				1	109				
	Mountain Whitefish	33	62	28 - 85				18	294	239 - 372
	Northern Pike	4	101	97 - 113	6	163	130 - 176			
	Walleye							13	439	342 - 502
	Yellow Perch							1	187	
Sucker	Largescale Sucker	2	42	39 - 44	10	50	41 - 146	1	480	
	Longnose Sucker	10	38	17 - 46	20	63	41 - 112	5	384	337 - 460
	White Sucker							13	439	342 - 502
Minnow	Northern Pikeminnow	2	31	23 - 39	2	74	58 - 90			

[a] Fish collected outside of summer period.

Catch rate, which is used synonymously with catch-per-unit-effort (CPUE), was calculated for each site by dividing the number of fish captured by sampling effort. Catch rate was expressed as follows:

- Boat electrofisher Number of fish/km.
- Backpack electrofisher Number of fish/100 m.
- Beach seine Number fish/100 m.

Habitat characteristics based on transect data were collected from side channels only by the post-spill study, and therefore, comparisons were not made to pre-spill conditions. Habitat characteristics of fish collection sites were measured during pre and post-spill studies, and as such comparisons were possible.

Analyses included pre and post-spill comparisons of the following:

- Substrate composition (fines, pebble/gravel, cobble, boulder).
- Cover (rock, LOD, submergent vegetation).
- $D_{90.}$
- Substrate compaction.
- Substrate embeddedness.

To simplify comparisons of substrate composition, small and large substrate particles were grouped as follows:

- Fines (organic matter, clay, silt, sand).

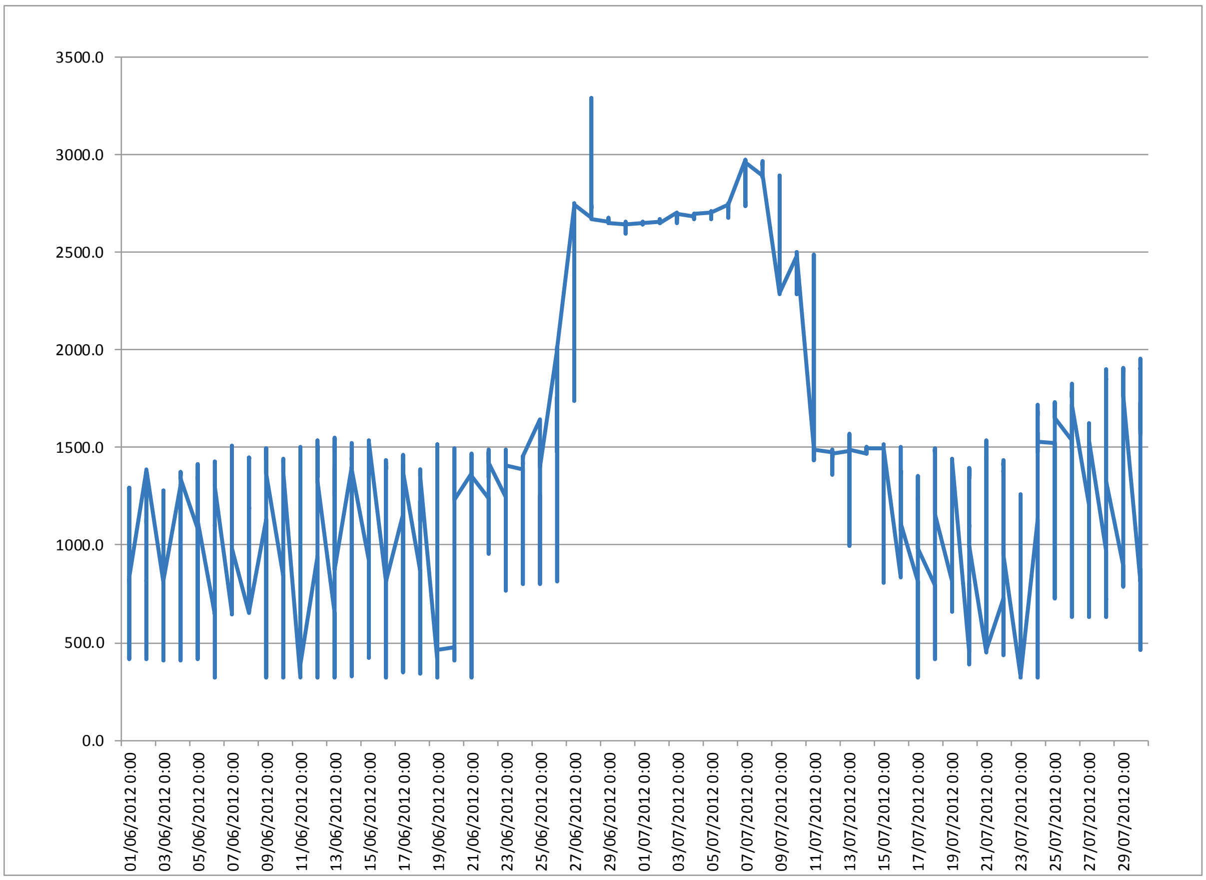
- Rock (gravel, pebble, cobble, boulder, bedrock).

Comparisons of other measured habitat characteristics (i.e., water depth, water velocity, emergent vegetation cover) were not undertaken because these metrics were affected by flow conditions at the time of sampling.

3.4 Hydrometric Data

GMSMON-8 is triggered by spill flows from PCN in excess of 2,500 m^3/s for a period greater than 2 days. The spill period was from June 27 0900 hrs to July 9 1700 hrs in 2012, where peak hourly flows ranged between 2,596 and 3,289 m^3/s (**Figure 3-3**). During the spill period, daily flow variation was minimized (except for a spike in flows on June 28) and maintained at a relatively constant 2,600 to 2,900 m^3/s as measured by release flows at PCN.

Figure 3-3 Hourly flows released from PCN.



3.5 Side Channel Sediment Textures

The cumulated grain size distrubtion results for each side channel are presented in **Figure 3-4** to **Figure 3-11**. At each site a series of photographs were taken of the bed sediment at random points along a transect transverse to the channel. Each of the photos were analysed using digital image processing techniques developed by SplitNet Engineering to determine the grain size distrubution (GSD) of the sediment in each photograph.

The analysis delineates each of the sediment grains and scales them based on set scale bar included in each picture. Grain size distrubutions for all photographs taken at a given site were combined to give an average for each location. Pre-spill curves are shown in solid lines while post-spill curves are dashed. Each curve is based on the summation of the results from several photos along the same transect at each site. In addition, Wolman stone counts were conducted at two sites (40.5L-B and 65.0L-A) to allow for comparsion with the digital imaging technique (**Figure 3-13** and **Figure 3-14**). This was undertaken to check for potential an errors in the study methodology.

Several of the sites that were covered in fines pre-spill (40.5L-A 49.9L-D, 65.0L-C), had measureable clasts post-spill, so only one curve is present for each of those sites. Side channels 83.3L and 88.7L had all sites submerged both before and after the spill. Side channels 73.0L, 98.2R and 102.5R only had one site with exposed sediment before the spill and no sites with exposed sediment after the spill. At sites 32.0L-D, 65.0L-D and 69.1L-B, only fine bed material was observed both pre and post spill, and they are not included in the results.

A common trend observed across most sites was towards a coarsening of the bed, seen as a shift of the curve towards the right from the pre to post spill grain size curves. When compared with the Wolman stone counts, the SplitNet analysis gives a good estimate of the D_{50} and coarser sediment. Wolman stone counts are known to yield coarser grain size distributions as they tend to under sample fine sediments (Wolman 1954). A bulk sample would likely produce a closer GSD to the SplitNet results.

To further examine trends between all of the sites, the D_{10}, D_{50}, and D_{90} were plotted on a chart with the pre-spill diameter on the abscissa axis and the post-spill diameter on the ordinate axis (**Figure 3-12**). On this plot, no change in size would plot along the 1:1 line. Points that fall above the line indicate an increase in size or coarsening and points that fall below the line indicate a decrease in size, or fining.

This plot confirms what is seen in the other GSD plots that most sites showed a relatively minor but consistent increase in grain size. Again, this is attributed to removal of fine sediment that was on top of the coarser bed material. In addition to shifting the low end of the GSD, fine material can partially obscure larger gravel and cobbles, skewing the results of the photogrammetric analysis. Furthermore, several of the sites had measureable sediment post-spill where only fines were observed pre-spill. This conclusion is substantiated by the lack of any geomorphic change observed between the pre and post-spill field visits.

Figure 3-4 GSD for site 8.1R.

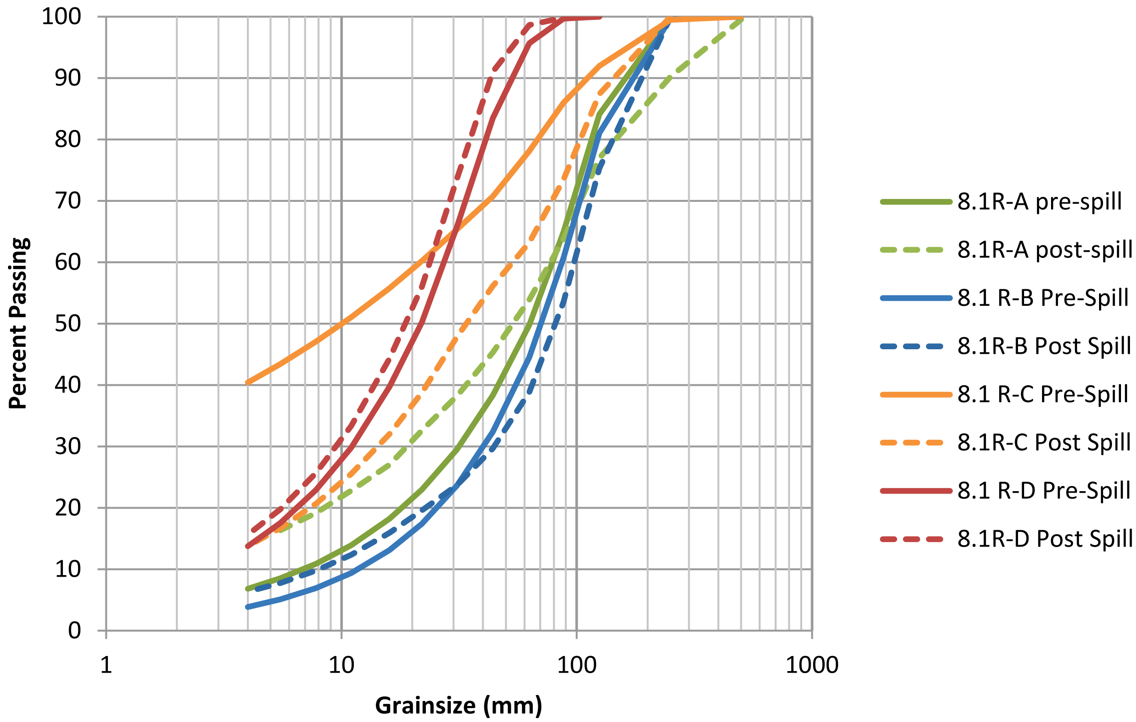


Figure 3-5 GSD for site 32.0L. Site 3.20L-D only consisted of fines both before and after the spill event.

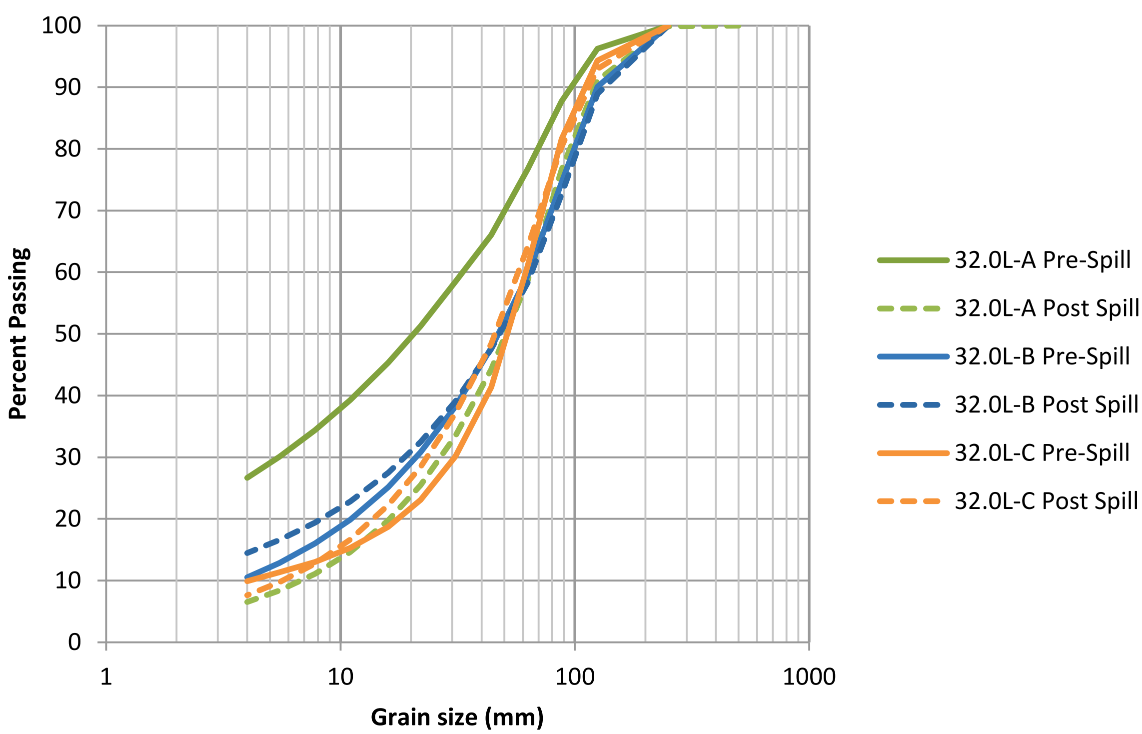


Figure 3-6. **GSD for site 40.5L. No post-spill analysis was done for 40.5L-D as it was submerged. Only fines were observed at site 40.5L-A pre-spill.**

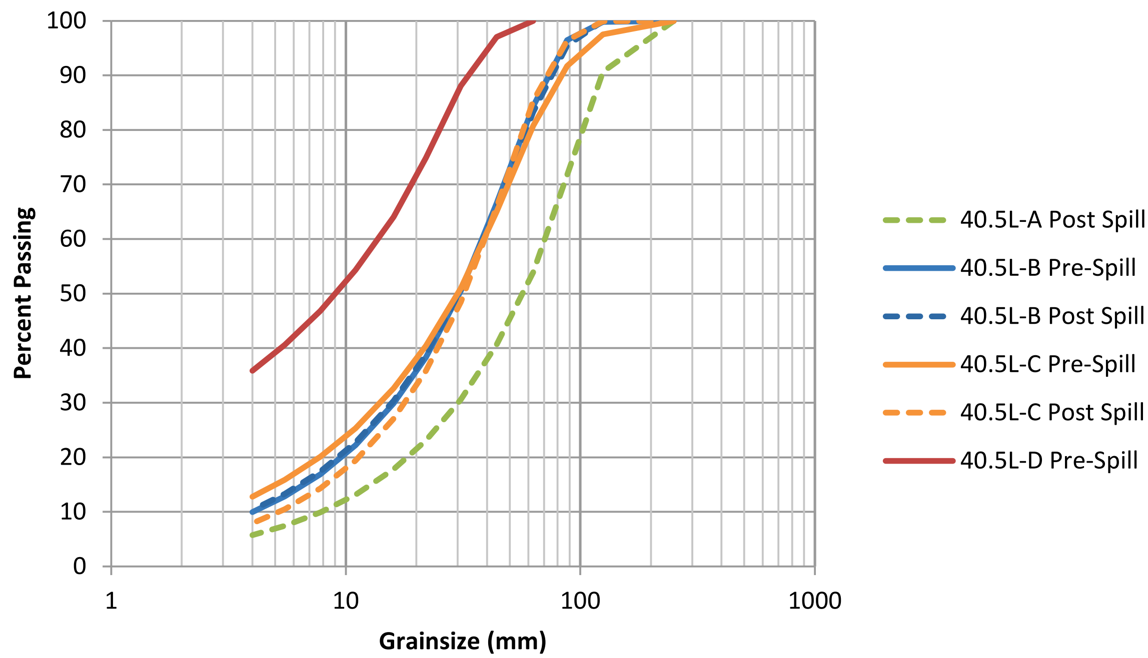


Figure 3-7 **GSD for site 49.9L. Only fines were observed at 49.9L-D pre-spill.**

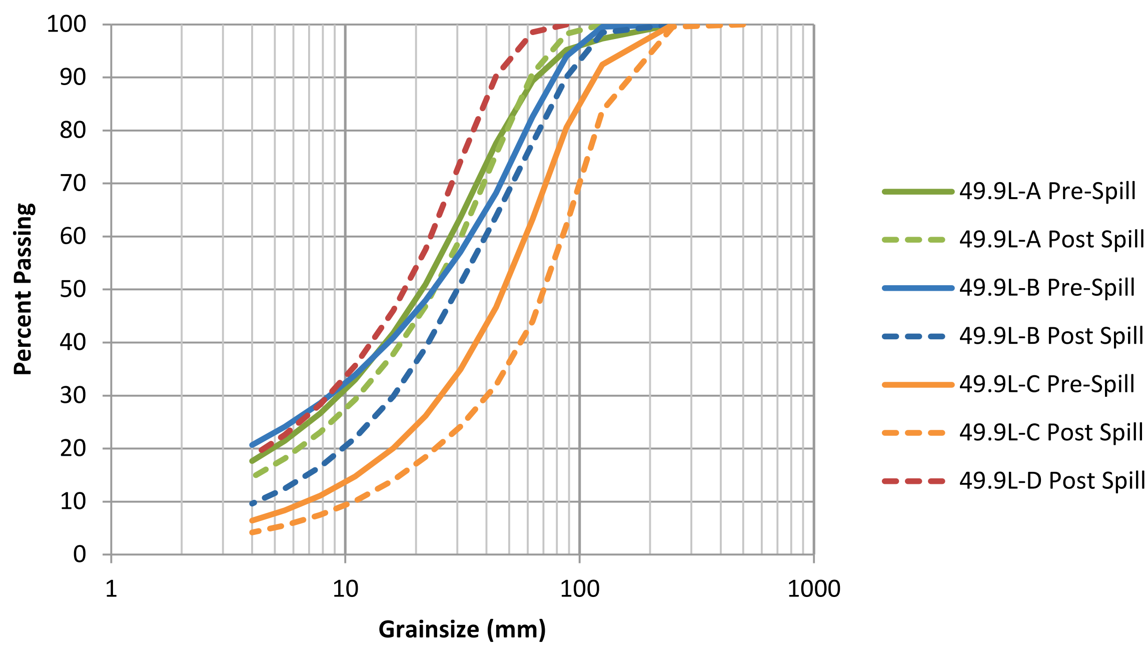


Figure 3-8 GSD for site 58.8R.

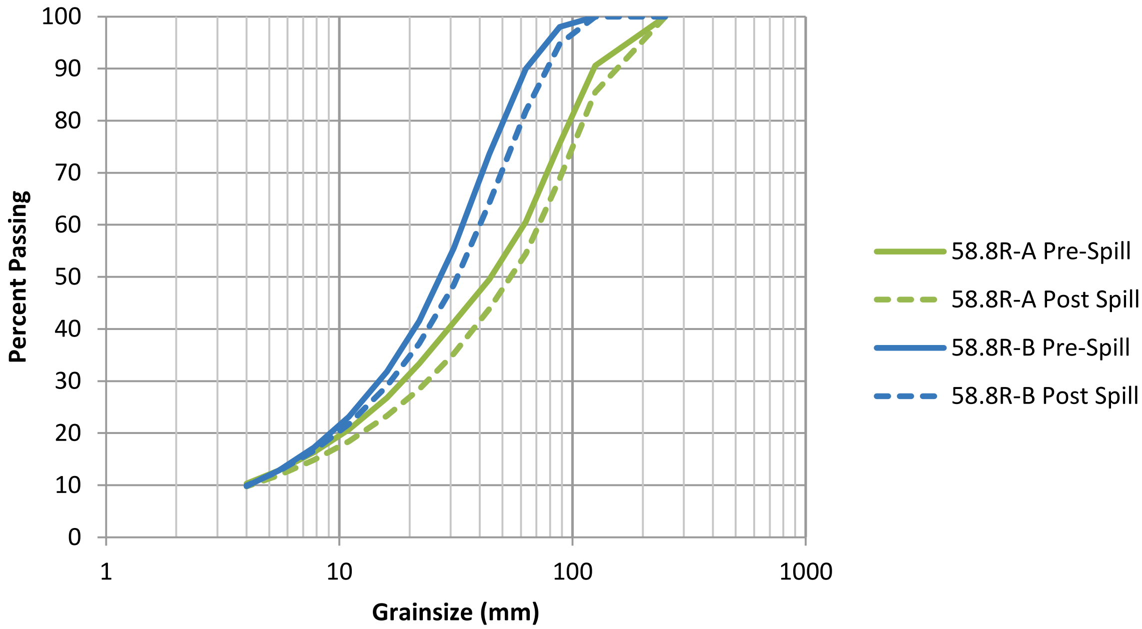


Figure 3-9. GSD data for 65.0L. Only fines were observed at 65.0L-C pre-spill. Only fines were observed at site 65.0L-D both before and after the spill.

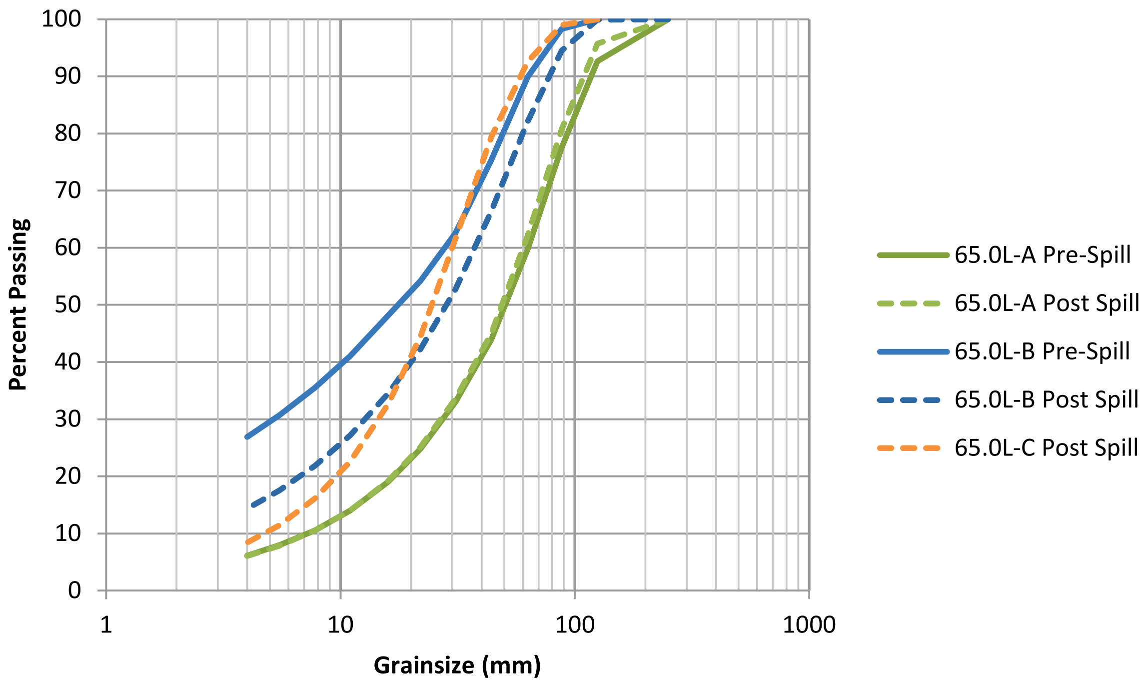


Figure 3-10 GSD for site 69.1L. Site 69.1L-B only consisted of fine material both before and after the spill.

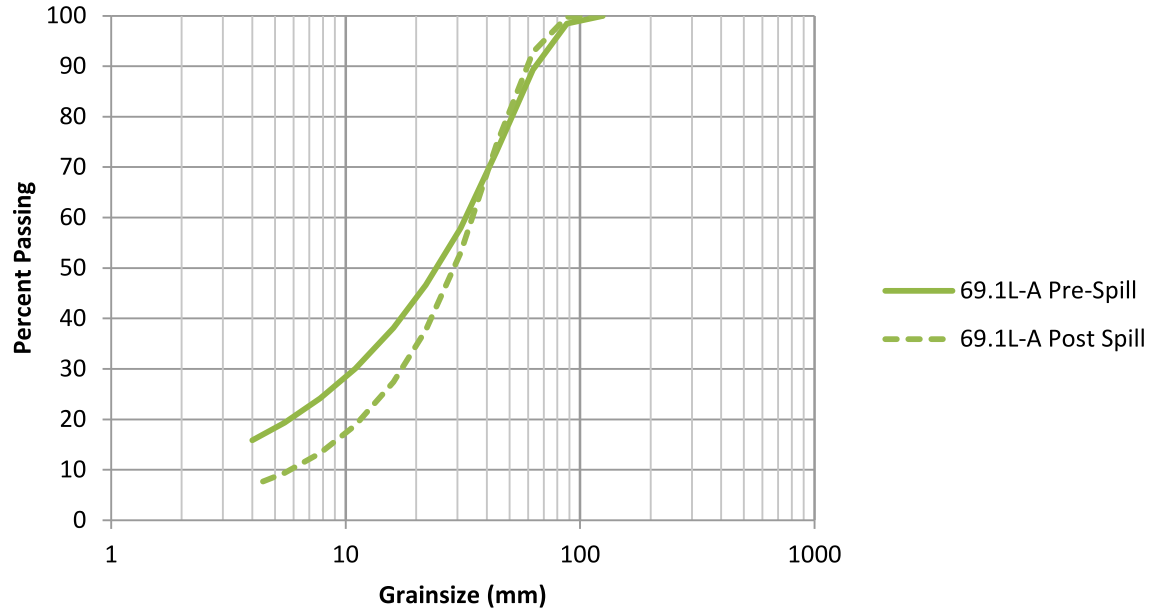


Figure 3-11 For sites 73.0L, 98.2R and 102.5R only one of the preselected areas had any exposed sediment during the pre-spill trip. All sites were submerged during the post-spill visit.

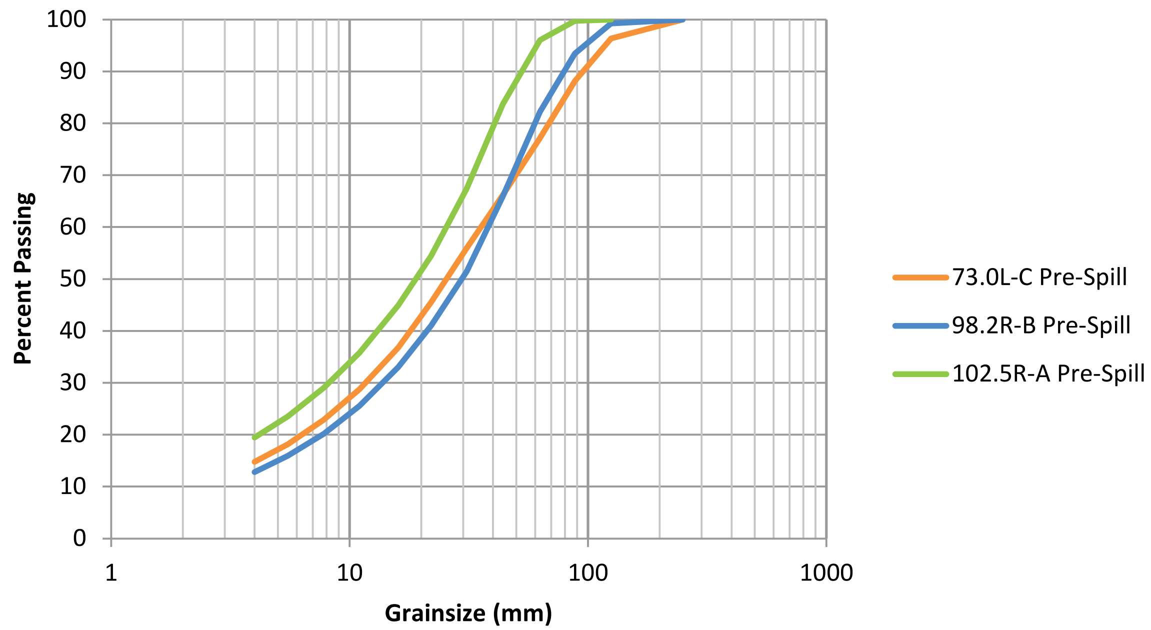


Figure 3-12 Comparison of the D_{10}, D_{50} and D_{90} between pre and post spill.

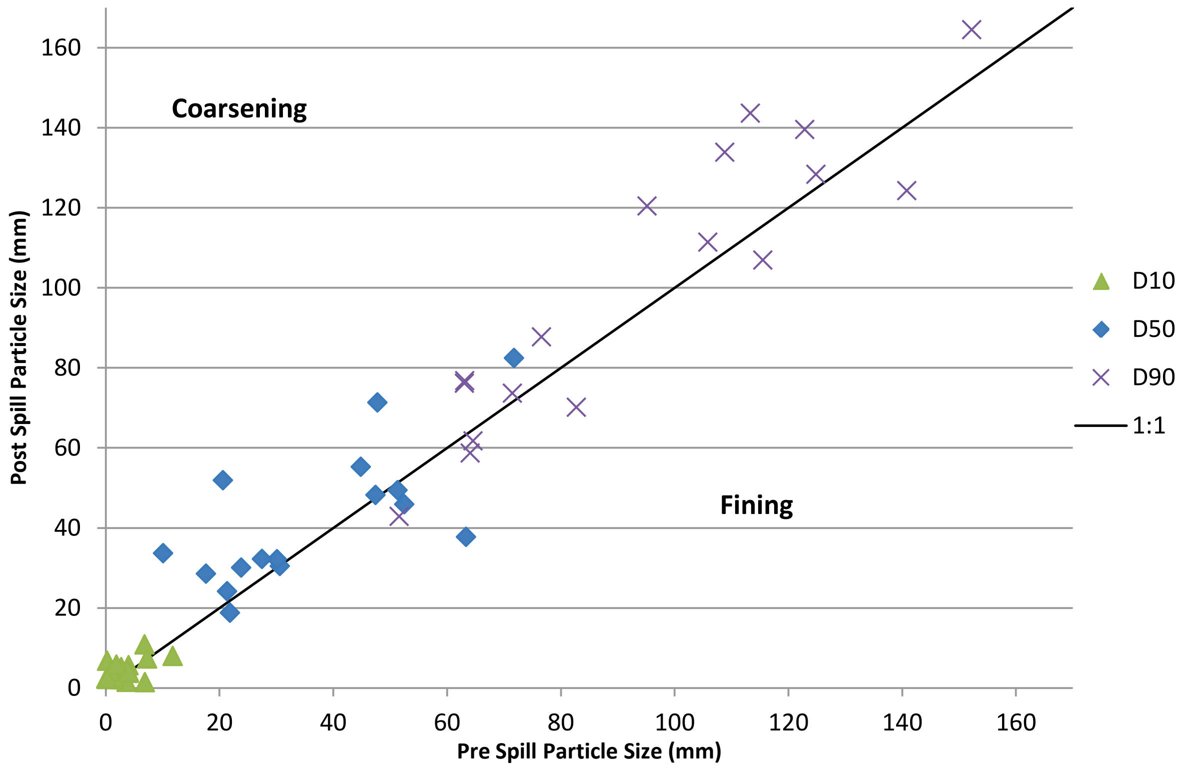


Figure 3-13 Comparison of the SplitNet digital image technique with the Wolman stone count for Site 40.5L-B

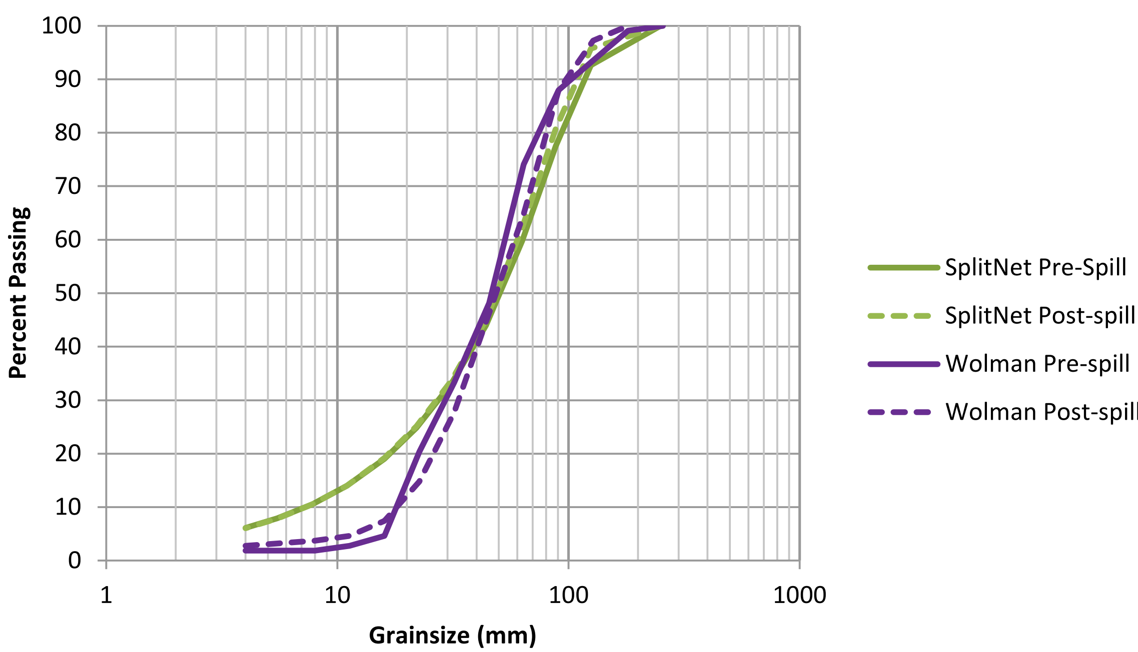
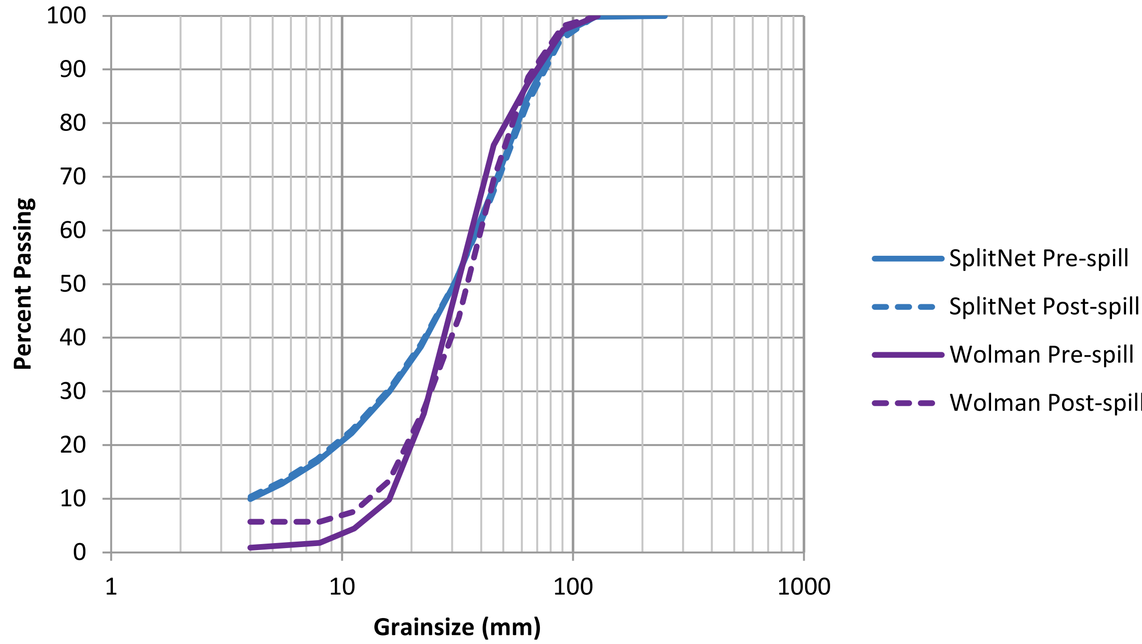


Figure 3-14 Comparison of the SplitNet digital image technique with the Wolman stone count for Site 65.0L-A.



3.6 Side Channel Morphology

3.6.1 Orthophoto Analysis

As part of this monitor, orthophotos are to be collected before and after a planned or expected spill event, and the channel response is to be interpreted from changes in mapped channel morphology. Based on the findings of this analysis, new or additional monitoring sites may be proposed and recommendations for changes or improvements to the program may be provided.

Two sites were selected for analyses: Side Channel 32L and 102.5R. Side Channel 32L has previously been classified as 'closed' meaning that the upstream inlet is not connected to the main channel except during flood flows (NHC *et al.* 2010). Side Channel 102.5R is located immediately downstream of the Pine River confluence and has also been classified as a closed channel because the upstream inlet is blocked. The combined effects of Peace River regulation, and Pine River flows and sedimentation complicate development of side channel over time at this site. In general, islands have been increasing in area and side channels have been narrowing through deposition of mainly fine sediments.

In 2012, pre-spill orthophotos were collected on June 9 (PCN mean daily flow of 1,193 m^3/s) and post-spill orthophotos were collected on June 19 (PCN mean daily flow of 1,107 m^3/s). On both dates, flows were considerably higher than the desired base low flow (283 m^3/s) for orthophoto acquisition and this limits the opportunity to fully assess any potential changes as the bar surface and emergent vegetation are inundated by water.

The pre-spill (June 9, 2012) and post-spill (June 19, 2012) orthophoto coverage extended to side channel 102.5R. Most of the side channel surface is inundated on both dates, and water further covers some lower elevation islands and floodplain, which complicates the interpretation of morphologic features.

All digitizing and geocoding was completed using ArcMap™ GIS tools. The orthophotos are geo-referenced to the UTM coordinate system and can be added directly to the GIS. Channel morphology was interpreted based on the following five (5) categories:

1. Open water - Includes both channels connected to the main river at a given discharge and isolated pools.
2. Bare bar - Surface may be comprised of fines, sand or gravel sediments (cannot be determined on imagery) and there is little or no emergent vegetation.
3. Bar with sparse vegetation - Emergent vegetation is visible (shrubs and grasses) but the distribution is generally patchy but may be continuous on lower elevation surfaces.
4. Young island - Vegetation cover is sufficiently dense to mask underlying bar deposits or is found on an elevated surface that can be distinguished from adjacent bars. Vegetation mainly includes shrubs and grasses with occasional small trees.
5. Old island - Vegetation cover is dense and includes mainly mature trees, including both conifer and deciduous species.

Islands are not part of side channel morphology per se (rather, they define the boundary of the side channels) but changes to islands over time can be related to changes in side channel development and help illustrate the effects of spills (i.e. through vegetation stripping or erosion).

The mapping categories identified above were developed by examining orthophotos taken during a known and ideally low flow, and qualitatively assessing the different types of morphologic habitat that were visible and could be distinguished. Not all surfaces can be easily categorized, however, so some of the interpretation is subjective.

The mapping is started by tracing lines around the margins of mature islands and along the edge of the adjacent floodplain just upstream and downstream of the side channel extents. These features are typically well defined so there is little difficulty in interpretation. Additional lines are traced around the bounds of young islands, which are also generally easily defined. Young islands are found as isolated polygons, but are also commonly connected to mature islands. Bars are digitized as lines that connect to the floodplain or edge of mature islands. The bars are then sub-divided by adding additional lines that separate young from mature surfaces. Finally, the outlines of water – ponded, or connected to the mainstem channel are added and a final set of lines is added at all side channel entrances to define a boundary and create a closed set of polygons.

Once the tracing of lineal boundaries is complete, polygon topology is created by ensuring there are no gaps between lines; any “dangling” lines or non-closed polygons are removed. Once topology is completed, individual polygons are created with a unique ID, surface area, and perimeter – each is bounded by at least one other polygon, and there are no gaps or overlapping polygons (i.e. pseudo polygons). The polygon boundaries are then overlaid on the orthophoto and each is visually checked for omissions or errors.

Once the checking is complete, a new field is added to the polygon database where a numeric code is added that corresponds to one of the five feature categories. Polygons are interactively selected in the GIS and assigned one of the numeric codes, which is related to a distinct colour to distinguish mapped features, and to identify polygons that have not yet been coded. The final step involves comparing the colour-coded map to the orthophoto to check for coding errors.

3.6.2 Baseline Mapping

Side Channel 32L

Since the July 9 orthophoto cannot be used to completely map baseline (pre-spill) conditions, the side channel was alternatively mapped from 2007 orthophotos taken at base flow. The 2007 orthophoto and interpreted morphologic mapping are presented in **Figure 3-1**. The fractional area of the different mapped morphologic features is given in **Table 3-6** below.

Table 3-6 Side Channel 32L Baseline Morphologic Features.

Feature class	Area (m^2)	Area (%)
Open water	54,419	9.81
Bare bar	48,009	8.65
Partly vegetated bar	94,524	17.04
Young island	104,082	18.75
Mature island	253,768	45.74
Total	**554,803**	**100**

Side Channel 32L covers a total area of 55.48 ha, nearly half of which was covered by mature forest in 2007. At flows of approximately 1,200 m^3/s, only 10% of the side channel is covered by open water but the majority of this area (90%) is not connected to the main channel at low flow. Bare bars occupy the smallest fractional area (9%) of the side channel.

The combined area of water and bars (18.5%) represents the primary available fish habitat at higher flows. The upstream entrance to the side channel is blocked by sedimentation and vegetation growth, isolating a large pool located several hundred meters downstream.

Side Channel 102.5R

The 2007 orthophotos did not extend downstream as far as side channel 102.5R, so this location was alternatively mapped from available July 9 2009 orthophotos at 304 m^3/s at PCN. The distinctions between mature and young island are not as obvious as at 32L because some of the vegetation has been cleared for a power line crossing and a campground. The 2009 orthophoto and interpreted morphologic mapping are presented in **Figure 3-15** and **Figure 3-16**. The fractional area of the different mapped morphologic features is given in **Table 3-7** below.

Table 3-7 102.5R Mapped Baseline Morphologic Features.

Feature class	Area (m^2)	Area (%)
Open water	68,987	9.40
Bare bar	148,106	20.17
Partly vegetated bar	54,979	7.49
Young island	36,177	4.93
Mature island	425,892	58.01
Total	**734,141**	**100**

Side Channel 102.5R covers a total area of 73.14 ha, more than half of which was covered by mature forest in 2009. At low flow, nearly 10% of the side channel is covered by open water and the majority of this area (58%) appears connected to the main channel at low flow. The minor channels connecting the mainstem channel to the interior wetted channels are shallow and narrow, however, and may present a physical barrier for some species. Excavating these channels would likely expand the habitat availability at low flows. Bare bars occupy the second largest fractional area of the side channel (20.2%). This fraction is distorted by inclusion of a large upstream point bar in the mapping. The bar forms part of the complete side channel morphologic complex at low flows but is inundated at higher discharge.

3.6.3 Pre-Spill Mapping

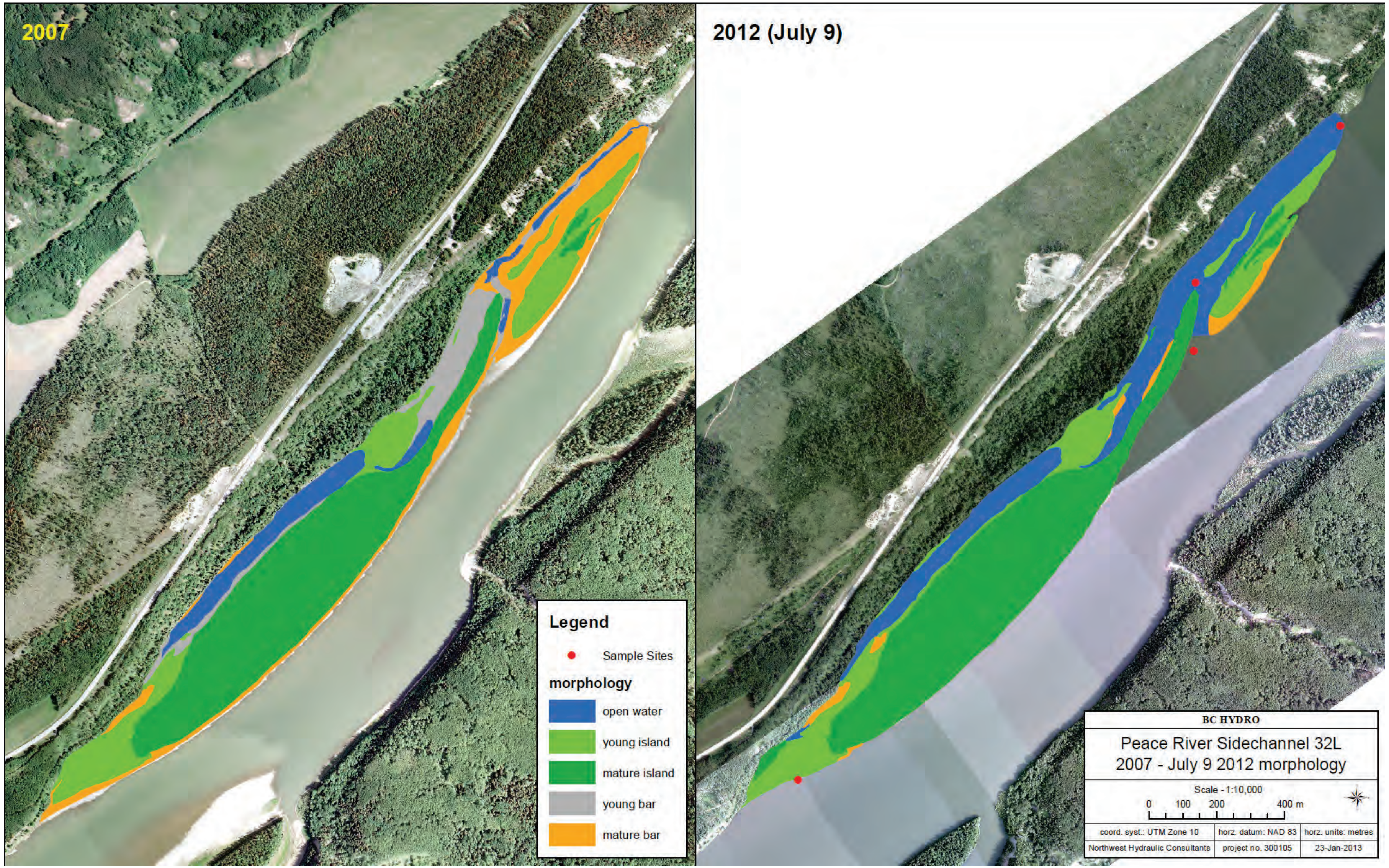
Side Channel 32L

The side channel was remapped using the same morphologic categories for the baseline orthophotography. The lines defining the boundary of features digitized in 2007 were copied as ‘2012’ lines and positions were adjusted as appropriate where changes could be interpreted. Therefore, if no clear morphologic change was identified, the two maps reveal identical outlines and polygons when superimposed.

Flows on this date were much higher relative to the 2007 orthophotography and all of the bar surface is inundated by water (**Figure 3-1**). At this flow, the wetted part of the side channel is connected to the main channel at the downstream limit and there is an additional connection to the main channel on the right side of the side channel roughly 750 m upstream. The upstream side channel entrance is partly flooded, but there is no clear channel connecting it to the large downstream side channel pool, which remains nearly isolated. Fish that are able to gain access to the side channel pool at this flow are at risk from stranding as flow levels recede.

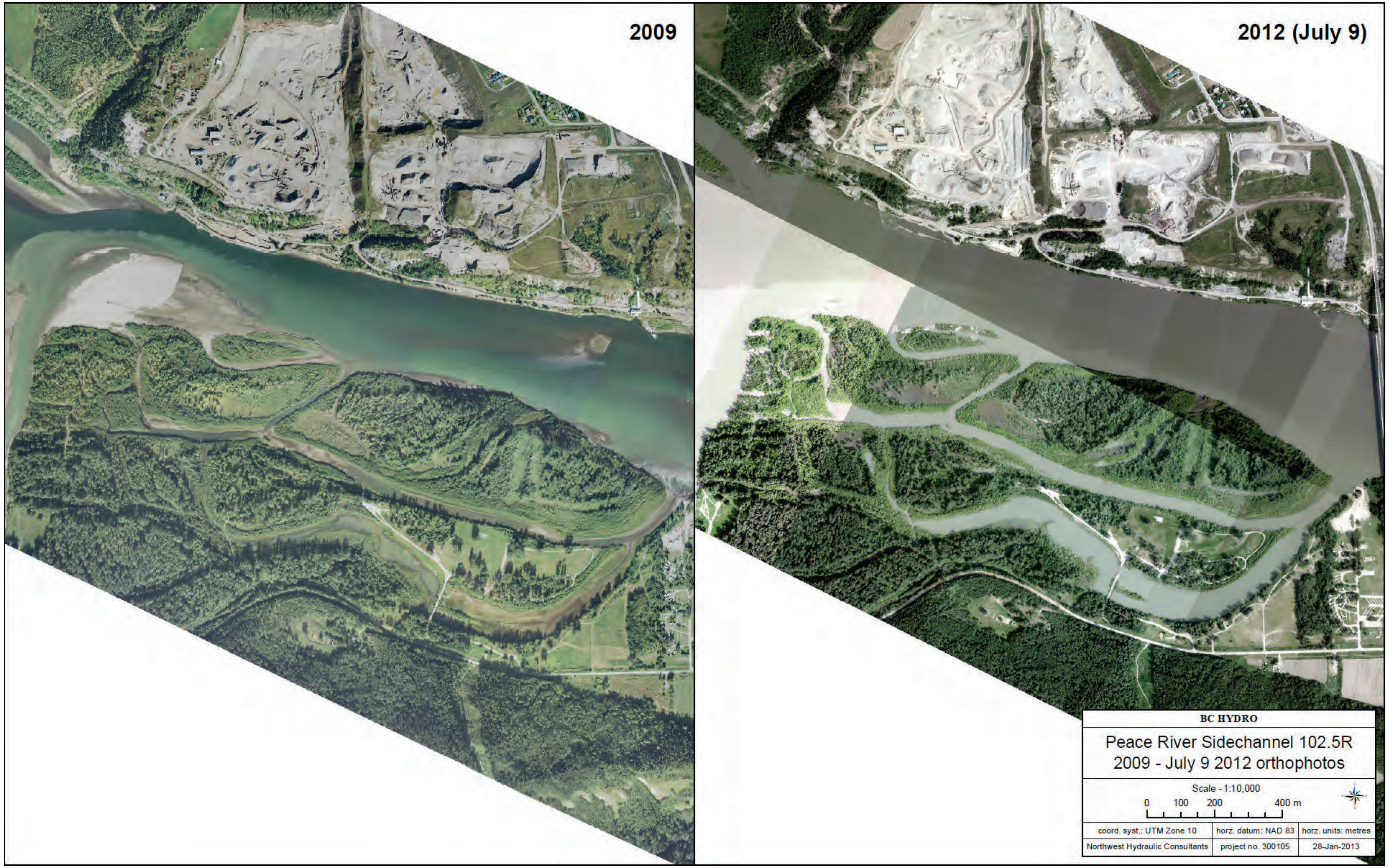
At the pre-spill flow, Side Channel 32L covers a total area of 51.74 ha. This apparent loss in area since 2007 is a result of inundation of mature bar edge along the right margins of the side channel and the corresponding re-mapping of the side channel boundary at the edge of water. The fractional area of mapped morphologic features is given in **Table 3-8** and mapped features are shown in **Figure 3-1**.

Figure 3-15 Side Channel 32L Mapping.



2007
2012 (July 9)
Legend
Sample Sites
morphology
open water
young island
mature island
young bar
mature bar
BC HYDRO
Peace River Sidechannel 32L
2007 - July 9 2012 morphology
Scale - 1:10,000
0 100 200 400 m
coord. syst.: UTM Zone 10
horz. datum: NAD 83
horz. units: metres
Northwest Hydraulic Consultants
project no. 300105
23-Jan-2013

Figure 3-16 Side Channel 102.5R Mapping.



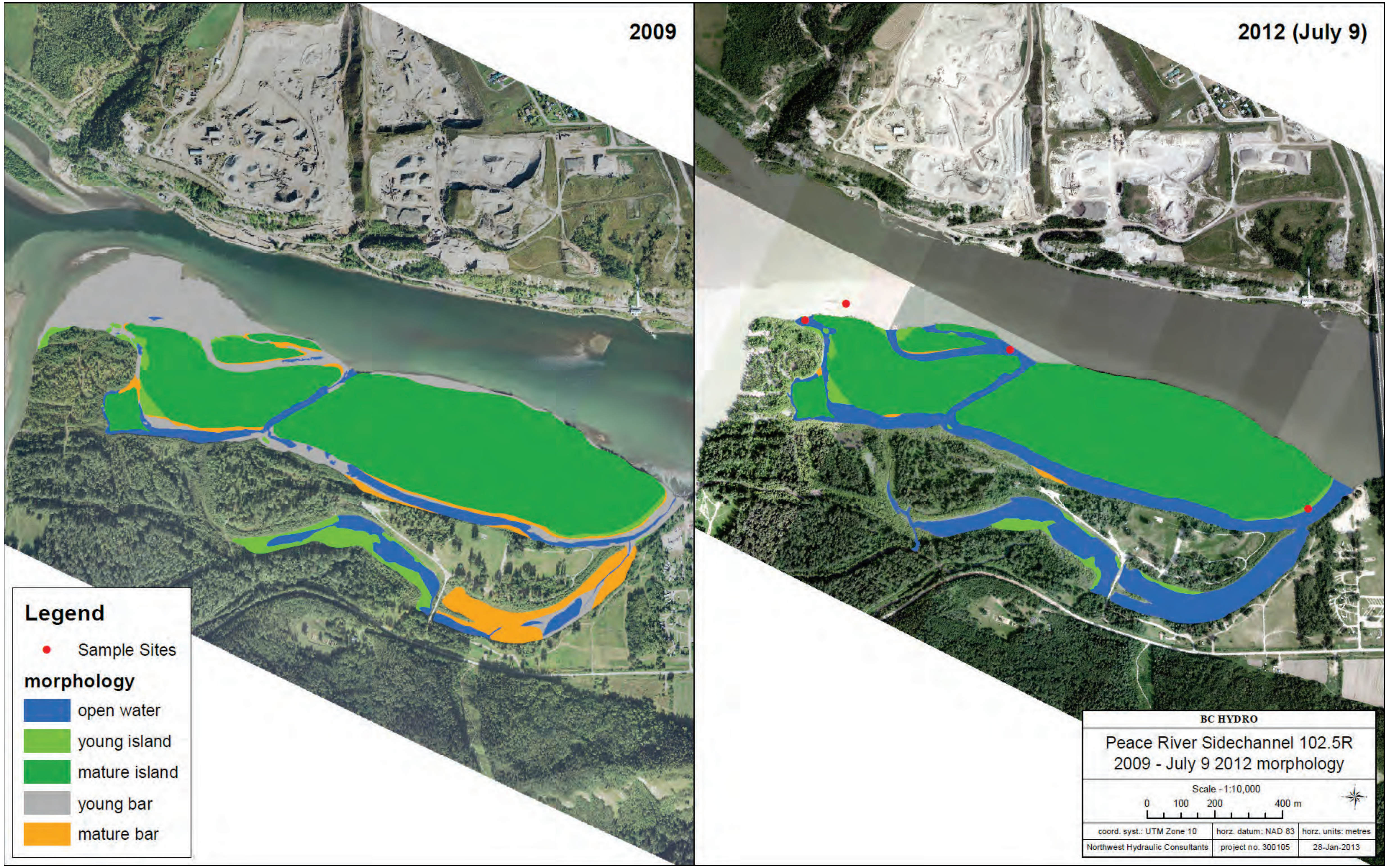

2009
2012 (July 9)
Legend
Sample Sites
morphology
open water
young island
mature island
young bar
mature bar
BC HYDRO
Peace River Sidechannel 102.5R
2009 - July 9 2012 morphology
Scale - 1:10,000
0 100 200 400 m
coord. syst.: UTM Zone 10
horz. datum: NAD 83
horz. units: metres
Northwest Hydraulic Consultants
project no. 300105
28-Jan-2013

Table 3-8 Side Channel 32L Mapped Pre-Spill Morphologic Features.

Feature class	Area (m^2)	Area (%)
Open water	144,291	27.89
Bare bar	0	0
Partly vegetated bar	15,297	2.96
Young island	98,280	18.99
Mature island	259,535	50.16
Total	**554,803**	**100**

Inundation of lower elevation bare bar and mature bar surfaces in the 2012 pre-spill photos resulted in an increase in the fractional area of the water surface (relative to 2007) to nearly 28% of total side channel area. It is not possible to attribute any morphologic significance to this change as the high water masks any real changes that might have occurred.

In general, the main changes appear to be a modest expansion and maturation of vegetation. There was sufficient expansion of vegetation on some mature bar surfaces to permit re-classification as young islands. The areal loss of young islands is nearly identical to the areal gain of mature islands, simply indicating vegetation maturation. These findings are consistent with known patterns of vegetation colonization and expansion in side channels over the past several decades.

Side Channel 102.5R

The side channel was remapped using the same morphologic categories for the baseline orthophotography. The lines defining the boundary of features digitized in 2009 were copied as 2012 lines as was done for side channel 32L and positions were adjusted as appropriate where changes could be interpreted. Therefore, if no clear morphologic change was identified, the two maps reveal identical outlines and polygons when superimposed. Flows on July 9 2012 were much higher relative to the 2009 orthophotography and the entire bar surface is inundated by water (**Figure 3-2**).

At this flow, all of the side channels are wetted and connected to the main channel. The upstream side channel entrance is partly flooded providing limited connectivity between Pine River and downstream side channels. Fish that access interior side channels through the upstream side channel entrance are at some risk of stranding as flow levels recede. The stranding risk is lower relative to Side Channel 32L because of the greater connectivity to the main channel at lower flows.

At the pre-spill flow, Side Channel 102.5R covers a total area of 63.55 ha. This loss in area since 2009 is mainly a result of inundation of the large point bar at the upstream edge of the side channel complex and corresponding adjustment of the side channel boundary at the edge of water. The fractional area of mapped morphologic features is given in **Table 3-9** and mapped features are shown in **Figure 3-2**.

Table 3-9 Side Channel 102.5R Mapped Pre-Spill Morphologic Features.

Feature class	Area (m^2)	Area (%)
Open water	198,287	31.2
Bare bar	0	0
Partly vegetated bar	2,353	0.37
Young island	18,884	2.97
Mature island	416,009	65.46
Total	**635,533**	**100**

Inundation of lower elevation bare bar, mature bar and young island surfaces resulted in an increase in the fractional area of the water surface (relative to 2009) to 31% of total side channel area. There was also a 1 ha loss of mature island area, which appears to be caused by erosion along the northern edge of the largest [downstream] island.

The expansion and maturation of vegetation observed at Side Channel 32L is not observed at Side Channel 102.5R. This site is likely inundated more frequently than the upstream side channel as it is located downstream from the unregulated Pine River, subject to uncontrolled flooding potentially limiting vegetation growth.

3.6.4 Post-Spill Mapping

Side Channel 32L

The post-spill orthophotos were taken at a slightly lower flow than during pre-spill, but water still obscures details of side channel morphology. To investigate whether there were any morphologic changes as a result of the spill, the outlines of features mapped on July 9 were superimposed on the July 19 imagery. Polygons and underlying imagery were compared and after careful review, there are no detectable changes to side channel morphology. The spill did not remove any of the vegetation visible on July 9, but it cannot be confirmed if there were any changes to lower elevation bars.

It is worth noting that individual wood pieces and small logjams do not appear to have moved at all despite the passage of the spill, and there is no evidence that any existing bank experienced any erosion. It is therefore likely that the spill had no impact at all on side channel morphology. The only difference that can be observed between the two sets of images is the emergence of submerged grass on part of the mature bar surface near the downstream extent of the side channel.

There is a slight increase in the exposed area of bars, young vegetation and young islands along the margins of mature islands that were fully or partly submerged on July 9. The upstream floodplain was still mainly filled with ponded water but the lower water levels appear to have eliminated direct links between the interior side channels and Pine River.

Side Channel 102.5R

The outlines of side channel features mapped for July 9 were superimposed on the July 19 imagery to see if any morphologic change could be detected. The 2012 spill did not cause any observable changes, even along the north edge of the large island complex where current velocity would have been greatest. As was observed at Side Channel 32L, even woody debris visible on July 9 does not appear to have been disturbed, suggesting the spill was either of too small a discharge or too brief a period of flow to have caused any significant change to side channel morphology.

As noted at Side Channel 32L, changes might have occurred if spill magnitude or duration were increased, however effects would likely be limited to vegetation and area of fine sediment that could be eroded under the magnitude and duration of the spill flow regime.

4 Fish Community and Fish Habitat Changes

4.1 Side Channel 32L

4.1.1 Fish Species

In total, 7 species were recorded in Side Channel 32L during the present study. This included 1 sportfish, 3 minnow, and 1 sculpin species (**Table 4-1)**. In general, species diversity was higher pre-spill summer (7 species) than post-spill summer (5 species), when all pre-spill seasons were included in the sample 12 species were recorded.

Of the sportfish, Mountain Whitefish was the only species recorded during pre-spill and post-spill summer sampling. Bull Trout and Kokanee also were recorded during pre-spill, but outside of the summer period. All three sucker species (Longnose, Largescale, and White) were recorded in pre-spill summer, but were absent from the post-spill sample. Of the minnow species, Lake Chub and Redside Shiner were recorded in pre-spill summer, while Longnose Dace, Northern Pikeminnow, and Redside Shiner were recorded post-spill summer. Prickly Sculpin was recorded in both pre and post-spill summer, while Slimy Sculpin was absent from the post-spill summer sample.

4.1.2 Fish Life Stage

Large fish species (sportfish, suckers, and Northern Pikeminnow) were categorized by life stage based on by fork length. Three life stages had the potential to occur, which were young-of-year, juvenile, and adult. The number of species represented by the young-of-the year life stage was higher in the pre-spill sample compared to the post-spill sample (**Table 4-2**). The numbers were 5 for the pre-spill total, 4 for the pre-spill summer, and 1 for the post-spill summer sample.

The species/group represented by the young-of-the-year life stage included Mountain Whitefish, the three sucker species, unidentified sucker spp., and Northern Pikeminnow. Young-of-the-year *sucker spp*. was the only group recorded in the post-spill sample. Juvenile was the most frequently encountered life stage in the pre and post-spill samples. The number of species represented by the juvenile life stage was higher in the pre-spill sample compared to the post-spill sample. The numbers were 7 for the pre-spill total, 3 for the pre-spill summer, and 2 for the post-spill summer sample. The species/group represented by the juvenile life stage were Bull Trout, Kokanee, Mountain Whitefish, the three sucker species, unidentified sucker spp., and Northern Pikeminnow. Juvenile sucker spp. and Northern Pikeminnow were the two groups recorded in the post-spill sample.

The number of species represented by the adult life stage was higher in the pre-spill sample compared to the post-spill sample. The numbers were 5 for the pre-spill total, 3 for the pre-spill summer, and 1 for the post-spill summer sample. The species represented by the adult life stage were Bull Trout, Kokanee, Mountain Whitefish, Longnose Sucker, and White Sucker. Adult Mountain Whitefish was the only group in the post-spill sample.

Table 4-1 Species present in Side Channel 32L, pre and post-spill (all sample methods and events combined).

Group	Species	Pre-spill All Seasons (n=28)[a]	Pre-spill Summer (n=12)	Post-spill Summer (n=12)
Sportfish	Bull trout	x[b]		
	Goldeye			
	Kokanee	x		
	Mountain whitefish	X[c]	X	X
	Northern pike			
	Walleye			
	Yellow perch			
Suckers	Largescale sucker	X	X	
	Longnose sucker	X	X	
	White sucker	X	X	
Minnows	Flathead chub			
	Lake chub	X	X	
	Longnose dace	x		X
	Northern pikeminnow	x		X
	Redside shiner	X	X	X
	Spottail shiner			
	Trout-perch			
Sculpin	Prickly sculpin	X	X	X
	Slimy sculpin	X	X	
Total Number of species		**12**	**7**	**5**

[a] n = number of samples.
[b] x denotes species recorded in spring or fall, but not summer.
[c] X denotes species recorded in summer
[d] Includes true minnows (Family *Cyprinidae*), and trout-perch (Family *Percopsidae*).

Table 4-2 Large-fish species life stage present in Side Channel 32L, pre and post-spill (all methods and sampling events combined).

Group	Species	Pre-spill All Seasons (n=28)[a]			Pre-spill Summer (n=12)			Post-spill Summer (n=12)		
		YOY	Juv	Adult	YOY	Juv	Adult	YOY	Juv	Adult
Sportfish	Bull trout		x[b]	x						
	Goldeye									
	Kokanee		x	x						
	Mountain whitefish	X[c]	x	X	X		X			X
	Northern pike									
	Walleye									
	Yellow perch									
Suckers	Largescale sucker	X	X		X	X				
	Longnose sucker	X	X	X	X	X	X			
	White sucker			X			X			
	Sucker spp.	X	X		X	X		X	X	
Minnows	Northern Pikeminnow	x	x						X	
Total Number		**5**	**7**	**5**	**4**	**3**	**3**	**1**	**2**	**1**

a n = number of samples.
b x denotes species recorded in spring or fall, but not summer.
c X denotes species recorded in summer

4.1.3 Fish Catch Rate

Sufficient samples were available to compare pre and post-spill fish catch rates during the summer session for the beach seine and boat electrofisher fish collection methods (no fish were captured using backpacker electrofisher during post-spill). A comparison of beach seine pre-and post-spill mean catch rates indicated low precision (i.e., large standard error); however, there was a trend of lower species relative abundance in the post-spill summer sample (**Figure 4-1**).

Of the 8 species and 2 species groups (sucker spp. and sculpin spp.) for which beach seine catch rates were generated, 7 were lower post-spill summer compared to pre-spill summer (Mountain Whitefish, Largescale Sucker, Longnose Sucker, sucker spp., Prickly Sculpin, Slimy Sculpin, and Lake Chub). The largest difference was recorded for sucker spp. (13.9 fish/100 m^2 pre-spill versus 6.2 fish/100 m^2 post-spill). Beach seine catch rates were higher post-spill summer for three species/groups (sculpin spp., Longnose Dace, and Redside Shiner).

A comparison of boat electrofisher pre and post-spill mean catch rates also indicated low precision (i.e., large standard error); however, there was a distinct trend of lower species relative abundance in the post-spill summer sample (**Figure 4-2**). Of the five species for which boat electrofisher catch rates were generated, all were lower post-spill summer compared to pre-spill summer (Bull Trout, Mountain Whitefish, Largescale Sucker, Longnose Sucker, White Sucker, and Northern Pikeminnow). The largest difference was recorded for Longnose Sucker (14.6 fish/1000 m pre-spill versus 0.0 fish/1000 m post-spill).

Figure 4-1 Average summer beach seine catch rates (± SE) of fish species/groups Side Channel 32L.

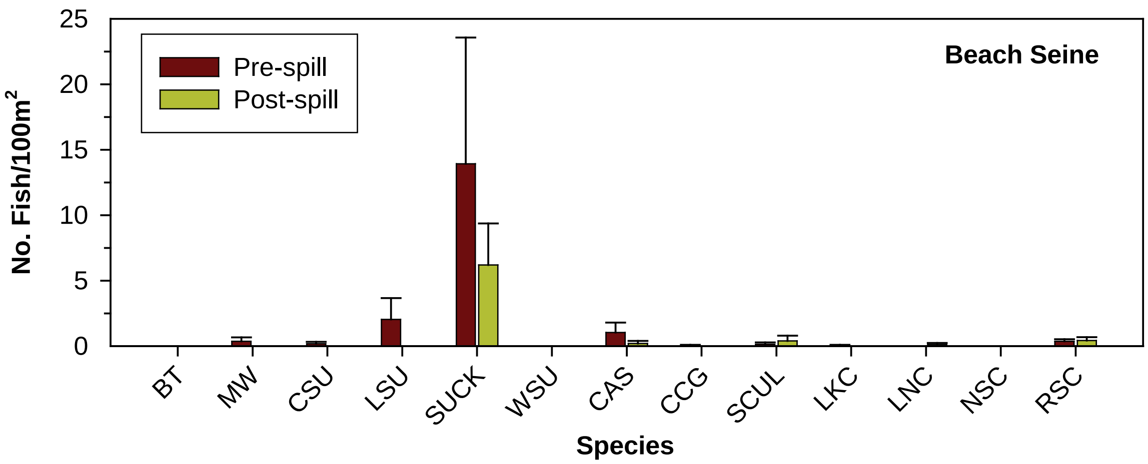
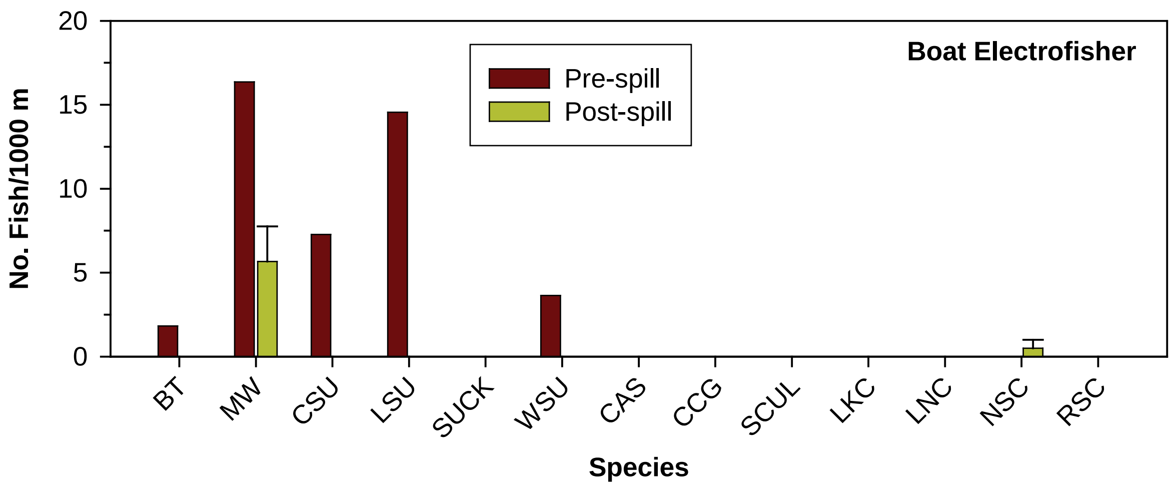


Figure 4-2 Average summer boat electrofisher catch rates (± SE) of fish species/groups Side Channel 32L.



4.1.4 Fish Size Distribution

Limited data were available for comparison of pre-spill summer and post-spill summer length characteristics (**Table 4-3**). Where comparisons were possible, there were no apparent differences in fish size between pre-spill and post-spill.

Table 4-3 Fish species/groups summer fork length characteristics in Side Channel 32L.

Group	Common Name	Beach Seine						Boat Electrofisher					
		Pre-spill			Post-spill			Pre-spill			Post-spill		
		n	Med	Range	n	Med	Range	n	Med	Range	n	Med	Range
Sportfish	Bull trout												
	Goldeye												
	Kokanee												
	Mountain whitefish	8	37.5	28-329							11	290	239-332
	Northern pike												
	Walleye												
	Yellow perch												
Sucker	Largescale sucker	4	53	39-62									
	Longnose sucker	19	52	29-86									
	White sucker												
	Sucker species	33	21	16-31	54	18.5	14-28						
Minnow/ Trout-perch	Flathead chub												
	Lake chub	1	30	-									
	Longnose dace				1	16	-						
	Northern pikeminnow										1	90	-
	Redside shiner	8	38	23-126	4	20	16-29						
	Spottail shiner												
	Trout-perch												
Sculpin	Prickly sculpin	13	49	38-81	2	37.5	35-40						
	Slimy sculpin	1	43	-									
	Sculpin species	3	23	18-28	4	15	11-32						

4.1.5 Fish Habitat

Habitat Transects

Eleven habitat transects were used to quantify physical characteristics of Side Channel 32L (**Table 4-4** and Appendix D). The dominant habitat type was Flat (10 of 11 transects), followed by and single Riffle habitat. Habitat transect sampling was not conducted during pre-spill studies. As such, comparisons to post-spill conditions were not completed.

Table 4-4 Physical characteristics measured at habitat transects in Side Channel 32L.

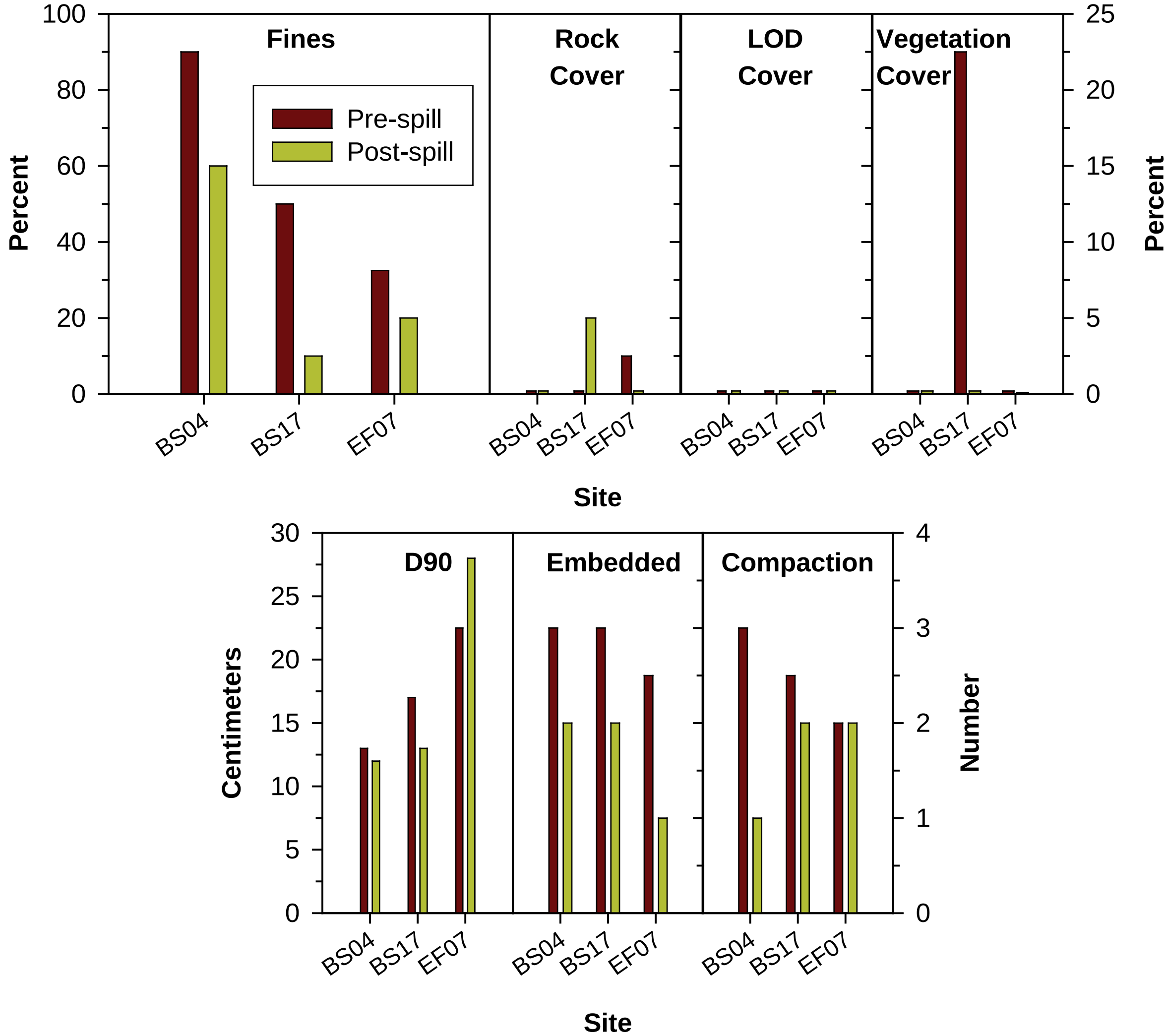
Transect No.	Habitat Type	Wet Width (m)	Channel Width (m)	D90 (cm)	Bed Material Type (%)					Substrate Condition		Physical Cover	
					OM	CL/SI/SA	PE/GR	CO	BO/BE	Comp	Embed	Cover	LOD
1	Flat	14	84	40	15	25	15	30	15	M	M	10	A
2	Flat	12	89	17	10	30	30	25	5	H	H	10	A
3	Flat	16	90	16	5	45	20	25	5	M	H	5	A
4	Flat	21	91	31	5	70	10	10	5	H	H	0	A
5	Flat	22	108	12	5	85	5	5	0	H	H	0	A
6	Flat	17	117	21	20	30	10	35	5	M	M	0	A
7	Flat	21	164	18	0	20	45	30	5	M	M	0	A
8	Flat	16	102	15	0	40	45	15	0	L	L	0	A
9	Riffle	16	165	18	0	35	20	40	5	L	M	10	A
10	Flat	21	50	28	0	20	25	45	10	M	H	5	A
11	Flat	16	4	28	5	15	30	40	10	L	M	10	A

[a] See Appendix B for definitions.

Fish Habitat at Sample Sites

Physical characteristics measured at fish sample sites during the post-spill study were compared to data collected at the same locations during pre-spill studies. Three fish sample sites that were sampled pre-spill and post-spill were BS04, BS17, and EF07. All raw site data are presented in Appendix H. Bed material composition differed between pre-spill and post-spill (**Figure 4-3**). The percentage of fines was lower post-spill compared to pre-spill. The largest decrease was recorded at Site BS17 (40%).

Figure 4-3 Habitat characteristics of fish sample sites in Side Channel 32L.



The physical cover available to fish did not demonstrate a consistent trend among sites. The amount of rock cover increased at Site BS17, decreased at EF07, and remained unchanged at BS04. Large organic debris cover (LOD) was not present at any site pre and post-spill. Submergent vegetation cover was recorded only at Site BS17. It declined from 22.5% pre-spill to 0.0% post-spill. Seasonal difference in the amount of submergent vegetation at the time of sampling was not a likely reason for the change because this cover type was recorded during all seasons by pre-spill inventories (Appendix H).

The size of the channel substrates decreased at Sites BS04 and BS17, but increased at Site EF07. The difference between sites may have reflected the relative exposure of bed materials by removal of fines due to site-specific water velocities during the spill.

Embeddedness and compaction are measures of fine sediment effects on rock materials (1 is low [clean]; 3 is high [silted]). Both metrics differed at most sites pre versus post-spill. Post-spill embeddedness values were lower at all sites compared to pre-spill values. Post-spill compaction values were lower at two of the three sites compared to pre-spill values. Compaction of Site EF07 was unchanged.

Fish Mesohabitats

Peace River flows were elevated at the time of post-spill orthophoto acquisition. As such, Side Channel 32L mesohabitats were inundated, which prevented comparison to pre-spill mesohabitat maps.

4.1.6 Side Channel 32L Summary

Side Channel 32L post-spill fish community differed from the pre-spill fish community. Species diversity was lower post-spill compared to pre-spill, caused primarily by the absence of the three sucker species from the post-spill sample. The number of large-fish species represented by life stages was lower post-spill compared to pre-spill. This result was consistent for young-of-the-year, juvenile, and adult life stages. A comparison of beach seine and boat electrofisher pre-spill and post-spill catch rates indicated a trend of lower species relative abundance in the post-spill summer sample. This was generally consistent for the sportfish, sucker, and minnow groups.

The changes to the Side Channel 32L fish community may reflect spill effects on fish health. Trends exhibited by three parameters support this finding. However three issues should be noted. First, the post-spill results may simply reflect limited sampling effort. Post-spill results were based on a short sample period during one season and a limited amount of sampling effort. In contrast, pre-spill results were based on data collected over multiple years and seasons, and a larger amount of sampling effort. Second, Peace River fish populations exhibit high spatial and temporal variability and habitat utilization of side channels is dependent on the flow regime (Mainstream 2010, 2011, 2012). The post-spill survey of Side Channel 32L may have occurred during a period of low utilization by fish, which would bias the results. Third, Peace River fish populations exhibit natural variability in biological characteristics, life stage abundance and population structure. This makes it difficult to differentiate between change caused by spill effects versus change associated with natural variation.

Side Channel 32L post-spill habitat characteristics of fish sample sites differed from the pre-spill habitat characteristics. Substrate composition differed between pre-spill and post-spill with the percentage of fines being lower post-spill. The results suggest that spill flows removed some of the overlaying fines to expose the underlying substrate.

Physical cover available to fish did not demonstrate a consistent trend; however, the amount of rock cover increased at one site and submergent vegetation cover was absent from another site. The increase in the amount of rock cover and the loss of submergent vegetation cover are supported by the sediment texture sampling results that indicate a loss of fines. Finally, embeddedness and compaction ratings were lower post-spill compared to pre-spill, which suggests that spill flows removed fines from the channel bed and may have mobilized rock substrates at inventoried sites.

4.2 Side Channel 102.5R

4.2.1 Fish Species

In total, 9 identified species were recorded in Side Channel 102.5R during the present study (**Table 4-5**). This included 3 sportfish, 5 minnow, and 1 sucker species. In general, species diversity was higher pre-spill summer (13 species) than post-spill summer (9 species). When all pre-spill seasons were included in the sample, 18 species were recorded.

Table 4-5 Species present in Side Channel 102.5R, pre and post-spill (all sample methods and events combined).

Group	Species	Pre-spill All Seasons (*n*=17)[a]	Pre-spill Summer (*n*=4)	Post-spill Summer (*n*=7)
Sportfish	Bull trout	x[b]		
	Goldeye	X	X	
	Kokanee			X
	Mountain whitefish	X[c]	X	X
	Northern pike	X	X	X
	Walleye	X	X	
	Yellow perch	X	X	
Suckers	Largescale sucker	X	X	
	Longnose sucker	X	X	X
	White sucker	X	X	
Minnows[d]	Flathead chub	x		
	Lake chub	x	X	
	Longnose dace	X	X	X
	Northern pikeminnow	x		X
	Redside shiner	X	X	X
	Spottail shiner	X	X	X
	Trout-perch	X	X	X
Sculpin	Prickly sculpin	x		
	Slimy sculpin	x		
Total Number of species		**18**	**13**	**9**

[a] *n* = number of samples.
[b] x denotes species recorded in spring or fall, but not summer.
[c] X denotes species recorded in summer
[d] Includes true minnows (Family *Cyprinidae*), and trout-perch (Family *Percopsidae*).

Of the sportfish, Mountain Whitefish and Northern Pike were recorded pre-spill and post-spill summer. Kokanee was only recorded in Side Channel 102.5R during the present study; this distribution of this species is typically restricted to upstream of the Halfway River (Mainstream 2012). Three species recorded pre-spill summer, but not post-spill summer were Goldeye, Walleye, and Yellow Perch. Bull Trout were also recorded pre-spill, but outside of the summer period.

All three sucker species (Longnose, Largescale, and White) were recorded in the pre-spill summer; however, only Longnose Sucker was recorded in Side Channel 102.5R post-spill summer. Of the minnow species, Lake Chub, Longnose Dace, Redside Shiner, Spottail Shiner and Trout-perch were recorded in both pre-spill summer and post-spill summer surveys. Northern Pikeminnow was recorded in post-spill summer, but were absent from the pre-spill summer sample.

4.2.2 Fish Life Stage

Large fish species (sportfish, suckers, and Northern Pikeminnow) were categorized by life stage based on by fork length. Three life stages had the potential to occur, which were young-of-year, juvenile, and adult. The number of species represented by the young-of-the year life stage was slightly higher in the post-spill sample compared to the pre-spill sample (**Table 4-6**). The numbers were 4 for the pre-spill total, 4 for the pre-spill summer, and 5 for the post-spill summer sample. The species/group represented by the young-of-the-year life stage included Mountain Whitefish, Northern Pike, Largescale Sucker, sucker spp., and Northern Pikeminnow.

Juvenile was a frequently encountered life stage in the pre-spill and post-spill samples. Numbers of species/group represented by the juvenile life stage was 7 for the pre-spill total, 3 for the pre-spill summer, and 4 for the post-spill summer sample. The species/group represented by the juvenile life stage during post-spill summer included Kokanee, Northern Pike, Longnose Sucker, sucker spp., and Northern Pikeminnow.

The number of species represented by the adult life stage was higher in the pre-spill sample compared to the post-spill sample. The numbers were 8 for the pre-spill total, 7 for the pre-spill summer, and 0 for the post-spill summer sample. The species represented by the adult life stage were Goldeye, Mountain Whitefish, Northern Pike, Walleye, Yellow Perch, Largescale Sucker, Longnose Sucker, and White Sucker. No adult life stages were recorded in the post-spill sample.

4.2.3 Fish Catch Rate

Sufficient samples were available to compare pre and post-spill fish catch rates during the summer session for the beach seine and boat electrofisher fish collection methods (backpack electrofisher was not used as a sample method by the post-spill survey). A comparison of beach seine pre and post-spill mean catch rates indicated low precision (i.e., large standard error); however, there was a trend of lower species relative abundance in the post-spill summer sample (**Figure 4-4**).

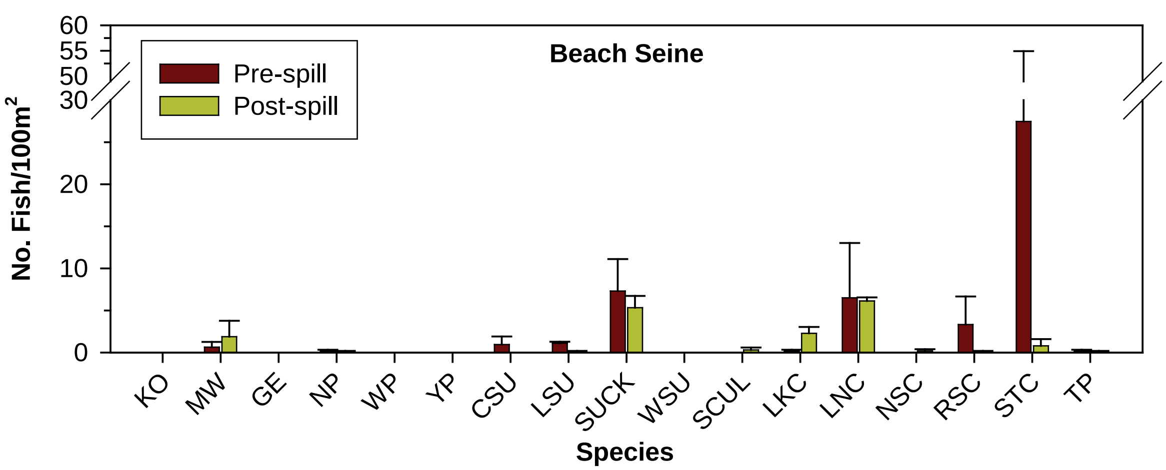
Of the 10 species and 2 species groups (sucker spp. and sculpin spp.) for which beach seine catch rates were generated, 8 were lower post-spill summer compared to pre-spill summer (Northern Pike, Largescale Sucker, Longnose Sucker, sucker spp., Longnose Dace, Redside Shiner, Spottail Shiner, and Trout-perch). The largest difference was recorded for Spottail Shiner (27.5 fish/100 m^2 pre-spill versus 0.8 fish/100 m^2 post-spill). Beach seine catch rates were higher post-spill summer for four species/groups (Mountain Whitefish, sculpin spp., Lake Chub, and Northern Pikeminnow).

Table 4-6 Large-fish species life stage present in Side Channel 102.5R, pre and post-spill (all methods and sampling events combined).

Group	Species	Pre-spill All Seasons (n=28)[a]			Pre-spill Summer (n=12)			Post-spill Summer (n=12)		
		YOY	Juv	Adult	YOY	Juv	Adult	YOY	Juv	Adult
Sportfish	Bull trout		x[b]							
	Goldeye			X			X			
	Kokanee								X	
	Mountain whitefish	X	x	X	X		X	X		
	Northern pike		x	x	X			X	X	
	Walleye			X			X			
	Yellow perch		x	X			X			
Suckers	Largescale sucker	x	X	X		X	X	X		
	Longnose sucker	X	X	X	X	X	X		X	
	White sucker			X			X			
	Sucker spp.		X		X	X		X	X	
Minnows	Northern Pikeminnow	x						X	X	
Total Number		**4**	**7**	**8**	**4**	**3**	**7**	**5**	**4**	**0**

[a] n = number of samples.
[b] x denotes species recorded in spring or fall, but not summer.
[c] X denotes species recorded in summer

Figure 4-4 Average summer beach seine catch rates (± SE) of fish species/groups Side Channel 102.5R.



The numbers were 4 for the pre-spill total, 4 for the pre-spill summer, and 5 for the post-spill summer sample. The species/group represented by the young-of-the-year life stage included Mountain Whitefish, Northern Pike, Largescale Sucker, sucker spp., and Northern Pikeminnow.

Juvenile was a frequently encountered life stage in the pre-spill and post-spill samples. Numbers of species/group represented by the juvenile life stage was 7 for the pre-spill total, 3 for the pre-spill summer, and 4 for the post-spill summer sample. The species/group represented by the juvenile life stage during post-spill summer included Kokanee, Northern Pike, Longnose Sucker, sucker spp., and Northern Pikeminnow.

The number of species represented by the adult life stage was higher in the pre-spill sample compared to the post-spill sample. The numbers were 8 for the pre-spill total, 7 for the pre-spill summer, and 0 for the post-spill summer sample. The species represented by the adult life stage were Goldeye, Mountain Whitefish, Northern Pike, Walleye, Yellow Perch, Largescale Sucker, Longnose Sucker, and White Sucker. No adult life stages were recorded in the post-spill sample.

4.2.4 Fish Catch Rate

Sufficient samples were available to compare pre and post-spill fish catch rates during the summer session for the beach seine and boat electrofisher fish collection methods (backpack electrofisher was not used as a sample method by the post-spill survey). A comparison of beach seine pre and post-spill mean catch rates indicated low precision (i.e., large standard error); however, there was a trend of lower species relative abundance in the post-spill summer sample (**Figure 4-5**).

Of the 10 species and 2 species groups (sucker spp. and sculpin spp.) for which beach seine catch rates were generated, 8 were lower post-spill summer compared to pre-spill summer (Northern Pike, Largescale Sucker, Longnose Sucker, sucker spp., Longnose Dace, Redside Shiner, Spottail Shiner, and Trout-perch). The largest difference was recorded for Spottail Shiner (27.5 fish/100 m^2 pre-spill versus 0.8 fish/100 m^2 post-spill). Beach seine catch rates were higher post-spill summer for four species/groups (Mountain Whitefish, sculpin spp., Lake Chub, and Northern Pikeminnow).

A comparison of boat electrofisher pre and post-spill mean catch rates also indicated low precision (i.e., large standard error); however, there was a trend of lower species relative abundance in the post-spill summer sample (**Figure 4-6**). Of the 10 species for which boat electrofisher catch rates were generated, 7 were lower post-spill summer compared to pre-spill summer (Goldeye, Walleye, Yellow Perch, Largescale Sucker, Longnose Sucker, White Sucker, and Spottail Shiner). Post-spill mean catch rates were higher for Kokanee, Mountain Whitefish, and Northern Pike.

Figure 4-5 Average summer beach seine catch rates (± SE) of fish species/groups Side Channel 102.5R.

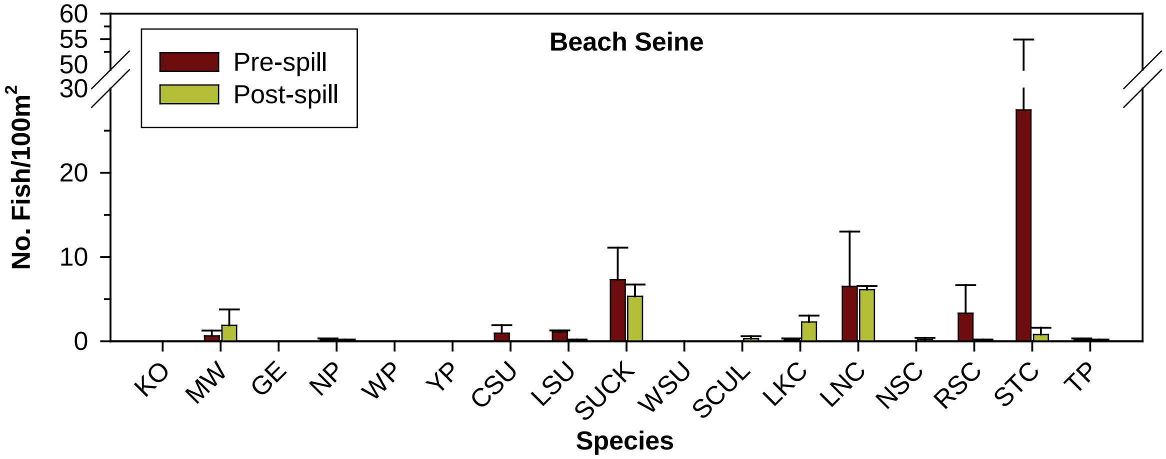
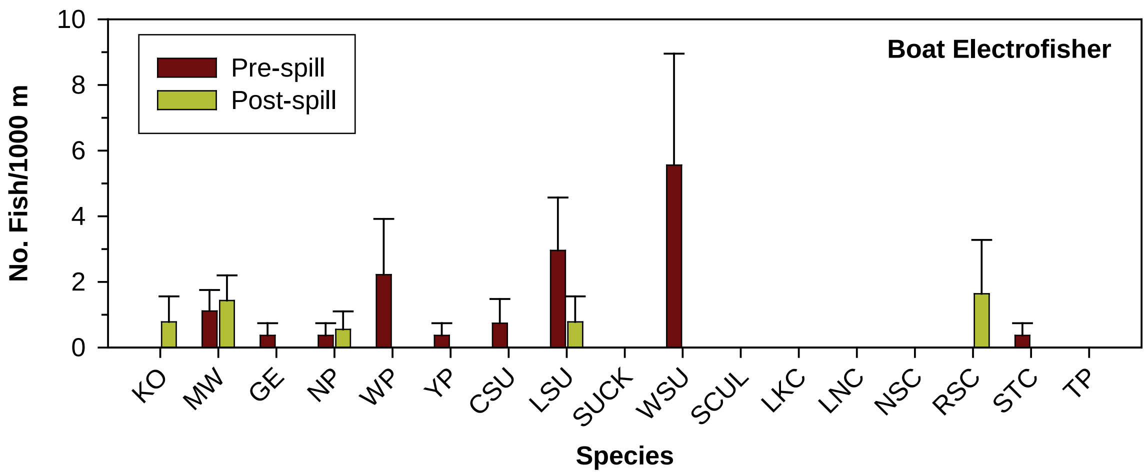


Figure 4-6 Average summer boat electrofisher catch rates (± SE) of fish species/groups Side Channel 102.5R.



4.2.5 Fish Size Distribution

Limited data were available for comparison of pre-spill summer and post-spill summer length characteristics (**Table 4-7**). In general, pre-spill summer and post-spill summer fork length median and range of sampled species were similar.

Table 4-7 Fish species/groups summer fork length characteristics in Side Channel 102.5R.

Group	Common Name	Beach Seine						Small-fish Boat Electrofisher					
		Pre-Spill			Post-Spill			Pre-Spill			Post-Spill		
		n	Med	Range	n	Med	Range	n	Med	Range	n	Med	Range
Sportfish	Bull trout												
	Goldeye												
	Kokanee										1	109	-
	Mountain whitefish	4	33.5	29 - 41	19	69	55 - 85				2	70	68 - 72
	Northern pike	1	103	-	1	176	-				1	152	-
	Walleye												
	Yellow perch												
Sucker	Sucker species	15	20	18 - 23	56	19.5	11 - 38						
	Largescale sucker	6	44.5	41 - 53									
	Longnose sucker	7	46	17 - 99	1	48	-				1	55	-
	White sucker												
Minnow/ Trout-Perch	Flathead chub												
	Lake chub	1	40	-	23	19	14 - 28						
	Longnose dace	10	34	31 - 42	62	15	10 - 28						
	Northern pikeminnow				2	31	23 - 39						
	Redside shiner	10	70	65 - 82	1	20	-				3	76	68 - 103
	Spottail shiner	17	22	16 - 27	8	23.5	13 - 30						
	Trout-perch				1	25	-						
Sculpin	Sculpin species				3	30	25 - 35						
	Prickly sculpin												
	Slimy sculpin												

4.2.6 Fish Habitat

Habitat Transects

Seventeen habitat transects were used to quantify physical characteristics of Side Channel 102.5R (Appendix D). The dominant habitat type was Flat (12 of 17 transects), followed by Riffle (3), and Run (2) (**Table 4-8**). Habitat transect sampling was not conducted during pre-spill studies. As such, comparisons to post-spill conditions were not completed.

Table 4-8 Physical characteristics measured at habitat transects in Side Channel 102.5R.

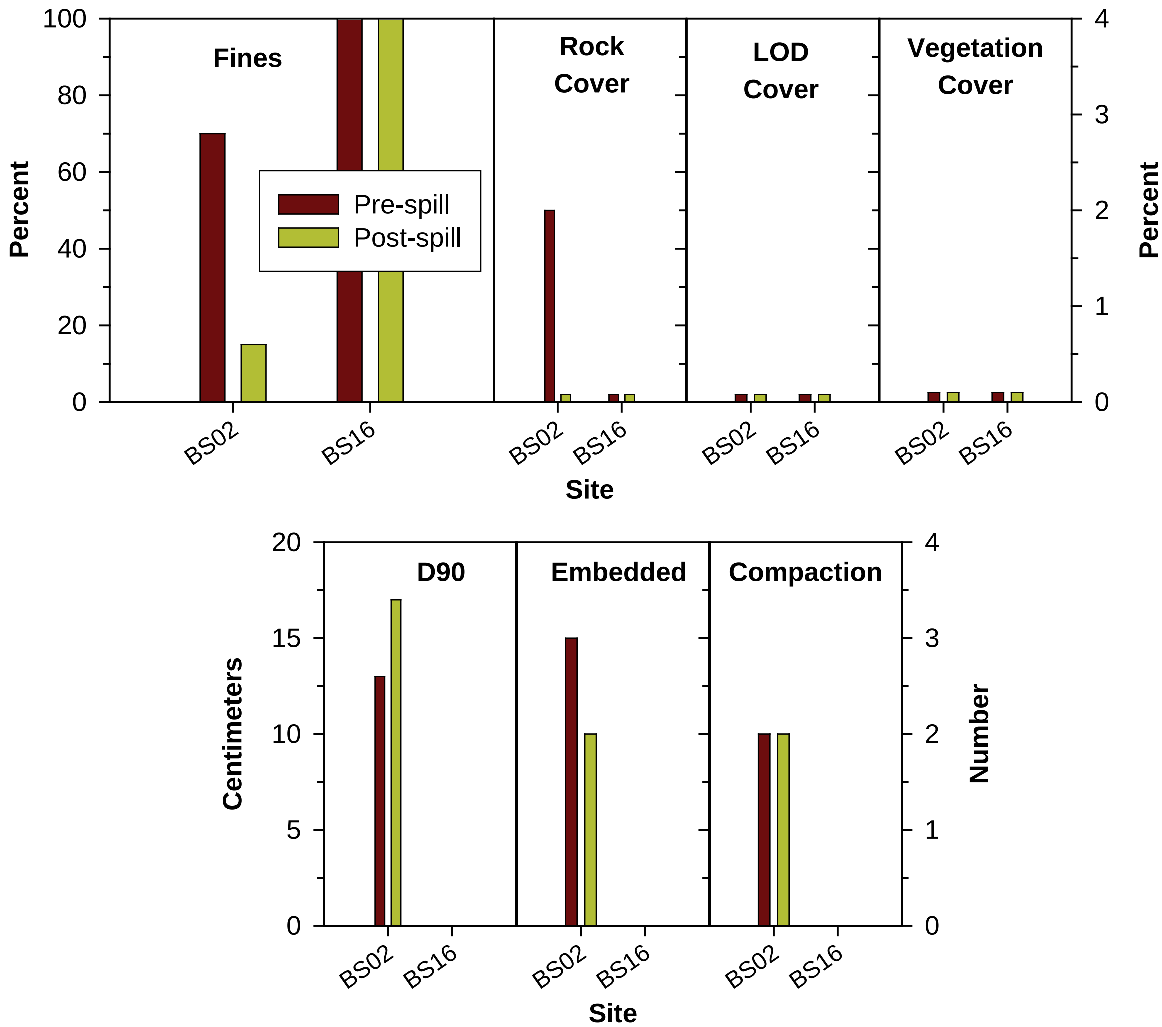
Transect #	Habitat Type	Wet Width (m)	Channel Width (m)	D90 (cm)	Bed Material (%)					Substrate Condition		Cover	LOD
					OM	CL/SI/SA	PE/GR	CO	BO/BE	Comp	Embed		
1	Flat	36	55	14	0	90	0	10	0	H	H	0	A
2	Flat	35	44		0	100	0	0	0			0	A
3	Flat	28	37	15	0	90	0	10	0	M	M	0	A
4	Flat	27	25	9	0	50	30	20	0	M	L	0	P
5	Flat	17	35	12	0	15	65	20	0	M	L	0	A
6	Riffle	26	39	17	0	15	65	20	0	M	M	10	A
7	Flat	29	36	17	0	40	0	60	0	H	H	5	A
8	Flat	30	40		0	40	5	50	5	M	H	5	P
9	Flat	32	41		0	85	5	10	0	M	H	0	P
10	Flat	31	38		0	95	0	5	0	M	H	0	A
11	Flat	31	39		0	90	5	5	0	M	H	0	A
12	Flat	32	38	18	0	20	25	50	5	M	M	0	A
13	Riffle	32	37	20	0	25	10	55	10	L	L	5	A
14	Riffle	32	35	20	0	15	30	50	5	M	M	0	A
15	Run	39	42	25	0	10	15	60	15	H	H	5	A
16	Flat	21	21		0	85	10	5	0			10	P
17	Flat	24	24	15	0	10	10	70	10	M	M	10	P

[a] See Appendix B for definitions.

Fish Habitat at Sample Sites

Physical characteristics measured at fish sample sites during the post-spill study were compared to data collected at the same locations during pre-spill studies. Two fish sample sites that were sampled pre-spill and post-spill were BS02, BS16. All raw site data are presented in Appendix H. Substrate composition differed between pre-spill and post-spill at Site BS02 (**Figure 4-7**). The percentage of fines was higher pre-spill compared to post-spill (70% versus 15%). There was no difference at Site BS16 (100% fines). The results for Site BS02 suggest that the spill flows may have removed some of the overlaying fines to expose the underlying gravel and cobble substrate.

Figure 4-7 Habitat characteristics of fish sample sites in Side Channel 102.5R.



There was minimal physical cover available to fish at Sites BS02 and BS16. The amount of rock cover decreased at Site BS02 from 2.5% to 0.0%. Other cover types (LOD cover and vegetation cover) were not recorded at these sites pre and post-spill.

The size of the channel substrates increased slightly at Site BS02 between pre-spill and post-spill (from 13 to 17 cm); no gravels or cobble were recorded at Site BS16. Embeddedness at Site BS02 was higher pre-spill compared to post-spill (3.0 versus 2.0); compaction did not change at Site BS02.

Fish Mesohabitats

Peace River flows were elevated at the time of post-spill orthophoto acquisition. As such, Side Channel 102.5R mesohabitats were inundated, which prevented comparison to pre-spill mesohabitat maps.

4.2.7 Side Channel 102.5R Summary

Side Channel 102.5R post-spill fish community differed from the pre-spill fish community. Species diversity was lower post-spill compared to pre-spill, caused primarily by the absence of some sportfish (Walleye and Yellow Perch) and two of three sucker species (Largescale and White suckers) from the post-spill sample.

The number of large-fish species represented by the adult life stages also was lower post-spill compared to pre-spill. A comparison of beach seine and boat electrofisher pre-spill and post-spill catch rates indicated a trend of lower species relative abundance in the post-spill summer sample. However, there was no consistent trend regarding changes within fish groups (i.e., sportfish, sucker, minnow, and sculpin).

The changes to the Side Channel 102.5R fish community were generally consistent, but not as distinct as results for Side Channel 32L. The results for Side Channel 102.5R may reflect spill effects on fish health. As with Side Channel 32L, two issues should be noted. First, the post-spill results may simply reflect limited sampling effort. Post-spill results were based on a short sample period during one season and a limited amount of sampling effort.

In contrast, pre-spill results were based on data collected over multiple years and seasons, and a larger amount of sampling effort. Second, Peace River fish populations exhibit high spatial and temporal variability and habitat utilization of side channels is highly dependent on the flow regime (Mainstream 2010, 2011, 2012). The post-spill survey of Side Channel 102.5R may have occurred during a period of low utilization by fish, which would bias the results.

Side Channel 102.5R post-spill habitat characteristics of fish sample sites did not differ substantially from pre-spill habitat characteristics. At one site substrate composition differed between pre-spill and post-spill with the percentage of fines being lower post-spill. Physical cover available to fish did not change; however, embeddedness ratings were lower post-spill compared to pre-spill at one site. The results suggest that spill flows may have influenced habitat characteristics, at least at one fish sample site.

5 Summary and Recommendations

GMSMON-8 was activated when BC Hydro implemented a spill in excess of normal operational flows at GMS and PCN. The dates and timing of the spill meeting the 2,500 m^3/s trigger ($\geq$ 2 days duration) were from June 27 to July 9 in 2012, and peak hourly flows ranged between 2,605 and 3,289 m^3/s. These flows resulted in a mead daily average flow between 2,600 to 2,800 m^3/s. Two key side channels (32L and 102.5R) were identified for air photo analysis to determine geomorphic change. These same two side channels were identified to monitor pre- and post-spill fish use and habitats. NHC and Mainstream field crews were mobilized and data were collected. Field data extents and coverage were limited pre and post-spill due to inundation.

5.1 Response of Side Channel Habitats

The side channels examined under this monitor exhibited little morphological change for the spill flow magnitude and duration, ranging from hourly value of 2,605 to 3,289 m^3/s for 14 days resulting in mean daily flows of 2,600 to 2,800 m^3/s. These mean daily flows are approximately half the pre-regulation freshet flows (NHC *at al*. 2010, pg. 6) and insufficient to mobilize coarser sediments within the mainstem or side channel areas below PCN. Analyses of grain size distributions (GSD) indicated that side channel sediment textures were coarsened by spill flows, mobilizing finer sediments eroded from overtop of existing cobbles and gravels. No changes to the underlying armour layer were noted at the sample sites.

Biological changes indicated changes in fish community structure with relatively minor changes in physical habitats and cover elements for the spill magnitude and duration in 2012. Both Side Channel 32L and 102.5R had lower relative abundance and changes in community structure that may reflect spill effects on fish health. Physical cover and measures of habitat type extracted using GIS differed little pre to post-spill at both sites. Changes in GSD and embeddedness are one noted physical change that was consistent between both the biological and morphological components of the monitor, although the changes were less distinct at 102.5R.

5.2 Management Issues

Following a spill of sufficient magnitude and duration, expected changes in side channels include erosion and/or deposition of bed and bar sediments; changes in aquatic and riparian habitats; changes in the textural quality of sediments and changes in channel section, profile and planform. If the spill was sufficient, there is the potential for larger-scale changes including the loss and/or creation of side channels due to erosion and lateral movement of the main river channel. The flows required for these changes would be associated with extreme floods or repeated events over a long time scale (e.g. annual freshet flows).

The potential morphological change is a function the magnitude and duration of the spill. Since regulation, the mean annual flood in the Peace River has been reduced by a factor of three (Church 2005). This reduction in large recurring flood flows has reduced the competence or ability of the river to move larger bed material sediments (e.g., gravels and cobble-sized materials) or similar sediments deposited by tributaries at their confluence with the mainstem river. Church (2005) estimated competent flows in the cobble-gravel reach (where all the study side channels are located) to be about 3,000 m^3/s as a mean daily flow at Hudson Hope. Coarser sediments in the side channels (where flow gradient and velocity are reduced) would likely only have been mobilized pre-regulation, and will not exhibit any movement at flows less than 3,000 m^3/s.

These reduced flood flows still have sufficient magnitude and power to transport finer fraction sands and silts. However, with reduced velocities and flows within the side channel complexes, these finer sediments accrue, infilling the channel section proving for growth of vegetation. This narrowing effect in side channels associated with reduced flood flows has been documented on both the Peace (Church and North 1996, Church *et al*., 1997) and Nechako Rivers (Neill and Rood 1987).

Spills on the Peace River below PCN at the duration and magnitude experienced in 2012 had limited physical effects on the side channels assessed under this monitoring program. Overall, side channel sediment textures were coarsened by spill flows mobilizing finer sediments eroded from overtop of existing cobbles and gravels. Sand and silt deposits in the side channels were mobilized by smaller flows provided these fully inundate the surface. No changes to this underlying armour layer or measured physical characteristics were noted at the sample sites for the 2012 spill.

Biological changes indicated changes in fish community structure with relatively minor changes in physical habitats and cover elements for the spill magnitude and duration in 2012. Both Side Channel 32L and 102.5R had lower relative abundance and changes in community structure that may reflect spill effects on fish health. Physical cover and measures of habitat type extracted using GIS differed little pre to post-spill at both sites. Changes in GSD and embeddedness are one noted physical change that was consistent between both the biological and morphological components of the monitor, although the changes were less distinct at 102.5R.

The monitor was not able to discern the cause of the fish community changes, whether they due to changes in habitat suitability, water quality or temperature, primary and secondary productivity, or some combination of these key factors. Understanding what is the cause of the changes in fish communities would also help explain the resilience and longevity of these ecological changes in a post spill environment. For example, if sediment flushing and changes to GSD are important factors then the time frame in which side channel habitats infill with sediment and revert to a fine textured substrate may be critical. In terms of the PFPP, more frequent spill flows in excess of 2,500 m^3/s may mitigate infilling and influence fish community structure and utilization.

One difficulty is the lack of data and ability to monitor the side channels. Spatially the Peace River side channels cover a large area, that is difficult to access. Sample sites are large, and multiple site are require to adequately reference index channel types and habitats. Temporally, physical changes resulting from floods are occurring and changing over long periods of time and the episodic flood events themselves are rare.

However, if the physical effects of a spill are of sufficient spatial extent and are sustained over time, this will result in changes to fish community structure and fish utilization of side channel habitats. If similar physical effects occurred in other non-index or monitored side channels, these physical effects may have implications to the overall Peace River fish community. This infers that some knowledge of the temporal effects of flood magnitude and duration on the Peace River are required.

All data suggests that larger, longer duration spill flows are likely required to affect significant changes in side channel section, planform and profile. Significantly higher flows – likely from 4,000 to 6,000 m^3/s for a period of weeks – are required for morphological change in the side channels that would affect channel structure, long term hydraulics and flows in these habitats. If changes in habitat suitability and hydraulics rely on these long term morphological changes, then lasting biological changes are unlikely to occur, and these would be reflected in the monitored fish communities.

All reviewed data suggests that larger, longer duration spill flows are likely required to affect significant changes by natural scour and erosion processes in side channel sections, planforms and profiles. Fish sampling conducted to date also suggests that extensive physical and hydraulic changes would have corresponding biological changes in fish utilization, habitats and community structure. These flow magnitudes are uncommon in the regulated Peace River and occur very infrequently. The likelihood of these changes occurring are low given the current operational regime, and only physical modifications to the side channels are likely to some restoration of physical and biological processes in these habitats.

5.3 Study Hypotheses

- Based on the methods and sites selected under this monitor, the 2012 spill flows did not result in erosion and sediment transport to affect differences in side channel morphology, and H_1 is rejected for 2012 spill flow magnitude and duration.
- Based on the range of site examined, sediment textures as represented by the D_{50} of GSD analyses indicate a minor increase as a result of 2012 spill flows, and H_2 is accepted.
- Based on the fish sampling conducted pre and post-spill, H_3 is accepted as changes were documented for fish numbers and species present. However, insufficient data is available to determine potential effect on fish species relative abundance and population structure.

5.4 Recommendations for further study under GMS Monitoring Programs

It is critical to adequately monitor the biological and physical effects of all future spill events for the both the PSP and the PFPP. The following recommendations are provided for future biological, sediment and geomorphological monitoring under these programs:

1. Both the PSP and the PFPP should incorporate additional detail in the timing, magnitude, and duration metrics to trigger changes in monitor(s) application, scope and tasks. Pre-spill hydrological and hydraulic modelling information should be able to determine the scope and extend of spill inundation and guide the scope of work for field monitors.
2. The data collected under GMSMON-8 suggest that limited geomorphic changes are experienced at 2012 spill flows, therefore a higher spill flow magnitude and duration (or combination of both) trigger level could be used in future PSP monitors. Only spill duration is used as a modifying factor in the current PSP. For example, the following table (**Table 5-1**) could be used as an interim guide for planning future GMSMON-8 work. Any spill-duration combination less than the criteria would default to the row above.

Table 5-1 Suggested Interim GMSMON-8 Spill Triggers.

Spill Flow mean daily (m^3/s) and duration[1]	GSD	Fish/Habitat	Orthophotos	Physical Surveys
> 2,000 for < 7 d	X	X		
2,000 – 3,500 for >7 d	X	X	X	
> 3,500 for > 7 d	X	X	X	X
[1.] As measured at PCN as mean daily flow over 24 hour period.				

3. This spill monitor requires spatial assessments of relatively larger areas. Additional side channel baseline maps could be produced using existing low water orthophotos produced under existing monitors or works (i.e., GMSWORKS-4 for flows less than 2,000 m^3/s). These data sets could then be compared to the next available orthophoto mosaic collected during other water levels to illustrate the morphologic effects of or future spills.

4. Physical effects cannot be determined by LiDAR as the vertical resolution will be unable to quantify changes in the side channels. Both air photo and topographic surveys are likely required in order to quantify potential morphological effects when they occur. The large spatial extent should use pre-identified index sites, similar to what is used under the GMSMON-8 and GMSMON-7 studies.

5. Any proposed index sites would be pre-selected for long-term monitoring with baseline surveys and benchmarks installed to facilitate rapid post-spill assessment. Cross sections at critical side channel features (i.e., bars, inlet channels and riffles) and long profile data may be useful measurements in a structured assessment program. GMSMON-7 is expected to include similar physical data collection on both study and index sites. GMSMON-8 should include sites other than those included under GMSMON-7 so larger sample of side channel types below PCN can be monitored effectively.

6. Biological data collection can be improved for the benefit of long-term assessment. Establishing fixed index sites for fish and habitat transects should be used, relying on the existing database of available sites. Multi-event datasets would allow statistical evaluation of potential spill effects on species diversity, relative abundance and age class structure.

7. The monitor should consider use of whole side channel estimate of fish abundance as a metric to measure potential spill effects. Biological sampling should occur at the same Peace River flow, and monitoring should include seasonal assessments in order to address natural variation in fish use of side channels that are not associated with potential spill effects. GMSMON-7 is expected to provide an improved estimate of fish community abundance and diversity and it is expected to commence in spring 2013.

8. Synoptic, repeat sampling at periodic intervals at index locations and sample sites should be considered in order to evaluate the time frame for change or reversion to a pre-spill state for both biological and physical elements under this GMSMON-8 as part of the PSP. These data will help determine the frequency and magnitude of spill events required to modify the morphology, habitats and fish communities in Peace River side channels.

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Appendix A Site Locations

Appendix A1 Sample site information (NAD 83, Zone 10), 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Method	Site	Easting	Northing	Upper Easting	Upper Northing	Lower Easting	Lower Northing
32L	2009	BOAT ELECTROFISHER	LF02SC115	587678	6225127	587502	6225005	587678	6225127
	2009	BOAT ELECTROFISHER	LF02SC115	587678	6225127	587502	6225005	587678	6225127
	2009	BEACH SEINE	BS0204	587506	6225003				
	2009	BEACH SEINE	BS0204	587506	6225003				
	2009	BACKPACK ELECTROFISHER	EF0204	587366	6224835				
	2009	GILL NET	GN0201	587571	6225057				
	2009	GILL NET	GN0201	587571	6225057				
	2009	GILL NET	GN0201	587571	6225057				
	2009	MINNOW TRAP	MT0203	587666	6225138				
	2009	BEACH SEINE	BS0209	587275	6224556				
	2009	BACKPACK ELECTROFISHER	EF0207	587265	6224509				
	2009	BACKPACK ELECTROFISHER	EF0207	587265	6224509				
	2010	BEACH SEINE	BS0204	587506	6225003				
	2010	BEACH SEINE	BS0204	587506	6225003				
	2010	BEACH SEINE	BS0204	587506	6225003				
	2010	BEACH SEINE	BS0217	587242	6224700				
	2010	BEACH SEINE	BS0217	587242	6224700				
	2010	BEACH SEINE	BS0217	587242	6224700				
	2010	BACKPACK ELECTROFISHER	EF0207	587265	6224509				
	2010	BACKPACK ELECTROFISHER	EF0207	587265	6224509				
	2010	BEACH SEINE	BS0218	586574	6223904				
	2011	BEACH SEINE	BS0204	587506	6225003				
	2011	BEACH SEINE	BS0204	587506	6225003				
	2011	BEACH SEINE	BS0204	587506	6225003				
	2011	BEACH SEINE	BS0217	587242	6224700				
	2011	BEACH SEINE	BS0217	587242	6224700				
	2011	BEACH SEINE	BS0217	587242	6224700				
	2011	BEACH SEINE	BS0209	587242	6224692				
	2011	BEACH SEINE	BS0209	587242	6224692				
	2011	BEACH SEINE	BS0209	587242	6224692				
	2011	GILL NET	GN0201	587571	6225057				
	2011	GILL NET	GN0201	587571	6225057				
	2012	BOAT ELECTROFISHER	PE116L01	586580	6223919	586276	6223602	586580	6223919
	2012	BOAT ELECTROFISHER	PE116L02	586859	6224153	586567	6223941	586859	6224153
	2012	BOAT ELECTROFISHER	116L01	587672	6225147	587353	6224835	587672	6225147
	2012	BOAT ELECTROFISHER	116L02	587326	6224807	587223	6224677	587326	6224807
	2012	BOAT ELECTROFISHER	116LSEF03	587627	6225120	587228	6224698	587627	6225120
	2012	BOAT ELECTROFISHER	116LSEF03	587228	6224698	587627	6225120	587228	6224698
	2012	BACKPACK ELECTROFISHER	32LEF03	586866	6224137				
	2012	BACKPACK ELECTROFISHER	EF01	587366	6224835				
	2012	BACKPACK ELECTROFISHER	116LEF01	587249	6224689				
	2012	BEACH SEINE	116LBS01	587292	6224630				
	2012	BEACH SEINE	116LBS02 (17)	587251	6224715				
	2012	BEACH SEINE	BS04 (04)	587506	6225002				
	2012	HABITAT TRANSECTS	1	587640	6225129				
	2012	HABITAT TRANSECTS	2	587572	6225080				
	2012	HABITAT TRANSECTS	3	587510	6225018				
	2012	HABITAT TRANSECTS	4	587443	6224952				

Appendix A1 Sample site information (NAD 83, Zone 10), 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Method	Site	Easting	Northing	Upper Easting	Upper Northing	Lower Easting	Lower Northing
	2012	HABITAT TRANSECTS	5	587385	6224889				
	2012	HABITAT TRANSECTS	6	587326	6224824				
	2012	HABITAT TRANSECTS	7	587266	6224762				
	2012	HABITAT TRANSECTS	8	587696	6225152				
	2012	HABITAT TRANSECTS	9	587259	6224673				
	2012	HABITAT TRANSECTS	10	587283	6224606				
	2012	HABITAT TRANSECTS	HT11 (07)	587250	6224517				
102.5RA	2009	BOAT ELECTROFISHER	LF06SC047	644486	6223512	644165	6223206	644486	6223512
	2009	BOAT ELECTROFISHER	LF06SC047	644486	6223512	644165	6223206	644486	6223512
	2009	BOAT ELECTROFISHER	LF06SC047	644486	6223512	644165	6223206	644486	6223512
	2009	BEACH SEINE	BS0602	644092	6223514				
	2009	BEACH SEINE	BS0602	644092	6223514				
	2009	BEACH SEINE	BS0602	644092	6223514				
	2010	BOAT ELECTROFISHER	LF06SC047	644486	6223512	644165	6223206	644486	6223512
	2010	BEACH SEINE	BS0616	644443	6223503				
	2010	BEACH SEINE	BS0616	644443	6223503				
	2010	BEACH SEINE	BS0616	644443	6223503				
	2010	BEACH SEINE	BS0602	644092	6223514				
	2011	BOAT ELECTROFISHER	LF06SC047	644486	6223512	644165	6223206	644486	6223512
	2011	BOAT ELECTROFISHER	LF06SC047	644486	6223512	644165	6223206	644486	6223512
	2011	BOAT ELECTROFISHER	LF06SC047	644486	6223512	644165	6223206	644486	6223512
	2012	BOAT ELECTROFISHER	SF47R01	643338	6223777	643585	6223952	643338	6223777
	2012	BOAT ELECTROFISHER	SF47R02	643894	6223550	643345	6223764	643894	6223550
	2012	BOAT ELECTROFISHER	SF47R03	644485	6223521	643917	6223519	644485	6223521
	2012	BOAT ELECTROFISHER	SF47R04	644320	6223312	644007	6223243	644320	6223312
	2012	BEACH SEINE	BS01	644443	6223502				
	2012	BEACH SEINE	BS03 (BS02)	644092	6223514				
	2012	BEACH SEINE	BS47R01	643613	6223664				
	2012	HABITAT TRANSECTS	31	644515	6223550				
	2012	HABITAT TRANSECTS	HT32 (BS16)	644444	6223483				
	2012	HABITAT TRANSECTS	33	644355	6223450				
	2012	HABITAT TRANSECTS	34	644247	6223465				
	2012	HABITAT TRANSECTS	35	644163	6223465				
	2012	HABITAT TRANSECTS	36	644099	6223508				
	2012	HABITAT TRANSECTS	37	644006	6223530				
	2012	HABITAT TRANSECTS	38	643924	6223553				
	2012	HABITAT TRANSECTS	39	643836	6223574				
	2012	HABITAT TRANSECTS	40	643743	6223599				
	2012	HABITAT TRANSECTS	41	643663	6223636				
	2012	HABITAT TRANSECTS	42	643583	6223675				
	2012	HABITAT TRANSECTS	43	643501	6223710				
	2012	HABITAT TRANSECTS	44	643419	6223745				
	2012	HABITAT TRANSECTS	2	643342	6223786				
	2012	HABITAT TRANSECTS	3	643403	6223858				
	2012	HABITAT TRANSECTS	4	643493	6223915				
102.5RB	2009	MINNOW TRAP	MT0601	643881	6223198				
	2009	MINNOW TRAP	MT0601	643881	6223198				
	2009	MINNOW TRAP	MT0601	643881	6223198				
	2009	MINNOW TRAP	MT0602	644325	6223305				

Appendix A1 Sample site information (NAD 83, Zone 10), 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Method	Site	Easting	Northing	Upper		Lower	
						Easting	Northing	Easting	Northing
	2009	MINNOW TRAP	MT0602	644325	6223305				
	2009	MINNOW TRAP	MT0602	644325	6223305				
	2009	BEACH SEINE	BS0603	644152	6223262				
	2009	BEACH SEINE	BS0603	644152	6223262				
	2009	BEACH SEINE	BS0603	644152	6223262				
	2010	BEACH SEINE	BS0603	644152	6223262				
	2012	BEACH SEINE	BS02	644152	6223262				
	2012	BEACH SEINE	BS47R02	644086	6223247				
	2012	BEACH SEINE	BS47R03	643781	6223400				
	2012	BEACH SEINE	BS47R04	643769	6223350				
	2012	BOAT ELECTROFISHER	SF47R05	644390	6223455	644005	6223243	644390	6223455

Appendix B Definitions

Appendix – B1
Habitat and Substrate Type Classification Systems

Instream Habitat

Provides a qualitative assessment of the physical characteristics of a stream and its potential as fish habitat.

Riffle - Portion of channel with increased velocity relative to Run and Pool habitat types; broken water surface due to effects of submerged or exposed bed materials; shallow (less than 25 cm). Limited value as habitat for larger juveniles and adults (i.e., feeding), but may be used extensively by young-of-the-year and small juveniles.

RF - Typical riffle habitat type; provides limited cover for all life stages.

RF/BG - Riffle habitat type with abundance of large cobble and boulder substrates. Limited cover for juveniles and adults; but, may be used extensively by young-of-the-year fish.

Rapids (RA) - Portion of channel with highest velocity relative to other habitat types. Deep (>25 cm); often formed by channel constriction. Substrate extremely coarse; dominated by large cobble and boulder substrates. Habitat provided for juveniles and adults in pocket eddies associated with substrate.

Run - Portion of channel characterized by moderate to high current velocity relative to Pool and Flat habitats; water surface largely unbroken. Potentially high habitat value for all life stages. Can be differentiated into five types based on depth and cover.

R1 - Maximum depth exceeding 1.5 m; average depth 1.0 m. High cover at all flow conditions. Highest quality habitat for larger juveniles and adults; limited value for young-of-the-year-fish.

R2/BG - Maximum depth reaching 1.0 m and generally exceeding 0.75 m; presence of large cobble or boulder substrates in channel. High cover at all flows. Moderate to high quality habitat for larger juveniles and adults.

R2 - Maximum depth reaching 1.0 m and generally exceeding 0.75 m. High cover during most flows, but not during base flows. Moderate quality habitat for juveniles and adults; limited value for young-of-the-year-fish.

R3/BG - Maximum depth of 0.75 m, but averaging <0.50 m; presence of large cobble or boulder substrates in channel. Moderate cover at all flows. Moderate quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

R3 - Maximum depth of 0.75 m, but averaging <0.50 m. Low cover at all flows. Lowest quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

Flat - Area of channel characterized by low current velocities (relative to RF and Run cover types); near-laminar (i.e., non-turbulent) flow. Depositional area dominated sand/silt substrates. Differentiated from Pool habitat type by high channel uniformity and lack of direct association with riffle/run complex. Potential habitat value for all life stages is moderate to high. Can be differentiated into five types based on depth and cover.

F1 - Maximum depth exceeding 1.5 m; average depth 1.0 m or greater. High cover at all flows. Highest quality habitat for larger juveniles and adults; limited value for young-of-the-year-fish.

F2/BG - Maximum depth reaching 1.0 m and generally exceeding 0.75 m; presence of large cobble or boulder substrates in channel. High cover at all flows. Moderate to high quality habitat for larger juveniles and adults.

F2 - Maximum depth exceeding 1.0 m; generally exceeding 0.75 m. High cover during most flows, but not during base flows. Moderate quality habitat for juveniles and adults; limited value for young-of-the-year-fish.

F3/BG - Maximum depth of 0.75 m, but averaging <0.50 m; presence of large cobble or boulder substrates in channel. Moderate cover at all flows. Moderate quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

F3 - Maximum depth of 0.75 m, averaging less than 0.50 m. Low cover at all flows. Lowest quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

Pool - Discrete portion of channel featuring increased depth and reduced velocity (downstream oriented) relative to Riffle and Run habitat types. Normally featuring Riffle/Run associations. Principal habitat value for all life stages is cover. When in close association with Riffle/Run habitats, value can be very high. Can be differentiated into three types based on depth.

P1 - Maximum depth exceeding 1.5 m; average depth 1.0 m or greater; high cover at all flow conditions. Often intergrades with deep-slow type of R1. Highest quality habitat for larger juveniles and adults; limited value for young-of-the-year-fish.

P2 - Maximum depth reaching or exceeding 1.0 m, generally exceeding 0.75 m. High cover at all but base flows. Moderate quality habitat for juveniles and adults; limited value for young-of-the-year-fish.

P3 - Maximum depth of 0.75 m, averaging <0.50 m. Low instream cover; includes small pocket eddies. Lowest quality habitat for all life stages.

Special Features - Includes the following instream features:

Ledges (LG) - Areas of bedrock intrusion into the channel; often creates Chutes and Pool habitat.

Falls (FAL) - Channel section exhibiting distinct vertical falls over boulder and bedrock. Often a barrier to fish.

Cascade (CAS) - Area of channel exhibiting distinct drop over boulder and bedrock, but, no defined falls. Often a barrier to fish.

Tributary Confluence (TC) - Area of main river channel directly affected by tributary confluence.

Backwater (BW) - Well-defined zone of zero or reverse flow water velocity associated with a large bank irregularity.

Tributary Confluence/Backwater (TCBW) – area of main channel and backwater associated with bank irregularities formed by tributary confluence.

Snye (SN) - Well-defined back channel not subjected to mainstem currents.

Oxbow (OX) – Bend or meander in a stream or river that becomes detached from the stream channel from natural fluvial processes.

Bank Habitat

The zone within the immediate hydraulic influence of the bank-water interface. Typically extends from the annual high-water to low-water mark.

Armoured

Bank is stable and is composed of armoured cobble to boulder substrates that are not subjected to movement during annual floods; can be differentiated into categories based on the amount of bank roughness.
(A1 very rough, A2 moderately rough, A3 not rough)

Canyon

Bank is stable, is near vertical, and is composed of boulder to bedrock substrates; can be differentiated into categories based on the amount of bank roughness (C1 very rough, C2 moderately rough, C3 not rough).

Depositional

Bank exhibits low relief and is composed of silt to cobble substrates; characterized by high substrate mobility and low bank roughness (D1 cobble; D2 gravel; D3 sand and silts). Differentiated into tributary (TD) and mainstem (MD) depositional zones.

Erosional

Bank is dominated silt to gravel substrates that exhibit evidence of active erosion; note that large rock substrates can be present; can be differentiated into categories based on the amount of bank roughness
(E1 very rough, E2 moderately rough, E3 not rough).

Mesohabitat
To address issues caused by sampling several habitat types within on site using small fish and large fish boat electrofisher methods , sampled instream and bank habitat types were categorized into discrete groups based on differences in physical characteristics that included bank slope, water velocity, and the presence of physical cover (see table).

Four mesohabitat types sampled during the program were as follows:

- SFC - Moderate slope; shallow water; high water; velocity; physical cover
- SFN - Gradual slope; shallow water; high water velocity; no physical cover
- SSC - Moderate slope; shallow water; slow; physical cover
- SSN - Gradual slope; shallow water; slow; no physical cover

MesoHabitat Category	Bank Habitat[a]	Instream Habitat	Water Velocity[a]	Channel Bed Slope[a]	Physical Instream Cover	Substrate
SFN	A3	Run	Moderate to High	Low	Absent	Rock
SFC	A1/A2	Run	Moderate to High	Moderate	Present	Rock
SSN	A3	Flat	Low	Low	Absent	Rock or Sand
SSC	A1/A2	Flat	Low	Moderate	Present	Rock or Sand

[a] Based on subjective measure by field biologist.

Substrate Classification System

Modified Wentworth classification for substrate particle sizes (from Cummins 1962)

Category	Particle Size Range (mm)
Bedrock	-
Boulder	>256
Cobble	32 - 256
Gravel	1 - 32
Sand	0.0625 - 0.2-1
Silt	0.0039-0.0625
Clay	<0.0039
Organics	-

Appendix – B2
Site Characteristics Definitions

Habitat type:	See Appendix B1 for definitions.
Water conductivity:	Measured using Hanna HI98311 EC/TDS meter (μ*S*/cm) (± 2% full scale).
Water temperature:	Measured using Hanna HI98311 EC/TDS meter (± 0.1^{o}C).
Water pH:	Measured using Hanna HI98311 EC/TDS meter (± 0.01).
Water clarity:	Measured to the nearest centimetre using a secchi plate mounted on a pole (plate was 2.5 cm wide x 21 cm long partitioned into three equal sections of black, white, and black).
Sample effort:	Dependent on sample method. Boat electrofishing measured as number of fish/km, backpack electrofishing effort measured as number of fish/m, beach seine effort measured as number fish/100 m^2, gill net effort measured as number fish/100 m^2/24 h, and minnow trap effort measured as number of fish/trap/24 h.
Substrate type (%):	Material forming the bottom of the stream bed (see Substrate Classification System, Appendix B1). Visually rated within a predetermined area of stream bed.
Fish Cover (%):	Overhead (Ovh) cover, rock cover, large organic debris (LOD) cover, submergent (Sub) vegetation cover, emergent (Emer) vegetation cover, algal cover, that provide protection for fish within a predetermined area.
D90 (cm):	Represented the average size of substrate particle that is in the 90th percentile.
Embeddedness:	Degree to which rock substrates are surrounded and/or are covered by fines (Low, Moderate, High).
Compaction:	Looseness of substrate; ability to be moved during high flow (Low, Moderate, High).
Depth (m):	Depth of water at a point measured to nearest centimetre. At beach seines sites depth is measured at ¼, ½, and ¾ of the haul width. Depth at electrofisher sites depth is measured in the same manner across the width of sampled area.
Velocity (m/s):	Measured in the same place depth is taken at beach seine and backpack electrofisher sites. Measured with Swoffer Model 2100 flow meter wading wand (wand automatically determines depth at 0.6 m from water surface – best place to determine average velocity of water column in relatively shallow water) (m/s every 6.0 seconds).

Appendix – B3
Fish Life History Data Abbreviations and Codes

BC Label	Alberta Label	Common Name	Scientific Name	BC Label	Alberta Label	Common Name	Scientific Name
RB	RNTR	Rainbow trout	*Oncorhynchus mykiss*	BB	BURB	Burbot	*Lota lota*
GB	BNTR	Brown trout	*Salmo trutta*	CCG	SLSC	Slimy sculpin	*Cottus cognatus*
CT	CTTR	Cutthroat trout	*Oncorhynchus clarkii*	CRI	SPSC	Spoonhead sculpin	*Cottus ricei*
BT	BLTR	Bull trout	*Salvelinus confluentus*	CAS	PRSC	Prickly sculpin	*Cottus asper*
DV	DLVR	Dolly varden	*Salvelinus malma*	CAL	CSSC	Coastrange sculpin	*Cottus aleuticus*
LT	LKTR	Lake trout	*Salvelinus namaycush*	CCN	SHSC	Shorthead sculpin	*Cottus confusus*
AC	ARCH	Arctic char	*Salvelinus alpinus*	CLA	PSSC	Pacific staghorn sculpin	*Leptocottus armatus*
EB	BKTR	Brook trout	*Salvelinus fontinalis*	CBA	MTSC	Mottled sculpin	*Cottus bairdii*
GR	ARGR	Arctic grayling	*Thymallus arcticus*	CRH	TRSC	Torrent sculpin	*Cottus rhotheus*
MW	MNWH	Mountain whitefish	*Prosopium williamsoni*	BSB	BRST	Brook stickleback	*Culaea inconstans*
RW	RNWH	Round whitefish	*Prosopium cylindraceum*	NSB	NNST	Ninespine stickleback	*Pungitius pungitius*
PW	PGWH	Pygmy whitefish	*Prosopium coulterii*	TSB	THST	Threespine stickleback	*Gasterosteus aculeatus*
LW	LKWH	Lake whitefish	*Coregonus clupeaformis*	RSC	RDSH	Redside shiner	*Richardsonius balteatus*
KO	KOKA	Kokanee	*Oncorhynchus nerka*	NSC	NPMN	Northern pikeminnow	*Ptychocheilus oregonensis*
LSU	LNSC	Longnose sucker	*Catostomus catostomus*	PDC	PRDC	Pearl dace	*Margariscus margarita*
WSU	WHSC	White sucker	*Catostomus commersonii*	PCC	PEAM	Peamouth	*Mylocheilus caurinus*
CSU	LSSC	Largescale sucker	*Catostomus macrocheilus*	FHC	FLCH	Flathead chub	*Platygobio gracilis*
BSC	BRSC	Bridgelip sucker	*Catostomus columbianus*	LKC	LKCH	Lake chub	*Couesius plumbeus*
MSC	MNSC	Mountain sucker	*Catostomus platyrhynchus*	LNC	LNDC	Longnose dace	*Rhinichthys cataractae*
CMC	CHIS	Chiselmouth	*Acrocheilus alutaceus*	FDC	FNDC	Finescale dace	*Phoxinus neogaeus*
LSG	LKST	Lake sturgeon	*Acipenser fulvescens*	RDC	NRDC	Northern redbelly dace	*Phoxinus eos*
WSG	WHST	White sturgeon	*Acipenser transmontanus*	LDC	LPDC	Leopard dace	*Rhinichthys falcatus*
GE	GOLD	Goldeye	*Hiodon alosoides*	ESC	EMSH	Emerald shiner	*Notropis atherinoides*
NP	NRPK	Northern pike	*Esox lucius*	STC	SPSH	Spottail shiner	*Notropis hudsonius*
WP	WALL	Walleye	*Sander vitreus*	FM	FTMN	Fathead minnow	*Pimephales promelas*
	SAUG	Sauger	*Sander canadensis*	TP	TRPR	Trout-perch	*Percopsis omiscomaycus*
YP	YLPR	Yellow perch	*Perca flavescens*		IWDR	Iowa darter	*Etheostoma exile*

Sex and Maturity Descriptions

M	F	Class	Description
99		Immature A	Sex indeterminable due to small gonad size.
01	11	Immature B	Small gonad size; fish has never spawned and will not spawn during the coming spawning season.
02	12		Maturing but not ready to spawn; will spawn this year
06	16	Alternate	Small gonad size associated with large size; suggests alternate year spawner.
07	17	Gravid	Sexual organs fill cavity testes white, drops of milt fall with pressure; eggs completely round, some already translucent.
08	18	Ripe	Roe or milt are extruded by slight pressure on the belly.
09	19	Spent	Spawning completed; reabsorption of residual ovarian tissue is not yet complete.
10	20	External	Sex determined by external characteristics
97		Adult	Based on fish size; sex not determined.
98		Juvenile	Based on fish size; sex not determined.

Capture Method Codes

Code	Capture Method	Code	Capture Method
SL	Set line	ES	Boat electrofisher
DN	Dip net	EF	Backpack electrofisher
GN	Gill net	AL	Angling
BS	Beach seine	GE	Gee minnow trap
HN	Hoop net	RST	Rotary screw trap
TR	Trap		

Tag Codes

Code	Tag Code
Y, W, O	Color code for tag (Yellow, White, Orange)

Tag Type
PIT (Passive Integrated Transponder)
Radio (Radio transmitter tags)
Floy

Capture Codes

Code	Capture Code
0	First capture, released
1	First capture, mortality
2	Recapture, released
3	Recapture, mortality
5	Recapture, fin clip and lost tag

Age Structure Codes

Code	Age Structure	Code	Age Structure
SC	Scales	CL	Cleithra
OT	Otoliths	CS	Cleithra and scales
SO	Scales and otoliths	SF	Scales and fin rays
FR	Fin ray		

Identified to Family

BC/Alberta Label	Family
SU/SUCK	Catostomidae
CC/SCUL	Cottidae
MINN	Cyprinidae

Appendix – B4
Observed and Release-No-data Definitions

Small Fish Catch:	Count of small fish (≤ 200 mm fork length) caught and measured.
Total Catch:	Total count of fish caught and measured.
Adult Observed:	Adult fish (> 200 mm fork length) observed, but not caught.
Small Fish Observed:	Small fish observed, but not caught.
YOY Observed:	YOY (young-of-the-year) observed, but not caught.
All RND:	All age groups caught with (RND, released-no-data) no measurements taken.
Adult RND:	Adult fish caught with no measurements taken.
Small Fish RND:	Small fish caught with no measurements taken.
YOY RND:	YOY fish caught with no measurements taken.
Small Fish Number:	Count of small fish catch, small fish observed, YOY observed, small fish RND, and YOY RND.
Total Number:	Total count of all caught, observed and RND fish.

Appendix C Water Quality Information

Appendix C1 Water quality information, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Date	pH	Conductivity (µS/cm)	Clarity (cm)
32L	2009	BS0204	5/17/09		310	90
	2009	BS0204	9/24/09		193	TCB
	2009	BS0209	7/16/09		153	32
	2009	EF0204	5/18/09		187	TCB
	2009	EF0207	7/16/09	8.2	155	210
	2009	EF0207	9/24/09	7.8	153	32
	2009	GN0201	5/18/09		187	90
	2009	GN0201	7/16/09		155	20
	2009	GN0201	9/25/09	8.3	172	210
	2009	LF02SC115	5/18/09		180	90
	2009	LF02SC115	7/16/09			25
	2009	MT0203	5/17/09		187	90
	2010	BS0204	5/29/10	7.6	301	0.45
	2010	BS0204	7/9/10	7.8	261	2.1
	2010	BS0204	10/3/10	8.9	303	2.1
	2010	BS0217	5/29/10	7.7	348	0.45
	2010	BS0217	7/9/10	7.7	250	2.1
	2010	BS0217	10/3/10	8.8	375	2.1
	2010	BS0218	5/29/10	9.1	331	
	2010	EF0207	5/29/10	7.7	148	0.45
	2010	EF0207	7/9/10	7.8	183	
	2011	BS0204	5/20/11	7.8	336	0.1
	2011	BS0204	7/14/11	8.3	169	0.1
	2011	BS0204	10/11/11	8.2	173	
	2011	BS0209	5/20/11	7.7	349	0.45
	2011	BS0209	7/15/11	7.7	434	0.26
	2011	BS0209	10/11/11	7.6	213	
	2011	BS0217	5/20/11	8.2	157	0.1
	2011	BS0217	7/15/11	8.2	162	0.09
	2011	BS0217	10/11/11	8.5	158	
	2012	116L01	8/20/12	7.81	346	TCB
	2012	116L02	8/20/12			
	2012	116LBS01	8/20/12	8.33	228	TCB
	2012	116LBS02	8/20/12	7.81	346	TCB
	2012	116LEF01	8/21/12	8.49	179	TCB
	2012	116LSEF03	8/21/12			
	2012	116LSEF03	8/21/12			
	2012	32LEF03	8/19/12	9.35	194	TCB
	2012	BS04	8/21/12	7.89	405	TCB
	2012	EF01	8/21/12	7.94	316	TCB
	2012	PE116L01	8/19/12	8.71	205	TCB
	2012	PE116L02	8/19/12	8.71	209	TCB

Appendix C1 Sample site information (NAD 83, Zone 10), 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Date	pH	Conductivity (µS/cm)	Clarity (cm)
102.5RA	2009	BS0602	5/24/09		220	18
	2009	BS0602	7/20/09	7.9	201	24
	2009	BS0602	10/1/09	8.2	246	TCB
	2009	LF06SC047	5/25/09			
	2009	LF06SC047	7/24/09		219	32
	2009	LF06SC047	9/26/09		234	120
	2010	BS0602	6/5/10		175	0.23
	2010	BS0616	6/5/10		207	0.2
	2010	BS0616	7/18/10	7.3	531	
	2010	BS0616	10/9/10	8.2	610	1
	2010	LF06SC047	6/4/10		175	0.23
	2011	LF06SC047	6/2/11			
	2011	LF06SC047	7/21/11			
	2011	LF06SC047	10/16/11			
	2012	BS01	8/24/12	8.42	258	0.45
	2012	BS03	8/24/12	8.42	258	TCB
	2012	BS47R01	8/24/12	8.65	251	TCB
	2012	SF47R01	8/24/12	8.74	251	
	2012	SF47R02	8/24/12	8.65	251	
	2012	SF47R03	8/24/12	8.42	258	
	2012	SF47R04	8/25/12	9.49	161	TCB
102.5RB	2009	BS0603	5/24/09		287	15
	2009	BS0603	7/20/09	7.6	223	12
	2009	BS0603	10/1/09	8.4	246	TCB
	2009	MT0601	5/24/09		287	50
	2009	MT0601	7/20/09		216	
	2009	MT0601	10/1/09			100
	2009	MT0602	5/24/09		287	15
	2009	MT0602	7/20/09			17
	2009	MT0602	10/1/09			50
	2010	BS0603	6/5/10		237	0.4
	2012	BS02	8/25/12	8.11	246	0.42
	2012	BS47R02	8/25/12	8.11	246	0.42
	2012	BS47R03	8/25/12	9.49	161	TCB
	2012	BS47R04	8/25/12	9.49	161	TCB
	2012	SF47R05	8/25/12	9.49	161	TCB

Appendix D Site Transect Data

Appendix D1 Habitat transect parameters measured, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Transect	Instream Habitat	Width (m) Wetted	Width (m) Channel	Substrate (%) Om	Si	Sa	Gr	Co	Bo	Be	D90 (cm)	Embed.	Compact.	LOD	Cover (%)	Erosion (%)
32L	2012	1	FLAT	14.0	84.0	15	5	20	15	30	15	0	40	M	M	ABSENT	10	50
	2012	2	FLAT	12.0	89.0	10	10	20	30	25	5	0	17	H	H	ABSENT	10	50
	2012	3	FLAT	16.0	90.0	5	10	35	20	25	5	0	16	M	H	ABSENT	5	0
	2012	4	FLAT	21.0	91.0	5	40	30	10	10	5	0	31	H	H	ABSENT	0	0
	2012	5	FLAT	22.0	108.0	5	50	35	5	5	0	0	12	H	H	ABSENT	0	0
	2012	6	FLAT	17.0	117.0	20	0	30	10	35	5	0	21	M	M	ABSENT	0	0
	2012	7	FLAT	21.0	164.0	0	5	15	45	30	5	0	18	M	M	ABSENT	0	0
	2012	8	FLAT	16.0	102.0	0	0	40	45	15	0	0	15	L	L	ABSENT	0	0
	2012	9	RIFFLE	16.0	165.0	0	25	10	20	40	5	0	18	L	M	ABSENT	10	0
	2012	10	FLAT	21.0	50.0	0	5	15	25	45	10	0	28	M	H	ABSENT	5	0
	2012	11	FLAT	16.0	4.0	5	5	10	30	40	10	0	28	L	M	ABSENT	10	0
102.5RA	2012	1	FLAT	36.0	55	0	70	20	0	10	0	0	14	H	H	ABSENT	0	0
	2012	2	FLAT	35.0	44	0	60	40	0	0	0	0				ABSENT	0	0
	2012	3	FLAT	28.0	37	0	60	30	0	10	0	0	15	M	M	ABSENT	0	0
	2012	4	FLAT	27.0	25	0	25	25	30	20	0	0	9	M	L	PRESENT	0	0
	2012	5	FLAT	17.0	35	0	5	10	65	20	0	0	12	M	L	ABSENT	0	0
	2012	6	RIFFLE	26.0	39	0	10	5	65	20	0	0	17	M	M	ABSENT	10	10
	2012	7	FLAT	29.0	36	0	30	10	0	60	0	0	17	H	H	ABSENT	5	5
	2012	8	FLAT	30.0	40	0	10	30	5	50	5	0		M	H	PRESENT	5	5
	2012	9	FLAT	32.0	41	0	20	65	5	10	0	0		M	H	PRESENT	0	0
	2012	10	FLAT	31.0	38	0	35	60	0	5	0	0		M	H	ABSENT	0	0
	2012	11	FLAT	31.0	39	0	10	80	5	5	0	0		M	H	ABSENT	0	0
	2012	12	FLAT	32.0	38	0	10	10	25	50	5	0	18	M	M	ABSENT	0	0
	2012	13	RIFFLE	32.0	37	0	15	10	10	55	10	0	20	L	L	ABSENT	5	50
	2012	14	RIFFLE	32.0	35	0	10	5	30	50	5	0	20	M	M	ABSENT	0	0
	2012	15	RUN	39.0	42	0	5	5	15	60	15	0	25	H	H	ABSENT	5	100
	2012	16	FLAT	21.0	21	0	50	35	10	5	0	0				PRESENT	10	80
	2012	17	FLAT	24.0	24	0	10	0	10	70	10	0	15	M	M	PRESENT	10	100

Appendix E Fish Catch Data

Appendix E1 Fish catch rate data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Method	Year	Site	Date	Species	CATCH No.	OBSER. No.	TOTAL No.	Catch Rate
32L	Beach Seine	2009	BS0204	5/17/09	MNWH	95	10	105	33
		2009	BS0204	5/17/09	LNSC	0	1	1	0
		2009	BS0204	5/17/09	LKCH	0	1	1	0
		2009	BS0204	5/17/09	SCUL	0	3	3	1
		2009	BS0204	5/17/09	PRSC	0	2	2	1
		2009	BS0204	9/24/09	LSSC	0	1	1	0
		2009	BS0204	9/24/09	LNSC	26	11	37	12
		2009	BS0204	9/24/09	LKCH	0	1	1	0
		2009	BS0204	9/24/09	RDSH	0	3	3	1
		2009	BS0204	9/24/09	SCUL	0	3	3	1
		2009	BS0204	9/24/09	PRSC	0	3	3	1
		2009	BS0209	7/16/09	PRSC	0	3	3	1
		2010	BS0204	5/29/10	MNWH	0	7	7	2
		2010	BS0204	5/29/10	LNSC	0	2	2	1
		2010	BS0204	5/29/10	RDSH	0	8	8	3
		2010	BS0204	5/29/10	PRSC	0	1	1	0
		2010	BS0204	7/9/10	SUCK	73	14	87	28
		2010	BS0204	7/9/10	LNSC	0	4	4	1
		2010	BS0204	7/9/10	PRSC	7	10	17	5
		2010	BS0204	7/9/10	SLSC	0	0	1	0
		2010	BS0204	10/3/10	MNWH	0	0	1	0
		2010	BS0204	10/3/10	SUCK	0	0	1	0
		2010	BS0204	10/3/10	LNSC	0	0	2	1
		2010	BS0204	10/3/10	NPMN	0	0	3	1
		2010	BS0204	10/3/10	RDSH	255	14	269	85
		2010	BS0217	5/29/10	MNWH	108	10	118	37
		2010	BS0217	5/29/10	SUCK	0	1	1	0
		2010	BS0217	5/29/10	LNSC	0	1	1	0
		2010	BS0217	5/29/10	RDSH	0	2	2	1
		2010	BS0217	5/29/10	SCUL	0	1	1	0
		2010	BS0217	7/9/10	SUCK	0	8	8	3
		2010	BS0217	10/3/10	SUCK	0	3	3	1
		2010	BS0217	10/3/10	LNSC	0	14	14	4
		2010	BS0217	10/3/10	LKCH	0	1	1	0
		2010	BS0217	10/3/10	NPMN	0	9	9	3
		2010	BS0217	10/3/10	RDSH	0	3	3	1
		2010	BS0217	10/3/10	PRSC	0	2	2	1
		2011	BS0204	5/20/11	MNWH	30	16	46	15
		2011	BS0204	5/20/11	LSSC	1	3	3	1
		2011	BS0204	5/20/11	LNSC	3	11	14	4
		2011	BS0204	5/20/11	NPMN	11	11	22	7
		2011	BS0204	5/20/11	RDSH	120	21	141	45
		2011	BS0204	40683	PRSC	0	1	1	0

Appendix E1 Fish catch rate data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Method	Year	Site	Date	Species	CATCH No.	OBSER. No.	TOTAL No.	Catch Rate
		2011	BS0204	5/20/11	SLSC	0	1	1	0
		2011	BS0204	7/14/11	MNWH	0	7	7	2
		2011	BS0204	7/14/11	SUCK	0	1	1	0
		2011	BS0204	7/14/11	LSSC	0	3	3	1
		2011	BS0204	7/14/11	LNSC	0	1	1	0
		2011	BS0204	7/14/11	RDSH	0	3	3	1
		2011	BS0204	10/11/11	SUCK	1	0	1	0
		2011	BS0204	10/11/11	LSSC	0	1	1	0
		2011	BS0204	10/11/11	LNSC	0	1	1	0
		2011	BS0204	10/11/11	SCUL	61	20	89	28
		2011	BS0209	5/20/11	MNWH	0	5	5	2
		2011	BS0209	5/20/11	LNSC	31	10	41	13
		2011	BS0209	5/20/11	NPMN	0	7	7	2
		2011	BS0209	5/20/11	RDSH	59	21	80	25
		2011	BS0209	7/15/11	MNWH	0	1	1	0
		2011	BS0209	7/15/11	SUCK	201	10	211	67
		2011	BS0209	7/15/11	LNSC	0	3	3	1
		2011	BS0209	7/15/11	RDSH	0	1	1	0
		2011	BS0209	10/11/11	SUCK	57	18	75	24
		2011	BS0209	10/11/11	RDSH	2	0	2	1
		2011	BS0209	10/11/11	SCUL	125	12	137	43
		2011	BS0217	5/20/11	BLTR	0	1	1	0
		2011	BS0217	5/20/11	KOKA	0	2	2	1
		2011	BS0217	5/20/11	MNWH	0	1	1	0
		2011	BS0217	5/20/11	LNSC	0	4	4	1
		2011	BS0217	5/20/11	RDSH	0	2	2	1
		2011	BS0217	5/20/11	PRSC	0	2	2	1
		2011	BS0217	5/20/11	SLSC	0	1	1	0
		2011	BS0217	7/15/11	RDSH	0	1	1	0
		2011	BS0217	10/11/11	SUCK	9	10	19	6
		2011	BS0217	10/11/11	RDSH	0	1	1	0
		2011	BS0217	10/11/11	SCUL	13	19	32	10
		2012	116LBS02	8/20/12	SUCK	0	29	29	11
		2012	116LBS02	8/20/12	LNDC	0	1	1	0
		2012	116LBS02	8/20/12	RDSH	0	1	1	0
		2012	BS04	8/21/12	SUCK	0	27	27	8
		2012	BS04	8/21/12	RDSH	0	3	3	1
		2012	BS04	8/21/12	SCUL	0	4	4	1
		2012	BS04	8/21/12	PRSC	0	2	2	1
	Backpack Electrofisher	2009	EF0204	5/18/09	LNSC	0	2	2	2
		2009	EF0204	5/18/09	LKCH	0	1	1	1
		2009	EF0204	5/18/09	SCUL	0	1	1	1
		2009	EF0207	40010	MNWH	0	1	1	1

Appendix E1 Fish catch rate data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Method	Year	Site	Date	Species	CATCH No.	OBSER. No.	TOTAL No.	Catch Rate
		2010	EF0207	9/24/09	MNWH	1	0	1	1
		2010	EF0207	9/24/09	LNSC	0	3	3	3
		2010	EF0207	9/24/09	LNDC	0	1	1	1
		2010	EF0207	9/24/09	RDSH	0	1	1	1
		2010	EF0207	9/24/09	PRSC	0	1	1	1
		2012	EF01	8/21/12	RDSH	0	1	1	1
		2012	EF01	8/21/12	PRSC	0	1	1	1
	Small Fish Boat Electrofisher	2012	116L	8/20/12	MNWH	0	6	6	12
		2012	116L	8/20/12	NPMN	0	1	1	2
		2012	116L01	8/20/12	MNWH	0	2	2	4
		2012	116L02	8/20/12	MNWH	0	1	1	4
		2012	116LSEF03	8/21/12	MNWH	0	2	2	3
		2012	PE116L01	8/19/12	MNWH	0	1	1	2
		2012	PE116L02	8/19/12	MNWH	0	1	1	1
	Large Fish Boat Electrofisher	2009	LF02SC115	5/18/09	BLTR	0	2	2	4
		2009	LF02SC115	7/16/09	MNWH	0	14	14	25
		2009	LF02SC115	7/16/09	BLTR	1	0	1	2
		2009	LF02SC115	7/16/09	MNWH	9	0	9	16
		2009	LF02SC115	7/16/09	LSSC	4	0	4	7
		2009	LF02SC115	7/16/09	LNSC	8	0	8	15
		2009	LF02SC115	7/16/09	WHSC	2	0	2	4
102.5RA	Beach Seine	2009	BS0602	5/24/09	MNWH	3	5	8	3
		2009	BS0602	5/24/09	LSSC	0	6	6	2
		2009	BS0602	5/24/09	LNSC	0	6	6	2
		2009	BS0602	5/24/09	FLCH	0	1	1	0
		2009	BS0602	5/24/09	LNDC	0	1	1	0
		2009	BS0602	5/24/09	RDSH	13	11	24	8
		2009	BS0602	5/24/09	PRSC	0	1	1	0
		2009	BS0602	5/24/09	SLSC	0	1	1	0
		2009	BS0602	7/20/09	MNWH	0	4	4	1
		2009	BS0602	7/20/09	SUCK	0	11	11	3
		2009	BS0602	7/20/09	LSSC	0	6	6	2
		2009	BS0602	7/20/09	LNSC	0	4	4	1
		2009	BS0602	7/20/09	LKCH	0	1	1	0
		2009	BS0602	7/20/09	LNDC	31	10	41	13
		2009	BS0602	7/20/09	RDSH	11	10	21	7
		2009	BS0602	7/20/09	TRPR	0	1	1	0
		2009	BS0602	10/1/09	LNDC	0	1	1	0
		2009	BS0602	10/1/09	RDSH	0	5	5	2
		2010	BS0602	6/5/10	MNWH	0	4	4	1
		2010	BS0602	6/5/10	LSSC	0	5	5	2
		2010	BS0602	6/5/10	LNSC	0	7	7	3
		2010	BS0602	40334	LNDC	0	6	6	2

Appendix E1 Fish catch rate data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Method	Year	Site	Date	Species	CATCH No.	OBSER. No.	TOTAL No.	Catch Rate
		2010	BS0602	6/5/10	RDSH	0	13	13	5
		2010	BS0602	6/5/10	SPSH	0	2	2	1
		2010	BS0602	6/5/10	SLSC	0	1	1	0
		2010	BS0616	6/5/10	MNWH	0	18	18	6
		2010	BS0616	6/5/10	LNSC	0	1	1	0
		2010	BS0616	6/5/10	LKCH	0	1	1	0
		2010	BS0616	6/5/10	LNDC	0	1	1	0
		2010	BS0616	6/5/10	RDSH	0	5	5	2
		2010	BS0616	7/18/10	NRPK	0	1	1	0
		2010	BS0616	7/18/10	SUCK	31	4	35	11
		2010	BS0616	7/18/10	LNSC	0	3	3	1
		2010	BS0616	7/18/10	SPSH	156	17	173	55
		2010	BS0616	10/9/10	SUCK	0	3	3	1
		2010	BS0616	10/9/10	LSSC	0	1	1	0
		2010	BS0616	10/9/10	LNSC	0	8	8	3
		2010	BS0616	10/9/10	LNDC	0	2	2	1
		2010	BS0616	10/9/10	NPMN	40	10	50	16
		2010	BS0616	10/9/10	RDSH	22	10	32	10
		2010	BS0616	10/9/10	SCUL	0	1	1	0
		2012	BS01	8/24/12	SUCK	0	9	9	3
		2012	BS01	8/24/12	LKCH	0	8	8	2
		2012	BS01	8/24/12	LNDC	0	21	21	6
		2012	BS01	8/24/12	SPSH	0	8	8	2
		2012	BS03	8/24/12	NRPK	0	1	1	0
		2012	BS03	8/24/12	SUCK	0	25	25	7
		2012	BS03	8/24/12	LNSC	0	1	1	0
		2012	BS03	8/24/12	LKCH	0	12	12	4
		2012	BS03	8/24/12	LNDC	0	18	18	5
		2012	BS03	8/24/12	NPMN	0	2	2	1
		2012	BS03	8/24/12	RDSH	0	1	1	0
		2012	BS03	8/24/12	SUCK	0	2	2	1
		2012	BS47R01	8/24/12	MNWH	0	19	19	6
		2012	BS47R01	8/24/12	SUCK	0	20	20	6
		2012	BS47R01	8/24/12	LKCH	0	3	3	1
		2012	BS47R01	8/24/12	LNDC	0	23	23	7
		2012	BS47R01	8/24/12	TRPR	0	1	1	0
		2012	BS47R01	8/24/12	SCUL	0	3	3	1
	Large Fish Boat Electrofisher	2009	LF06SC047	5/25/09	MNWH	0	1	1	1
		2009	LF06SC047	5/25/09	NRPK	4	0	5	6
		2009	LF06SC047	5/25/09	WALL	1	1	2	2
		2009	LF06SC047	5/25/09	LNSC	0	1	1	1
		2009	LF06SC047	5/25/09	WHSC	0	1	1	1
		2009	LF06SC047	40018	WALL	0	1	1	1

Appendix E1 Fish catch rate data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Method	Year	Site	Date	Species	CATCH No.	OBSER. No.	TOTAL No.	Catch Rate
		2009	LF06SC047	7/24/09	LNSC	4	1	5	6
		2009	LF06SC047	7/24/09	WHSC	2	1	3	3
		2009	LF06SC047	9/26/09	MNWH	1	1	2	2
		2009	LF06SC047	9/26/09	YLPR	0	1	1	1
		2009	LF06SC047	9/26/09	WHSC	0	1	1	1
		2009	LF06SC047	9/26/09	SPSH	0	1	1	1
		2010	LF06SC047	6/4/10	NRPK	0	3	3	3
		2010	LF06SC047	6/4/10	WHSC	0	2	2	2
		2011	LF06SC047	6/2/11	BLTR	0	1	1	1
		2011	LF06SC047	6/2/11	MNWH	0	32	32	36
		2011	LF06SC047	6/2/11	NRPK	2	0	2	2
		2011	LF06SC047	6/2/11	LSSC	0	1	1	1
		2011	LF06SC047	6/2/11	LNSC	0	3	3	3
		2011	LF06SC047	7/21/11	GOLD	0	1	1	1
		2011	LF06SC047	7/21/11	MNWH	0	1	1	1
		2011	LF06SC047	7/21/11	NRPK	1	0	1	1
		2011	LF06SC047	7/21/11	WALL	2	3	5	6
		2011	LF06SC047	7/21/11	LSSC	0	2	2	2
		2011	LF06SC047	7/21/11	LNSC	0	3	3	3
		2011	LF06SC047	7/21/11	WHSC	0	11	11	12
		2011	LF06SC047	10/16/11	MNWH	0	2	2	2
		2011	LF06SC047	10/16/11	NRPK	1	3	4	4
	Small Fish Boat Electrofisher	2012	SF47R01	8/24/12	MNWH	0	1	1	3
		2012	SF47R02	8/24/12	KOKA	0	1	1	2
		2012	SF47R02	8/24/12	LNSC	0	1	1	2
		2012	SF47R03	8/24/12	MNWH	0	1	1	2
		2012	SF47R03	8/24/12	NRPK	0	1	1	2
		2012	SF47R03	8/24/12	RDSH	0	3	3	5
102.5RB	Beach Seine	2009	BS0603	5/24/09	NRPK	0	2	2	1
		2009	BS0603	5/24/09	YLPR	0	5	5	2
		2009	BS0603	5/24/09	LNDC	0	2	2	1
		2009	BS0603	5/24/09	RDSH	0	2	2	1
		2009	BS0603	5/24/09	TRPR	0	1	1	0
		2009	BS0603	7/20/09	NRPK	0	2	2	1
		2009	BS0603	7/20/09	SUCK	0	5	5	2
		2009	BS0603	7/20/09	LNSC	0	1	1	0
		2009	BS0603	7/20/09	LNDC	0	1	1	0
		2009	BS0603	7/20/09	RDSH	0	1	1	0
		2009	BS0603	7/20/09	SPSH	0	5	5	2
		2009	BS0603	7/20/09	TRPR	0	3	3	1
		2009	BS0603	10/1/09	NRPK	0	1	1	0
		2010	BS0603	6/5/10	MNWH	0	1	1	0
		2010	BS0603	40334	YLPR	0	1	1	0

Appendix E1 Fish catch rate data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Method	Year	Site	Date	Species	CATCH No.	OBSER. No.	TOTAL No.	Catch Rate
		2012	BS47R02	8/25/12	NRPK	0	1	1	0
		2012	BS47R02	8/25/12	SUCK	0	1	1	0
		2012	BS47R02	8/25/12	LNDC	0	2	2	1
		2012	BS47R02	8/25/12	NPMN	0	1	1	0
		2012	BS47R02	8/25/12	SPSH	0	2	2	1
		2012	BS47R03	8/25/12	NRPK	0	2	2	1
		2012	BS47R03	8/25/12	SUCK	0	8	8	2
		2012	BS47R03	8/25/12	LSSC	0	1	1	0
		2012	BS47R03	8/25/12	SPSH	0	12	12	4
		2012	BS47R04	8/25/12	NRPK	0	2	2	1
		2012	BS02	8/25/12	SPSH	0	1	1	0
	Small Fish Boat Electrofisher	2012	SF47R05	8/25/12	LNSC	0	1	1	2

Appendix F Fish Sample Data

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
32L	2009	LF02SC115	MNWH	313	334						0
	2009	LF02SC115	MNWH	283	230						0
	2009	LF02SC115	MNWH	314	388						0
	2009	LF02SC115	MNWH	268	198						0
	2009	LF02SC115	BLTR	387	728				PIT	965000000107313	0
	2009	LF02SC115	MNWH	278	236						0
	2009	LF02SC115	MNWH	229	154						0
	2009	LF02SC115	MNWH	304	318						0
	2009	LF02SC115	MNWH	263	216						0
	2009	LF02SC115	BLTR	534	2026				PIT	965000000090226	0
	2009	LF02SC115	MNWH	313	368						0
	2009	LF02SC115	MNWH	299	330						0
	2009	LF02SC115	MNWH	334	362						0
	2009	LF02SC115	MNWH	347	484						0
	2009	LF02SC115	MNWH	316	298						0
	2009	LF02SC115	MNWH	318	330						0
	2009	GN0201	LNSC	441	1080						0
	2009	GN0201	MNWH	339	438						0
	2009	GN0201	LNSC	379	622						0
	2009	GN0201	MNWH	351	444						0
	2009	GN0201	WHSC	399	916						0
	2009	BS0204	LNSC	68							0
	2009	BS0204	SCUL	18							0
	2009	BS0204	RDSH	23							0
	2009	BS0204	SCUL	23							0
	2009	BS0204	RDSH	26							0
	2009	BS0204	LNSC	63							0
	2009	BS0204	LNSC	46							0
	2009	BS0204	LNSC	86							0
	2009	BS0204	MNWH	18							0
	2009	BS0204	MNWH	24							0
	2009	BS0204	MNWH	22							0
	2009	BS0204	MNWH	25							0
	2009	BS0204	MNWH	21							0
	2009	BS0204	MNWH	19							0
	2009	BS0204	MNWH	19							0
	2009	BS0204	MNWH	21							0
	2009	BS0204	LNSC	40							0
	2009	BS0204	LNSC	52							0
	2009	BS0204	LSSC	39							0
	2009	BS0204	RDSH	53							0
	2009	BS0204	MNWH	23							0
	2009	BS0204	LNSC	38							0
	2009	BS0204	MNWH	21							0
	2009	BS0204	SCUL	28							0
	2009	BS0204	SCUL	31							0
	2009	BS0204	SCUL	32							0
	2009	BS0204	SCUL	39							0
	2009	BS0204	LKCH	24							0
	2009	BS0204	LNSC	36							0
	2009	BS0204	PRSC	40							0
	2009	BS0204	PRSC	30							0
	2009	BS0204	LNSC	41							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2009	BS0204	LNSC	45							0
	2009	BS0204	LKCH	30							0
	2009	BS0204	LNSC	29							0
	2009	EF0204	SCUL	35							0
	2009	EF0204	LNSC	49							0
	2009	EF0204	LNSC	32							0
	2009	EF0204	LKCH	26							0
	2009	BS0209	PRSC	39							0
	2009	BS0209	PRSC	49							0
	2009	BS0209	PRSC	46							0
	2009	EF0207	MNWH	36							0
	2010	BS0204	RDSH	30							0
	2010	BS0204	RDSH	28							0
	2010	BS0204	MNWH	27							0
	2010	BS0204	MNWH	30							0
	2010	BS0204	MNWH	31							0
	2010	BS0204	RDSH	29							0
	2010	BS0204	RDSH	31							0
	2010	BS0204	RDSH	30							0
	2010	BS0204	MNWH	31							0
	2010	BS0204	RDSH	27							0
	2010	BS0204	RDSH	30							0
	2010	BS0204	MNWH	30							0
	2010	BS0204	LNSC	58							0
	2010	BS0204	MNWH	30							0
	2010	BS0204	RDSH	28							0
	2010	BS0204	MNWH	31							0
	2010	BS0204	PRSC	33							0
	2010	BS0204	LNSC	43							0
	2010	BS0204	PRSC	81							0
	2010	BS0204	PRSC	38							0
	2010	BS0204	PRSC	42							0
	2010	BS0204	PRSC	42							0
	2010	BS0204	PRSC	51							0
	2010	BS0204	PRSC	53							0
	2010	BS0204	PRSC	78							0
	2010	BS0204	PRSC	75							0
	2010	BS0204	PRSC	80							0
	2010	BS0204	PRSC	38							0
	2010	BS0204	LNSC	70			SC	1			0
	2010	BS0204	LNSC	55			SC	1			0
	2010	BS0204	SLSC	43							0
	2010	BS0204	SUCK	22							0
	2010	BS0204	SUCK	22							0
	2010	BS0204	SUCK	22							0
	2010	BS0204	SUCK	18							0
	2010	BS0204	SUCK	24							0
	2010	BS0204	SUCK	23							0
	2010	BS0204	SUCK	21							0
	2010	BS0204	SUCK	23							0
	2010	BS0204	SUCK	24							0
	2010	BS0204	SUCK	22							0
	2010	BS0204	SUCK	31							0
	2010	BS0204	SUCK	27							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2010	BS0204	SUCK	26							0
	2010	BS0204	SUCK	28							0
	2010	BS0204	LNSC	62			SC	1			0
	2010	BS0204	LNSC	54			SC	1			0
	2010	BS0204	MNWH	321							0
	2010	BS0204	LNSC	52							0
	2010	BS0204	RDSH	33							0
	2010	BS0204	RDSH	33							0
	2010	BS0204	RDSH	27							0
	2010	BS0204	RDSH	27							0
	2010	BS0204	RDSH	30							0
	2010	BS0204	RDSH	27							0
	2010	BS0204	RDSH	27							0
	2010	BS0204	RDSH	29							0
	2010	BS0204	RDSH	28							0
	2010	BS0204	RDSH	32							0
	2010	BS0204	RDSH	31							0
	2010	BS0204	RDSH	29							0
	2010	BS0204	RDSH	25							0
	2010	BS0204	NPMN	39							0
	2010	BS0204	NPMN	39							0
	2010	BS0204	RDSH	22							0
	2010	BS0204	LNSC	99							0
	2010	BS0204	SUCK	30							0
	2010	BS0204	NPMN	24							0
	2010	EF0207	LNDC	35							0
	2010	EF0207	RDSH	29							0
	2010	EF0207	LNSC	36							0
	2010	EF0207	LNSC	37							0
	2010	EF0207	PRSC	81							0
	2010	EF0207	LNSC	39							0
	2010	BS0217	MNWH	35							0
	2010	BS0217	MNWH	36							0
	2010	BS0217	MNWH	30							0
	2010	BS0217	MNWH	33							0
	2010	BS0217	MNWH	34							0
	2010	BS0217	MNWH	30							0
	2010	BS0217	MNWH	30							0
	2010	BS0217	MNWH	32							0
	2010	BS0217	MNWH	24							0
	2010	BS0217	MNWH	29							0
	2010	BS0217	RDSH	27							0
	2010	BS0217	SCUL	30							0
	2010	BS0217	LNSC	52							0
	2010	BS0217	RDSH	28							0
	2010	BS0217	SUCK	33							0
	2010	BS0217	SUCK	27							0
	2010	BS0217	SUCK	19							0
	2010	BS0217	SUCK	19							0
	2010	BS0217	SUCK	19							0
	2010	BS0217	SUCK	20							0
	2010	BS0217	SUCK	22							0
	2010	BS0217	SUCK	20							0
	2010	BS0217	SUCK	27							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2010	BS0217	LNSC	53							0
	2010	BS0217	LNSC	45							0
	2010	BS0217	LNSC	47							0
	2010	BS0217	PRSC	36							0
	2010	BS0217	LNSC	40							0
	2010	BS0217	RDSH	29							0
	2010	BS0217	RDSH	29							0
	2010	BS0217	NPMN	36							0
	2010	BS0217	NPMN	27							0
	2010	BS0217	NPMN	24							0
	2010	BS0217	LNSC	46							0
	2010	BS0217	NPMN	34							0
	2010	BS0217	LNSC	40							0
	2010	BS0217	LNSC	37							0
	2010	BS0217	NPMN	39							0
	2010	BS0217	SUCK	34							0
	2010	BS0217	NPMN	22							0
	2010	BS0217	NPMN	27							0
	2010	BS0217	RDSH	31							0
	2010	BS0217	NPMN	26							0
	2010	BS0217	LKCH	30							0
	2010	BS0217	LNSC	47							0
	2010	BS0217	LNSC	49							0
	2010	BS0217	LNSC	41							0
	2010	BS0217	SUCK	23							0
	2010	BS0217	PRSC	41							0
	2010	BS0217	NPMN	42							0
	2010	BS0217	LNSC	41							0
	2010	BS0217	SUCK	34							0
	2010	BS0217	LNSC	39							0
	2010	BS0217	LNSC	40							0
	2010	BS0217	LNSC	35							0
	2011	BS0204	MNWH	325							0
	2011	BS0204	MNWH	313							0
	2011	BS0204	MNWH	264							0
	2011	BS0204	MNWH	303							0
	2011	BS0204	RDSH	85							0
	2011	BS0204	RDSH	91							0
	2011	BS0204	RDSH	88							0
	2011	BS0204	RDSH	88							0
	2011	BS0204	RDSH	89							0
	2011	BS0204	RDSH	94							0
	2011	BS0204	RDSH	86							0
	2011	BS0204	RDSH	63							0
	2011	BS0204	RDSH	91							0
	2011	BS0204	RDSH	89							0
	2011	BS0204	RDSH	41							0
	2011	BS0204	RDSH	39							0
	2011	BS0204	RDSH	37							0
	2011	BS0204	RDSH	39							0
	2011	BS0204	RDSH	34							0
	2011	BS0204	MNWH	103							0
	2011	BS0204	RDSH	34							0
	2011	BS0204	NPMN	136							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2011	BS0204	NPMN	135							0
	2011	BS0204	NPMN	40							0
	2011	BS0204	RDSH	44							0
	2011	BS0204	NPMN	38							0
	2011	BS0204	NPMN	39							0
	2011	BS0204	NPMN	132							0
	2011	BS0204	NPMN	141							0
	2011	BS0204	NPMN	87							0
	2011	BS0204	NPMN	92							0
	2011	BS0204	LNSC	137							0
	2011	BS0204	NPMN	124							0
	2011	BS0204	NPMN	41							0
	2011	BS0204	LSSC	143							0
	2011	BS0204	PRSC	41							0
	2011	BS0204	LSSC	178							0
	2011	BS0204	SLSC	120							0
	2011	BS0204	LNSC	125							0
	2011	BS0204	LNSC	119							0
	2011	BS0204	LNSC	58							0
	2011	BS0204	LNSC	78							0
	2011	BS0204	LNSC	58							0
	2011	BS0204	LNSC	59							0
	2011	BS0204	LNSC	116							0
	2011	BS0204	LNSC	129							0
	2011	BS0204	LSSC	170							0
	2011	BS0204	LNSC	101							0
	2011	BS0204	LNSC	64							0
	2011	BS0204	RDSH	37							0
	2011	BS0204	RDSH	28							0
	2011	BS0204	RDSH	28							0
	2011	BS0204	RDSH	24							0
	2011	BS0204	MNWH	22							0
	2011	BS0204	MNWH	18							0
	2011	BS0204	MNWH	17							0
	2011	BS0204	MNWH	16							0
	2011	BS0204	MNWH	18							0
	2011	BS0204	MNWH	19							0
	2011	BS0204	MNWH	18							0
	2011	BS0204	MNWH	18							0
	2011	BS0204	MNWH	18							0
	2011	BS0204	MNWH	18							0
	2011	BS0204	MNWH	18							0
	2011	BS0204	MNWH	329							0
	2011	BS0204	MNWH	37							0
	2011	BS0204	MNWH	43							0
	2011	BS0204	MNWH	39							0
	2011	BS0204	MNWH	38							0
	2011	BS0204	SUCK	20							0
	2011	BS0204	MNWH	35							0
	2011	BS0204	RDSH	38							0
	2011	BS0204	RDSH	39							0
	2011	BS0204	RDSH	38							0
	2011	BS0204	LSSC	62							0
	2011	BS0204	LSSC	49							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2011	BS0204	LNSC	62							0
	2011	BS0204	LSSC	57							0
	2011	BS0204	MNWH	28							0
	2011	BS0204	SCUL	21							0
	2011	BS0204	SCUL	21							0
	2011	BS0204	SCUL	20							0
	2011	BS0204	SCUL	25							0
	2011	BS0204	SCUL	17							0
	2011	BS0204	SCUL	21							0
	2011	BS0204	SCUL	18							0
	2011	BS0204	SCUL	23							0
	2011	BS0204	SCUL	16							0
	2011	BS0204	SCUL	21							0
	2011	BS0204	SCUL	21							0
	2011	BS0204	SCUL	20							0
	2011	BS0204	SCUL	17							0
	2011	BS0204	SCUL	18							0
	2011	BS0204	SCUL	16							0
	2011	BS0204	SCUL	21							0
	2011	BS0204	SCUL	20							0
	2011	BS0204	SCUL	16							0
	2011	BS0204	SCUL	19							0
	2011	BS0204	SCUL	18							0
	2011	BS0204	SCUL	22							0
	2011	BS0204	SCUL	18							0
	2011	BS0204	SCUL	20							0
	2011	BS0204	SCUL	23							0
	2011	BS0204	SCUL	18							0
	2011	BS0204	SCUL	16							0
	2011	BS0204	SCUL	18							0
	2011	BS0204	SCUL	24							0
	2011	BS0204	LSSC	44							0
	2011	BS0204	LNSC	43							0
	2011	BS0217	BLTR	180			SC				0
	2011	BS0217	KOKA	182							0
	2011	BS0217	PRSC	101							0
	2011	BS0217	PRSC	70							0
	2011	BS0217	SLSC	64							0
	2011	BS0217	MNWH	103							0
	2011	BS0217	KOKA	70							0
	2011	BS0217	LNSC	51							0
	2011	BS0217	LNSC	47							0
	2011	BS0217	LNSC	58							0
	2011	BS0217	LNSC	32							0
	2011	BS0217	RDSH	30							0
	2011	BS0217	RDSH	26							0
	2011	BS0217	RDSH	31							0
	2011	BS0217	SCUL	19							0
	2011	BS0217	SCUL	17							0
	2011	BS0217	SCUL	20							0
	2011	BS0217	SCUL	20							0
	2011	BS0217	SCUL	22							0
	2011	BS0217	SCUL	15							0
	2011	BS0217	SCUL	18							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2011	BS0217	SCUL	22							0
	2011	BS0217	SCUL	20							0
	2011	BS0217	SCUL	16							0
	2011	BS0217	SCUL	19							0
	2011	BS0217	SCUL	17							0
	2011	BS0217	SCUL	18							0
	2011	BS0217	SCUL	17							0
	2011	BS0217	SCUL	19							0
	2011	BS0217	SCUL	22							0
	2011	BS0217	SCUL	21							0
	2011	BS0217	SCUL	20							0
	2011	BS0217	SCUL	20							0
	2011	BS0217	RDSH	22							0
	2011	BS0217	SUCK	20							0
	2011	BS0217	SUCK	16							0
	2011	BS0217	SUCK	18							0
	2011	BS0217	SUCK	17							0
	2011	BS0217	SUCK	17							0
	2011	BS0217	SUCK	21							0
	2011	BS0217	SUCK	18							0
	2011	BS0217	SUCK	17							0
	2011	BS0217	SUCK	20							0
	2011	BS0217	SUCK	20							0
	2011	BS0209	RDSH	35							0
	2011	BS0209	RDSH	36							0
	2011	BS0209	RDSH	30							0
	2011	BS0209	RDSH	30							0
	2011	BS0209	RDSH	29							0
	2011	BS0209	RDSH	34							0
	2011	BS0209	RDSH	27							0
	2011	BS0209	RDSH	32							0
	2011	BS0209	RDSH	31							0
	2011	BS0209	RDSH	25							0
	2011	BS0209	RDSH	24							0
	2011	BS0209	RDSH	85							0
	2011	BS0209	RDSH	81							0
	2011	BS0209	RDSH	62							0
	2011	BS0209	RDSH	63							0
	2011	BS0209	RDSH	55							0
	2011	BS0209	RDSH	92							0
	2011	BS0209	RDSH	83							0
	2011	BS0209	RDSH	90							0
	2011	BS0209	RDSH	93							0
	2011	BS0209	RDSH	90							0
	2011	BS0209	MNWH	119							0
	2011	BS0209	MNWH	126							0
	2011	BS0209	MNWH	108							0
	2011	BS0209	MNWH	110							0
	2011	BS0209	NPMN	93							0
	2011	BS0209	NPMN	47							0
	2011	BS0209	NPMN	69							0
	2011	BS0209	NPMN	50							0
	2011	BS0209	LNSC	50							0
	2011	BS0209	LNSC	49							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2011	BS0209	LNSC	48							0
	2011	BS0209	LNSC	41							0
	2011	BS0209	LNSC	40							0
	2011	BS0209	LNSC	43							0
	2011	BS0209	LNSC	41							0
	2011	BS0209	LNSC	39							0
	2011	BS0209	LNSC	44							0
	2011	BS0209	LNSC	48							0
	2011	BS0209	NPMN	35							0
	2011	BS0209	NPMN	40							0
	2011	BS0209	NPMN	44							0
	2011	BS0209	MNWH	18							0
	2011	BS0209	LNSC	41							0
	2011	BS0209	LNSC	43							0
	2011	BS0209	MNWH	33							0
	2011	BS0209	RDSH	126							0
	2011	BS0209	LNSC	72							0
	2011	BS0209	SUCK	16							0
	2011	BS0209	SUCK	16							0
	2011	BS0209	SUCK	19							0
	2011	BS0209	SUCK	18							0
	2011	BS0209	SUCK	18							0
	2011	BS0209	SUCK	18							0
	2011	BS0209	SUCK	18							0
	2011	BS0209	SUCK	21							0
	2011	BS0209	SUCK	21							0
	2011	BS0209	SUCK	21							0
	2011	BS0209	SCUL	24							0
	2011	BS0209	SCUL	22							0
	2011	BS0209	SCUL	21							0
	2011	BS0209	SCUL	26							0
	2011	BS0209	SCUL	17							0
	2011	BS0209	SCUL	24							0
	2011	BS0209	SCUL	25							0
	2011	BS0209	SCUL	23							0
	2011	BS0209	SUCK	20							0
	2011	BS0209	SUCK	24							0
	2011	BS0209	SUCK	26							0
	2011	BS0209	SUCK	22							0
	2011	BS0209	SUCK	24							0
	2011	BS0209	SUCK	25							0
	2011	BS0209	SUCK	23							0
	2011	BS0209	SUCK	19							0
	2011	BS0209	SUCK	19							0
	2011	BS0209	SUCK	25							0
	2011	BS0209	SUCK	32							0
	2011	BS0209	SUCK	23							0
	2011	BS0209	SUCK	31							0
	2011	BS0209	SUCK	38							0
	2011	BS0209	SUCK	20							0
	2011	BS0209	SUCK	25							0
	2011	BS0209	SUCK	24							0
	2011	BS0209	SUCK	24							0
	2011	BS0209	SCUL	19							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2011	BS0209	SCUL	22							0
	2011	BS0209	SCUL	22							0
	2011	BS0209	SCUL	18							0
	2011	GN0201	MNWH	407		12	SC/OT				9
	2011	GN0201	MNWH	360		12	SC/OT				9
	2011	GN0201	BLTR	740			FR				0
	2011	GN0201	LKWH	410		12	SC/OT				9
	2011	GN0201	BLTR	560							0
	2011	GN0201	WHSC	501		12	FR				9
	2011	GN0201	MNWH	312		12	SC/OT				9
	2011	GN0201	BLTR	429	820						0
	2012	EF01	RDSH	61							0
	2012	EF01	PRSC	35							0
	2012	116LBS02	SUCK	21							0
	2012	116LBS02	SUCK	18							0
	2012	116LBS02	SUCK	26							0
	2012	116LBS02	SUCK	19							0
	2012	116LBS02	SUCK	25							0
	2012	116LBS02	SUCK	28							0
	2012	116LBS02	SUCK	25							0
	2012	116LBS02	SUCK	19							0
	2012	116LBS02	SUCK	17							0
	2012	116LBS02	SUCK	17							0
	2012	116LBS02	SUCK	17							0
	2012	116LBS02	SUCK	17							0
	2012	116LBS02	SUCK	16							0
	2012	116LBS02	SUCK	21							0
	2012	116LBS02	RDSH	24							0
	2012	116LBS02	SUCK	20							0
	2012	116LBS02	SUCK	17							0
	2012	116LBS02	SUCK	20							0
	2012	116LBS02	SUCK	16							0
	2012	116LBS02	SUCK	23							0
	2012	116LBS02	SUCK	17							0
	2012	116LBS02	SUCK	20							0
	2012	116LBS02	SUCK	15							0
	2012	116LBS02	SUCK	17							0
	2012	116LBS02	SUCK	27							0
	2012	116LBS02	SUCK	21							0
	2012	116LBS02	SUCK	19							0
	2012	116LBS02	SUCK	19							0
	2012	116LBS02	LNDC	16							0
	2012	116LBS02	SUCK	19							0
	2012	116LBS02	SUCK	17							0
	2012	BS04	SUCK	17							0
	2012	BS04	SUCK	19							0
	2012	BS04	SUCK	19							0
	2012	BS04	SUCK	16							0
	2012	BS04	SUCK	19							0
	2012	BS04	RDSH	29							0
	2012	BS04	SUCK	17							0
	2012	BS04	SUCK	16							0
	2012	BS04	RDSH	16							0
	2012	BS04	RDSH	16							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2012	BS04	SUCK	17							0
	2012	BS04	SUCK	16							0
	2012	BS04	SUCK	19							0
	2012	BS04	SUCK	21							0
	2012	BS04	SUCK	19							0
	2012	BS04	SUCK	16							0
	2012	BS04	SUCK	16							0
	2012	BS04	SUCK	24							0
	2012	BS04	SUCK	17							0
	2012	BS04	SUCK	17							0
	2012	BS04	SUCK	18							0
	2012	BS04	SCUL	32							0
	2012	BS04	PRSC	35							0
	2012	BS04	SUCK	24							0
	2012	BS04	SUCK	18							0
	2012	BS04	SUCK	21							0
	2012	BS04	SUCK	14							0
	2012	BS04	SUCK	19							0
	2012	BS04	SUCK	18							0
	2012	BS04	SUCK	16							0
	2012	BS04	PRSC	40							0
	2012	BS04	SUCK	15							0
	2012	BS04	SCUL	11							0
	2012	BS04	SCUL	16							0
	2012	BS04	SCUL	14							0
	2012	BS04	SUCK	16							0
	2012	PE116L01	MNWH	263			SC				0
	2012	PE116L02	MNWH	266			SC				0
	2012	116L01	MNWH	315							0
	2012	116L01	MNWH	290							0
	2012	116L02	MNWH	306							0
	2012	116LSEF03	MNWH	298							0
	2012	116LSEF03	MNWH	288							0
	2012	116L	MNWH	285							0
	2012	116L	MNWH	332							0
	2012	116L	MNWH	313							0
	2012	116L	MNWH	285							0
	2012	116L	MNWH	284							0
	2012	116L	MNWH	239							0
	2012	116L	NPMN	90							0
102.5RA	2009	LF06SC047	YLPR	187	104		SC	2			0
	2009	LF06SC047	SPSH								0
	2009	LF06SC047	MNWH	372	560		SC		PIT	965000000093399	0
	2009	LF06SC047	WHSC	342	536				PIT	965000000090992	0
	2009	LF06SC047	MNWH	171	60						0
	2009	LF06SC047	WALL	452	1062				PIT	965000000088828	0
	2009	LF06SC047	LNSC	445	1240				PIT	965000000084637	0
	2009	LF06SC047	WHSC	349	622						0
	2009	LF06SC047	NRPK	492	940				PIT	965000000084467	0
	2009	BS0602	RDSH	24							0
	2009	BS0602	LSSC	47							0
	2009	BS0602	SUCK	21							0
	2009	BS0602	SUCK	21							0
	2009	BS0602	LNSC	64							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2009	BS0602	LSSC	51							0
	2009	BS0602	LSSC	41							0
	2009	BS0602	LNSC	46							0
	2009	BS0602	SUCK	18							0
	2009	BS0602	SUCK	19							0
	2009	BS0602	LSSC	41							0
	2009	BS0602	SUCK	21							0
	2009	BS0602	LKCH	40							0
	2009	BS0602	LSSC	53							0
	2009	BS0602	SUCK	19							0
	2009	BS0602	RDSH	29							0
	2009	BS0602	RDSH	18							0
	2009	BS0602	RDSH	25							0
	2009	BS0602	RDSH	19							0
	2009	BS0602	LNDC	21							0
	2009	BS0602	LNDC	38							0
	2009	BS0602	MNWH	37							0
	2009	BS0602	MNWH	30							0
	2009	BS0602	LNSC	109							0
	2009	BS0602	LSSC	172	60						0
	2009	BS0602	RDSH	63							0
	2009	BS0602	RDSH	62							0
	2009	BS0602	RDSH	70							0
	2009	BS0602	RDSH	79							0
	2009	BS0602	RDSH	79							0
	2009	BS0602	LNSC	85							0
	2009	BS0602	RDSH	74							0
	2009	BS0602	RDSH	75							0
	2009	BS0602	LSSC	75							0
	2009	BS0602	RDSH	66							0
	2009	BS0602	RDSH	65							0
	2009	BS0602	RDSH	64							0
	2009	BS0602	SUCK	22							0
	2009	BS0602	LSSC	63							0
	2009	BS0602	LSSC	37							0
	2009	BS0602	LNSC	165	62						0
	2009	BS0602	MNWH	108							0
	2009	BS0602	LNSC	119							0
	2009	BS0602	SLSC	32							0
	2009	BS0602	LNSC	35							0
	2009	BS0602	RDSH	65							0
	2009	BS0602	LSSC	53							0
	2009	BS0602	LNSC	48							0
	2009	BS0602	MNWH	19							0
	2009	BS0602	MNWH	102							0
	2009	BS0602	MNWH	117							0
	2009	BS0602	LSSC	110							0
	2009	BS0602	FLCH	108							0
	2009	BS0602	MNWH	93							0
	2009	BS0602	LNDC	32							0
	2009	BS0602	LNDC	38							0
	2009	BS0602	MNWH	41							0
	2009	BS0602	LNSC	92							0
	2009	BS0602	LNDC	35							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2009	BS0602	LNDC	32							0
	2009	BS0602	TRPR	43							0
	2009	BS0602	SUCK	19							0
	2009	BS0602	LNDC	33							0
	2009	BS0602	MNWH	29							0
	2009	BS0602	LNDC	31							0
	2009	BS0602	LNDC	33							0
	2009	BS0602	LNSC	99							0
	2009	BS0602	LSSC	42							0
	2009	BS0602	PRSC	41							0
	2009	BS0602	LNDC	37							0
	2009	BS0602	RDSH	67							0
	2009	BS0602	RDSH	75							0
	2009	BS0602	RDSH	65							0
	2009	BS0602	RDSH	65							0
	2009	BS0602	RDSH	70							0
	2009	BS0602	RDSH	70							0
	2009	BS0602	SUCK	20							0
	2009	BS0602	RDSH	82							0
	2009	BS0602	RDSH	79							0
	2009	BS0602	RDSH	69							0
	2009	BS0602	SUCK	20							0
	2009	BS0602	SUCK	18							0
	2009	BS0602	LNDC	32							0
	2009	BS0602	LNDC	42							0
	2009	BS0602	RDSH	75							0
	2010	LF06SC047	WHSC	444	1048				PIT	965000000084251	0
	2010	LF06SC047	NRPK	520	1000		FR	5			0
	2010	LF06SC047	WHSC	423	1094				PIT	965000000085569	0
	2010	LF06SC047	NRPK	544	1112		FR	4	PIT	965000000093250	0
	2010	LF06SC047	NRPK	436	614		FR	3	PIT	965000000076936	0
	2010	BS0602	LNSC	311							0
	2010	BS0602	SPSH	48							0
	2010	BS0602	SPSH	64							0
	2010	BS0602	LNSC	41							0
	2010	BS0602	MNWH	28							0
	2010	BS0602	SLSC	67							0
	2010	BS0602	LSSC	56							0
	2010	BS0602	LNDC	24							0
	2010	BS0602	LNSC	33							0
	2010	BS0602	RDSH	62							0
	2010	BS0602	LNSC	27							0
	2010	BS0602	LNSC	42							0
	2010	BS0602	LNSC	43							0
	2010	BS0602	LNDC	32							0
	2010	BS0602	LNSC	43							0
	2010	BS0602	LSSC	94							0
	2010	BS0602	RDSH	57							0
	2010	BS0602	RDSH	53							0
	2010	BS0602	LSSC	73							0
	2010	BS0602	RDSH	113							0
	2010	BS0602	LSSC	46							0
	2010	BS0602	LSSC	77							0
	2010	BS0602	RDSH	24							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2010	BS0602	RDSH	52							0
	2010	BS0602	RDSH	63							0
	2010	BS0602	LNDC	32							0
	2010	BS0602	LNDC	23							0
	2010	BS0602	RDSH	84							0
	2010	BS0602	RDSH	87							0
	2010	BS0602	MNWH	26							0
	2010	BS0602	RDSH	97							0
	2010	BS0602	RDSH	89							0
	2010	BS0602	RDSH	89							0
	2010	BS0602	MNWH	26							0
	2010	BS0602	LNDC	25							0
	2010	BS0602	LNDC	36							0
	2010	BS0602	RDSH	77							0
	2010	BS0602	MNWH	28							0
	2010	BS0616	LNSC	98							0
	2010	BS0616	MNWH	27							0
	2010	BS0616	MNWH	27							0
	2010	BS0616	MNWH	34							0
	2010	BS0616	MNWH	26							0
	2010	BS0616	MNWH	24							0
	2010	BS0616	LKCH	72							0
	2010	BS0616	RDSH	74							0
	2010	BS0616	RDSH	58							0
	2010	BS0616	MNWH	26							0
	2010	BS0616	RDSH	89							0
	2010	BS0616	LNDC	22							0
	2010	BS0616	MNWH	27							0
	2010	BS0616	MNWH	32							0
	2010	BS0616	RDSH	79							0
	2010	BS0616	RDSH	82							0
	2010	BS0616	MNWH	26							0
	2010	BS0616	MNWH	24							0
	2010	BS0616	MNWH	23							0
	2010	BS0616	MNWH	27							0
	2010	BS0616	MNWH	25							0
	2010	BS0616	MNWH	32							0
	2010	BS0616	MNWH	33							0
	2010	BS0616	MNWH	29							0
	2010	BS0616	MNWH	18							0
	2010	BS0616	MNWH	23							0
	2010	BS0616	NRPK	103			SC				0
	2010	BS0616	SPSH	27							0
	2010	BS0616	SPSH	25							0
	2010	BS0616	SPSH	22							0
	2010	BS0616	SPSH	16							0
	2010	BS0616	SPSH	24							0
	2010	BS0616	SPSH	23							0
	2010	BS0616	SPSH	22							0
	2010	BS0616	SPSH	21							0
	2010	BS0616	SPSH	24							0
	2010	BS0616	SPSH	22							0
	2010	BS0616	SUCK	23							0
	2010	BS0616	SPSH	27							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2010	BS0616	SPSH	20							0
	2010	BS0616	SPSH	16							0
	2010	BS0616	SPSH	22							0
	2010	BS0616	SPSH	23							0
	2010	BS0616	SPSH	18							0
	2010	BS0616	SPSH	21							0
	2010	BS0616	LNSC	25							0
	2010	BS0616	LNSC	17							0
	2010	BS0616	LNSC	27							0
	2010	BS0616	SUCK	21							0
	2010	BS0616	SUCK	19							0
	2010	BS0616	SUCK	20							0
	2010	BS0616	NPMN	26							0
	2010	BS0616	NPMN	27							0
	2010	BS0616	NPMN	35							0
	2010	BS0616	SUCK	32							0
	2010	BS0616	NPMN	28							0
	2010	BS0616	NPMN	24							0
	2010	BS0616	NPMN	32							0
	2010	BS0616	NPMN	25							0
	2010	BS0616	NPMN	30							0
	2010	BS0616	NPMN	35							0
	2010	BS0616	NPMN	30							0
	2010	BS0616	RDSH	13							0
	2010	BS0616	RDSH	17							0
	2010	BS0616	RDSH	19							0
	2010	BS0616	RDSH	28							0
	2010	BS0616	RDSH	17							0
	2010	BS0616	RDSH	16							0
	2010	BS0616	RDSH	25							0
	2010	BS0616	RDSH	14							0
	2010	BS0616	RDSH	26							0
	2010	BS0616	RDSH	25							0
	2010	BS0616	LSSC	37							0
	2010	BS0616	LNSC	33							0
	2010	BS0616	LNSC	38							0
	2010	BS0616	LNSC	38							0
	2010	BS0616	LNSC	44							0
	2010	BS0616	LNDC	17							0
	2010	BS0616	LNDC	25							0
	2010	BS0616	SUCK	30							0
	2010	BS0616	SCUL	26							0
	2010	BS0616	LNSC	39							0
	2010	BS0616	LNSC	36							0
	2010	BS0616	LNSC	38							0
	2010	BS0616	LNSC	45							0
	2010	BS0616	SUCK	27							0
	2011	LF06SC047	LSSC	364	584				PIT	965000000280236	0
	2011	LF06SC047	MNWH	370	664				PIT	965000000087347	0
	2011	LF06SC047	MNWH	260	190				PIT	900026000034389	0
	2011	LF06SC047	MNWH	269	242				PIT	900026000034474	0
	2011	LF06SC047	MNWH	227	132						0
	2011	LF06SC047	MNWH	170	64						0
	2011	LF06SC047	LNSC	400	956				PIT	965000000279149	0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2011	LF06SC047	MNWH	366	518				PIT	900026000034384	0
	2011	LF06SC047	MNWH	324	420				PIT	900026000033854	0
	2011	LF06SC047	LNSC	260	284				PIT	900026000034059	0
	2011	LF06SC047	MNWH	260	210				PIT	965000000280094	0
	2011	LF06SC047	MNWH	353	390				PIT	965000000280701	0
	2011	LF06SC047	MNWH	193	72						0
	2011	LF06SC047	MNWH	156	40						0
	2011	LF06SC047	MNWH	289	258				PIT	900026000033940	0
	2011	LF06SC047	MNWH	295	270				PIT	965000000247196	2
	2011	LF06SC047	MNWH	296	326				PIT	965000000088584	0
	2011	LF06SC047	MNWH	270	220				PIT	965000000278262	0
	2011	LF06SC047	MNWH	280	236				PIT	965000000280331	0
	2011	LF06SC047	LNSC	365	668				PIT	965000000064971	0
	2011	LF06SC047	MNWH	265	220				PIT	965000000280230	0
	2011	LF06SC047	MNWH	174	50						0
	2011	LF06SC047	MNWH	246	174						0
	2011	LF06SC047	MNWH	140	30						0
	2011	LF06SC047	MNWH	247	162						0
	2011	LF06SC047	MNWH	157	44						0
	2011	LF06SC047	MNWH	311	332				PIT	900026000034624	0
	2011	LF06SC047	MNWH	245	182						0
	2011	LF06SC047	MNWH	277	236				PIT	965000000278508	0
	2011	LF06SC047	MNWH	342	440				PIT	965000000280322	0
	2011	LF06SC047	MNWH	185	74						0
	2011	LF06SC047	MNWH	267	226				PIT	965000000280506	0
	2011	LF06SC047	MNWH	187	70						0
	2011	LF06SC047	MNWH	184	68						0
	2011	LF06SC047	MNWH	255	176				PIT	965000000278553	0
	2011	LF06SC047	BLTR	285	294		FR	4			9
	2011	LF06SC047	WHSC	440	1190						0
	2011	LF06SC047	WHSC	482	1728						0
	2011	LF06SC047	LNSC	460	1160						0
	2011	LF06SC047	WHSC	470	1494						0
	2011	LF06SC047	WHSC	391	892						0
	2011	LF06SC047	WHSC	502	2072						0
	2011	LF06SC047	WHSC	439	1170						0
	2011	LF06SC047	WHSC	387	826						0
	2011	LF06SC047	LSSC	480	1630						0
	2011	LF06SC047	WALL	435	1052		FR	10	PIT	900026000035471	0
	2011	LF06SC047	LNSC	384	670						0
	2011	LF06SC047	WHSC	445	1256				PIT	965000000086777	2
	2011	LF06SC047	WHSC	418	1146						0
	2011	LF06SC047	LNSC	337	518						0
	2011	LF06SC047	WHSC	491	1652						0
	2011	LF06SC047	WHSC	390	926						0
	2011	LF06SC047	LSSC	146	36						0
	2011	LF06SC047	MNWH	287	236				PIT	900026000056484	2
	2011	LF06SC047	WALL	394	604	1	FR	6			9
	2011	LF06SC047	WALL	439	852	11	FR	7			9
	2011	LF06SC047	GOLD	404	696	19	SC	13			9
	2011	LF06SC047	MNWH	299	278				PIT	900026000057041	0
	2011	LF06SC047	MNWH	142	36						0
	2011	LF06SC047	NRPK	237	98		SC				0
	2011	LF06SC047	NRPK	196	56		SC				0
	2011	LF06SC047	NRPK	179	34		SC				0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2012	BS01	SPSH	24							0
	2012	BS01	SPSH	28							0
	2012	BS01	SPSH	29							0
	2012	BS01	LNDC	19							0
	2012	BS01	SUCK	22							0
	2012	BS01	SUCK	19							0
	2012	BS01	SUCK	14							0
	2012	BS01	SUCK	14							0
	2012	BS01	SPSH	30							0
	2012	BS01	SUCK	19							0
	2012	BS01	SUCK	20							0
	2012	BS01	SPSH	13							0
	2012	BS01	SPSH	14							0
	2012	BS01	LKCH	19							0
	2012	BS01	LKCH	20							0
	2012	BS01	LKCH	19							0
	2012	BS01	LNDC	14							0
	2012	BS01	LNDC	16							0
	2012	BS01	LNDC	13							0
	2012	BS01	LNDC	12							0
	2012	BS01	LKCH	18							0
	2012	BS01	LNDC	15							0
	2012	BS01	LNDC	15							0
	2012	BS01	LNDC	14							0
	2012	BS01	LNDC	16							0
	2012	BS01	SPSH	20							0
	2012	BS01	LNDC	16							0
	2012	BS01	LNDC	12							0
	2012	BS01	LNDC	13							0
	2012	BS01	LNDC	13							0
	2012	BS01	LKCH	14							0
	2012	BS01	LNDC	13							0
	2012	BS01	LNDC	16							0
	2012	BS01	LNDC	14							0
	2012	BS01	LNDC	13							0
	2012	BS01	LKCH	16							0
	2012	BS01	LKCH	15							0
	2012	BS01	LNDC	13							0
	2012	BS01	LNDC	12							0
	2012	BS01	SPSH	23							0
	2012	BS01	LNDC	14							0
	2012	BS01	LNDC	12							0
	2012	BS01	LKCH	15							0
	2012	BS01	SUCK	16							0
	2012	BS01	SUCK	20							0
	2012	BS01	SUCK	18							0
	2012	BS03	NRPK	176							0
	2012	BS03	SUCK	28							0
	2012	BS03	SUCK	21							0
	2012	BS03	SUCK	22							0
	2012	BS03	LNDC	28							0
	2012	BS03	SUCK	25							0
	2012	BS03	LNDC	15							0
	2012	BS03	SUCK	24							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2012	BS03	LNDC	15							0
	2012	BS03	LNDC	19							0
	2012	BS03	NPMN	39							0
	2012	BS03	LKCH	24							0
	2012	BS03	SUCK	28							0
	2012	BS03	LNDC	14							0
	2012	BS03	SUCK	25							0
	2012	BS03	SUCK	26							0
	2012	BS03	LNDC	18							0
	2012	BS03	SUCK	30							0
	2012	BS03	LKCH	18							0
	2012	BS03	RDSH	20							0
	2012	BS03	SUCK	20							0
	2012	BS03	SUCK	29							0
	2012	BS03	SUCK	30							0
	2012	BS03	LNDC	20							0
	2012	BS03	SUCK	31							0
	2012	BS03	LNDC	22							0
	2012	BS03	LNDC	21							0
	2012	BS03	SUCK	25							0
	2012	BS03	SUCK	25							0
	2012	BS03	SUCK	26							0
	2012	BS03	LKCH	21							0
	2012	BS03	LNDC	19							0
	2012	BS03	SUCK	26							0
	2012	BS03	SUCK	20							0
	2012	BS03	SUCK	22							0
	2012	BS03	SUCK	27							0
	2012	BS03	SUCK	22							0
	2012	BS03	SUCK	23							0
	2012	BS03	LNDC	19							0
	2012	BS03	LKCH	22							0
	2012	BS03	LKCH	19							0
	2012	BS03	SUCK	28							0
	2012	BS03	SUCK	24							0
	2012	BS03	LNDC	24							0
	2012	BS03	LNDC	15							0
	2012	BS03	LNSC	48							0
	2012	BS03	SUCK	38							0
	2012	BS03	LKCH	25							0
	2012	BS03	NPMN	23							0
	2012	BS03	LNDC	26							0
	2012	BS03	LNDC	19							0
	2012	BS03	LKCH	17							0
	2012	BS03	LKCH	18							0
	2012	BS03	LKCH	28							0
	2012	BS03	LKCH	18							0
	2012	BS03	LNDC	15							0
	2012	BS03	LNDC	13							0
	2012	BS03	LNDC	13							0
	2012	BS03	LKCH	18							0
	2012	BS03	LKCH	22							0
	2012	BS47R01	MNWH	59							0
	2012	BS47R01	SUCK	15							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2012	BS47R01	SUCK	16							0
	2012	BS47R01	SUCK	15							0
	2012	BS47R01	SUCK	14							0
	2012	BS47R01	LNDC	12			SC				0
	2012	BS47R01	LNDC	13			SC				0
	2012	BS47R01	SUCK	16			SC				0
	2012	BS47R01	LNDC	12							0
	2012	BS47R01	LNDC	19							0
	2012	BS47R01	LNDC	10							0
	2012	BS47R01	SUCK	15							0
	2012	BS47R01	LNDC	19							0
	2012	BS47R01	LNDC	12							0
	2012	BS47R01	MNWH	85							0
	2012	BS47R01	LKCH	20							0
	2012	BS47R01	LNDC	14							0
	2012	BS47R01	SUCK	16							0
	2012	BS47R01	LNDC	14							0
	2012	BS47R01	SUCK	14							0
	2012	BS47R01	SUCK	16							0
	2012	BS47R01	SUCK	16							0
	2012	BS47R01	LNDC	20							0
	2012	BS47R01	LNDC	15							0
	2012	BS47R01	SUCK	11							0
	2012	BS47R01	SUCK	11							0
	2012	BS47R01	SUCK	14							0
	2012	BS47R01	SUCK	12							0
	2012	BS47R01	MNWH	72			SC				0
	2012	BS47R01	MNWH	55			SC				0
	2012	BS47R01	MNWH	81							0
	2012	BS47R01	MNWH	69							0
	2012	BS47R01	MNWH	81							0
	2012	BS47R01	MNWH	69							0
	2012	BS47R01	LNDC	16							0
	2012	BS47R01	SUCK	16							0
	2012	BS47R01	MNWH	59							0
	2012	BS47R01	MNWH	60							0
	2012	BS47R01	LNDC	15							0
	2012	BS47R01	MNWH	75							0
	2012	BS47R01	MNWH	75							0
	2012	BS47R01	MNWH	69							0
	2012	BS47R01	LNDC	11							0
	2012	BS47R01	SUCK	14							0
	2012	BS47R01	LNDC	16							0
	2012	BS47R01	LNDC	14							0
	2012	BS47R01	SUCK	15							0
	2012	BS47R01	SUCK	14							0
	2012	BS47R01	SUCK	13							0
	2012	BS47R01	SUCK	17							0
	2012	BS47R01	LKCH	18							0
	2012	BS47R01	LKCH	19							0
	2012	BS47R01	LNDC	14							0
	2012	BS47R01	MNWH	69							0
	2012	BS47R01	MNWH	69							0
	2012	BS47R01	TRPR	25							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2012	BS47R01	MNWH	64							0
	2012	BS47R01	LNDC	15							0
	2012	BS47R01	LNDC	17							0
	2012	BS47R01	LNDC	15							0
	2012	BS47R01	LNDC	12							0
	2012	BS47R01	LNDC	13							0
	2012	BS47R01	LNDC	14							0
	2012	BS47R01	MNWH	62							0
	2012	BS47R01	MNWH	84							0
	2012	BS47R01	SCUL	35							0
	2012	BS47R01	SCUL	25							0
	2012	BS47R01	SCUL	30							0
	2012	SF47R01	MNWH	68			SC				0
	2012	SF47R02	LNSC	55							0
	2012	SF47R02	KOKA	109			SC				0
	2012	SF47R03	RDSH	76							0
	2012	SF47R03	RDSH	103							0
	2012	SF47R03	RDSH	68							0
	2012	SF47R03	MNWH	72			SC				0
	2012	SF47R03	NRPK	152			SC				0
	2012	SF47R05	LNSC	112							0
102.5 RB	2009	BS0603	SUCK	19							0
	2009	BS0603	TRPR	29							0
	2009	BS0603	NRPK	97							0
	2009	BS0603	LNSC	68							0
	2009	BS0603	SPSH	20							0
	2009	BS0603	SPSH	18							0
	2009	BS0603	SUCK	17							0
	2009	BS0603	SPSH	20							0
	2009	BS0603	SPSH	25							0
	2009	BS0603	NRPK	113							0
	2009	BS0603	LNDC	42							0
	2009	BS0603	TRPR	27							0
	2009	BS0603	TRPR	25							0
	2009	BS0603	LNDC	32							0
	2009	BS0603	SUCK	18							0
	2009	BS0603	YLPR	69		8					0
	2009	BS0603	SUCK	19							0
	2009	BS0603	SPSH	19							0
	2009	BS0603	RDSH	35							0
	2009	BS0603	SUCK	24							0
	2009	BS0603	NRPK	188	40						0
	2009	BS0603	TRPR	30							0
	2009	BS0603	RDSH	23							0
	2009	BS0603	YLPR	188	98						0
	2009	BS0603	YLPR	140							0
	2009	BS0603	YLPR	129							0
	2009	BS0603	NRPK	171	28						0
	2009	BS0603	RDSH	23							0
	2009	BS0603	LNDC	13							0
	2009	BS0603	YLPR	126							0
	2010	BS0603	YLPR	67			SC	1			0
	2010	BS0603	MNWH	24							0
	2012	BS02	SPSH	14							0

Appendix F1 Biological characteristics data for sampled fish, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Species	Fork Len. (mm)	Wt. (g)	Sex Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
	2012	BS47R02	NPMN	58							0
	2012	BS47R02	SPSH	25							0
	2012	BS47R02	SPSH	22							0
	2012	BS47R02	LNDC	22							0
	2012	BS47R02	LNDC	24							0
	2012	BS47R02	SUCK	22							0
	2012	BS47R02	NRPK	130							0
	2012	BS47R03	NRPK	165							0
	2012	BS47R03	NRPK	98							0
	2012	BS47R03	SPSH	41							0
	2012	BS47R03	SPSH	40							0
	2012	BS47R03	SPSH	41							0
	2012	BS47R03	SPSH	36							0
	2012	BS47R03	SPSH	37							0
	2012	BS47R03	SPSH	36							0
	2012	BS47R03	SPSH	46							0
	2012	BS47R03	SPSH	38							0
	2012	BS47R03	SUCK	37							0
	2012	BS47R03	SUCK	38							0
	2012	BS47R03	SPSH	37							0
	2012	BS47R03	SPSH	36							0
	2012	BS47R03	SUCK	36							0
	2012	BS47R03	SUCK	34							0
	2012	BS47R03	SPSH	38							0
	2012	BS47R03	SUCK	27							0
	2012	BS47R03	SUCK	36							0
	2012	BS47R03	SUCK	35							0
	2012	BS47R03	SUCK	27							0
	2012	BS47R03	LSSC	44							0
	2012	BS47R03	SPSH	44							0
	2012	BS47R04	NRPK	165							0
	2012	BS47R04	NRPK	160							0

Appendix G Fish Species Composition Data

Appendix G1 Side channel species composition by method, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Table G1A Number of fish enumerated by species and capture method in the Peace River Side Channel 32L.

Group	Species	Pre-spill Baseline Data													Present Study				
		2009						2010				2011							
		EF	**BS**	**GN**	**LF**	**Total**	**%**	**EF**	**BS**	**Total**	**%**	**BS**	**Total**	**%**	**EF**	**BS**	**SF**	**Total**	**%**
Sportfish	Bull trout				3	3	1.4					1	1	0.1					
	Goldeye																		
	Kokanee											2	2	0.2					
	Mountain whitefish	1	105	2	23	131	62.4	1	126	127	22.2	60	60	6.4			13	13	15.7
	Northern pike																		
	Walleye																		
	Yellow perch																		
	Subtotal	*1*	*105*	*2*	*23*	*131*	*63.8*	*1*	*126*	*127*	*22.2*	*63*	*63*	*6.7*			*13*	*13*	*15.7*
Suckers	Largescale sucker		1		4	5	2.4					7	7	0.7					
	Longnose sucker	2	38	2	8	5	23.8	3	23	26	4.5	64	64	6.8					
	White sucker			1	2	3	1.4												
	Sucker spp.								100	100	17.5	307	307	32.8		56		56	67.5
	Subtotal	*2*	*39*	*3*	*14*	*58*	*27.6*	*3*	*123*	*126*	*22*	*378*	*378*	*40.4*		*56*		*56*	*67.5*
Minnows[b]	Flathead chub																		
	Lake chub	1	2			3	1.4		1	1	0.2								
	Longnose dace							1		1	0.2					1		1	1.2
	Northern pikeminnow								12	12	2.1						1	1	1.2
	Redside shiner		3			3	1.4	1	282	283	49.4	231	231	24.7	1	4		5	6
	Spottail shiner																		
	Trout-perch																		
	Subtotal	*1*	*5*			*6*	*2.9*	*2*	*295*	*297*	*51.8*	*231*	*231*	*24.7*	*1*	*5*	*1*	*7*	*8.4*
Sculpins	Prickly sculpin		5			5	2.4	1	20		3.7	3	3	0.3	1	2		3	3.6
	Slimy sculpin								1	1	0.2	2	2	0.2					
	Sculpin spp.	1	6			7	3.3		1	1	0.2	258	258	27.6		4		4	4.8
	Subtotal	*1*	*11*			*12*	*5.7*	*1*	*22*	*23*	*4*			*28.1*	*1*	*6*		*7*	*8.4*
Total		**5**	**160**	**5**	**40**	**210**	**100**	**7**	**566**	**573**	**100**	**935**	**935**	**100**	**2**	**67**	**14**	**83**	**100**

[a] Methods:EF – backpack electrofisher; BS – beach seine; SF – small fish boat electrofisher; GN – gill net; LF – large fish boat electrofisher.

[b] Includes true minnows (Family Cyprinidae) and trout-perch (Family Percopsidae).

Appendix G1 Side channel species composition by method, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Table G1B Number of fish enumerated by species and capture method in the Peace River Side Channel 102.5RA.

Group	Species	2009				2010				2011			2012			
		BS	**LF**	**Total**	**%**	**BS**	**LF**	**Total**	**%**	**LF**	**Total**	**%**	**BS**	**SF**	**Total**	**%**
Sportfish	Bull trout									1	1	1.4				
	Goldeye									1	1	1.4				
	Kokanee													1	1	0.5
	Mountain whitefish	12	3	15	9.0	22		22	5.8	35	35	50.7	19	2	21	11.4
	Northern pike		5	5	3.0	1	3	4	1.1	7	7	10.1	1	1	2	1.1
	Walleye		3	3	1.8					5	5	7.2				
	Yellow perch		1	1	0.6											
	Subtotal	*12*	*12*	*24*	*14.4*	*23*	*3*	*26*	*6.9*	*49*	*49*	*71.0*	*20*	*4*	*24*	*13.0*
Suckers	Largescale sucker	12		12	7.2	6		6	1.6	3	3	4.3				
	Longnose sucker	10	6	16	9.6	19		19	5.0	6	6	8.7	1	1	2	1.1
	White sucker		5	5	3.0		2	2	0.5	11	11	15.9				
	SUCK	11		11	6.6	38		38	10.1				56		56	30.3
	Subtotal	*33*	*11*	*44*	*26.3*	*63*	*2*	*65*	*17.2*	*20*	*20*	*29.0*	*57*	*1*	*58*	*31.4*
Minnows[b]	Flathead chub	1		1	0.6											
	Lake chub	1		1	0.6								23		23	12.4
	Longnose dace	43		43	25.7	9		9	2.4				62		62	33.5
	Northern pikeminnow					50		50	13.3				2		2	1.1
	Redside shiner	50		50	29.9	50		50	13.3				1	3	4	2.2
	Spottail shiner		1	1	0.6	175		175	46.4				8		8	4.3
	Trout-perch	1		1	0.6								1		1	0.5
	Subtotal	*96*	*1*	*97*	*58.1*	*284*		*284*	*75.3*				*97*	*3*	*100*	*54.1*
Sculpins	Prickly sculpin	1		1	0.6											
	Slimy sculpin	1		1	0.6	1		1	0.3							
	SCULPIN					1		1	0.3				3		3	1.6
	Subtotal	*2*		*2*	*1.2*	*2*		*2*	*0.5*				*3*		*3*	*1.6*
Total		**141**	**24**	**167**	**100**	**372**	**5**	**377**	**100**	**69**	**69**	**100**	**177**	**8**	**185**	**100**

[a] Methods: BS – beach seine; SF – small fish boat electrofisher; LF – large fish boat electrofisher.
[b] Includes true minnows (Family Cyprinidae) and trout-perch (Family Percopsidae)

Appendix G1 Side channel species composition by method, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Table G1C Number of fish enumerated by species and capture method [a] in the Peace River Side Channel 102.5RB.

Group	Species	2009		2010		2011	2012			
		BS	**%**	**BS**	**%**		**BS**	**SF**	**Total**	**%**
Sportfish	Bull trout					No Data				
	Goldeye									
	Kokanee									
	Mountain whitefish			1	50					
	Northern pike	5	16.1				5		5	14.7
	Walleye									
	Yellow perch	5	16.1	1	*50*					
	Subtotal	*10*	*32.2*	*2*			*5*		*5*	*14.7*
Suckers	Largescale sucker						1		1	2.9
	Longnose sucker	1	3.2					1	1	2.9
	White sucker									
	SUCK	5	16.1				9		9	26.5
	Subtotal	*6*	*19.3*				*10*	*1*	*11*	*32.4*
Minnows[b]	Flathead chub									
	Lake chub									
	Longnose dace	3	9.7				2		2	5.9
	Northern pikeminnow						1		1	2.9
	Redside shiner	3	9.7							
	Spottail shiner	5	16.1				15		15	44.1
	Trout-perch	4	12.9							
	Subtotal	*15*	*48.4*				*18*		*18*	*52.9*
Sculpins	Prickly sculpin									
	Slimy sculpin									
	SCULPIN									
	Subtotal									
Total		***31***	***100***	***2***	***100***		***33***	***1***	***34***	***100***

[a] Methods: BS – beach seine; SF – small fish boat electrofisher

[b] Includes true minnows (Family Cyprinidae) and trout-perch (Family Percopsidae)

Appendix H Habitat Data

Appendix H1 Habitat Data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Date	Instream Habitat	Depth (m) 1/4	Depth (m) 1/2	Depth (m) 3/4	Velocity (m/s) 1/4	Velocity (m/s) 1/2	Velocity (m/s) 3/4	Substrate (%) Om	Si	Sa	Gr	Co	Bo	Be	D90 (cm)	Embed.	Compact.	Cover (%) Overhead	Rock	LOD	SubV	EmgV
32L	2009	BS0204	5/17/09	OXBOW	0.5	0.5	0.7	0.0	0.0	0.0	10	80	0	0	10	0	0				0	0	0	0	0
	2009	BS0204	9/24/09	OXBOW	0.8	0.9	0.9	0.0	0.0	0.0	10	90	0	0	0	0	0				0	0	0	20	0
	2009	EF0204	5/18/09	FLAT	0.2	0.3	0.4	0.0	0.0	0.0	0	70	0	0	30	0	0	33	H	H	0	0	0	0	5
	2009	EF0207	9/24/09	FLAT	0.2	0.2	0.2	0	0	0	10	50	0	0	40	0	0	30	M	L	0	40	0	0	60
	2009	EF0207	7/16/09	RUN	0.2	0.4	0.4	0	0.1	0.24	10	30			60			16	H	H	0	0	5	20	50
	2010	BS0204	5/29/10	FLAT	0.5	0.5	0.5	0	0	0	10	30	0	35	20	5	0	11	H	H	0	0	0	5	0
	2010	BS0204	7/9/10	FLAT	0.5	0.5	1	0	0	0	0	5	50	10	30	5	0	15	H	H	0	0	0	15	0
	2010	BS0204	10/3/10	FLAT	0.4	0.5	0	0	0	0	0	0	95	0	5	0	0				0	0	5	0	10
	2010	EF0207	5/29/10	POND	0.3	0.3	0	0	0	0	0	20	0	30	45	5	0	25	H	M	0	0	0	0	0
	2010	EF0207	7/9/10	POND	0.4	0.5	1	0	0	0	0	5	20	10	45	20	0	20	M	M	0	5	0	0	0
	2010	BS0217	5/29/10	SNYE	0.2	0.5	0	0	0	0	0	10	65	20	5	0	0	17	H	H	0	0	5	30	0
	2010	BS0217	7/9/10	SNYE	0.4	0.5	1	0	0	0	0	0	40	20	35	5	0	18	M	M	0	0	0	25	0
	2010	BS0217	10/3/10	FLAT	0.2	0.3	0	0	0	0	0	60	10	10	20	0	0	14	H	M	0	5	0	80	0
	2011	BS0204	5/20/11	OXBOW	0.4	0.5	1	0	0	0	0	95	0	0	5	0	0	0	NA	NA	0	0	0	0	0
	2011	BS0204	7/14/11	SCOX	0.5	0.6	1	0	0	0	0	90	0	0	10	0	0	16	H	H	0	0	0	0	0
	2011	BS0204	10/11/11	FLAT	0.7	0.8	1	0	0	0	0	95	0	0	5	0	0	10	M	M	0	0	5	10	5
	2011	BS0217	5/20/11	POND	0.3	0.5	1	0	0	0	0	35	0	10	50	5	0	17	H	H	0	0	0	0	0
	2011	BS0217	7/15/11	SCPD	0.3	0.6	0.6	0	0	0	0	40	0	0	60	0	0	8	H	H	0	0	0	0	0
	2011	BS0217	10/11/11	SCPD	0.3	0.4	0.5	0	0	0	0	60	0	0	20	20	0	28	L	L	0	0	0	20	0
	2012	BS04	8/21/12	BW	0.1	0.3	0.7	0.0	0.0	0.1	0	50	10	20	20	0	0	12	M	L	0	0	0	0	5
	2012	BS02(17)	8/20/12	F3	0.4	0.8	0.9	0.0	0.0	0.0	0	5	5	60	30	0	0	13	M	M	0	5	0	0	0
	2012	HT11 (07)	8/22/12	F3	-	-	-	-	-	-	5	5	10	30	40	10	0	28	L	M					
102.5RA	2009	BS0602	5/24/09	OXBOW	0.3	0.4	0.5	0.0	0.0	0.2	0	60	0	60	0	40	0		H	L	0	0	0	0	0
	2009	BS0602	7/20/09	OXBOW	0.3	0.4	0.5	0.1	0.3	0.41	0	90	0	90	0	10	0				0	5	0	0	5
	2009	BS0602	10/1/09	OXBOW	0.4	0.6	0.7	0	0.3	0.42	0	80	0	80	0	20	0	12	H	M	0	0	0	0	20
	2010	BS0602	6/5/10	SNYE	0.3	0.5	0.5	0.2	0	0.11	0	50	0	50	25	25	0	14	H	H	0	10	0	0	5
	2010	BS0616	6/5/10	SNYE	0.2	0.4	0.5	0.0	0.0	0.0	0	0	95	95	0	5	0				0	0	0	0	0
	2010	BS0616	7/18/10	SNYE	0.2	0.2	0.1	0.0	0.0	0.0	0	0	100	100	0	0	0				0	0	0	0	0
	2010	BS0616	10/9/10	SNYE	0.1	0.2	0.2	0.0	0.0	0.0	0	80	20	100	0	0	0				0	0	0	0	5
	2012	BS03 (02)	8/24/12	F3	0.5	0.5	0.5	0.0	0.1	0.0	0	10	5	15	65	20	0	17	M	M	0	0	0	0	5
	2012	HT32 (16)	8/24/12	F1	-	-	-	-	-	-	0	60	40	100	0	0	0				0	0	0	0	0

Appendix H1 Habitat Data, 2012 PCR Side Channel Spill Response Fish and Habitat Inventory

Side Channel	Year	Site	Date	Instream Habitat	Depth (m) 1/4	Depth (m) 1/2	Depth (m) 3/4	Velocity (m/s) 1/4	Velocity (m/s) 1/2	Velocity (m/s) 3/4	Substrate (%) Om	Substrate (%) Si	Substrate (%) Sa	Substrate (%) Gr	Substrate (%) Co	Substrate (%) Bo	Substrate (%) Be	D90 (cm)	Embed.	Compact.	Cover (%) Overhead	Cover (%) Rock	Cover (%) LOD	Cover (%) SubV	Cover (%) EmgV
102.5RB	2009	BS0603	5/24/09	OXBOW	0.2	0.3	0.3	0.0	0.0	0.0	10	90	0	100	0	0	0				0	0	0	20	0
	2009	BS0603	7/20/09	OXBOW	0.4	0.6	0.8	0.0	0.0	0.0	0	100	0	100	0	0	0				0	0	0	10	20
	2009	BS0603	10/1/09	OXBOW	0.3	0.6	0.7	0.0	0.0	0.0	0	100	0	100	0	0	0				0	0	0	0	20
	2010	BS0603	6/5/10	SNYE	0.3	0.4	0.4	0.0	0.0	0.0	10	90	0	100	0	0	0				0	0	0	35	35
	2012	BS02	8/25/12	F3/POND	0.3	0.4	0.5	0.0	0.0	0.0	0	100	0	100	0	0	0				0	0	0	0	35