King County Normative Flow Studies Project
Science Review Team Work Session #3
Thursday, March 6 and Friday, March 7
Mountaineers Club, Seattle

Meeting Summary

Hydrologic Indicator Presentation Summary

The first presentation covered proposed indicators of Human Action and Hydrologic Alteration and introduced three case study sites, Upper Green River, Little Bear Creek and Taylor Creek near Maple Valley. Much time was spent discussing the individual components of the proposed IHA/RTV analysis. The Upper Green River analysis included some initial hypotheses as to possible biologically affects resulting from the hydrologic alteration created by dam operations and water withdrawals.

Biological Indicator Presentation Summary

The second presentation summarized the geomorphic/biological indicators, supporting rationale, and metrics that were submitted to SRT prior to the meeting. It also presented preliminary data explorations linking degree of hydrologic alteration (as expressed in the number of IHA variables showing a significant change over time as urbanization increased) with BIBI metrics for a number of small streams.

Discussion

To help focus the SRT's discussion the County provided the following charge-

KC is interested in a scientific basis for sharper management tools than they currently are using. Currently understanding allows only working with watershed information applied at parcel level. Watershed level management issues include land use decisions/ regulations that affect total TIA or maximum forested area; site-specific issues include directing specific capital improvement or capital projects.

SRT Discussion Summary

- If flow is the focus of management and the project, it should include other factors besides flow in the analyses; they will be needed to distinguish the effect(s) of flow (i.e., as co-variants). Consider using ranked or categorical variables for some of these to simplify analysis.

- One way to do this may be to focus on different types of indicators – i.e., one type of indicator reflects functional responses to flow that may be relatively independent of other factors. What types of functional responses would you expect to be independent of, for example, changes in water quality?

- There was some interest in looking at overall hydrologic alteration (e.g., Kelly's Index of Hydrologic Alteration; some ranking of degree of hydrologic alteration based on number and/or magnitude of hydrologic changes). Such an index may include hydro variables that we do not find have relationships with biology (i.e., look at hydro variables that characterize the flow regime, as well as variables that are thought to be functionally linked to biological response).

- We should consider computing all hydro indices separately for seasons that affect life-history stages or periods of population bottlenecks (e.g., incubation, overwinter survival?). Most "all year" statistics will be hard to relate to biology. Need to consider the length of hydrograph used to compute differences and find relationships.

- Should we use biological variables (e.g., BIBI data) to cluster streams into groups based on biological similarity, and then use hydrological/human use variables to discriminate among these groups (i.e. RIVPACS).

- Discussions of linking hydrologic, biological, and human use/geomorphic data emphasized the importance of understanding variability within and among watersheds/sub-basins and relative importance of hydrology. For example, for two sub-basins that differ in hydrologic alteration, choose sites within each basin that reflect range of variation in biological and habitat/human use conditions; use within and between basin comparisons to evaluate what portion of variation is due to hydrology.

Does Flow Affect Different Species Populations In A Watershed And How?

The SRT grappled with what would be needed to address that issue with several questions:

- What has been done to describe the hydrologic processes at the places where you have monitoring?
- How many sites are there were you have biological data?
- Is there a model that can say what that change means?
- Can you account for the hydrologic signal at several different levels?
- You need some geomorphic connection to show the causal linkage
- What are the attributes important for that species

Where Do We Find The Flow/Biology Connections?

The Objective for the SRT:

- evaluate what the management issues are
- what should be measured and what are the fine scale measurements that can be done

The SRT Identified the kinds of areas where data to measure indicators should exist:

- Land condition information in two scales (upland and site) need to focus more on measuring the in-channel physical characteristics
- Riparian conditions
- Hydrologic data and models
- Biological Conditions

Suggested Hydrologic Indicators For Small Streams

Timing

- C/V for flow
  CV of daily flows; CV of daily flows during a particular season (i.e., summer low flows)

- Seasonal TQ mean
  TQ mean for late summer

- Look at the number of days likely to provide good spawning conditions—correlate flow loss to spawning area

- Timing of summer and flows that are not necessary minimum but low and its affect on spawning access
  Sequence of flow events surrounding salmon life-stages/population bottlenecks
  Timing of low flows in summer in relation to temperature

- Monthly time-step is tough to make a bio link—seasonal time-step might be more useful if you tie it to a biological relevant—emergence, spawning Onset of spring flows – timing and duration – maybe also rate of change
  Change or rate of change over extended period to make sure aren't identifying false peak or initiation
  Timing and duration of first flow increase in fall

- Times series of hydrologic metrics
  Timing of low flows in summer in relation to temperature

Duration

- Frequency-duration under a certain threshold metric—assigning the threshold to a tolerant taxa
  Frequency and duration of low flows below some threshold (i.e., critical threshold for that stream)

- Duration of summer and flows that are not necessary minimum but low and its affect on spawning access
  Comparisons of 1, 7, 20 day low flows

- Pulses—they are related to the TQ mean
  Number high pulses; especially high pulses during normally low-flow or stable flow periods

- Length of quiescence and volume of flow—removing the peaks/pulses eliminate the out of the average peaks and pulses
  Peaks during low flows (during quiescent flows of out migration and rearing times)
  Duration and volume of quiescent flows between peaks during periods important for salmon growth (late winter/spring?)

Flow Volume

- Calculating stream power- would integrate many elements
  Stream power; stream power during salmon egg incubation

- Measure of base flow stability

- Discharge Ratio—channel hydraulic

Which Streams Have The Most Promise

In addition to availability of hydrologic modeling data, small streams to include in more detailed analyses should have BIBI data. We should look for streams which we have modeling data, that can span the rate of development. The County needs to use existing methodology—within the established near term project timeline they don't have the time to create something new. To return to the Index of Indicators idea, biological classes based on BIBI could be created and use indicators to discriminate different streams based on some predictors. There are multiple ways to use data to tease out different kinds of information

Priority Watersheds with models

First tier streams have good BIBI data and there are recent hydrologic models.
Second tier steams have less data generally, even if they have a hydrologic model

First Tier	Second Tier
North	Thornton
Swamp	Chico
Little Bear	Quilceda
Big Bear	Taylor
May	Soos/Jenkins
Kelsey	
Rock	

Suggested Biological/Geomorphic Indicators for Streams

Heterogeneity of channel bed topography

- channel width and depth, substrate, velocity—spatial variability
- Local land cover
- Road Density index

Bed/Bank stability

- Channel confinement
- Are there bed disturbances resulting from other than flow
- propensity for bed loading/disturbance—bed stability
- Sediment channel geometry--sediment mobility

Habitat variability

- Canopy closure
- Woody debris—visual count of what's in the reach-push for both small and large
- Low Temperature as indicator of groundwater

Big River Comparison

The fish data should be coho presence. But additional coho sampling needs to be done to make the data more consistent at specific sites and from site to site. Should historical data be abandoned so that you have consistent data, using a carefully constructed /designed sampling?

- Density across same kind of habitat
- Pool samples

One approach is to take rivers that we do know something about and make a comparison. We can we look at the Waterways 2000 rivers and compare them to another set of rivers so we can compare management manipulations. That report identified the best reaches for protection. There was no data collected—but the list was based on some existence of data in the county.

Waterways 2000 indicators

- Number of fish taxa
- Specific populations of anadromous concentrations
- Riparian vegetation—classifications—what you needed to make an assessment
- Diversity and abundance of stream invertebrates

Big Rivers Discussion Summary

- Large streams do not have replicates (as small streams do) so we may have to use within-stream variability, and (adaptive management) experiments to test relationships in large streams.

- Most large rivers in KC have dams, while most small streams do not (they are more affected by urbanization). Pre and post hydrology comparisons are relatively easy for large streams; pre and post hydrology must be defined for small streams (e.g., some threshold of percent TIA, forest cover, road density, population density).

- Off-channel metrics will provide most ecological meaning in large streams (in absence of biological data). Especially measures that describe creation, rejuvenation, maintenance and connection of off-channel habitats (e.g. off-channel forming, flushing, and interconnecting flows).

- In off-channel areas, fish use can provide short-term measures (i.e., respond rapidly to re-connection of habitat); habitat diversity provides longer-term measures of response (if flow manipulations/changes are maintained).

- Adaptive management in large rivers (e.g., Green) - No point in managing flows in (larger number of) "straight jacketed" reaches – target adaptive management/experiments towards managing flows to maximize function in (smaller number of) still biologically ok areas (i.e., where channel has not been leveed).

Suggested Big River Indicators

- Off channel habitat renewal - main channel switching or off channels scouring
- A variety of habitat maturities which benefit different species
- Flow manipulations that are timing, not volume-- Timing of the onset of peak flow—rate of change
- Maintenance of wetland and terrestrial habitat-

- Main stem nearness to off channel
- Timing/duration of first flow increase--freshwater receipt near shore could affect queuing stimulants

Some Questions Were Still Being Weighed By The SRT:

- What additional hydraulic data do you need?
- What are the right metrics to characterize the things that are biologically important?
    - What is the triggering event for reconstruction/forming off channel? (Big flows, anytime, in the ten to 100 year range, of some duration--there is an interplay of duration and magnitude)
    - What effect might Seasonality of flow have? Fish are tuned to expect the flow—spring
    - Inter peak flows are as important for main stem fish—spring when growing

- 1, 7, and 21 day summertime low flow measure would be useful as an index
- How does flow affect temperature--average date and maximum temp?
- Is there a biological stress if the low flow ends earlier?---duration

- How do you pick the onset of on-set of autumn? End of low flow—sliding window of 7 day flows—greater than the minimum for a period of time, signals the on set

Suggested Next Steps before Next SRT Meeting

- Connect the hydrologic and biologic data and analysis at the proper locations for small streams
- Define a discreet list of metrics characterizing hydro data-Waterways 2000 may be a good start
- Generate time series metric connecting
  floodplain- side channels
  Timing of low flows time/magnitude
- Identify historical inundation regimes and metrics for them
- Assemble all BIBI data in one place and perform a heterogeneity check
- Develop the list of indicators
- Complete some of the indicators site testing
- Consider a side channel degree of alteration or index of hydrologic indicators

Next points of input for the SRT

- After the list of indicators is created and has had some testing
- Some interpretation of the results
- Early June (6/7/03) is likely date for the next full SRT work session
- SRT members offered to be available to review and consult in between full work sessions