

## **APPENDIX D: ACTIONS**

## APPENDIX D-PART 1

### Criteria to Develop the Action Lists in the WRIA 8 Draft Chinook Plan

Approved by the WRIA 8 Steering Committee, July 28, 2004

#### Criteria for Comprehensive Action Lists

- For each of the three Chinook populations, separate comprehensive lists of land use recommendations, site-specific habitat protection and restoration projects, and public outreach actions will be included in the draft plan for Tier 1 subareas and migratory corridors and for Tier 2 subareas. Watershed-wide or basinwide land use and public outreach actions will address Tier 3 subareas.
- For the public review draft, there will be no site-specific habitat projects in Tier 3 subareas, although the Steering Committee and the Forum could decide to address these in the future by directing development of actions for coho and kokanee.
- Within each comprehensive list, actions are prioritized or evaluated using similar criteria:
  - Conservation strategy (benefits to Chinook)
  - Collaborative process by area experts and stakeholders
  - Feasibility/implementability (technical, community/local support)
  - These factors vary somewhat according to the type of action

#### Criteria for Action Start-Lists

- Land use, site-specific habitat protection and restoration projects, and public outreach are integrated into a single strategic start list to focus watershed priorities. Start lists should consist of approximately 50 actions for each of the three Chinook populations. Actions for the nearshore and migratory corridors will be included as part of the start list.
- With the exception of the four actions added by the Steering Committee in response to the public review process, as provided for below, the start list was generated from the comprehensive lists for each action type and subarea that have been developed collaboratively with area experts and stakeholders. The intent is to include the highest priority actions but the driver is to have a manageable number.
- The specific needs of each population and area should drive the mix of actions.
- Beyond being included on the start list, actions will not be further ranked for each population, across populations, by type of action, nor across types of action.
- The start list needs to include actions at the landscape scale as well as the reach scale to ensure geographic equity and opportunities for implementation by all jurisdictions.
- Actions that are high priority but challenging to implement need to be included as well as high priority actions that are easier to implement or ready to go.
- Up to five actions may be added to the start list through the public review process. Recommendations will be brought back to the Steering Committee to consider.
- The Steering Committee directed that up to five actions be included in the Start List for Tier 2 subareas.
- Development of these lists, particularly the start list, is to be an iterative process.
- Cost estimates will be done only for actions on the integrated start list. Where readily available, cost estimates will be included for actions on the comprehensive lists.

To develop the initial start-lists, the following criteria beyond the comprehensive lists are used for each action type:

#### Land Use Actions (includes incentive, regulatory, and programmatic recommendations)

- Apply technical hierarchy from WRIA 8 Technical Committee

- Include actions where explicitly referenced by Steering Committee goals
- Include actions that are most developed, specific, and directive

#### Site-Specific Protection and Restoration Actions

- Did not include “non-projects” (recommendations that do not require new actions, e.g., protecting St. Edwards State Park) or projects with “uncertain benefit”
- Used logical combining of projects
- Protection based on EDT reach rank (closest to template conditions) and existing science-based habitat protection programs such as Waterways and Cedar River Legacy
- Projects are sorted by reach rank; within reach, by benefits to Chinook
- Included all projects in A reaches that were ranked high and high-medium benefit to Chinook, regardless of feasibility
- Screened projects in B reaches for feasibility: included only projects ranked high and high-medium benefit to Chinook that should be easier to implement
- For Tier 2 subareas, where Start List actions were limited by the Steering Committee’s direction to only 5 actions, actions were selected based on worst factor of decline as well as EDT prioritization of reaches and subarea experts’ rating of projects’ Benefits to Chinook and Feasibility.

#### Public Outreach Actions

- Focus on actions with regional application
- Identify what is needed to support land use and site-specific actions

## APPENDIX D, PART 2

### Process and Criteria for Identifying and Prioritizing Potential Site-Specific Projects

Potential site-specific habitat protection and restoration projects were identified by ad hoc groups of subarea experts and members of the WRIA 8 Technical Committee for each Tier I and II subarea in the watershed during a series of meetings in 2003 and 2004. The potential projects were based on the Technical Committee's technical hypotheses for the protection and restoration for each subarea. The site-specific projects are listed by Chinook population in two ways in Chapter 10: in priority order by subarea with shortened project descriptions and in comprehensive lists by subarea in geographic order from downstream to upstream. Site-specific projects have also been prioritized in the "Short List" for each Chinook population.

#### How Site-Specific Protection and Restoration Projects Were Prioritized

Protection and Restoration projects were prioritized using the WRIA 8 Conservation Strategy (Chapter 4), the Ecosystem Diagnostic and Treatment (EDT) Modeling results and professional opinion of subarea experts about the benefit and feasibility of potential projects. Protection and restoration projects were identified and listed separately because they are treated differently by the EDT model. They were also prioritized using similar, but different criteria.

The prioritization of potential protection projects is based on:

- The Tier of the subarea,
- The EDT results for the subarea reaches (the habitat index) AND/OR whether or not the project/reach has been identified as a priority by an existing science-based habitat protection program such as Waterways or Cedar River Legacy, and
- How the proposed habitat protection projects are rated by subarea experts and WRIA 8 Technical Committee members on their benefit to Chinook and feasibility or ease of implementation.

The prioritization of potential restoration projects is based on:

- The Tier of the subarea,
- The EDT Restoration Potential of the subarea reaches, and
- How the proposed projects are rated by subarea experts and WRIA 8 Technical Committee members on their benefit to Chinook and feasibility or ease of implementation.

#### How EDT Modeling Results were Used to Help Prioritize Potential Site-Specific Projects

##### EDT Modeling for Restoration

The criteria and use of the EDT Modeling results differs somewhat between protection and restoration projects. For restoration projects, EDT's Restoration Benefit Rank was applied directly in prioritizing reaches for restoration. This rank is a measure of the benefit to Chinook of restoring each reach to "template" or ideal conditions. For restoration, some of the reaches with similar restoration potential have been grouped together. For example, the Lower Cedar River reaches are broken out into A Reaches (Reaches 2, 3), B Reaches (Reaches 5, 7, 10, 4, 6) and C reaches (Reaches 11, 1, 8, 9). So although reaches are listed in priority order within these groupings there is not a

large difference in the restoration potential between the reaches in the same grouping. However, there is a significant difference in restoration potential between the groupings. A Reaches have significantly higher restoration benefit than B Reaches.

**EDT Modeling for Protection**

The EDT Protection Benefit Rank is not as straight forward as the Restoration Benefit Rank to apply in prioritizing site-specific habitat protection projects. The EDT habitat model evaluates the protection potential of river reaches by evaluating the exposure of fish in all their life stages to in-stream habitat conditions (e.g. pools, large woody debris, spawning areas). The EDT Protection Benefit Rank prioritizes which reaches if fully degraded would most harm Chinook. However, what you do to protect instream-habitat conditions in a reach should not be limited to taking actions within the reach to protect habitat. Much of what needs to be done to protect instream-habitat in a reach must be done upstream in other reaches or subarea-wide. For example, if there are pools and large woody debris in Reach 3 of the Cedar River it is in part because there was a source of large woody debris upstream. If egg incubation of Chinook benefits from the lack of sedimentation and high water quality in a reach, it is because there are not sediment sources or inputs of pollutants upstream. Also, habitat protection projects should consider things such as landscape conditions and habitat-forming processes in addition to fish use and instream-habitat conditions.

Therefore, the WRIA 8 Technical Committee used the Habitat Diversity Index results from the EDT model to prioritize reaches for their protection potential rather than the Protection Benefit Rank. The Habitat Diversity Index is a measure of how close reaches are to “template” or ideal conditions for numbers of pieces of large woody debris, riparian function and channel connectivity. Basically this is an indication of which reaches are in the best condition. See example below from the WRIA 8 Conservation Strategy from Chapter 4 for the Cedar River.

**Table 4-2: Cedar Tier 1 Reach-Level Protection Recommendations  
(Middle Cedar and Lower Cedar)  
Reaches are listed in order of Relative Protection Priority**

<i>Tier 1 Subarea:</i>	<i>Critical Chinook Life Stages for Protection:</i>	<i>LWD, Riparian Function, and Channel Connectivity should be protected in the following reaches:</i>
<i>Middle Cedar (Reaches 12-18)</i>	<i>Pre-Spawning Migrant; Fry Colonization</i>	<i>16, (tie 17 &amp; 18), 15, 14, 12, 13</i>
<i>Lower Cedar (1- 11)</i>	<i>Pre-Spawning Migrant; Fry Colonization</i>	<i>4, 8, 9, 3, (tie 5 &amp; 6 &amp; 11), 7, 10, 1, 2</i>

**Recognizing Existing Habitat Protection Programs**

There are several strong, science-based habitat protection programs in place in WRIA 8, including but not limited to: Bear Creek Waterways, Cedar River Legacy, and Issaquah Creek and Lake Sammamish Waterways. Recognizing the strength of these programs and their greater landscape focus, the WRIA 8 Technical Committee recommended (and the WRIA 8 Steering Committee approved) using the priorities identified by these

programs in additions to the EDT modeling results in prioritizing site-specific habitat protection projects. In the prioritized lists of site-specific protection projects in Chapter 10, existing priority protection projects from science-based habitat protection programs have been shaded.

### **Criteria used by Subarea Experts to Evaluate Potential Protection Projects**

Within the subarea reaches that have been prioritized for their protection potential using the EDT Model, identified projects are further prioritized using the expert opinion of subarea experts about each potential projects' benefits to Chinook and feasibility or ease of implementation. Here are the criteria the subarea experts used in evaluating the potential protection projects.

#### **Technical Criteria: Benefits of Project to Chinook**

High – Expected to have high benefit to Chinook.

Medium – Expected to have moderate benefit to Chinook.

Low – Expected to have low benefit to Chinook.

#### **In making determination of H, M, L, consider the following:**

- Extent to which habitat is connected to other high quality habitats and already protected areas
- Extent to which property has intact riparian conditions, forest cover
- Extent to which project would protect habitat-forming processes (e.g. includes headwater areas, confluences, unarmored banks, gravel erosion and deposition areas, woody debris recruitment sources, springs or groundwater upwelling)

#### **Policy Criteria: Feasibility of Project**

High - Potential project is highly feasible.

Medium – Potential project is moderately feasible.

Low – Potential project has low feasibility.

#### **In making determination of H, M, L, consider the following:**

- Community/jurisdictional support
- Cost/fundability of project
- Likelihood that habitat is threatened by future changes in land use (or extent to which habitat is protected by regulations)
- Degree to which project is ready to go (Is there a sponsor? A willing landowner? A partnership or matching opportunity?)

### **Criteria used by Subarea Experts to Evaluate Potential Restoration Projects**

Within the subarea reaches that have been prioritized for their restoration potential using the EDT Model, identified projects are further prioritized using the expert opinion of subarea experts about each potential projects' benefits to Chinook and feasibility or ease of implementation. Here are the criteria the subarea experts used in evaluating the potential restoration projects.

#### **Technical Criteria: Benefits of Project to Chinook**

High – Expected to have high benefit to Chinook.

Medium – Expected to have moderate benefit to Chinook.

Low – Expected to have low benefit to Chinook.

**In making determination of H, M, L, consider following criteria:**

- Degree to which project addresses factors of decline in reach and relative importance of the factors of decline
- Type and scale of project and how well it fits with technical hypothesis for reach
- Project method and how well it has been proven successful in other projects

**Policy Criteria: Feasibility of Project**

High - Potential project is highly feasible.

Medium – Potential project is moderately feasible.

Low – Potential project has low feasibility.

**In making determination of H, M, L, consider the following:**

- Community/jurisdictional support
- Cost/fundability of project
- Degree to which project is ready to go (Is there a sponsor? Is there a design? Is there landowner willingness?)
- Complexity of the project

## APPENDIX D, PART 3

### Preliminary Cost Estimates for WRIA 8's Action Start List - Methodology

An overview of the cost estimate methodology is provided in Chapter 9, *Preliminary Cost Estimate of Site Specific Projects and Programmatic Actions* section. This Appendix section provides further details on the methodology and cost estimate charts (Tables D-3-1 – D-3-4) for the three Chinook populations: Cedar River, North Lake Washington, and Issaquah, and migratory and rearing areas. Cost estimates were prepared for two main groups of actions: site specific projects and programmatic actions, which include land use actions, public outreach, and studies.

#### Site Specific Projects:

Cost estimates for site specific projects were formed from three main sources: (1) pre-design cost estimates, (2) the Army Corps of Engineers' Lake Washington/Ship Canal General Investigation Study, or (3) *A Primer on Habitat Project Costs (Primer, Evergreen 2003)*. The *Primer* provides estimates for various components of different types of projects. These components were formed into groups to correspond to the conditions in the WRIA 8 watersheds. Many of the components were consistent across the Cedar, North Lake Washington, and Issaquah population areas. Some of the components varied, such as acquisition values, or size of waterway, which is based on the mean flow given in cubic feet per second (cfs). Permitting, initial (2 year) monitoring, and maintenance costs are factored into the cost range provided by the *Primer*.

The values are given as planning level tools, and therefore cost estimates at this level are for decision makers to use in preliminary planning of overall costs. The high and low range of costs varied either due to the multiplier value (high and low values) or due to variations in the scoping of the project site (e.g. range of stream miles or acreage).

A few projects tended to bring the average project cost up within each of the four cost estimate charts. For example, Dorre Don Area Flood Buyouts and Floodplain Restoration in the Cedar River, adds about \$10 million into the overall "high" total costs. If this outlying value is not accounted for then the values would be closer to the "low" cost estimates. In the North Lake Washington and Issaquah Action Start-list, single projects identified large areas for acquisition that are typically acquired as multiple projects occurring over many years. These areas were divided into multiple projects to reflect more realistically the cost and to not skew the average cost per project. For example, completing the acquisitions identified in the Waterways 2000 program would be approximately 250 acres for North Lake Washington. This one, \$25 million, Start-list action was divided into 17 individual projects at an average cost of \$1.5 million, which is a more typically project cost.

**Acquisition:** For acquisition planning, the cost estimate per acre multiplier value was \$35,000 to \$55,000. Property values may vary more widely within the rural areas; however, these values are for planning purposes only. These values also should not be used to value a specific site or parcel. The following components were selected from the *Primer* to reflect the characteristics of the Chinook population areas:

- Cost range \$24,000 - \$60,000 per acre,
- Medium development potential and amenity value,
- Rural residential zoning,
- Moderate percent sensitive areas (50-80 percent not developable),
- Average site access, and
- Moderate distance from major city

**Restoration:** For restoration project cost estimates four groups of components from the *Primer* were formed; (1) riparian enhancement, (2) stream bank improvements, (3) large woody debris placement, and (4) floodplain restoration.

**(1) Riverine riparian enhancement** includes projects that remove invasive plant species and restore native plant species. These projects can restore the existing buffers or recreate a buffer. The cost estimate used a multiplier value of \$15,000 per acre. The selected *Primer* components are as follows:

- Cost range \$10,000 to \$15,000 per acre,
- Somewhat complex riparian enhancement:
  - Medium: size plants, mulch, slope, clearing & grubbing,
- 50 foot buffer width,
- Site accessible by vehicle, and
- Average labor costs and maintenance

**(2) Stream bank improvements** include projects that involve reshaping of the stream bank area through rip-rap removal, grading, and then restoration of the riparian vegetation. The earthmoving and size of the waterway components are the primary determinants of the cost. Some of the waterways mean flow was near the cut-off of 100 cfs for the small versus medium waterway. More weight was thus given to the earthmoving cost component and a cost of \$200 per lineal foot was used as the multiplier value. The selected *Primer* components are as follows:

- Cost range: \$150 - \$250 lineal foot
- Moderate earthmoving - some rip-rap removal,
- Medium waterway (100-2,000 cfs; e.g., the Cedar River is 675 csf.)
- No reconnection to the floodplain,
- Average permitting costs,
- Medium material use
  - 2 gallon trees and shrubs, rocks, some logs and rootwads.

**(3) Large Woody Debris placement** projects restore wood to the stream channel either by placing logs on the stream bank or by forming piles of logs as a log jam structure. The size of the waterway, materials and transportation cost components are the primary cost factors. The projects in the Start List have a slightly higher number of pieces of large woody debris specified than the *Primer* components below, thus the cost estimate multiplier used was on the high end of the range. For small waterways the multiplier value per mile was \$50,000 and for medium waterways the value was \$45,000.

- Small waterway cost range: \$20,000 - \$50,000 per mile,
- Medium waterway cost range: \$15,000 - \$45,000 per mile,
- Average transportation cost,
- Medium material use, 0-12" diameter logs for small waterway, and 13-24" diameter for medium waterway,
- Risk – minimal.

**(4) Floodplain restoration** projects reconnect the river with its floodplain through levee removal or side-channel creation. These types of projects are quite variable and can be estimated with the *Primer* only to a fair degree. The energy of the waterway and the amount of earthmoving are the key variables that affect cost. The cost range used for multiplier values was \$20,000 to \$30,000 per acre. The selected *Primer* components are as follows for a side-channel re-connection:

- Cost range: \$20,000 - \$30,000 per acre,
- Energy of waterway – low,
- Minimal earthmoving,
- Access - near,
- Moderate material use.

### **Programmatic Actions:**

Programmatic actions include land use actions, public outreach actions, and studies. The cost estimates were developed by the WRIA 8 Service Provider Team's Action Leads for land use and public outreach. The estimates are considered a rough, first-cut budget estimate, with the full time equivalent (FTE) staff estimates based on existing, or similar, programs and actions. The FTE staff estimate for the Action

Start-list is an additional level of effort to the staff identified in Chapter 2. There was limited consultation with local jurisdictions to tailor costs and identify efficiencies that may be obtained through collaboration.

Each action was evaluated as to whether the existing level of effort was adequate or whether an additional level of effort was needed. A number of assumptions were made for this preliminary effort. If a zero appears under the low range of cost then the action was covered under existing jurisdictional responsibilities and the level of funding was assumed to be adequate. Eleven programmatic actions were given zero values because the actions were considered fully funded by all jurisdictions at this time or had no additional cost element. If the FTE range has values of 0.03 to 0.6 then there is a need for collaborative work with a range of level of effort needed. For example, research and training on Low Impact Development (LID) techniques already occurs within some jurisdictions. The additional level of effort may involve coordination to expand the existing programs or additional research to apply the information to more situations. After an FTE value was developed, the *Primer* value of \$100, 000 per FTE was used as the multiplier to estimate costs.

**Table D-3-1 WRIA 8 Action Start-List - "Ballpark" Cost Estimates Cedar River Chinook Population**

<b>Site - Specific Projects</b>		
Tier I - Within UGA 6 Projects	\$4.4M	\$4.6M
Tier I - Outside UGA 9 Projects	\$16.5M	\$30.2M
Sub-total Cost - Tier I	\$20.9M	\$34.9M
Tier II - 2 Projects	\$1.4M	\$1.4M
<b>Average Cost per project (17)</b>	<b>\$1.3M</b>	<b>\$2.1M</b>
<b>Total Cost - Site Specific Tier I and Tier II</b>	<b>\$22.3M</b>	<b>\$36.3M</b>
<b>Programmatic Actions</b>		
Tier I - Basinwide 16 Actions	\$169,000	\$345,000
Tier I - Within UGA 1 Actions	\$0	\$40,000
Tier I - Outside UGA 2 Actions	\$0	\$80,000
Tier II - 2 projects	\$10,000	\$30,000
Annual number of FTEs / Staff	1.79	4.95
Annual Cost for 21 Actions	\$179,000	\$495,000
<b>Average Annual Cost per action (21)</b>	<b>\$8,523</b>	<b>\$23,571</b>
One Upper Cedar River Study	\$941,000	\$941,000
<b>Total Cost - Programmatic includes study above</b>	<b>\$2.7M</b>	<b>\$5.9M</b>

**Table D-3-2 WRIA 8 Action Start-List - "Ballpark" Cost Estimates  
North Lake Washington Chinook Population**

<b>Site Specific Projects</b>		
	<b>Low</b>	<b>High</b>
Tier I - Within UGA 14 Projects	\$34M	\$36M
Tier I - Outside UGA 31 Projects	\$36M	\$37.6M
Sub-total Cost Tier I	\$70.6M	\$73.8M
Tier II - 6 Projects	\$18.3M	\$22.4M
<b>Tier I - Average Cost per project (45)</b>	<b>\$1.5M</b>	<b>\$1.6M</b>
<b>Tier II - Average Cost per project (6 Acquisitions - over 323 acres)</b>	<b>\$3.1M</b>	<b>\$3.7M</b>
<b>Total Cost - Site Specific Tier I and Tier II</b>	<b>\$88.3M</b>	<b>\$96.2M</b>
<b>Programmatic Actions</b>		
	<b>Low</b>	<b>High</b>
Tier I - Basinwide 20 Actions	\$142,000	\$387,000
Tier I - Within UGA 4 Actions	\$20,000	\$60,000
Tier I - Outside UGA 3 Actions	\$30,000	\$100,000
Tier II - 3 Actions	\$0	\$40,000
Annual number of FTEs / Staff	1.92	5.87
Annual Cost for 30 actions	\$192,000	\$587,000
<b>Average Cost per action (30)</b>	<b>\$6,400</b>	<b>\$18,900</b>
One Basinwide Study	\$645,000	\$645,000
<b>Total Cost - Programmatic includes study above</b>	<b>\$2.6M</b>	<b>\$6.5M</b>
Note: M = million		

**Table D-3-3: WRIA 8 Action Start-List - "Ballpark" Cost Estimates for Issaquah Chinook Population**

<b>Site Specific Projects</b>		
	<b>Low</b>	<b>High</b>
Tier I - Within UGA 8 Projects	\$9.2M	\$10.3M
Tier I - Outside UGA 10 Projects	\$17.5M	\$19.8M
<b>Average Cost per project (18)</b>	<b>\$1.5M</b>	<b>\$1.7M</b>
<b>Total Cost - Site Specific</b>	<b>\$26.7M</b>	<b>\$30.1M</b>
<b>Programmatic Actions</b>		
	<b>Low</b>	<b>High</b>
Tier I - Basinwide 18 Actions	\$143,000	\$364,000
Tier I - Within UGA (4 Actions not included in average)	\$0	\$0
Tier I - Outside UGA 2 Actions	\$20,000	\$70,000
Annual number of FTEs / Staff	1.63	4.29
Annual Cost for 20 actions	\$163,000	\$429,000
<b>Average Annual Cost per action (20)</b>	<b>\$8,100</b>	<b>\$21,700</b>
<b>Total Cost - Programmatic</b>	<b>\$1.6M</b>	<b>\$4.3M</b>
Note: M = million		

**Table D-3-4 WRIA 8 Action Start-List - "Ballpark" Cost Estimates - Migratory Areas**

<b>Site Specific Projects</b>		
	<b>Low</b>	<b>High</b>
6 Projects	\$5.1 M	\$7.1M
<b>Average Cost per project (6)</b>	<b>\$857,000</b>	<b>\$1.2M</b>
<b>Total Cost - Site Specific</b>	<b>\$5.1 M</b>	<b>\$7.1M</b>
<b>Programmatic Actions</b>		
	<b>Low</b>	<b>High</b>
Annual Number of FTEs / Staff	2.51	5.90
Annual Cost - 29 Actions	\$251,000	\$590,000
<b>Average Annual Cost per Action (29)</b>	<b>\$8,655</b>	<b>\$20,344</b>
<b>Total Cost - Programmatic</b>	<b>\$2.5M</b>	<b>\$5.9M</b>
Notes: 1) Migratory Areas include Lakes Washington and Sammamish, Ship Canal, Locks, and Estuary/ Nearshore; 2) M = million		

## PART 4: KING/SNOHOMISH COUNTY WRIA 8 20-YEAR POPULATION ESTIMATES

Jurisdiction	2002 population estimate	2022 additional population target	Total population target in 2022
<b>King County - inside UGA</b>			
Beaux Arts	295	7	302
Bellevue	117,000	24,078	141,078
Bellevue PAA	4,650	424	5,074
Bothell- King County	16,330	4,167	20,497
Bothell PAAs (King Co.)	4,000	1,390	5,390
Clyde Hill	2,895	50	2,945
Hunts Point	455	2	457
Issaquah	13,790	9,503	23,293
Issaquah PAAs	15,150	1,909	17,059
Kenmore	19,180	5,534	24,714
Kent (water supply only in WRIA 8)			
Kirkland	45,790	13,042	58,832
Kirkland PAA	32,400	1,778	34,178
Lake Forest Park	12,860	1,108	13,968
Maple Valley	1,504	500	2,004
Medina	3,010	74	3,084
Mercer Island	21,955	3,420	25,375
Newcastle	8,205	2,054	10,259
Redmond	46,040	21,618	67,658
Redmond PAAs	3,200	928	4,128
Redmond Ridge UPD	1,000	9,756	10,756
Renton	37,688	10,803	48,491
Renton PAAs (3 below)			
East Renton PAA	7,600	1,476	9,076
Fairwood PAA	21,708	1,859	23,567
West Hill PAA	10,082	400	10,482
Sammamish	34,660	9,144	43,804
Seattle	399,560	53,055	452,615
Shoreline	53,250	5,461	58,711
Woodinville	9,215	4,448	13,663
Yarrow Point	1,010	67	1,077
misc. unincorporated King County	2,000	most in PAAs	2,000
<b>Total inside UGA</b>	<b>946,482</b>	<b>188,055</b>	<b>1,134,537</b>
<b>King County - outside UGA</b>			
Unincorporated King Co	50,000	6,000	56,000
<b>Total King County in WRIA 8</b>	<b>996,482</b>	<b>194,055</b>	<b>1,190,537</b>
<b>Total Snohomish County in WRIA 8 (details next page)</b>	<b>306,717</b>	<b>118,382</b>	<b>425,099</b>
<b>Total King &amp; Snohomish in WRIA 8</b>	<b>1,303,199</b>	<b>312,437</b>	<b>1,615,636</b>

## PART 4: KING/SNOHOMISH COUNTY WRIA 8 20-YEAR POPULATION ESTIMATES

Jurisdiction	2002 population estimate	2022 additional population target	Total population target in 2022
<b><i>Snohomish County inside UGA</i></b>			
Bothell-SnoCo	14,490	6,530	21,020
Bothell-SnoCo (MUGA)	16,457	10,372	26,829
Brier	6,445	1,170	7,615
Brier (MUGA)	2,186	964	3,150
Edmonds	39,460	4,713	44,173
Edmonds (MUGA)	3,537	372	3,909
Everett-WRIA8	30,598	13,548	44,146
Everett-WRIA8 (MUGA)	27,104	19,626	46,730
Lynnwood	33,990	3,930	37,920
Lynnwood (MUGA)	22,821	13,508	36,329
Mill Creek	12,055	3,508	15,563
Mill Creek (MUGA)	30,588	22,284	52,872
Mountlake Terrace	20,470	1,727	22,197
Mountlake Terrace (MUGA)	82	20	102
Mukilteo	18,600	3,440	22,040
Mukilteo (MUGA)	10,310	4,100	14,410
Woodway	990	157	1,147
Silver Firs	3,682	1,115	4,797
Total inside UGA	293,865	111,084	404,949
<b><i>Snohomish Co. - Outside UGA</i></b>			
Unincorporated Snohomish County	12,852	7,298	20,150
<b>Total SnoCo in WRIA8</b>	<b>306,717</b>	<b>118,382</b>	<b>425,099</b>
<b>Total King &amp; Sno County Combined</b>	<b>1,303,199</b>	<b>312,437</b>	<b>1,615,636</b>

**NOTES:**

All population estimates are for the portion of the jurisdiction inside WRIA 8 only.

For King County:

2002 estimates from 2002 King County Annual Growth Report (based on OFM), with estimates of areas within WRIA 8 by Chandler Felt, King Co. demographer; 2022 estimates from Growth Management Planning Council household growth targets approved Sept. 2002. Maple Valley estimates are from city staff.

For Snohomish County:

Incorporated areas for 2002 from Washington OFM estimates  
2022 targets are mathematically interpolated from 2025 targets in "Draft Initial Population Growth Target Ranges – Cities, UGAs and the Rural Resource Areas" (9/03) for incorporated areas, and in "Draft Initial Population Growth Target Ranges – MUGA Analysis Zones" (9/03) for unincorporated area

## **APPENDIX D, PARTS 5 and 6 - Introduction**

### **Purpose of Menu of Land Use Actions (Part 5)**

The WRIA 8 Steering Committee asked for land use actions for Tier 1 and 2 subareas that could be applied by jurisdictions on a voluntary basis, and a menu of land use actions for jurisdictions to consider, that could be applied WRIA-wide. Actions for Tier 1, 2, and 3 subareas are part of the comprehensive lists (and start-list) found in Chapters 9 through 15. The menu in this appendix lists land use tools by the scientific outcome which they address, and describes actions by implementation and feasibility criteria. Examples are given of where certain tools are being used, and comments from jurisdictions and other stakeholders on action feasibility are incorporated. The actions in this menu are not mandatory, jurisdictions can choose to implement them or not.

### **Purpose of References (Part 6)**

Part 6 of Appendix D provides references about critical areas, stormwater management, low impact development (including BMPs, demonstration projects, and example ordinances), and Shoreline Master Programs. These references are provided for informational purposes only, because many stakeholders requested examples and resources on land use topics.

While the Chinook conservation strategy provides detailed information about salmon habitat protection and restoration priorities, and examples of buffer standards are provided in the references, the Plan does not set specific buffer standards. The Steering Committee and WRIA 8 Technical Committee did not want the Plan to provide specific buffer recommendations, nor was it feasible to do so, given the broad range of landscapes and development conditions across the watershed. Rather, individual jurisdictions should develop their own best available science (using the conservation strategy as one of a number of resources) and then develop their own buffer standards based on their BAS.



**Part 5: Menu of Land Use Actions**

Proposed Action	Desired Outcomes	Community Support (public, government, others)	Implementability (and other considerations)	Scientific Uncertainties (none identified if left blank)
<b>PROTECTION AND RESTORATION OF FOREST COVER AND CRITICAL AREAS (riparian buffers, shorelines, wetlands, floodplains)</b>				
Require adequate riparian and wetland buffers through critical areas ordinances (CAOs) or other regulations, including zoning codes and Shoreline Master Programs (SMPs).  REGULATION	Protect riparian forest cover; Protect wetlands	Support varies by jurisdiction. Mukilteo is developing prescriptive standards for what should be included in buffer (e.g., type, amount of vegetation); this may help gain support by making enforcement easier and more educational. Explaining other buffer functions can improve public acceptability of buffers; other functions include water quality, flood hazard reduction, habitat for species in addition to fish.	WRIA 8 Conservation Strategy should be used as one of a number of resources in developing a jurisdiction's best available science (BAS), on which to base current and future CAO and other policy and regulatory updates. Allowing other uses (e.g., trails, stormwater facilities) in buffers limits effective buffer function; these other uses could be prohibited or required to be sited in the landward side of the buffer.	The WRIA 8 Technical Committee (W8TC) has not provided specific guidance on buffer size. However, see Appendix D, Part 6 for references on critical areas.
In Tier 1 subareas in urban areas, require or encourage larger riparian buffers than for other urban subareas which are not Tier 1.  REGULATION	Protect riparian forest cover	Example: King Co. CAO applies rural aquatic buffers in urban areas designated as "special urban waters", based on premise that regulations should vary based on differences in environmental conditions and biological value in subarea. Some developers/jurisdictions oppose concept because they say if development must occur inside UGA, shouldn't also have to have strong sensitive area protections there.	WRIA8 watershed evaluation which establishes tiers is consistent with KC analysis of subareas for special urban waters protection. Note that other jurisdictions have used overlay zones to impose certain standards in areas which are considered of greater value in terms of salmon habitat or other natural resources.	
In rural areas, protect 65% forest cover, limit effective impervious area to 10% on a parcel-by-parcel basis (often referred to as 65-10 rule).  REGULATION	Protect forest cover; Limit impervious area; Manage stormwater	Example: King Co. CAO applies clearing restrictions in rural areas, 35% or 50% clearing allowed depending on lot size. This standard has raised questions from private property rights advocates and rural property owners. Some property owners and developers believe that this concept has not been sufficiently proven in the field, and that this one-size-fits-all approach is not scientifically based.	Can implement through clearing and grading regulations, and stormwater regulations. Some jurisdictions consider this a goal that may not be achieved through regulation alone, but should be pursued on a subarea or watershed-wide level through regulation, acquisition, and incentives. Some jurisdictions lack scientific staff to effectively apply and enforce such a standard. Some environmentalists believe that even such a standard does not achieve 65% forest protection; strict enforcement and accompanying public education are essential to insure that such a standard is effective.	There are technical uncertainties regarding the effect of such a standard (applied on a parcel-by-parcel basis) on hydrologic function, particularly where forest cover in a subarea is already significantly degraded. Where 65% forest retention standard is applied, it should take into account substrate, topography, type of vegetation, etc. which affect retention and infiltration.
In urban areas, protect remaining trees and forests and restore forest cover through street tree programs, tree retention/replacement programs, and urban reforestation programs.  REGULATION/INCENTIVE	Protect and restore forest cover	Note that in urban areas, some forest protection is also achieved through open space acquisition, zoning, buffers, LID stormwater regulations; these approaches have varying degrees of public and government support. Where reforestation programs are supported by grants and technical assistance, they are likely to have greater public support.	Examples include: Redmond's tree protection ordinance where developers are required to save a minimum of 35% of significant trees (6"+ DBH) on site. Incentives are offered for higher levels of tree protection. For each significant tree removed one needs to be replaced. If replacement can't occur on site, developers pay \$250/tree into a Tree Replacement Fund. Seattle and King County's urban forest programs. Olympia's tree protection ordinance.	
Prohibit or limit new bulkheads along lake shorelines and the nearshore; require or encourage that new docks meet NOAA Fisheries standards for overwater structures. Adopt and enforce through CAOs, SMPs, and steep slope ordinances.  REGULATION	Protect shoreline connectivity	Considerable interest among shoreline jurisdictions in specifications for overwater piers that NOAA Fisheries and other federal/state agencies have developed, and proposed for streamlined permitting.	Developing similar specifications for bulkheads is more difficult and controversial. Building several demonstration projects on public land where shoreline landowners, jurisdictions, and contractors can see how they really work is next crucial step, prior to regulatory approaches.	
Limit future development/ redevelopment in floodplains and channel migration zones (CMZs) through CAOs and flood regulations.  REGULATION	Protect floodplain connectivity and complexity	Support may vary by incorporated vs. unincorporated areas. Could also have health and safety benefits by reducing flooding hazards. Need to coordinate with boater concerns about LWD.	Note that FEMA allows some types of development and redevelopment within floodplains and CMZs; local jurisdictions can adopt stricter standards. One challenge is areas which were platted in the past; property takings issues could arise. Should coordinate with flood hazard planning efforts underway by jurisdictions.	

**Part 5: Menu of Land Use Actions**

Proposed Action	Desired Outcomes	Community Support (public, government, others)	Implementability (and other considerations)	Scientific Uncertainties (none identified if left blank)
<p>In urban areas, many existing structures along creeks, shorelines, etc. encroach into buffers and are nonconforming with development and environmental regulations. Over the long term (e.g., 50 years), jurisdictions should encourage or require that major redevelopment projects come into conformity.</p> <p>REGULATION/REG. FLEXIBILITY</p>	<p>Restore riparian forest cover</p>	<p>This is a significant challenge with both landowners and local politicians uncomfortable with reversing the direction of earlier development. Tradeoff is between encouraging economic development (which would allow more unconstrained redevelopment of nonconforming uses) and environmental protection which would limit continued development of a shoreline area. Some compromise is possible through restricted redevelopment incorporating LID and other environmentally sensitive features.</p>	<p>A sliding scale could be applied (e.g., based on redevelopment thresholds), where the greater the degree of redevelopment, the greater the expectation that the development come into compliance.</p>	
<p>Allow flexible approaches to meeting riparian and wetland buffers and 65-10 forest protection rule, e.g., farm plans, stewardship plans, cluster development.</p> <p>REGULATORY FLEXIBILITY</p>	<p>Protect forest and riparian cover; Protect wetlands; Limit impervious area; Manage stormwater</p>	<p>Many landowners and governments prefer flexibility. Example: KC CAO includes rural stewardship plan because public asked for greater flexibility; can serve to educate property owners as well. Clustering is opposed by some rural property owners because they feel it opens the way for future urbanization of rural areas.</p>	<p>Flexibility can require more training and time by local staff and applicant to do site specific analysis; process and materials provided for flexible approach must be kept relatively simple and inexpensive or they become disincentive to applicant. Design guidelines or templates are needed to help jurisdiction staff and landowners when negotiating flexible development permits (note work on BMPs that King County is doing for CAO implementation). Clustering has possible regulatory constraints and must be done very deliberately to balance environmental protection and lifestyle/aesthetic considerations.</p>	
<p>If forest cover cannot be protected, maintain hydrologic functions through stormwater regulations, programs, and BMPs.</p> <p>REGULATORY FLEXIBILITY</p>	<p>Protect forest cover; Limit impervious area; Manage stormwater</p>	<p>See actions in stormwater section below.</p>		
<p>During redevelopment, allow flexibility in meeting development standards and CAO requirements, so that there is no net loss to ecological function and to encourage some improvement such as enhancement of riparian buffers, minimizing floodplain development, and removal of impervious surfaces.</p> <p>REG. FLEXIBILITY/INCENTIVE</p>	<p>Protect/restore riparian forest cover; Limit impervious area; Manage stormwater; Restore floodplain connectivity</p>	<p>High local jurisdiction support – has been suggested by numerous local staff. Flexibility can be offered, e.g., through:</p> <ul style="list-style-type: none"> <li>• Buffer averaging or decreasing buffer in one place in exchange for buffer enhancement in another portion of buffer;</li> <li>• Increased density or clustering;</li> <li>• Flexibility in bulk standards, setbacks, siting and orientation that focuses active areas (e.g., driveways) away from critical areas.</li> </ul>	<p>Jurisdictions that have offered a range of buffer sizes recommend against this approach because smallest buffer will always be implemented. Dept. of Ecology recommends against buffer averaging. City of Issaquah cautions against flexibility in prescriptive buffer widths in exchange for buffer enhancement, because for Issaquah Creek, encroachment into floodplain and channel confinement are significant issues, and revegetation does not improve this riparian function. Certain forms of flexibility, e.g. clustering, should only be considered for certain sizes of projects.</p>	<p>W8TC cautions that the more flexibility allowed in buffer widths (e.g., buffer averaging) the more uncertainty that buffer functions will actually be protected; need for monitoring and enforcement is increased with increased administrative flexibility. Wild Salmonid Policy opposes flexible buffers because they are too easily compromised.</p>
<p>During new or redevelopment, allow mitigation through restoration and protection of offsite habitat, e.g., wetland and habitat banking, as long as direct impacts to Tier 1 salmon habitat are mitigated onsite.</p> <p>REGULATORY FLEXIBILITY</p>	<p>Protect/restore riparian forest cover; Protect/restore forest cover; Protect/restore wetlands</p>	<p>Allows flexibility to jurisdiction and developer while restoring and protecting critical habitat within the watershed. King County CAO includes mitigation reserves, whereby King County would own or manage wetland or aquatic areas where restoration is a priority (would use WRIA plans to set these priorities), and these areas could be used for mitigation. Habitat Bank and other private companies are working on banking concept in WRIAs 7, 8, and 9.</p>	<p>For large projects, EDT could be used to evaluate impact of restoring site(s) upstream and how much would need to be done to achieve equivalent of restoring onsite. Some jurisdictions think local ordinances will need to be modified to allow project mitigation to occur outside of the project's jurisdiction.</p>	<p>Where can/should the offsite mitigation be allowed – within the subarea, within the Chinook population area, within the WRIA, to achieve functional equivalence of restoring onsite?</p>
<p>Offer incentives and regulatory flexibility to encourage shoreline restoration through salmon friendly bulkhead and dock design, and restoration of sloping beaches and shoreline vegetation.</p> <p>REG. FLEXIBILITY/ INCENTIVE</p>	<p>Restore shoreline connectivity and riparian cover</p>	<p>Considerable interest among shoreline jurisdictions in specifications for overwater piers that NOAA Fisheries and other federal/state agencies have developed, and proposed for streamlined permitting.</p>	<p>Developing similar specifications for bulkheads is more difficult and controversial. Building demonstration projects on public land where shoreline landowners, jurisdictions, and contractors can see how they really work is next crucial step, prior to regulatory approaches. There is a possible disincentive in the Shoreline Management Act to shoreline restoration projects as the OHWM can be moved landward as a result of bulkhead removal; see Appendix D, Part 6.</p>	<p>Need additional data on how effective these types of restoration projects are in reducing predation on juvenile Chinook.</p>

**Part 5: Menu of Land Use Actions**

<b>Proposed Action</b>	<b>Desired Outcomes</b>	<b>Community Support (public, government, others)</b>	<b>Implementability (and other considerations)</b>	<b>Scientific Uncertainties (none identified if left blank)</b>
Offer incentives for protecting existing forest cover beyond required levels, e.g., current use taxation, conservation easements, transferable development rights (see next action).  INCENTIVE	Protect forest cover; Limit impervious area; Manage stormwater	Incentives have public support because they reward property owners who are willing to be stewards; can be less costly to local government than outright acquisition, although can be more costly than regulation. Some property owners oppose current use taxation because they believe it reduces the rural tax base, and other rural landowners must pick up the difference.	Lots of examples locally and nationally which could be examined for what works best, including: King County's Public Benefit Rating System (PBRS) and Timberland Program for current use taxation. Issue of long-term maintenance of parcels protected through incentives or through acquisition must be addressed and recognized as a real cost. Maintenance, stewardship, monitoring, adaptive monitoring of protected parcels can be through government, private associations, non-governmental organizations (see, e.g., Cascade Land Conservancy stewardship of wetlands in Redmond Ridge UPD).	
Promote transferable development rights (TDRs) programs to shift development away from critical habitat areas to areas where existing infrastructure can support additional growth.  INCENTIVE	Protect forest cover; Limit impervious area; Manage stormwater; Protect riparian forest cover	A number of jurisdictions are trying this. King and Snohomish Cos. and Black Diamond have TDR ordinances; Seattle has designated Denny Triangle as receiving site. King County program has lots of applicants; note recent Snoqualmie Tree Farm action. Land in rural area is easier to acquire to protect once the development rights are purchased, because it is cheaper. TDR programs should include provision to give the urban receiving site certain amenities (e.g., pocket park, additional green space) so that they have an incentive to take the additional density; this will increase public support for such programs.	One of biggest challenges is in assuring there will be receiving sites for the density credits. This is affected by development market in general, where strong development market will increase the demand for density credits. Unfortunately, most cities already have sufficient density and buildings are not using available zoned density. One option is for urban areas to downzone certain areas, so that there is a greater need for developers to buy the density credits to achieve the densities they would like. What are tradeoffs and feasibility of rural to rural TDRs?	
Offer incentives to encourage revegetation of degraded riparian buffers and deforested areas, and removal of impervious areas, e.g., reduced permit fees, streamlined permit process, technical assistance, etc.  INCENTIVE	Restore forest and riparian forest cover; Limit impervious area; Manage stormwater	Incentives have public support because they reward property owners who are willing to be stewards. It's difficult to require property owners to restore environmental conditions without incentives. Bellevue has Stream Team fee waiver where clearing and grading fee is waived for stream revegetation projects. If fish habitat project is applied for through JARPA, fee is waived. NOAA Fisheries et al example on dock permit streamlining if meet salmon friendly standards.	Incentives can be less costly to local governments than outright acquisition, but can be more costly than regulations. The effort by NOAA Fisheries and other agencies which offers streamlined permitting to applicants which meet specifications for overwater structures provides example of mechanism that is in place to encourage voluntary retrofits of docks to include salmon-friendly features. Could use GIS maps to identify areas for reforestation which were former forested wetlands or uplands.	To what extent can environmental function be improved over time through these incremental improvements?
Adopt salmon-friendly standards for maintenance of public lands (e.g., irrigation, drought resistant plantings, pesticide use, road construction and maintenance)  VOLUNTARY PROGRAM	Protect forest and riparian cover; Limit impervious area; Manage stormwater	Shows that local jurisdictions can set good example as stewards, and that they put their money where their mouth is. Some jurisdictions are already doing integrated pest management, e.g., Seattle, Renton, King Co.	Would require development of guidelines/ standards. Local parks departments would need to weigh salmon friendly standards with other considerations such as liability, cost-effectiveness, public safety, recreational uses, etc.	
Develop and implement landscape certification programs for private contractors.  VOLUNTARY CERTIFICATION	Protect forest and riparian cover; Manage stormwater	Rewards landscape firms that are good stewards. Could start with education program, and find out what barriers exist to using environmentally sound landscape practices. Note this action is also recommended by Public Outreach Committee.	Would require development of guidelines/ standards and training.	
Acquire critical habitat areas  ACQUISITION	Protect forest and riparian cover; Limit impervious area	Cost to buy land can be high, and long term maintenance costs must be considered. Public ownership also takes the land out of tax base, and some citizens oppose this. Can offer other public benefits, including open space, passive recreation, education opportunities.	Provides greatest certainty of protection, when regulations and incentives may not provide enough protection. Depends on funding availability. Requires long term maintenance (as discussed see above).	EDT model provides some guidance on which stream reaches are highest priority to protect through acquisition; however, there is less guidance on relative importance of protecting headwater and upland parcels.

**Part 5: Menu of Land Use Actions**

<b>COMPREHENSIVE STORMWATER MANAGEMENT (FOR WATER QUALITY AND QUANTITY)</b>				
Phase 2 jurisdictions should adopt comprehensive stormwater management programs consistent with Ecology's NPDES Phase 2 permit.  REGULATION	Manage stormwater to reduce quantity/quality impacts from past, present, & future development.	Some jurisdictions believe the political and economic impacts of applying Ecology's 2001 Stormwater Management Manual for Puget Sound in areas that are highly urbanized would be difficult and result in high cost with relatively small benefit.	It is not yet known if the Phase 2 permit will include adoption of the state's 2001 manual or equivalent; however, it is likely that many Phase 2 jurisdictions will adopt all or part of the manual on their own – it is too soon to say.	W8TC or other local experts could revisit the adequacy of specific stormwater control standards (in terms of salmon habitat) once Phase 2 permit is published.
Phase 2 jurisdictions could go beyond Ecology's minimum standards, for example, they could add stormwater planning and capital improvement projects to their stormwater programs  REG. OR VOLUNTARY PROGRAM	Manage stormwater to reduce quantity and quality impacts	These elements are part of Phase 1 and Tri-County stormwater program, so expertise exists; some Phase 2 jurisdictions already have capital improvement programs to address flooding, water quality, and habitat needs. However, other jurisdictions may not be willing to exceed Ecology minimum standard.	Could provide opportunities for multi-jurisdiction planning to analyze stormwater problems, and shared construction of capital projects on voluntary basis. Could provide opportunity for jurisdictions to prevent further degradation in urban areas and restore in rural areas through stormwater planning on subbasin or broader level (see WRIA-wide approach below)	
Phase 1 jurisdictions should update their comprehensive stormwater management programs consistent with Ecology's next Phase 1 permit, including 2001 manual or equivalent  REGULATION	Manage stormwater to reduce quantity and quality impacts	Phase 1 permit will likely not increase requirements until Phase 2 programs are increased after first permit term.	King Co. manual will have more flow control BMPs (also referred to as LID BMPs) – See Appendix D, Part 6. Seattle has initiated an effort to coordinate with other jurisdictions on revisions to their stormwater, grading, and drainage codes. They have also completed an initial "Restore Our Waters" strategy, which coordinates across city departments to establish priorities for restoration of water quality, flows, and critical habitat.	
Implement Total Maximum Daily Loads (TMDLs).  REGULATION	Manage stormwater to reduce quantity and quality impacts	Ecology is required under the Clean Water Act and a lawsuit settlement to complete all TMDLs for 303(d) listed waters within approximately 10 years. Implementation of TMDLs will be incorporated into NPDES permit conditions. Centennial Clean Water Fund should help fund TMDL implementation.	Affected jurisdictions should participate with Ecology in developing TMDLs to increase the likelihood that the implementation plan is effective and practicable. Ecology is working closely with local jurisdictions and other stakeholders on TMDL development and implementation in Issaquah Creek, North Creek, and Little Bear Creek (all for bacteria).	
Address agricultural impacts on water quality, flows, as well as on riparian buffers, through adoption and implementation of livestock ordinances, adoption and implementation of farm plans, and other mechanisms.  REGULATION/REGULATORY FLEXIBILITY/INCENTIVE	Manage stormwater; Protect and restore forest and riparian cover; protect and restore flows	Education is an important element of making these combined approaches effective. There are many stewardship programs to coordinate with, e.g., Horses for Clean Water. WRIA planners need to be sensitive to economic demands of agriculture when developing and implementing actions, and to involve farmers in development of appropriate actions.	Highest priority are those farm areas which are most susceptible due to fine soils.	
Require or encourage low impact development (LID) through education, training, regulation, and demonstration projects (see demonstration actions below).  REGULATION/REGULATORY FLEXIBILITY/INCENTIVE	Manage stormwater; Protect forest cover; protect and restore flows	There is growing interest in LID among local jurisdictions, developers, and landowners as it offers a potential approach to accommodate growth while providing long term, sustainable approach to managing stormwater through improved retention and infiltration. A few examples include: City of Sammamish is working on an LID ordinance; Snohomish Co. has adopted a voluntary Reduced Drainage Discharge Demonstration Program.	There are many tools to encourage or require LID, including stormwater regulations and manuals, revising ordinances to better allow and promote LID BMPs, offering training, offering regulatory flexibility. See Appendix D, Part 6 for numerous resources and examples.	
Retrofit existing neighborhoods with natural drainage systems. Plan and build new developments to include LID features.  DEMONSTRATION PROGRAM	Manage stormwater	Hands-on examples can develop knowledge and support among local staff, elected officials, homeowners, and developers. Projects develop important data on costs and marketing as well as technical effectiveness and challenges.	Seattle's Natural Drainage System Program includes numerous examples of retrofit and new construction at different scales including: SEA Streets, Broadview Neighborhood and High Point Redevelopment. Additional examples exist in King County, Issaquah, Snohomish Co., and others (see Appendix D, Part 6). Feasibility will vary by density, underlying geology/soils, etc.	

**Part 5: Menu of Land Use Actions**

Phase 1 and 2 jurisdictions could develop and adopt a WRIA-wide stormwater management program and work with Ecology to use it as the basis of a WRIA-wide municipal permit  VOLUNTARY COLLABORATION	Manage stormwater to reduce quantity and quality impacts	By working together, smaller jurisdictions could benefit from expertise and resources of larger jurisdictions; regional stormwater facilities could be planned, cost shared, and built where local facilities would not have been cost-effective. Would be more efficient and effective use of public funds. Some jurisdictions oppose this concept, as they believe there may not be benefits to them and it could raise legal issues.	WRIA-wide planning structure already exists through ILA for salmon conservation planning. More aggressive stormwater checklist was developed for Tri-Co. – this could be used as starting point for WRIA wide stormwater program; Would require support and cooperation from Dept. of Ecology. ISP review of state manual encouraged this kind of watershed-level planning.	
Plan and build regional stormwater facilities to address stormwater problems in developed areas which predate stormwater regulations.  VOLUNTARY COLLABORATION	Manage stormwater to reduce quantity and quality impacts	Des Moines Creek regional stormwater detention pond example shows how fees from new development can help support facilities like this, and help pay for habitat restoration.	Lots of existing development doesn't meet stormwater regulations; regulations would only apply if redevelopment occurs, so this is voluntary approach (note it requires stormwater planning to find these opportunities); implementation could be expensive and physically challenging in urbanized areas, so must weigh costs and benefits.	
<b>PROTECTION AND RESTORATION OF INSTREAM FLOWS</b>				
Improve data about and enforcement of water rights for surface and groundwater withdrawals.  REGULATION/REGULATORY COORDINATION	Protect/restore adequate flows	Water rights and their enforcement are controversial, and some local jurisdictions believe that they have no influence over what Ecology (and the State Legislature) decides to do about water withdrawals. Other jurisdictions and environmentalists believe that this issue must be pursued because it has such important impacts on salmon habitat.	Includes illegal withdrawals, allowed withdrawals that exceed limits, and municipal withdrawals. Need to coordinate with Ecology, local health departments, water suppliers, local permitting agencies. See, e.g., RCW 90.54.060, RCW 90.54.090, RCW 90.54.130.	Considerable uncertainties exist about what exactly is causing low flow conditions in particular basins and how to correct it.
Restrict or eliminate use of exempt wells where those wells directly affect stream-flows or groundwater recharge.  REGULATION/COORDINATION	Protect/restore adequate flows	Local jurisdictions have greater authority over exempt wells through local health department and construction department policies, regulations, and site reviews. These exempt wells include wells serving multiple residences but not exceeding 5000 gallons a day (also referred to as 6-packs, or not more than 6 homes on one well), watering of a lawn or garden not exceeding ½ acre.	Local jurisdictions should work with Dept. of Ecology to more effectively monitor and enforce the limit to ½ acre of irrigated land per exempt well. Jurisdictions could place more restrictions on use of exempt wells; e.g., proposed revisions to KC Comprehensive Plan include policies that would limit 6 packs (e.g., no more than one exempt well per development), and encourage users to hookup to existing water systems.	
Protect critical aquifer recharge areas through CAOs and zoning designations  REGULATION	Protect/restore adequate flows	Examples include King Co.'s and Issaquah's proposed CAOs.	While this addresses aquifers which are used for domestic water use, it does not protect groundwater recharge areas which benefit salmon, e.g., Cold Creek headwaters. Jurisdictions should consider this additional application.	
Adopt/enforce stormwater regulations and BMPs to address high and low flows, including forest retention, low impact development, infiltration standards, and redevelopment opportunities to redesign and retrofit stormwater facilities.  REGULATION/INCENTIVE	Protect/restore adequate flows	See discussion above under <i>COMPREHENSIVE STORMWATER MANAGEMENT</i>		
Regulate lawn size or frequency and amount of watering during summer  REGULATION	Protect/restore adequate flows	Likely very low support from public; most jurisdictions are uncomfortable with this regulatory approach.	May be more effective if utilities promote on voluntary basis first through education (e.g., expand natural yard care programs) or water rate structures.	
Promote water conservation programs for residential and commercial customers through land development and water hook-up permit processes, e.g. by providing education materials to permit applicant.  INCENTIVE/EDUCATION	Protect/restore adequate flows	Numerous education and incentive programs exist; can they be more effectively promoted? A number of jurisdictions have or are planning water conservation demonstration gardens, to relate the message of water conservation to salmon recovery. Examples include Woodinville Water, Issaquah, and Redmond.	While conservation is important year-round, summer low flows are especially critical to salmon, so actions to address summer uses such as residential and commercial landscaping are particularly important. Water conservation efforts will become even more critical as human populations continue to grow in the WRIA.	

**Part 5: Menu of Land Use Actions**

Water suppliers should look into working together to shift supply from one source to another to protect instream flows crucial to salmon in a particular area. Could promote new development to go on existing public water systems.  VOLUNTARY PROGRAM	Protect/restore adequate flows	Examples of where this could be useful include Sammamish River and Rock Creek. Central Puget Sound Water Supplier's Forum looked into this concept with Regional Integrated Management Area. Any approach like this will require Dept. of Ecology cooperation/support.	Part of the argument for putting new rural development on public water systems is that the water is brought into a basin and then that water recharges local groundwater through onsite septic systems. Septic systems must be operating correctly, so this involves local and state health departments.	Any proposal for interbasin transfer must consider instream flow impacts to Chinook and other salmonids in all systems.
Establish standards for onsite irrigation (could apply to public and private properties); could apply these as incentive (e.g., reduction of fees), education, or mandatory.  VOLUNTARY CERTIFICATION	Protect/restore adequate flows	Depends on whether standards are mandatory or voluntary; generally educational and incentive approaches have higher public support. Some jurisdictions will want to develop their own standards, while others will prefer to collaborate.	Should incorporate in landscape certification program. Could use standards in development review process to give option for use of drought tolerant native vegetation that does not require installation of irrigation systems for development.	Issues of where irrigation water is drawn from (e.g., local well, Seattle's water supply, etc.), where it is recharging, and impact on base flows need to be explored.
Promote use of reclaimed water for certain projects (e.g., parks, golf courses, recreation areas, industrial areas).  VOLUNTARY PROGRAM	Protect/restore adequate flows	Example: King Co. is working towards reclaimed water projects. Education is needed; KC Water Reclamation Project along the Sammamish Valley has met with some resistance. Some jurisdictions have concerns about using reclaimed water for parks/golf courses due to potential for heavy metals, increase in algae and nitrogen, and human health risk.	Need to involve Dept. of Health. Opportunities may be expensive. Are LEED standards (from Green Building Council) for gray water use applicable here?	
Work with local groundwater protection committees, and King County's Groundwater Protection Program  VOLUNTARY COLLABORATION	Protect/restore adequate flows	Most of the local groundwater committees have diverse local jurisdiction and stakeholder support. Where this support does not exist, it can cause problems for the substance and process of the planning and implementation effort. A few jurisdictions question the value of this approach.	KC Groundwater Protection Program offers opportunity to coordinate with another cross-jurisdictional program and work toward common goals.	
<b>GROWTH MANAGEMENT, LAND USE AND TRANSPORTATION PLANNING</b>				
Encourage most growth inside UGA (with no net loss to critical area function), and protect rural resources outside of UGA. Emphasize low impact development wherever feasible.  REGULATION	Addresses most outcomes	While this is a very broad action, it is important to recognize it as a significant contribution by urban areas to protecting high quality habitat in rural areas. Public support may vary by how strictly growth management is imposed, and whether or not costs and benefits to rural and urban areas are perceived as equitable. LID features can help accommodate growth while better protecting natural resources.	This is consistent with the Growth Management Act. Note that some cities have regionally designated Urban Centers where residences and jobs are targeted at higher concentrations than in other areas, which can create additional challenges for protecting and restoring salmon habitat.	
Limit new roads and road crossings in proximity to aquatic areas in Tier 1 and Tier 2 subareas.  REGULATION	Limit impervious surfaces; Minimize road crossings	Numerous road projects underway in WRIA 8, e.g. I-405, SR 520, etc.	Could encourage standards for new roads, e.g., to minimize runoff, use native vegetation, require bridges to span floodplain rather than encroach, prohibit floodplain fill, etc.	
Retrofit roads to address water quality and flow issues as part of major maintenance, expansion, or upgrade projects. Adopt and implement Regional Road Maintenance Endangered Species Act Program Guidelines (i.e., Tri-County standards) for road maintenance.  VOLUNTARY PROGRAM	Limit impervious surfaces; Minimize road crossings; Manage stormwater	Many jurisdictions have already adopted the maintenance standards formally or informally; the standards have been approved by NOAA Fisheries.	Retrofit of roads can be very expensive, and technically difficult given space requirements. Regional funding could help cover costs.	

**Part 5: Menu of Land Use Actions**

***ENFORCEMENT, VARIANCES, REASONABLE USE EXCEPTIONS***

Strengthen enforcement of existing regulations, and in the future if revised regulations are adopted  REGULATION	Addresses most outcomes	It is difficult to garner support from environmentalist and landowners for stricter environmental regulations, when current levels of regulation are poorly enforced. Many local planners and environmentalists point out need for increased enforcement of existing laws and policies. Education about why regulations exist, and incentives to go beyond regulations increases public acceptability of regulations.	Enforcement is complaint driven. Buffers are often in backyards or behind fences and are difficult to see. Many jurisdictions lack adequate enforcement staff, and sometimes fines are not a sufficient disincentive to stop a landowner from taking an illegal action. Citizen watchdog groups, e.g., Water Tenders, can play an important role in alerting local governments to buffer encroachment. Contacting multiple agencies about an infringement can increase likelihood something will be done to stop it. Focus on site design issues that can be addressed during permit stage rather than become enforcement issues?
Adopt policies and procedures which limit cumulative impacts on critical areas from variances and reasonable use exceptions (e.g., see next actions)  REGULATION/POLICY	Protect forest and riparian cover; protect wetlands	Tri-County has a useful reasonable use provision. See KC policy in CAO; it more clearly defines reasonable use when evaluating a variance proposal. It may be necessary to create of fund to buy out property owners who are denied "reasonable use" of their properties as a result of prohibiting an exemption or a variance.	Note that Snohomish Co. designed study of buffer encroachment and how it varies by land cover, etc.
Prohibit or minimize any variances into a sensitive area, or require that permit staff consult with scientific staff and salmon plan before granting a variance into a sensitive area. A more flexible approach would be to require that variances be granted from front and side yard setbacks before allowing a variance to encroach into an aquatic buffer.  REGULATION/REG. FLEXIBILITY	Protect forest and riparian cover; protect wetlands	Wash. Dept. of Ecology is recommending no variances from buffers.	The more flexible approach allows developer to have flexibility to build larger home, yet reduces impacts to natural resource. Redmond uses this flexible concept to promote greater tree protection and higher quality designs. Des Moines has used this approach in their CAO for years.
Continue to enforce Native Growth Protection Easements (NGPE)  REGULATION/VOLUNTARY PROGRAM	Protect forest and riparian cover; protect wetlands	Challenge is to protect NGPEs from encroachment, even though many were negotiated some time ago as part of subdivision approvals; enforcement is relatively low priority for jurisdictions, yet encroachments are common.	Possible solutions include: signage, platting the NGPE as a separate plat, fencing. Redmond uses signage, fencing, and requires the NGPE to be recorded with the plat development, and the city then tracks the recorded NGPE in a GIS database. However, this does not assure enforcement. As noted earlier, maintenance of these lands is another issue.
Re-organize enforcement staff to improve the effectiveness of environmental regulations.  VOLUNTARY PROGRAM/TRAINING	Addresses most outcomes	A number of jurisdictions expressed interest in some way to consolidate and better train staff who are in charge of environmental regulations. Another concern frequently expressed, especially among medium and smaller jurisdictions, is the lack of scientific staff to support planners who process development proposals.	Options include: Increase connection between scientific staff who develop codes and code-implementing staff (whoever is implementing salmon-related regulations). Could train "green" permit staff and separate them from regular building and other code staff. Could provide a circuit rider scientist to serve multiple smaller jurisdictions on a consulting basis.

**NOTES:**

- Actions in the menu apply to rural and urban areas unless specified.
- See also references in Appendix D, Part 6 re: critical areas, stormwater, low impact development, shoreline management.
- Note that all actions require education and enforcement to be effective.
- Timing for current land use revisions includes:
  - ✓ Critical areas ordinances are being revised by most jurisdictions by Dec. 04, based on review of best available science.
  - ✓ Shoreline Master Programs are being updated by many jurisdictions between 2004 and 2009.
  - ✓ NPDES Phase 1 and Phase 2 municipal stormwater permits are being updated during 2004 and 2005.

## **Part 6: References for WRIA 8 Land Use Actions**

**Note: This list of references was requested by WRIA 8 stakeholders. The references are for informational purposes only; they do not provide mandatory standards for WRIA 8 jurisdictions. The list is not inclusive of all information resources; those items which were readily available at the time the report went to the printer were included.**

### **Outline**

#### **1. Critical Areas**

##### Streams

- Puget Sound Action Team
- WA Department of Fish and Wildlife
- WA Department of Community, Trade and Economic Development
- Tri-County Salmon Conservation Coalition
- Local Jurisdiction Resources
- Non-governmental Organization Resources

##### Wetlands

- Puget Sound Action Team
- WA Department of Community, Trade and Economic Development

#### **2. Stormwater**

##### Standards and General Programmatic Elements

- WA Department of Ecology
- Puget Sound Action Team
- Tri-County Salmon Conservation Coalition

#### **3. Low Impact Development**

- General LID Concepts
- LID Online Information Resources
- LID Publications and Fact Sheets
- LID Sample Projects Around Puget Sound
- LID Sample Ordinances and Regulations

#### **4. Shoreline Management**

- WA Department of Ecology
- WA Department of Community, Trade and Economic Development Handbook
- Puget Sound Action Team
- Other References

#### **5. References**

# 1. CRITICAL AREAS

## Streams

Note: The following resources are just a few of those available on critical areas “best available science” and the regulations based on this BAS. The WRIA 8 Technical Committee has not systematically reviewed these references or links. The Committee did, however, recommend that buffer sizes should reflect the desired function, such as LWD recruitment, shade, bank stabilization, nutrient sources, etc. (WRIA 8 TC meeting minutes, 5/12/04).

**Puget Sound Action Team.** PSAT published guidance for critical areas regulations in Growth Management Updates (March 2004) – available at [www.psat.wa.gov](http://www.psat.wa.gov). The following guidance is included for fish and wildlife habitat areas.

- Designate marine riparian areas and nearshore habitats (surf smelt and sand lance spawning areas, eelgrass and kelp beds) as critical fish and wildlife habitat areas.
- Designate feeder bluffs not only as geologically hazardous (eroding, slide-prone) bluffs, but also as areas critical for maintaining forage fish spawning habitat where sediment from the feeder bluffs nourishes such habitat.
- Designate shell fish beds as critical fish and wildlife habitat areas.
- Require consistence of habitat protection plans with recommendations in WDFW Aquatic Habitat guidelines for fish and wildlife habitat conservation areas ([www.wa.gov/wdfw/hab/ahg](http://www.wa.gov/wdfw/hab/ahg)).

**WA Department of Fish and Wildlife.** See WDFW-Tribal Wild Salmonid Policy (WDFW, 1997).

**WA Department of Community, Trade and Economic Development.** See critical areas handbook at:

<http://www.cted.wa.gov/DesktopModules/Documents/ViewDocument.aspx?DocumentID=1034>

**Tri-County Salmon Conservation Coalition.** The Tri-County Model 4(d) Rule Response Proposal (May 2001) proposed management zones to protect fish habitat.

Aquatic Area Type	Definition	Rural Buffer Requirement (inner mgt. zone/outer mgt. zone)	Urban Buffer Requirement (inner mgt. zone/outer mgt. zone)
Type S	Shorelines of the state (rivers over 20 cfs, marine shorelines and lakes over . 20 acres)	150 feet/50 feet	115 feet/85 feet
Type F	All non-shorelines of the state, streams, lakes and ponds that have fish or fish habitat	150 feet/50 feet	115 feet/85 feet
Type F (steep ravine)	All non-shorelines of the state, streams, lakes and ponds that have fish or fish habitat	Greater of 100 feet or 25 feet from top of bank	Greater of 100 feet or 25 feet from top of bank

<b>Aquatic Area Type, cont.</b>	<b>Definition, cont.</b>	<b>Rural Buffer Requirement (inner mgt. zone/outer mgt. zone)</b>	<b>Urban Buffer Requirement (inner mgt. zone/outer mgt. zone)</b>
Type N (within ¼ mi. upstream of Type S or F)	Other natural waters connected to Type S or F waters	115 feet/0 feet	115 feet/0 feet
Type N (more than ¼ mi. upstream of Type S or F)	Other natural waters connected to Type S or F waters	65 feet/0 feet	65 feet/0 feet

Additional Tri-County Model 4(d) Rule Response Proposal program elements include:

- Buffer averaging
- Land use restrictions and allowed uses in each management zone
- Seasonal clearing restrictions
- Flexibility in buffer widths if Habitat Evaluation completed

**Local Jurisdictions in WRIA 8:**

Due to time limitations, it was not possible to obtain best available science documents or buffer examples from many WRIA 8 jurisdictions. Therefore, examples are presented from the largest jurisdictions and those which requested that their information be included. Other jurisdictions' best available science documents and buffer standards can be found at their websites.

**City of Seattle.** The City of Seattle's proposed critical areas update is described at <http://www.ci.seattle.wa.us/dpd/news/20031216a.asp>

**City of Renton.** The City of Renton's proposed critical areas update is described at <http://www.ci.renton.wa.us/ednsp/cao.htm>

**City of Bellevue.** The City of Bellevue's proposed critical areas update is described at <http://www.ci.bellevue.wa.us/page.asp?view=33557> and <http://www.cityofbellevue.org/page.asp?view=7615>

**Snohomish County.** Snohomish County is currently developing their best available science and proposed critical areas regulations. Contact Larry Adamson, Snohomish County Department of Planning and Development Services, (425) 388-3311.

**King County.** King County's recently adopted critical areas regulations include new protection regulations for aquatic areas (streams, rivers, lakes, ponds and marine shorelines). Details are available at <http://www.metrokc.gov/ddes/cao>. King County's Best Available Science Analysis includes buffer information completed through the Tri-County Salmon Conservation Coalition biological review process. The following is excerpted from King

County's best available science document (Best Available Science, Volume I: A Review of Science Literature [February 2004]). This document and full references cited are available at <http://www.metrokc.gov/ddes/cao>.

The dynamic nature of aquatic habitats notwithstanding, the most common method for aquatic habitat protection has been the use of fixed riparian buffers (Haberstock et al. 2000). These are intended to protect a footprint of sufficient size to provide shade and temperature regulation, flood conveyance, water quality protection and pollutant removal, nutrient cycling, sediment transport and woody debris recruitment. In addition, buffers are thought to be essential in protecting aquatic habitat from excessive or unnatural development-related disturbance and other detrimental impacts (Spence et al. 1996; IMST 2001).

A variety of technical reports summarize and synthesize the scientific literature on buffer functions and make recommendations for buffer widths. Tables X, Y and Z, summarizing three such reports, are excerpted from the Biological Review of the Tri-County Model 4(d) Rule Response Program (Parametrix 2002). Others include Castelle et al. (1992), Castelle and Johnson (2000), Desbonnet et al. (1994), Johnson and Ryba (1992) and Portland Metro (1999). These reports summarize the findings of multiple studies on buffer width effectiveness and synthesize those findings into recommendations for various buffer functions.

**Table X. Riparian Buffer Functions and Appropriate Widths Identified by May (2000)**

<b>Function</b>	<b>Range of Effective Buffer Widths</b>	<b>Minimum Recommended</b>	<b>Notes On Function</b>
Sediment Removal/Erosion Control	26 - 600 ft (8 – 183 m)	98 ft (30 m)	For 80% sediment removal
Pollutant Removal	13 - 860 ft (4 - 262 m)	98 ft (30 m)	For 80% nutrient removal
Large Woody Debris Recruitment	33-328 ft (10 –100 m)	262 ft (80 m)	1 SPTH based on long-term natural levels
Water Temperature Protection	36 - 141 ft (11 – 43 m)	98 ft (30 m)	Based on adequate shade
Wildlife Habitat	33 - 656 ft (10 – 200 m)	328 ft (100 m)	Coverage not inclusive
Microclimate <sup>1</sup> Protection	148 - 656 ft (45 – 200 m)	328 ft (100 m)	Optimum long-term support

<sup>1</sup> Microclimate is the local climate (humidity, wind, and air temperature) within the stream-riparian ecosystem that is primarily affected by the quality and extent of riparian vegetation in a buffer.

**Table Y. Riparian Functions and Appropriate Widths Identified by Knutson and Naef (1997)**

<b>Function</b>	<b>Range Of Effective Buffer Widths (Ft)</b>
Water Temperature Protection	35 - 151
Pollutant Removal	13 - 600
Large Woody Debris Recruitment	100 - 200
Erosion Control	100 - 125
Wildlife Habitat	25 - 984
Sediment filtration	26 - 300
Microclimate	200 - 525

**Table Z. Riparian Functions and Appropriate Widths Identified from FEMAT (1993)**

<b>Function</b>	<b>Number of SPTH</b>	<b>Equivalent (Ft) Based on SPTH of 200 Ft.</b>
Shade	0.75	150
Microclimate	up to 3	up to 600
Large Woody Debris	1.0	200
Organic Litter	0.5	100
Sediment Control	1.0	200
Bank Stabilization	0.5	100
Wildlife Habitat	-----	98 – 600

In addition to the fixed buffer width approach, some variable width buffer approaches have been proposed (e.g. see Forman 1995). Haberstock et al. (2000) provides recommendations for a variable width two-zone approach for the protection of endangered Atlantic salmon habitat. In their approach, Zone 1 is a fixed 35-ft width closest to the water in which no disturbance should occur. Zone 2 is a variable-width area wherein limited low-impact uses (recreation, low-impact forestry) that do not compromise the desired functions of the buffer could be allowed. Total buffer widths (Zone 1 plus Zone 2) range from a minimum of 70 ft to 400 ft, with a maximum of 1,000-ft in rare cases, such along streams that are flanked by extensive steep (> 25%) slopes. Adjustments in Zone 2 width can be made for the presence of surface and groundwater seepage features, forest floor roughness, sand and gravel aquifers, wetlands, floodplains, very steep slopes, and stream order. All but one of the adjustment factors (the degree of forest floor surface roughness) causes Zone 2 to increase. These authors note that buffer widths are expected to vary regionally as a function of buffer conditions, management objectives and instream habitat characteristics. They also note that theirs is a conceptual model and potentially subject to change as studies and scientific literature provide new data that better indicate the relationships between buffer characteristics and buffer effectiveness.

There is no consensus in the scientific literature regarding single buffer widths for particular functions, or to accommodate all functions. However, neither does the literature indicate that buffers are not needed, nor do they recommend buffers beyond the equivalent of several site potential tree heights (SPTHs). One SPTH, the maximum height a tree will attain given the existing geology, soils, and other site conditions, ranges from 50 to 250 feet, depending on species, for a tree at least 300 years old in western Washington forests. A buffer width equal to one SPTH would provide for a broad range of riparian functions important for sustaining salmonids.

The effects of human activities in and near buffers are a factor not often assessed in reviews of buffer widths, but such activity can definitely impact buffers. As the number of people and development intensity near a waterbody increases, it is reasonable to assume that wider buffers and restrictions such as building setbacks are needed to prevent damage to the buffer. Conversely, narrower buffers may suffice in areas of low-intensity land-use and where the surrounding landscape is native forest. A wider buffer may be needed to protect streams from impacts resulting from the day-to-day impacts of people, such as trail construction, recreation, pets, garbage, and tree removal.

There is also no clear consensus in the scientific literature on whether fixed or variable width buffers are most effective. Fixed-width buffers are more widely applied and easier to implement (Chase et al. 1997 as cited in Haberstock 2000). Variable width buffers have been described as being more ecologically sound, however, because they have the potential to reflect the true complexity of the environment and management goals (Haberstock et al. 2000; IMST 2001). Todd (2000 as cited in May 2000) suggests that variable width buffers provide the best protection while respecting property rights. While variable-width buffers may be more ecologically sound and theoretically allow landowners more flexibility, there are no generally accepted criteria for the establishment of variable-width buffers. To ensure success in the face of uncertainty about specific site conditions, and to be effective under a worst-case scenario, May (2000) and Haberstock (2000) suggest that fixed-width buffers should be designed conservatively, i.e., larger than the bare minimum needed for protection.

***Non-governmental Organizations:***

Several other resources are available from non-governmental organizations; two examples follow. Again, these have not been reviewed by the WRIA 8 Technical Committee, but are presented for informational purposes

***Washington Environmental Council.*** “Habitat Protection Took Kit, A Guide to Habitat Conservation Planning Under Washington’s Growth Management and Shoreline Management Acts,” WEC, June 2004. Copies are at <http://www.wecprotects.org/habitat/documents/2004TKf.pdf>

***Sustainable Fisheries Foundation.*** “The Role of Critical Area Regulations in Recovering Puget Sound Salmon: A Checklist for Advocates,” SFF, Jan. 2005. Available online: <http://www.sff.bc.ca/>

## Wetlands

***Puget Sound Action Team.*** PSAT published guidance for critical areas regulations in Growth Management Updates (March 2004) – available at [www.psat.wa.gov](http://www.psat.wa.gov). The following guidance (not developed directly for purposes of fish habitat protection) is included for wetlands:

- Recommend WA Department of Ecology’s draft Best Available Science for Freshwater Wetlands (available at [www.ecy.wa.gov/programs/sea/bas](http://www.ecy.wa.gov/programs/sea/bas))
- Revise wetland buffers to be consistent with the Department of Ecology publication Wetland Buffers: Use and Effectiveness (Publication #92-10)
- Adopt mitigation policies for wetlands consistent with the state Alternative Mitigation Policy Guidance for Aquatic Permitting (available at [www.wa.gov/wdfw/hab/ahg](http://www.wa.gov/wdfw/hab/ahg))
- Recommend WA Department of Fish and Wildlife’s Aquatic Habitat Guidelines at [wdfw.wa.gov/hab/ahg/marnsrc](http://wdfw.wa.gov/hab/ahg/marnsrc)

***WA Department of Community, Trade and Economic Development.*** See handbook at: critical areas handbook:

<http://www.cted.wa.gov/DesktopModules/Documents/ViewDocument.aspx?DocumentID=1034>

## 2. STORMWATER

### Standards and General Programmatic Elements

***WA Dept of Ecology.*** The Phase II NPDES municipal permit program to be administered by DOE includes multiple program elements for local stormwater management. The minimum required program elements will likely include:

- Public education
- Public involvement/outreach
- Illicit discharge detection and elimination
- Construction site stormwater runoff control (erosion and sedimentation control)
- Post-construction stormwater management (flow control and WQ treatment requirements)
- Stormwater pollution prevention (municipal operations and maintenance)

These required elements, plus monitoring and capital improvement requirements, currently apply to Phase I jurisdictions including King County and Seattle. Ecology’s 2001 Stormwater Management Manual for Western Washington provides standards to address construction and post-construction stormwater management. A brief summary of some of these requirements follows:

- Drainage review required for any development proposal greater than 2,000 square feet of impervious surface or 7,000 square feet of land disturbing activity
- Drainage requirements: flow control facility or BMPs for projects with greater than 2,000 square feet of impervious surface; flow control facility or BMPs for projects with greater than 35,000 square feet of land clearing or alteration

- Water quality control requirements for projects with greater than 5,000 square feet of pollution-generating impervious surface or 35,000 square feet of land clearing or alteration
- Flow control facilities designed to match flow durations from 50% of 2-year through 50-year event assuming forested condition
- Construction erosion and sediment control
- Pollution source control required

For additional information: <http://www.ecy.wa.gov/programs/wq/stormwater/index.html>

***Puget Sound Action Team.***

The comprehensive stormwater program of the Puget Sound Water Quality Management Plan (PSMP SW-1.1) is adopted by the state as the goal for all Puget Sound jurisdictions (see [www.psat.wa.gov](http://www.psat.wa.gov)). The comprehensive program provides guidance for protection of public and private property and sensitive natural areas from the adverse effects of stormwater runoff from development. PSAT recommends that Comprehensive Plans include a policy to adopt the comprehensive stormwater program elements not yet incorporated into the jurisdiction's program, including adoption of the 2001 Ecology Stormwater Management Manual for Puget Sound or an equivalent manual. Program elements include:

- Stormwater controls for new development and redevelopment
- Site plan review
- Inspection of construction sites
- Maintenance of permanent facilities
- Source control
- Illicit discharges and water quality response
- Identification and ranking of problems
- Public education and involvement
- Low Impact development practices
- Watershed or basin planning
- Local funding capacity
- Monitoring program
- Schedule for implementation

***Tri-County Salmon Conservation Coalition.*** The Tri-County Model 4(d) Rule Response Proposal (May 2001) proposed a stormwater program to protect fish habitat. The full proposal is available at <http://www.salmoninfo.org/tricounty/tcdocuments>. Program elements (and standards if relevant) include:

- Land use regulations, including:
  - ✓ Protection of 65 percent of a development site for the purpose of retaining forest cover and protecting wetlands and stream corridors
  - ✓ Minimization of total effective impervious surface to less than 10 percent of the development site and fully disperse runoff to the maximum extent practicable
  - ✓ Low impact development pilot projects
- Technical standards, including:
  - ✓ Meet the 1992 Ecology Manual design, performance, source control and implementation standards
  - ✓ Duration control standard to match the discharge durations for peak discharge rates ranging from 50 percent of the 2-year rate to 100 percent of the 50-year rate for the site condition that existing prior to any development in the Puget Sound region

- Inspection and enforcement programs
- Maintenance standards and programs
- Illicit discharge reduction programs
- Public education
- Public involvement/outreach
- Intergovernment/intragovernment coordination
- Monitoring
- Stormwater planning
- Capital improvement program
- Habitat enhancement/rehabilitation
- Habitat acquisition

### 3. LOW IMPACT DEVELOPMENT (LID) OVERVIEW

This section provides a brief overview of Low Impact Development (LID) approaches to stormwater management, and their use throughout the Puget Sound Region. Much of the following information was drawn from the Puget Sound Action Team website at: <http://www.psat.wa.gov/Programs/LID.htm> This section is organized into five sub-sections:

- A. General LID Concepts
- B. LID Online Information Resources
- C. LID Publications and Fact Sheets
- D. LID Sample Projects Around Puget Sound
- E. LID Sample Ordinances and Regulations

#### General Low Impact Development Concepts

The main objective of low impact development is to help protect aquatic resources, water quality, and the natural hydrology of a watershed as development takes place. Rather than collecting and conveying stormwater runoff through storm drains, pipes, or other conveyances to a centralized stormwater facility, LID-designed sites use natural vegetation and small-scale treatment systems to treat and infiltrate stormwater runoff close to where it originates. Reducing the amount of impervious surfaces reduces the amount of stormwater runoff generated in the first place. The following are low impact development (LID) strategies from the National Association of Home Builders Research Center at <http://www.nahbrc.org/tertiaryR.asp?TrackID=&DocumentID=2007&CategoryID=1071>:

#### Low Impact Design Strategies:

The strategies fall under the two broad categories of **practices** and **site design**. The most common concepts are summarized below by the National Association of Home Builders Research Center at <http://www.nahbrc.org/tertiaryR.asp?TrackID=&DocumentID=2007&CategoryID=1071>:

##### *Practices:*

Basic LID strategy for handling runoff is to: 1) reduce the volume of runoff and 2) decentralize flows. This is usually best accomplished by creating a series of smaller retention/detention areas that allow localized filtration rather than carrying runoff to a remote collection area. Common methods include:

- **Bio-retention cells** typically consist of grass buffers, sand beds, a ponding area for excess runoff storage, organic layers, planting soil and vegetation. Their purpose is to provide a storage area, away from buildings and roadways, where stormwater collects and filters into the soil. Permanent ponds can be incorporated into the cell design as landscaping features. Temporary storage areas

without ponds may be called **detention cells**. Bioretention areas have also been called **rain gardens** since they are typically landscaped with native plants and grasses, selected according to their moisture requirements and ability to tolerate pollutants. Annual maintenance of bioretention cells must be planned in order to replace mulching materials, remove accumulated silt, or revitalize soils as required.

- **Grass Swales** function as alternatives to curb and gutter systems, usually along residential streets or highways. They use grasses or other vegetation to reduce runoff velocity and allow filtration, while high volume flows are channeled away safely. Features like plantings and checkdams may be incorporated to further reduce water velocity and encourage filtration. Walkways are either separated from roadways by swales, or relocated to other areas. In areas where salts are commonly used for winter de-icing, careful attention must be paid to selecting plant species which are salt tolerant.
- **Filter strips** can be designed as landscape features within parking lots or other areas, to collect flow from large impervious surfaces. They may direct water into vegetated detention areas or special sand filters that capture pollutants and gradually discharge water over a period of time.
- **Disconnected Impervious Areas** direct water flows collected from structures, driveways, or street sections, into separate localized detention cells instead of combining it in drainpipes with other runoff. Disconnecting the flow limits the velocity and overall amount of conveyed water that must be handled by end-of-pipe facilities.
- **Cistern Collection Systems** can be designed to store rainwater for dry-period irrigation, rather than channeling it to streams. Smaller tanks that collect residential roof drainage are often called "**rain barrels**" and may be installed by individual homeowners. Some collection systems are designed to be installed directly under permeable pavement areas, allowing maximum water storage capacity while eliminating the need for gravel beds. Other innovative systems incorporate **graywater collection** for additional water conservation (see separate PATH Technology Inventory article on Graywater Reuse).

#### *Site Design:*

**Decreasing Impervious Surfaces** can be a simple strategy to avoid problems from stormwater runoff and water table depletion, by reducing surfaces that prevent natural filtration. Methods may include:

- **Reducing Roadway Surfaces** can retain more permeable land area. In some cases, planners have reduced pavement needs by up to 40% by using longer, undulating roads that create more available lot frontage, instead of wide shorter streets with more intersections. Other options may include shared driveways, "flag" lots with reduced street frontage, landscaped detention islands within cul-de-sacs, or alternate designs for turn-around areas.
- **Permeable Pavement Surfaces** can be constructed from a variety of materials, including traditional asphalt and concrete, gravel or pavers. Permeable roadway or parking areas allow water to flow through, replenishing soil areas directly beneath. However, the subbase underneath permeable pavements must be engineered to accommodate temporary water storage and filtration. In many cases, permeable surfaces can reduce or eliminate the need for traditional stormwater structures. Further information is available in a separate PATH Technology Inventory article titled "Permeable Pavement."
- **Vegetative Roof Systems** create a lightweight, permeable vegetative surface on an impervious roof area. Moss, grass, herbs, wildflowers, and native plants can be used, creating an aesthetically pleasing roof landscape. The systems start with a high strength rubber membrane placed over the base roof structure. Various layers above the rubber may contain insulation, filter and drainage media, separation fabrics, lightweight growth media, vegetation, and wind erosion fabric. Some systems even incorporate rainbarrel runoff collection, pumping, and irrigation equipment. These systems are more costly than standard roofs, and have not been used on a large scale for residential development in the U.S.

- **Planning site layout and grading to natural land contours** can minimize grading costs and retain a greater percentage of the land's natural hydrology. Contours which function as filtration basins can be retained or enhanced, and incorporated into the landscaping design.
- **Natural Resource Preservation and Xeriscaping** can be used to minimize the need for irrigation systems and enhance property values. Riparian, or stream bank, areas are particularly crucial to water quality, and in most areas, subject to Federal or State regulations. Preserving existing wooded areas, mature trees, and natural terrain, can give new developments a premium "mature landscape" appearance and provide residents with additional recreational amenities. Both of these features can improve marketability. Xeriscaping refers to landscaping with plants native to area climate and soil conditions. These plants thrive naturally, requiring less maintenance and irrigation than most hybrid or imported varieties. For more information, refer to the separate PATH Technology Inventory article on this subject.
- **Clustering Homes** on smaller lot areas can allow more preserved open space to be used for recreation, visual aesthetics, and wildlife habitat. Clustering can reduce infrastructure costs to the builder, since fewer feet of pipe, cable, and pavement are needed, and maintenance costs are reduced for homeowners. Builders in many areas have been able to charge a premium price for "view lots" facing undisturbed natural vistas, or pond areas that also function as bioretention cells.

## Low Impact Development Online Information Resources

This section includes links to key organizations that are involved in LID research and outreach.

**National Low Impact Development Center:** <http://lowimpactdevelopment.org/>

**Low Impact Development (LID) Urban Design Tools:** <http://www.lid-stormwater.net/>

**Center for Watershed Protection:** <http://www.cwp.org/>

**Puget Sound Action Team:** <http://www.psat.wa.gov/Programs/LID.htm>

**University of British Columbia's James Taylor Chair in Landscape and Liveable Environments:** <http://www.sustainable-communities.agsci.ubc.ca/about.html>

**National Association of Home Builders Research Center** (includes cost comparisons between LID and conventionally designed projects):

<http://www.nahbrc.org/tertiaryR.asp?TrackID=&DocumentID=2007&CategoryID=1071>

## Low Impact Development Publications and Fact Sheets

### Low Impact Development Technical Materials

The Puget Sound Action Team contracted with CH2M Hill to develop technical information on the applicability of low impact development techniques in Puget Sound. CH2M Hill released three technical memoranda for this project on January 16, 2004:

1. Review of Low-Impact Development Techniques - [http://www.psat.wa.gov/Programs/LID/PSAT\\_TechMemo1.pdf](http://www.psat.wa.gov/Programs/LID/PSAT_TechMemo1.pdf) (PDF 1,906k)
2. Analysis and Recommendations for the use of LID Techniques in Puget Sound - [http://www.psat.wa.gov/Programs/LID/PSAT\\_TechMemo2.pdf](http://www.psat.wa.gov/Programs/LID/PSAT_TechMemo2.pdf) (PDF 4,303k)

3. Suggested Adaptations to BMPs in the Department of Ecology's 2001 Stormwater Management Manual for Western Washington to Include the Benefits of LID Techniques - [http://www.psat.wa.gov/Programs/LID/PSAT\\_TechMemo3.pdf](http://www.psat.wa.gov/Programs/LID/PSAT_TechMemo3.pdf) (PDF 1,468k)

### **Natural Approaches to Stormwater Management: LID in Puget Sound**

An informative book offering innovative techniques for builders and developers, local planners, engineers and others to better protect Puget Sound from the harmful effects of development. Published in March 2003. [http://www.psat.wa.gov/Publications/LID\\_studies/LID\\_approaches.htm](http://www.psat.wa.gov/Publications/LID_studies/LID_approaches.htm)  
Case studies from around Puget Sound include: amended soils and bioretention, permeable pavement, rooftop rainwater harvesting, innovative foundations, green roofs, new and redevelopment projects.

### **National Resources Defense Council publication on innovative stormwater strategies**

May 1999 report from the NRDC documents effective strategies, including LID, being employed by communities around the country to control stormwater runoff. Published May 1999. <http://www.nrdc.org/water/pollution/storm/stoinx.asp>

### **Bioretention Applications**

A fact sheet by the U.S. Environmental Protection Agency and the Low Impact Development Center, Inc., on bioretention, or rain gardens. Two case studies (in Largo, Maryland, and Tampa, Florida) demonstrate the potential to use low impact development practices in parking facilities. Includes monitoring data. Published October 2000. [http://www.psat.wa.gov/Programs/LID/lid\\_cd/pdf\\_docs/LID\\_BIO.PDF](http://www.psat.wa.gov/Programs/LID/lid_cd/pdf_docs/LID_BIO.PDF)

### **Conservation Design for Stormwater Management**

A conservation design manual that provides guidance on protecting and incorporating natural site features into a site's land development process and stormwater management plan. Contains guidance on site assessment; design principles, procedures and practices; and case studies. Produced by the Delaware Department of Natural Resources and Environmental Control and the Environmental Management Center of the Brandywine Conservancy. Published September 1997. [http://www.psat.wa.gov/Programs/LID/lid\\_cd/pdf\\_docs/DEL\\_MAN.PDF](http://www.psat.wa.gov/Programs/LID/lid_cd/pdf_docs/DEL_MAN.PDF)

### **Field Evaluation of Permeable Pavements for Stormwater Management**

A fact sheet by the U.S. Environmental Protection Agency and the Low Impact Development Center, Inc., illustrating a case study conducted by the City of Olympia on permeable and other alternative pavement surfaces. The study demonstrates the potential of alternative pavement systems to reduce stormwater runoff and provide water quality and cost savings benefits. Published October 2000. [http://www.psat.wa.gov/Programs/LID/lid\\_cd/pdf\\_docs/LID\\_PAVE.PDF](http://www.psat.wa.gov/Programs/LID/lid_cd/pdf_docs/LID_PAVE.PDF)

### **Low-Impact Development Design Strategies: An Integrated Design Approach**

The national low impact development manual produced by Prince George's County, Maryland, and the U.S. Environmental Protection Agency presents goals and principles for this technology, and guidance on site planning, design practices, erosion and sediment control considerations, maintenance needs, and techniques for public outreach. Published June 1999. [http://www.psat.wa.gov/Programs/LID/lid\\_cd/pdf\\_docs/LID\\_NATL.PDF](http://www.psat.wa.gov/Programs/LID/lid_cd/pdf_docs/LID_NATL.PDF)

### **Low-Impact Development Hydrologic Analysis**

The hydrology supplement to the national low impact development manual provides information on hydrologic analysis procedures for this technology. Published July 1999. [http://www.psat.wa.gov/Programs/LID/lid\\_cd/pdf\\_docs/LID\\_HYDR.PDF](http://www.psat.wa.gov/Programs/LID/lid_cd/pdf_docs/LID_HYDR.PDF)

### **Low Impact Development (LID): A Literature Review**

A literature review of studies on the effectiveness of low impact development techniques conducted by the U.S. Environmental Protection Agency and the Low Impact Development Center, Inc., a non-profit organization located in Maryland. Published October 2000.

[http://www.psat.wa.gov/Programs/LID/lid\\_cd/pdf\\_docs/EFFECT.PDF](http://www.psat.wa.gov/Programs/LID/lid_cd/pdf_docs/EFFECT.PDF)

## **Low Impact Development Demonstration Projects Around Puget Sound**

### **King County LID Demonstration Projects**

King County currently has three low impact demonstration projects that are being reviewed under a demonstration ordinance passed by the county council. They are a 14-lot single-family residential subdivision on a forested site, a 118-lot subdivision on a cleared site and a 1000 unit redevelopment of an existing 550 home subdivision. Each of these projects proposes to include LID to a varying extent. For more information, contact Steve Foley, King County, Water and Land Resources Division, at [steve.foley@metrokc.gov](mailto:steve.foley@metrokc.gov) or 206-296-1973.

- **Hope VI Park Lake Homes, located in White Center** - This mixed income housing development by King County Housing Authority (KCHA) will provide over 900 units of new single family and multi-family housing units. This project proposes narrower roads and open swale conveyance. KCHA Executive Director Stephen Norman notes, "This ordinance allows the Authority the flexibility to develop environmentally friendly alternatives and implement solutions that will provide an ecologically sustainable future for the White Center Park Lake Homes community."
- **Camwest's Shamrock, located east of Renton** - This development will create approximately 100 single family housing units. This project includes bioretention, soil amendment, partial downspout infiltration and alternative street design with open swales. Camwest President Eric Campbell noted, "We look forward to implementing development practices which better utilize clean rainwater as a resource. I am hopeful that practical, cost effective solutions benefiting the environment will be a direct outcome of this demonstration ordinance."
- **Vashon Household's Sunflower development** - Located on Vashon Island, this development provides for 14 single family homes. This project includes over 50% forest retention, small footprint houses, pervious pavements and bioretention. Executive Director, Sam Hendricks, noted, "There is a perception that low-impact, green design is something only the wealthy can afford. The Sunflower development will show that sustainable, environmentally-friendly development is a realistic and economically viable option." **NOTE:** There is additional enthusiasm building on Vashon about LID as a tool to increase groundwater recharge. There are not additional projects identified at this time, but motivated citizens are working with the County to begin considering options.

### **Seattle's Natural Drainage Systems Program**

Seattle's drainage capital improvement program has conducted a number of demonstration projects using LID techniques in street right-of-ways. Techniques include: infiltration and slowing of stormwater flow; filtering and bio-remediation of pollutants by soils and plants; reduced impervious surface; porous paving; increased vegetation; and related pedestrian amenities. More information is available at:

[http://www.seattle.gov/util/About\\_SPU/Drainage\\_&\\_Sewer\\_System/Natural\\_Drainage\\_Systems/Natural\\_Drainage\\_Overview/index.asp](http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Natural_Drainage_Overview/index.asp). If you have questions after reviewing the site, contact Sylvia Cavazos at [sylvia.cavazos@seattle.gov](mailto:sylvia.cavazos@seattle.gov).

- **SEA Streets** - Located in northwest Seattle, an alternative street design called Street Edge Alternative, or "SEA Streets," has successfully shown that streets can be redesigned to achieve both community and creek protection goals. SEA Street takes an innovative approach to street design, with narrow, curved streets, open drainage swales, and an abundance of diverse plants and trees. Residents along SEA Street maintain city infrastructure in the form of street "gardens" in front of

their homes. In this case, Natural Drainage Systems united the community visually, environmentally, and social -- something traditional piped systems simply can't do. More Information:

[http://www.ci.seattle.wa.us/util/About\\_SPU/Drainage\\_&\\_Sewer\\_System/Natural\\_Drainage\\_Systems/Street\\_Edge\\_Alternatives/index.asp](http://www.ci.seattle.wa.us/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.asp). A **hydrologic monitoring report** is available for this project

and the earlier "Viewlands Cascade" project at:

[http://www.seattle.gov/util/stellent/groups/public/@spu/@esb/@dwwsweng/documents/spu\\_project/hydrologic\\_200406180904017.pdf](http://www.seattle.gov/util/stellent/groups/public/@spu/@esb/@dwwsweng/documents/spu_project/hydrologic_200406180904017.pdf)

- **110th Cascade** - 110th Cascade, also located in northwest Seattle, was built in response to the success of the Viewlands Cascade project, due to a flooding problem at Third Avenue Northwest, and because it was in a priority watershed (Pipers Creek). The project was altered to a natural system approach. A creek-like cascade now intercepts, infiltrates, slows and filters over 21 acres of stormwater draining through the project. More Information: [http://www.ci.seattle.wa.us/util/About\\_SPU/Drainage\\_&\\_Sewer\\_System/Natural\\_Drainage\\_Systems/110th\\_Cascade\\_Project/index.asp](http://www.ci.seattle.wa.us/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/110th_Cascade_Project/index.asp)
- **High Point Project** - Seattle Public Utilities (SPU) is partnering with Seattle Housing Authority (SHA) to integrate a natural drainage system (NDS) into the High Point project -- a 129 acre mixed-income housing redevelopment located in the Longfellow Creek Watershed in West Seattle. The natural system design proposes to integrate 22,000 lineal feet of vegetated and grassy swales throughout the development within the planting strip of the street right-of-way. These swales include sub-surface engineered soil to provide storage and infiltration opportunities. Each swale is designed to treat the runoff from the road and housing of the adjacent block. At a system scale, natural drainage systems will provide water quality treatment for the 6-month storm and ease the 2-year, 24-hour storm to pre-developed pasture conditions, which will better protect Longfellow Creek. This distributed block-scale system provides much greater opportunity to cleanse, cool and infiltrate stormwater runoff than the traditional piped and centralized management approach. The design team has developed a block-scale continuous hydrologic model to refine the design performance and predict how the system will perform under different storm events. Seattle Public Utilities will be working with the University of Washington to monitor the performance of the system at the block and sub-basin scale. More Information at: [http://www.ci.seattle.wa.us/util/About\\_SPU/Drainage\\_&\\_Sewer\\_System/Natural\\_Drainage\\_Systems/High\\_Point\\_Project/index.asp](http://www.ci.seattle.wa.us/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/High_Point_Project/index.asp)
- **Broadview Green Grid Project** - The Broadview Green Grid Project, involving 15 city blocks, is Seattle's most ambitious natural drainage system project to date. This natural infrastructure will manage stormwater flow from approximately 32 acres, and is almost an entire sub-basin of the Pipers Creek watershed. Seattle Public Utilities is partnering with Seattle Department of Transportation (SDOT) to provide neighborhood improvements to integrate landscaping, traffic calming, and a sidewalk on each north-south street into the natural drainage system design. Common natural drainage features include swales, stormwater cascades, small wetland ponds, larger landscaped areas and smaller paved areas. These features help reduce the quantity and speed of the runoff water. This helps Pipers Creek by reducing the occurrence of large, fast flows of water that can damage the creek channel and habitat. Construction began in late August 2003. The project area includes a "Cascade" system planned for North 107th Street, from Fourth Avenue North to Phinney Avenue North, similar to the cascade constructed along North 110th Street in 2002. More information: [http://www.ci.seattle.wa.us/util/About\\_SPU/Drainage\\_&\\_Sewer\\_System/Natural\\_Drainage\\_Systems/Broadview\\_Green\\_Grid\\_Project/index.asp](http://www.ci.seattle.wa.us/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Broadview_Green_Grid_Project/index.asp)
- **Pinehurst Green Grid Project** SPU will be constructing an integrated natural drainage system project in the Pinehurst neighborhood late next spring (2005). This is a needed improvement to the City's drainage infrastructure and will enhance drainage service in the Pinehurst area. The project will combine neighborhood enhancements with a new stormwater system that will decrease the amount and improve the quality of the runoff to Thornton Creek. The project will be constructed on:

19th Avenue NE between NE 115th and NE 117th Streets , 20th Avenue NE between NE 113th and NE 117th Streets, 23rd Avenue NE between NE 113th and NE 117th Streets, 117th from 16th Avenue NE to 23rd Avenue NE, NE 113th Street between 20th Avenue NE and 23rd Avenue NE. Integrated natural drainage systems lessen the quantity and improve the quality of stormwater runoff. These improvements will benefit the habitat for wildlife in Thornton Creek. The project will also benefit the neighborhood by including enhancements for pedestrians and drivers, and landscaping in the right-of-way area. More Information at:

[http://www.seattle.gov/util/About\\_SPU/Drainage\\_&\\_Sewer\\_System/Natural\\_Drainage\\_Systems/Pinehurst\\_Project/index.asp](http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Pinehurst_Project/index.asp). If you have questions regarding the project goals, design and impacts, please contact the Project Manager, Keith Ward at (206) 615-0734 or by email at [keith.ward@seattle.gov](mailto:keith.ward@seattle.gov)

### **Issaquah Highlands**

The Issaquah Highlands development incorporated a number of LID techniques mixed in with a larger suite of “sustainability” goals. Although low impact stormwater design was not the highest priority, the site was required to achieve 100% on-site infiltration, which was achieved by routing stormwater to large infiltration galleries for aquifer recharge. Some effort was made to separate clean stormwater from roofs from that from streets and driveways that needed treatment before infiltration. Other LID techniques included narrower streets and shared driveways to minimize impervious area and a high soil amendment standard. Additional information about the development is available from:

<http://www.issaquahhighlands.com>. Additional site design features include:

#### ***Conservation of Water / Preserving Water Quality***

##### Site Design:

- Structured land so stormwater infiltrates naturally to help protect Issaquah drinking water, aquifer and streams
- Preserved over 120-acres of wetlands
- Limited the amount of impervious surface (hard surfaces) throughout the community by using narrower streets and shared driveways.
- Prevented road pollutants from entering Lake Sammamish, streams and wetlands by creating vegetated pond areas to filter vehicle oils
- Conserve and recycle water for irrigating landscaping
- Established a water budget for landscaping to limit overall use of water

##### During Construction:

- Minimized erosion during winter months by clearing site during other seasons
- Limited any potential damage to groundwater and streams by enacting a thorough spill/containment program
- Monitor water quality continuously to assure project design is protecting quality

#### ***Other “Green” Community Attributes:***

- Preserved over 1,500 acres as permanent open space and habitat for local wildlife such as birds, rabbits, deer and many other animals
- Protected community from unauthorized pesticide/herbicide use by homeowners
- Created local “Adopt a Wetland” Program to educate community volunteers to maintain environmental quality
- Educate homeowners on Best Management Practices for green living
- Published a handbook on green development for contractors and homeowners
- Planted thousands of trees as part of Master Tree Plan

Camp Creek Landslide: On January 30, 2004 a small landslide occurred at the Issaquah Highlands site that was the result of the stormwater infiltration system. Preliminary analysis had underestimated the infiltration and aquifer recharge capacity of the site. A *White Paper* was developed by technical experts representing the City; the Issaquah Highlands Master Developer; Microsoft (as an interested landowner);

the Washington State Department of Transportation (WSDOT); the Department of Ecology (Ecology); and interested parties. This report includes data on the stormwater infiltration systems, the stormwater systems' compliance with the applicable development requirements; slope stability; turbidity discharges; stormwater quality compliance; and particularly the cause of the events leading up to the January 30, 2004 Camp Creek Landslide. Parties are currently reevaluating the infiltration system at the site and devising alternative strategies to meet the 100% infiltration goal. The report is available at:

<http://www.ci.issaquah.wa.us/Page.asp?NavID=696>

For more information about site design standards at Issaquah Highlands contact the City of Issaquah, Major Development Review Team (MDRT) at <http://www.ci.issaquah.wa.us/SectionIndex.asp?SectionID=18>. Or contact, Keith Niven, MDRT Program Manager, 425-837-3430.

### **Education-Focused LID Demonstration Projects:**

#### ***Carkeek Park Environmental Learning Center***

The Carkeek Park Environmental Learning Center (ELC) has been built to provide additional space for environmental education and stewardship activities and to create additional community gathering/meeting space.

#### **Sustainable building features include:**

- rooftop rainwater harvest for flushing toilets and managing storm water
- salmon-friendly landscaping - drought tolerant, native species and increased storm water infiltration
- energy-efficient features - highly-insulated building envelope, intelligent lighting, natural ventilation
- solar electric (photovoltaic) panels provided by City Light's Green Power program
- 80% recycling or salvaging of demolition and construction waste
- paints/coatings, adhesives, sealants, wood composites and carpeting which protect indoor air quality
- recycled content products - concrete, backfill, wood composite casework, insulation, and flooring
- salvaged materials include peeler logs from a naval building in South Lake Union
- regional materials which support our regional economy and reduce the energy, waste, and pollution associated with transportation.

For more information visit: <http://www.cityofseattle.net/parks/parkspaces/CarkeekPark/ELC.htm>. Or contact the Environmental Learning Center at (206) 684-0877.

#### ***Pickering Farm Community Teaching Garden***

The Pickering Farm Community Teaching Garden is a living classroom that educates residents and Farm visitors on landscaping techniques that save water, improve water quality, improve natural habitat and reduce the amount of garbage Issaquah generates. Features include:

- Rooftop rainwater harvesting for irrigation
- Seasonal stream from rooftop runoff.
- Soil Amendment
- Green Roof demonstration kiosks.

For more information visit: <http://www.ci.issaquah.wa.us/Page.asp?NavID=665>. Or contact Chrys Bertolotto, City of Issaquah, for details at (425) 837-3442 or [chrysb@ci.issaquah.wa.us](mailto:chrysb@ci.issaquah.wa.us).

### **BUILT GREEN Guidelines**

BUILT GREEN homes are designed to provide homeowners with comfortable, durable, environmentally friendly homes that are cost-effective to own and operate. BUILT GREEN is a program of the Master

Builders Association of King and Snohomish Counties, developed in partnership with King County, Snohomish County, and other agencies in Washington State. The BUILT GREEN program certifies homes with one to three stars based upon points accrued for various elements of site and building design. Although the major focus of the program is on energy conservation and other elements of green architecture, there are several points available for various site design features.

More information about BUILT GREEN is available at <http://www.builtgreen.net> or at (425) 451-7920. Many large local developers are participating in the program. Issaquah Highlands, Redmond Ridge, Talus, Snoqualmie Ridge and many other large local developments include BUILT GREEN certified homes. A list of participating businesses is available at: <http://www.builtgreen.net/members.html#builders>.

See additional projects listed at *Review of Low-Impact Development Techniques*, available from the Puget Sound Action Team at: [http://www.psat.wa.gov/Programs/LID/PSAT\\_TechMemo1.pdf](http://www.psat.wa.gov/Programs/LID/PSAT_TechMemo1.pdf)

## **Low Impact Development Sample Ordinances and Regulations**

### **Island County Stormwater Code - Low Impact Development Requirements**

In December 1998, Island County adopted a stormwater ordinance that provides developers with the option of using low impact development practices. The design standards are based on *Low Impact Development Design Strategies—An Integrated Design Approach*, prepared by Prince Georges County, Maryland, January 2000. The Island County Stormwater and Surface Water Ordinance provides special performance requirements that developers must meet for their development proposals to qualify as LID. The ordinance allows applicants who propose to use LID practices for development approvals a choice. Applicants of small development projects may accept permit conditions that fulfill the best management practices for LID surface water rate control in lieu of submitting a drainage narrative. For major development activities and engineered grading projects, applicants who propose to use LID drainage controls may submit a drainage narrative instead of a preliminary drainage plan. The ordinance does not require a downstream analysis when the project design includes and is approved for using LID standards. To date, LID practices have been partially applied in developments such as Bayview Corner, but no major developments have used LID technologies in Island County.

**Contact:** Phil Cohen, Surface Water Management Division, Island County Public Works, Phone: (360) 679-7331 extension 7440, FAX: (360) 678-4550, [philc@co.island.wa.us](mailto:philc@co.island.wa.us)

### **City of Issaquah - Stormwater Management Policy for Low Impact Development**

In 2000, the city of Issaquah adopted an update to the stormwater code (Title 13.28.055) that provides a process and criteria for evaluating low impact development proposals. The municipal code authorizes the Director of Public Works to authorize deviations from stormwater design standards to achieve “low impervious surface development.” The director also has the option of requiring evaluation and monitoring of project elements. The code language is on the Municipal Research Services Center website ([www.mrsc.org](http://www.mrsc.org)). Go to “Legal Resources,” then “City and County Codes,” then “City Codes” to Issaquah City Code Title 13.28.055. The Issaquah Municipal Code (Title 13.30) also provides an incentive for projects that infiltrate stormwater. Projects that infiltrate 100 percent of the stormwater can receive up to a 50 percent reduction in the stormwater utility fee. On other fronts, the city is considering a more comprehensive sustainable development program, including incentives. Some of these provisions relate directly to LID, such as green streets, green roofs, and pervious pavers.

**Contact:** Kerry Ritland, City of Issaquah, (425) 837-3410 or [kerryr@ci.issaquah.wa.us](mailto:kerryr@ci.issaquah.wa.us)

### **City of Olympia - Low Impact Development Strategy for Green Cove Basin**

In 1998, Olympia undertook a process to “define the balance between human activities and protecting habitat” in its streams and watersheds. After reviewing all city watersheds, the city council decided to

focus on the 2,600-acre Green Cove Creek watershed in west Olympia. In October 2001 the Olympia City Council adopted a unique set of mandatory low impact development regulations to prevent further damage to aquatic habitat from urban development in the Green Cove Basin. The Olympia City Council completed a comprehensive policy revision covering development density, impervious surface coverage, lot size, open space/tree retention, street design, street width, block sizes, parking, sidewalks, and stormwater management requirements. Key policy changes for the Green Cove Basin were adopted through comprehensive plan amendments, municipal code amendments, development guidelines and public works standards, and a drainage design and erosion control manual. Since part of the Green Cove Basin is in Thurston County, the county adopted policy and regulatory changes to complement Olympia's program. This included changes to the county's comprehensive plan, zoning, and open space program. Unlike LID ordinances in Lacey and Tumwater that are voluntary, Olympia's Green Cove regulations are mandatory. As of October 2002, the city has received two subdivision projects for development under the new policies.

**Contact:** Andy Haub, City of Olympia Public Works, (360) 753-8475, [ahaub@ci.olympia.wa.us](mailto:ahaub@ci.olympia.wa.us)  
For a more detailed case study and a CD-ROM containing project reports and ordinances, contact the City of Olympia. [http://www.psat.wa.gov/Programs/LID/Green\\_Cove.pdf](http://www.psat.wa.gov/Programs/LID/Green_Cove.pdf)

### **City of Lacey - Zero Effect Drainage Discharge Ordinance**

**Zero Effect (or Impact) Development (ZID)** refers to a project that adheres to a 60/0 development standard and is constrained by characteristics of a healthy watershed as described in the Salmon in the City Conference Abstracts. "60/0" means 60 percent forest cover preserved /zero effective impervious surface. In 1999, the Lacey city council enacted a "Zero Effect Drainage Discharge" ordinance. The goal of Lacey's ordinance is to retain the critical functions of a forest including evapotranspiration and infiltration after site development such that near zero effective impervious surface is achieved. The ordinance is flexible and establishes performance standards for development rather than specific design criteria. A committee of Lacey staff has the authority to grant administrative variances from traditional standards to achieve the ordinance's goal. Projects must preserve 60 percent natural habitat area and achieve "near zero effective impervious surface."

**Contact:** Eric Hielema, City of Lacey, (360) 438-2686, [ehielema@ci.lacey.wa.us](mailto:ehielema@ci.lacey.wa.us)  
Website for Chapter 14.31 Zero Effect Ordinance: [http://www.ci.lacey.wa.us/lmc/lmc\\_main\\_page.html](http://www.ci.lacey.wa.us/lmc/lmc_main_page.html)

### **City of Tumwater - Zero Effect Development Ordinance**

In 2000, Tumwater enacted the Zero Effect Drainage Ordinance (Title 13, Chapter 13.22). The city found that typical site development hinders stormwater retention, that stormwater discharges offsite adversely affect stream habitat, and that retaining forest canopy aids evapotranspiration and infiltration of stormwater runoff. The ordinance provides developers with the option of using zero impact development practices in residential and commercial projects. A set of performance guidelines indicates the characteristics of an acceptable project. A committee reviews project proposals and can approve variances to the city's development code to accommodate nontraditional construction techniques. Projects approved under the ordinance must preserve 65 percent of forest area on the development site. Runoff must not be collected or discharged to surface water (thus achieving zero effective impervious area). The guidelines encourage looped one-way streets; narrow pervious driveways; small, pervious garage aprons; and small home footprints. Roof runoff must be infiltrated or mitigated. To compensate for narrower roads and reduced access for emergency vehicles, structures are required to meet more rigorous fire standards.

Full Text of the ordinance is available at:

<http://www.ci.tumwater.wa.us/Departments/Planning%20&%20Facilities/Zero%20Effect%20Drainage%20Discharge%20Developments%20Ordinance.htm>

**Contact:** Michael Matlock, City of Tumwater, (360) 754-4210

Website: <http://www.ci.tumwater.wa.us/> Follow the link to City Departments, then Planning and Facilities.

**King County Stormwater Management – Surface Water Design Manual Update**

During 2004, King County is updating its 1998 Surface Water Design Manual to:

- Achieve compliance with Endangered Species Act (ESA) goals, and
- Achieve equivalency with the 2001 Washington State Department of Ecology Manual.

The revised manual will give developers the option to choose from a number of LID approaches to achieve stormwater management requirements. LID techniques are included under flow control BMPs which must be applied to new and/or existing impervious surfaces. Where full dispersion or full infiltration of impervious area runoff is not feasible or applicable, or will cause flooding or erosion impacts, one or more of the following BMPs must be applied to (or used to mitigate for) impervious area:

- Partial Infiltration
- Basic Dispersion
- Rain Garden
- Permeable Pavement
- Rainwater Harvesting
- Vegetated Roof
- Reduced Impervious Surface Credit
- Native Growth Retention Credit

Draft Table 1.2.3.C below lists the proposed sizing credits for various LID techniques.

<b>TABLE 1.2.3.C FLOW CONTROL BMP FACILITY SIZING CREDITS</b>	
<b>Flow Control BMP Type</b>	<b>Facility Sizing Credit</b>
Full dispersion	Model fully dispersed surface as forest
Full infiltration	Subtract impervious area that is fully infiltrated
Partial infiltration	Model tributary impervious surface as 50% impervious, 50% grass
Basic dispersion	Model dispersed impervious surface as 50% impervious, 50% grass
Rain garden	Model tributary impervious surface as 50% impervious, 50% grass
Permeable pavement (non-grassed)	Model permeable pavement area as 50% impervious, 50% grass
Grassed modular grid pavement	Model permeable pavement as all grass
Rainwater harvesting	Subtract roof area that is fully controlled
Vegetated roof	Model vegetated roof area as 50% impervious, 50% grass
Reduced impervious surface credit	Model reduced footprint rather than standard assumed footprint
Native growth retention credit	No facility sizing credit, only a credit toward meeting BMP requirement
Perforated pipe connection	No facility sizing credit

The draft King County Surface Water Design Manual includes specific design specifications for LID stormwater management techniques. These may be found in Appendix C at <http://dnr.metrokc.gov/wlr/dss/Manual-Draft.htm>

**WA State Dept. of Transportation - LID in the Highway Runoff Manual**

The Washington State Department of Transportation is revising its *1995 Highway Runoff Manual*. As part of this revision, the department will develop and reference three low impact development elements in the revised manual:

1. Permeable paving at park and rides, pedestrian paths, and lower speed roadways.
2. Bioretention along roadways.
3. Constructed wetlands for stormwater treatment.

The LID portion of the revised manual includes plans, specifications, methodology for estimating costs, and a hydraulic design process.

**Contacts:** Rick Johnson, Washington State Department of Transportation, (260) 440-4642, [johnsor@wsdot.wa.gov](mailto:johnsor@wsdot.wa.gov)  
Larry Schaffner, Washington State Department of Transportation, (360) 570-6657, [schaffl@wsdot.wa.gov](mailto:schaffl@wsdot.wa.gov)  
Website: <http://www.wsdot.wa.gov/fasc/EngineeringPublications/Manuals/HighwayRunoff2004.pdf>

## 4. Shoreline Management

**WA Department of Ecology.** Shoreline Master Program Guidelines at:  
<http://www.ecy.wa.gov/programs/sea/sma/index.html>

**WA Department of Community, Trade and Economic Development.** Guidance from critical areas handbook:  
<http://www.cted.wa.gov/DesktopModules/Documents/ViewDocument.aspx?DocumentID=1034>

**Puget Sound Action Team.** Growth Management Updates guidance at:  
[http://www.psat.wa.gov/Programs/GMA/GMA\\_checklist\\_2004.pdf](http://www.psat.wa.gov/Programs/GMA/GMA_checklist_2004.pdf)

### **Other References.**

For a discussion of possible disincentives created by the Shoreline Management Act for shoreline restoration projects, see:

- Eric Laschever, Preston Gates & Ellis, LLP. 2003. The Shoreline Management Act Jurisdiction and Incentives for Shoreline Restoration Projects. Project Manager, Miles Mayhew, City of Seattle.

Guidelines for marine overwater structures:

- Battelle Marine Sciences Laboratory et al. May 2001. Reconnaissance assessment of the state of the nearshore ecosystem: eastern shore of Central Puget Sound, including Vashon and Maury Islands (WRIAs 8 and 9). Prepared for King Co. Dept. of Natural Resources, Seattle, WA (pg. 12-9).
- Nightingale, Barbara and Charles Simenstad. May 2001. White paper, overwater structures: marine issues. Submitted to WA Dept. of Fish and Wildlife, WA Dept. of Ecology, and WA Dept. of Transportation. Seattle, University of Washington, Wetland Ecosystem Team, School of Aquatic and Fishery Science (pg. 92-103).

Guidelines for marine dredging:

- Nightingale, Barbara and Charles Simenstad. July 2001. White paper, dredging activities: marine issues. Submitted to WA Dept. of Fish and Wildlife, WA Dept. of Ecology, and WA Dept. of Transportation. Seattle, University of Washington, Wetland Ecosystem Team, School of Aquatic and Fishery Science (pg. 77-91).

## 5. References

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