

Stave River Project Water Use Plan

Monitoring Programs Annual Report: 2009

- Pelagic Monitor (Nutrient Load/Total Carbon Levels)
- Littoral Productivity Assessment
- Fish Biomass Assessment
- Limited Block Load as Deterrent to Spawning
- Risk of Adult Stranding
- Risk of Fry Stranding
- Diel Pattern of Fry Out-migration
- Seasonal Timing and Assemblage of Resident Fish
- Turbidity Levels in Hayward Reservoir
- Archaeological Management

For Conditional Water Licences 117530, 117531, 117532, 117533, 117535, 117536, and 117537

BC Hydro Stave River Project Water Use Plan Monitoring Programs Annual Report: 2009

1 Introduction

This document represents a summary of the status and the results of the Stave River Water Use Plan (WUP) monitoring programs to 30 June 2009, as per the Stave River Order under the *Water Act*, dated 6 May 2004. There are nine monitoring programs:

- Pelagic Monitor (Nutrient Load/Total Carbon Levels)
- Littoral Productivity Assessment
- Fish Biomass Assessment
- Limited Block Load as Deterrent to Spawning
- Risk of Adult Stranding
- Risk of Fry Stranding
- Diel Pattern of Fry Out-migration
- Seasonal Timing and Assemblage of Resident Fish
- Turbidity Levels in Hayward Lake Reservoir

As an additional component of Stave River WUP and the Order under the *Water Act*, dated 6 May 2004, a final summary report of Stave Archaeological Management Plan (SAMP) dated 10 June 2002 must be submitted to the Comptroller of Water Rights (Comptroller). The 15 March 2008 SAMP summary report was included as a separate submission accompanying the 2008 monitoring program's annual report.

2 Background

The water use planning process for BC Hydro's Stave River project was initiated in September 1997 and completed in October 1999. The conditions proposed in the WUP for the operation of the project reflect the October 1999 recommendations of the Stave River WUP Consultative Committee.

In November 1999, the Stave River WUP was submitted to the Comptroller.

On 6 May 2004, BC Hydro was ordered to implement the conditions proposed in the Stave River WUP and prepare the monitoring programs terms of reference (TOR).

On 10 June 2005, the Stave River WUP monitoring programs TOR were submitted to the Comptroller for review and approval. On 30 June 2005, the TOR for all monitoring programs were accepted by the Comptroller.

On 11 January 2007, a revised Fish Biomass Assessment TOR was submitted based on minor budget and methodology revisions. On 7 February 2007, the TOR revisions were accepted by the Comptroller.

On 3 April 2007, a notification was sent to the Comptroller advising that implementation of the risk of fry stranding monitor would be delayed from spring

2007 to spring 2008 based on possible confounding issues relating to reduced fry survival related to a high total gas pressure incident at the Ruskin Generating Station in the proceeding months.

On 13 September 2007, a Fish Biomass Assessment TOR amendment was submitted based on a minor budget revision to account for additional sampling effort. On 17 October 2007, the TOR amendment was accepted by the Comptroller.

On 13 September 2007, a Limited Block Load as Deterrent to Spawning TOR amendment was submitted based on further data collection requirements and final reporting delay. On 17 October 2007, the TOR amendment was accepted by the Comptroller.

As outlined in the Stave River WUP, a review of this WUP is recommended within ten years of its implementation. A review may be triggered sooner if significant risks are identified that could result in a recommendation to change operations.

Some components of the Stave River WUP monitoring programs were initiated prior to acceptance by the Comptroller. Given this prior work pre-dates the TOR development and the Comptroller's acceptance, it is considered to be outside the present WUP monitoring programs framework. Consequently, this work will not be subject to annual reporting, though the results will be fully integrated into the present programs, including implications on the interpretation of all new monitoring data.

3 Status

The following table outlines the status and schedule for the Stave River WUP monitoring programs.

Table 3-1: Status and Schedule of Stave River WUP Monitoring Programs Implementation

Monitoring Program	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5	WLR YR6	WLR YR7	WLR YR8	WLR YR9	WLR YR10
Pelagic Monitor (Nutrient Load/Total Carbon Levels)	✓	✓	✓	✓	U/W	■	■	■	■	■
Littoral Productivity Assessment	✓	✓	✓	✓	U/W	■	■	■	■	■
Fish Biomass Assessment	✓	✓	✓	✓	■	■	■	■	■	■
Limited Block Load as Deterrent to Spawning	x	✓	✓	✓	U/W	■	■	■	■	■
Risk of Adult Stranding		✓								
Risk of Fry Stranding		x	x	x	U/W					
Diel Pattern of Fry Out-migration				✓	U/W					
Seasonal Timing and Assemblage of Resident Fish						■	■			
Turbidity Levels in Hayward Reservoir	✓	✓	✓	✓	U/W	■	■	■	■	■

Legend: ✓ = Project is complete for the year

■ = Project to be undertaken/initiated in identified year

U/W = Project is underway

x = Program started, but encountered operational or hydrological delays

4 Stave River WUP Monitoring Programs

This section outlines the status of the Stave River WUP monitoring programs as per the Order under the *Water Act*, dated 6 May 2004.

4.1 Pelagic Monitor (Nutrient Load/Total Carbon Levels)

4.1.1 Overview

The objective of this monitoring program is to determine the principle pathways and assess the extent to which reservoir management actions affect pelagic productivity in Stave Lake and/or Hayward Lake Reservoirs. During the Stave River water use planning process, the Consultative Committee assumed that the pelagic zone of the reservoirs were immune to operations, but noted that there was considerable risk in doing so and recommended that a monitoring program be carried out to assess the assumption's validity.

A direct test of the assumption proved to be difficult and costly. As a result, the Consultative Committee recommended that the monitoring program be carried out through a weight of evidence approach where a series of impact hypotheses are tested to identify the most likely pathway(s) of principle influence by deduction.

Monitoring Indicators:

- a) Water Quality – Physical Variables.
- b) Water Quality – Chemical.
- c) Plankton.
- d) Carbon Estimate of Primary Production.

This monitoring program involves collection of data up to eight times per year at two or more locations, and in some cases at several depths.

4.1.2 Status

This monitoring program will be implemented in two phases. The first phase was completed in April 2004, prior to Comptroller acceptance of the TOR, and therefore is not subject to the same reporting requirements as the present monitoring program.

Year four of the second phase of this monitoring program was initiated in April 2008 and was carried out over seven months. The field component ended in November 2008 and the Stave Reservoir Pelagic Monitor and Littoral Productivity Assessment report was completed in May 2009. Results will be presented to the Stave Monitoring Committee in September 2009. Year five of the second phase of this monitoring program is currently underway.

4.1.3 Interpretation of Data

See 2008 annual report for summary of phase one program results.

Notable year four phase two program results include:

- Nitrate concentrations exhibit a seasonal trend with peak values occurring in the winter and early spring periods when the reservoirs are isothermal (mixing) and low values in stratified periods in summer and early fall.
- Total dissolved phosphate values, which are the best approximation of bioavailable phosphorus, are 25- 40% lower than total phosphate values which is a typical pattern observed in reservoir systems.

- Chlorophyll-a estimates of biomass production from Hayward reservoir were generally higher than those from Stave.

Upcoming phase two year four summary reporting due for submission in fall 2009 will attempt to establish trends in data collected since the initiation of phase one in 2001 in particular looking at the relationships between environmental variables and reservoir operations. Fall reporting will also include estimates of pelagic primary production as lab analysis of 2008 samples is currently underway.

4.2 Littoral Productivity Assessment

4.2.1 Overview

The objective of this monitoring program is to test the validity of the Effective Littoral Zone (ELZ) performance measure used in the Stave River water use planning process and, in turn, use the results to determine the nature and extent of reservoir operations impacts on littoral productivity. Like the pelagic monitoring program, this monitoring program uses a set of impact hypotheses to evaluate the range of possible impact pathways in a weight of evidence approach. The program also takes advantage of the relatively stable operation on Hayward Lake Reservoir as a comparative control for evaluating the effects of water level fluctuations on Stave Lake Reservoir.

Monitoring Indicators: a) Periphyton.
 b) Littoral primary production.
 c) Carbon Estimate of Primary Production.

The water quality data and primary production estimates of the Pelagic Monitor are used in this monitoring program.

This monitoring program involves collection of data up to eight times per year at two or more locations, in most cases at several depths (2 m intervals).

4.2.2 Status

This monitoring program will be implemented in two phases. The first phase was completed in April 2004, prior to Comptroller acceptance of the TOR, and therefore is not subject to the same reporting requirements as the present monitoring program.

Year four of the second phase of this monitoring program was initiated in April 20078 and was carried out over seven months. The field component ended in November 2008 and the Stave Reservoir Pelagic Monitor and Littoral Productivity Assessment report was completed in May 2009. Results will be presented to the Stave Monitoring Committee in September 2009. Year five of the second phase of this monitoring program is currently underway.

4.2.3 Interpretation of Data

See 2008 annual report for summary of phase one program results.

Notable year four phase two program results include:

- Total littoral periphyton accrual shows that production in both Stave and Hayward varies seasonally with low production during winter and generally high production in late summer/early fall.
- Overall production in 2007 was lower in both Stave and Hayward than in 2006 and 2008. This pattern may be indicative of two factors:
 1. Hayward reservoir was likely less productive than what is typical due to water level variability and drawdown, and
 2. Stave reservoir was likely more productive due to less impact from less drawdown (i.e. 2007 did not experience extreme low).

Upcoming phase two year four summary reporting due for submission in fall 2009 will attempt to establish trends in data collected since the initiation of phase one in 2001 in particular looking at the relationships between environmental variables and reservoir operations. Fall reporting will also include estimates of littoral primary production and will include proposals for addressing recent sample sedimentation issues.

4.3 Fish Biomass Assessment

4.3.1 Overview

The objective of this monitoring program is to determine whether an increase in fish biomass occurs in Stave Lake Reservoir following implementation of the WUP, as was predicted from performance measure modelling. Considerable uncertainty was expressed by the Consultative Committee regarding this outcome: Some Committee members believed that the potential was great and that further gains in fish biomass were possible with greater constraint on reservoir operations. Other Committee members believed that the likelihood of an observable effect is low and that further attempts to constrain the reservoir would likely lead to a negligible response in fish biomass at great financial cost. To resolve the uncertainty, the Consultative Committee recommended that a monitoring program be carried out with the recommended WUP constraints operations, which are expected to partially reduce reservoir fluctuation in Stave Lake Reservoir.

Monitoring Indicator: a) Total relative fish biomass.

This monitoring program involves hydro-acoustic surveys and fish surveys.

4.3.2 Status

The fourth year of data collection was carried out during a single day of hydroacoustic assessment in September 2008. The Stave Reservoir Fish Biomass Assessment report was completed in March 2009. Results of the monitoring program will be presented to the Stave Monitoring Committee in September 2009. Year five of this monitoring program including even year fish sampling activities is scheduled for initiation in October 2009.

4.3.3 Interpretation of Data

Between year comparisons in fish biomass will not be valid until 2005 and 2006 estimates have been recomputed using the horizontal stratification and additional fish

sampling incorporated into 2007 sampling. For example, an apparent 72% reduction in total fish biomass (species combined) from 2006 to 2007 was mainly due to the exclusion in 2007 of char and most northern pikeminnow from the pelagic population estimate with its large volume expansion factor. Recalculation of biomass estimates will be completed as a component of year five data reporting

The major species contribution of the biomass were as follows:

	Year 1 (kg/ha)	Year 2 (kg/ha)	Year 3 (kg/ha)	Year 4 (kg/ha)
Cutthroat trout	0.4	0.6	1.1	0.9
Dolly Varden	6.9	12	0.5	0.3
Kokanee	1.3	1.8	3.0	5.2
Rainbow trout	0.03	0.05	0.02	0.01
Peamouth chub	0.04	0.05	0.08	0.09
Total	10.1¹	17.2¹	4.9	6.7

¹ Year one and two species biomass require recalculation based on horizontal stratification and additional fish sampling incorporated into 2007 sampling.

Monitoring program results were consistent with the reconnaissance data of prior fish surveys in Stave Lake Reservoir, and are in line with that of other oligotrophic lakes and reservoirs. Any comment on trends in both total and species specific biomass trends would be considered preliminary given forthcoming recalculation of year one and two biomass estimates as well as limited data points available for consideration.

4.4 Limited Block Load as Deterrent to Spawning

4.4.1 Overview

The objective of this monitoring program is to verify the assumption made by the Stave River WUP Consultative Committee that a fall limited block loading operation (allowance for annual peaking operations from 15 October to 30 November when discharge at Ruskin Dam exceeds 100 m³/s) deters salmonid spawners from spawning high on the stream banks, which typically dewater during the incubation period causing significant egg mortality. The proposed operation is expected to increased operational flexibility at the Ruskin generating facility while significantly reduced egg mortality, and hence increase smolt output. The Stave River WUP Consultative Committee recommended that a monitoring program be carried out to ensure that the hypothesised benefits were being realized.

There are three aspects to this monitoring program:

1. Verify that the operation deters spawning in high stranding risk areas
2. Verify that the operation does not impact spawning in low stranding risk areas
3. Verify that the recent high chum salmon escapement numbers in the river are not impacted by the operation.

Monitoring Indicators:

- a) Redd Density.
- b) Redd Size.
- c) Egg Pockets.

Each variable is measured and compared from areas above and below the water level at a Ruskin Dam discharge of 100 m³/s.

This monitoring program involves data collection in three parts. The first part consists of weekly redd counts, a daily monitor of redd construction, and egg pocket surveys. The second part consists of a modelling exercise to understand the interplay between Ruskin Generating Station flow release and tidal factors and how they impact water level. The third part consists of collating the annual escapement data.

4.4.2 Status

Year one of this monitoring program began on 19 October 2005 and ended prematurely on 27 October 2005 due to insufficient inflows. Completion of the monitoring program was postponed until October 2006 when sufficient inflows were available to continue monitoring activities. Based on review of 2005/06 field data the continuation of monitoring in October 2007 was recommended to further address management questions regarding the effectiveness of the fall block load operation. Preliminary findings were presented to the Stave Monitoring Committee in June 2008 with the final Limited Block Load as Deterrent to Spawning reporting completed in November 2008. Final results of the monitoring program will be presented to the Stave Monitoring Committee in September 2009. Year one of the annual Fisheries and Oceans Canada escapement data collation reporting is scheduled for submission in spring 2010.

4.4.3 Interpretation of Data

The limited block load operation appears partially successful at reducing spawning chum salmon from utilizing sub-optimal high elevation spawning habitat above the water level at a Ruskin Dam discharge of 100 m³/s. Significantly fewer and smaller redds were observed at the high elevation sites discovered when compared to low elevations sites.

Additional findings of interest include:

- Water level could be variable during base discharge flows of 100 m³/s and variation in water level from tidal and Fraser River influences can act to counter the limited block loading strategy especially in spawning habitats further downstream.
- The effect of variable water levels at a Ruskin Dam discharge of 100 m³/s do not appear to severely impact the success of spawning chum salmon at the current spawning escapements.
- Active redd construction ubiquitously though out the channels regardless of habitat type especially after the peak escapement dates.
- All redds, regardless of elevation, took only two to three days to complete and all high elevations redds that were covered by burial mounds contained egg pockets.

4.5 Risk of Adult Stranding

4.5.1 Overview

The objective of this monitoring program is to verify the assumption made by the Stave River WUP Consultative Committee that a fall limited block loading operation that provides a 100 m³/s base flow does not cause significant stranding of unspawned (gravid) adult female chum salmon, thus offsetting the expected benefits of improved incubation success (see the Limited Block Load as Deterrent to Spawning monitoring program).

Monitoring Indicator: a) Stranded female carcasses that contain unspawned eggs compared to those found instream.

This one year monitoring program involved weekly chum carcass counts done over the course of the spawning period.

4.5.2 Status

Monitoring was initiated in October 2006, carried out over several weeks and successfully completed in November 2006. The Risk of Adult Stranding Monitor report was completed in March 2007. Results of the monitoring program were presented to the Stave Monitoring Committee in June 2007.

4.5.3 Interpretation of Data

Study complete, see 2008 annual report for summary of findings.

4.6 Risk of Fry Stranding

4.6.1 Overview

The purpose of the monitoring program is to track the occurrence of chum fry stranding following implementation of a spring limited block loading operation (allowance for peaking operations from 15 February to 15 May when discharge at Ruskin Dam exceeds 100 m³/s). While some stranding is expected, it is not to exceed 1.5% of the total chum fry population, a threshold established in prior fry stranding studies.

Monitoring Indicator: a) The proportion of stranded chum fry relative to the estimated total chum fry population.

This monitoring program will involve an annual stranding survey.

4.6.2 Status

This two year monitoring program was scheduled for implementation in April 2006, however, based on insufficient inflows was postponed until April 2007. April 2007 initiation was further postponed until April 2008 based on potential impacts to fry downstream of Ruskin Dam due to a high total gas pressure incident. Year one monitoring initiation occurred in April 2008, however, was stopped prematurely after two surveys due to insufficient inflows. The final year two stranding surveys were completed as scheduled in April 2009 with a final report scheduled for submission in

August 2009. Results will be presented to the Stave Monitoring Committee in September 2009.

4.6.3 Interpretation of Data

During the pre-WUP1997 and 1998 assessments it was estimated that 0.17 % and 1.48 % of the total chum fry production was lost due to operational ramp downs. In direct comparison, preliminary findings from the 2008 and 2009 assessments indicate similar losses of 0.28 % and 1.59 %. The range of stranding densities and projected impacts observed during the recent 2008/09 assessments were slightly higher, but, not significantly different to those observed during the original Pre-WUP 1997/98 surveys.

A notable preliminary study recommendation includes identification of peak stranding window prior to each fry emergence period where operational constraints such as: 1) ramp down avoidance during the period prior to Fraser River backwater and 2) ramp down avoidance during early evening through to midnight when fry emerge from gravels to out-migrate would be considered.

4.7 Diel Pattern of Fry Out-migration

4.7.1 Overview

The objective of this monitoring program is to collect behavioural data on out-migrating chum fry in response to rapid flow changes, in order to better understand diel migratory patterns and hence devise better operational strategies to minimize fry stranding while maintaining operational flexibility.

Monitoring Indicators:

- a) Colonization rate of habitat newly watered from upstream areas and/or through emergence from bottom substrate.
- b) Fry response to rising and falling water levels as cues and triggers to out migration behaviours.
- c) Diel propensity for a response to migratory cues and triggers.

This monitoring program will involve using stationary trapping techniques, direct diver observation and underwater video.

4.7.2 Status

Year one of this two year monitor was initiated in February 2008, carried out over three months and successfully completed in April 2008. The year one monitor report was submitted in January 2009 with year two data collection completed in April 2009. Final year two reporting will be complete in September 2009. Results of the monitoring program will be presented to the Stave Monitoring Committee in September 2009.

4.7.3 Interpretation of Data

Notable year one results include:

- A distinct periodicity of out-migrating chum fry was recorded, with catches being higher during the night than during the day.
- The number of out-migrating chum fry peaked soon after dark, with catches declining overnight, and being negligible during the day.
- Chum fry showed a propensity to migrate further offshore during periods of low flow.
- Rapid flow changes in the Lower Stave River did not appreciably affect chum fry out-migration behaviour.

Limited visibility hindered visual observations underwater resulted in difficulties in addressing several monitoring program questions relating to fry behaviour during year one data collection. Year two data collection and associated reporting is expected to address these questions given reconsideration of methods and use of more sophisticated underwater imaging equipment.

4.8 Seasonal Timing and Assemblage of Resident Fish

4.8.1 Overview

The objective of this monitoring program is to prepare an inventory of resident fish species downstream of Ruskin Dam, assess how the inventory may change though the year, and evaluate the likelihood of operational impacts. The fish community structure of non-anadromous salmonids and non-salmonids was poorly characterized in the existing inventory data. As a result, potential impacts to this community could not be directly addressed in the present WUP and therefore will be carried over to the next WUP review period.

Monitoring Indicators:

- a) Seasonal timing of fish species and life-stage presence.
- b) Relative abundance.
- c) Habitat type association.
- d) Likelihood of an operations related impact for each species and life-stage.

This monitoring program will involve reconnaissance-level fish surveys carried out every six to eight weeks, non-lethal fish capture methods and fish enumeration.

4.8.2 Status

This monitoring program is scheduled to begin in January 2010 and will be carried out in years six and seven following implementation of the WUP. The first program report is expected in August 2011.

4.8.3 Interpretation of Data

At this time there is no data to interpret for this monitoring program.

4.9 Turbidity Levels in Hayward Lake Reservoir

4.9.1 Overview

The objective of this monitoring program is to track turbidity levels in Hayward Lake Reservoir to ensure that they do not exceed Provincial Drinking Water Quality Standards following implementation of the WUP, which is expected to cause a slight increase in the amplitude of water level fluctuation during fall and spring block load periods. There are a number of local residents that draw their drink water directly from Hayward Lake Reservoir. Some expressed concern that the increased range of water level fluctuation could increase turbidity levels and impact water quality.

Monitoring Indicator: a) Water turbidity.

This monitoring program will involve turbidity observations and an annual shoreline survey.

4.9.2 Status

Year four of the proposed ten year monitor involved turbidity measurement at six sites and three tributaries between August 2008 and April 2009. The fourth year of Turbidity Levels in Hayward Reservoir report was completed in July 2009. The results will be presented to the Stave River WUP Monitoring Committee in September 2009. Year five of this monitoring program is currently, however, based on outcomes of the upcoming September 2009 Monitoring Committee meeting the study may be terminated or have a reduction in field monitoring intensity.

4.9.3 Interpretation of Data

Six sampling sessions were completed in this fourth year of monitoring and the results suggest that turbidity levels are generally low averaging 0.77 ± 0.21 NTU though susceptible to increase above the Federal and Provincial Drinking Water Quality Standard of 1 NTU during periods of heavy rain and wind. These year four findings were comparable to the previous three years of data collection.

Additional continuous turbidity data available from the District of Mission domestic water intake and a separate BC Hydro Ruskin Dam seismic upgrade monitoring program was also used to complement the year four Water Licence Requirement program data.

In consideration of all available data no correlation was found between elevated levels of turbidity and increased reservoir flexibility at any point during the past four years fall and spring block load periods.

Several actively eroding shoreline locations were observed during the single year four shoreline survey. Continued monitoring of these sites is recommended to assess potential for sediment contribution during reservoir fluctuation.

5 Stave River WUP Monitoring Programs Costs

The following table summarizes the Stave River WUP monitoring programs costs approved by the Comptroller on 30 June 2005 and actual costs to 30 June 2009.

Table 5-1: Stave River WUP Monitoring Program Costs

Monitoring Programs	Costs approved by CWR	Total Forecast (Actuals and Forecast) Life to Date	Variance Total to Approved(\$)	Explanation	Corrective Action
SFLWLR ANNUAL REPORT	\$104,580.00	\$19,928.86	\$84,651.14	Original estimates overestimated and streamlined	Resubmit to CWR
SFLMON#1 PELAGIC MONITOR	\$409,107.00	\$291,142.33	\$117,964.67		
SFLMON#1 Direct Management 001	\$139,307.00	\$24,145.53	\$115,161.47	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#1 Implementation 002	\$269,800.00	\$266,996.80	\$2,803.20	Efficiencies realized in program delivery	Resubmit to CWR
SFLMON#2 LITTORAL PRODUCTIVITY ASSESSMENT	\$659,139.00	\$548,144.51	\$110,994.49		
SFLMON#2 Direct Management 001	\$140,339.00	\$21,545.01	\$118,793.99	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#2 Implementation 002	\$518,800.00	\$526,599.50	(\$7,799.50)	Overage due additional data analysis requirements.	Resubmit to CWR
SFLMON#3 FISH BIOMASS ASSESSMENT	\$473,885.00	\$460,639.21	\$13,245.79		
SFLMON#3 Direct Management 001	\$62,586.00	\$42,254.21	\$20,331.79	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#3 Implementation 002	\$411,299.00	\$418,385.00	(\$7,086.00)	Overage in year 1 implementation due to additional reporting and analysis requirements	Resubmit to CWR
SFLMON#4 LIMITED BLOCK LOAD AS DETERRENT TO SPAWNING	\$164,206.00	\$85,852.78	\$78,353.22		
SFLMON#4 Direct Management 001	\$71,991.00	\$20,017.78	\$51,973.22	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#4 Implementation 002	\$92,215.00	\$65,835.00	\$26,380.00	Efficiencies realized in program delivery	Resubmit to CWR
SFLMON#5 RISK OF ADULT STRANDING	\$38,185.00	\$23,099.00	\$15,086.00		
SFLMON#5 Direct Management 001	\$17,985.00	\$2,404.00	\$15,581.00	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#5 Implementation 002	\$20,200.00	\$20,695.00	(\$495.00)		
SFLMON#6 RISK OF FRY STRANDING	\$93,529.00	\$65,757.76	\$27,771.24		
SFLMON#6 Direct Management 001	\$34,129.00	\$6,324.76	\$27,804.24	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#6 Implementation 002	\$59,400.00	\$59,433.00	(\$33.00)		
SFLMON#7 DIEL PATTERN FRY OUT-MIGRATION	\$114,654.00	\$110,442.95	\$4,211.05		
SFLMON#7 Direct Management 001	\$36,254.00	\$12,930.95	\$23,323.05	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#7 Implementation 002	\$78,400.00	\$97,512.00	(\$19,112.00)	Overage due to additional equipment requirements in spring 2009 field investigations.	Resubmit to CWR
SFLMON#8 SEASONAL TIMING AND ASSEMBLAGE OF RESIDENT FISH	\$53,699.00	\$43,578.50	\$10,120.50		
SFLMON#8 Direct Management 001	\$19,299.00	\$9,178.50	\$10,120.50	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#8 Implementation 002	\$34,400.00	\$34,400.00	\$0.00		
SFLMON#9 TURBIDITY LEVELS IN HAYWARD RESERVOIR	\$182,462.00	\$108,182.01	\$74,279.99		
SFLMON#9 Direct Management 001	\$106,662.00	\$31,677.01	\$74,984.99	Variance is the result of project management efficiencies.	Resubmit to CWR
SFLMON#9 Implementation 002	\$75,800.00	\$76,505.00	(\$705.00)		
SFLMON#10 ARCHAEOLOGICAL MANAGEMENT	\$143,803.00	\$147,849.00	(\$4,046.00)		
SFLMON#10 Direct Management 001	\$23,803.00	\$14,191.00	\$9,612.00	Study complete in 2008. Reference March 15, 2008, SAMP summary report for CWR notification of variance from approved amount.	
SFLMON#10 Implementation 002	\$120,000.00	\$133,658.00	(\$13,658.00)	Study complete in 2008. Reference March 15, 2008, SAMP summary report for CWR notification of variance from approved amount.	