Appendix I

Whipple Creek Watershed-Scale Stormwater Plan Report

Use of Hydrologic Metrics as Designated Use Targets

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Background

The concept of using hydrologic metrics to estimate a biologic indicator provides an appealing option to describe whether a watershed will support salmon populations. Considering this, the Permit requires model calibration to reflect current hydrologic and biologic (B-IBI scores) conditions. The Permit further requires the use of a calibrated hydrologic model to calculate B-IBI scores for various future scenarios. However, the hydrologic model is calibrated to hydrologic metrics, not B-IBI scores.

The requirement to use hydrologic metrics to estimate biologic conditions poses a problem for modelers because there are stream and watershed conditions other than hydrologic regime influencing B-IBI scores. The main ones are channel substrate quality, elevated temperature and the presence of toxic pollutants in urban stormwater runoff. Also, subwatershed-scale pool-riffle sites having both flow data and B-IBI scores are extremely rare, making statistical analysis weak.

Simply put, streams with forested hydrology have higher B-IBI scores not only because of the channel hydrology, but also because stressors such as pollutants in urban runoff and lack of stream channel shade are less prevalent than in rural or urban streams.

If the watershed plan objective is to restore watershed hydrologic function to that of a forest as a prerequisite for supporting salmon habitat (B-IBI above high 30s), hydrologic metrics may be an appropriate tool for presenting model results.

Purpose

King County completed an analysis of flow and water quality targets for their WRIA 9 planning project (Horner, March 2013) summarizing available science on target metrics or indicators. The results of Horner's report for King County are summarized and discussed to lead to recommendations for hydrologic metric targets for Whipple Creek. Along with an evaluation of the King County work, there is an analysis of the complete set of Clark County sites for the purpose of finding reasonable hydrologic metrics to measure degree of designated use attainment for salmon habitat.

Indicator Ranges for Use Attainment

Generally, B-IBI scores are broken into five categories describing very poor, poor, fair, good and excellent conditions. For Whipple Creek, the goal is to fully support designated uses, which implies a specific B-IBI score somewhere in the upper 30s or higher (of 50). Generally, a B-IBI score below about 25 to 28 is considered non-supporting.

In 2014, Ecology used B-IBI scores to list streams as not meeting narrative standards. The criteria were greater than 37 for fully supporting beneficial uses and less than 28 for non-supporting. Waters of concern were designated for scores of 28 to 37.

For purposes of a watershed plan with a very long implementation period due to the ultimate goal of restoring watershed conditions to fully support salmon use, indicator ranges can be simplified to:

Not supporting	303(d) listing criteria with hydrologic metrics associated with a B-IBI of approximately < 25 -27
Partly supporting	303(d) water body of concern criteria with hydrologic metrics associated with B-IBI of approximately 26 -37
Fully supporting	303(d) fully supporting criteria with hydrologic metrics associated with B-IBI of approximately > 38

Possible Hydrologic Metrics for Whipple Creek Use Attainment

Three hydrologic metrics emerge as likely candidates for assessing strategy success at restoring the beneficial use of salmon habitat.

- High Pulse Count
- High Pulse Range
- TQmean

Each is briefly discussed.

High Pulse Count

King County recognized high pulse count as one of the more useful metrics for calculating the B-IBI indicator. Horner found that sites having HPCs between 3 and 7 generally supported salmon use (B-IBI greater than 35). The report also found that very low B-IBI scores (< 16) were associated with HPCs above 15. B-IBI scores above 25 were associated with HPCs less than 11.

King County published a regression equation for HPC and BIBI on page 17 in the stormwater retrofit analysis for Juanita Creek report (August 2012).

Clark County data showed increasing B-IBI with lower HPC, making it a viable indicator based on local data and the Puget Sound results.

Non supporting	Partially supporting	Fully Supporting
>11	8-11	<7

High Pulse Range

High pulse range was the second metric used by King County to estimate B-IBI. A high pulse range of 90 to 110 was associated with B-IBI scores greater than 35. B-IBI scores less than 16 were associated with HPRs greater than 200. While B-IBI scores between 25 and 38 were associated with HPRs between 175 and 100.

King County published a regression equation for HPR and B-IBI on page 17 in the stormwater retrofit analysis for Juanita Creek report (August 2012).

Clark County data for HPR showed a very poor correlation between B-IBI and the metric, suggesting it not be used for real world B-IBI estimation. However, it could be useful for presenting model results.

Non supporting	Partially supporting	Fully Supporting
>150	100-150	<100

TQmean

The Puget Sound analysis identified TQmean as a useful metric for calculating the B-IBI indicator. Evaluation of Clark County data for basins similar to Whipple Creek found a strong correlation.

King County published a regression equation for TQmean and B-IBI on page 17 in the stormwater retrofit analysis for Juanita Creek report (August 2012).

Clark County data suggest that a TQmean of about 0.25 to 0.27 is equivalent to the threshold for non-supporting streams and that about 0.37 is the lower threshold for fully supporting.

Non supporting	Partially supporting	Fully Supporting
10-27 percent	28-37 percent	>37 percent

Recommendations

The lack of precision in calculating B-IBI scores from hydrologic metrics suggests the approach is flawed and can introduce error. However, the Permit does require the use of B-IBI to demonstrate designated use attainment. The model output should be converted to B-IBI scores for TQmean, HPC and perhaps HPR. This is required to satisfy the Permit need for the biological indicator and to present hydrologic metrics in a common language for biological integrity. Use King County's Juanita Creek work (August 2012) for to calculate HPC and HPR.

The Whipple Creek report should also show model output as the actual hydrologic metrics because the analytical tool is a hydrologic model and the targeted stressor is excess flows. Horner (2013) provides a good basis for directly using hydrologic metrics and use attainment indicators.

The significant hydrologic modification of Whipple Creek watershed compared to a forested watershed suggest that the goal of fully supported salmon habitat is unattainable within any realistic time frame. The lack of precision in modeling introduces additional difficulties in accurately predicting use attainment. Because of this discrepancy between the reality of Whipple Creek watershed conditions and the NPDES Permit plan objectives, the model results should be described as fully supporting, partly supporting and not supporting.

Furthermore, the variability in hydrologic model metric and B-IBI regressions suggest presenting a gradational change between salmon habitat support categories; not supporting shades into partially supporting and partly supporting shades into fully supporting as a means to present relative strategy effectiveness in the context of making the best use of limited restoration resources.

Non supporting Partially Supporting Fully Supporting

References

Horner, Richard R, March 2013, Development of a Stormwater Retrofit Plan for WRIA 9: Flow and Water Quality Indicators and Targets; King County Department of Water Resources and Parks, Seattle Washington. http://your.kingcounty.gov/dnrp/library/water-and-land/watersheds/green-duwamish/stormwater-retrofit-project/final-report-indicators-targets-0413.pdf

King County, August 2012, Stormwater Retrofit Analysis and Recommendations for Juanita Creek Basin in the Lake Washington Watershed, Department of Natural Resources and Parks, Water and Land Resources Division, Seattle, WA. http://your.kingcounty.gov/dnrp/library/water-and-land/stormwater/juanita-retrofit/main-document.pdf

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