Memorandum

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TO: Thurston County Science to Local Policy Project Staff

FROM: David Hartley and Derek Stuart

SUBJECT: Basin Selection for Hydrologic Modeling

Introduction

Thurston County (the County) received funding from the U.S. Environmental Protection Agency (USEPA) to undertake a "Science to Local Policy" grant. The grant will allow Watershed Based Land Use Planning in portions of Thurston County that drain to Puget Sound. The boundaries of the study area are defined by portions of the County lying within two continuous water resource inventory areas (WRIAs 13 and 14) defined by the Washington Administrative Code. (WAC) 173-500-040. For planning purpose, the County has divided these study areas into subwatersheds that contribute runoff to four distinct inlets to Puget Sound, Totten, Eld, Budd, Henderson, and the Nisqually Reach. These subwatersheds in turn are comprised of a total of 69 headwater and 3 non-headwater stream basins or drainage areas. Modeling of a subset of these basins will apply existing hydro-meteorological and water quality data sets for calibration and potentially validation (assuming sufficient data are available) of a watershed model capable of generating continuous stream flow and pollutant loads. The basin models will be applied to compare the existing hydroecological status of the modeled basins in reference to pre-European land-use conditions, and to estimate this status under alternative future buildout conditions. Results of these simulations will support basin management decisions related to land use and stormwater regulations, capital projects, and other actions that are aimed at restoration, protection, and enhancement of aquatic resources and beneficial uses.

Due to limited project resources only a handful (3 or 4) of these basins can be modeled, therefore a rationale was needed to select these basins. This memorandum documents the basin selection criteria, their application, and the resultant recommendation of basins for modeling.

Selection Criteria

Over several meetings and phone calls spanning a period of months, NHC, County, and TRPC staff developed and prioritized a set of criteria as follows:

1. Adequacy of precipitation, flow, and water quality data
2. Stakeholder Interest and Jurisdictional Cooperation
3. Existing ecological status of basin and aquatic resources
4. Future changes in basin land use and management
5. Purpose/Effectiveness of Basin modeling to support protection, restoration, and enhancement measures
6. Representativeness of selected basin group

Criterion 1. Data availability

Data Availability was evaluated through a detailed inventory of available data conducted by NHC (2013) for the entire project area. From this inventory, it was determined that water quality data had been collected for a period exceeding two years in seventeen out of the 69 mapped basins within the study area. These seventeen basins were further categorized into five groups based on the availability of local contemporaneous precipitation and stream flow data accompanying the water quality data. A minimum of two years of contemporaneous water quality, precipitation, and stream flow data are highly desirable for purposes of calibration and validation of a watershed model, and the absence or insufficiency in contemporaneous data sets at a stream location diminishes the prospects for credible hydrologic and pollutant runoff modeling. Seven out of the seventeen basins had no qualifying stream flow data and were therefore eliminated from further consideration. The remaining ten basins were then ranked into three tiers of data richness and suitability to support basin modeling. These tiers are shown in Table 1 in descending order of data availability. The top set of six all have at least two years of contemporaneous precipitation, stream flow, and water quality data. The second tier have slightly less than two years, and the third tier represents a special case because the two Deschutes "basins" are not headwater basins of the Deschutes River, but are contributing sub-areas, and as such, present additional challenges to basin modeling.

Table 1. Thurston County Basins with Significant Flow and Water Quality Data Records

Basin	Watershed	Drainage Area (ac)	Note
Green Cove Creek	Eld	2220	Very Close RG, > 2 yrs of Flow Data
Percival Creek	Budd-Deschutes	5660	Moderately Close RG, > 2 yrs of Flow Data
Woodard Creek	Henderson	5310	Moderately Close RG, > 2 yrs of Flow Data
Black Lake	Budd-Deschutes	4390	Rain Gage over 2 mi distant, > 2 yrs of Flow Data
McLane Creek	Eld	7090	Rain Gage over 2 mi distant, > 2 yrs of Flow Data
Chambers Creek	Budd-Deschutes	8480	Rain Gage over 2 mi distant, > 2 yrs of Flow Data
Woodland Creek	Henderson	16280	Moderately Close RG, < 2 full yrs of Flow Data
Ellis Creek	Budd-Deschutes	940	Moderately Close RG, < 2 yrs of Flow Data,
Deschutes River (Mainstem Lower)*	Budd-Deschutes	11210	Rain Gage over 2 mi distant, < 2 yrs of Flow Data, USGS E St gage and quality sites provide approximate lower boundary, upper boundary data lacking.
Deschutes River (Mainstem Middle)*	Budd-Deschutes	23180	Moderately Close RG, < 2 yrs of Flow Data, Vail Rd sites provide upper boundary for flow and quality, data for lower boundary of basin lacking.

Criterion 2. Stakeholder Interest and Jurisdictional Cooperation

(note: material for Criterion 2 was contributed by Allison Osterberg, Associate Planner, Thurston County)

Stakeholder input was identified as an important supplemental factor in the basin selection process. By engaging key players early in the process, the results and recommendations of the project can be better targeted to their demonstrated needs and available resources, and thus are more likely to be successfully implemented.

Project staff from Thurston County and Thurston Regional Planning Council (TRPC) conducted a series of meetings and outreach to jurisdictions, Tribal managers, and other parties with interest in the basins under consideration. The object of this effort was to identify basin preferences, understand which jurisdictions might have the resources to assist in working on land-use changes within a basin in their area, learn about any ongoing or expected projects that might be complementary to this project, and gather information that could be used in developing future scenarios for modeling. Comments were collected from the following groups between March 5 and March 20, 2013:

- City of Olympia, planning and public works (Oly)
- City of Tumwater, planning and public works (Tum)
- City of Lacey, planning and public works (Lacey)
- Water Resource Inventory Area 13 & 14 Salmon Habitat Restoration Workgroup (WRIA 13/14)
- Stormwater Technical Advisory Committee (StormTAC)
- Squaxin Island Tribe natural resources staff

These discussions revealed considerable support for the project overall, and for several basins in particular. Out of the ten basins with sufficient data for modeling, six were identified as having strong stakeholder support from one or more groups:

- McLane Creek
- Woodard Creek
- Deschutes River (Middle and Lower)
- Black Lake
- Woodland Creek

Detailed descriptions of stakeholder input on all basins considered are included in Table 2. Percival Creek basin, which is divided between the cities of Olympia and Tumwater, received conflicting input. It was noted as a basin of secondary interest to staff from Tumwater, after Black Lake, but was not considered a priority basin to the City of Olympia.

Table 2. Stakeholder Input on Potential Basins for Modeling

Basin	Preferred Basin?	Stakeholder comments
McLane Creek	X	• Preferred basin for WRIA 13/14 Salmon Habitat Restoration work group, which has done restoration work in the basin, and has plans to do more. • Wild Fish Conservancy is conducting an extensive stream typing survey in this basin, focusing on Swift Creek. (WRIA 13/14)
Woodard Creek	X	• Preferred basin for City of Olympia. Staff indicate they know the least about this basin out of those in their jurisdiction, but it is an area they want to devote attention to - the future is not "established" in this basin, and there is much room still to build out. (Oly) • Basin is representative of other basins in the region: It has a large wetland complex, residential development, an urban corridor and rural lands. (Oly) • Basin is included in Challenge Grant study of infrastructure along Martin Way - would make a good tie in. (TRPC) • Basin was ranked highly by Ecology as a candidate for stormwater retrofit grant - that potential work would tie in with this project. (StormTAC)

Deschutes River (Lower)	X	• Modeling this basin could help Tumwater determine strategies to improve water quality and temperature. That information is less valued than information for Black Lake, because recent modeling information exists for Deschutes with TMDL. (Tum) • Basin is a priority for WRIA 13/14 Salmon Habitat Restoration work group, which has done restoration work in the basin, and has plans to do more. (WRIA 13/14)
Deschutes River (Middle)	X	• Preferred basin for Squaxin Island Tribe. • Preferred basin for WRIA 13/14 Salmon Habitat Restoration work group, which has supported restoration work in the basin, and has plans to do more.
Black Lake	X	• Preferred basin for City of Tumwater. Basin has considerable residential growth potential. Staff see more value in modeling this basin than others suggested - less known about this basin than Deschutes, particularly about tributaries. (Tum)
Woodland Creek	X	• Preferred basin for City of Lacey. Residential and commercial growth expected in this basin; city has purchased a large area in upper/mid basin and are considering options, including sewer extensions - modeling could help city consider ways to mitigate environmental degradation as basin continues to develop. (Lacey) • Preferred basin for Squaxin Island Tribe, because of salmon resource.
Percival Creek	(X)	• Northern half of basin is highly urbanized - Olympia staff see little value in modeling and working in their part of this basin. (Oly) • Southern half of basin is less developed, with considerable development expected in City of Tumwater. Modeling could be valuable for this portion of the basin, especially for area around Trosper Lake. (Tum)
Green Cove Creek		• City staff feel this basin has been studied extensively - little political or technical value to be added by modeling this basin. (Oly)
Ellis Creek		• Basin is too small to make effective changes. (Oly)
Chambers		• Basin has been studied extensively and modeling will have little added value. (Oly)

Criterion 3. Existing Ecological Status

This criterion was assessed using multiple sources of information including cover data and basin narrative descriptions from the Basin Evaluation and Management Strategies Report (2013), Thurston County Watershed Characterization (2012), and Ecology's Puget Sound Characterization.

Basin Evaluation and Management Strategies Report (BEMSR)- The BEMSR provides the most comprehensive summarization to date of existing basin and aquatic resource conditions- as well as projections of potential future basin cover conditions. Key information characterizing existing basin conditions from this report that were used to assist in basin selection for modeling includes existing percent total impervious, percent forest cover, and descriptions of existing water quality status.

Thurston County Watershed Characterization (TCWC)- TCWC evaluated riparian condition through its "Movement of Wood" assessment of drainage analysis units (DAUs). The primary parameter used to evaluate movement of wood is percentage of mature forest cover within the 67 meter buffer of streams within each unit. NHC used GIS processing of TCWC ratings (PF, AR, NPF) of DAUs to develop basin average riparian conditions for all basins in the study area. The results were then binned using a Jenks classification to provide three categories (poor, fair, good) that are indicative of riparian conditions relative other basins within the study area.

Puget Sound Characterization (PSC) – PSC provides several indicators of intrinsic hydroecological importance and degradation for analysis units (AUs) which drainage areas within basins.. Recently, a freshwater habitat index has been developed for PSC (WDFW, 2013) that ranks the relative importance of freshwater AU habitat in comparison with other AUs in a WRIA. This index considers both the intrinsic characteristics of an AU that are generally not affected by human impact (underlying geology, e.g.), the level of basin degradation caused by human actions (basin impervious area), and the existing access and usage of AU streams by salmonids. As in the case of TCWC results for DAUs, the freshwater habitat ratings for AUs were averaged over study area basins.

Table 3 summarizes basin ecological characteristics derived from each of the three sources discussed above. Although the entries in this table represent a selective and highly summarized assessment of conditions in each basin, they provide a reasonable thumbnail and ranking of their existing hydroecological status.

Table 3. Indicators of Current Hydroecological Status

Basin	Watershed	Basin Area	2010 Total Impervious Area %	Percent Forest Cover	Relative Riparian Forest Integrity	Freshwater Habitat Value
McLane Creek	Eld	7,094	1%	73%	Low	High
Green Cove Creek	Eld	2,219	12%	66%	High	Medium
Ellis Creek	Budd-Deschutes	937	8%	65%	Medium	Medium
Deschutes River (Middle)	Budd-Deschutes	23,181	2%	53%	Medium	Low
Black Lake	Budd-Deschutes	4,392	8%	44%	Low	Low-Medium*
Woodard Creek	Henderson	5,311	15%	46%	Low	Medium
Percival Creek	Budd-Deschutes	5,657	26%	46%	Medium	Medium
Deschutes River (Lower)	Budd-Deschutes	11,213	15%	42%	Medium	Low
Woodland Creek	Henderson	16,279	22%	40%	Low	Low
Chambers	Budd-Deschutes	8,478	20%	32%	Low	Low

*Black Lake was not mapped as part of the Puget Sound Basin and was therefore not rated in PSC by WDFW. The "Low-Medium" rating was estimated based on the rating for Percival Creek to which Black Lake is connected by Black Lake Ditch.

McLane Basin ranks highest in overall ecological condition and aquatic resource value based on top ratings in three out of four categories. It has the lowest existing impervious cover, highest existing forest cover, and highest salmon habitat conservation value of all of the basins. The only low ecological attribute listed for McLane is derived from TCWC's rating of the maturity of riparian vegetation for which it is ranked "low". This overall picture for McLane is substantiated by additional information provided in the BEMSR and its appendices. For example, McLane had a relatively high average BIBI score between 2002 and 2009 of 38.5; however a 1999 study found canopy closure to be too low to maintain stream temperature. Forestry and agricultural land use predominate within the basin and it is on the 303d list for fecal coliform bacteria. Multiple salmonid species use the stream system including ESA-listed fall Chinook salmon. Green Cove

and Ellis Creek basins also rank high for existing ecological condition based on existing cover, riparian condition, and freshwater conservation value. These basin have TIA values of 12% and 8% respective, existing forest cover of at least 65%, and riparian condition and habitat conservation value that is medium or high.

A second group is comprised of the two Deschutes non-headwater basins plus Woodard and Black Lake basins. These basins have TIA values ranging from 2% and 15%, forest cover between 40% and 56%, and low to medium riparian vegetation condition and habitat conservation value.

The lowest group is comprised of Percival, Woodland, and Chambers basins. These basins have existing TIA values that exceed 20%, forest cover from 32% to 46%, and low to medium riparian vegetation condition and habitat conservation value.

Criterion 4. Potential Future Changes in Basin Land Use and Management

This criterion is aimed at quantifying the potential threat to aquatic resources posed by changes in future land use and vegetation cover as basins build out in the future. The metrics used to evaluate this criterion include increases in basin impervious percentage and losses of existing forest cover. A summary of the metric values for each basin is shown in Table 4. The ten basins in the table can be divided into three groups.

Future Increases in Impervious Area

McLane, Middle Deschutes, Ellis, and Black Lake all have existing levels of total impervious area that are below the 10% level. Of these, only Black Lake is projected to be significantly affected by future urbanization with a near doubling of TIA from 8% to 15% at buildout. Black Lake is unique among the listed basins because a significant portion of the basin (13%) is occupied by the lake itself which receives drainage from the remainder of the basin. If only the land associated with the drainage area to the lake is considered, then existing TIA in the Black Lake basin is closer to 9% and future TIA (again excluding the lake area) would be closer to 17%.

Green Cove, Woodard, and Lower Deschutes are basins forming a second group based on existing and future TIA. Existing TIA in this group ranges from a low of 12% for Green Cove to a high of a high of 15% for both Woodard and Lower Deschutes. Future projected increases in imperviousness at buildout are all low to moderate ranging from 2%-4%.

The final group is made up of Chambers, Woodland, and Percival with existing TIA levels ranging from 20% to 26% and projected future increases in impervious percentages from 4% to 7%.

From the perspective of both the ratio of projected to existing total impervious cover as well as the simple magnitude of the future increment in imperviousness, Black Lake appears to be the basin with the most dramatic projected increase in total impervious area.

Potential Future Loss of Forest Cover

McLane Creek, Lower Deschutes, and the Middle Deschutes Basins appear have the highest potential for forest loss at buildout (13% to 14%).

The second highest group is made up of Black Lake and Percival Creek Basins, each with 6% of projected forest loss.

In the remaining five basins, Green Cove, Ellis, Woodard, Woodland and Chambers, only small amounts (0% to 2%) of forest loss are projected.

Table 4. Potential Land Use Change (Increase in TIA and Forest Cover Loss*)

Basin	Watershed	Basin Area	2010 Total Impervious Area %	Increase in impervious at Buildout	Percent Forest Cover	Potential Forest Loss at Buildout
McLane Creek	Eld	7,094	1%	1%	73%	13%
Green Cove Creek	Eld	2,219	12%	2%	66%	0%
Ellis Creek	Budd-Deschutes	937	8%	1%	65%	0%
Deschutes River (Middle)	Budd-Deschutes	23,181	2%	1%	53%	14%
Black Lake	Budd-Deschutes	4,392	8%	7%	44%	6%
Woodard Creek	Henderson	5,311	15%	3%	46%	1%
Deschutes River (Lower)	Budd-Deschutes	11,213	15%	4%	42%	13%
Percival Creek	Budd-Deschutes	5,657	26%	6%	46%	6%
Woodland Creek	Henderson	16,279	22%	7%	40%	2%
Chambers	Budd-Deschutes	8,478	20%	4%	32%	2%

*Note that potential loss of forest cover at buildout represents the assumption that existing forested areas that are currently zoned for urban, rural and agricultural uses would be fully converted to non-forest cover.

Criterion 5. Likely Purpose and Effectiveness of Basin Modeling to Support Management Actions

Table 5 summarizes information provided by the BESMR (2013) that sheds light on how modeling might be used to address hydroecological concerns in each of the basins.

Table 5. Purpose/Benefits of Modeling					
Basin	**Watershed**	**Existing and Future Flow and Quality/Habitat Concerns**	**Potential Key Model Outputs**	**Potential Management Decisions Supported by Modeling**	**Notes**
McLane Creek	Eld	Fecal Coliform, Phosphorus,Temperature, Fine Sediment, Riparian Cover	Q, Temp, Fecals, Sediment	Riparian and stream restoration, conservation easements, livestock/ag BMPs	High resource stream, minimal future land development,
Green Cove Creek	Eld	Hydrology/Wetland Filling	Q	Zoning, Drainage Standards/LID	Many protections already in place
Ellis Creek	Budd-Deschutes	Fecal Coliform, Fine Sediment	Q, Sediment	Zoning, Drainage Standards/LID	
Deschutes River (Middle)	Budd-Deschutes	DO, Temperature, Fecal Coliform, fine sediment, instream flow	See Notes	Riparian and stream restoration, conservation easements, livestock/ag BMPs	Not a headwater basin. River problems are not solely caused only by local basin inputs. TMDL in progress.
Black Lake	Budd-Deschutes	Flooding, sedimentation, lake algae blooms, Total P, PCB, Low riparian cover in Black Lake Ditch	Q, Total P Temp, Fecals, Suspended Sediment, Total P	Zoning, Drainage Standards/LID, Stormwater Retro-fits, TDR	Formerly headwaters of Black River, a tributary of the Chehalis, drains primarily to Percival Creek via Black Lake Ditch. Complex groundwater interaction. May be difficult to model lake quality processes and algae responses to land use. Stream flow data for one tributary to lake. No lake inflow quality data. In-lake quality data, and outlet ditch quality data.

Woodard Creek	Henderson	Clearing and existing impairment of riparian cover, fecal coliform (Part 2 failure), DO (303D), high N and P concentrations, urban runoff, septic systems, Henderson Inlet TMDL for FC. Henderson shellfish beds.	Q, DO, Fecals	Zoning, Drainage Standards/LID, Stormwater Retro-fits, TDR	
Deschutes River (Lower)	Budd-Deschutes	DO, Temperature, Fecal Coliform, fine sediment, instream flow	See Notes	Zoning, riparian and stream restoration, conservation easements	Not a headwater basin. River problems are not solely caused only by local basin inputs. TMDL in progress.
Percival Creek	Budd-Deschutes	DO, Temperature, Bank Erosion, Riparian Cover, Turbidity	Q, DO, Temperature, Sediment	Zoning, Drainage Standards/LID, Stormwater Retro-fits	To model whole basin requires inclusion of Black Lake. Could potential model southern headwater subbasin including Trosper Lake and outlet stream. Flow but no water quality data on this branch.
Woodland Creek	Henderson	Peak flows, low base flow, high temperature, fine sediment, stream bank instability,	Q, DO, Temperature, Sediment	Zoning, Drainage Standards/LID, Stormwater Retro-fits	
Chambers	Budd-Deschutes	Impaired riparian buffer, high nitrates in groundwater, on 303(d) list for fecal coliform,	Q, Fecals, Nitrate	Livestock BMPs, Fertilizer BMPs (Ag, golf course, residential)	Highly altered drainage system, perennial mainstem, downstream of Rich Rd crossing.

Basin Selection Process

The following process was applied to screen basins and select those to be studied further using hydrologic modeling. An initial ranking of the basins was made using a combination of data availability and stakeholder interest criteria in which each of these considerations was equally weighted. This results in the ranking of the 10 basins shown in Table 6.

Table 6: Initial Ranking of 10 Candidate Basins

Basin	Watershed	Data Availability Rank	Stakeholder Rank
McLane Creek	Eld	High	High
Black Lake	Budd-Deschutes	High	High
Woodard Creek	Henderson	High	High
Woodland Creek	Henderson	Medium	High
Green Cove Creek	Eld	High	Low
Deschutes River (Middle)	Budd-Deschutes	Low	High
Deschutes River (Lower)	Budd-Deschutes	Low	High
Chambers	Budd-Deschutes	High	Low
Upper Percival Creek*	Budd-Deschutes	Low	Medium
Ellis Creek	Budd-Deschutes	Medium	Low

In this initial screening, basins with a “Low” score for either attribute were eliminated from further consideration. Upper Percival (marked with an asterisk) is a special case worthy of note. There was moderate stakeholder interest in the southern portion of the basin that drains the area around Trosper Lake; however, the available water quality data on this portion of the creek is limited compared to Thurston County’s sites on Black Lake Ditch or downstream of the confluence of the ditch with Percival Creek. So while relative data availability for the entire Percival Creek basin was judged to be “High,” availability for the southern portion of the creek upstream of its confluence with Black Lake Ditch is judged to be “Low”.

The top four basins from this initial screening were then ranked according to their hydroecological importance and the potential for future impact from land development and land use practices.

Basin ranking of hydroecological importance used all four factors shown in Table 3 following scoring rules shown in Table 7. The sum of scores from the four factors was then averaged for a total score as shown in the “Hydroecological Condition and Value” column of Table 10.

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Table 7. Scoring of Hydroecological Importance using Table 3 Values

Table 3 Factor	Score = 3	Score = 2	Score = 1
TIA	TIA ≤ 10	10% < TIA ≤ 20%	TIA > 20%
Forest Cover (FC)	FC ≥ 65%	50% ≤ FC < 65%	FC < 50%
Relative Riparian Forest Integrity	High	Medium	Low
Salmon Habitat Value	High	Medium	Low

Potential impact from future development utilized data from Table 4 which indicates potential changes in TIA and forest cover at buildout. Potential change scores for each of these parameters were based on a sliding scale related to TIA and forest cover under existing conditions as shown Tables 8 and 9.

Table 8. Future Impact Score Based on Existing Basin TIA and Potential Increase at Buildout			
Δ %TIA @ Buildout	TIA ≤ 10%	10% < TIA ≤ 20%	TIA > 20%
Δ > 10%	3	3	3
5% < Δ ≤ 10%	3	3	3
3% < Δ ≤ 5%	3	2	2
2% < Δ ≤ 3%	2	2	1
Δ < 2%	1	1	1

Table 9. Future Impact Score Based on Existing Basin Forest and Potential Forest Loss at Buildout			
Δ % FC @ Buildout	FC ≥ 65%	50% ≤ FC < 65%	FC < 50%
Δ > 10%	3	3	3
5% < Δ ≤ 10%	3	3	2
3% < Δ ≤ 5%	3	2	2
2% < Δ ≤ 3%	2	2	1
Δ < 2%	1	1	1

Basin ranking for vulnerability to future urbanization was based on values from Table 4 and rules in Tables 8 and 9. Scores for change in TIA and loss of forest cover were averaged as shown in Table 10. Results of the second screening of the four basins rank McLane first, followed by Black Lake, with Woodard and Woodland tied for the 3rd position. As indicated by the values shown for these two basins, Woodard currently has a higher level of ecological function, but it is less threatened by growth and urbanization than Woodland.

Table 10. Second Screening of Basins				
Basin	Watershed	Hydroecological condition and value	Potential Impacts from Future Land Development/Use	Combined Average
McLane Creek	Eld	2.5	2.0	2.3
Black Lake	Budd-Deschutes	1.6	2.5	2.0
Woodard Creek	Henderson	1.5	1.5	1.5
Woodland Creek	Henderson	1.0	2.0	1.5

Representativeness and Diversity of Modeled Basins

Results of the ranking and screening shown in Table 10 suggest that if three basins are modeled, the selected basins should be McLane, Black Lake, and either Woodard or Woodland. While diversity of hydroecological concerns and basin management approaches represented by such a selection have not been used as criteria to arrive at this result, these criteria deserve some discussion. Fortuitously, the selected basins are located in three distinct Thurston County watersheds feeding major inlets to Puget Sound and more significantly, as a group, they provide a representative array of hydroecological concerns and potential basin management alternatives.

Acre for acre, McLane Creek is the highest functioning, most habitat-rich basin in the WRIA 13 study area. Unlike any other selected basin, no portion of McLane is within an urban growth boundary. The primary challenges in McLane are to preserve existing aquatic habitat values, recover diminished riparian vegetation, forestall losses of forest cover which may accompany rural development, and encourage agricultural and livestock best management practices that protect stream quality.

Unlike McLane, Black Lake basin is expected to experience considerable future urban development. However, it is distinct from Woodard and Woodland because of the particular concerns for water quality and beneficial uses associated with the dominant physical feature of the basin, a lake that provides a high level of recreational use and esthetic enjoyment. Algal blooms and closures of Black Lake for swimming and other contact recreation are problems unique to Black Lake among the selected basins.

Woodard and Woodland, while similar in many respects, are distinct from the other two basins in the group. They are both stream basins draining to Henderson Inlet with significant amounts of existing urbanization (greater than 15% total impervious area). Stormwater retro-fits that address past impacts as well as careful consideration of how to target future urbanization to prevent further degradation are both potential management directions which should be investigated in these basins. Of the two, Woodard provides a higher level of aquatic resource function, suggesting that retro-fits and other measures aimed at protection and restoration be considered here, while holding the degradation line for Woodland might be more appropriate.

Recommended Selection of Basins for Modeling

An initial set of ten candidate basins was developed based on an inventory available climatic, stream flow and water quality data. From the data availability perspective, these basins were broken into three categories reflecting relatively low, medium and high levels of data availability. These data availability levels were combined with results of a survey of stakeholder interest in applying hydrologic modeling to address existing and potential future basin concerns. Four basins with the highest combined scores for these two criteria include McLane Creek, Black Lake, Woodard Creek, and Woodland Creek which have been listed in descending order of existing hydroecological condition and habitat value. Additionally, these basins were ranked in terms of their sensitivity to future land development which results in a similar order except that the Woodland and Woodard Creek positions are switched.

McLane Creek, Black Lake, and Woodard Creek basins are recommended for further study using hydrologic modeling in the Science to Local Policy project. The logic for McLane and Black Lake rests on their distinct hydroecological values and management concerns. Woodard Creek has been selected over Woodland Creek as the third basin for hydrologic modeling because aquatic resource values are in better condition in Woodard Creek making it a likely target for stormwater retrofits and other restorative actions. If some contingency arises (for example, as yet undiscovered data quality problems) for one of the three selected basins, Woodland Creek is recommended as an alternate. Additionally, at a later stage of the project, if resources allow modeling a fourth basin, Woodland Creek would also be modeled.

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