Policy and Practice Report

Gravel Removal in the Lower Fraser River

20 May 2011

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Introduction

1. This policy and practice report ("Report") provides an overview of gravel removal in the lower Fraser River as it relates to sockeye salmon.

2. The information contained in this Report is derived from documents disclosed to the commission or otherwise obtained through the commission's investigations.[1] The accuracy of this Report is therefore subject to the accuracy of the documents so provided or obtained. Descriptions of policy and program objectives, purposes, outcomes, reviews or other qualitative assessments contained in this Report are as provided in the documents cited and are not necessarily the views of the commission.

3. This Report is not intended to be comprehensive nor authoritative, but instead aims to provide a contextual background to inform the hearings on gravel removal in the lower Fraser River. After a brief introduction to the Fraser River gravel reach, this Report is divided into two sections. The first section provides an overview of how sockeye salmon may use habitat in the gravel reach. The second section explains how the Department of Fisheries and Oceans ("DFO" or the "Department") manages the potential impacts to sockeye arising from gravel removal.

The Fraser River Gravel Reach

4. The Fraser River follows a steep, confined course, along which it picks up rocks, gravel and finer sediments from its banks and from tributaries.[2] Along most of its

[1] The commission's Terms of Reference direct the Commissioner to use the automated document management program specified by the Attorney General of Canada: Ringtail Legal. Source references in this Report, where possible, refer to the unique document identifier attached to a given document by Ringtail Legal. For such documents, citations refer to the Ringtail pagination. Where Ringtail page numbers are not embedded in the document, the original pagination is also given where possible. References to "exhibits" refer to exhibits tabled at the commission's evidentiary hearings. A full list of exhibits can be found at <http://cohencommission.ca/en/Exhibits.php>.

[2] Michael Church, "Sediment Management in Lower Fraser River: Criteria for a Sustainable Long-Term Plan for the Gravel-Bed Reach" (30 March 2010) [Church 2010] CAN429784 at 5.

1,400 km length, the Fraser River is structurally constrained: lateral movement is limited by bedrock or terraces.[3] Downstream of Hope, the river is less constricted as it enters the floodplain,[4] although it is not entirely free to meander because of bank hardening, flood dikes and other development along the lower Fraser River.[5] Gradually, as the gradient the river traverses declines and the water flow becomes less powerful, the river deposits its sediment load.[6]

5. "Sediment," as referred to in this Report, is a term that includes, in descending size, boulders, cobble, gravel, sand, silt and clay.[7] Boulders and larger cobble are deposited first, followed by smaller cobble and gravel, then sand and finally silt and clay.[8] Gravel is largely deposited between Hope and Mission, a stretch of approximately 85km.[9] This area, sometimes defined specifically as the area between the mouth of Sumas River at km99 and Laidlaw at km148, is known as the gravel reach.[10] Downstream of Mission, as the gradient and flow velocity continue to decline, the channel cannot transport larger sediments and becomes a mainly sand-bedded channel.[11]

6. The gravel reach is characterized by a wandering main channel, with large islands, sloughs and side channels.[12] Sedimentation zones occur where sediments tend to accumulate, separated by narrow transport zones where there is little sediment storage.[13] The accumulation of sediment as gravel bars and islands in moderate and low-gradient channels creates outstanding habitat for

[3] "Fraser River Sediment Budget Phase 2: Final Report", Northwest Hydraulic Consultants for EMBC (October 2009) [Sediment Budget Phase 2] BCP002179 at 15 (8 in original).
[4] *Ibid.*
[5] *Ibid.*
[6] Laura Rempel & Michael Church, "Physical and Ecological Response to Disturbance by Gravel Mining in a Large Alluvial River" (2009) 6 Can. J. Fish Aquat. 52, [Rempel & Church 2009] CAN402663 at 1.
[7] Marvin Rosenau & Mark Angleo (for Pacific Fisheries Resource Conservation Council), "Sand and Gravel Management and Fish Habitat Protection in British Columbia Salmon and Steelhead Streams" (May 2000) [Rosenau &Angelo 2000] CAN002593 at 13. Specifically, boulders are defined as greater than 250mm, cobble as 64-250mm, gravel as 2-64mm, sand as .062-2mm, and silt and clay as less than .062mm.
[8] *Ibid.* at 52.
[9] Sediment Budget Phase 2, *supra*, BCP002179 at 15 (8 in original).
[10] Church 2010, *supra* CAN429784 at 5.
[11] *Ibid.*
[12] *Ibid.*
[13] *Ibid.*

various fish species and aquatic organisms.[14] Many of the older islands in the channel have high surface elevations that are only flooded at the highest freshets (periods of increased water flow usually associated with spring runoff).[15] The location and number of sedimentation zones varies over time, as do sedimentation rates.[16] The volume of sediment transfer within the gravel reach is roughly ten times the average annual volume of sediment influx.[17] However, changes in the location and number of sedimentation zones occur slowly, usually over several years to several decades.[18]

7. River-run gravel is highly desirable for construction purposes because of its high quality and often easy access and removal.[19] In the lower Fraser River, gravel is primarily "scalped" from bars, meaning it is excavated from the tops of gravel bars during low flow, when the bars are dry.[20] Today, British Columbia has identified gravel removal as a strategic element of its approach to flood protection in the lower Fraser Valley.[21] Gravel is removed for public safety, rather than for commercial purposes.[22] British Columbia does not receive royalty or rent; the gravel removed becomes the property of the contractor undertaking the removal.[23]

Sockeye Habitat in the Gravel Reach and Potential Impacts from Gravel Removal

8. For most Fraser River sockeye salmon, the gravel reach provides habitat only during the relatively brief periods of migration. Sockeye salmon are not known to

[14] Rempel &Church 2009, *supra* CAN402663 at 1.
[15] Marvin Rosenau & Mark Angelo (for Pacific Fisheries Resource Conservation Council),"Saving the Heart of the Fraser: Addressing Human Impacts to the Aquatic Ecosystem of the Fraser River, Hope to Mission, British Columbia" (November 2007), [Rosenau & Angelo 2007] CAN002600 at 34.
[16] Sediment Budget Phase 2, *supra*, BCP002179 at 15 (8 in original).
[17] *Ibid.* at 16 (9 in original).
[18] *Ibid.* at 15 (8 in original).
[19] Rempel & Church 2009, *supra* CAN402663 at 1.
[20] Church 2010, *supra* CAN429784 at 12.
[21] Provincial Emergency Program [PEP], "Fraser River Sediment Management Program", online: PEP <http://www.pep.bc.ca/floods/fraser_sediment_prog.html>.
[22] "Management Plan" (n.d., for 2011 sediment management projects) CAN402981 at 2.
[23] *Ibid.*

spawn in the gravel reach, unlike pink and coho salmon.[24] Particular populations of sockeye salmon use portions of the gravel reach as rearing habitat.[25] Unfortunately, there is little information available on the status of these populations or the condition of their habitats.[26] There is also a paucity of information on the biological impacts of gravel removal, particularly within the lower Fraser River.[27]

Sockeye Salmon Use of Gravel Reach Habitats

9. Most sockeye salmon occupy the lower Fraser River for a brief period of time during adult migration upstream to spawning grounds, and again during juvenile migration to the Pacific Ocean—perhaps only a few days.[28] Adults likely use bar edges in the gravel reach for "holding" during upstream migration because of the favourable low-velocity conditions.[29]

10. Small numbers of juvenile sockeye have been regularly seen in the gravel reach outside the normal spring outmigration period.[30] One stewardship group reported to the Department "substantial numbers" of juvenile stream-rearing sockeye in the gravel reach in surveys conducted in November 2008.[31] The juvenile sockeye may be part of a stream-rearing population that grows in the mainstem Fraser River before heading to sea.[32] A small number of sockeye populations in British Columbia are known to rear in streams, rather than lakes, before migrating to the ocean.[33]

[24] Rosenau & Angelo 2000, *supra* CAN002593 at 53.
[25] *Ibid.*
[26] Cohen Commission Technical Report 3: "Fraser River Freshwater Ecology and Status of Sockeye Salmon Conservation Units" at 13. Data were not available that could be used to reliably describe basic habitat conditions for the six river-type Conservation Units (CUs).
[27] Rempel & Church 2009, *supra* CAN402663 at 2.
[28] Cohen Commission Technical Report 12: "Fraser River Sockeye Habitat Use in the Lower Fraser and Strait of Georgia" at 20.
[29] "Information Assessment Matrix for Tranmer Bar" (22 June 2010), CAN419315.
[30] Rosenau & Angelo 2007, *supra* CAN002600 at 57.
[31] Email, "Subject: Ad Hoc Fraser River Stewardship Gravel Committee 2009 Site extractions review" (17 November 2008), CAN082292 at 2.
[32] *Ibid.*
[33] *Ibid.*

11. One such population comes from the Harrison watershed. While most Harrison watershed sockeye rear in Harrison Lake for one year prior to migrating to the ocean, fry emerging from spawning grounds in the Harrison River rapids are not able to move upstream past the rapids and into the lake.[34] These fry are considered river-type sockeye and migrate downstream in the spring and rear in the lower Fraser off channel and backwater channel habitat areas over the early summer.[35] Small numbers of sockeye fry are found throughout many non-tidal portions of the lower Fraser River and are considered to be "Harrison Rapids 0+ river-type sockeye".[36]

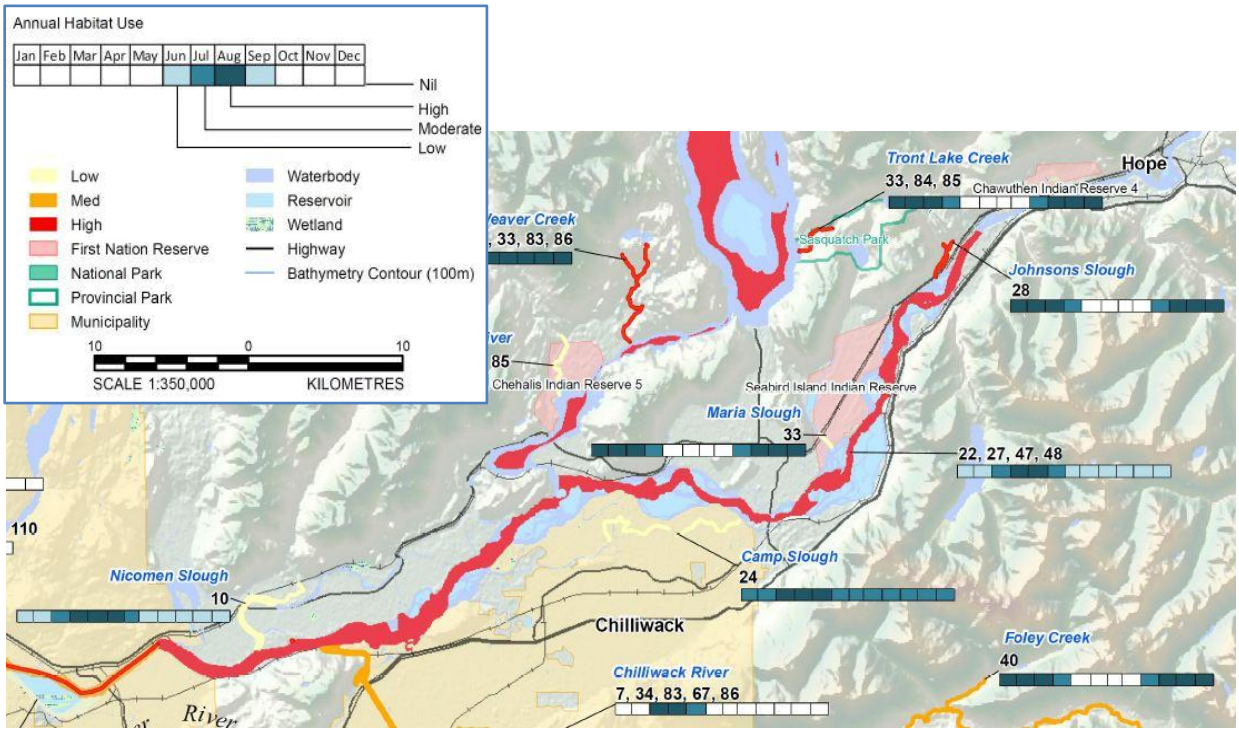

Figure 1. Map 3-B-i: Juvenile Fraser Sockeye Habitat Use in the Lower Fraser River. (Adapted from Cohen Commission Technical Report 12, Map 3-B-i.)

12. These Harrison river-type fry enter the Strait of Georgia at the end of July, having spent up to six months in Lower Fraser sloughs and off channel habitats.[37] They remain in the Strait of Georgia for several months before leaving through the

[34] Cohen Commission Technical Report 12, *supra* at 110.
[35] *Ibid.*
[36] *Ibid.*
[37] *Ibid.* at 111, 22.

Juan de Fuca Strait and are found off the west coast of Vancouver Island in February and March.[38]

Emerging Importance of River-Type Sockeye

13. The vast majority of Fraser River sockeye salmon populations are associated with lakes. However, the small number of river-type sockeye does not necessarily imply that the population has limited importance to the species' long-term sustainability. The commission`s Technical Report 3, “Evaluating the Status of Fraser River Sockeye Salmon and Role of Freshwater Ecology in their Decline”, explains:

> Although lake-type sockeye salmon populations can be enormously productive these specialized habitats may also be vulnerable to environmental changes, which could move them beyond the range to which local populations are especially well adapted. Conversely, river-type sockeye salmon are more generalized in their habitat requirements and only weakly differentiated by genetic markers. Being highly specialized, there have been suggestions that lake-type sockeye salmon populations could be considered evolutionary dead ends. Though relatively rare, river-type populations are more likely to stray from their natal stream to spawn and colonize new habitats. While this flexibility would indicate that river-type sockeye salmon could be important in conferring some greater overall resilience to the species as a whole, there is unfortunately little information available on the status of Fraser river-type populations or the condition of their river habitats.[39]

14. In addition to being more “flexible,” river-type sockeye also have a different life history than that of lake-type sockeye.[40] Some Harrison sockeye return to spawn after just three years, rather than the typical four years for most sockeye.[41]

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[38] *Ibid* at 111.
[39] Cohen Commission Technical Report 3 at 12-13 (citations removed, emphasis added).
[40] Mike Lapointe, “Overview of Freshwater Life History of Fraser Sockeye”, PowerPoint Presentation, Exhibit 1 at 7.
[41] *Ibid.*

Impacts of Gravel Removal

15. Stream gravel plays an important role in creating and maintaining stream structure and its habitat characteristics.[42] Physical impacts of gravel removal may include increased flow velocities, erosion, scour and straightening of the channel.[43] These impacts can extend for kilometres both downstream and upstream (through a process called headcutting) from the point of gravel extraction.[44]

16. While many studies have examined the physical effects of in-stream sediment removal, few have identified the direct biological impacts.[45] Gravel mining directly alters channel morphology, thereby affecting flow velocity, water depth, and substrate composition, all of which influence the distribution and abundance of aquatic organisms.[46] Dry bar scalping can simplify bar topography and reduce availability of shallow-water habitat at higher flows.[47] Species with specific habitat requirements can disappear from a system where substantial habitat modifications have occurred.[48]

17. Increased turbidity is an additional effect of gravel mining.[49] Turbidity reduces light penetration and thus can limit plant and algae growth; it can also smother benthic invertebrates.[50] When turbidity reduces the algal biomass or other plant production in a stream, the invertebrates can lose a large part of their food source, which can reduce populations.[51] A study of one site in the gravel reach

[42] DFO, "Fish Habitat Protection Needs in Relationship to the Aggregates Industry in British Columbia" (4 December 2000) [DFO Aggregates Paper} CAN023565 at 6.
[43] *Ibid.* at 5.
[44] *Ibid.* at 6.
[45] Rempel & Church 2009, *supra* CAN402663 at 2.
[46] *Ibid.*
[47] Laura Rempel, "Physical and Ecological Organization in a Large Gravel-Bed River and Response to Disturbance" (July 2004) (PhD Thesis: UBC), BCP001764 at 234 (210 in original).
[48] *Ibid.*
[49] *Ibid.* at 233 (209 in original).
[50] *Ibid.*
[51] DFO Aggregates Paper, *supra* CAN023565 at 6.

showed that benthic invertebrate populations appear to recover from gravel mining impacts quickly.[52]

18. While little is known about the dietary habits of rearing sockeye in the gravel reach, salmonids generally are highly dependent on invertebrates that are produced in streams as a food source.[53] Because salmonids generally depend on visual spotting of their prey, if the clarity of the water is lowered due to turbidity, salmonids may have difficulty spotting prey.[54]

19. There is a risk that fish will be stranded in isolated pools that develop after gravel is removed. In 2010, gravel removal in the lower Fraser River resulted in the stranding of sockeye salmon and other fish in such a pool, presenting a risk of mortality if the pool were to freeze.[55]

20. Overall, physical changes from gravel removal operations are believed to fall "within the range to which local aquatic populations are accustomed during [regular] flooding[.]"[56] For migrating sockeye, impacts are also lessened by the transient nature of the migration. For river-type salmon that rear in the gravel reach, there is does not appear to be enough information to determine the key habitats and assess with certainty the threat posed by gravel removal.

[52] Rempel & Church 2009, *supra.*
[53] DFO Aggregates Paper, CAN023565 at 8.
[54] *Ibid.*
[55] Email, "Subject: RE: Little Big Bar" (8 December 2010) CAN357655 at 1. An outlet channel was proposed to reconnect the pool with the Fraser River. The results of the proposed work were not available at the time this Report was published.
[56] Rempel & Church 2009, *supra* CAN402663 at 1.

Management of Gravel Removal in the Lower Fraser River

Gravel Removal to Date

21. Gravel has been removed from the Fraser River on a regular basis since around the 1950s.[57] Historically, gravel was mined for the purpose of obtaining construction aggregate.[58] River floodplains provide durable, high-quality gravel that is usually easy to access.[59]

22. With concerns rising over harm to fish habitat in the 1990s, a "partial moratorium" was put in effect while technical issues were studied.[60] This included assessments of the channel morphology, rate of gravel recruitment and deposition/erosion of sediments, fish utilization and habitat impacts, and development of hydraulic profiles associated with bed level and channel alignment changes.[61] Studies in these areas continue to be produced.[62]

23. Despite the "partial moratorium," records suggest gravel has been mined from the gravel reach every year from at least 1964 to 2010.[63] The average annual removal from 1964 to 1998 is estimated at 130,000 m^3.[64] The average annual removal from 2000 to 2010 is approximately 167,000 m^3.[65] Table 1 provides the exact locations and quantities of gravel removals since 2000. Figure 2 provides a map of the gravel reach showing the locations of most of the bars where gravel has been removed.

[57] Rosenau & Angelo 2007, *supra* CAN002600 at 94.
[58] *Ibid.*
[59] Rempel & Church 2009, *supra*, CAN402663 at 1.
[60] Rosenau & Angelo 2007, CAN002600 at 94.
[61] *Ibid.*
[62] This Report attempts to reference both the most recent and the most widely cited studies, where relevant.
[63] Michael Church, Darren Ham & Hamish Weatherly, "Gravel Management in Lower Fraser River" (12 December 2001) CAN024267 at 22-23.
[64] Hamish Weatherly & Michael Church, "Gravel Extraction Inventory for Lower Fraser River (Mission to Hope) 1964 to 1998 (15 March 1999), BCP002208 at 4 (2 in original).
[65] Calculated from Table 1.

LOWER FRASER RIVER (HOPE TO MISSION) Sediment Removal Record (in M^3)												
Sites (in upstream order)	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total (m^3)**
Webster Bar												0
Queens Bar						58,000						58,000
Harrison Bar	70,000				45,000					147,615		262,615
Foster Bar												0
Gill Island				60,000		50,820	70,000				205,300	386,120
Hamilton Bar	2,000	21,800	10,000	10,000			10,000		41,600		48,500	143,900
Little Big Bar					50,000						68,550	118,550
Big Bar							60,000					60,000
Powerline Island									19,000			19,000
Herrling (Popkum) Bar						33,000	133,000					166,000
Spaeti Bar		10,000			5000							15,000
Tranmer Bar										146,000		146,000
Spring Bar C&D						8,000			339,500			347,500
Seabird Island (Spring B)					85,000			25,000				110,000
Total Removed	**72,000**	**31,800**	**10,000**	**70,000**	**185,000**	**149,820**	**273,000**	**25,000**	**400,100**	**293,615**	**322,350**	**1,832,685**
Estimated Annual Recruitment	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	2,530,000
											Total accumulated in system	**697,315**

Table 1. Emergency Management British Columbia, Ministry of Public Safety and Solicitor General, record of sediment removal from 2000-2010.[66]

[66] British Columbia, Provincial Emergency Program, "Table of annual sediment removals 2000-2010", online: PEP <http://www.pep.bc.ca/floods/sediment_docs/quantities.pdf>. Note the numbers should be considered estimates. There are also small discrepancies between the numbers in this table and those reported in certain consultants' reports. See email, "Re: Website" (10 December 2010), CAN328408 attaching notes CAN328410.

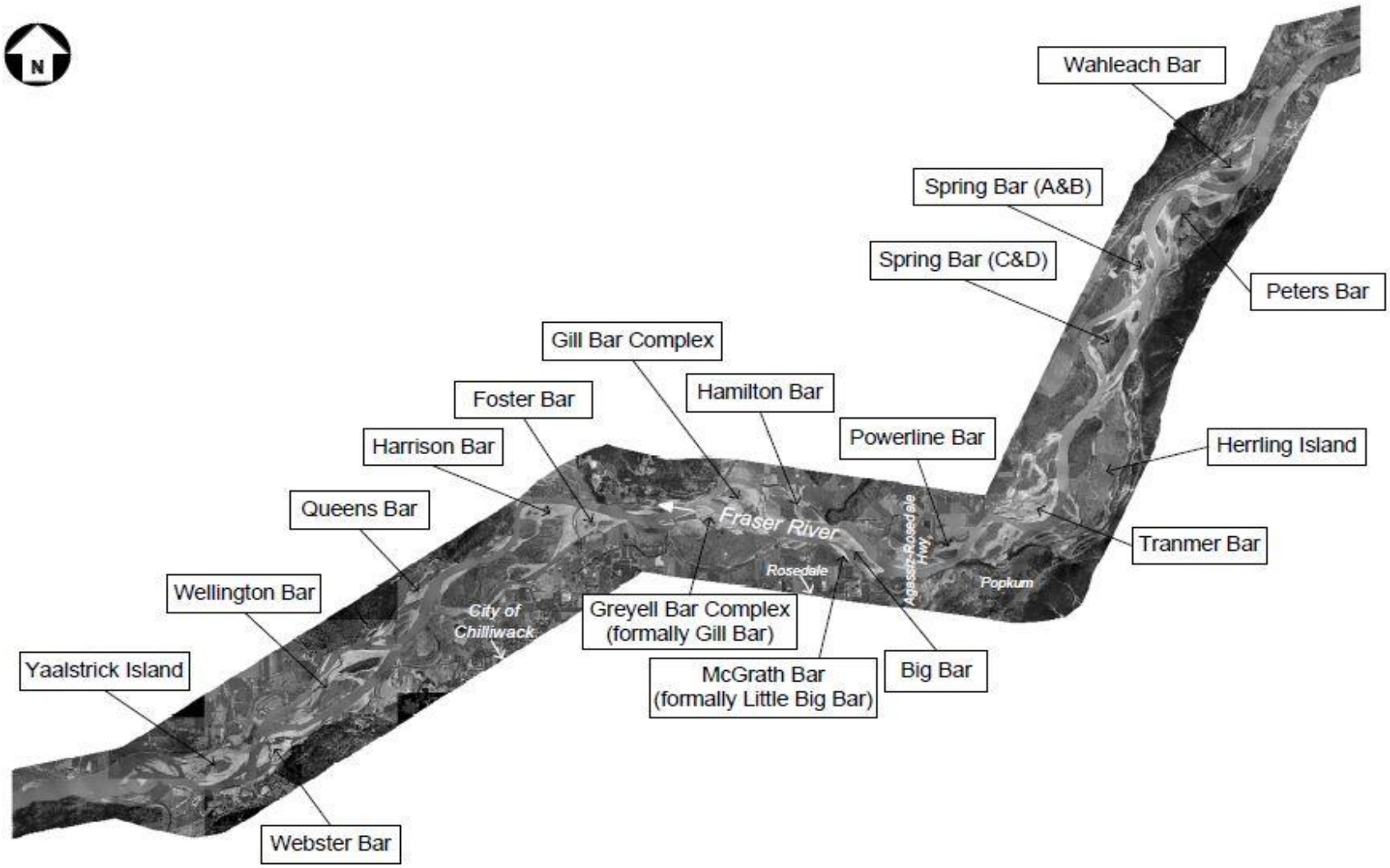

Figure 2. Location of gravel bars in the Fraser River.[67]

[67] British Columbia, Provincial Emergency Program, "Location of Gravel Bars in the Fraser River Hope to Mission, BC" (September 2010) online: PEP <http://www.pep.bc.ca/floods/sediment_docs/gravel_bars.pdf>.

Governance

24. This section of the Report explains that gravel removal in the Fraser River has, since 2004, been guided by an agreement between DFO and British Columbia. Currently, gravel is removed as one component of British Columbia's approach to flood hazard management. As a result, the "proponent" of gravel removal is, since 2007, Emergency Management British Columbia, Ministry of Public Safety and Solicitor General ("EMBC"). Representatives from EMBC, along with DFO, the BC Ministry of Environment ("MOE"), and other organizations, collectively decide where and when to remove gravel from the Fraser River through a process described below.

Letter of Agreement

25. In 2004, Land and Water BC Inc. and DFO signed a Letter of Agreement ("LOA") with respect to gravel removal from the lower Fraser River for 2004 through 2008.[68] The one-page LOA commits the two parties to "work together to take immediate action on the progressive reduction of the flood hazard risk to communities over along the Fraser River[.]" It signifies the parties' intentions to authorize the removal of approximately 500,000 m^3 per year in 2005 and 2006, and 420,000 m^3 per year until 2009.[69] The specifics of how gravel removal is to occur are set out in an appendix to the LOA, a seven-page Lower Fraser River Gravel Removal Plan (the "Gravel Removal Plan").

26. One purpose of the Gravel Removal Plan is to establish common timelines and processes for annual decision-making on gravel removals.[70] Key regulatory responsibilities and their associated annual target dates include:[71]

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[68] Letter of Agreement: Lower Fraser Gravel Removal Plan (n.d.), CAN036190.
[69] *Ibid.* at 3.
[70] *Ibid.* at 2.
[71] *Ibid.* at 3. Table is adopted from Attachment B and is meant to be a summary only. It does not include all dates or regulatory responsibilities.

May	Establish list of candidate sites that demonstrate hydraulic benefit
June	Pre-removal biological monitoring
August	Consultation with First Nations
September	More biological monitoring; removal tendering process
October	Final sites selected; *Land Act* approval; CEAA listing; consultation with First Nations; site designs finalized
November	*Fisheries Act* approval
December	Pre-removal biological monitoring and other information complete as conditions of authorization
January 1	Gravel removal begins
March 7	Work in the river is complete; reclamation and assessment
March 15	Winter work window ends

27. The original LOA expired on March 31, 2009. A February 2009 letter between DFO and the Minister of Public Safety and Solicitor General extended the LOA until March 31, 2010.[72] The extension was to "provide time to gather the best available knowledge and science upon which to base the new LOA and allow the continuing removal of sediment and gravel."[73] Gravel was removed in the winter work window of 2010. Gravel was not removed in the winter work window of 2011. A new LOA was being negotiated in 2010.[74]

Flood Hazard Mitigation

28. In 2007, British Columbia tasked EMBC with what would become known as the Lower Fraser Sediment Management Program (the "Sediment Management Program").[75] EMBC provides that the program is "one component of an integrated approach to flood hazard management[.]"[76] EMBC indicates that

[72] Letter of Agreement: Lower Fraser River Gravel Removal Plan (16 February 2009), CAN205456.
[73] *Ibid.*
[74] "Fraser Gravel – Issues and Consideration for how DFO Manages the File", memorandum (21 April 2010), [Fraser Gravel Memo] CAN403377 at 2.
[75] British Columbia Provincial Emergency Program, "Lower Fraser River Sediment Management Program" at 1, online: PEP <http://www.pep.bc.ca/floods/sediment_docs/introduction.pdf>. The terminology appears to change from "gravel removal" to "sediment management" around April, 2010, according to Technical Committee meeting notes of 28 April 2010, CAN403307 at 1.
[76] "Letter of Agreement: Lower Fraser River Gravel Removal Plan" *supra* CAN205456.

"gravel and sand settling on the river bottom raises the river bed in relation to the top of the dikes reducing the conveyance capacity of the river and increasing the risk of flood."[77] If sediment were not removed, EMBC explains, "the bed of the river would continue to [rise] and increase the risk of flood to the many residence[s] and businesses located in the Fraser Valley."[78]

29. It is beyond the scope of this Report to examine whether the Sediment Management Program can attain its stated goal of reducing flood risk. However, it must be noted that some individuals and groups do not accept the validity of the program's objectives.[79]

30. DFO retained consultants to provide an assessment of the impact on the water surface profile of the Fraser River, both locally and over the entire reach, from a series of proposed gravel removals.[80] The 2007 report concluded that it "does not appear that large scale gravel removals from the gravel reach of the Fraser River are effective in lowering the flood profile. Localized reductions in water surface elevations are possible, but significant, wide-scale reductions at flood flows are unlikely."[81]

31. EMBC, meanwhile, maintains that it bases gravel removal decisions on a number of scientific reports.[82] These reports include:[83]

- Darren Ham & Michael Church, "The Sediment Budget in the Gravel-Bed Reach of Fraser River: 2003 Revision" (20 October 2003)[84]

[77] British Columbia Provincial Emergency Program, "Lower Fraser River Sediment Management Program" at 1, online: PEP <http://www.pep.bc.ca/floods/sediment_docs/introduction.pdf>.
[78] *Ibid.* at 2.
[79] See, e.g., Letter, "Re: Meeting between BC Wildlife Federation and Ministry of Environment on Lower Fraser Gravel Issues" (18 January 2010), BC Wildlife Federation to Regional Water Manager, MOE, CAN409228; Tyee Bridge, "Between a Rock and Hard Place" (July 2010) *BC Business*, CAN402931; Fraser River Ad Hoc Stewardship Gravel Removal Committee, "Fish Habitat Destruction Through Gravel Removal in the Lower Fraser River", presentation for the Auditor General (June 2008) CAN077021 at 13-18, 38-66.
[80] Northwest Hydraulics Consultants Ltd., "Fraser River 2-D Numerical Modelling Large-scale Gravel Extraction Scenarios Tranmer Bar to Harrison Bar" (April 2007) BCP001780 at 7.
[81] *Ibid.* at 7.
[82] British Columbia Provincial Emergency Program, "Fraser River Sediment Management Program", online: PEP <http://www.pep.bc.ca/floods/fraser_sediment_prog.html>.
[83] Other reports may inform EMBC's assessment of flood risk, estimation of the sediment budget or other aspects of its decisions. The reports are listed as provided on EMBC's website, *Ibid.*

- "Fraser River Potential Gravel Removals 2007 – 2011" BGC Engineering report for BC Integrated Land Management Bureau (31 March 2006)[85]
- Darren Ham, "Morphodynamics and Sediment Transport in a Wandering Gravel-Bed Channel: Fraser River" (July 2005)[86]
- Laura Rempel & Michael Church, "Physical and Ecological Organization in a Large , Gravel-Bed River and Response to Disturbance[87]
- Michael Church & Darren Ham, "Atlas of the Alluvial Gravel-Bed Reach of Fraser River in the Lower Mainland" (15 October 2004)[88]
- Michael Church, Darren Ham & Hamish Weatherly, "Gravel Management in Lower Fraser River" (12 December 2001)[89]

32. A recent report commissioned by the EMBC observes:

> As the bed of Fraser River rises (aggrades) in the gravel-bed reach, the water surface level also rises for a given flow. If no action is taken to offset this process, the level of flood protection afforded by the dykes along the river is progressively reduced. As the result of a series of studies it is known that at various places along the river the dykes today are not sufficiently high to assure protection against the water level for which the dyke system was nominally designed; that is, the 1894 flood of record.[90]

33. The report goes on to list sediment removal as one of five options to mitigate the developing hazard.[91] However, a covering letter to the report cautions, "we know from substantial experience that individual sediment removals short of the order of a million m^3 will not substantially affect local water levels in the short term. But *sediment removals of such a scale would very significantly disrupt the aquatic ecosystem*."[92]

34. DFO's position is that "[t]he provincial government, not the Department, has the authority and responsibility for flood protection, including the management of

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[84] BCP001762.
[85] BCP001774.
[86] BCP001770.
[87] CAN402663.
[88] BCP001767.
[89] BCP001757.
[90] Church 2010, *supra* CAN429784 at 6. Citations omitted.
[91] *Ibid.* at 7.
[92] Letter, Michael Church to Manager, Strategic Mitigation Programs, EMBC (30 March 2010), CAN421275 at 1. Emphasis added.

gravel removal projects."[93] DFO officials defers to EMBC's "expertise and jurisdiction" in public safety and treat gravel removal as a "public safety priority".[94] The role of DFO in gravel removal is to "manage the fish and fish habitat issues associated with these works."[95] Some documents suggest the Department has become more deferential over the years.[96] Overall, "DFO seeks to balance the Province's interest in flood prevention with the need to protect fish and fish habitat."[97]

Governance Structure

35. A Technical Committee and a Management Committee together oversee the Sediment Management Program.[98] EMBC chairs the Technical Committee, which also includes one representative from each of DFO, the Provincial Emergency Program ("PEP"), the BC Ministry of Natural Resource Operations and Transport Canada.[99] DFO and MOE co-chair the Management Committee.[100] Representatives of the BC Integrated Land Management Bureau, EMBC, PEP and Transport Canada round out the Management Committee.[101]

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[93] DFO, "Questions and Answers on Fraser River Gravel Removals" (17 February 2010), CAN028091 at 1. Version "going into approvals now" but marked 'draft' – see covering email CAN028089.
[94] Email, "Subject: Draft reply to Gravel Stewardship group" (25 October 2010), CAN357783 at 1.
[95] *Ibid.* This view of the Department's role is in accord with the stated role for DFO in the Technical Committee's Terms of Reference, discussed below.
[96] DFO Aggregates Paper, *supra* CAN023565 at 5-6. This document states that "an authorization under Sec. 35(2) of the *Fisheries Act* will only be granted where there is clear evidence that the operation has the desired beneficial effect (e.g. flood control)[.] In addition, as part of the conditions of the authorization, the proponent will be required to develop and implement a plan to compensate for the residual impacts to fish habitat[.] This compensation plan must be approved by DFO." It is not clear whether this document accurately reflects DFO's policies or practices in 2000.
[97] DFO, "Questions and Answers: Fraser River Gravel Removals" *supra* CAN028091 at 3.
[98] "Governance Structure: BC Lower Fraser River Sediment Management" (15 December 2010), CAN295264. The Technical Committee formed, at least in part, as a result of a recommendation that arose in a DFO report investigating an incident during gravel removal in 2006 at Big Bar, where a side channel was dewatered, resulting in the destruction of between 1 and 2.25 million pink salmon alevins. "A Review of Access Issues Associated with Lower Fraser River Gravel Extraction Operations" (September 2006) CAN002557. See also Letter, "To the Fraser River Gravel Removal Technical Committee" (7 May 2007) CAN031547.
[99] *Ibid.*
[100] *Ibid.*
[101] *Ibid.*

36. According to the latest available terms of reference, the purpose of the Management Committee is "to ensure that gravel removal meets the annual targets in keeping with the Letter of Agreement."[102] The Management Committee also reviews and approves or rejects gravel removal proposals recommended by the Technical Committee.[103]

37. The Technical Committee provides recommendations to the Management Committee with respect to sediment removal.[104] It appears to meet much more frequently.[105] The Technical Committee's roles and responsibilities include:

- coordinate a planning cycle to ensure sediment is removed within the appropriate time frames, identify sites for sediment removal;
- identify sites for sediment removal;
- clarify permitting requirements specific to any project;
- identify additional information requirements associated with sediment removal;
- complete the applicable sections of the Issues Rating Matrix (described below) or other tools requested by the Management Committee;
- review reports and studies;
- provide feedback to the Management Committee in regard to CEAA and other timing restraints; and
- provide knowledge and expertise that will facilitate the removal of sediment form the Fraser River using best practices and continuous improvement.[106]

38. Specific roles and responsibilities are also set out for each department or agency with representation on the Technical Committee. The Terms of Reference contemplate a Ministry of Environment representative to provide expertise on hydrology and fish interests, and technical advice for flood protection.[107] There is no MOE representative on the Technical Committee;[108] this has been an ongoing

[102] Lower Fraser River Gravel Management Committee: Terms of Reference (21 May 2008) (marked draft), CAN403310 at 1.
[103] *Ibid.* at 2.
[104] Lower Fraser River Gravel Technical Committee: Terms of Reference (19 March 2010) (marked draft), CAN403309.
[105] This observation is based on the number of meeting minutes found in the Ringtail database for each committee, which is assumed to accurately reflect the number of meetings.
[106] Lower Fraser River Gravel Technical Committee: Terms of Reference, *supra* CAN403309 at 3.
[107] *Ibid.* at 2.
[108] "Governance Structure: BC Lower Fraser River Sediment Management", *supra* CAN295264.

concern for DFO's committee representatives.[109] MOE staff have recommended refusal of at least one approval application under the *Water Act* for various reasons, including perceived risks to fish and fish habitat, uncertainty about flood protection benefits, and failure of applications to meet the requirements of the LOA.[110] The Regional Water Manager in this case issued the approval.[111] DFO official has observed that "the gravel removal agenda often overrides objective technical input."[112]

Removal Site Selection

39. According to EMBC, gravel removal locations are chosen based on a number of factors:

- hydraulic benefit;
- adjacent erosion;
- height and strength of local dikes;
- "fish use (including spawning and juvenile rearing areas)";
- "First Nations concerns regarding erosion of property and protection of traditional fishing areas"; and
- site accessibility.[113]

40. Multiple sites may initially be selected to undergo further assessment and study. As part of this process, EMBC takes the lead in coordinating the completion of what are commonly known as 'issues rating matrices', 'risk tables', or 'risk matrices' to assist in the selection of suitable gravel removal sites.[114] Sections of the risk matrices are completed, typically by members of the Technical

[109] Fraser Gravel Memo, *supra*, CAN403377 at 2.
[110] "Water Stewardship Report on an Approval Application" (6 February 2009), CCI001179 at 8. See also email, "Sect 9 Application A2005590, EMBC, Tranmer Bar, Fraser River" (2 January 2009), CAN082179 at 1.
[111] See "Reason for Decision: Application for Approval of Gravel Removal from Tranmer Bar" (6 February 2009), CAN434732.
[112] Fraser Gravel Memo, *supra*, CAN403377 at 2.
[113] BC Provincial Emergency Program, "Lower Fraser River Sediment Management Program: Background Information", online: PEP <http://www.pep.bc.ca/floods/sediment_docs/introduction.pdf>.
[114] Email "Subject: Risk Matrix" (21 October 2009) CAN357875 at 1. Risk tables (which may be incomplete or draft versions) are found, for the 2010 removals at CAN357362 through CAN357365 and for the proposed 2011 removals that did not occur, at CAN357964.

Committee, who input numerical values for categories under general headings such as biological information, public safety, navigation, and hydraulic information.[115] The numerical values correspond to perceived risk.

41. The Technical Committee also relies on studies of long-term gravel transport rate to govern reach-wide removal volumes.[116] The committee relies on more recent, decadal-scale deposition/erosion patterns to guide decisions about where along the reach may be most appropriate to locate gravel removals.[117]

Permitting and Environmental Assessment

42. Gravel removal is governed by several federal acts and regulations, including the *Fisheries Act*,[118] the *Navigable Waters Protection Act*,[119] and the *Canadian Environmental Assessment Act* ["CEAA"].[120] Applicable provincial legislation[121] includes the *Water Act*[122] and *Water Regulation*,[123] the *Dike Maintenance Act*,[124] the *Land Act*[125] and *Crown Land Fees Regulation*,[126] the *Mines Act*,[127] and the Health, Safety and Reclamation Code.

43. Before beginning gravel removal, the proponent (EMBC) must receive a number of authorizations, depending on the specifics of the application. Table 2 shows the permits that may be required and provides examples of each by reference to Ringtail database numbers.

[115] Email "Subject: RE: Risk Matrix" (22 October 2009) CAN357875 at 1.
[116] Email "Subject: RE: Tranmer Bar hydraulic piece" (27 October 2010), CAN402988 at 1.
[117] *Ibid.*
[118] R.S.C. 1985, c. F-14.
[119] R.S.C. 1985, c. N-22.
[120] S.C. 1992, c. 37.
[121] Province of British Columbia's Submission of Information: Fraser River Sediment Management Program (n.d.) BCP002113 at 1.
[122] R.S.B.C. 1996, c. 483.
[123] B.C. Reg. 204/88.
[124] R.S.B.C. 1996, c. 95.
[125] R.S.B.C. 1996, c. 245.
[126] B.C. Reg. 177/2003.
[127] R.S.B.C. 1996, c. 293.

Legislation	Authorization/Report	Issuing Authority	Example
Fisheries Act, subsection 35(2)	Authorization for the harmful alteration, disruption or destruction of fish habitat	DFO	CAN365039 (Little Big Bar, 2010)
Fisheries Act, section 32	Authorization for the destruction of fish	DFO	CAN144644 (joint s. 35(2) and s. 32 authorization – Tranmer Bar, 2009)
Canadian Environmental Assessment Act	Screening Report	DFO	CAN365041 (Little Big Bar, 2010)
Navigable Waters Protection Act, subsections 5(1) and 5(3)	Approval of work (only required in some circumstances, e.g., when bridge required)	Transport Canada	CAN365051 (temporary access ramp at Little Big Bar, 2010)
Water Act, section 9	Approval/authorization to make changes in and about a stream	BC Ministry of Environment	CAN371041 (Little Big Bar, 2010)
Land Act, section 17	Designation of portion of Crown land for a particular use	BC Integrated Land Management Bureau	CAN371043 and CAN371044 (Little Big Bar, 2010)
Mines Act, subsection 10(2)	Permit/authorizing letter approving work system and reclamation program	BC Ministry of Energy and Mines	CAN371042 (Little Big Bar, 2010)

Table 2. Authorization that may be required for gravel removal in the Fraser River.

Subsection 35(2) Authorization

44. Most of the fish and fish habitat related conditions imposed, especially those required by the LOA and Long Term Plan, are found in the subsection 35(2) authorization for the harmful alternation, disruption or destruction of fish habitat, which may be jointly issued with a section 32 authorization for the destruction of fish.[128] Many conditions attempt to mitigate harm to fish habitat, such as conducting all work "in the dry" and not removing gravel from lower than 0.2

[128] See Table 2.

metres above the water table.[129] There are also specific conditions relating to compensation and monitoring (both discussed below). Environmental monitors are required on site at each removal location. On recent permits, the environmental monitor is empowered to stop work over environmental concerns.[130]

45. The Gravel Removal Plan sets out information proponents need to provide as the "minimum necessary for [DFO] to evaluate compliance with the Federal *Fisheries Act.*"[131] These include biological and physical monitoring requirements, described in the monitoring section below. However, not all of the information requirements are met all of the time.[132] Late submission of application documents from the proponent is described as a "chronic problem."[133]

46. A noted challenge with the current approach to site selection is that detailed planning does not begin until river levels recede, usually in September.[134] Water levels often prevent access to the bars to do the required surveys and sampling.[135] As removal is expected to begin in January, there is limited time to produce the required permits and to engage in consultation and public engagement.[136] The tight timelines are "not ideal for either [EMBC], the environmental watch dogs, or the application approvers."[137]

[129] DFO, "Authorization for Works or Undertakings Affecting Fish Habitat: Little Big Bar" (25 January 2010) CAN365039 at 3.
[130] *Ibid.* at 10.
[131] Letter of Agreement: Lower Fraser Gravel Removal Plan, *supra* CAN036190 at 5.
[132] Email, "Re: Gravel update", (18 January 2010), CAN357680 at 4. This email notes that pre-assessment sampling of the Little Big Bar site for sturgeon did not occur.
[133] Fraser Gravel Memo, *supra,* CAN403377 at 1.
[134] *Ibid.* at 2.
[135] Email "Subject: Fraser River Sediment Removal program" (12 January 2010), CCI001178 at 10.
[136] *Ibid.*
[137] *Ibid.* at 9.

Environmental Assessment

47. The federal environmental assessment is normally led by DFO.[138] To date, all environmental assessments have proceeded as screenings. A more inclusive comprehensive study is only required for a gravel "pit" with a production capacity of 1,000,000 tonnes per year or more,[139] which it "is unlikely that the Province would ever consider exceeding[.]"[140]

48. No provincial environmental assessments have been conducted for gravel removal in the gravel reach. In British Columbia, assessment is required for a gravel "pit facility" with a production capacity greater than or equal to 500,000 tonnes per year, or, 1,000,000 tonnes over less than four years.[141]

49. DFO screening reports may note email correspondence with the BC MOE identifying provincial fisheries concerns.[142] They may also note correspondence received from external groups.[143]

50. Many screening reports note that "[a]ll species of anadromous Pacific salmon utilize habitat within the reach to a varying degree for adult holding and migration to spawning grounds, smolt migration to the ocean, and rearing habitat for juveniles."[144] None of the screening reports reviewed in preparing this Report mention potential impacts on sockeye or sockeye habitat specifically, although many describe potential impacts to pink and chum habitat, which are known to spawn in the region. Many of the screening reports identify a potential reduction in habitat quality for juvenile salmonids, due to a change in substrate conditions and a potential reduction in the invertebrate population, reducing availability as

[138] Section 35(2) of the *Fisheries Act* is a "trigger" under the *Law List Regulations*, SOR/94-636. For more on the Department's role in environmental assessments, see the commission's Policy and Practice Report: "The Department of Fisheries and Oceans' Habitat Management Policies and Practices".
[139] *Comprehensive Study List Regulations*, SOR/94-638, Schedule, s. 18(i).
[140] Email "Subject: CEAA process" (21 April 2010), CAN082218.
[141] *Reviewable Projects Regulation*, B.C. Reg. 370/2002. Table 6. A sediment bulk density of 1.75 tonnes/m^3 is commonly used to determine the weight of a given volume of gravel, or vice versa. The highest annual removal to date is thus approximately 700,000 tonnes in 2008.
[142] See, e.g., DFO, Screening Report for Little Big Bar (21 January 2010) CAN365041 at 2.
[143] *Ibid.*
[144] See, e.g., *Ibid.* at 3.

food.[145] They also identify a potential loss of habitat complexity where irregular bar topography and large woody debris may be reduced.[146]

51. Some screening reports, or the processes that led to their production, have drawn criticism from the public and the technical community.[147] A 2008 memorandum from Ecofish Research to a DFO official formerly responsible for managing aspects of gravel removal expresses concerns with the amount of gravel proposed for extraction, potential impacts on juvenile salmon resident in or migrating through the extraction area and potential impacts on benthic invertebrates.[148]

Public Participation and Consultation with First Nations

52. When preparing a screening report under the CEAA, the Department does not normally consider public participation under subsection 18(3) appropriate.[149] However, the latest DFO manager involved in gravel removal has made efforts to meet with, correspond with and provide information to concerned groups, including the Fraser River Gravel Stewardship Committee and the Fraser River Coalition.[150] Some parties have voiced concerns that public participation would be better facilitated by a comprehensive study or panel than a screening-level environmental assessment.[151]

53. One DFO manager involved in gravel observed that EMBC and MOE have been more receptive to engagement with external interests of late.[152] Recently, the EMBC has made significant efforts to make gravel removal information more

[145] See, e.g., *Ibid.* at 6.
[146] *Ibid.*
[147] See, e.g., Marvin Rosenau, "Comments on 2009 Harrison Bar CEAA DFO Screening Report for Gravel Removal Draft" (February 2009), CAN180755. The actual screening report for Harrison Bar can be found at CAN006014.
[148] Adam Lewis & Andrew Harwood, Memorandum re: "Critical Issues Relating to Proposed Gravel Extraction at Harrison Bar" (10 December 2008), CAN190526.
[149] See, e.g., Screening Report for Little Big Bar, CAN365041 at 11.
[150] See, e.g., email CAN336865, email CAN357680 at 1, email CAN357785.
[151] Fraser Gravel Memo, *supra,* CAN403377 at 2.
[152] Fraser Gravel Memo, *supra,* CAN403377 at 1.

available to the public, in part by hosting a page on the PEP website.[153] The website is intended to list all gravel-related information except transitory documents, emails and committee meeting minutes.[154]

54. EMBC coordinates consultation with First Nations for all provincial agencies.[155] The Department also invites comments on sediment removal proposals.[156] Recently, several First Nations "with little previous input" on gravel removal have been voicing concerns and requesting opportunity for input.[157]

Monitoring Impacts

55. The Department has required proponents of gravel removal to monitor site-specific impacts since 2004.[158] The monitoring program is outlined in the 2004 Letter of Agreement. Although it has been modified over the years, it is based on protocols established by Rempel and Church in 2003.[159] In summary, the proponent (today EMBC) is required to conduct:

- topographic and bathymetric surveys (pre-removal, post-removal, post-freshet);
- surface sediment sampling (pre-removal, post-freshet);
- juvenile fish sampling (two episodes, both at removal and reference sites);
- benthic invertebrate sampling (pre- and post-removal, at removal and reference sites);
- habitat mapping (post-removal, post-freshet); and

[153] BC PEP, "Fraser River Sediment Management Program", online: PEP <http://www.pep.gov.bc.ca/floods/fraser_sediment_prog.html>.
[154] Lower Fraser River Sediment Management Technical Committee, Meeting notes (22 September 2010) CAN429705 at 1. The website provides the screening report, *Fisheries Act* authorization, *Water Act* authorizations, Final Removal Design, and associated permit applications. Risk matrices are not posted because they are "based on preliminary and sparse information."
[155] Letter, EMBC to Peters Band (14 May 2010) CAN371155 at 1. Note this letter is one of 35 sent to different First Nations groups in the area, found attached to email "Subject: Joint Consultation Letters and attachments" (14 May 2010) CAN371154.
[156] See, e.g., letter, "Subject: Application for Fraser River sediment removal in 2011" (19 November 2010) CAN454536.
[157] Fraser Gravel Memo, *supra*, CAN403377 at 1.
[158] Church 2010, *supra* CAN429784 at 14.
[159] Laura Rempel and Michael Church, "The Harrison Bar Gravel Removal Experiment: Final Report" (September 2003) CAN420839.

- channel hydraulic and morphological assessment.[160]

56. Specific monitoring requirements are given in each subsection 35(2) authorization. Monitoring studies have, in general, expended less effort than was made in Rempel and Church's original study.[161] DFO officials also observe that monitoring requirements have not been met by proponents in several past years.[162] This has reduced the opportunity to adaptively manage based on monitoring results.[163] Monitoring to date has also been entirely site-specific; there has been no effort to look at gravel reach-level issues, especially from channel morphology and habitat availability perspectives.[164]

57. It appears that most pre-extraction fish sampling efforts that identify salmonids do not identify salmonids to the level of species, such as sockeye.[165]

58. The accumulation of multiple monitoring responsibilities and reports covering multiple years at multiple removal sites has made DFO's role challenging at a technical and workload level.[166] One DFO official has observed that these challenges make it difficult to determine whether subsection 35(2) authorization objectives are being met.[167]

59. EMBC and DFO commissioned a meta-analysis of monitoring reports from 2004 to 2008 to assess potential impacts to fish and fish habitat result from sediment extraction activities.[168] The report concluded that data collected to 2008 do not

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[160] Letter of Agreement: Lower Fraser Gravel Removal Plan, *supra* CAN036190; DFO, "Revised Recommendations for Fraser River Gravel Removal Monitoring" (8 September 2004) CAN402702. This list is a summary and does not explain the information requirements in the same detail as the Gravel Removal Plan and Revised Recommendations document.
[161] Church 2010, *supra*, CAN429784 at 14.
[162] Fraser Gravel Memo, *supra*, CAN403377 at 3.
[163] *Ibid.* at 3.
[164] *Ibid.*
[165] See, e.g., "Herrling Bar and Tranmer Bar Biological Monitoring Program Report" (31 January 2008) BCP001787 at 17; "Fraser River Gravel Removal Proposed Hamilton Bar Extraction 2009" (21 November 2008), BCP002318 at 16; email "Subject: RE: 2010 08 20 Tranmer Biological Monitoring Report DRAFT lfp lr.doc" (8 December 2010) CAN403229 at 1.
[166] *Ibid.* at 2.
[167] *Ibid.* at 2.
[168] "Fraser River Sediment Removal Surveys: Statistical Meta-Analysis", prepared for DFO and EMBC by G3 Consulting (April 2009), CAN024231 at 5.

provide evidence of an overall effect of scalping on benthic infauna or fish.[169] This was attributed, to a large extent, to limitations in sampling design.[170] According to the report, EMBC, DFO and consultants with monitoring experience concur that the monitoring program does not adequately address questions of magnitude and extent of effect of gravel bar scalping.[171]

60. Thus, there is general consensus, at least within the Department, that a more strategic and comprehensive monitoring program is required.[172] DFO and EMBC are working toward a new monitoring plan, but have not finalized it.[173]

Compensation

61. Guided by the 1986 Policy for the Management of Fish Habitat, DFO's normal approach for development that cannot proceed without harming fish habitat is to require, as a condition of the *Fisheries Act* authorization, the proponent to provide a compensatory increase in the productive capacity of fish habitat.[174]

62. In contrast, the Gravel Removal Plan accompanying the original LOA states:

> Habitat compensation may not be required where it is determined that features that fully mitigate habitat impacts shall be constructed as part of the gravel removal[.] [To date,] DFO has not required compensation for gravel removals where, following one to three freshets, there has been recruitment, replenishment and re-stabilization of the bar's productivity.[175]

63. Thus, as long as new gravel is washed down the river to replace the gravel removed, the harm to habitat is suggested to be temporary. There is inherent

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[169] *Ibid.*
[170] *Ibid.*
[171] *Ibid.*
[172] Fraser Gravel Memo, *supra*, CAN403377 at 3.
[173] "Province of British Columbia's Submission of Information – Fraser River Sediment Management Program" (n.d.) BCP002113 at 2. See also email, "Subject: Fraser River Gravel Mining – Environmental Monitoring Program" (25 March 2010) CAN178195, attaching "Fraser River Gravel Extraction Assessment and Monitoring Plan DRAFT V1" (March 2010), CAN178196.
[174] "Policy for the Management of Fish Habitat", (1986) CAN021794. This policy is more thoroughly described in the commission's policy and practice report: The Department of Fisheries and Oceans' Habitat Management Policies and Practices (18 May 2011).
[175] Letter of Agreement: Lower Fraser Gravel Removal Plan, *supra* CAN036190.

uncertainty in this approach that necessitates post-extraction monitoring, as the Department acknowledges in a recent screening report:

> The nature and duration of the harmful alteration, disruption and/or destruction to fish habitat is predicted to be non-significant and temporary as a result of 1) design features described herein, and 2) natural sediment recruitment and stabilization of the site by subsequent freshets. There remains, however, uncertainty associated with this prediction. This uncertainty will be addressed through post-excavation monitoring following the 2010 freshet, described above. The Monitoring Program includes methods to evaluate the effectiveness of mitigative habitat design features within the project footprint, post-excavation habitat conditions, available habitat area for select fish species, and the duration of change. The results of this monitoring will be used to calculate an overall habitat balance resulting from the works; compensatory activities may be required of the Proponent to offset a negative habitat balance.[176]

64. Similar language is included in the subsection 35(2) authorizations, indicating to the proponent that compensation may, in the future, be demanded.[177] To date, the Department has not demanded compensatory habitat from any proponent for gravel removal in the lower Fraser River.

Need for Compensation May Depend on Local Replenishment Rates

65. The screening reports and subsection 35(2) authorizations make clear that replenishment of habitat depends on a number of factors, including the magnitude of the spring freshet. A 2009 study examined both ecological and physical responses to gravel mining on one particular dry bar in the Fraser River.[178] The study observed that subsequent to gravel removal, two below-average freshets yielded no gravel replenishment.[179] A third, above-average freshet replenished 31% of removal volume.[180] However, the high elevation bar

[176] See, e.g., Screening Report for Little Big Bar (2010) CAN365041 at 10.
[177] See, e.g., Authorization for Works or Undertakings Affecting Fish Habitat, Little Big Bar (2010), CAN365039 at 4.
[178] Rempel & Church 2009, *supra*, CAN402663 at 1.
[179] *Ibid.*
[180] *Ibid.*

area, which provides fish habitat at high flows, remained 25% smaller after three floods.[181]

66. Local recruitment estimates (for a given proposed gravel extraction site or group of sites) may differ from reach-wide gravel recruitment estimates. A 1998-2008 sediment budget estimates between 130,000 and 269,000 m^3 of sediment enter the gravel reach each year, but that transport past the Aggasiz-Rosedale Highway Bridge (see Figure 1) is only between 30,000 and 61,000 m^3 per year.[182] The Department notes this estimate in the screening report for gravel removal at Little Big Bar in 2010, adding that the three removals scheduled for 2010 would exceed the *local* annual sediment transport rate by up to a factor of ten.[183] The screening report adds that based on case studies from other rivers, sediment extraction rates that persistently exceed the natural rate of recruitment may lead to channel simplification and loss of habitat for fish.[184] However, the report appears to accept the consultant's prediction that sediment replenishment at the site will take three to four subsequent freshets.[185]

Current Status, Long Term Plan and Proposed Changes

No Removals in 2011

67. In 2010, PEP, DFO and MOE completed the risk matrix for 2011 removal from three gravel bars: Tranmer, Powerline and Harrison.[186] Both MOE and DFO rated Harrison as the preferred site in terms of biological risk and hydraulic benefit.[187] In late fall, 2010, EMBC submitted applications for gravel removal at Powerline

[181] *Ibid.*
[182] Sediment Budget Phase 2, *supra* BCP002179 at 4 (ii in original). According to the report, the range of sediment budget estimates represents an error range induced by assumptions about the sediment budget, and is not a statement of statistical or measurement precision.
[183] Screening Report for Little Big Bar (21 January 2010) CAN365041 at 7.
[184] *Ibid.*
[185] *Ibid.*
[186] Lower Fraser River Sediment Management Technical Committee, Meeting notes (23 June 2010) CAN403312 at 2.
[187] *Ibid.*

Bar and Tranmer Bar.[188] EMBC anticipated proceeding with a removal of 230,000 m^3 from Tranmer Bar, with contingent removal of 38,000 from Powerline Bar.[189] On November 18, 2010, EMBC asked DFO to "focus effort on the Tranmer Bar Application."[190]

68. No gravel removal took place in the usual spring gravel removal window of 2011. EMBC "determined that due to the limited remaining construction window, work at Tranmer Bar will not begin in 2011, but will be reviewed for possible start in 2012."[191]

Renewal of the Letter of Agreement and Long Term Plan

69. According to EMBC, the permitting timelines and seasonal variations in river flow combine to create, "a virtually unworkable program."[192] The required permits are often not in place for January 1.[193] EMBC would prefer to have the gravel removal program examined over a ten-year period, with a one-time CEAA process to cover extraction for ten years.[194]

70. Accordingly, DFO and EMBC are considering multi-year extraction planning and approval to resolve the approval timing challenge. DFO notes the process could also be used to permit more consultation and public engagement.[195]

71. In November 2010, the Technical Committee recommended that the Management Committee make the development of a Long Term Plan a

[188] "Fraser River Sediment Removal Plan: Proposed Tranmer Bar Sediment Removal – 2011" (9 November 2010) CAN402991; "Fraser River Sediment Removal Plan: Proposed Powerline Bar Sediment Removal – 2011" (1 October 2010) CAN409239.
[189] Email, "Tranmer Bar and Powerline Bar – Project Priority" (18 November 2010) CAN336878.
[190] *Ibid.*
[191] British Columbia Provincial Emergency Program, "Fraser River Sediment Management Program", online: PEP <http://www.pep.bc.ca/floods/fraser_sediment_prog.html>.
[192] Email, "Subject: CEAA process" (21 April 2010) CAN082218.
[193] *Ibid.*
[194] *Ibid.*
[195] Fraser Gravel Memo, *supra,* CAN403377 at 2.

priority.[196] A new LOA would include an associated new Long Term Plan setting out the details supporting the LOA. Ten years is suggested as the preferred duration of any new gravel removal agreement.[197] Measures of water levels, habitat quantity and habitat quality are most effectively appraised on a ten year scale, more comparable with the time scale of morphological and ecological changes in the river.[198]

72. EMBC commissioned Dr. Michael Church to write a report to assist with the development of a long-term sediment management strategy.[199] His report, released in March, 2010, is intended to define criteria for a program that might be licensed for multi-year sediment removals in a long-term sediment management program that would not create deleterious consequences for the riverine ecosystem.[200] The report includes a summary of recommendations, including that knowledge of the annual pattern of fish activities within the gravel reach needs to be detailed.[201]

73. A covering letter to the report notes that adequate monitoring of the impacts of gravel removal will require a substantial increase in expenditures, bringing the relative costs of other strategies for river management "back into the picture".[202] In the Lower Fraser area, human development occurs right to the dikes, and even inside them.[203] It may be more effective in the long term, the letter adds, to provide greater dike setbacks where possible, increasing the river floodway and thereby returning the river closer to its original state.[204]

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[196] Lower Fraser River Sediment Management Technical Committee, Meeting notes (draft, 23 November 2010) CAN429707.
[197] Email, "Subject: Fraser River Sediment Removal program" (12 January 2010), CCI001178 at 10.
[198] Church 2010, *supra* CAN429784 at 2-3.
[199] Email, "Fraser River Sediment Removal program", (12 January 2010), CCI001178 at 9.
[200] Church 2010, *supra* CAN429784 at 2.
[201] *Ibid.* at 21.
[202] Letter, Michael Church to Manager, Strategic Mitigation Programs, EMBC (30 March 2010), CAN421275.
[203] *Ibid.*
[204] *Ibid.*