Section 8
Water Quality

8.1 Introduction

Beyond quantities themselves, accessibility to the region's water resources can also be limited by water quality. Certainly, various levels of pollution can restrict the beneficial uses of both ground and surface water. On the surface side, the State is mandated to comply with the federal Clean Water Act (CWA) and the Endangered Species Act (ESA). Under the CWA, the State must establish water quality standards for it surface water resources (as defined under RCW 90.48) and then identify those portions of the inventory that are impaired with regards to those standards. In accordance with Section 303(d) of the CWA, every four years the State must submit a list of its polluted waterbodies to the U.S. Environmental Protection Agency (EPA), including citations to all estuaries, lakes, and streams that fall short of state standards and are not expected to improve within the next four years. These standards and their associated restoration efforts are established as a means of protecting designated beneficial uses ranging from fishing, swimming, boating, and drinking to industrial and agricultural purposes, and fish habitat.

Notwithstanding, ESA brings its own goals and criteria for water quality statewide. Under ESA, the State is required to establish plans for the recovery of identified threatened and endangered species, most notably various fish populations such as salmon and steelhead. Unlike the CWA where specific standards have been created, the rules under ESA are much less defined. The water quality goals here are not parameter specific but are instead directed at the recovery of these identified species. Hence, guidelines are the norm based on various scientific findings and advisory group recommendations. Unfortunately, specific standards have yet come forth that will ensure compliance under ESA. As a result, the requirements under ESA remain largely undefined and are still evolving statewide.

On the ground water side, the rules are somewhat different. The State has adopted ground water quality standards, as defined under RCW 90.48. However, these standards are largely in place to protect against contamination from human activity and preserve the potable quality of various ground water resources. The rules are directed at controlling accidental and illegal application of various contaminants (or waste) onto the land and establishing clean up standards in response known or potential contamination.

In supporting watershed planning effort, the section is designed to identify and assess the available data regarding both ground and surface water quality in WRIAs 25 and 26. The intent is to identify potential problem areas as they relate to the goals and standards of the state and to identify any conditions with regards limiting future beneficial use of these resources. In addition, reviews are presented of current restoration plans and the data that are available to assist in supporting future efforts of this kind. Like all elements of this report, the principal goal and objective of this is to collect all relevant data and assess its adequacy in supporting the future development of a watershed management plan for WRIAs 25 and 26.

8.2 Principal State and Federal Water Quality Regulations

8.2.1 State Stream Classification

The State of Washington has classified and assigned water quality criteria to all surface waters in the State (see WAC 173-201A-030). There are four basic stream classifications (AA, A, B, C), each based on the intended uses for each stream or stream segment. For each stream classification, there are associated water quality criteria. These criteria have been established to support a variety of stream uses consistent with public health and public enjoyment, and the propagation and protection of fish, shellfish, and wildlife. In addition, special water quality conditions have been applied to certain water bodies and stream segments based on location-specific circumstances.

Class AA streams are those that *markedly* and *uniformly* exceed all requirements for all, or substantially all, of their uses. Typically, a Class AA stream would possess superior water quality, pose no significant public health risks, adequately protect fish and wildlife, and might, in principle, be appropriate for recreational purposes. Class AA streams often serve as sources of domestic water supply and can be used for primary contact recreation. The state has defined "primary contact recreation" to mean activities where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and water skiing. In addition, these streams should be capable of supporting salmonid and other fish migration, rearing, spawning, and harvesting. Class AA stream reaches are scattered across five of the WRIA 26 subbasins and include portions of the Cispus, Coweeman, Toutle and Cowlitz Rivers. In addition, one Class AA stream, a portion of Grays River, is located in WRIA 25. A summary of these locations is outlined in Table 8-1.

Class A streams are those that *meet* or *exceed* the requirements for all, or substantially all, of their uses. A Class A stream would typically possess good water quality, pose little or no significant health risk, adequately protect fish and wildlife, and might be appropriate for certain recreational purposes. Uses would include domestic use and primary contact recreation; as well as salmonid and other fish migration, rearing, spawning and harvesting. There are four explicitly classified Class A streams in WRIAs 25 and 26. These are spread across four different subbasins and are distributed evenly across WRIA 25 and 26.

Classes B and C generally define a lower level of required water quality and are limited with regards to beneficial use. There are no Class B or Class C stream segments in either WRIA 25 or WRIA 26. In general, streams that have not been explicitly classified by the State are considered Class A. A list of specifically defined streams for WRIA 25 and WRIA 26 is shown in Table 8-1.

Table 8-1
Classified Rivers and Streams in WRIA 25 and 26

River or Stream Reach	Class
Cispus River	Class AA
Coweeman River from Mulholland Creek (river mile 18.4) to headwaters	Class AA
Cowlitz River from base of Riffle Lake Dam (river mile 52.0) to headwaters	Class AA
Grays River from Grays River Falls (river mile 15.8) to headwaters	Class AA
Green River (Cowlitz County)	Class AA
Toutle River, north fork, from Green River to headwaters	Class AA
Toutle River, south fork	Class AA
*Columbia River from mouth to the Washington-Oregon border (river mile 309.3)	Class A
Coweeman River from mouth to Mulholland Creek (river mile 18.4)	Class A
Cowlitz River from mouth to base of Riffle Lake Dam (river mile 52.0)	Class A

- *Special Conditions: temperature shall not exceed 20.0 C due to human activities. When natural conditions exceed 20.0 C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3 C; nor shall such temperature increases, at any time, exceed 0.3 C due to any single source or 1.1 C due to all such activities combined. Dissolved oxygen shall exceed 90 percent of saturation. Special fish passage exemption as described in WAC 173-201A-060 (4)(b).*

Note, in Table 8-1, there are several exemptions from water quality standards applicable to the Columbia River from the river mouth to river mile 309.3. These exemptions include temperature and fish passage.

8.2.2 State Standards for Surface Waters

The State's surface water quality standards are formed from a combination of the stream classification (based on the intended use of a stream segment) and specific water quality criteria designed to help ensure its continued use and prevent future degradation. The use of the term “criteria” here may be somewhat misleading since this term is often used in other documents to describe unenforceable water quality “goals”. Here, however, the State’s criteria should be considered as regulated “standards.”

Table 8-2 provides a detailed description of the State's use classification system and associated water quality criteria (standards) for the Class A, AA, and Lake classifications. (As noted earlier, there are no Class B or Class C streams in WIRAs 25 and 26.) The first two columns define the stream classification and the intended uses for a stream with that specific designation. The third column lists specific water quality criteria that must be met in order to ensure the designated use. Generally, the criteria are less stringent as one moves from Class AA to Class A (and so on), reflecting the diminished uses of each stream.

In addition, the State of Washington also has specific surface water quality criteria with respect to toxic materials and other contaminants. A complete summary of those standards has been included as Appendix A to this report and can be found in reference to Washington Administrative Code (WAC) 170-201A.

8.2.3 303(d) Listing and Total Maximum Daily Loads (TMDLS)

The federal Clean Water Act (CWA) includes provisions addressing surface waters that do not meet established water quality standards. Under Section 303(d) of the CWA, the State of Washington is directed to identify surface-water bodies for which the traditional approach of regulating point sources may be inadequate to achieve water quality standards. These water bodies are commonly known as the "303(d) list."

Based on the 303(d) list, Ecology is further required to establish priorities for improving water quality conditions in the waters identified. Under the law, this process is handled by quantifying a "loading capacity" for the identified 303(d) waters. Here, loading capacity represents the maximum quantity of a contaminant that a water body can assimilate without violating water quality standards at a particular location. Section 303(d) also requires Ecology to develop Total Maximum Daily Loads (TMDL)s for the identified waters. In essence, a TMDL is the sum of all point-source discharges, non-point-source discharges and natural background loading that can be allocated without exceeding a water body's loading capacity. Moreover, a TMDL is established for each contaminant identified and must include a margin of safety to account for technical uncertainty or lack of data. Hence, a given impaired stream segment may have more than one TMDL assigned to it. The most common example is that of temperature and dissolved oxygen.

Table 8-2
General Characteristic Uses and Water Quality Criteria for Surface Waters of the State of Washington (WAC 173-201A-030)

General Use Classification	Uses	General Water Quality Criteria
Class AA (extraordinary) Water quality in this class shall *markedly and uniformly* exceed the requirements for all or substantially all uses. Applies to all surface waters lying within national parks, national forests, and/or wilderness areas unless specifically noted (see list below). In addition, all unclassified surface waters that are tributaries to Class AA waters are also Class AA waters	Shall include but not be limited to: 1) Water Supply: i) domestic ii) industrial iii) agricultural 2) Stock Watering 3) Fish: i) salmonid and other fish migration ii) rearing and spawning iii) harvesting 4) Wildlife Habitat 5) Recreation: i) primary contact recreation ii) sport fishing iii) boating iv) aesthetic enjoyment 6) Commerce and Navigation	1) Fecal Coliform Organisms: i) shall not exceed a geometric mean value of 50 colonies/100 mL AND ii) shall not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100mL 2) Dissolved Oxygen shall exceed 9.5 mg/L 3) Total Dissolved Gas shall not exceed 110% of saturation 4) Temperature: i) shall not exceed 16°C due to human activities ii) when natural conditions exceed 16°C, no temperature increases greater than 0.3°C to receiving waters are allowed 5) Incremental Temperature Increases: i) for point sources, shall not exceed t°C, where t =23/(background measured temperature + 5) ii) for non-point sources, shall not exceed 2.8°C 6) pH shall fall within the range of 6.5 – 8.5 with a human caused variation within the above range of less than 0.2 7) Turbidity: i) shall not exceed 5 NTU (nephelometric turbidity units) over background, when background turbidity is 50 NTU or less, OR ii) have more than a 10% increase in turbidity when background levels are above 50 NTU 8) Toxic, Radioactive, and other Deleterious Materials shall not exceed concentrations that might singularly or cumulatively affect water use, cause acute or chronic effects to the most sensitive biota dependent on those waters, or affect public health. Note: see specific guidelines as outlined in (WAC 173-201A-040 and 050) 9) Aesthetic values shall not be impaired by the presence of non natural materials or their effects which offend the senses of sight, smell, taste, or touch

Table 8-2 (Continued)
General Characteristic Uses and Water Quality Criteria for Surface Waters of the State of Washington (WAC 173-201A-030)

General Use Classification	Uses	General Water Quality Criteria
Class A Water quality in this class shall *meet or exceed* the requirements for all or substantially all uses. Applies to all waters that are not specifically classified (see list below) or are already classified as Class AA	Shall include, but not be limited to: 1) Water Supply: i) domestic ii) industrial iii) agricultural 2) Stock Watering 3) Fish: i) salmonid and other fish migration ii) rearing and spawning iii) harvesting 4) Wildlife Habitat 5) Recreation: i) primary contact recreation ii) sport fishing iii) boating iv) aesthetic enjoyment 6) Commerce and Navigation	1) Fecal Coliform Organisms: (i) shall not exceed a geometric mean of 100 colonies/100mL for all samples AND (ii) shall not have more than 10% of all samples used to calculate (i) above exceed 200 colonies/100mL 2) Dissolved Oxygen shall exceed 8.0 mg/L 3) Total Dissolved Gas: same as for Class AA 4) Temperature: i) shall not exceed 18°C due to human activities ii) when natural conditions exceed 18°C, no temperature increases greater than 0.3°C to receiving waters are allowed 5) Incremental Temperature Increases: i) for point sources, shall not exceed t°C, where t =28/(background measured temperature + 7) ii) for non-point sources, shall not exceed 2.8°C 6) pH shall fall within the range of 6.5 – 8.5 with a human caused variation within the above range of no more than 0.5 7) Turbidity: same as for Class AA 8) Toxic, Radioactive, and other Deleterious Materials: same as for Class AA 9) Aesthetic values: same as for Class AA

Table 8-2 (Continued)
General Characteristic Uses and Water Quality Criteria for Surface Waters of the State of Washington (WAC 173-201A-030)

General Use Classification	Uses	General Water Quality Criteria
Lake Class Water quality in this class shall *meet or exceed* the requirements for all or substantially all uses. Applies to all lakes and reservoirs except those that have a mean detention time of 15 days or less (these are classified the same as the river section in which they are located).	Shall include but not be limited to: 1) Water Supply: i) domestic ii) industrial iii) agricultural 2) Stock Watering 3) Fish: i) salmonid and other fish migration ii) rearing and spawning, iii) harvesting 4) Wildlife Habitat 5) Recreation: i) primary contact recreation ii) sport fishing iii) boating iv) aesthetic enjoyment 6) Commerce and Navigation	1) Fecal Coliform Organisms: same as for Class AA 2) Dissolved oxygen: no measurable decreased from natural conditions 3) Total Dissolved Gas: same as for Class AA 4) Temperature: no measurable change from natural conditions 5) pH: no measurable change from natural conditions 6) Turbidity shall not exceed 5 NTU over background conditions. 7) Toxic, Radioactive, and other Deleterious Materials: same as for Class AA 8) Aesthetic values: same as for Class AA 9) Recommended Nutrient criteria (based on ecoregions) See table below

Regulations issued by USEPA with regard to the TMDL program allow states to set “load allocations” and “waste load allocations” in order to improve water quality in listed water bodies. A “load allocation is established for non-point sources; and a “waste load allocation” is established for point sources. This allocation system is intended to allow the assimilative capacity of a lake, river or other water body to be divided among all of the point and non-point sources that discharge to that water body. For example, each identified source contributing to a particular stream could be assigned a specific loading to that stream. The objective is that all sources combined will not exceed the assimilative capacity of the stream, and the stream will then be capable of meeting water quality standards.

Currently, no formal TMDLs have been established for any stream segments within WRIA 25 or 26.

8.2.4 State Standards for Ground Waters

Like surface water, the State has established a number of water quality standards for ground water, including limits for a range of inorganic and organic contaminants. Specific water quality criteria have been established for a variety of organic and inorganic contaminants. The intent of these standards is preserve a level of quality for ground waters capable of meeting current state and federal safe drinking water standards. By doing so, the state provides a means for preserving "... a great variety of existing and future beneficial uses (WAC 173-200-040)." The State generally manages these resources based on an "anti-degradation” policy (WAC 173-200-030) that essentially limits human activities with regards to degradation of existing ground water quality. Hence, the majority of the rules established for ground water protection are directed at preventing pollution from various sources, including the accidental and illegal disposal of waste and hazardous materials onto the land.

For reference, a copy of the state standards (WAC 173-200) has been included in this report as Appendix B. A summary of the ground water standards is also shown in Table 8-3.

Table 8-3
Ground Water Quality Criteria

Contaminant	Criterion	
I. Primary and Secondary Contaminants and Radionuclides		
A. Primary Contaminants		
Barium*	1.0	Milligrams/li
Cadmium*	0.01	mg/L
Chromium*	0.05	mg/L
Lead*	0.05	mg/L
Mercury*	0.002	mg/L
Selenium*	0.01	mg/L
Silver*	0.05	mg/L
Fluoride	4	mg/L
Nitrate (as N)	10	mg/L
Endrin	0.0002	mg/L
Methoxychlor	0.1	mg/L
1,1,1-Trichloroethane	0.2	mg/L
2-4D	0.2	mg/L
2,4,5-TP Silvex	0.01	mg/L
Total Coliform Bacteria	1/00	mL
B. Secondary Contaminants		
Copper*	1.0	mg/L
Iron*	0.30	mg/L
Manganese*	0.05	mg/L
Zinc*	5.0	mg/L
Chlorine	250	mg/L
Sulfate	250	mg/L
Total Dissolved Solids	600	mg/L
Foaming Agents	0.5	mg/L
PH	6.5-8.5	
Corrosivity	Noncorrosive	
Color	15	Color units
Odor	3	Threshold
C. Radionuclides		
Gross Alpha Particle Activity	15	Pico
Gross Beta Particle Radioactivity		
Gross Beta Activity	50	p/Ci/L
Tritium	20,000	p/Ci/L
Strontium-90	8	p/Ci/L
Radium 226 & 228	5	p/Ci/L
Radium-226	3	p/Ci/L
II. Carcinogens		
Acrylamide	0.02	µg/l

Table 8-3 (Continued) Ground Water Quality Criteria		
Contaminant	**Criterion**	
Acrylonitrile	0.07	µg/l
Aldrin	0.005	µg/l
Aniline	14	µg/l
Aramite	3	µg/l
Arsenic*	0.05	µg/l
Azobenzene	0.7	µg/l
Benzene	1	µg/l
Benzidine	0.0004	µg/l
Benzo(a)pyrene	0.008	µg/l
Benzotrichloride	0.007	µg/l
Benzyl chloride	0.5	µg/l
Bis(chloroethyl)ether	0.07	µg/l
Bis(chloromethyl)ether	0.0004	µg/l
Bis(2-ethylhexyl) phthalate	6.0	µg/l
Bromodichloromethand	0.3	µg/l
Bromoform	5	µg/l
Carbazole	5	µg/l
Carbon tetrachloride	0.3	µg/l
Chlordane	0.06	µg/l
Chlorodibromomethane	0.5	µg/l
Chloroform	7.0	µg/l
4 Chloro-2-methyl aniline	0.1	µg/l
2 Chloro-2-methyl analine hydrochloride	0.2	µg/l
o-Chloronitrobenzene	3	µg/l
p-Chloronitrobenzene	5	µg/l
Chlorthalonil	30	µg/l
Diallate	1	µg/l
DDT (includes DDE and DDD)	0.3	µg/l
1,2 Dibromoethand	0.0001	µg/l
1,4 Dichlorobenzene	4	µg/l
3,3' Dichlorobenzidine	0.2	µg/l
1,1 Dichloroethane	1.0	µg/l
1,2 Dichloroethane (ethylene chloride)	0.5	µg/l
1,2 Dichloropropane	0.6	µg/l
1,3 Dihloropropene	0.2	µg/l
Dichlorvos	0.3	µg/l
Dieldrin	0.005	µg/l
3,3'Dimethoxybenzidine	6	µg/l
3,3 Dimethylbenzidine	0.007	µg/l
1,2 Dimethylhydrazine	60	µg/l
2,4 Dinitrotoluene	0.1	µg/l
2,6 Dinitrotoluene	0.1	µg/l

Table 8-3 (Continued) Ground Water Quality Criteria		
Contaminant	**Criterion**	
1,4 Dioxane	7.0	µg/l
1,2 Diphenylhydrazine	0.09	µg/l
Direct Black 38	0.009	µg/l
Direct Blue 6	0.009	µg/l
Direct Brown 95	0.009	µg/l
Epichlorohydrin	8	µg/l
Ethyl acrylate	2	µg/l
Ethylene dibromide	0.0-01	µg/l
Ethylene thiourea	2	µg/l
Folpet	20	µg/l
Furazolidone	0.02	µg/l
Furium	0.002	µg/l
Furmecyclox	3	µg/l
Heptachlor	0.02	µg/l
Heptachlor Epoxide	0.009	µg/l
Hexachlorobenzene	0.05	µg/l
Hexachlorocyclohexane (alpha)	0.001	µg/l
Hexachlorocyclohexane (technical)	0.05	µg/l
Hexachlorodibenzo-p-dioxin, mix	0.00001	µg/l
Hydrazine/Hydrazine sulfate	0.03	µg/l
Lindane	0.06	µg/l
2 Mehoxy-5-nitroaniline	0.2	µg/l
2 Mehylaniline	0.2	µg/l
2 Methylaniline hydrochloride	0.5	µg/l
4,4' Methylene bis(N,N'-dimethyl)aniline	2	µg/l
Methylene chloride (dichloromethane)	5	µg/l
Mirex	0.05	µg/l
Nitrofurazone	0.06	µg/l
N-Nitrosodiethanolamine	0.03	µg/l
N-Nitrosodiethylamine	0.0005	µg/l
N-Nitrosodimethylamine	0.002	µg/l
N-Nitrosodiphenylamine	17	µg/l
N-Nitroso-di-n-propylamine	0.01	µg/l
N-Nitrosopyrrolidine	0.04	µg/l
N-Nitroso-di-n-butylamine	0.01	µg/l
N-Nitroso-N-methylethylamine	0.01	µg/l
PAH	0.01	µg/l
PBBs	0.005	µg/l
PCBs	0.01	µg/l
o-Phenylenediamine	0.005	µg/l
Propylene oxide	0.01	µg/l

Table 8-3 (Continued) Ground Water Quality Criteria		
Contaminant	**Criterion**	
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.0000006	µg/l
Tetrachloroethylene(perchloroethylene)	0.8	µg/l
P,,, -Tetrachlorotoluene	0.004	µg/l
2,4 Toluenediamine	0.002	µg/l
0-Toluidine	0.2	µg/l
Toxaphene	0.08	µg/l
Trichloroethylene	3	µg/l
2,4,-Trichlorophenol	4	µg/l
Trimethyl phosphate	2	µg/l
Vinyl chloride	0.02	µg/l

- *Metals are measured as total metals*
- *[Statutory Authority: RCW 90.48.035. 90-22-023, 172-200-040, filed 10/31/90, effective 12/1/90.]*

8.2.5 Non-regulatory Programs

Many government agencies administer non-regulatory programs that are designed to protect or improve water quality. Typically these non-regulatory programs involve financial incentives or technical assistance programs that help citizens, farmers, businesses or other government agencies carry out projects on a voluntary basis. The non-regulatory programs that are directly related to water quality include:

- Local Non-regulatory Programs
  - Conservation District Programs designed to reduce erosion and sediment loading to surface waters, improve water quality monitoring, or vegetate riparian areas. WRIAs 25 and 26 encompass portions of 4 Conservation Districts: Wahkiakum, Cowlitz, Underwood, and Lewis.
- State Non-regulatory Programs
  - The State manages several funding programs designed to assist various parties in improving water quality. These programs include the Centennial Clean Water Fund, Washington State Water Pollution Control Fund; and Clean Water Act Section 319 Nonpoint Source Fund.
  - The State Department of Fish and Wildlife manages the Watershed Recovery Project that involves collecting information about land use practices and water quality within watersheds. The information is collected into a usable format to assist watershed managers to prioritize improvements programs.

- Federal Non-regulatory Programs
  - Natural Resources Conservation Service Programs that assist farmers and landowners.
  - Farm Service Agency programs such as the Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP).

8.3 Summary of Surface Water Quality Data

In general, ample surface water quality data sources are available for WRIA 25 and 26 to achieve a number of goals with regards to future water supply planning. The majority of is information is available from federal and state programs such as the Washington State Department of Ecology (Ecology), United States Geological Survey (USGS), the Washington State Conservation Commission, the Department of Natural Resources and the Department of Fish and Wildlife. In addition, supplemental information is also available through many independent papers and on-going research projects. Much of the data collected also include an evaluation of water quality impacts, as well as assessment of the causes of degradation such as pollution discharge, timber, agricultural methods and natural events (i.e. namely the eruption of Mt. Saint Helens in 1980). In addition to current water quality data, many of these programs and projects have also collected historical baseline data that is useful in establishing a record of water quality change throughout the two WRIAs.

Within WRIAs 25 and 26 there has been some improvement in water quality at some locations. This is evident through multiple 303(d) List de-listings since 1996. Many of these improvements are a result of natural riparian habitat recovery since the eruption of Mt. St. Helens, localized restoration projects, and increased point source discharge management. Despite these improvements, water quality degradation is still prominent as a result of deforestation, agriculture and urban center stormwater runoff.

According to the available data, the most significant problems within WRIA 25 and 26 are those related to sediment loading and temperature, as well as dissolved oxygen depletion and coliform contamination. The sediment loading to area streams is dominated by the eruption of Mt. St. Helens, infrastructure development and timer harvesting. Deforestation and the destruction of riparian corridors have negatively impacted water temperature across WRIA 25 and 26. Non-point pollution caused by agricultural practices and point source discharges from municipal or industrial centers have also led to localized impairment of a few stream segments. Additionally, historical data shows that the primary sources of water quality degradation may be shifting from point source discharges to virtually unregulated non-point sources of pollution. Notwithstanding, the overall picture with regards to water quality is relatively good. By comparison to other WRIAs, the number and severity of water quality problems is somewhat limited.

Despite the large amount of data available, information about water quality is limited for many of the small streams and creeks within WRIA 25 and 26; many of these streams should potentially be included on the impaired segment 303(d) list but have not been included because of a lack of water quality data meeting state assessment data standards. Additionally, more data is needed to support stream restoration and fish reintroduction efforts including, instream habitat variability, shade cover, biological health and biodiversity, and the instream distribution of large woody debris (LWD). Further details describing current monitoring efforts in each WRIA and their results as they relate to potential impacts on area water quality are outlined below.

8.3.1 Existing Surface Water Quality Monitoring

As stated in Section 8.2, there are many regulatory and non-regulatory programs addressing water quality. Many of these programs include water quality monitoring programs as described in this subsection.

The Washington State Department of Ecology (Ecology) and its predecessor agency has conducted a long-term Ambient Water Quality Monitoring Program since 1959. This program now supports the Ecology 303d listing program under the federal and state CWA. Water quality data collected through this program is compared to relevant state standards. The program involves routine monthly water quality sampling during Water Years that begin on October 1 and end on September 30 of the following year. Ecology uses two types of monitoring stations in the program:

- ❑ Long-term stations are monitored yearly to track water quality changes over time; and
- ❑ Basin stations are generally monitored for a few years to support basin water quality management or waste permitting processes but may be revisited every 5 years.

Water quality parameters typically measured through this program include: conductivity, dissolved oxygen, pH, temperature, total suspended solids, turbidity, fecal coliform bacteria, soluble reactive phosphorus, total phosphorus, ammonia, nitrate plus nitrite, and total nitrogen. Selected sites are also sampled for dissolved and total recoverable metals each year. Numeric water quality standards associated with each of these parameters are discussed in Section 8.2 and presented in detail in Appendix A. Although several of these and other parameters were not reviewed in detail for this assessment, this should not be interpreted to mean that they lack significance for further study and or improvement of water quality conditions. Following is a brief discussion of some of the most important water quality monitoring parameters pertaining to WRIAs 25 and 26.

Temperature

Water temperature influences many chemical and biological processes in the water column. It can speed up or slow down chemical reactions affecting water quality. Variations in temperature affect the amount of dissolved oxygen (DO) in water, since oxygen becomes more soluble in water at colder temperatures. Higher temperatures also contribute to eutrophication of water bodies, which leads to depletion of DO.

Dissolved Oxygen

The State of Washington has imposed its own DO minimum requirements as shown in Table 8-2 (see also Appendix A). DO is important in maintaining healthy aquatic ecosystems and low DO can increase the availability of toxic substances like ammonia that can have a direct affect on fish populations. Adequate DO is essential to maintain healthy salmonid stocks.

Nutrients

Nutrient parameters include a number of different chemical species of nitrogen and phosphorus that relate generally to the analytical methods used for their measurement. Generally, nitrogen is measured analytically in terms of nitrate plus nitrite (filtered), ammonia (filtered), and ammonia plus organic nitrogen (unfiltered). Phosphorus is measured analytically in terms of soluble reactive phosphorus (SRP) (filtered) and total phosphorus (unfiltered). SRP is also sometimes termed orthophosphate.

Nutrienst in the water column can affect both human health and the vitality of aquatic ecosystems. Nutrient enrichment can lead to the occurrence of harmful algal blooms, which cause eutrophication, contributing to a reduction in dissolved oxygen. This causes habitat degradation for many aquatic organisms. As with any set of parameters having pronounced effects on aquatic habitat conditions, nutrient enrichment can potentially alter the composition and species diversity of aquatic populations.

Human health can also be affected by nutrients in water bodies used as a source of drinking water. At levels above 1.0 mg/L, nitrite (a reduced form of nitrate) can be hazardous to infants under the age of 3 months. In additions, nutrient enrichment has been associated with the formation of trihalomethanes (THMs). THMs are carcinogenic compounds that are produced when certain organic compounds (many crated during eutrophication) combine with chlorine compounds during the disinfection process in a drinking water treatment facility.

Fecal Indicator Bacteria

The fecal coliform bacterial group is frequently used as an indicator of public health concerns related to water quality. Fecal colifrom bacteria originate in the intestinal tracts of warm-blooded animals, and reach water through fecal discharge. The group includes the species *Escherichia coli* (*E. coli*). Identification of fecal coliform bacteria in a water body can suggest the possible presence of other organisms, which cause cholera, hepatitis A, shigellosis, typhoid fever, bacillary and amoebic dysentery, as well as gastrointestinal illnesses associated with protozoans like *Giardia lamblia*, and *Cryptosporidium parvum*. It should be emphasized that the presence or absence of fecal indicator bacteria within a water body does not automatically indicate the presence of disease causing agents. However, it indicates the degree to which a water body is polluted with fecal material.

Suspended Sediment and Turbidity

Turbidity is closely related to total suspended solids (TSS). Although these two parameters are measured differently, they are both a measure of the amount of solids suspended in water. TSS is determined by transferring suspended solids from a water sample to dry filter paper. Turbidity is determined by measuring the amount of light penetrating a sample. Both TSS and turbidity can be caused by any combination of organic or inorganic material. Many water quality pollutants, especially lipophilic contaminants, many of which are pesticides, can attach to sediments and be transported into surface water bodies during erosion events. Therefore sediment and organic fines can be a significant transport mechanism for chemicals into surface water bodies. In additions, suspended sediments can have adverse impacts on aquatic life, including aquatic plants, invertebrates, and fish by blocking light penetration, reducing visibility, clogging spawning beds, etc.

Seven Ecology Ambient Water Quality Monitoring Stations have been located in WRIAs 25 and 26 since 1980. The distribution of these stations by WRIA and watershed subbasin is shown in Table 8-4.

Long-term monitoring programs typically change and improve over time to meet data needs. Ecology uses a quality assurance/quality control (QA/QC) program to ensure that the data collected is accurate and meets analytical standards. Despite this, improved sampling and analytical methods can affect results when data trends are analyzed over extended time periods. To assist water quality data analysis, each Yearly River and Stream Ambient Monitoring Report (Ecology 1997) contains an appendix listing all known changes in the program data collection techniques that have occurred since 1959. Any trending analysis using data from the Ambient Monitoring

Program should consider any changes in sampling or analytic equipment or sampling techniques to reduce any related bias.

Table 8-4
Ecology Ambient Water Quality Monitoring Stations

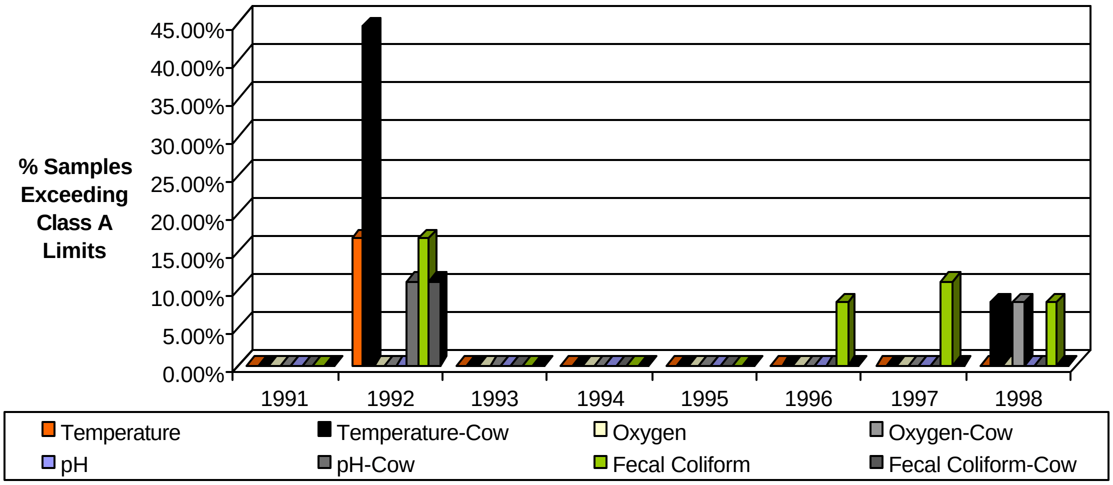
Station ID #	WRIA	Watershed Subbasin	Years of Data (1980 - 1998)	Station Type
25C070	25	Elochoman River	1997, 1998	Basin
25B070	25	Grays River	1997, 1998	Basin
26B070*	26	Coweeman River	1980, 1982-1998	Long-term
26D070	26	Lower Cowlitz	1980-1992	Long-term
26C070	26	Coweeman River	1984-1992, 1998	Basin
26C080	26	Coweeman River	1998	Basin
26B150	26	Lower Cowlitz	1980, 1991, 1992	Basin

*NOTE: * Station for regular and metals parameters*

Of the two WRIA 25 Ambient Monitoring Sites, 25C070-Elochoman River and 25B070-Grays River (Ecology 1999a), both exceeded the limits for fecal coliform in 1998 in 8.3% of the samples taken. Neither of these sites had fecal coliform violations in the preceding year, 1997.

In WRIA 26, the five monitoring stations had varying results (Ecology 1999b). One station, 26B150-Cowlitz River at Toledo had no limit violations for any parameter when it was last sampled in 1991 and 1992. Two stations, 26D070-Toutle River and 26C080-Coweeman River at Gobble Creek, exceeded the limits for temperature. 26D070-Toutle River, exceeded temperature standards 44.4% of the time in 1992. In 1998, 8.3% of the samples at station 26C080-Coweeman River at Goble Creek exceeded temperature standards. Exhibit 8-1 shows the percentage of sample violations for Ambient Monitoring Stations 26B070-Cowlitz River at Kelso and 26C070-Coweeman River at Kelso. These two stations were monitored more frequently and exhibited higher percentages of sample result violations than the other stations located across WRIAs 25 and 26. It is probable that the close vicinity of these stations to Kelso and Longview, the primary industrial centers of WRIAs 25 and 26, impacts the water quality at these stations.

Exhibit 8-1
Stations 26B070-Cowlitz River at Kelso and 26C070-Coweeman River at Kelso Sample Violations from 1991-1998



Note: Solid columns represent percentages in the Cowlitz River and hashed columns represent percentages in the Coweeman River.

In addition to Ecology monitoring sites, historical daily water quality data for several locations in WRIA 25 and 26 is available through the United States Geological Survey (USGS 1994). Table 8-5 lists the USGS monitoring stations by WRIA subbasin, year(s) of monitoring, and parameters monitored. No USGS water quality monitoring stations are currently within WRIA 25 and 26. Years represented in the data are water years beginning on October 1st and ending on September 30th.

In addition to state and federal water quality monitoring programs, hundreds of special focus studies are available that provide information regarding water quality monitoring efforts within WRIA 25 and 26 (Fish and Wildlife 2000). Among these studies are several reports that are products of the Watershed Recovery Inventory Project being conducted by the Washington State Department of Fish and Wildlife. Through this program, water quality and land use surveys are conducted within sub-watershed basins to form a baseline of information that can later be used to develop watershed improvement management strategies. Table 8-6 lists the studies available from this program for the sub-basins within WRIA 25 and 26.

Table 8-5
USGS Historical Daily Water Quality Monitoring Stations in WRIA 25 and 26

Station No.	WRIA	Parameters	Years
Elochoman	25		
14246500		Temperature	1954
14247500		Temperature	195_
Abernathy/Germany Creek	25		
1424000		Temperature	1950
Coweeman River	26		
14242690		Temperature, sediment, pH, specific conductance	1980-1982
14242580		Temperature, sediment	1950-1973
14245000		Temperature	1950-1972
Lower Cowlitz River	26		
14236200		Temperature	1965-1982
Toutle River	26		
14241490		Temperature, sediment, specific conductance	1981
14241500		Sediment	1981
14243000		Temperature, specific conductance	1990-1991
14242500		Temperature	1951-1962
Tilton River	26		
14235500		Temperature	1951-1959
14238000		Temperature	1950-1982
Mayfield Dam	26		
14234810		Temperature	1970-1982
Upper Cowlitz River	26		
14226500		Temperature	1971
14232500		Temperature	1950-1972
14233400		Temperature	1953-1982

Table 8-6
Studies Related to the WDFW Watershed Recovery Inventory Project

▪ Arkansas Creek	▪ Cispus Lower East
▪ Cispus North Fork	▪ Lewis Subbasin Plan
▪ Cispus River	▪ Silver Lake
▪ Cispus, Middle and Upper	▪ Coweeman Upper
▪ Cowlitz River	▪ Cispus Lower West
▪ Cowlitz Subbasin Plan	▪ Burley Mountain
▪ Cowlitz Upper	▪ Cowlitz Middle
▪ Elochoman Main	▪ Adams Creek
▪ Iron Creek	▪ Tilton East Fork

Special studies that may be of particular interest are those related to erosion within WRIA 25 and 26. Associated impacts are related to increased turbidity in area surface water bodies. While many of the smaller streams in WRIA 25 and 26 are not included in the 1998 303(d) List, many are known to have degraded water quality caused by high turbidity. Highly turbid water can adversely affect fish habitat and stream restoration efforts by suffocating spawning beds and inhibiting photosynthetic streambed vegetation that can support micro and macro invertebrate populations. High turbidity can also reduce the reliability of drinking water supply sources by harboring harmful bacteria and pathogens regulated by the Safe Drinking Water Act. The primary sources of high turbidity in WRIA 25 and 26 include erodable soil types, especially in WRIA 25, and mud deposits and bank instability caused by the Mt. St. Helens eruption of 1980, especially in WRIA 26. This high turbidity, though often caused by natural conditions can be exacerbated through deforestation, agriculture and infrastructure projects including road construction for timber harvesting. Several special studies focusing on the issue of turbidity in WRIAs 25 and 26 are summarized in Table 8-7.

Table 8-7
Turbidity Related Studies

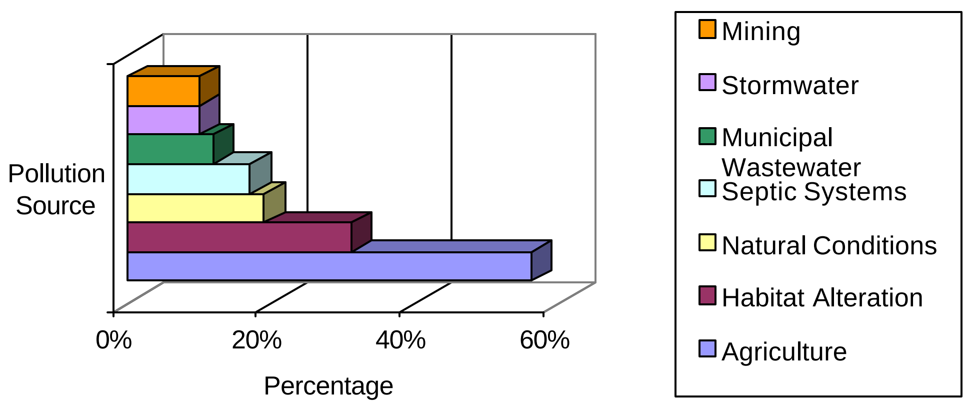
		Primary Causes Studied		
Reference	**Study Location**	**Human Activity**	**Soil Type**	**Volcanic**
Shuett-Hames, Joanne (2000)	Germany Creek (WRIA 25-Abernathy/Germany Subbasin)			
Rashin, E. et al. (1994)	Mulholland Creek (WRIA 26-Coweeman Subbasin)			
Dinehart, Randy (1987)	WRIA 26			
Lisle et. al (1982)	Toutle River (WRIA 26-Toutle Subbasin)			
Gifford Pinchot (1999) – GIS Coverage	WRIA 26			

It should be noted that most of the studies related to Mt. St. Helens related problems were conducted in the early to mid 1980s. It is likely that more recent studies are available and these should be located. Restoration projects and forest regrowth may be altering the amount of turbidity in surface waters within WRIA 26 and water quality may be improving.

8.3.2 Natural and Human Causes of Surface Water Quality Degradation

Traditionally, human activities directly related to water withdrawal and waste disposal were considered to be the greatest causal factor of water quality degradation in U.S. surface waters. These uses include, among others, domestic, commercial, industrial, hatchery, and agricultural water use through water rights and NPDES permits, in addition to spills and waterway transportation. Historical data however indicate that the primary sources of water quality degradation may be shifting from point source discharges to virtually unregulated non-point source pollution. In fact, the most frequent water quality problems occurring within WRIAs 25 and 26 may be primarily a result of non-point pollution. This recent trend is evident in Exhibit 8-2 that shows possible sources of pollution in streams assessed in Washington State for the 1998 303(d) list development.

Exhibit 8-2
Possible Sources of Pollution in Streams Assessed in Washington State



Data from: Ecology 1998c.

For centuries, scientists have linked land use practices to both direct and indirect impacts on water resources. As part of the natural hydrologic cycle, the waters of an area are innately linked to the land that stores and conveys that resource. There is an obvious link between the quantity and quality of water resources and the types of land use that exist in a given basin. There have been numerous studies conducted throughout the world regarding the related impacts generated from such activities as deforestation, urbanization, and agriculture, as well as many other naturally occurring and man-made events.

The waters of the State of Washington are no exception. In fact, the Washington State Department of Ecology has connected many land use activities with some of the state's most wide spread surface water quality problems including, thermal pollution (high temperature), pathogens, pH, low dissolved oxygen, metals, sediment and nutrients (Ecology 2000a). Table 8-8 summarizes Potential Causes of Surface Water Quality Degradation.

In addition to human caused water quality degradation, natural conditions or (catastrophic) events can contribute to poor water quality. A summary of natural events contributing to surface water quality degradation in WRIAs 25 and 26 are listed in Table 8-9.

Table 8-8
Potential Causes of Surface Water Quality Degradation
(Adapted from Yakima Valley Conference of Governments, 1995, v. II, Table II-1)

Parameter/Issue	Potential Causes
Aesthetic Values	❑ Littering in and around waters ❑ Highway litter blown onto water ❑ Vehicle emissions, leaks ❑ Runoff from highways and roads ❑ Periodic transportation spills, accidents ❑ Use of oils and tars for weed control ❑ Urban Runoff ❑ Dumping oil on ground, in gutters, or down storm drains
Alkalinity	❑ Agricultural return flows
Ammonia	❑ Sewage treatment plants ❑ Septic systems ❑ Animal waste
Bacteria and Viruses	❑ Wastewater treatment plant ❑ Septic systems ❑ Livestock waste ❑ Camping and other outdoor recreation, including use of stock ❑ Pet waste ❑ Urban stormwater runoff
Dissolved Oxygen Depletion	❑ High water temperature ❑ Excessive plant growth due to high nutrient levels ❑ Decomposing plant materials ❑ Decomposing animal waste ❑ Effluent from wastewater treatment facilities ❑ Low instream flows ❑ Discharge of poorly-oxygenated ground water

Table 8-8 (Continued)
Potential Causes of Surface Water Quality Degradation
(Adapted from Yakima Valley Conference of Governments, 1995, v. II, Table II-1)

Parameter/Issue	Potential Causes
Major Metals and Trace Elements	❑ Mining ❑ Industrial processes ❑ Industrial waste disposal ❑ Copper and lead pipes ❑ Urban stormwater runoff ❑ Motor vehicle brakes, tires, and fluides ❑ Leaded Gasoline
Nutrients	❑ Fertilizer applications ❑ Animal waste ❑ Sewage treatment plants ❑ Urban runoff ❑ Septic systems
Suspended Sediment and Turbidity	❑ Crop production ❑ Construction site erosion ❑ Timber harvest and related road building ❑ Loss of vegetative cover ❑ Mining (hydraulic mining, sand and gravel operations, surface mining) ❑ ORV use and other recreational uses that disturb soils and water bodies ❑ Livestock in water bodies ❑ Confined animal feeding operations ❑ Erosion from other land disturbance (military training activities; public land management, maintenance and inspection of roads/canals/power lines, pipe lines; etc.)
Synthetic Organic Compounds	❑ Pesticides remaining in soils from past agricultural applications ❑ Improper application of pesticides ❑ Household hazardous wastes ❑ Application in immediate vicinity of waterbodies, or where runoff is likely
Temperature	❑ Conversion of forest lands to other uses ❑ Timber harvest ❑ Loss of riparian cover resulting from mining, recreational activities, grazing, or intentional clearance for lawns, gardens, canal maintenance, etc. ❑ Low water/flow levels ❑ Discharges of treated effluent

Source	Nitrogen	Fecal Coliform	Sediment	Dissolved Oxygen	Flow	Temp.
Mt. St. Helens Eruption (1980)						
Mass Wasting						
Forest Fires						
Forest Seral Cycling						
Soil Characteristics						
Aquatic Vegetation Growth						
Wildlife Population Changes						
Drought Storm Events						

Table 8-9
Natural Event Impacts on Water Quality

8.3.3 Impaired Stream Segments

Washington State Department of Ecology (Ecology) is required under Section 303(d) of the Clean Water Act (CWA) to prepare a list every two years containing water body segments not expected to meet state surface water quality standards after the implementation of technology-based controls. The list contains the "water quality limited segment(s)" as defined in 40 CFR 130.29j. The state is also required to complete a total maximum daily load (TMDL) assessment for all water body segments on the list. For a water body to be included in a 303(d) list, at least one of the following must apply:

- For temperature, dissolved oxygen, pH, turbidity and total dissolved gas, at least two measurements are required (in the past 5 years) and at least 10% of those measurements must exceed water quality criteria;
- For toxic pollutants at least two measurements must exceed water quality criteria in the past three years that data has been collected;
- Marine sediment samples that do not comply with sediment management standards under WAC 173-204-320;
- Bioassay tests on freshwater sediments, low salinity sediments, and water column samples show statistically significant adverse effects as evaluated on a case specific basis;
- Fin fish muscle tissue or whole shellfish tissue samples exceed human health impacts criterion in one fish on two distinct excursions, or at least five separate fish on one excursion;

- Documented alteration, characteristic impairment on the subject water body, and identification of a direct human caused contribution to the environmental alteration;
- Impaired fish habitat relating to stream flow conditions; or
- A modeling analysis of an existing or proposed activity that shows water quality standards will not likely be met during the next 2 years.

Table 8-2 (and Appendix A) list water quality criteria used to evaluate monitoring results for water segments of each use classification. WRIA 25 and 26 stream classifications are shown in Table 8-1. Exceptions to these standards have been identified for some stream segments on a case-by-case basis. Results outside of the indicated range are considered to exceed the stated criterion.

Current 303(d) Listings in WRIA 25 and 26

EPA has allowed states to skip the year 2000 303(d) list due to ongoing development of new federal rules affecting the listing process and the TMDL program. The next list is due in April of 2002. As a result, Washington State was not required to update the list in year 2000 per the regular two-year review cycle. The GIS coverage obtained from Ecology 2001b, presented in Exhibits 8-3 and 8-4, show the water bodies included in the 1998 303(d) CWA Listing in WRIA 25 and 26, respectively.

The most common parameters for which water bodies in WRIA 25 and 26 do not meet standards include temperature, turbidity, and dissolved oxygen. More than 20 segments are listed for temperature and of these, 5 have been added since the 1996 303(d) Listing. The greatest concentration of thermal pollution (temperature) listings seems to occur in smaller streams throughout WRIA 25 and 26 and is presumed to be a result of riparian vegetation loss.

The highest concentration of listed segments for turbidity, dissolved oxygen and fecal coliform are located in the Longview Ditches (WRIA 25-Coal Creek/Longview Slough Subbasin) and Columbia River that are shown in Exhibit 8-3. It is likely that these concentrations are a direct result of point source discharges and industrial and urban runoff. Table 8-10 lists the contaminated segments of the Longview Ditches by stream route number; many of the segments within the ditch drainage system are contaminated by several parameters so that all of the 303(d) listed information cannot be displayed simultaneously on the GIS coverage exhibits. Additionally, more comprehensive information regarding water quality in the Longview Ditch System can be obtained from two reports: *Longview Ditches Water Quality Survey* (Ecology 1989) and *Longview Drainage System Part I – Water Quality Assessment* (Ecology 1993).

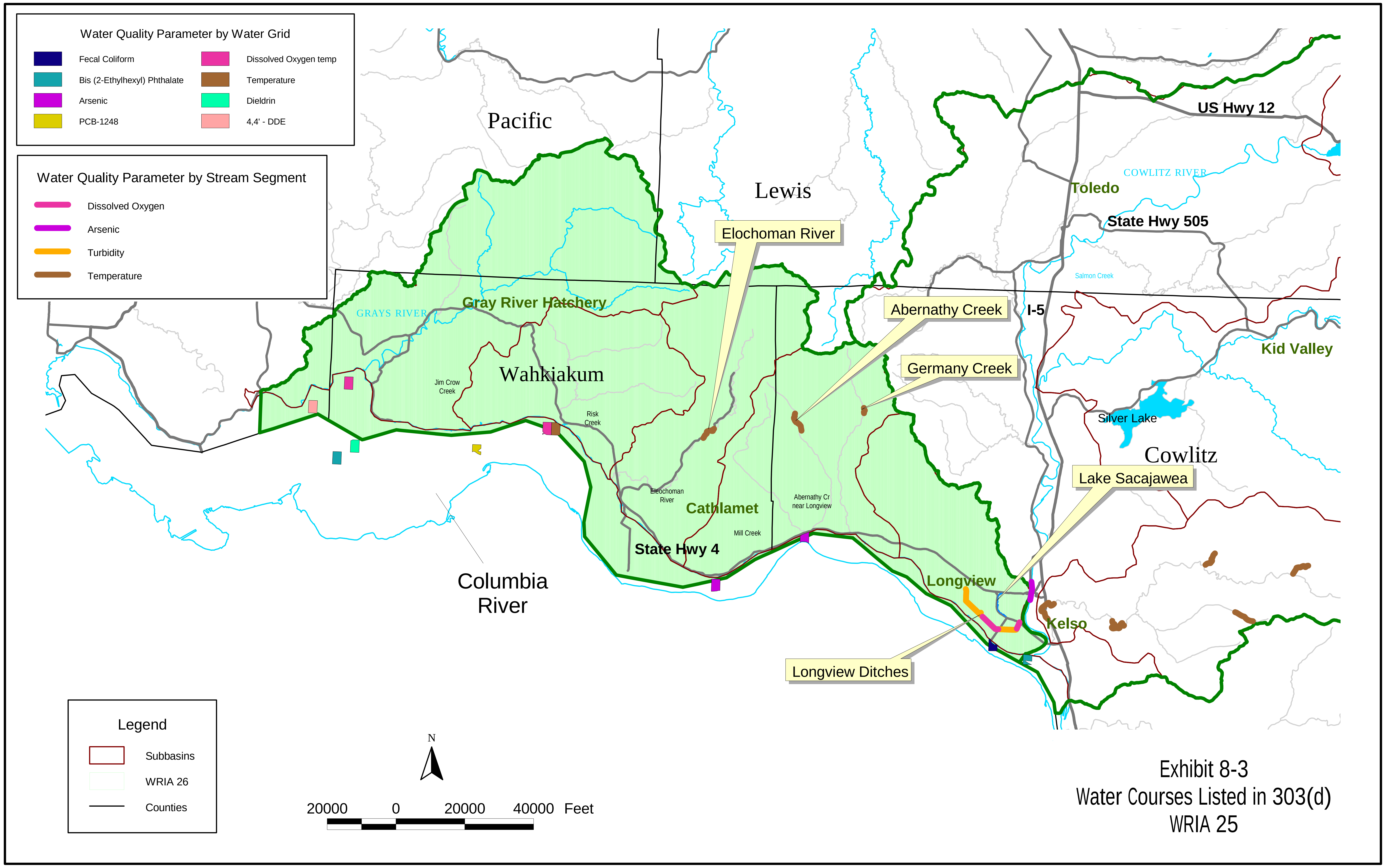


Exhibit 8-3
Water Courses Listed in 303(d)
WRIA 25

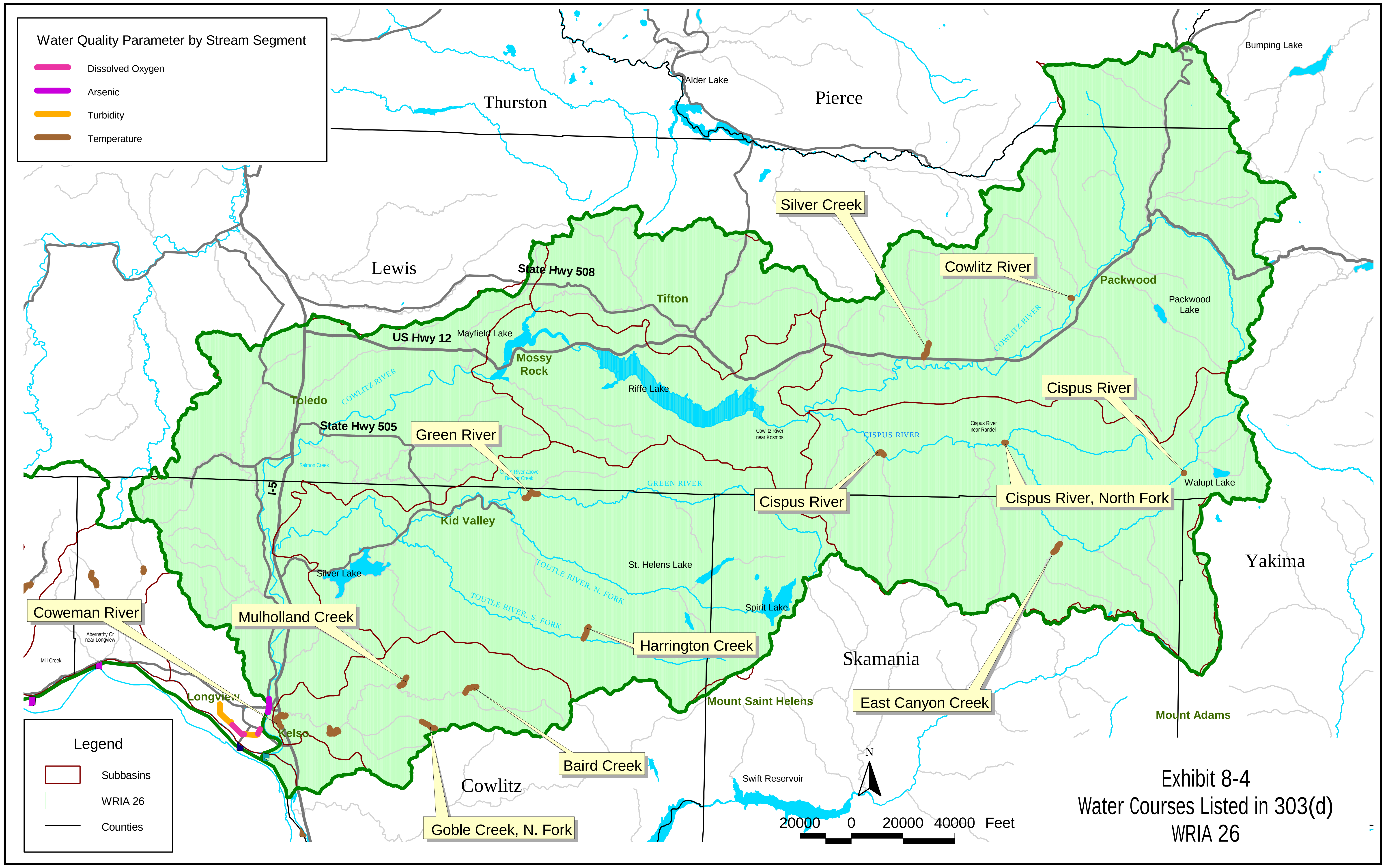


Exhibit 8-4
Water Courses Listed in 303(d)
WRIA 26

Table 8-10
Longview Ditches 303(d) Listings (WRIA 25 Coal Creek/Longview Slough Subbasin)
Water Quality Violations

Stream Route #	Dissolved Oxygen	Turbidity	Fecal Coliform	Lead
0.0				
0.803				
3.094				
4.932				
6.62				

Several water body segments in WRIA 25 and 26 are also listed for metal contamination of arsenic and different forms of PCBs. Between 1996 and 1998, an additional 3 segments were added to the 303(d) for not meeting arsenic standards.

Lake Sacajawea is shown in Exhibit 8-3 within the Coal Creek/Longview Slough Subbasin. Lake Sacajawea, or portions of the lake, is listed for the following parameters in the Final 1998 303(d) list: 4,4' DDE, Chlordane, PCB-1254, PCB-1260, and Dieldrin.

It should be noted that some of the Ecology 1998 303(d) List GIS coverage does not correlate with the actual listed 1998 303(d) water body segments in WRIA 25 and 26. Only those water bodies that agree with the Final 303(d) List have been included in Exhibits 8-3 and 8-4. Ecology has been notified of the existing data correlation problems and is updating the GIS coverage so that it includes all of the listed segments for all of the water quality parameters. It is recommended that at a later time, the GIS coverage shown in Exhibits 8-3 and 8-4 be reviewed and updated as Ecology improves this coverage. Table 8-11 includes a list of water body segments that are listed in the 1998 303(d) list but are not included or are located in the wrong location in the Ecology GIS coverage.

Table 8-11
Ecology GIS Coverage Data Inconsistencies with Final 1998 303(d) List

Water Body	Identification #	WRIA	Subbasin	Contaminant
Grays River W.F.	OV80RL	25	Grays River	Temperature
Columbia River	46122A8B5	25	Coal Creek/Longview Slough	Temperature
Columbia River	46123B117	25	Abernathy/Germany Creek	Temperature
Columbia River	46123C6E9	25	Grays River	PCB-1254
Columbia River	46122A8B5	25	Coal Creek/Longview Slough	Total Dissolved Gas
Columbia River	46123C7H4	25	Grays River	PCB-1260
Columbia River	46123B2E7	25	Abernathy/Germany Creek	Dieldrin

Table 8-11 (cont'd)
Ecology GIS Coverage Data Inconsistencies with Final 1998 303(d) List

Water Body	Identification #	WRIA	Subbasin	Contaminant
Columbia River	46123C7H4	25	Grays River	Arsenic
Columbia River	46123B2E7	25	Abernathy/Germany Creek	PCB-1254
Iron Creek	ZZ28DH	26	Cispus River	Temperature
Wilame Creek	CT81WJ	26	Upper Cowlitz River	Temperature

In addition, Ecology has aggressively pursued the restoration of various listed stream segments statewide. Those efforts have led in many cases to improved water quality conditions in those areas. As a result, a number of stream segments have been removed from the 303(d) list since 1996. Many of these improvements are a result of restoration projects and the revegetation of zones destroyed in the 1980 Mt. St. Helens eruption. A summary of de-listed stream segments in WRIAs 25 and 26 are shown in Table 8-12.

Table 8-12
Stream Reaches and Lakes De-Listed since 1996
WRIA 25 and 26

Water Body	Segment	WRIA	Subbasin	Contaminant	Reason
Columbia River	Grid: 46123B0E2	25	Coal Creek/Longview	Temperature	Does not meet criteria
Longview Ditches	Route #: 3.094	25	Coal Creek/Longview	Dissolved oxygen, fecal coliform,	Does not meet criteria
Longview Ditches	Route #: 6.62	25	Coal Creek/Longview	Dissolved oxygen	Does not meet criteria
Longview Ditches	Route #: 0.803	25	Coal Creek/Longview	Dissolved oxygen Fecal Coliform	Does not meet criteria
Longview Ditches	Route #: 4.445	25	Coal Creek/Longview	Fecal coliform	Does not meet criteria
Longview Ditches	Route #: 0.0	25	Coal Creek/Longview	Dissolved oxygen	Does not meet criteria
Longview Ditches	Route #: 4.932	25	Coal Creek/Longview	Dissolved oxygen	Does not meet criteria
Sacajawea Lake	837NAY	25	Coal Creek/Longview	Total Phosphorus	Restoration in progress
Columbia River	Grid #: 46123B3E0	25	Elochoman	Temperature	Does not meet criteria
Cinnabar Creek		26	Lower Cowlitz	pH, dissolved oxygen, temperature	Previously listed in error
Coweeman River	ON59SG	26	Coweeman	pH, dissolved oxygen	Does not meet criteria
Cowlitz River	EG25YW	26	Coweeman	pH	Meets standards

Table 8-12 (Continued)
Stream Reaches and Lakes De-Listed since 1996
WRIA 25 and 26

Water Body	Segment	WRIA	Subbasin	Contaminant	Reason
Cowlitz River	EG25YW	26	Coweeman	Temperature, fecal coliform	Does not meet criteria
Toutle River	TT61QP	26	Toutle	Fecal coliform	Does not meet criteria
Silver Creek	CT81WJ	26	Upper Cowlitz	Temperature	Lack of QA/QC
Silver Lake	093NJJ	26	Upper Cowlitz	Total phosphorous	Restoration in progress

Note: "Does not meet criteria" generally refers to a lack of repeat water quality samples and does not necessarily reflect improved water quality

The control of NPDES discharges and increased water quality monitoring may has also enables watershed managers to identify and rectify specific water quality problems. A map of current NPDES discharge locations within each WRIA has been collected and is shown in Exhibits 8-5 and 8-6.

Despite these improvements, water quality degradation is still prominent as a result of deforestation, agricultural, and urban center stormwater runoff practices. Historical data shows that the primary sources of water quality degradation may be shifting from point source discharges to virtually unregulated nonpoint source pollution. The water quality parameters of temperature and turbidity, which is in part caused by natural conditions, that typically result from deforestation and nonpoint pollution seem to be critical and of increasing concern within WRIA 25 and 26.

Additionally, through the CWA, Ecology establishes statewide lists of priority Total Maximum Daily Loads or Water Cleanup Plans based on results of monitoring data. In essence, a TMDL is the sum of all point-source discharges, non-point-source discharges and natural background loading that can be allocated without exceeding a water body's loading capacity. Loading capacity represents the maximum quantity of a contaminant that a water body can assimilate without violating water quality standards at a particular location. All TMDLs must include a margin of safety to account for technical uncertainty or lack of data. Table 8-13 lists the prioritized bodies in WRIAs 25 and 26 from 1999-2001 by subbasin. No studies began in year 2000 within WRIAs 25 or 26.

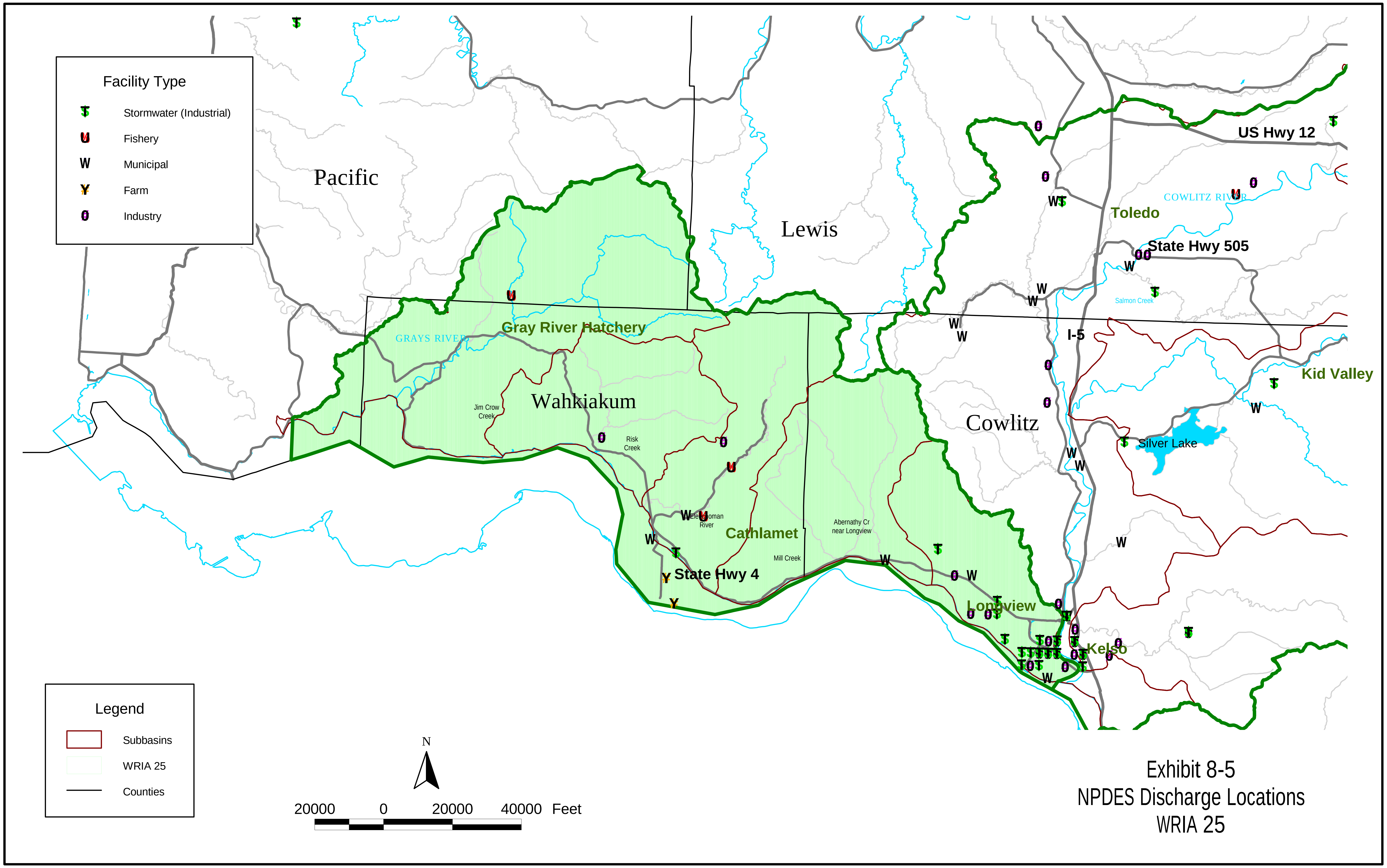


Exhibit 8-5
NPDES Discharge Locations
WRIA 25

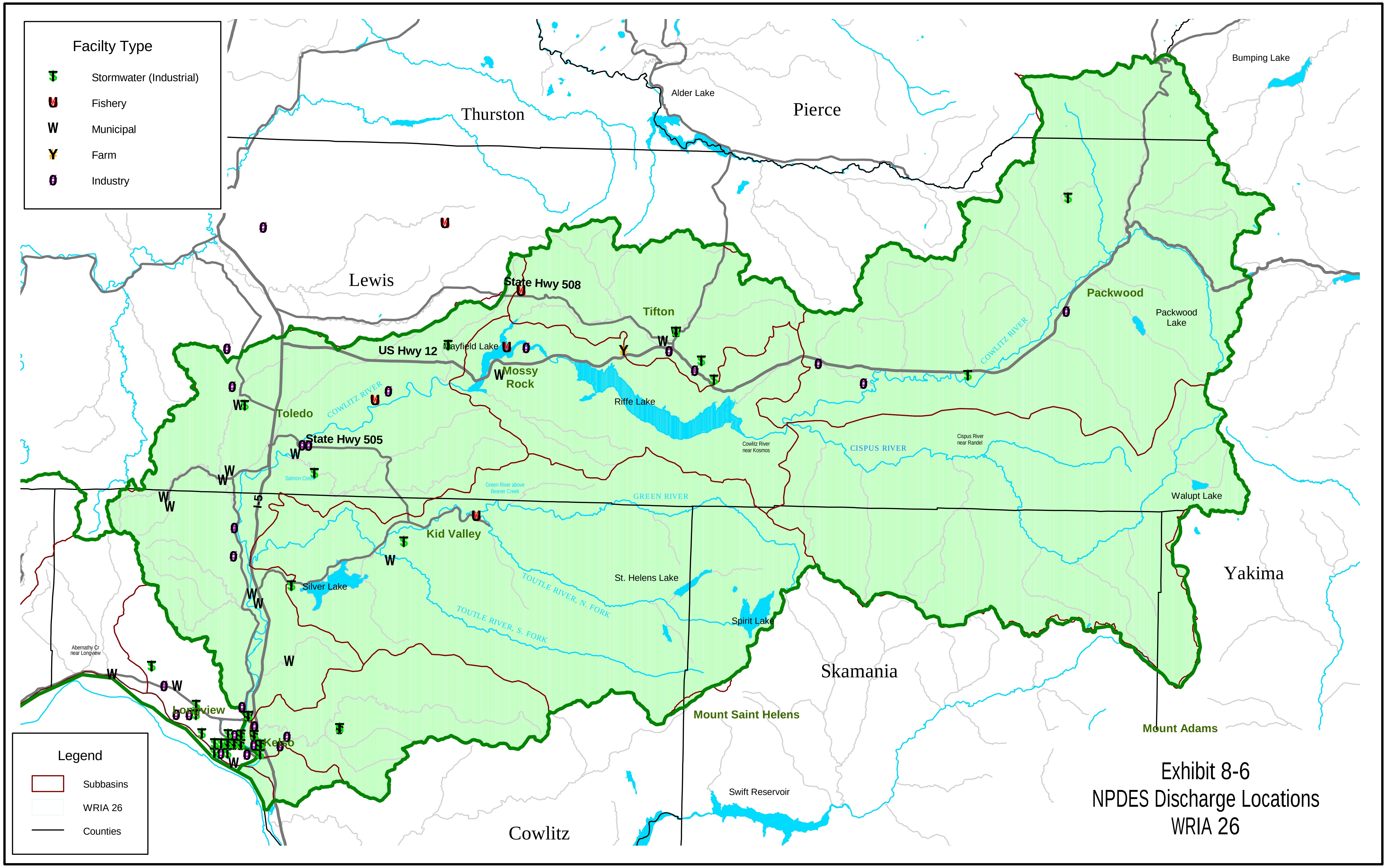


Exhibit 8-6
NPDES Discharge Locations
WRIA 26

Table 8-13
TMDL Studies in WRIAs 25 and 26

Waterbody	Year	Subbasin	WRIA	Problem
Longview Ditches	1999	Coal Creek/ Longview	25	Fecal coliform, dissolved oxygen, turbidity, lead
Gibbons Creek	1999	Coweeman River	26	Fecal coliform
Salmon Creek	1999	Lower Cowlitz	26	Fecal coliform, temperature, turbidity
Cowlitz River*	2001	Coweeman River	26	Arsenic
Lower Columbia*	2001	Grays River	25	Bis 2-ethylhexyl phthalate, arsenic

** Listing Verification – Resampling Only*

8.3.4 Point Discharges

Water quality in a receiving body is often related to discharge type, frequency, and quality. Exhibits 8-5 and 8-6 are GIS coverages that have been created to show the location of stormwater, fisheries, municipal, agricultural, and industrial National Pollution Discharge Elimination System (NPDES) Permitted discharge locations using data obtained from Ecology 2001c. 144 NPDES permitted sites were listed for WRIA 25 and 26 that included:

- 19 municipal facilities,
- 38 industrial facilities,
- fisheries,
- 3 farms,
- stormwater-construction sites, and
- 64 stormwater-industrial sites.

Some of these sites were not included in the GIS coverages, Exhibits 8-5 and 8-6, because not all of the facilities had location coordinates. Table 8-14, General Permits, summarizes general information about the NPDES permitted facilities in WRIA 25 and 26. Several of the facilities located at the bottom of each of the table do not have a WRIA or subbasin designation. These facilities are located in the Longview/Kelso area and may be located in either WRIA 25 or WRIA 26. It should be noted that the subbasin designation within Table 8-14 does not indicate the stream into which each of the permits discharges but only the subbasin in which the facility is located.

It should be noted that there is an agglomeration of industrial and stormwater-industrial permitted facilities in Exhibit 8-5 within the Coal Creek/Longview Slough Subbasin in the Longview/Kelso area. These facilities may have some effect on the complicated and degraded water quality found in the Longview Ditch drainage system. In the Longview/Kelso area there are approximately 35 general permits and greater than 50 stormwater discharge permits. Exhibits 8-7 and 8-8 show the percentage of industrial and municipal discharge facilities in the Kelso and Longview by permit type.

Exhibit 8-7
Kelso NPDES Discharge Permit

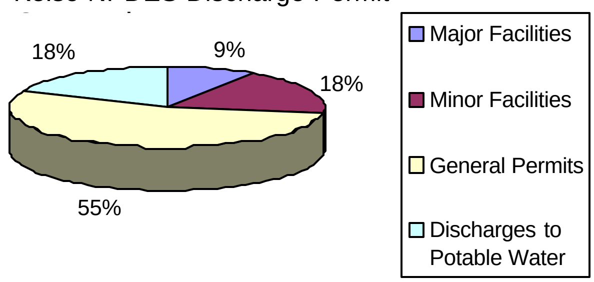


Exhibit 8-8
Longview NPDES Discharge Permit Categories

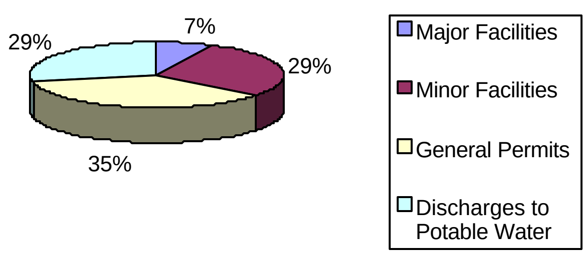


Table 8-14
General NPDES Permits
WRIA 25 and 26

Facility Name	Discharge Type	Subbasin	WRIA	Permit Expiration
J L Storedahl & Sons Carrolls Pit	Industry	Coweeman River	26	6-Aug-04
Craig Opsahl Paget Pit	Industry	Coweeman River	26	6-Aug-04
Craig Opsahl Olequa Pit	Industry	Coweeman River	26	6-Aug-04
Jesse Amos	Industry	Coweeman River	26	6-Aug-04
Cowlitz Co. Hall Of Justice	Industry	Coweeman River	26	30-Jun-01
Derosier Trucking Coweeman Pit	Industry	Coweeman River	26	6-Aug-04
Zimmerly Rock Products Kelso	Industry	Coweeman River	26	6-Aug-04
Zimmerly Rock Products Kelso	Industry	Coweeman River	26	6-Aug-04
Foster Farms Kelso	Industry	Coweeman River	26	30-Jun-01
Castle Rock Stp	Municipal	Coweeman River	26	30-Jun-01
Castle Rock Wtp	Municipal	Coweeman River	26	1-Feb-03
Woodbrook Stp	Municipal	Coweeman River	26	30-Jun-01
Longview Wtp	Municipal	Coweeman River	26	1-Feb-03
Cascade Aqua Farms	Fish	Lower Cowlitz	26	1-Apr-00
North Toutle Hatchery	Fish	Lower Cowlitz	26	1-Jun-05
Cowlitz Salmon Hatchery	Fish	Lower Cowlitz	26	1-Jun-05
Cascade Aqua Tilton River	Fish	Lower Cowlitz	26	1-Apr-00
Cowlitz Trout Hatchery	Fish	Lower Cowlitz	26	1-Jun-05
Lewis Cnty Pw Brim Pit	Industry	Lower Cowlitz	26	6-Aug-04
Morgan Brothers Construction (Sand & Gravel)	Industry	Lower Cowlitz	26	6-Aug-04
Lewis Cnty Pw Toledo Shop & Crusher	Industry	Lower Cowlitz	26	6-Aug-04
Askin Land Co Toledo S & G	Industry	Lower Cowlitz	26	6-Aug-04
Johnson Quality Rock	Industry	Lower Cowlitz	26	6-Aug-04
Johnson Quality Rock	Industry	Lower Cowlitz	26	6-Aug-04
Shakertown Corp (Cedar Panels)	Industry	Lower Cowlitz	26	28-Jul-01
Ryderwood Stp	Municipal	Lower Cowlitz	26	30-Jun-01
Ryderwood Wtp	Municipal	Lower Cowlitz	26	1-Feb-03
Toledo Stp	Municipal	Lower Cowlitz	26	30-Jun-01
Vader Stp	Municipal	Lower Cowlitz	26	30-Jun-01
Vader Wtp	Municipal	Lower Cowlitz	26	1-Feb-03
Winlock Stp	Municipal	Lower Cowlitz	26	1-Feb-04
Cisco Dairy	Farm	Tilton River	26	2-Sep-99
Mossyrock Hatchery	Fish	Tilton River	26	1-Jun-05
Morton Forest Products (Sawmill)	Industry	Tilton River	26	27-Jul-01
Central Reddi Mix Morton Plant (Concrete)	Industry	Tilton River	26	6-Aug-04
Lewis Cnty Pw Larson Pit	Industry	Tilton River	26	6-Aug-04
Morton Stp	Municipal	Tilton River	26	17-Jun-01
Morton Wtp	Municipal	Tilton River	26	1-Feb-03
Mossyrock Stp	Municipal	Tilton River	26	11-Mar-03
Toutle Stp	Municipal	Toutle River	26	30-Jun-01
Hampton Lumber Mills/Packwood Inc	Industry	Upper Cowlitz	26	26-Aug-91
Lewis Cnty Pw Kiona Pit	Industry	Upper Cowlitz	26	6-Aug-04
Cowlitz Stud Co Gries Pit	Industry	Upper Cowlitz	26	6-Aug-04

Table 8-14 (Continued)
General NPDES Permits
WRIA 25 and 26

Facility Name	Discharge Type	Subbasin	WRIA	Permit Expiration
Houghton International (Oil & Chemical Manufacturer)	Industry	Coal Creek/ Longview	25	13-Jul-01
Lakeside Industries Longview (Asphalt Plant)	Industry	Coal Creek/ Longview	25	6-Aug-04
Glacier Nw Inc Longview	Industry	Coal Creek/ Longview	25	6-Aug-04
J L Storedahl & Sons Coal Creek Pit	Industry	Coal Creek/ Longview	25	6-Aug-04
Reynolds Metals	Industry	Coal Creek/ Longview	25	28-Oct-97
Ross Simmons Hardwood Lumber Co	Industry	Coal Creek/ Longview	25	30-Jun-01
Port Of Longview	Industry	Coal Creek/ Longview	25	14-Jul-01
Cowlitz Water Pollution Cntrl Stp	Municipal	Coal Creek/ Longview	25	30-Sep-96
Longview Stp	Municipal	Coal Creek/ Longview	25	30-Jun-01
Stella Stp	Municipal	Coal Creek/ Longview	25	30-Jun-01
Cathlamet Farms	Farm	Elochoman River	25	2-Sep-99
Sunny Sands Farm	Farm	Elochoman River	25	31-Mar-05
Beaver Creek Hatchery	Fish	Elochoman River	25	1-Jun-05
Elochoman Hatchery	Fish	Elochoman River	25	1-Jun-00
Burns Construction Inc	Industry	Elochoman River	25	6-Aug-04
Cathlamet Stp	Municipal	Elochoman River	25	30-Jun-01
Cathlamet Wtp	Municipal	Elochoman River	25	1-Feb-03
Grays River Hatchery	Fish	Grays River	25	1-Jun-05
Wahkiakum Cnty Skamokawa Rock Pit	Industry	Skamokawa Creek	25	6-Aug-04
Alpine Redi-Mix Inc	Industry			6-Aug-04
Derosier Trucking Nevada Pit	Industry			6-Aug-04
Derosier Trucking Pleasant Hill Pit	Industry			6-Aug-04
Stowe Woodward	Industry			30-Jun-01
Cytec Industries	Industry			28-Jul-01
Terra Firma	Industry			6-Aug-04
Allied Colloids	Industry			30-Jun-01
Cowlitz Cnty Landfill	Industry			30-Jun-98

STP = Municipal Sewage Treatment Plant
WTP = Municipal Water Treatment Plant

Details about each receiving water body and permit limits are available from the Department of Ecology.

In addition to NPDES discharge permits, Ecology publishes quarterly reports of NPDES discharge penalties exceeding $1,000 on the Internet (Ecology 2001). Table 8-15 lists the location and types of discharges penalized in the 3rd (July 1-Sept 30) and 4th (October 1-December 31) of 2000. Receiving water bodies that are subject to more frequent discharge penalties are likely to suffer from greater water quality degradation.

Table 8-15
Discharge Penalties for 3rd and 4th Quarters of Year 2000

Location	Cause of Penalty	Quarter of Penalty
Longview	Discharge of untreated domestic sewage	3
Longview	Eight counts of exceeding wastewater permit limits	3
Not Listed	Oil spill into Toutle River	4
Longview	Violated state regulations for handling hazardous waste	4
Longview	Failure to submit stormwater plan as previously ordered	4

8.3.5 Non-Point Sources of Pollution

As discussed in Section 8.3.2, historical data suggest that the majority of primary sources of water quality degradation may be shifting from point source discharges to unregulated non-point source pollution. In fact, the largest water quality problems occurring within WRIAs 25 and 26 may be primarily a result of non-point pollution. Most non-point pollution sources are a result of multiple land use practices and are therefore difficult to regulate. Table 8-16 summarizes some of the land use impacts on nonpoint sources of pollution as determined by Ecology 2000.

The most frequent water quality problems in WRIAs 25 and 26 that are likely results of nonpoint pollution are turbidity and suspended solids, fecal coliform, and low dissolved oxygen. Several sources are available to the Planning Unit that may provide insight into correlations between land use practices and nonpoint caused pollution:

- ❑ Land coverage/Land use GIS coverage by the Department of Fish and Wildlife GAP Project (See Section 3). This coverage could be used to correlate agricultural and timber practices to water quality degradation as applicable.

Table 8-16
Land Use Impacts on Nonpoint Source Pollution

Nonpoint Source	Nitrogen	Fecal Coliform	Sediments	pH	Dissolved Oxygen	Pesticides	Flow	Temperature
Agriculture								
Animal Feeding Operations	•	•	•	•	•			
Dryland	•		•			•		•
Irrigation	•		•	•	•	•	•	•
Noncommercial	•	•	•					•
Forest Practices								
Road construction			•			•	•	•
Timer harvesting			•				•	•
Reforestation	•					•		•
Urban/Rural								
Construction			•					•
On-site sewage systems	•	•		•	•			
Stormwater runoff	•		•	•		•	•	•
Hydromodification								
Channelization			•		•		•	•
Dams			•		•		•	•
Wetlands and riparian areas								
Vegetative clearing			•		•	•	•	•
Draining of Wetlands	•		•				•	•
Recreation								
Marinas and boats	•	•	•	•	•			
Off-road		•	•					
Hiking, fishing		•						

Note: **Table from Washington's Nonpoint Source Management Plan April, 2000.*

- Gifford Pinchot National Forest GIS coverages showing tree community stage and structure throughout the forest as well as wildfire burn areas and historical wildfire occurrence areas (WRIA 26 only). Vegetative cover data could be used to correlate turbidity in surface waters to erosion caused by differentials in vegetative cover. Wildfire data can be correlated to turbidity and nutrient loading in surface waters resulting from reduced vegetative cover and nutrient deposition during fire events.
- Gifford Pinchot National Forest GIS coverages showing road systems and forest trails (WRIA 26 only), Washington State Conservation Stream Adjacent Roads GIS coverages (WRIA 26 only, Section 3), and Washington State Department of Transportation and Cowlitz County Transportation facility GIS coverages could be used to correlate infrastructure related transportation and stormwater runoff caused pollution to surface water quality.
- Gifford Pinchot National Forest GIS coverage showing potentially unstable soils could be correlated with instream sediment loading and watershed mass wasting.
- A Germany Creek Channel Stability Evaluation: 1990-2000 using Germany Creek Photo Points (Schuett-Hames 2000) correlates mass wasting, riparian corridor erosion, and erodable soil types with water quality (WRIA 25 only).
- USGS coverage of reported pesticide usage could be correlated with water quality degradation to determine the amount of surface water pollution caused through the application of pesticides.

8.3.6 Impacts to Beneficial Use

In general, the impacts to beneficial use within the two WRIAs are relatively limited. As noted in Section 8.2, the quality of surface waters with WRIAs 25 and 26 remain fairly high, with no Class B or C stream segments present. While impacts to human beneficial uses may be significant in some specific locations (such as in the Longview Ditch System), the most significant impacts are those related to degradation of salmonid and aquatic habitat. Such impacts are largely associated with excess turbidity and sediment loading. In the future, the importance of these impacts is only expected to increase as more stocks of anadromous fish are protected under the Endangered Species Act (ESA). Future compliance with ESA remains an unanswered element within each WRIA as the rules and standards surrounding the law evolve. What can be anticipated is a growing demand for instream flows and restoration of primary habitat. Under this scenario, there will be greater competition for area water resources and less water available for domestic, municipal, industrial, agricultural, and recreational use.

8.4 Summary Ground Water Quality Data

By contrast to the surface water system, available groundwater data is extremely fragmented and exists in only a few localized areas, for example near the City of Kelso wells. Yet, a review of the available records did uncover some basic descriptions of the native water quality that may prove useful in establishing a fundamental baseline for area ground waters. A summary of that information is presented in the following subsections with reference to the principal geologic units in the area. For additional descriptions of these hydrogeologic units, the reader is referred to the presentation in Section 6.

8.4.1 Alluvium And Older Alluvium Units

Cascade Volcanic Arc-Source

Chemical quality of groundwater from these units ranges from excellent to poor. Shallow wells proximal to streams/rivers typically appear to have the best water quality, while deeper wells and/or wells located a greater distance from the stream/river appear to often produce groundwater of lower chemical quality. The major problem constituents are typically iron (greater than 0.3 milligrams per liter (mg/L)), manganese (greater than 0.05 mg/L), hardness (greater than 10 mg/L), and total dissolved solids (greater than 500 mg/L) found at levels that produce undesirable aesthetic/cosmetic (taste, odor, color, discoloration) effects, but not necessarily pose health risks (Ebbert and Payne, 1985; Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972; Sweet and Edwards, 1983; Piechowski and Krautkramer, 1998; Krautkramer and Ellis, 2000). The source of these elevated constituents in the alluvial groundwater is inferred to arise from bedrock groundwater (containing elevated constituent levels) recharge to the alluvial aquifer and/or long residence time for groundwater within the alluvial aquifer which allows leaching of these constituents from the sediment that hosts the aquifer (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972; Piechowski and Krautkramer, 1998; Krautkramer and Ellis, 2000). If groundwater residence times within the alluvial aquifer is a primary cause of elevated constituent levels, this has some potentially important implications concerning groundwater movement within this unit. Studies of general groundwater/rock interaction (e.g., USDOE, 1988) suggests that mobilization of chemical constituents from the rock into solution ("leaching") usually occurs at relatively slow rates (depending on initial water composition/temperature). This suggests that "residence times" to produce constituent concentrations found in the alluvial aquifers would likely be on the order of hundreds to thousands of years.

Another groundwater quality problem associated with alluvial aquifers in this area is the potential presence of phenol compounds. These phenol compounds are produced by the decomposition of vegetative materials that was incorporated into lahars/debris flows during there generation and emplacement and mobilized by the dewatering of these lahars/debris flows (Sweet and Edwards, 1983). If the phenol-bearing groundwater undergoes a chlorination process, the treated water may acquire a "medicinal" taste and odor (Sweet and Edwards, 1983).

Marine Sediments/Non-Cascadian Volcanics

Virtually no published data is available that systematically examines the chemical quality of groundwater from alluvial aquifer units in WRIA 25. WADOE (1972, p. 139) describes the groundwater quality from these units as general good, with total dissolved solids concentrations from shallow wells typically less than 20 mg/L and hardness (as $CaCO_3$) less than 100 mg/L. However it was noted that "deeper" wells within these units often produced waters with "high" iron concentrations.

Columbia River

Chemical quality of groundwater from this unit ranges from excellent to poor. Shallow wells appear to have the best water quality, while deeper wells and/or wells located a greater distance from the river appear to often produce groundwater of lower chemical quality (Myers, 1970). The major problem constitutes are typically iron (greater than 0.3 mg/L), manganese (greater than 0.05 mg/L), hardness (greater than 10 mg/L), and total dissolved solids (greater than 500 mg/L) found at levels that produce undesirable aesthetic/cosmetic (taste, odor, color, discoloration) effects, but not necessarily pose health risks (Ebbert and Payne, 1985; Myers, 1970; WADOE, 1972; Piechowski and Krautkramer, 1998; Krautkramer and Ellis, 2000). The source of these elevated constituents in the alluvial groundwater is not from either precipitation nor surface waters (recharge sources), but is inferred to arise from bedrock groundwater (containing elevated constituent levels) recharge to the alluvial aquifer and/or long residence time for groundwater within the alluvial aquifer which allows leaching of these constituents from the sediment that hosts the aquifer (Myers, 1970; WADOE, 1972; Piechowski and Krautkramer, 1998; Krautkramer and Ellis, 2000). If groundwater residence times within the alluvial aquifer is a primary cause of elevated constituent levels it has some potentially important implications concerning groundwater movement within this unit. As discussed above, studies of groundwater/rock interaction (e.g., USDOE, 1988) suggests that mobilization of chemical constituents from the rock into solution ("leaching") usually occurs at relatively slow rates (depending on initial water composition/temperature). This suggests that "residence times" to produce constituent concentrations found in the alluvial aquifers would likely be on the order of hundreds to thousands of years.

8.4.2 Glacial And Terrace Units

Data available on the chemical quality of groundwater from these units is limited to qualitative descriptions from (Weigle and Foxworthy, 1962; WADOE, 1972) and limited analyses from selected wells reported in Ebbert and Payne (1985, plate 3). They found that a significant percentage of samples that they analyzed had iron, and/or manganese concentrations that would be in excess of secondary drinking water standards (iron greater than 0.3 mg/L, manganese greater than 0.05 mg/L). Ebbert and Payne (1985, p. 25) noted that water wells in part of the Jackson Prairie area (Marys Corner) consistently had high sodium (up to 6.4 mg/L) and chloride (up to 144 mg/L) concentrations. The source of these elevated constituents in these units is inferred to arise from (1) leaching of these constituents from the sediment that hosts the aquifer and/or (2) bedrock groundwater (containing elevated constituent levels) that may provide some component of recharge to these aquifers (Weigle and Foxworthy, 1962; Myers, 1970; Ebbert and Payne, 1985). The high sodium and chloride concentrations are most likely the result of connate saline waters in older bedrock units (e.g., Marine sedimentary unit; Plate 1) being discharged into this unit (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972).

8.4.3 Tertiary Continental Sedimentary Rock Unit

Troutdale and Wilkes Formations

There is no available data on the chemical quality of groundwater produced from the Troutdale Formation in WRIAs 25 and 26. Only limited data exists on the chemical quality of groundwater from the Wilkes Formation. The data that exists (Weigle and Foxworthy, 1962; Myers, 1970; Ebbert and Payne, 1985) suggest that the chemical quality is often poor. As with many of the previously discussed aquifers, the major problem constitutes are typically iron (greater than 0.3 mg/L) and manganese (greater than 0.05 mg/L) found at levels that produce undesirable aesthetic/cosmetic (taste, odor, color, discoloration) effects. As noted above, the likely source of these elevated constituents in the Wilkes Formation groundwater is due to groundwater (containing elevated constituent levels) from older bedrock units that are entering this aquifer and/or long residence time for groundwater within this aquifer which would allow the leaching of these constituents from the sediment that hosts the aquifer (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972).

Puget Group

No information is available on the chemical quality of Puget Group groundwater in WRIA 25 and 26.

8.4.4 Columbia River Basalt Group (CRBG)

No data on the chemical quality of groundwater from the CRBG was found. However, the flood basalt flows of the CRBG often serve as good aquifers capable of producing groundwater of typically good chemical quality (Mundorff, 1964; Gannett and Caldwell, 1998). Both Myers (1970) and WADOE (1972) note that the chemical quality of groundwater from the CRBG is generally of "high quality".

8.4.5 Tertiary Cascade Volcanics

Limited data on the chemical quality of groundwater from this unit has been reported in Myers (1970) and Ebbert and Payne (1985). Myers (1970, p. 21) characterized the general chemical quality of groundwater form this unit as "good". However as with many of the previously discussed aquifers, both iron (greater than 0.3 mg/L) and manganese (greater than 0.05 mg/L) are reported as problem constituents at levels that produce undesirable aesthetic/cosmetic (taste, odor, color, discoloration) effects. The likely source of these elevated constituents in this unit is due to the direct leaching of these constituents from the volcanic bedrock that hosts this aquifer (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972).

8.4.6 Tertiary Marine And Nearshore Sedimentary Rocks

The chemical quality of groundwater from this unit varies greatly, ranging from fair to non-potable (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972). Chemical quality data that is reported (Weigle and Foxworthy, 1962; Myers, 1970; Ebbert and Payne, 1985) indicates that the major problem constitutes are typically iron (greater than 0.3 mg/L) and manganese (greater than 0.05 mg/L) found at levels that produce undesirable aesthetic/cosmetic (taste, odor, color, discoloration) effects. Another problem associated specifically with this unit is the presence of connate saline waters – sea water that was originally "trapped" within these sediments as they were deposited. Water wells drilled deeper than a few hundred feet typically risk encountering non-potable, saline waters (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972; Ebbert and Payne, 1985).

8.4.7 Crescent Formation And Grays River Volcanics

Limited data on the chemical quality of groundwater from this unit has been reported in Myers (1970) and Ebbert and Payne (1985). Myers (1970) characterized the general chemical quality of groundwater form this unit as "poor". However as with many of the previously discussed aquifers, both iron (greater than 0.3 mg/L) and manganese (greater than 0.05 mg/L) are reported as problem constituents at levels that produce undesirable aesthetic/cosmetic (taste, odor, color, discoloration) effects. The likely source of these elevated constituents in this unit is due to the direct leaching of these constituents from the volcanic bedrock that hosts this aquifer (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972). Like the Marine/Nearshore Sedimentary units, this unit also contains connate saline waters (Weigle and Foxworthy, 1962; Myers, 1970). Water wells drilled deeper than a hundred feet typically risk encountering non-potable, saline waters (Weigle and Foxworthy, 1962; Myers, 1970; WADOE, 1972; Ebbert and Payne, 1985).

8.4.8 High Cascade Volcanics

No information was available on the groundwater quality for these units.

8.4.9 Pre-Tertiary Rocks and Intrusions

No information was available on the groundwater quality for these units.

8.5 Summary of Existing Restoration Plans and Data Requirements

Water quality restoration projects are becoming more common as local and neighborhood backyard stream segments have noticeable aesthetic degradation. In addition, the ESA listing of Pacific Northwest Salmon and Steelhead stocks has gained widespread media attention, informing citizens about land use practices and their effects on water and habitat quality. As a result, government and local agencies are working in cooperation with tribal and local grass roots organizations to improve water quality and coordinate stream restoration volunteer efforts.

This section briefly describes the primary restoration projects occurring in WRIAs 25 and 26 at this time and includes a summary of water quality data that is being collected to support local and watershed scale surface water restoration projects. It is assumed that not all local small-scale projects are included in this section. Despite this fact, it should be recognized that many of these small-scale restoration efforts are significantly contributing to improved water quality throughout Washington State.

Two distinct schools of surface water restoration are often employed, either separately or in combination to restore habitat for fish and wildlife. The first is that of *reintroduction* and the second *restoration*. Within this report, reintroduction will be used to describe any population restoration effort that is being completed by physically introducing any indigenous species to an area where it has disappeared as a result of human activities impacting water quality and instream and riparian habitat. Bt contrast, restoration will be used to describe efforts that focus on improving physical habitat functionality including water quality in the hope that native species recovery will occur naturally as soon as the habitat is restored.

8.5.1 Current Restoration Programs

A number of restoration projects are in progress throughout WRIA 25 and 26 that are being coordinated through various federal, state, local, and private organizations. Table 8-17 summarizes some of these projects.

While data collected in conjunction with these projects are not specifically addressed in the following subsections discussing data collection efforts that are being conducted in order to support restoration projects, each of these projects can provide valuable information to groups beginning restoration efforts. Important information beyond site specific physical data are available from these projects including how to develop measurable goals, summaries of useful methods, and assessments of those methods based on project results.

Table 8-17
Restoration Projects in WRIA 25 and 26

Program	Description
Reintroduction of anadromous species above Mayfield Dam to the Tilton River and above Mossyrock Dam to the Cowlitz River	This reintroduction program used trucks to transport fish above the dams to provide for limited fishing. In 1981 IHN virus (hematopoietic necosis) was found in fish being transported sot the project was terminated except for Coho salmon, which have not exhibited any infections. A new project is examining the feasibility of trapping and hauling native late winter steelhead, Coho, and coastal cutthroat to those basins.
Cowlitz Hydro Project	Tacoma Power, state and federal resource agencies, the Yakima Nation, and conservation groups agreed for the continued long-term operation of the Mossyrock, Mayfield, and Barrier dams. The terms include fish passage at the dams, management for sufficient instream flows, habitat improvements and hatchery production measures.

Table 8-17 (cont'd) Restoration Projects in WRIA 25 and 26	
Program	**Description**
Ecology Priority Water Cleanup Plans	These projects are TMDL studies aimed to manage pollution in receiving water bodies. More information on these programs is available in Table 8-15, TMDL Studies in WRIAs 25 and 26
Ecology Lake Treatments to control aquatic herbicides	The following Lakes were treated with aquatic herbicides in 1993: Mayfield for elodea, Leisure Time Pond for pondweeds and elodea, and Swofford Pond for Eurasian milfoil.
Ecology Lake Restoration Program	This program provides funding and support for local interest groups to conduct lake restoration projects. The projects consist of three phases including: Phase I assessment of water quality and lake conditions and preparing a restoration plan recommendation, Phase II recommendation implementation, and Phase III assessment of completed restoration projects. Lake rehabilitation techniques vary including in-lake treatments such as herbicide application dredging and biological manipulation, watershed treatments such as erosion control and land practice management, and education, local management strategies and zoning regulations. Silver Lake in WRIA 26 is being restored through this program.
Trout Unlimited projects	This grassroots organization has at least two chapters in WRIAs 25 and 26. Although these chapters are currently inactive, they frequently lead and participate in surface water restoration projects.
Coweeman Subbasin Culvert Inventory Survey	This project that was scheduled that was completed in 2000 includes data about all currently existing culverts blocking fish passage within the Coweeman Subbasin of WRIA 26.
Silver Lake Restoration Project	The project has allowed for the removal of the Lake from the 1998 303(d) list. The project aims to reduce nitrification and control aquatic vegetation within the lake

8.5.2 Recommendations for Restoration Data

In addition to summarizing the habitat limiting factors, the Limiting Factors Analysis for WRIA 26 also offers recommendations about information that needs to be collected so that restoration project goals can be achieved and so that progress attained through restoration activities can be quantitatively assessed. The goals and recommendations of the Washington State Conservation Commission for data collection and restoration projects in WRIA 26 include:

- Monitoring the impacts of dam operations on salmonids and reintroduction efforts above the dams;
- Develop land ordinances to control land use practices in sensitive riparian habitat;

- Assess, repair or decommission roads contributing to stream sediment loading;
- Increase instream large woody debris (LWD);
- Restore riparian corridors, especially mature conifers;
- Reduce water temperatures, especially in the Coweeman, Toutle, and Tilton subbasins.
- Augment stream flows during low flow periods; and
- Maintain and increase mature subbasin vegetation.

Many of these goals and data needs are also applicable to WRIA 25. At this time, the Salmon and Steelhead Limiting Factors Analysis for WRIA 25 is in preliminary draft format and data summaries and recommendations are still being prepared by the Washington State Conservation Commission. It is expected that the draft report will be produced later this year. As a result, this subsection will present data needs for restoration recommended by the WRIA 26 Habitat Limiting Factors Analysis. However, it is assumed these recommendations will be applicable to each. Specifically, the most significant problems within WRIA 25 and 26 surface waters are those related to sediment loading and temperature, as well as dissolved oxygen depletion and coliform contamination. Moreover, according to Ecology studies and 303(d) stream listings, many of the data requirements for restoration needs are common between the two WRIAs. Therefore, while the recommendations included in this subsection were specifically developed for WRIA 26, most are expected to apply to WRIA 25, equally as well.

The one exclusion of interest here may apply to the issue surrounding sediment loading in each WRIA. For example, while sediment loading is a problem in both areas, in WRIA 26, this problem is primarily caused by habitat destruction from the Mt. St. Helens eruption. By contrast, sediment loading within WRIA 25 is primarily caused by agriculture and forestry land use practices. As a result, data needs related to sediment loading in WRIA 26 may focus on measuring the potential for natural habitat recovery while data needs in WRIA 25 may focus on identifying the primary human causes of water quality degradation. Notwithstanding, it is generally assumed that the data needs in each WRIA will be fairly similar.

Table 8-18 summarizes the habitat limiting factors and the recommendations of the Conservation Commission for WRIA 26 and data needs that may be associated with each limiting factor or recommendation. Many of the water quality data needs listed in Table 8-18 are discussed in further detail below.

Table 8-19
Data Needed to Address Habitat Limiting Factors and Support Restoration Efforts

	Water Quality					Other				
Limiting Factor or Recommendation	**SS [1], Turbidity**	**Temp**	**DO [2]**	**Coliform**	**Nutrients**	**Instream Habitat Variability**	**LWD [3]**	**Instream Flows**	**Riparian Conditions**	**Land Use Practices**
Monitor Impacts of Dams and Fish Passage Barriers	●	●	●		●	●	●	●	●	
Develop land ordinances to control land use practices	●	●	●	●	●			●	●	●
Repair or decommission roads contributing to sediment-loading	●								●	●
Increase instream LWD						●	●	●	●	
Restore riparian corridors	●	●		●	●			●	●	●
Reduce water temperatures		●				●		●	●	
Augment stream flows during low flow periods and control elevated peak flows from urban development	●	●	●			●	●	●	●	●
Maintain and increase mature subbasin vegetation		●						●	●	●
Reconnect floodplain and backwater habitats and increase channel complexity		●	●		●	●		●	●	●
Reduce water turbidity and sediment loading	●					●	●	●	●	●
Improve reservoir habitat		●	●		●			●		●
Increase instream habitat diversity						●	●	●		

1) *Suspended Solids*
2) *Dissolved Oxygen*
3) *Large Woody Debris*

8.5.3 Analysis of Available Data to Meet Restoration Project Needs

General Assessment

According to the Salmon and Steelhead Habitat Limiting Factors Final Report prepared by the Washington State Conservation Commission (Wade 2000) for WRIA 26, there is a lack of current habitat assessment data that is essential to effective recovery and restoration planning. According the study, the list of missing data includes:

- Watershed level processes including sediment transport and storage, nutrient cycling, and vegetation structure and composition;
- Recent and comprehensive data on fish stock distribution and conditions;
- Physical surveys of habitat conditions and fish usage within most streams;
- Comprehensive water quality data; and
- Data measuring the success of reintroduction and restoration efforts in the Tilton River, Cispus, and Upper Cowlitz subbasins.

According to the Conservation Commission, data gaps about habitat and riparian conditions are common throughout WRIAs 25 and 26, especially around small streams. In order for any stream restoration project to be successful, it is recommended that comprehensive site-specific habitat, water quality, and water quantity assessments be made to establish usable baseline data. The information collected by the Conservation Commission can add to this data by providing more general information on total watershed health so that any project can be completed in the larger watershed context. The information collected by the Commission will also help restorationists to assess whether the desired outcomes of a specific project are attainable based on habitat conditions surrounding the project site. For example, if restoration is being conducted to improve habitat for anadromous species, it is absolutely necessary to assess fish passage barriers within the watershed beyond the specific project site boundaries.

Water Quality Data

Table 8-19 summarizes the general status of water quality data availability in WRIAs 25 and 26. Based on the recommendations of the Conservation Commission regarding restoration goals and habitat limiting factors it was determined that information and data about the five water quality parameters of temperature, suspended solids or turbidity, dissolved oxygen, coliform and nutrients would greatly enhance water quality problem diagnostic studies and restoration projects. Table 8-18 lists each of these parameters and correlates their usefulness to the Conservation Commission goals and recommendations. Each of the 5 water quality data types and the availability of data for each parameter are discussed further below.

Temperature

Temperature is the most frequent water quality parameter that does not meet 303(d) list standards across both WRIAs 25 and 26. The primary causes of the frequent high temperatures include riparian corridor deterioration caused by human and natural causes that provides important aquatic shade, reservoir stagnation and stratification resulting from reservoir and dam operations, minimal industrial process thermal loading, and stormwater runoff from urban and agricultural centers. High water temperatures can adversely affect aquatic biological communities including vegetation, micro and macro-invertebrate populations and fish, which are especially susceptible in early life cycle stages. In addition, high temperatures can exacerbate other water quality problems including low dissolved oxygen levels and the rates of aquatic nutrient cycling.

Current and historical temperature data is readily available for WRIAs 25 and 26. Through a combination of Ecology and USGS monitoring stations, information about temperature data is available for most large rivers, many lakes and some small streams. However most of the monitoring data is available as discrete samples and may not be adequate to reflect seasonal trends. Some continuous temperature data may be available from dam operating stations that could reflect seasonal reservoir temperature trends, reservoir temperature stratification, and downstream temperatures dependent on water intake and bypass structure vertical positions within the upstream reservoir. A high priority within the Conservation Commission recommendations includes collecting further data about the impacts of dam and reservoir operations on stream habitat. More temperature data may be needed to meet this recommendation. In addition, it is suspected that many

Table 8-19
Status of Existing and Planned Water Quality Data

Water Quality Parameter	Restoration Importance	Status of Available Data	Recommendations
Temperature	• Most frequent parameter on 303(d) list in WRIAs 25/26 • Dependent on stream flow, side-stream habitat, riparian vegetation, land use practices, and dam and reservoir operations • Essential for micro/macro invertebrate, fish, and instream vegetation survival • Affects DO levels • Affects usability for commercial and industrial uses	Available at many locations on most large rivers and in some small streams and lakes	• Increase monitoring in small streams • Conduct baseline monitoring at restoration sites • Conduct monitoring to assess seasonal trends • Increase monitoring in listed segments • Conduct monitoring in segments with varying riparian conditions • Conduct monitoring around dams and within reservoirs
Suspended Solids and Turbidity	• Dependent on stream flow, riparian corridor conditions, land use practices, adjacent roads, and dam and reservoir operations • Affects instream photosynthetic activity, and visibility • Buries spawning beds • Affects usability for potable, commercial and industrial uses	Available at some locations on large rivers and some small streams at study sites	• Conduct monitoring in small streams • Conduct monitoring near suspect roads and infrastructure • Increase monitoring near stormwater discharges • Conduct monitoring near vital spawning beds • Conduct monitoring above and below dams • Conduct baseline monitoring at restoration sites
Dissolved Oxygen	• Dependent on stream flow, temperature, land use practices and dam and reservoir operations • Low levels adversely affect all aquatic life • Impacts the beneficial uses of backwaters, lakes and reservoirs • Indicator of nutrient loading, stagnation, and high temperatures	Limited to 303(d) monitoring locations and a few special studies	• Conduct monitoring in backwaters, lakes and reservoirs, especially those created by dams • Increase monitoring in listed segments • Conduct monitoring near agriculture centers • Conduct baseline monitoring at restoration sites
Coliform	• Indicator of land use practices and riparian corridor health • Affects human beneficial uses including drinking water and contact recreation • Affects fish and wildlife health	Limited to 303(d) monitoring locations and in potable supply watersheds	• Continue monitoring in listed segments • Conduct baseline monitoring at restoration sites • Conduct monitoring in waters receiving runoff from dairy and livestock farms
Nutrients	• Dependent upon longitudinal and lateral nutrient transport and affects nutrient cycling through biological communities • Dependent on stream flow, land use practices, riparian corridor health, side channel connectivity, and dam and reservoir operations • Regulates abundance of aquatic vegetation • Affects usability for potable, commercial and industrial users	Limited to some 303(d) monitoring locations, lakes monitored by volunteer citizen groups, and lake restoration sites	• Increase monitoring in lakes and reservoirs • Increase monitoring in areas receiving agriculture and silviculture runoff • Conduct baseline monitoring at restoration sites • Conduct monitoring in locations with encroaching exotic species or excessive instream vegetation • Conduct monitoring above and below dams and where riparian corridors are in poor health

small streams suffering from riparian corridor deterioration as a result of agriculture silviculture and other land use practices, and natural causes such as the eruption of Mt. St. Helens, have elevated temperatures that have not yet been diagnosed. Temperature monitoring throughout WRIAs 25 and 26 should be expanded to include these smaller streams. Despite the large amount of available aquatic temperature data, comprehensive data that would be needed to support a restoration project is not available at most locations.

Suspended Solids and Turbidity

While only a few segments in WRIAs 25 and 26 are listed for turbidity problems such as the Longview Ditches, it is known that many small streams suffer from excessive sediment loading. The cause of the loading varies but is primarily a result of the following processes:

- Erosion of unstable soil types that are common in WRIA 25 and exist to some extent in WRIA 26;
- The eruption of Mt. St. Helens and subsequent ash and mud deposits in WRIA 26;
- Mass wasting in regions where riparian vegetation has been destroyed by land use practices and volcanic eruption;
- Runoff of turbid water into receiving water bodies resulting from stormwater discharges, agriculture and silviculture practices, and urban center development;
- Increased runoff from impervious structures and roads adjacent to water bodies that causes additional soil erosion; and
- Dredging and dam operations that affect stream channel stability or increase velocities causing channel scour.

Increased turbidity can have several effects on beneficial uses of water bodies. Turbidity can hide microorganisms during disinfection processes used to produce potable water and can disrupt industrial processes. Turbidity also affects instream habitat beneficial uses by clogging and consequently suffocating spawning beds and aquatic vegetation, reducing visibility for aquatic fish and wildlife needed for feeding, navigation and predation activities, reducing photosynthetic potential, and filling lakes and reservoirs.

Turbidity data is available at many locations throughout WRIAs 25 and 26. Most rivers and some larger streams have at least limited information available about turbidity levels that has been collected by Ecology and through various special site-specific studies such as those conducted on Germany Creek and the Longview Ditches. Data for smaller streams however is lacking. It is suspected that many streams throughout both WRIAs, which are not included on the 303(d) list and have not been monitored, suffer from excessive sediment loading. It is hoped that some of this loading in WRIA 26 will naturally be reduced as watershed vegetation recovers from the effects of the 1980 volcanic eruption. Additional data may be available from dam operations or the Washington State Corps of Engineers related to stream channel or reservoir dredging practices. As with temperature data needs, additional turbidity data that includes seasonal trends should be collected around spawning beds of evolutionary significant units (ESU) of threatened fish runs to prioritize restoration projects, and turbidity monitoring should be conducted above and below dams to assess dam and reservoir operating practices on solids loading and channel stability. While turbidity data is available at many river and stream reaches and some lakes, comprehensive data that would be needed to support a restoration project is not available at most locations.

Dissolved Oxygen

The only segments included in the 303(d) list for dissolved oxygen in WRIAs 25 or 26 are located in the Longview Ditch Drainage System with the exception of a few water grids located on the Columbia River. Low dissolved oxygen levels are generally caused by aerobic microbiological processing of excessive nutrient loads that deplete the water body of dissolved oxygen necessary for aerobic respiration of other aquatic organisms. Low dissolved oxygen levels can also be caused in part or exacerbated by high temperatures that reduce the solubility of oxygen in water or stagnant water that does not mix with the air and relies on passive diffusion for the incorporation of additional oxygen.

Relatively little is known about dissolved oxygen in most water bodies in WRIA 25 and 26. Available data is related to Ecology 303(d) monitoring and a few special study sites such as the Longview Ditch Drainage System. The only locations where low DO levels would be expected are in backwaters of which there are relatively few in WRIAs 25 and 26 or in lakes, ponds or reservoirs. To determine the full extent of low DO levels, additional monitoring may be required in stagnant waters and in slow moving or minimally turbid stream reaches that run through agricultural areas or are subject to high nutrient loading. Comprehensive data that would be needed to support a restoration project including seasonal variability of DO levels in most lakes are not available.

Coliform Contamination

At this point, coliform contamination has only been identified within the Longview Ditch Drainage System and within a few water grid locations in the Columbia River. Coliform contamination is usually an indicator of excessive fecal or wastewater discharge into the contaminated water body and can have serious health effects on humans and wildlife. As a result, areas that exceed coliform limits have restricted contact recreational uses and require added monitoring and treatment for potable water uses.

As with dissolved oxygen, the primary data available about coliform levels in WRIA 25 and 26 surface waters have been collected through the Ecology water quality monitoring program that supports the 303(d) listing process. In addition, contaminated sites such as the Longview Ditch System and the Columbia River sites have been subjected to additional monitoring as TMDL programs are adopted to address the water quality problems. Several studies assessing the impacts of dairies and livestock operations are also available that include some coliform water quality monitoring. Many dairies are also required to report discharge loading through the NPDES process. It is likely that coliform contamination exists along many of the small streams in WRIAs 25 and 26 located adjacent to animal holding areas, where livestock have access to the stream, or where a high potential for runoff exists where animal wastes are collected and used as field fertilization. Additional monitoring in suspect locations would increase the understanding of coliform contamination throughout the WRIAs and help to prioritize riparian corridor restoration projects and establish better land use management practices. Any restoration project should conduct baseline coliform monitoring to assess seasonal trends and levels within the subject water body.

Nutrients

No water bodies within WRIAs 25 and 26 are listed under the 303(d) list for nutrient level exceedance. Despite this, it is expected that many small streams in agricultural and silviculture areas exceed nutrient limits as a result of animal waste and pesticide runoff. Lakes are especially susceptible, as collection receptacles for nutrient loads. In many cases lakes are overgrown with aquatic vegetation, which is a good indicator that nutrient contamination may exist. High nutrient loads can promote aquatic vegetation proliferation, affect DO levels as a result of microbiological processing of those nutrients, and adversely affect beneficial uses of water for potable commercial and industrial users.

In addition, stream segments can become starved of nutrients. Increased stream flows resulting from impervious boundaries, diking and chanellization or dam and reservoir operations can sweep instream nutrients downstream disrupting longitudinal nutrient cycling. Dams and reservoirs can also serve as sinks or barriers to the downstream transport of nutrients and starve lower stream reaches. While some data is available regarding excessive nutrient loads, very little to no information is available describing nutrient starvation processes throughout WRIAs 25 and 26.

Available data about nutrients is limited to data collected at Ecology 303(d) monitoring sites and a few locations where special studies have been completed. In addition, a citizens lake monitoring program may have useful data about specific nutrient levels at lakes within WRIA 25 and 26 but this data is not subject to standardized QA/QC requirements. Several lake restoration projects, such as that being conducted at Silver Lake, also contain information about nutrient levels and loading. Nutrient monitoring should be expanded throughout WRIA 25 and 26 to include any potential restoration sites, stream reaches surrounding potential restoration sites, lakes, and susceptible areas that are not currently being monitored. As with all types of water quality data, comprehensive baseline monitoring should be conducted on any site that will be targeted for restoration.

Other Data

Habitat Data

A large amount of data was collected during the development of the Limiting Factors Analysis regarding water quality and quantity as well as fish habitat quality and availability that would be useful to restoration groups. In locations where data was not available, many of the technical advisory group members estimated information to provide a more complete data set. As comprehensive collections of data regarding fish habitat, these reports are a good starting point for any surface water restoration effort for fish habitat. GIS coverages generated by the Washington State Conservation Commission (Commission) showing anadromous fish passage barriers, stream and floodplain connectivity and stream riparian conditions are included as part of the WRIA 26 Limiting Factors Assessment (LFA). At this time, similar GIS coverages are being developed by the Commission in a similar LFA effort in WRIA 25.

Other useful habitat related data available to restoration groups has been collected and summarized in this report and includes, land use planning and practices, surface and groundwater rights and usage, and surface and groundwater resource availability.

Biological Data

At this time in WRIA 26, most of the stream data available to restorationists describe the availability and stability of habitat using geomorphologic and vegetative assessments as indicators of stream health. This information is very useful to restore habitat functionality but may not be sufficient to completely restore the habitat to historical conditions. Data on biological stream health including micro and macro invertebrate communities, the presence of herbivore and smaller fish populations, in addition to the riparian vegetation assessments already available may serve as important indicators of stream health and be used to prioritize habitat functionality restoration goals. Biological health information is also essential to successful restoration in areas with competing or exotic species such as the Silver Lake Watershed in the Toutle Subbasin.

In addition, many of the poor habitat conditions within WRIA 26 are results of the eruption of Mt. St. Helens and have only been exacerbated by human activities including dredging and filling to restore lost habitat, road construction and forestry. As a result of this natural source of disturbance, the processes that are currently occurring within WRIA 26 can be classified as semi-naturally occurring habitat recovery. During this process, invertebrate communities and other populations can be early indicators of habitat recovery and demonstrate the rate of that recovery. These insights may provide valuable information and enable restoration efforts to determine the actual need for human intervention in areas disturbed by the eruption, and to prioritize proposed activities in those areas.

Finally, by collecting baseline data about biological communities prior to restoration and comparing that information to biological community health for several years after a restoration is complete, the biologist can obtain invaluable quantitative information measuring the success of a restoration project.