

WSP Habitat Indicators, Metrics, Benchmarks and Sampling Protocols

Habitat type	Indicator type	Indicator	Measured	Metric	Benchmark(s)	Complimentary Projects	Sampling Rate	Sampling Methodology
			Reported as available Web-link					
Stream	Pressure	Watershed: Total land cover alterations	Measured	Roll-up data ¹ e.g. Watershed Statistics and report out on Total, and sub-indicators e.g. forestry, fires, urban, agriculture, other (possibly range)	Relative ranking of watersheds (e.g. low, med, high) of total from distribution curve	To enable weighting of different land-use types, do probability analysis of different types of land use impacts.	Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years as required.	As per metric.
Stream	Pressure	Watershed: Road density	Measured	Kilometer/km ²	<0.4 km/km ² lower risk, > 0.4km/km ² higher risk	Develop correlation between road density, road network (via spatial analysis), stream network (S1, S2, etc.), fish distribution and crossing type e.g. culvert, bridge, etc.	Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years as required	Roll-up satellite imagery data (e.g. Watershed Statistics) that is augmented by provincial reporting systems until such time as reporting systems consistently utilized and up to-date.
Stream	Pressure	Water extraction	Measured	Volume licensed for consumptive use e.g. m ³ /yr, as a proportion of total yield summarized by watershed	Compare watershed ratios and rank based on proportion		Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years as required	Tracking NCC concurrent development of similar indicator.
Stream	Pressure	Riparian disturbance	Measured	% aerial basis of development within 30 meters of the shoreline, reported on a watershed basis	5% as first benchmark, subsequent categories determined via distribution curve of watersheds within the CU		Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years as required	Satellite imagery data e.g (Watershed Statistics) or Streamkeepers methodology.
Stream	Pressure	Permitted Discharges	TBD	TBD When data available will evaluate for potential metric and benchmark	TBD	TBD	TBD	TBD
Stream	Pressure	Sediment	Measured	Total Suspended Sediments (mg/l, ppm)	<ul style="list-style-type: none"> • CCEM • 25 mg/L in 24 hours when background is less than or equal to 25 • mean of 5 mg/l in 30 days 	Develop correlation curve of Turbidity Units to TSS	Use Environment Canada sampling to report out on trends (@ 60 sites across Region).	Initially physical sampling until correlation curves developed and then turbidity sensors.

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						when background is less than or equal to 25 • 25 mg/ when background is between 25 and 250 • 10% when background is greater than 250		New monitoring on 1 or 2 key streams in a CU. Monitor continuously and on stochastic events relating these to life history stages.	
Stream	Status	Water Quality		N/A	N/A				
			Web-link						
Stream	Status	Temperature, Coho juvenile rearing	Measured	Maximum Weekly Average Water Temperature	Upper Optimum Temperature Range (UOTR) and Impairment Temperature (IT). Temperatures between UOTR and IT low/medium risk and temperatures above IT high risk. UOTR 15 degrees C IT 20 degrees C	Augment Temperature Sensitive streams database, Yukon water Temperature Data, WATEMP database where needed with Mean Weekly Average temperature.	New monitoring on 1 or 2 key streams in a CU. Monitor continuously and on stochastic events relating these to life history stages. Locate in a spawning and incubation site e.g. ch, pk and if rearing is in a different area, then also install there e.g. coho.	Data loggers and install these with turbidity sensors.	
Stream	Status	Temperature, Migration Spawning all species	Measured	Maximum Daily Water Temperature during migration/spawning period	Upper Optimum Temperature Range (UOTR) and Impairment Temperature (IT). Temperatures between UOTR and IT low/medium risk and temperatures above IT high risk. Chinook UOTR 14 degrees C IT 20 degrees C Coho UOTR 14 degrees C IT 20 degrees C Sockeye UOTR 15 degrees C IT 18 degrees C Pink UOTR 15 degrees C IT 21 degrees C Chum UOTR 15 degrees C IT		New monitoring on 1 or 2 key streams in a CU. Monitor continuously and on stochastic events relating these to life history stages. Locate in a spawning and incubation site e.g. ch, pk and if rearing is in a different area, then also install there e.g. coho.	Data loggers and install these with turbidity sensors. Also Streamkeepers protocol.	

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Stream	Status	Stream discharge	Measured		m3 during Aug/Sept	21 degrees C Discharge (m ³) less than 20% Natural Mean Annual Discharge during July /Sept.	Review water data i.e. Coulsen and Obedkoff (1998), Rood and Hamilton (1995), MOE "Sensitive Stream Listing" spreadsheet (1997) and MOE "Fish/Water Database (2001); Imap BC and Ron Ptolemy, BC Ministry of Environment (pers. comm. Jan. 2008 based on above and archived WSC hydrometric station data) and where gaps for data exist, examine augmenting and updating with current information.	Every 5 years.	As per project.
Stream	Status	Benthic Invertebrates	Reported as available		CABIN	Reference Condition Approach		Report out on CABIN results.	
Stream	Quantity	Accessible stream length, barriers	Measured		Kilometers	N/A	Predicted/Potential fish distribution of juveniles and adults-Investigate if Yukon Habitat Suitability or Provincial FSW models could work for WSP.	Need to update obstructions database so that it is species and lifestage specific and ID's when barriers fixed plus have different groups contribute their data to it. This will enable annual reporting similar to that in WA State State of the Salmon model.	
Stream	Quantity	Key Spawning Areas (length)	Measured		Total length of spawning area per watershed and roll-up for the CU		Need to ID the extent of the habitat and track changes over time. Need to augment data where it doesn't exist. May need to ID sentinel streams for a CU.	Report out annually.	FISS paper audit and field GPS for updates and missing Key Spawning Areas.
Lake	Pressure	Watershed: Total land cover alterations	Measured		Roll-up data ² e.g. Watershed Statistics and report out on Total, and sub-indicators e.g. forestry, fires, urban, agriculture, other (possibly	Relative ranking of watersheds (e.g. low, med, high) of total from distribution curve	To enable weighting of different land-use types, do probability analysis of different types of land use impacts.	Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating	As per metric.

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Lake	Pressure	Watershed: Road Density	Measured	range)	Km/km ²	<0.4 km/km ² lower risk, > 0.4km/km ² higher risk	Develop correlation between road density, road network (via spatial analysis), stream network (S1, S2, etc.), fish distribution and crossing type e.g. culvert, bridge, etc.	every 2 years as required.	Roll-up satellite imagery data (e.g. Watershed Statistics) that is augmented by provincial reporting systems until such time as reporting systems consistently utilized and up to-date.
Lake	Pressure	Riparian Disturbance	Measured	% aerial basis of development within 30 meters of the shoreline, reported on a watershed basis	% aerial basis of development within 30 meters of the shoreline, reported on a watershed basis	5% as first benchmark, subsequent categories determined via distribution curve of watersheds within the CU		Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years as required	Satellite imagery data e.g (Watershed Statistics) or Streamkeepers methodology.
Lake ³	Pressure	Discharge Permits	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Lake	Quantity for sockeye lakes	Lake Productive Capacity	Measured	Nitrogen and Phosphorous x Lake Surface Area. See Project.	Nitrogen and Phosphorous x Lake Surface Area. See Project.	Relative ranking of sockeye lakes (e.g. low, med, high) of total from distribution curve	Nutrients (N&P) and photosynthetic rate (chlorophyll) correlated for most sockeye lakes (cold glacial lakes excepted). Track DFO's Sockeye Lakes Group's investigations into this correlation to enable direct estimate of productive capacity from N&P and replace N&P with chlorophyll if chlorophyll better correlation with smolt production.	All sockeye lakes within the Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years as required.	As per DFO's sockeye Lakes Group methodology.
Lake	Quantity for sockeye lakes	Coldwater refuge zone	Measured	Meters deep as measured through Dissolved Oxygen and Temperature profiles	Meters deep as measured through Dissolved Oxygen and Temperature profiles	Develop distribution curve of depth of all sockeye lakes coldwater refuge zones and rank e.g. low, med, high risk.	Recommend Sockeye Lakes group also measure DO profiles when undertaking lake assessments to enable refuge width to be calculated.	Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years as required	As per DFO's Sockeye Lakes Group methodology plus include DO profile.
Lake	Quantity	Shore spawning area (length)	Measured	Total length of spawning area per watershed and roll-up for the CU	Total length of spawning area per watershed and roll-up for the CU	N/A	There are currently lat/long's for @ 70 sites where sockeye spawning distribution noted. However, need to ID the extent of the habitat and	Report out annually.	TBD if FISS and/or NuSEDS to be repository(ies) for this information.

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						track changes over time. Need to augment data where it doesn't exist. May need to ID sentinel streams for a CU.		
Estuary	Pressure	Marine vessel traffic	Measured	#vessels or density	Develop rate of change for those estuaries where most relevant of the 5 Coast Guard monitoring sites i.e. Tofino, Vancouver, Prince Rupert, Victoria, Comox		Entire Region initially and on a five year return rate. Utilize results and Regional expertise to select areas for updating every 2 years if necessary.	Analysis of Coast Guard reporting information/MoE State of the Environment reporting.
Estuary	Pressure	Disturbance of riparian, intertidal (e.g. Carex and Typha) and sub-tidal (e.g. eel-grass) habitats	Measured	Rate of increase of crown tenures (licences and leases) within all estuaries/ five years	N/A, rate of increase will guide recommendations for possible status monitoring	Model for coarse particulate matter in estuaries-use estuarine gradient from CHS data and lease information for log-storage. May be able to use deposition model from Scotland for log-storage.	Report out on Pacific Estuaries and Ducks Unlimited schedule every five years.	Report out on Pacific Estuaries and Ducks Unlimited reports.
Estuary	Pressure	Discharge Permits		TBD When data available will evaluate for potential metric and benchmark	TBD		TBD	TBD
Estuary	Status	Chemistry e.g. N, P, N:P and Contaminants e.g. Metals, PAHs and PCBs	Reported as data becomes available Web-link	Reporting out only e.g. links in web-mapping application and in Habitat Status Reports where generated	N/A			
Estuary	Status	Dissolved Oxygen	Measured	Percent saturation and stratification	See Project	In a sub-set of estuaries determine DO saturation and stratification.	Study TOR could state undertake on a 5 year basis.	
Estuary	Quantity	Estuarine habitat area (riparian, sedge, eelgrass and mudflat)		Hectares	N/A		Currently no largescale monitoring on quantity of mudflat, marsh and eelgrass habitats at sufficient resolution. Through Provincial CRIS program, riparian is monitored in sufficient resolution in developed areas. Province plans to do every five years. One estuary FREMP does have status monitoring of marsh and mudflat. May be undertaken by groups	Field, aerial photography

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							on individual estuary basis.	

Further Projects

1. Predictive model for stream and estuarine off-channel habitat.
2. Develop sampling program for presence/absence of key indicator species of invertebrates in the estuary as an alternative to RCA or IBI
3. Create a model to ID land conversion on deltas in lakes utilizing Watershed Statistics data.
4. Recommend Sockeye Lakes study group also capture shoreline temperatures.
5. Increase Fisheries Project Registry information to allow for calculations of habitat gains i.e. include quantity, geo-referenced location, and the same standards are used to quantify that habitat
6. Capture gains/losses in stream, lake and estuarine project reviews, mitigation efforts, authorized and unauthorized works.