Nechako Fisheries Conservation Program
5 Year Plan: 2012-2017

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Prepared by:

NFCP Technical Committee

Executive Summary

Nechako Fisheries Conservation Program planning occurs annually to provide operational guidance for monitoring projects as well as every 5 years to guide activities over a longer time horizon. This is the second 5 year plan developed by the NFCP Technical Committee and covers the period 2012--2017. The plan is based on an evaluation of results from the previous 5 years and defines NFCP sampling activities for the next 5 years. For the purposes of this planning document, it is assumed that core water management activities including the Annual Water Allocation (AWA) and Summer Temperature Management Program (STMP) will remain unchanged, consistent with 1987 Settlement Agreement requirements. Adult Chinook will continue to be monitored annually using 5 helicopter overflights scheduled in September into early October. Juvenile Chinook monitoring will be measured once over the 5 year period consistent with the previous five-year plan. The long term average residency time for scaling adult Chinook numbers (10.6 days) will be adopted and measured once during the 5 year period. Adult carcass surveys will continue to provide biological supporting data for the Chinook population counts and to provide linkage to the historic data set. Program reviews with the Steering Committee will be scheduled on an annual basis to track progress and review annual work plans.

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Introduction

The Nechako Fisheries Conservation Program (NFCP) has a mandate to carry out monitoring, research and, if necessary, remedial measures to conserve Chinook salmon in the Nechako River. The program was designed to detect long-term changes in the Nechako River Chinook salmon population in relation to changes in flow. The *1987 Settlement Agreement* which was prepared in anticipation of the Kemano Completion Project sets out a "Conservation Goal" to sustain a target population of between 1,700 to 4,000 Chinook spawners. Since 1988, the NFCP has measured Chinook spawning escapements to the Nechako to assess achievement of the Conservation Goal.

Juvenile Chinook monitoring has also been undertaken to assess in-river habitat quality and to potentially trigger remedial activities in the event of habitat degradation in relation to flow changes. The fry emergence project has shown that the quality of the incubation environment in the Upper Nechako River is stable. The juvenile out-migration project has shown that the numbers of juveniles produced in the Nechako River have generally been sufficient to return spawners within the values identified by the Conservation Goal.

The overall conclusions reported in the NFCP Technical Data Review (2005) are that "in-river conditions examined by the committee are sufficient to sustain a population of Chinook salmon that fluctuates generally within the target population range" and "the intent and spirit of the Conservation Goal have been met". In order to have a reasonable level of certainty that the in-river conditions remain stable, the Technical Committee undertakes monitoring and evaluations of fish and fish habitat to identify possible long-term trends. However, in view of the observed stability in environmental conditions as reported in the 2005 NFCP Technical Data Review, a re-evaluation and rationalization of program activities was undertaken in 2006-7 resulting in the NFCP Five Year Plan for 2007-2012. One of the main guiding principles for the planning exercise was the necessity to maintain data integrity as well as the ability to monitor trends over time.

This document is the second NFCP Five Year Plan and covers the period 2012 - 2017.

Overview of NFCP Monitoring Programs

The NFCP monitors fisheries, flow discharge and water temperature. Careful monitoring and critical evaluation of these parameters provides essential feedback to the NFCP on whether the Conservation Goal and other program objectives are being met.

NFCP activities presently include monitoring of:

- Skins Lake Spillway discharge of the Annual Water Allocation (AWA),
- effectiveness of summer discharges to moderate stream temperatures as part of the Summer Temperature Management Program (STMP),
- adult Chinook spawner abundance and biological sampling, and,
- Chinook incubation and rearing conditions.

Nechako River Chinook have been monitored annually in relation to the Conservation Goal. The Area under the Curve (AUC) method for Chinook spawner estimation uses both periodic helicopter counts of spawner numbers during fall Chinook spawning and estimates of the time female spawners spend on the redd (residence time) in the calculation of the spawner population size. Nechako Chinook escapements are shown in Figure 1.

To evaluate Chinook habitat quality, NFCP has developed procedures and derived relationships between spawner abundance and fry emergence as well as juvenile outmigration. Future reductions in incubation or juvenile habitat quality may be detectable as outliers or departures from the measured statistical relationships.

Changes to the monitoring of Skins Lake Spillway discharges (AWA) or the effectiveness of summer discharges to moderate stream temperatures (STMP) are core activities defined by the *Settlement Agreement* and no changes are contemplated in view of their demonstrated effectiveness. However, given the documented stability of the habitat performance indicators between 1988 - 2005, the Technical Committee recommended streamlining the approach to increase efficiency and reduce costs. The main modifications were:

1. a reduction in fry and juvenile monitoring frequency from annually to once every five years;
2. measurement of residence time estimates from annually to once every five years;
3. a reduction in helicopter overflight frequency to five weekly flights in September/early October; and,
4. use of a long-term mean redd residency time of 10.6 days to scale helicopter overflight observations and generate escapement estimates

These modifications are evaluated in the present document as a precursor for defining the 2012 - 2017 activities.

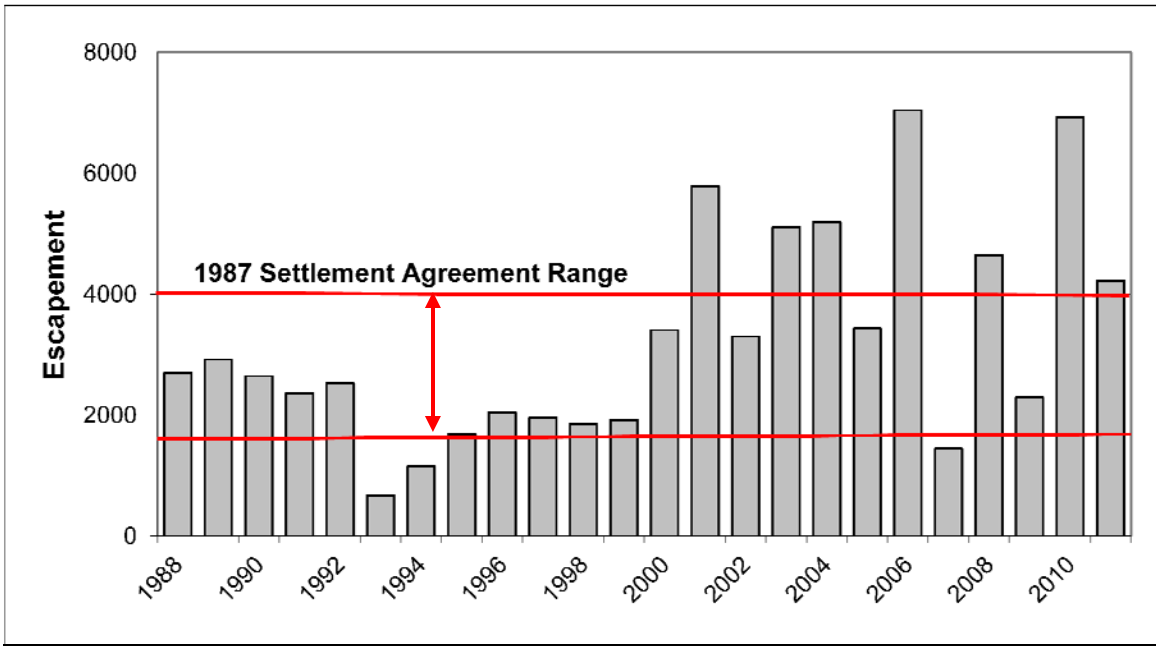

Figure 1. Number of adult Chinook in the Nechako River since 1988. Horizontal lines indicate target population level of 1700 – 4000 spawners.

The 2007-2012 NFCP Five Year Plan and the 2005 Technical Data Review discusses previous work which explored whether variations in year-to-year Nechako chinook returns are a result of independent variation in the productivity of this stock or whether these variations are synchronous in other stocks. This included 15 years of escapement monitoring in the Stuart River as well as statistical comparisons with other Upper Fraser chinook populations. The intention was to use escapement data for other stocks to identify when extrinsic factors (i.e. outside of the Nechako watershed) might explain unexpected changes in abundance in Nechako Chinook. Nether approach has been successful to date.

Evaluation

A summary of the sampling frequencies prior to, and during the 2007-2012 period is shown in the Table 1. The approach reflects an evolution of the program from undertaking all projects in all years to an approach, based on experience, of undertaking projects when they are deemed to provide maximum benefit in achieving program objectives.

Table 1. NFCP activities prior to 2007 compared with 2007-2012.

Activity	Previous to 2007	2007 - 2012 Five Year Plan
AWA	annual	annual
STMP	annual	annual
helicopter overflights	annual	annual
residence time	annual	once in 5 yr
carcass surveys	annual	once in 5 yr
fry emergence	annual	once in 5 yr
juvenile outmigration	annual	once in 5 yr
physical data collection	annual	once in 5 yr
habitat complex inspections (opportunistic)	annual	annual
gravel surveys	once every 10 yr	not done

Scheduling

The previous Five Year Plan set the schedule for annual NFCP activities. Remedial measures including the STMP, AWA, habitat structure inspection/ removal and flow discrepancy project were undertaken annually as scheduled in the previous Five Year Plan (Table 2). There were some minor adjustments to the scheduling of residency time estimates, fry emergence and juvenile outmigration measurements and the collection of physical data. The reason for the adjustments stemmed from a predicted low escapement of Chinook during 2008. While the concern turned out to be unfounded[1] , the prediction of low numbers triggered the Technical Committee to defer by 1 year the fry emergence and juvenile outmigration scheduling, as well as the residency time estimation and the physical data collection. This timing shift was motivated by a desire to optimize the value of the data in view of the high effort and cost associated with running these programs. The Technical Committee reviewed the data collected under the deferred schedule and concluded that there were no adverse consequences from the timing shift.

[1] escapement in 2008 reached 4643 spawners, well above the target population level shown in Figure 1

Table 2. Comparison of project timing between years. Red circles indicate deviations from the Five Year Plan.

5-year Plan: 2007-2012	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012
REMEDIAL MEASURES					
Summer Temperature Management	●	●	●	●	●
Habitat Structure Removal	●	●	●	●	●
Flow Control	●	●	●	●	●
Flow Discrepancy Project	●	●	●	●	●
MONITORING					
Enumeration	●	●	●	●	●
Residency Time		●			
Carcass Recovery	●	●	●	●	●
Juvenile Outmigration			●		
Physical Data Collection		●	●		
Fry Emergence			●		
Substrate Quality and Composition				●	
Outstanding NFCP Reports	●	●	●	●	●
Web-site Maintenance	●	●	●	●	●

Actual: 2007-2012	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012
REMEDIAL MEASURES					
Summer Temperature Management	●	●	●	●	●
Habitat Structure Removal	●	●	●	●	●
Flow Control	●	●	●	●	●
Flow Discrepancy Project	●	●	●	●	●
MONITORING					
Enumeration	●	●	●	●	●
Residency Time			●		
Carcass Recovery	●	●	●	●	●
Juvenile Outmigration				●	
Physical Data Collection			●	●	
Fry Emergence				●	
Substrate Quality and Composition					
Outstanding NFCP Reports	●	●	●	●	●
Web-site Maintenance	●	●	●	●	●

● = 5 yr plan/actual **● = timing shift from plan**

Flexibility to adjust the annual timing of project execution is useful as it provides the Technical Committee with an ability to optimize NFCP resources in relation to changing conditions.

Helicopter Overflight Scheduling during Escapement Surveys

DFO reviewed the sensitivity of the precision of the spawner estimate to the frequency of the spawner flights and concluded that the use of five weekly flights (occurring throughout the first 4 weeks in September and into the first week of October) achieved the best balance between survey frequency, accuracy of resultant escapement estimates, and ability to produce reliable inferences for stock status. This timing was adopted and overflights took place on the dates shown in Table 3.

Table 3. Helicopter overflight timing

	Flight 1	**Flight 2**	**Flight 3**	**Flight 4**	**Flight 5**
2007	Sep 5	Sep 12	Sep 19	Sep 26	Oct 3
2008	Sep 3	Sep 10	Sep 17	Sep 24	Oct 1
2009	Sep 2	Sep 10	Sep 17	Sep 23	Sep 30
2010	Sep 1	Sep 8	Sep 15	Sep 22	Sep 29
2011	Aug 31	Sep 7	Sep 14	Sep 21	Sep 28

There is high degree of confidence in the estimation procedures in view of the previous evaluation of this sampling approach (presented in the 2007-2012 NFCP Five Year Plan).

Use of Mean Residency Time for Population Estimation

AUC procedures are sensitive to estimates of female residency time, necessitating the need for accurate estimates of this parameter. In the Nechako, there is a good historical data set and the statistical properties of the residency time estimates are well understood. Mean female residency time on redds has varied between 8.9 days in 1994 to 12.5 days in 2004.

Across different years in the Nechako, the average residency time is 10.6 days. In 2007, the Technical Committee concluded that, based on a sensitivity analysis, the use of the mean residency time in future AUC calculations would provide a sufficiently precise estimate of the spawner population. However, if the population were to approach the minimum level (1700) included in the 1987 Settlement Agreement, the Technical Committee would re-evaluate the necessity to revert to annual estimates of the residency time.

In 2009, as a precursor to the 2010 fry and juvenile programs, residency time was measured using the techniques that were previously developed for Nechako

Chinook. The study yielded a measured residency time of 9.8 days, very similar to the long-term mean and justifying its continued use.

Fry Emergence and Juvenile Outmigration Surveys

Juvenile life history data indicate several strong correlations between number of spawners in the river and corresponding juvenile production indices. The indices developed by NFCP include:

- Fry emergence index
- Juvenile outmigration index

During 2010, Triton Environmental Consultants Ltd. undertook the fry emergence and juvenile outmigration assessments on behalf of the NFCP Technical Committee. Results are shown in Figures 2 and 3 respectively.

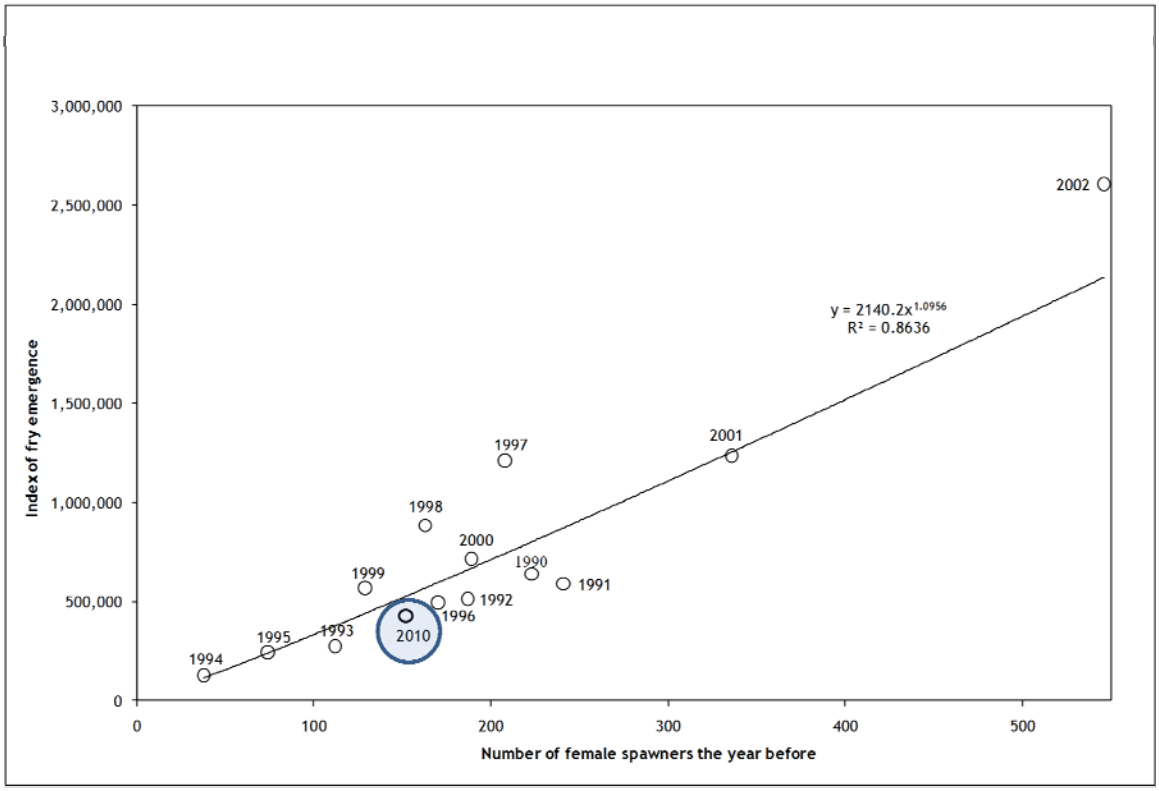

Figure 2. Index of fry emergence vs. spawner escapement during the previous year above Bert Irvine's, km 19 of the Nechako River, 1991-2002, 2010 (circled data point).

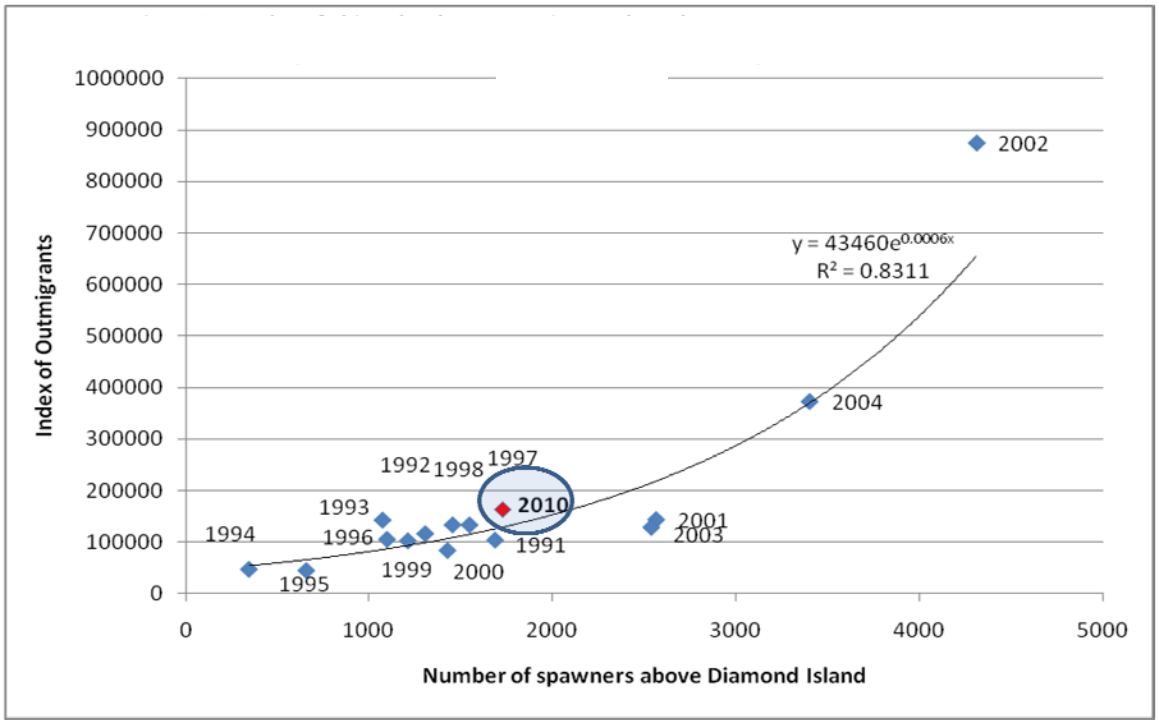

Figure 3. Index of Chinook salmon outmigrants based on rotary screw captures vs. the number of spawners above Diamond Island the previous year, Nechako River 1992-2004, 2010.

The regressions, including the 2010 data points, indicate a stable riverine environment over the period of record. In addition the relationships provide the opportunity to identify the percent departure for each of the project years. Based on the data on record and corresponding adult returns, the ranges in index values reflect conditions that are consistent with the achievement of the Conservation Goal. Deviation from these regression lines in future assessments could serve to trigger additional investigation from the NCFP.

Formerly, NFCP undertook fry and juvenile surveys on an annual basis. Based on the strength of the statistical relationships and the apparent stability of in-river habitat conditions, it was recommended in the 2007-2012 Five Year Plan that fry and juvenile surveys be carried out once every five years. It was further recommended that measurements of adult residence time be scheduled for the year prior to fry and juvenile surveys so as to optimize the accuracy of fry per spawner and juvenile outmigrants per spawner estimates. These recommendations were implemented and the results (Figures 2-3) confirm previous conclusions that the Nechako River provides a stable incubation and rearing habitat for Chinook salmon.

Recommendations for 2012 - 2017

This 5-year plan defines a set of projects that meet the requirements of the 1987 Settlement Agreement and also take into account the results of NFCP monitoring between 1989 – 2011. The water management functions of the NFCP are narrowly defined under the Settlement Agreement and it is assumed that the AWA and STMP components will remain unchanged from 2012-2017.

The evaluation of NFCP projects has identified a number of refinements for the Chinook monitoring component to improve overall cost-effectiveness and build on the knowledge that has been generated throughout the program. One major refinement is the use of the historic mean residency time, 10.6 days, during AUC surveys.

In the event that Chinook population levels decline below the lower target value of 1700, the NFCP will consider reverting to annual measurements of residency time. Should new residency time measurements be deemed necessary, it is recommended that this be undertaken at a single site in the Upper Nechako. Additionally it is recommended that measurements of residency time be scheduled for the year prior to fry and juvenile surveys so as to optimize the accuracy of fry per spawner and juvenile outmigrants per spawner estimates.

It is recommended that the area-under-the-curve/helicopter survey program be continued between 2012-2017 to generate reliable adult Chinook population estimates. A flight frequency of 5 weekly overflights per year, scheduled to start in the first week of September, will provide a defensible population estimate.

Relationships between fry emergence indices, rearing densities, outmigrant densities and adult spawners are well established from data collected over the 14 year period. Should future observations deviate significantly from the established statistical relationships, it is recommended that this serve as a trigger for the consideration of additional evaluation.

In summary, the NFCP Technical Committee recommends the following program components for 2012-2017:

- Key water management activities including establishment of the Annual Water Allocation (AWA) and operation of the Summer Temperature Management Program (STMP) to continue annually unchanged, consistent with the 1987 Settlement Agreement.

- Annual adult Chinook surveys using the Area-Under-The-Curve method and the Maximum Likelihood Approach for population estimation;

- A total of 5 helicopter flights per year scheduled on a weekly basis between early September and the end of the 1st week of October;

- Use of the historical mean redd residency time of 10.6 days for calculating adult numbers

- Measurement of the mean redd residency time at the Upper River site in 2013 during the year prior to fry and juvenile surveys (2014);

- Annual Chinook carcass recovery program scheduled both during the early and late portion of the migration period and covering the lower, middle and upper sections of the enumeration area;

- Regular (annual) evaluation of the utility of using other Fraser Chinook stocks or other methods to establish a reference population unaffected by flow regulation;

- Fry emergence program scheduled in 2014 (frequency of once out of 5 yr) to confirm stability of in-river conditions; decisions regarding additional scheduling of the program based on current habitat conditions;

- Juvenile outmigration program scheduled in 2014 (frequency of once out of 5 yr) to confirm stability of in-river conditions; decisions regarding additional scheduling of the program based on current habitat conditions;

- Physical data collection to be initiated during the fall prior to, and continuing through, the duration of the fry program;

- Measurement of substrate quality and composition every 10 yr (to commence in 2015);

- Annual inspections of instream structures.

Table 4 shows the seasonal timetable of NFCP activities.

Risk Assessment

The Recommendations identify a NFCP Chinook monitoring program that was arrived at based on a combined assessment of technical merit, cost-effectiveness and practicality. These changes represent a refinement to the previous (pre-2007) program and a significant reduction in effort however they do not represent a risk in terms of the NFCP's ability to meet it's mandate.

It is proposed that the NFCP continue to conduct annual projects on the Nechako River to assess Chinook spawner abundance and to conduct biological sampling of carcasses. The proposal includes refinements to the methods used to conduct these projects, but the technical aspects of the proposed changes have been thoroughly examined and data quality will be consistent with the historic dataset. These changes will not affect the NFCP's ability to assess the annual spawner abundance against the Conservation Goal.

The most significant proposed change, carried forward from the first Five Year plan, is to move from annual assessments of fry emergence and juvenile outmigration on the Nechako River to periodic assessments, every 5 years. This change has been evaluated based on technical merit, and it has been identified that there is a very small risk that a potential change in the suitability of in-river habitat could occur, but not be detected for several years. Based on the information collected to date, it appears that the habitat is stable and it is unlikely that this will change except in the event of a dramatic physical perturbation in the river, or as a result of a very long-term, gradual trend. A dramatic physical perturbation would be observed and the NFCP would respond by re-initiating annual assessments, and a long-term trend would be detectable by the proposed period assessments.

Overall, the changes to the Chinook monitoring program introduce a very low level of risk to the NFCP's ability to detect and respond to environmental changes. The continuation of some annual projects assures that personnel are out on the river on a regular basis and that the NFCP remains a functional group, annually reviewing project results, discussing potential concerns, and responding to any unforeseen difficulties.

Table 4. Seasonal timing of NFCP projects and activities for 2012-2017.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Management				Apr 1: water year begins Apr 20 spring flows begin			STMP: July 10 to Aug 20		Sep 1 fall/ winter flows begin			
Adult Chinook									5 weekly helicopter flights in Sep and 1st week of Oct			
Fry Emergence (every 5 yr)			late March to mid-May									
Juvenile Outmigration (every 5 yr)				mid-April to mid-July							1 week	
Physical measurements (every 5 yr during juvenile programs	continuous data loggers											
Habitat complex inspections				opportunistically during juvenile surveys								
Gravel surveys		field surveys during low water periods?										

Budget Projections

Annual operational costs of different NFCP program elements[2], are shown in Table 5. Totals are based on estimated personnel costs of $500/day.

Table 5. NFCP operating costs.

	Frequency	Personnel Costs	Expenses	Total Cost
Remedial Measures - funded by Rio Tinto Alcan 100%				
Summer Temp Management	annual	$54,750	$15,910	**$70,660**
Flow Control	annual	$11,250	$3,410	**$14,660**
Habitat Complex Inspection	annual	$6,000	$4,821	**$10,821**
Chinook Monitoring – equally funded by DFO & Rio Tinto Alcan				
Spawner Enumeration – 5 flights	annual	$8,000	$30,000	**$38,000**
Carcass Recovery - Nechako	annual	$22,000	$1,000	**$23,000**
Residence Time – upper site only	5 yrs	$73,000	$30,000	**$103,000**
Fry and Juvenile Contract	5 yrs	$372,100		**$372,100**
Gravel Study	10 yrs		$120,000	**$120,000**

This 5-year plan includes a proposed schedule for conducting specific projects, however it also includes the principle that the NFCP will remain flexible and responsive to both the results of the scheduled projects and to observed or unexpected events in the watershed. Budget projections for any given year will be determined by the NFCP's response to these situations, but the costs of the anticipated monitoring program, as proposed in this plan have been projected below.

The total cost of the annual Remedial Measures projects, which are funded by Rio Tinto Alcan, is $96,141. In addition to these costs, Rio Tinto Alcan will be responsible for funding half of the total cost of monitoring in each year, as described below.

The total cost of the annual Chinook Monitoring projects is $61,000. Calendar years 2013 and 2014 will mark the second "five-year cycle" for conducting the Residence Time (2013) and Fry/Juvenile projects (2014) and the next scheduled Gravel study will be deferred until such time as it is deemed necessary by the Technical Committee. The total cost of monitoring in any given year will be determined by the projects which are conducted, but those costs will be equally shared by DFO and Alcan.

[2] unadjusted for inflation

The total annual funding requirement from each agency in order to carry out the projects as proposed in this 5-year plan is summarized in Table 6. These costs are based on conducting the projects as proposed, but the projects conducted in any given year may vary from the proposed plan depending on observed or expected events in the watershed.

Table 6. Operating costs by calendar year.

	Chinook Monitoring		Remedial Measures
Calendar Year	**DFO**	**Alcan**	**Alcan**
2012	$30,500	$30,500	$96,141
2013	$82,000	$82,000	$96,141
2014	$216,550	$216,550	$96,141
2015	$30,500	$30,500	$96,141
2016	$30,550	$30,550	$96,141
2017	$30,550	$30,550	$96,141