Draft 2.0

Appendix A: Guidelines for In-Stream Routine Effectiveness Evaluation

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WORKING DRAFT – In-Stream REE Guidelines

This is a working draft of the Watershed Restoration Program's (WRP's) Routine Effectiveness Evaluation Guidelines. Your comments and suggestions on ways to improve these guidelines are welcome. Please complete the comment sheet provided in Appendix A-1 at the back of this technical circular and forward it to us.

Background

The WRP was established in 1994 under the auspices of Forest Renewal BC. As of 1999, the key five-year target of the WRP is to protect and restore high priority water quality and fisheries resources in 20% of the province's Priority Key watersheds by 2004. Since its inception, the WRP has invested considerable time and effort in restoring habitat and water quality in many watersheds throughout the province. A standardised effectiveness evaluation procedure is required to ensure that WRP activities are:

1. successful at achieving the watershed objectives as defined in the Restoration Plan (RP);
2. conducted in a cost-effective manner;
3. optimised and adjusted to best meet restoration objectives based on lessons learned from successes and failures in the field through an adaptive management process.

A framework for conducting effectiveness evaluations for all WRP components (up-slope, stream and riparian) was developed to provide a rationale for undertaking effectiveness evaluations throughout the province (Gaboury and Wong, 1999). The framework breaks effectiveness evaluations into three levels based on statistical rigor and scope. The most basic level of evaluation defined in the framework is Routine Effectiveness Evaluations (REE), while intensive effectiveness evaluation (IEE) and operational techniques refinement (OTR) are more focussed at addressing specific questions or issues in watershed restoration.

While the effectiveness evaluation framework applies to all WRP components, each component requires specific procedures be undertaken to determine the overall component effectiveness. This document describes the REE procedures to be implemented for the stream, off-channel and riparian restoration components of watershed restoration work in key watersheds.

Objective

Routine effectiveness evaluations provide a low intensity, standardised procedure for determining the success of WRP stream and riparian restoration projects at a broad scale, and low cost. The intent of the REE procedure is to examine all sites within restoration projects to determine, at a qualitative level, if physical and biological objectives at the site, component and watershed level are being met satisfactorily (see Gaboury and Wong, 1999 for objective definitions).

The outputs of REE are:

1. recommendations for site-specific maintenance or remedial works;
2. documentation of unexpected and instructive site-specific successes and failures;
3. a statement of progress towards component restoration completion including a time frame for additional evaluation and;
4. recommendations (if any) for potential IEE and OTR projects stemming from REE findings.

The REE outputs will be used to both determine restoration component completion in eligible watersheds by feeding information back to Restoration Plans (RP's), as well as being rolled up on

annual basis to summarise province-wide REE findings in an annual effectiveness evaluation compendium. Recommendations from the annual REE compendium form a component of an adaptive management loop that will be used to adjust WRP delivery, and where warranted government policy and legislation.

A limitation of REE is that it inherently is directed at a component and particularly at a site level. Thus it is not well suited for identifying restoration gaps at a watershed level or providing recommendations for watershed completion. These aspects are covered off via an audit of restoration plans. REE confirms that completed works achieve, at a site level, the objectives of the prescriptions, and provide limited feedback regarding the overall appropriateness of prescriptions at a site level.

In-Stream REE Methodologies

The in-stream REE methodologies follow directly from Koning et al. (1998). However, the methods have been updated to reflect changes in the program that have occurred in recent years. An updated field form for entering REE information modified from Koning et al. (1998) is included as Appendix A-2.

The site-specific objectives for in-stream restoration can relate to short-term habitat generation or long-term channel re-forming processes. As such, it is important that the watershed level objectives be reviewed as per the RP to determine the nature and intent of in-stream works prior to undertaking a REE. Otherwise, restoration works successful at providing long-term channel recovery could be identified as failing to create short-term fish habitat and remedial actions recommended.

The REE plan, updated as required following the annual construction period, must include a submission of a completed REE form indicating the objectives of each restoration structure (see Appendix A-3 for an example). This is accomplished by placing a circle in the appropriate columns for physical and biological performance objectives for each restoration site as per the methodology of Koning et al. (1998). The task of the REE methodology is to contrast the planned physical and biological performance with the realised physical and biological performance.

Timing for conducting REE of stream projects will need to be considered. If the site objectives all pertain to high flow conditions, REE should be timed for freshet. If objectives are better observed at low flow, then REE should be conducted at low flows. Selection of REE timing, by activity, will be outlined in the regionally derived Schedule A.

General Information

MYA / AA Holder No.
Enter the MYA or AA holder name and FRBC MYA / AA number.

FRBC Activity No.
Enter the FRBC Activity number for the restoration work being evaluated.

Project Name
Enter the name of the watershed restoration project on which the REE is being conducted.

Watershed
Identify the name of the watershed or watershed group in which the in-stream restoration was completed, as referenced in the Regional Resource Management Plan.

Sub-watershed
Identify the sub-watershed in which the restoration works were completed.

Date
Enter the day, month and year that the REE was completed.

Survey Crew
Enter the initials of the survey crew and the organisation with which they are affiliated.

Weather
Enter the weather and flow conditions on the date of the REE survey (very high – greater than bankfull, high – bankfull, moderate – intermediate flow less than bankfull, low – low flow, typical of late summer). Note, the REE should be conducted in a flow that is suitable for assessing the performance of structures. As such, very high and high flows are excessive for the majority of REE, and should be avoided.

Forest District
List the Ministry of Forests forest district in which the REE is being completed.

REE Interval
Enter the year following construction for which the REE is being completed. If this is a follow up REE, also indicate the time interval since last REE. If the REE is being undertaken following a large-scale flood event, indicate the estimated return period for the flood.

Other Components Surveyed
Identify what other WRP components are being evaluated within the watershed (e.g. upslope, riparian, fish access and off-channel). Listing this information will facilitate the compilation of all REE summaries in a provincial REE compendium.

Restoration Activities Complete
Review the restoration plan. If all restoration activities for the in-stream component have been implemented and evaluated, and there are no requirements for remedial work or recommendations for follow-up REE, enter that the in-stream component is complete. If in-stream work is on-going, remedial works are identified, or follow-up REE is recommended, enter that the in-stream watershed restoration component is not complete.

Project Specific Information for In Channel Projects

These definitions apply to the stream project evaluation criteria for the REE field form (Appendix A-2):

Stream
List the particular stream within the watershed that is being evaluated.

Distance
Measure the distance from the start of the reach to the restoration structure being evaluated or use the chainage from the from the Level 2 Prescription or Major Works reports.

Site ID #
Individual restoration sites must be entered as separate line items and identified in a consistent fashion with REE plans, as-built reports and other REE documents.

Structure Type
Enter the appropriate code for the restoration structure being evaluated. As the REE is a non-intensive evaluation procedure, all possible restoration structure types have not been listed. Use the code that best describes the structure being evaluated. If a structure type is not listed, use the “other” category and supply a list describing the additional codes.

LWD-single	LWD-1

LWD-multiple/A-jam	LWD-M / LWD-A
LWD-revetment	LWD-R
LWD-deflector (single or double)	LWD-D
LWD-sill logs	LWD-S
LWD-bar stabilisation	LWD-B
Bioengineering – Bar stabilisation	BIO-BAR
Bioengineering – Bank stabilisation	BIO-BANK
Boulder-single	BLD-1
Boulder-cluster	BLD-C
Boulder-groyne	BLD-G
Rip rap	RR
Rock Riffle	RIFF
Fertilisation (reach level)	FERT
Gravel placement	GRAV

Site Objective
The site objective of a particular restoration structure is a simplified and generic statement of purpose that parallels the site-specific objective. For an LWD jam, the intended function could be to scour a pool, deflect flow from an area of erosion or induce deposition of sediment to accelerate revegetation. The intended function will come from restoration summaries, REE plans developed at the prescription development phase or previous REE reports.

Performance Objectives

The data collected at the level of performance objectives allows for the systematic review of physical and biological performance objectives to determine if in-stream restoration structures are adequately meeting site objectives.

All performance objectives are scored on a 4-point scale to indicate how well a restoration structure is, or is not meeting an objective. In all cases, a score of 4 indicates the structure is exceeding expectations for that particular attribute, and a score of 1 represents a failure to achieve the site or component objective. **Half point scoring is allowed to provide a greater degree of discretion to REE implementers**. The following definitions, modified from Koning et al. (1998), apply for stream component REE activities:

4. site conditions resulting from works are exceeding expectations and objectives;
3. site conditions resulting from works are meeting expectations and objectives.
2. site conditions resulting from works are failing to meet expectations or objectives;
1. site conditions resulting from works fail to meet objectives. Expectations are not met.

For each of the physical and biological objectives, a series of scoring definitions are provided to guide the evaluation of structure performance. Site objectives and on-site conditions must be considered when evaluating structure performance. It is acknowledged that the scoring definitions do not apply to all projects or site objectives. If additional definitions are required for unique or non-standard sites or projects, summarise the definitions used in the REE report.

Physical Objectives

The categories of data collected for the physical performance objectives relate to the impact of the structure on the morphology of the stream channel. The scoring of attributes relates only to those attributes that the structure was designed to effect. Those attributes should be marked with a circle and available from the REE plan as described above. Thus, a boulder cluster would not have a site-specific objective of scouring a pool. Thus the pool column would be left blank, and another column, such as stream cover selected.

Some restoration structures may fulfil additional objectives than what they were originally designed. To separate out design objective rankings from unanticipated benefits, designed benefits should be recorded in circles and non-designed objectives should be recorded without circles (see Appendix A-3 for an example of a completed form).

Pool
This column is suitable for those structures with the objective of scouring or preserving pool habitat. Has the structure managed to scour or maintain a pool to the expectations of the site specific restoration objectives? Does a pool exist according to the definitions of Johnston and Slaney (1996)? Has the pool filled in with sediment? Does the pool appear to be stable and present in high flow? Is a pool with an acceptable residual depth present in low flow? The REE crew may not be present in high flow or low flow, so judgement will need to be used when considering this performance objective.

4. The pool created by the structure is exceeding expectations in terms of surface area and residual depth. The pool is stable and effective throughout all flow conditions.

3. The pool created by the structure is meeting expectations in terms of surface area and depth. However, it is not exceeding expectations of size or function.

2. The pool does not meet expectations. It is either too small, too shallow, has partially filled in or is not functional at high and or low flows.

1. Site Failure. The structure has failed in its performance objective and has not formed or protected a pool adequately. The pool does not exist and or the structure has been displaced from the location. The pool washes out in high flow and or is non-existent in low flows.

Riffle
For constructed rock and or LWD riffles. Riffles are designed to return a measure of horizontal and vertical stability to channelised or otherwise uniform stream sections. Riffles must be evaluated in terms of meeting these objectives. Has a riffle remained in place? Is there an indication of erosion at the riffle tail? In-filling at the head? Do flows go subsurface in low flow?

4. The riffle is exceeding expectations. Pools have formed upstream and or downstream of the structure. Spawning gravel has been trapped at the pool tail-out.

3. The riffle is meeting restoration objectives adequately. Pools are being adequately maintained, minimal infilling occurring.

2. The riffle has is not providing adequate habitat. Pools associated with the riffle are filling in.

1. The riffle has failed to provide habitat for the target species and lifestage. It has washed out, filled in, been abandoned by the channel, or otherwise has failed to meet objectives.

Gravel Bar
For prescriptions to stabilise gravel bars, induce deposition, or vegetate gravel bars. Has a gravel bar formed as a result of the structure? Is there evidence of aggradation? Is vegetation regenerating on gravel bars?

4. Gravel bars have aggraded, vegetation has extensively regenerated, and the stream channel is down cutting. No movement of bar stabilisation components, the site has trapped additional LWD and SWD. Evidence of soil build-up and rootmass binding.

3. Gravel bars objectives are being achieved as described in the restoration summary, but not beyond expectations.

2. Gravel bar structures are not attaining objectives. Scour and erosion may be occurring instead of deposition and aggradation. Soil is washing out or not being maintained on bar surfaces.

1. Gravel bar stabilisation failure. Washout of stabilisation structure, substantial scour and erosion as a result of structure.

Streambank
Some restoration structures have the objective of protecting streambanks from erosion. This can be facilitated through the placement of LWD and or boulders along the margins of stream channels and or through bioengineering techniques. Thus, restoration with an objective of protecting streambanks must be evaluated in terms of bank condition resulting from restoration structures.

4. Revetment type works are protecting streambanks upstream, downstream and at site. The structure has trapped additional materials (SWD and LWD). Extensive habitat values have formed in addition to bank protection. Erosion is being prevented on both the inside and outside bends of the channel.

3. The streambank is adequately protected as per the restoration prescription and restoration objectives. No evidence of erosion associated with structure.

2. Structure still in place, but erosion evident in vicinity or within structure. Structure not adequately protecting streambank or preventing input of sediment to the stream channel. Stream has migrated away from structure.

1. Structure has failed. Bank erosion is continuing and or has accelerated following instillation of restoration structure.

Stream Cover
The objective of some restoration projects is to provide stable cover for the target species. The effectiveness of cover must be evaluated from a physical performance perspective.

4. Abundant cover has formed that exceeds expectations. Complex habitat made up of several cover components (overhanging vegetation, deep pools, LWD, undercut banks, boulders). Additional cover material has been trapped and the quantity and or quality of cover have increased following major works.

3. The components of stream cover installed have not moved following instillation. The cover installed in the stream channel meets expectations. Quality fish habitat and cover are abundant at the site.

2. As a result of cover elements shifting, being buried or otherwise compromised little quality cover exists.

1. Total failure of cover to be provided at the site resulting from the complete washout, burial or destruction of stream cover components.

Nutrient
Stream fertilisation has become an increasingly important component of restoration projects. Evaluations of effectiveness at the routine level should include an assessment of stream productivity by observing primary and secondary production. However, for streams undergoing fertilisation, it is required that samples are obtained for nutrient assay (consult Ashley and Slaney (1997) and fertilisation approval documents for additional detail).

4. Abundant periphyton growth (substrate is very slimy). Evidence of abundant benthic macro-invertebrates. Whole reach appears productive.

3. Adequate amount of periphyton on substrate surface. Response to fertilisation treatment is visible throughout the reach.

2. Little evidence of fertilisation throughout the treated stream reaches. Low productivity evident through reaches.

1. No evidence of fertilisation having taken place in treated reaches. There are no visible differences in periphyton abundance upstream of treatment area. Very low benthic invertebrate production. Overall sterile conditions predominate throughout the reach.

Overall Rating
Review the desired physical performance objectives for each site and compare with the recorded performance objective value for all physical performance ratings. List the overall rating as the lowest value identified as a structure objective (e.g. ignore unexpected successes). Once all structures have been evaluated, the mean and standard deviation of physical performance objectives will be charted for all structures as well as for each type of structure (see Appendix A-4 for example figures).

Biological Objectives

Species
Enter the target species for the restoration site, using species definitions found in Appendix A-5. If multiple species are targeted at a given a site, list all species abbreviations.

Life Stage
List all lifestages for which the particular restoration structure was designed to provide habitat.

Overwinter
One of the most critical fish habitats compromised by streamside forest harvesting is overwinter habitat. The effectiveness of restoration structures that have a focus on overwintering habitat needs to be evaluated in terms of stable pool habitat with abundant cover.

4. Abundant, stable, deep pools have formed as a result of restoration structure. The influence of the structure upstream and downstream in terms of providing overwintering habitat is in excess of expectations.

3. Adequate stable, deep pools have formed as a result of restoration structure.

2. Insufficient stable, deep pools have formed as a result of restoration structure.

1. No pool habitat has formed that is conducive to providing overwintering habitat to the target species and lifestage.

Rearing
Juvenile rearing habitat differs for various species and lifestages. The overall effectiveness of restoration for all target species rearing must be evaluated.

4. Abundant rearing habitat has formed upstream and downstream of the site as a result of the restoration structure, in excess of expectations.

3. Adequate rearing habitat has formed at the site as a result of the structure.

2. Insufficient rearing habitat has formed at the site. Partial failure of structure threatens continued provision of rearing habitat.

1. Structure fails to provide rearing habitat.

Holding
Resident trout and char species may spend months to years in stream or river habitats. As such, adult holding habitat may be a critical factor to be considered as a restoration objective. While this is very important for resident species, adult salmon and steelhead also require holding habitat for weeks or even months that they spend in freshwater prior to spawning. For projects with an objective of providing adult holding habitat, the following should be considered in routine effectiveness evaluations:

4. Holding habitat has been formed for all target species as a result of the restoration structure. Deep stable pools with abundant cover provide habitat for multiple adults.

3. Adequate holding habitat generated as a result of the restoration structure. Cover is present, but only to support a limited number of adults.

2. Limited holding habitat has formed from the instillation of the restoration structure. Pools have filled in, cover has been lost, and few adults can coexist in the available space.

1. Total failure of the structure to provide holding habitat for adult salmonids.

Spawning
Some restoration structures focus on trapping, preserving or otherwise obtaining high quality and stable spawning habitat. The quantity and quality of spawning habitat must be assessed in terms of both physical and spatial criteria (e.g. does gravel exist, is it the right size, is there enough of it, is it clean, is it at a suitable location to be conducive for spawning?).

4. The structure has created extensive spawning habitat in stable areas that are in areas conducive to use by the target species.

3. Adequate amounts of spawning gravel have been trapped by the structure, but not in excess of expectations.

2. Little spawning gravel has been trapped, or it is in a poor location, or is in an unstable configuration.

1. The structure has failed to trap spawning gravel suitable for the target species.

Incubation
Restoration projects need to provide more than just spawning gravel. For the project to be successful, eggs must be successfully incubated throughout their gestation period. Thus, restoration projects with an objective of providing spawning habitat also need to be evaluated in terms of the potential for incubation success.

4. No evidence of redd scour in vicinity of structure. Spawning substrate is located in stable areas, is free of fines, and has suitable flows for the target species incubation requirements.

3. Little evidence of redd scour. Spawning gravel is present and appears to be stable, free of fines and with sufficient flow for the target species.

2. Evidence of redd scour. Spawning gravel partially washed out or filled in with fines. Flows are not ideal for the target species.

1. Incubation is poor as a result of structure. Redds are extensively scoured, gravel washed out, filled in and insufficient or excessive flows have compromised the ability of the gravel to sustain eggs to fry.

Overall Biological Performance Rating
Review performance for all biological performance ratings that pertain to site objectives. List the overall biological performance rating as the lowest value identified as a structure objective (e.g. ignore unexpected successes). Once all structures have been evaluated, the mean and standard deviation of the biological performance rating will be graphed for all structure types, and broken out for each type of structure. See Appendix A-4 for model figures.

Overall Performance

The overall performance of any structure must be summarised to develop an understanding of how it has performed in relation to its site objectives. The overall performance ratings can be summarised across like structures in a project and discussed in the REE report to illustrate how performance among structures relative to objectives has developed. Overall performance objectives also allow for an indication of maintenance requirements in the projects.

Structural Condition
This category relates to the overall physical condition of the restoration structure including, the state of LWD, cables, rock fragmentation, condition of epoxy or adequacy of ballast.

4. The structure is in excellent condition, all components are solid and there is no evidence of breakage or wear. Material recruited to the site is also in excellent condition. Many years of function left in the structure.

3. The structure is in adequate condition. Normal wear and tear may have caused localised damage to the condition, but nothing out of the ordinary.

2. The structure condition is poor, evidence of decay in LWD, cable is rusting, and clamps have broken or are otherwise not functioning. Boulders are fragmenting, and epoxy has failed at several locations.

1. Overall condition of the structure is very poor and it is unable to meet any performance objectives. LWD collapsed, boulders crumbled, cables rusted and failed and the structure will not last another high flow season.

Structural Stability
This criterion for evaluations relates to the extent that a structure has moved as a result of scour or sheer stress in comparison to how it was designed and built.

4. The structure is very stable in its configuration. No movement is detectable and no erosion is evident that could threaten the long-term function of the structure.

3. The structure has settled and shifted to a small degree. However, function has not been compromised, and the shifting has not led to any perceived loss of stability. Small amounts of bank erosion may occur as the channel adjusts to the presence of the structure.

2. The structure has shifted substantially following instillation. Structure movement has compromised function, but a degree of functionality still exists. Long-term function is doubtful because of stability issues. Excessive bank or bar erosion from structure is destabilising the channel.

1. The structure has failed and does not meet design objectives.

High Flow
Though not a performance objective, structures or major works must be evaluated with respect to their effectiveness and or functionality at all flow levels. Some areas may emphasise an objective relating to high flow scour habitat, or low flow. Regardless, the efficacy of the structure at bankfull or greater flow conditions must be appraised.

4. The structure is exceeding design expectations during high flow. Evidence of substantial scour during freshet periods. No evidence of structure movement, failure, bank erosion or other adverse response in the channel as a result of restoration structure.

3. The structure functions at high flows, but does not fulfil additional objectives.

2. Evidence of failure at some areas. Erosion evident, but not immediately threatening the structure. No scour occurring at site, conversely excess scour occurring that threatens to collapse or otherwise destabilise restoration structure.

1. Total failure of structure to achieve objective at high flows. Failure of structure, extensive erosion, harmful effects to adjoining habitat units or washout of structure.

Low Flow
As per the high flow evaluation, the structure's or major works' physical performance must be evaluated in terms of its effectiveness at low flow periods, regardless of objectives.

4. The structure is functioning in excess of expectations at low flow conditions. Cover is abundant; material has been recruited that exceeds expectations of structures.

3. At low flows, the structure adequately meets its objectives. Pools have been scoured to an acceptable residual depth, boulders continue to provide rearing habitat and riffles are still flooded.

2. The structure is functioning according to its objectives, but not in an optimal condition. Pools have not scoured sufficiently to provide abundant low-flow refugia, riffles are locally de-watering or failing to concentrate sufficient flow to allow for fish passage.

1. Failure of structure to achieve restoration objectives at low flow. The structure is not in the wetted channel width. No pool has scoured; flow over riffles is entirely sub-surface. Fish passage is not possible due to structure placement or effect in low flow conditions.

Maintenance Recommendations
A recommendation for maintenance or remedial works is required for each site as a result of REE. Does the structure meet its site objectives? Are remedial works warranted? Will remedial works or maintenance help achieve component and watershed level objectives?

4. No repairs of maintenance required.

3. Minor repairs or remedial works could be undertaken but are not required. Repairs / remedial works were undertaken at the time of REE survey and no follow-up is required.

2. Repairs are required to return the site to a functioning state. However, the works are minor, or do not require immediate action (can be completed within a year).

1. Major repairs are required using the existing or new prescriptions or plans. Works are required as a priority and must be undertaken within a short time frame (e.g. less than six moths).

Photo Numbers
Enter the number and roll of all photographs taken of the structure.

Photographs
Photographs are required as a component of REE. As the REE compendium is limited to four pages, few photographs will be incorporated. Emphasis for photographs should be placed on those structures or works that demonstrate opportunities for learning. Unexpected successes and failures should be documented, as well as areas/sites recommended for remedial works. Other noteworthy photographs should be included at the discretion of the REE project supervisor.

Comments

Any comments regarding the function or failure of restoration sites, or anything else worth noting that will help with understanding why a structure is meeting, exceeding, or failing its objectives should be included on the form.

Detailed REE Requirements

At the Ministry representative's discretion, additional data may be required under REE. This is called Detailed REE and is required to ensure sufficient information is collected on top of the basic REE methodology outlined above to ensure that effectiveness of restoration works at a routine level is achieved.

Pre- and Post-Restoration Photopoints
Detailed REE requirements may include establishing pre-restoration photopoints and obtaining photographs at photopoints whenever REE is undertaken. As pre-restoration photopoints must be established prior to construction, the Ministry Representative will identify particulars of photopoints and include them in the construction Schedule A.

Fish Sampling
Fish sampling is not a requirement of the basic REE methodology. Observation and professional judgement are to be used to determine if fish are present and or using the restoration structure in a manner in accordance with the site objectives.

At a more detailed level, fish sampling can be expanded to include snorkel surveys, electroshocking, G-trapping, angling or seining. Details of fish sampling including level of rigour (presence versus population estimates), timing and requirements for obtaining and analysing age structures will be determined in consultation with the MELP WRP specialist.

Water Quality Evaluation
Water quality may be included in a REE plan. Typically, this will include temperature monitoring, dissolved oxygen monitoring, suspended sediment or turbidity sampling, and inorganic nutrients (total phosphorous, soluble reduced phosphorous, total nitrogen and nitrate).

Temperature is best measured at short intervals (e.g. hours) over extended time periods (e.g. seasons). This is easily facilitated with the use of automated recording devices.

Dissolved oxygen may be measured with probes or through Winkler titration. Samples must be collected and analysed according to appropriate methodologies (e.g. Wetzel and Likens, 2000). Samples must be collected at appropriate intervals and at appropriate seasons to address the evaluation objective (e.g. overwintering ponds should be assessed periodically throughout the winter).

Suspended sediment and turbidity sampling may be considered as an additional requirement for REE. This will only be a consideration as an add-on for those projects that have had an objective of reducing sediment transport to streams.

Inorganic nutrients shall be measured at time frames and to requirements as specified by WRP specialists and discussed in Ashley and Slaney (1997). Methods for data collection and analysis will follow standard methods (e.g. Wetzel and Likens, 2000). This level of data collection is only required for projects with an in-stream fertilisation perspective.

References

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Appendix A-1. REE Feedback Form

This document is intended as a working draft. Changes/edits and release of this document in its final form is scheduled for spring 2001. The Watershed Restoration Program Provincial Co-ordination Team would appreciate any feedback on information presented in these guidelines, including content and format of the document, subjects that may require further clarification and additional topics that should be considered for inclusion.

Comments can be sent to Andrew.Wilson@gems4.gov.bc.ca.

All feedback will be forwarded to the WRP Provincial Co-ordination Team for their consideration. Please reference the appropriate page number when providing comments, as well as your name, phone/fax number and email address if applicable.

Appendix A-2. Field Form for In-Stream REE

Form 1. Restoration Works Summary

MYA /AA Holder No.__________ Watershed ______________ Survey Crew_____________ REE Interval___________________

FRBC Activity No.____________ Sub-watershed___________ Weather / Flow___________ Watershed Classification_________

Project Name _______________ Date ____________________ Forest District ____________ In-stream Works Complete Y/N

					Performance Objectives															Overall						Comments
					Physical							Biological														
Stream	Distance	Site ID #	Structure Type	Site Objective	Pool	Riffle	Gravel Bar	Streambank	Stream Cover	Nutrient	Overall rating	Species	Life Stage	Overwinter	Rearing	Holding	Spawning	Incubation	Overall rating	Structural Condition	Structural Stability	High Flow Function	Low Flow Function	Maintenance Recommendation	Photo Numbers	

Appendix A-3. Example Entry for In-Stream REE Field Form

Form 1. Restoration Works Summary

MYA /AA Holder No._____ Watershed _____ Survey Crew_____ REE Interval_____

FRBC Activity No._____ Sub-watershed_____ Weather / Flow_____ Watershed Classification_____

Project Name _____ Date _____ Forest District _____ In-stream Works Complete Y/N

					Performance Objectives														Overall						Comments
					Physical							Biological													
Stream	Distance	Site ID #	Structure Type	Site Objective	Pool	Riffle	Gravel Bar	Streambank	Stream Cover	Nutrient	Overall rating	Species	Life Stage	Overwinter	Rearing	Holding	Spawning	Incubation	Overall rating	Structural Condition	Structural Stability	High Flow Function	Low Flow Function	Maintenance Recommendation	Photo Numbers	
Zappa	0+350	LWD-8	LWD-M	scour pool	(4)			3			4	BT	JV	(4)	(2)		3		3	4	3	4	1.5	4		excellent pool habitat in winter, but insufficient residual depth in summer flows.

Note: Values enclosed in circles represent original Performance Objectives. Unanticipated performance objectives are marked without circling.

Appendix A-4. Figures for Summarising REE Performance Data

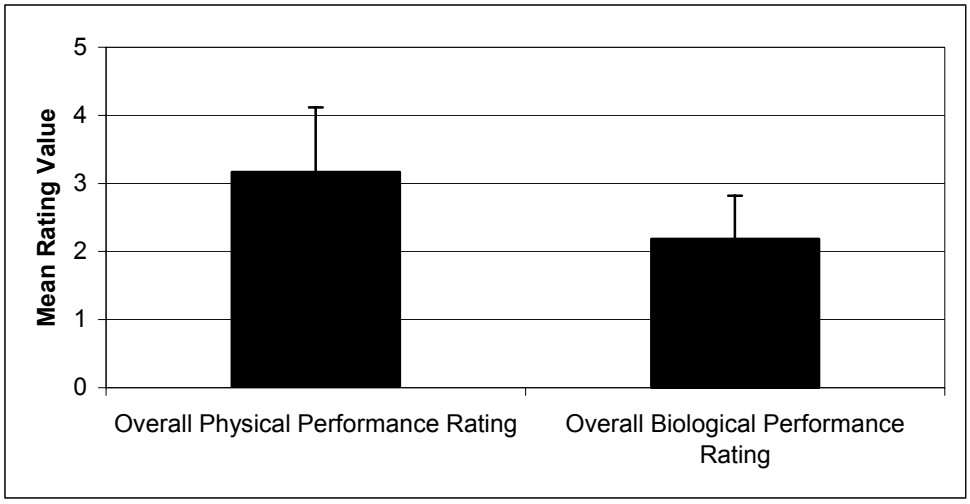

Figure 1. Summary of performance ratings across all structure types in Unnamed Watershed (± one standard deviation).

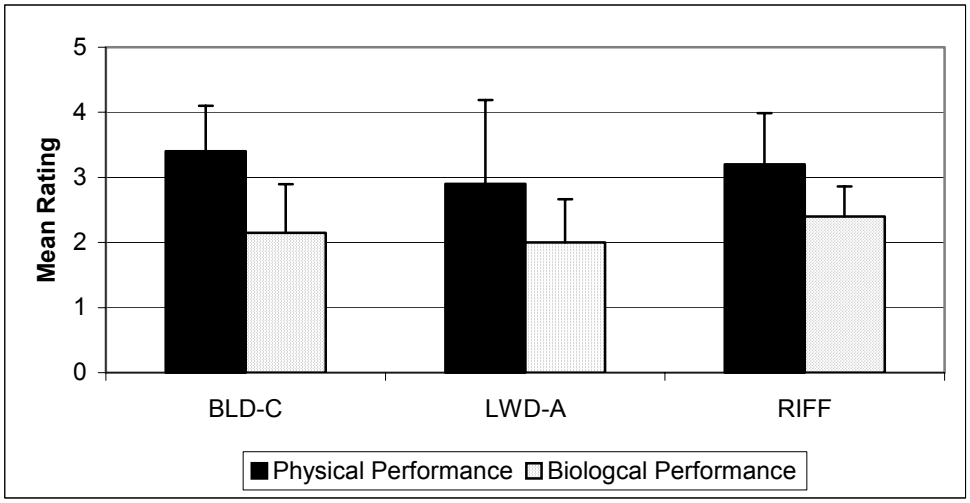

Figure 2. Summary of performance ratings for structure types in Unnamed Watershed (± one standard deviation).

Table 1. Summary of remedial work recommendations for the Unnamed Watershed.

Priority	Watershed	Distance and UTM (Zone, Northing,	Site Id	Maintenance Score	Problem / Fix	Estimated Cost of Work	Person Days Required	Materials and Equipment Required	Prescription Required
1	Unnamed Creek Reach 1	0+240	LWD-7	1	Structure failure due to NSF ballast. Add ballast	$2,500	4	Spyder, 5-1000kg boulders, epoxy and cable	No
2	Unnamed Creek Reach 1	0+80	LWD-1	1	Bank erosion due to structure. Install bank protection structure	$3,500	5	Spyder, 10-1000kb boulders, 5 LWD, cable, epoxy	Yes
3	Unnamed Creek Reach 2	1+120	LWD-9	2	Re-epoxy broken cable, add SWD	$500	1	30 m cable, 10 tubes epoxy	No
4	Unnamed Trib 1	0+300	RIFF-4	3	Re-seed streambank to stabilise exposed soil	$250	0.25	10 kg bag Coastal reclamation mix grass seed	No
5	Unnamed Trib 2	0+90	RIFF-1	3	Re-seed stream bank to stabilise exposed soil	$250	0.25	10 kg bag Coastal reclamation mix grass seed	No

Appendix A-5. Fish species definitions to be used in REE

CODE	COMMON NAMES	LATIN NAMES
Salmonids (Salmon, Trout, Char)		
SA	Salmon (General)	*Oncorhynchus* spp., *Salmo salar*
AO	All Salmon	*Oncorhynchus* spp., *Salmo salar*
AS	Atlantic Salmon	*Salmo salar*
GB	Brown Trout	*Salmo trutta*
AGB	Anadromous Brown Trout	*Salmo trutta*
CM	Chum Salmon, Dog Salmon	*Oncorhynchus keta*
CH	Chinook Salmon, Spring Salmon, King Salmon, Tyee	*O. tshawytscha*
PK	Pink Salmon, Humpback Salmon	*O. gorbuscha*
CO	Coho Salmon	*O. kisutch*
SK	Sockeye Salmon	*O. nerka*
KO	Kokanee	*O. nerka*
CT	Cutthroat Trout (General)	*O. clarki*
ACT	Anadromous Cutthroat Trout	*O. clarki*
CCT	Coastal Cutthroat Trout	*O. clarki clarki*
WCT	Westslope Cutthroat Trout, Yellowstone Cutthroat Trout	*O. clarki lewisi*
RB	Rainbow Trout, Kamloops Trout	*O. mykiss*
ST	Steelhead	*O. mykiss*
AC	Arctic Char	*Salvelinus alpinus*
BT	Bull Trout	*S. confluentus*
DV	Dolly Varden, Dolly Varden Char	*S. malma*
ADV	Anadromous Dolly Varden, Anadromous Dolly Varden Char	*S. malma*
EB	Brook Trout, Eastern Brook Trout	*S. fontinalis*
AEB	Anadromous Eastern Brook Trout	*S. fontinalis*
SPK	Splake	*Salvelinus fontinalis* x *namaycush*
LT	Lake Trout, Lake Char	*S. namaycush*
Sturgeon		
SG	Sturgeons (General)	*Acipenser* spp.
GSG	Green Sturgeon	*A. medirostris*
WSG	White Sturgeon	*A. transmontanus*
Cod		
BB	Burbot, Freshwater Ling Cod, Ling, Loche, Lawyer	*Lota lota*
Whitefish		
WG	Whitefish (General)	*Prosopium* spp., *Coregonus* spp., *Stenodus* sp.
PW	Pygmy Whitefish, Coulter's Whitefish	*Prosopium coulteri*
GPW	Giant Pygmy Whitefish	*P*. sp., poss. subspecies of *Prosopium coulteri*
MW	Mountain Whitefish, Rocky Mountain Whitefish	*P. williamsoni*
RW	Round Whitefish	*P. cylindraceum*
LW	Lake Whitefish, Common Whitefish, Humpback Whitefish	*Coregonus clupeaformis*
HW	Humpbacked Whitefish	*C. pidschian*
BW	Broad Whitefish, Round-nosed Whitefish, Sheep-nose Whitefish	*C. nasus*
SQ	Squanga	*C*. sp.
CS	Least Cisco	*C. sardinella*
CA	Arctic Cisco	*C. autumnalis*
CL	Lake Cisco	*C. artedii*
IN	Inconnu, Sheefish, "Conny"	*Stenodus leucichthys*
Grayling		
GR	Arctic Grayling	*Thymallus arcticus*

Appendix A-6. Model REE Deliverable