

# **APPENDIX C. SUPPORTING INFORMATION ADDRESSING BASIN ISSUES AND NEEDS**

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- C-1. Summary of Physical, Water Quality, and Biological Issues Resulting from Urbanization, and Evaluation Criteria
- C-2. Existing Basin Plans and Information
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- C-4. Status of Projects and Recommendations of Major Plans and Studies



**Appendix C-1.** Summary of Physical, Water Quality, and Biological Issues Resulting from Urbanization, and Evaluation Criteria.

Source: Adapted from *A Science Framework for Ecological Health in Seattle’s Streams* (Seattle Public Utilities and Stillwater Sciences 2007)

Urban Stressors	Metric	Impacts			Natural Influencing Factors	Mitigators/Corrective Actions
		Direct	Primary Indirect	Secondary Indirect		
Physical  Impervious Surfaces	Area of impervious surface	Reduced aquifer recharge	Reduced summer baseflow	Warmer stream temperatures	Geology	Reduce impervious surface areas, use infiltration, install flow control and water quality facilities
			Flooding	Property Damage	Location of floodplain areas, wetlands	Preserve floodplains and wetlands, install flow control and water quality facilities
		Increased surface water runoff	Channel erosion	Sedimentation	Geology, topography, vegetation	Maintain streambank vegetation, detain flows to more natural hydrologic conditions, install flow control and water quality facilities
			Conveyance system deficiencies	Infrastructure damage and increased maintenance	Geology (infiltration potential)	Upgrade pipe system, install natural drainage practices (e.g., rain gardens, pervious pavement), install flow control and water quality facilities
			Heat island effect	Warmer temperatures	Vegetation	Preserve forest property, use pervious pavement, install flow control and water quality facilities
		Land conversion-vegetation to impervious surface	Loss of evapo-transpiration (ET)	More runoff from ET loss	Vegetation, water table	Minimize impervious surfaces, use bioretention, install flow control and water quality facilities
			Disconnection of floodplain from stream channel		Geology, topography, vegetation	Channel restoration, grade control, reconstructed floodplain terraces, install flow control and water quality facilities

Urban Stressors	Metric	Direct	Impacts			Natural Influencing Factors	Mitigators/Corrective Actions
			Primary Indirect	Secondary Indirect			
Water Quality	Channel Hardening	Miles of modifications	Channel Incision	Downstream sedimentation	Downstream flooding	Topography	Upstream channel restoration, channel or conveyance system maintenance (including dredging), culvert upgrades.
	Pollution-generating surfaces	Area of pollution-generating surfaces, Ecology 303(d) list	Pollutants in runoff	Adsorbs to sediment Discharge to surface water	Biological uptake by aquatic organisms, plants Decreased dissolved oxygen	Groundwater- surface water connections, geology, wildlife, vegetation	Water quality treatment of runoff prior to release into environment, catch basin cleaning/maintenance  Prevention and source control of pollutants
	Loss of Open Space	Acres of Open Space/Parks	Land conversion	Reduced carbon sequestration, heat islands, loss of ET	More runoff from ET loss		Preserve mature forests or neighborhood trees where possible, flow control and water quality facilities, and water quality BMPs.
Biological	Loss of Tree Canopy	% Tree Canopy	Modified forest structure (younger vs. mature forests)	Lost interflow in duff layer	More runoff from lost soil retention capacity		Soil amendments for new plantings, flow control and water quality facilities, and water quality BMPs
			Modified soil structure	Higher stream temperatures in summer months	Different, more tolerant aquatic communities	Groundwater connection, baseflow conditions	Protect riparian areas, flow control and water quality facilities, and water quality BMPs.

Urban Stressors	Metric	Direct	Impacts		Natural Influencing Factors	Mitigators/Corrective Actions
			Primary Indirect	Secondary Indirect		
Riparian Encroachment	% Tree Canopy in Stream Buffers	Reduced shade	Higher stream temperatures in summer months Simplified ecological food chain	Different, more tolerant aquatic communities	Groundwater connection, baseflow conditions Transport of leaf litter, detritus from upstream and upland	Protect aquifer recharge areas that supply baseflow to affected streams  Protect and restore riparian areas, flow control and water quality facilities, and water quality BMPs

**Appendix C-2. Existing Basin Plans and Information**

Whenever studies or projects are to be initiated within a basin, previous studies should be reviewed to avoid duplication of efforts. Basins with multiple issues that have not received basin studies should have higher consideration for future basin studies. Early basin-level plans and studies focused on primary conveyance capacity, flooding, erosion, sedimentation, and geology or soil infiltration rates. Over time, the scope of basin studies have expanded to include water quality and habitat/fish criteria. A review of major plans and studies conducted in previous years, as well as the status of their associated recommendations are listed in [Appendix C-4](#). Plans completed between 1987 and 1999 for Phantom Lake, Larsen Lake, Meydenbauer Creek, and Richards Creek basins primarily addressed water quality and sedimentation issues. However, Richards Creek also had conveyance issues that were addressed. Many of the projects recommended in these plans have been completed. Some of the recommended projects from these older plans are no longer a priority, and will not be built (see Appendix C-4 for a review of previously proposed projects and reasons why these projects were not carried out).

These basin plans and status of recommendations are summarized to provide greater understanding of the level of effort that has occurred for individual basins and are recommended for review for any future basin studies.

Appendix C-3. Basin Evaluation by Available Evaluation Criteria.

Basin	Flood Protection					Water Quality				Aquatic Habitat			Presence or Absence of Key Basin Issues		
	Primary Street Closures per 100-year, 24-hour Storm	Secondary Street Closures per 100-year, 24-hour Storm	Flooded Structures (2000-2009) <i>Note: 4+ years less than claims</i>	Flooding Claims (10/1/96 to 2/28/11)	Area Built prior to Stormwater Control Standards (%)	Total Impervious Area (%)	Phosphorus-sensitive Lake	Impaired Water Body (Ecology 303(d) list 2008)	Water Quality Risk Level (IDDE)	LWD Pieces per Channel Width	Pool Frequency and Quality (deep and cool with cover)	B-IBI Score (most recent)	Flood Protection	Water Quality	Aquatic Habitat
Salmon Spawning Stream Basins															
Coal Creek	0	1	≥5	6	16	20	No	Yes	Low	Fair	ND	20	√	√	√
East Creek	0	0*	≤2		45	48	No	No	High	Poor	Poor	ND		√	√
Goff Creek	0	0	≤2		46	30	No	No	High	ND	ND	18		√	√
Kelsey Creek	2	1	3-4	7	57	40	No	Yes	High	Poor	Poor	18	√	√	√
Mercer Slough	0	0	≤2	2	38	32	No	Yes	Medium	ND	ND	NA	√	√	
Newport Area	0	0	3-4		82	39	No	No	Low	ND	ND	16	√	√	√
Richards Creek	1*	0	3-4	4	32	45	No	No	High	Poor	Poor	ND	√	√	√
Valley Creek	0	0	≤2	1	36	34	No	No	High	Poor	Poor	16	√	√	√
Vasa Creek	0	0	3-4	1	36	40	Yes	No	Medium	ND	ND	24	√	√	√
West Tributary	0	0	3-4	2	51	46	No	No	High	ND	ND	18	√	√	√
Small and Steep Stream Basins															
Ardmore	0	0	≤2		63	43	Yes	Yes	Low	ND	ND	22		√	√
Lakehurst	0	0	≤2	3	37	33	No	No	Low	ND	ND	20	√		√
Lewis Creek	1	0	≤2		4	29	Yes	Yes	Medium	ND	ND	20	√	√	√
North	0	0	≤2	2	56	32	Yes	No	Low	NA	NA	NA	√		

Basin	Flood Protection					Water Quality				Aquatic Habitat			Presence or Absence of Key Basin Issues		
	Primary Street Closures per 100-year, 24-hour Storm	Secondary Street Closures per 100-year, 24-hour Storm	Flooded Structures (2000-2009) <i>Note: 4+ years less than claims</i>	Flooding Claims (10/1/96 to 2/28/11)	Area Built prior to Stormwater Control Standards (%)	Total Impervious Area (%)	Phosphorus-sensitive Lake	Impaired Water Body (Ecology 303(d) list 2008)	Water Quality Risk Level (IDDE)	LWD Pieces per Channel Width	Pool Frequency and Quality (deep and cool with cover)	B-IBI Score (most recent)	Flood Protection	Water Quality	Aquatic Habitat
Sammamish															
Phantom Creek	0	0	≤2	1	35	35	Yes	No	Low	ND	ND	26	√		√
Sunset Creek	0	1	≥5		47	42	No	No	High	Poor	Poor	14	√	√	√
South Sammamish	0	0	≤2		22	31	Yes	No	Low	ND	ND	ND			
Wilkins Creek	0	0	≤2	2	76	41	Yes	No	Low	ND	ND	22	√		√
Yarrow Creek	0	0	3-4	2	40	31	No	Yes	High	ND	ND	ND	√	√	√
Closed Conveyance System Basins (>96% piped storm drainage system)															
Beaux Arts Area	0	1	≤2		53	34	No	No	NA	NA	NA	NA	√		
Clyde Beach	0	0	≤2	1	62	47	No	No	NA	NA	NA	NA	√		
Meydenbauer Creek	0	0	≥5	4	48	59	No	Yes (Bay)	Medium	ND	ND	ND	√	√	
Rosemont Area	1	0	3-4	8	55	38	Yes	No	NA	NA	NA	NA	√		
Sears Creek	0	0	≤2		32	63	No	No	High	ND	ND	ND		√	
Spirit Ridge	0	0	3-4	2	65	40	Yes	No	NA	NA	NA	NA	√	√	
Sturtevant Creek	0	0	≤2	2	34	71	Yes	No	High	ND	ND	ND	√	√	

NA = Not applicable; ND = no data available; \*= Flooding problem corrected by 2004 culvert replacement. Street closures prior to this date were not included in total.

**Appendix C-4. Status of Projects and Recommendations of Major Plans and Studies as Listed in Table 7-1.**

Date	Plan Name	Focus Area	Status of Recommendations
1976	Drainage Master Plan	Entire city, except Lewis Creek, Lakehurst Area, and South Sammamish Area basins	Many of the recommended actions in this plan were completed in the early 1980s, including acquisition of property for regional detention, and capital construction of infrastructure.
1979	Draft Environmental Impact Statement for the 1976 Drainage Master Plan	Same as above	Same as above.
1980	Meydenbauer Basin Study	Meydenbauer Basin	Recommendations related to modify the diversion vault to send more flow into the bypass line were completed. Recommendations for flow and sedimentation monitoring were also implemented. Other projects related to conveyance upgrade were not implemented because they were based on predicted flooding, not actual flooding events
1984	Bellevue Urban Runoff Program Summary Report	Surrey Downs and Lake Hills neighborhoods	No recommendation. This study characterized the beneficial uses and the water quality problems of an urban stream compared to a pristine reach.

Date	Plan Name	Focus Area	Status of Recommendations
1987	Coal Creek Basin Plan and Environmental Impact Statement	Coal Creek Basin	King County established Cougar Mountain Regional Wildland Park, and I-405 regional detention pond and Coal Creek sediment pond were built.
1987-1993	Phantom and Larsen Lakes Restoration Reports	Phantom Lake and Larsen Lake	Completed.
1988	Comprehensive Drainage Plan	City-wide	Approximately 60% of the recommended capital improvements have been constructed. The remainder are no longer recommended for construction due to inability to obtain property rights, changed policies, or low ranking of project.
1988	Meydenbauer Creek Basin Study	Meydenbauer Creek basin	Completed or ongoing.
1990	Lewis Creek Basin Drainage Report	Lewis Creek basin	A compilation of pre-1990 reports, agreements, design data, plat history, water quality information, Lakemont pond performance during storm events, and policies prepared for the storm and surface water commission to address surface water policies being discussed in 1990.
1994	Comprehensive Drainage Plan	City-wide	

Date	Plan Name	Focus Area	Status of Recommendations
1995	Characterization and Source Control of Urban Stormwater Quality	City-wide	A 4 ½-year water quality study to support NPDES processes. The report recommended using a watershed-based approach to characterize stormwater, to use source control programs to improve water quality, and revisions to water quality criteria.
1996	Lake Sammamish Water Quality Management Plan, 1996	Lake Sammamish basins	This plan made recommendations on how the neighboring jurisdictions could protect the water quality of Lake Sammamish through a combination of phosphorus control practices including source control, retrofit, forest management, and regional treatment technologies.
1999	Richards Creek Basin Plan	Richards Creek basin	Two culvert enlargement projects to improve fish passage and flood flow conveyance.
2001	City of Bellevue Stream Typing Inventory	Stream typing inventory of Bellevue streams	
2003	Hydrologic Study of Kelsey Creek	Kelsey Creek basin and tributaries	Analysis to evaluate operation of regional detention facilities to reduce erosive flows, improve aquatic habitat, and maintain existing flood control.

Date	Plan Name	Focus Area	Status of Recommendations
2005	Coal Creek Environmental Impact Statement	Coal Creek basin	All identified projects built, including numerous streambank stabilization projects, and off-channel sedimentation pond.
2006	Lake Bellevue Water Quality Study and Management Recommendations	Sturtevant Creek basin	This study addressed current and future developments and land uses and their impact on water quality; current nutrient dynamics and their impact upon algal blooms; sources of petroleum products; and made management recommendations on achievable lake water quality goals.