



Fraser River Estuary Management Program (FREMP)

Sediment Budget

&

Dredging Activities

Annual Report

For the Fiscal Year

April 1, 2004 to March 31, 2005

Prepared by FREMP

2004/05 SEDIMENT BUDGET AND DREDGING ACTIVITIES ANNUAL REPORT

1. INTRODUCTION

The Fraser River Estuary Management Program (FREMP) is a partnership among federal, provincial and regional government agencies to foster co-ordinated and sustainable activities in the Fraser River estuary.

FREMP is guided by its Estuary Management Plan (EMP). Developed through a multi-stakeholder consensus process in 1994 and updated in 2003, the EMP outlines a shared vision, goals and an action plan for improving the environmental, economic, and social health of the estuary. A key target in the EMP is to manage the removal of sediment from the Fraser River while maintaining the sediment regime of the river in balance. FREMP developed a tool called the “Sediment Budget”, which allows FREMP to deliver on this key Plan target.

2. THE FREMP SEDIMENT BUDGET

The FREMP Sediment Budget is used to ensure that the average amount of sediment removed over a five- to ten-year period does not change the shape of the riverbed. This “averaging” approach acknowledges two factors:

- The amount of sediment deposited by the Fraser River’s annual spring flood fluctuates widely from year to year.
- Even in years where a relatively low amount of sediment flows into the estuary, water action may form underwater sandbars that need to be removed to prevent grounding of ships using the Fraser River. Conversely, in years where large amounts of sediment may enter the estuary, not all of it will pose a navigational hazard, and therefore, all of it may not need to be removed.

The FREMP Sediment Budget covers sand-sized sediment in the estuary as far upstream as Mission. For the purposes of the Budget, “sand” is any material that has a grain size between 0.177mm and 2.000mm. All other materials are not considered in the Budget. Thus, the Sediment Budget represents the amount of sand within that range that needs to be removed in order to maintain a balanced riverbed from year to year.

The Sediment Budget is derived from a mathematical model which is described in detail in a report entitled “Lower Fraser River Sediment Budget Analysis” prepared for FREMP in 1999 by Northwest Hydraulic Consultants. Following on a FREMP commitment to evaluate the predictive ability of the equation every five years, the model was reviewed in the 2002 by Northwest Hydraulic Consultants (NHC). NHC concluded that a sediment surplus has accumulated since 1996, and that the original target dredging figure of 70% of incoming bed material load is still appropriate and applies to grain sizes greater than 0.177mm. The report also noted that the Fraser River appears to be a stable “transport reach” between Mission and Douglas Island, and recommended that FREMP

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consider maintaining the sediment balance over the long term (10 years) as there is less need for concern about individual years.

3. THE 2004/05 BUDGET

The Sediment Budget is calculated annually for what is called the “freshet” year. Generally, the dredging period runs from August of one calendar year to March of the next calendar year.

The Sediment Budget formula requires data for two separate variables:

- 1) the freshet volume between April and September at Hope¹; and
- 2) the annual peak discharge at Mission.²

For the 2004/05 freshet, these respective values measured 53,600 million cubic metres and 6,960 cubic metres per second. **Placing these values into the Sediment Budget formula gave an estimate that the incoming sediment bed load would be approximately 0.55 million cubic metres during the period April 1, 2004 to March 31, 2005³.** As in 2003/04 which was classified as an extremely low inflow year, the 2004/05 inflow was classified as an extremely low inflow year.

4. DREDGING ACTIVITIES IN 2004/05

During the period April 2004 to March 2005, 1.96 million cubic metres of sediment were removed from the navigation channel of the Fraser River. Thus, dredging managers were above the Sediment Budget in the 2004/05 dredging year. Note, however, that the re-evaluation of the Sediment Budget equation illustrated the need for a long-term equilibrium compared to individual years.

Sediment was removed as follows:

Amount of sediment removed from the river and taken to upland sites (A):	1.33 million m³
Amount of sediment removed from the river and disposed in ocean (B):	0.63 million m³

Total removed from River = (A) + (B) = **1.96 million m³**

Thus, a total of 1.96 million cubic meters of sediment were removed from the navigation channel in 2004-2005. Of this amount, 699,210 m³ was approved capital dredging undertaken to deepen the navigation channel, of which 286,040 m³ represented grain sizes greater than 0.177mm. Capital dredging began in 2001-2002 and will continue into 2005-2006 to allow larger ships entry into the port. Environmental and hydraulic reviews were carried out to approve the channel deepening. Because the purpose of the FREMP Sediment Budget is to calculate sediment removal that will maintain the riverbed at an equilibrium, and capital dredging is a decision made to change the morphology and create a new equilibrium, capital dredging volumes over the period 2001-2005

¹ Forecast volume for the Fraser River at Hope from April 1 to September 30, 2004 as noted in Seasonal Runoff Volume Forecast available at <http://wlapwww.gov.bc.ca/rfc/archive/index.html>.

² Peak flow at Mission was achieved on June 11, 2004 as noted in preliminary peak discharge data available from Environment Canada, <http://scitech.pyr.ec.gc.ca/waterweb/selectProvince.asp>.

³ This figure represents the refined FREMP Sediment Budget calculated in September 2004.

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have been removed from the summary provided below though details and volumes are noted. The resulting numbers therefore reflect the sediment volumes that have been removed with respect to the Sediment Budget (70% of the total Sediment Forecast). Note that capital dredging volumes will be used, however, in future reviews of long-term changes to the channel.

The map attached to the end of this report shows the locations where sediment was dredged during 2004/05, and for comparison purposes, where sediment was dredged during 2003/04.

5. OVERALL SEDIMENT BUDGET BALANCE DURING PAST EIGHT YEARS

2004/05 marks the eighth year that FREMP has forecasted the sediment (size between 0.177 mm and 2.000 mm) that enters the Lower Fraser River. The table below summarizes the annual Sediment Budget forecasts (in millions of cubic metres) and the actual amount of sediment removed from the River by dredging (in millions of cubic metres) during the past eight years.

The data shown below for the Sediment Forecast and Budget are taken from past FREMP Dredging Annual Reports⁴. Note that a comparison of forecast versus hindcast (actual) volumetric sediment loads in the NHC report showed that forecast loads are generally quite close to actual loads.

Data for “Actual Removed from the River” has been updated based on the December 2002 Northwest Hydraulics report. Where previous Annual Reports included in this column dredging totals for all particle sizes, the numbers below for “Actual Removed from River” now reflect net removal of sediment greater than 0.177 mm. As noted above, capital dredging volumes for grain sizes greater than 0.177mm over the period 2001-2005 have been netted out in the summary provided below. The resulting numbers therefore reflect the volumes that have been removed with respect to the Sediment Budget (70% of the Sediment Forecast).

“Net Infill” compares “Actual Removed from River” against the “70% of Sediment Forecast” (i.e. what is still available to be dredged in keeping with sustainable sediment removal).

“Percentage of Forecast Removed” compares actual removed against the sediment bed load forecast.

⁴ Previous FREMP Dredging Annual Reports reported a maximum of cubic meters that could be removed without changing the shape of the riverbed. This represented the 70% level of the Sediment Forecast.

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Year	Sediment Forecast (0.177mm to 2.000mm)	70% of Sediment Forecast	Actual Removed From River (>0.177mm)	Net Infill Or (Net Removal)	% of Forecast Removed
1997/98	4.7	3.3	1.32	1.98	28.1%
1998/99	1.11	0.78	1.00	(0.22)	90.1%
1999/00	4.5	3.15	1.85	1.30	41.1%
2000/01	1.7	1.19	1.20	(0.01)	70.6%
2001/02	0.72	0.50	0.76	(0.26)	105.5%
<i>Actual less capital dredging⁵</i>			<i>0.76-0.21=0.55</i>	<i>(0.05)</i>	<i>76.4%</i>
2002/03	2.98	2.09	2.79	(0.70)	93.6%
<i>Actual less capital dredging⁶</i>			<i>2.79-0.48=2.31</i>	<i>(0.22)</i>	<i>77.5%</i>
2003/04	0.61	0.43	1.61	(1.18)	263.9%
<i>Actual less capital dredging⁷</i>			<i>1.61-0.16=1.45</i>	<i>(1.02)</i>	<i>237.7%</i>
2004/05	0.55	0.39	1.96	(1.57)	356.3%
<i>Actual less capital dredging⁸</i>			<i>1.96-0.29=1.67</i>	<i>(1.28)</i>	<i>303.6%</i>
1997/98 to 2004/05	16.87	11.83	11.35	0.48	67.3%

The 1999 report by Northwest Hydraulic Consultants stated that “using the results of the Sediment Budget, an approximate long-term equilibrium can be maintained if the net dredging volumes are maintained at about 70% of the incoming bed material load”. During the past eight years, the volume of dredged material amounts to 67.3% of the forecasted bed material load. Thus, there has been a **net infill in the navigation channel during the past eight years that is estimated to be 480,000 cubic metres.**⁹

⁵ Channel Widening from Steveston Bend downriver to Sand Heads - 208,890 m3

⁶ Channel Deepening (Grade Dredging) from GM Tunnel downriver to Sand Heads - 478,340 m3.

⁷ Channel Deepening (Yr-1 Sub-Grade) from GM Tunnel downriver to Sand Heads - 157,120 m3.

⁸ Channel Deepening (Yr-2 Sub-Grade) from GM Tunnel downriver to Sand Heads - 286,040 m3.

⁹ Numbers used in the table are taken from FREMP Dredging Annual Reports, and so represent sediment forecasts based on preliminary discharge data. The NHC Report (2002) included findings based on actual sediment loads.

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6. OTHER DREDGING-RELATED ACTIVITIES DURING 2004/05

FREMP Dredging Impacts Data Gaps Study

In 2003, FREMP began a project to identify data gaps with respect to the biological impacts of dredging in the estuary. The purpose of the study was to identify areas in the estuary requiring impact analysis (i.e. what data gaps exist with respect to our knowledge of these impacts) and develop appropriate designs for these analyses. Limnotek/ESSA Technologies were retained for this project. The project included a literature review and boat reconnaissance to review the division of the river into segments for purposes of the study. A workshop in November 2003 reviewed a draft set of impact hypotheses and created a prioritized set of feasible environmental studies to fill information gaps in reaches of the river.

Limnotek/ESSA submitted their final report to FREMP in April 2004. This report is now being used by the FREMP Water & Land Use Committee to develop a Comprehensive Dredging Strategy for the estuary. The Strategy will identify dredging activities and impact data needs for the different channel segments of the estuary, while taking into account findings from the studies noted below (i.e., a stepped approach in which completed scientific findings are connected back into identified data needs). In addition to developing a Comprehensive Dredging Strategy, FREMP is updating the Dredge Management Guidelines intended for dredging proponents.

Impact Assessment of Dredging Activities at Proposed Transfer Pit Site on Barnston Island

In 2000, the Fraser River Port Authority (FRPA) contracted Limnotek Research & Development Inc. to conduct a three-year \$225,000 study to assess the possible impact that dredging may have on the aquatic community in the Fraser River near Barnston Island. The results of the study will be used to determine if a permanent transfer pit site can be established upstream in this reach of the Fraser River near Barnston Island. The project at Barnston Island was structured into two assessments: one at a temporary transfer pit site located at the lower end of Barnston Island and the other at the proposed permanent transfer pit site at the upper end of Barnston Island, adjacent to the Katzie First Nation dock.

Dredging occurred at the temporary transfer pit in March 2000 and at the proposed permanent transfer pit between November 2001 and January 2002. Limnotek compiled data sets from the two sites with a dredge study conducted in the Fraser River near Mission, BC into one report for FRPA. In summary, the study found that:

- dredging removed coarse sand and pebble sized particles which were replaced (by backfilling of the transfer pits) with a homogeneous mixture of medium and fine sand that remained during the 10 months of observations after dredging.
- eulachon embryos and larvae originated mostly from spawning upstream of Barnston Island, and recommended that future dredging should avoid sites meeting certain criteria (including water depths, velocities and temperatures) to ensure no disturbance of substrates that appear to be selected by spawning eulachon.
- recolonization of the benthic community (composed of mainly chironomid species: genera *Chemovskia*, *Robackia*, and *Beckidia*) occurred within 6 to 9 months after dredging.

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- white sturgeon are suggested to use the dredge sites as mainly a transit corridor and would not directly be affected by dredging.
- prickly sculpin (*Cottus asper*) were the most common fish collected during the study. However, the very low relative abundance of fish at the dredge sites suggest that very few fish were entrained by dredging or otherwise indirectly affected.

Dredging Impact Assessment – Sapperton Bar

A dredging impact assessment is underway at Sapperton Bar again funded by FRPA. The study involves the collection of benthic invertebrates, turbidity observations and fish data collection in the area both before and after dredging. Dredging took place between December 2002 and January 2003, and sampling was undertaken in fall 2002, spring 2003 and fall 2003. In summary, the study found that:

- no impacts of dredging were detected on the benthic invertebrate or resident fish communities at Sapperton Bar. Findings suggested that the biological communities were highly resilient, with recovery through re-colonization completed in less than 3.5 months after dredging was completed.
- eulachon may swim through the Sapperton Bar area enroute to spawning sites upstream and would not be affected by modified substrate depths caused by dredging events several months earlier.
- the distinctive community structure, diversity and abundance of benthic invertebrates and fish at Sapperton Bar appears resilient to dredging at the scale that was tested in the project, and that this feature of the site seems due to the geomorphological attributes of bar habitat.

Dredging Impact Assessment – Sand Heads

Fraser Port is also funding a study to assess dredging impacts on benthic communities in the Sand Heads and Steveston segment of the estuary. Sampling occurred in February and April 2004, with dredging taking place in March 2004. There was no consistent difference between control and dredge sites with regards to changes in sandlance catch rates between February (before dredging) and April (after dredging). Preliminary results therefore indicate that any effect of entrainment on sandlance is very short term, with rapid recruitment into the dredged sites after disturbance. Lab work to identify and enumerate benthic invertebrates in sediment and fish stomach samples has now been completed, along with data compilation and statistical analysis. A draft report has been submitted for FRPA review.

Dredging Impact Assessment - Big Bend (North Arm)

Assessment of sand dredging impacts on benthic communities is also ongoing in the Fraser River North Arm at Big Bend, funded by Fraser River Pile & Dredge. Sampling took place in November 2003 and May 2004 following dredging in January 2004. Researchers found a decline in catchable fish in relation to site disturbance. Initial findings are that the biological response to operation of a transfer pit in this part of the North Arm is behaving in a way similar to that found upstream at Barnston Island - the difference being that this part of the estuary has a much greater diversity of fish species than found upstream. Data suggests that resident fish recolonated the transfer pit within four months after dredging.

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7. MEMBERS OF WATER AND LAND USE COMMITTEE

The following agencies are represented on the FREMP Water and Land Use Committee (WLUC) and provide input and expertise with respect to dredging matters:

Fisheries and Oceans Canada

- Oceans, Habitat and Enhancement Branch
- Canadian Coast Guard

North Fraser Port Authority

Public Works and Government Services
Canada

Environment Canada

BC Ministry of Environment

Fraser River Port Authority

8. FOR FURTHER INFORMATION

For further information on FREMP, the Sediment Budget, or this Annual Report, please contact:

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