PROTOCOL
FOR
MONITORING EFFECTIVENESS
OF
INSTREAM DIVERSION PROJECTS

(Irrigation Diversion Dams, Water Treatment Plants, Pipes, Ditches, Headgates, Hydropower Penstocks)

MC-8

Washington Salmon Recovery Funding Board

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Fish & Wildlife Dept of; Skyline Canal Fish Screen (#00-1158)
Attachment #1, New screen

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TABLE OF CONTENTS

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ORGANIZATION

Instream Diversions have accounted for 5% of all SRFB projects. They have the potential to create improvements in fish production in a very short time (1-5 years). This document details the monitoring procedures necessary to document and report the effectiveness of these projects at the reach scale. Projects designed to protect salmon from instream diversions treated in this procedure include:

- Irrigation Diversion Dams
- Water Treatment Plants
- Pipes
- Ditches
- Headgates
- Hydropower Penstocks

This document is in compliance with the Washington Comprehensive Monitoring Strategy (Crawford et al. 2002)

The goal of instream diversion projects is to prevent passage of salmon into areas where they may be stranded or subjected to increased mortality such as irrigated fields, turbines, treatment plants, factories, and other uses of water hazardous to fish survival. By screening and otherwise protecting diversions, salmon survival for a watershed can be improved.

MONITORING GOAL

Determine whether diversion screening projects are effective in meeting the project screen design criteria.

QUESTION TO BE ANSWERED

Have the engineered fish diversion screening projects continued to meet design criteria post-project for at least five years?

NULL HYPOTHESIS

Diversion screening placed at instream diversions has not maintained its design criteria over time.

OBJECTIVES

BEFORE PROJECT OBJECTIVES (YEAR 0)

Determine the proper design criteria for meeting best management practices for the diversion screening projects.

AFTER PROJECT OBJECTIVES (YEARS 1, 2, AND 5)

Determine whether diversion screening design criteria are being met at each project sampled.

RESPONSE INDICATOR

Level 1 - Project design criteria taken from construction blueprints or pre-project plan. New diversion screening projects should comply with WDFW criteria and guidelines found in *Draft Fish Protection Screen Guidelines for Washington State* by Nordland and Bates (2002) and National Marine Fisheries Service Guidelines found in the *Anadromous Salmonid Passage Facility Guidelines and Criteria* (NMFS 2004). The literature has shown that screening, when properly designed, can eliminate diversion and stranding of fish without impingement on the diversion screen. By following the best management practices (BMPs) available, a known response can be expected from the fish population.

MONITORING DESIGN

The Board will employ a simple after-installation monitoring design for all diversion screening projects. The outcome is to meet the approved project design criteria for diversion screening. Therefore a sample of ten projects will be monitored in Years 1, 2, and 5 to determine if the diversion screen is functional and in compliance with design specifications.

Testing for significant trends can begin as early as Year 1. Final sampling may be completed in 2009 depending upon the availability of diversion screening projects.

DECISION CRITERIA

Effective if design criteria are met for 80% of the structures in Year 5. Effective at the project level if the screen meets 80% of the design criteria.

Table 1. Decision criteria for testing diversion screening

Indicators	Metric	Test Type	Decision Criteria
Measure of whether the screen diversion meets design criteria. (SCRNDESIGN)	%	None. Count of functional screen diversions.	≥ 80% of projects are intact by Year 5. Intact means that 80% or more of the design criteria are met at inspection.

SAMPLING

BEFORE PROJECT SAMPLING

All diversion screening projects identified for long term monitoring by the SRFB must have completed pre-project Year 0 monitoring prior to beginning the project.

Year 0 monitoring will consist of:

- Determining the flow rate (cfs) of diversion projects to be protected by screening.
- Determining the total quantity of water allowed to be diverted (acre-feet) of diversion projects to be protected by screening.
- Using project design documents, determine the design criteria for the diversion screening structures.

AFTER PROJECT SAMPLING

Upon completion of the diversion screening projects, Years 1, 2, and 5 monitoring will determine the status of the project screen using design criteria for the diversion screening structure and the method laid out on page 7.

METHOD FOR QUANTIFYING DESIGN EFFECTIVENESS OF STREAM DIVERSION PROJECTS

PURPOSE

This protocol is to be implemented after a habitat restoration project funded by the SRFB has placed a diversion screen into the stream. The intent is to document whether the diversion screen remains according to engineered specifications (Level 1 monitoring) where it was placed, or whether flooding or other actions altered the design or efficiency of the screen so that it no longer protects fish from either diversion or impingement.

EQUIPMENT

Project engineering design drawings, Vernier calipers, 50 m measuring tape, flow meter

PROCEDURE

Step 1: In Year 0 prior to placing the diversion screen into the stream, determine from the engineering drawings and specifications the overall dimensions, mesh size, and angle to the flow of the proposed screen.

Step 2: During Year 1 and immediately after the diversion screen has been placed in the stream measure the overall dimensions, mesh size, and angle to the flow to determine if they meet preconstruction design.

Step 3: During Year 2, 5, and 10 repeat the measurements.

SUMMARY STATISTICS

While summary statistics are not performed for Diversion Screening Projects, these projects are evaluated based on a set of NOAAF compliance criteria. The following diversion screen characteristics are surveyed for Diversion Screening Projects:

- **Parallel Flow -** Where physically practical and biologically desirable, the screen should be constructed at the point of diversion with the screen face generally parallel to river flow.

- **Approach Velocity** - must not exceed 0.40 ft/s for *active screens*, or 0.20 ft/s for *passive screens*.

  Uniform Flow - The screen design must provide for nearly uniform flow distribution over the screen surface, thereby minimizing *approach velocity* over the entire screen face. Uniform flow distribution avoids localized areas of high velocity, which have the potential to impinge fish.

- **Sweeping Velocity vs. Approach Velocity -** Screens longer than 6 feet must be angled and must have *sweeping velocity* greater than the *approach velocity*.

- **Sweeping Velocity Decrease -** For screens longer than 6 feet, *sweeping velocity* must not decrease along the length of the screen.

- **Screen Mesh Size**

  Circular Screens: Circular screen face openings must not exceed 3/32 inch in diameter. Perforated plate must be smooth to the touch with openings punched through in the direction of approaching flow.

  Slotted Screens: Slotted screen face openings must not exceed 1.75 mm (approximately 1/16 inch) in the narrow direction.

  Square Screens: Square screen face openings must not exceed 3/32 inch on a diagonal.

- **Corrosion Resistant -** The *screen material* must be corrosion resistant and sufficiently durable to maintain a smooth uniform surface with long term use.

- **Gaps -** Other components of the screen facility (such as seals) must not include gaps greater than the maximum screen opening defined above.

- **Maximum Withdrawal - U**sed to determine if site conditions are appropriate for a passive screen, versus an active screening structure. A *passive screen* can only be used when the rate of diversion is less than 3 CFS.

- **Debris Accumulation -** Structural features must be provided to protect the integrity of the fish screens from large debris, and to protect the facility from damage if overtopped by flood flows. A *trash rack*, log boom, sediment sluice, and other measures may be required.

- **Clearance -** *End of pipe screens* must be submerged to a depth of at least one screen radius below the minimum water surface, with a minimum of one screen radius clearance between screen surfaces and natural or constructed features.

Projects are evaluated against the NOAAF criteria by assigning a response of “Yes” or “No” regarding whether the project is in compliance with each criterion.

TESTING FOR SIGNIFICANCE

We can create a table resembling the following from the data collected for Level 1 diversion screening design.

Table 2. Example table for hypothetical Level 1 Diversion Screening design criteria met (Yes/No)
Yes means that 80% or more of the design criteria were met for that project. 1

	Year 0 2003	Year 1 2004	Year 2 2005	Year 5 2008
	Impact	Impact	Impact	Impact
Proj. 1	No	Yes	Yes	No
Proj. 2	No	Yes	Yes	Yes
Proj. 3	No	Yes	Yes	Yes
Proj. 4	No	Yes	Yes	Yes
Proj. 5	No	Yes	No	No
Proj. 6	No	Yes	Yes	Yes
Proj. 7	No	Yes	No	No
Proj. 8	No	Yes	Yes	Yes
Proj. 9	No	Yes	Yes	No
Proj. 10	No	Yes	Yes	Yes
Percent Effective	0	100	80	60

DATA MANAGEMENT PROCEDURES

Data will be collected in the field using various hand-held data entry devices. Raw data will be kept on file by the project monitoring entity. A copy of all raw data will be provided to the SRFB at the end of the project. Summarized data from the project will be entered into the PRISM database after each sampling season. The PRISM database contains data fields for the following parameters associated with these objectives.

Table 3. Category 1 Diversion Screening Projects – no fish present pre-project

Indicator	Metric	Pre impact Year 0	Post impact Year 1	Post impact Year 2	Post impact Year 5
Flow rate	cfs	√			
Total quantity of water allowed to be diverted	acre-feet	√			
Diversion Structure Level 1 effective	Yes/No		√	√	√

REPORTS

PROGRESS REPORT

A progress report will be presented to the SRFB in writing after the sampling season for Year 1 and Year 2.

FINAL REPORT

A final report will be presented to the SRFB in writing after the sampling season for Year 5. It shall include:

- Estimates of precision and variance.
- Confidence limits for data.
- Summarized data required for PRISM database.
- Determination whether project met decision criteria for effectiveness.
- Analysis of completeness of data, sources of bias.

Results will be reported to the SRFB during a regular meeting after 1, 2, and 5 years post project. Results will be entered in the PRISM database and will be reported and available at the Interagency Committee for Outdoor Recreation web site and the Natural Resources Data Portal.

ESTIMATED COST

It is estimated that approximately 3 hours per project would be required to conduct all field activities under the protocol. This results in a relative 2004 cost of $140-$600 per project.

REFERENCES CITED

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