Snohomish County Public Works
Snohomish County Marine Resources Committee

# Assessment of Existing Marine Water Quality Data

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# Snohomish County Public Works
# Snohomish County Marine Resources Committee
# ASSESSMENT OF EXISTING MARINE WATER QUALITY DATA

FEBRUARY 2009

*This assessment of existing marine water quality data represents a collaborative effort between Snohomish County and the Marine Resources Committee to improve decision-making through recommendations to the County Council and Executive*

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# CHAPTER 1.
# PURPOSE

In an effort to understand the effect of population growth on local marine water quality, Snohomish County is assessing marine water quality conditions by compiling and evaluating existing data. The large and rapidly growing human population in the County has resulted in increased point and non-point marine discharges. These sources include marine outfalls from various sources, including municipal sewage treatment plants, urban and rural stormwater drainage systems, railroad ditches, and residential on-site septic systems.

To date, there is no coordinated county-wide effort to monitor marine water quality, and a county-wide assessment of marine water quality conditions has never been performed. However, the 303(d) assessment by the Department of Ecology does provide a statewide assessment of marine water quality applicable to Snohomish County. Such an assessment is essential to obtain a comprehensive understanding of water quality issues and to begin the effort to coordinate monitoring efforts with multiple agencies and organizations throughout the county whenever possible.

This assessment will help Snohomish County and the Marine Resources Committee (MRC) to characterize marine water quality, identify data gaps and evaluate trends and concerns. These agencies may pursue the creation of a GIS database for further analysis of water quality conditions in Snohomish County. Findings from this evaluation will serve as the basis for MRC recommendations to the Snohomish County Council and Executive where appropriate.

Snohomish County has requested that Tetra Tech, Inc. identify marine water quality monitoring programs, assess the availability of local marine water quality data, and identify any data gaps relevant to discussions for the management effort by Snohomish County and the MRC. The results of this effort are provided in two summary documents; this report (Assessment of Existing Marine Water Quality Data) and a spreadsheet summarizing available data (the table template included in the appendix to this report).

The table template, in its current state, provides a representative sample of the data available on local marine water quality. This database is intended to provide an overview of the types of data available, the relevance that the data has to the needs of Snohomish County and the MRC, and an assessment of data quality. The Assessment of Existing Marine Water Quality Data report provides a narrative that fully describes the table template, the methods used in its construction, an overview of results, and a summary of recommendations.

# CHAPTER 2.
# BACKGROUND

Snohomish County is actively collecting local marine water quality data and identifying data gaps. Through this evaluation, Tetra Tech has provided Snohomish County and the MRC an assessment of existing and available county-wide marine water quality data including Puget Sound tributaries, connected lakes, sloughs, estuaries, domestic storm drains, and outfalls; and a summary of marine water quality data gaps. Results have been compiled into a GIS-ready table; the table template, which includes data sources, their associated data findings, and avenues for future data exploration.

The table template, in its present state, does not represent an exhaustive list of available data. It is intended to provide a structured database to use as a foundation for Snohomish County to pursue the creation of a GIS-database for further analysis of water quality in Snohomish County. Future work by Snohomish County should consider marine water quality conditions from adjacent sites in Island, Skagit, and King Counties. Introduction of data from these nearby locations may explain some of the observations at Snohomish County marine water quality sites. Maximum flexibility is inherent in the table template, allowing it to be updated anytime or imported into an Access or GIS database. An overview of how the table template is structured and a narrative-based tutorial on how it should be used are available in Appendix A. Findings from this evaluation may serve as the basis for further data compilation and analysis by Snohomish County, the MRC, and capable technical consultants. These data and analyses will be the basis for MRC recommendations to the Snohomish County Council and Executive.

## 2.1 OBJECTIVES

The following objectives were developed by Snohomish County and the MRC in order to begin evaluating the value of existing data, how to use it for decision-making, and where to continue monitoring effort to reach current and future goals:

- Create a document that clearly identifies available data (spatial and non-spatial; e.g., water sample collected at a discrete location) and data gaps that must be addressed and pursued in the future.
- Outline a clear path for further data development and acquisition opportunities, including a list of stakeholders, potential partners, and possible data resources.

# CHAPTER 3.
# TABLE TEMPLATE: SUMMARY OF AVAILABLE DATA

Environmental information is reported using identifiers that include: site name, location, date of collection, and results. Additional details about the sampling results accompany this minimal information and are useful for further describing the quality of data and the purpose for collecting and characterizing water quality. Several fields were considered for inclusion in the table template, and those reported in the appendix were necessary to include for the purpose of determining comparability of existing data sets and level of quality. Both comparability and quality are primary characteristics used to determine potential for combining data for use in specialized applications like trend analysis of water quality conditions or status of current conditions over broader spatial areas. The following sections describe the source and completeness of data sets available for addressing some or all of the objectives outlined for this study.

## 3.1 METHODS

### Protocols for Data Collection

A thorough investigation of potential sources of marine water quality data within Snohomish County was performed. Potential data sources were obtained by contacting agencies that have been known contributors to environmental studies in the greater Snohomish County area. Once an exhaustive list of potential sources was obtained, these sources were contacted to assess the availability of the data and to determine the applicability of the data to the objectives of this project. The agencies contacted and their corresponding data sources are listed in Table 1.

Once a dataset was identified, it was assessed for quality, applicability to the objectives of this project, and the potential for the data to be obtained by Snohomish County for future analysis. The data that was found to comply with each of these factors was then summarized in the table template. In some cases, datasets that were either identical or similar in structure and scope to other already summarized datasets were omitted from the table template due to time constraints. Locations for these omitted datasets are indicated in Table 1, the table template, and in the references at the end of this report.

### Interpreting Quality of Data (QA Elements)

The quality of each dataset was assessed to determine if the data would contribute to the understanding of marine water quality in Snohomish County. This was determined by the following dataset characteristics: dataset completeness, ease of data acquisition, having a database-compatible format, the parameters sampled, units of measure, and overall compatibility with the table template data. Datasets that met these characteristics were summarized in the table template. This method of data assessment allowed for a clear understanding of the data limitations and usefulness.

A further assessment of data quality was conducted with data acquired from the Environmental Information Management (EIM) database (Ecology 2009a) using quality assurance (QA) elements developed by EIM. These elements describe the study that collected the data, the study objectives, the sampling design, sampling locations, sampling analysis, and quality control procedures. A rank from 1 to 4 was applied to each dataset to describe the level of QA rigor each had undergone during sampling.

**TABLE 1.**
**AGENCIES AND MONITORING PROGRAMS REVIEWED TO IDENTIFY AVAILABLE MARINE WATER QUALITY DATA**

| Agency | Data Source(s) Consulted |
|---|---|
| Washington State Department of Ecology (Ecology) | Environmental Information Management System (EIM)<br>Washington State's Water Quality Assessment 303(d)/305(b) integrated report<br>Water Resource Inventory Area (WRIA) |
| Snohomish County | Surface Water Management Division (SWM) online data application |
| Puget Sound Partnership (PSP) | NA |
| National Oceanic and Atmospheric Administration (NOAA) | Coastal Services Center (CSC)<br>The Center for Coastal Monitoring and Assessment (CCMA)<br>Mussel Watch Program (MWP)<br>National Marine Fisheries Service (NMFS); Northwest Fisheries Science Center |
| U.S. Army Corps of Engineers (USACE) | Dredged Material Management Office (DMMO); sediment characterization results for the lower Snohomish River settling basin and adjacent navigation channels |
| Stillaguamish Tribe of Indians (STI) | Stillaguamish Tribe Research Activities |
| Tulalip Tribes | Tulalip Natural Resources Department |
| Sewage treatment plants in Snohomish County | City of Everett WWTP; Edmonds WWTP; Olympus Terrace WWTP; Lake Stevens Sewer District WWTP; Marysville WWTP; Monroe WWTP; Snohomish WWTP; Stanwood WWTP; Warm Beach WWTP; the Tulalip WWTP; and King County's Brightwater WWTP (under construction). |
| Washington State Department of Health (DOH) | Sentry Internet Data (SID)<br>Beach Environmental Assessment, Communication and Health Program (BEACH) |
| Everett Community College | Ocean Research College Academy (ORCA) |
| Washington Department of Fish and Wildlife (WDFW) | Puget Sound Ambient Monitoring Program (PSAMP) |

These ranks are as follows:

- Level 1—Informal or no QA documentation
- Level 2—Generic or incomplete document
- Level 3—Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP), or equivalent
- Level 4—Approved QAPP or SAP.

The quality of datasets in the table template that were not collected by EIM has not yet been rated using the QA elements. QA elements would probably be appropriate for assessing the quality of these datasets, though this possibility has not been examined to date. Any data quality ranking that has been entered can be viewed in the "QUALITY RATING" column in the table template (Appendix B).

## 3.2 RESULTS

The identification of potential data sources revealed that an extensive amount of data are available that will allow Snohomish County to assess the quality of its marine waters. Lack of comparability between data sources, however, will limit the County to assessing the available data by categorical ratings rather than producing a single, complete dataset. Though many potential data sources were examined, data were only able to be summarized from a portion of these sources. These sources revealed that a wide range of locations and parameters are represented in the available data (Figure 1). Specific locations of where the representative data were compiled, along with the range of parameters sampled, data type, collection interval, and any available QA, and entered into the table template. Location of data (presented as a URL), format, collecting organization, and contact information are also summarized in the table template.

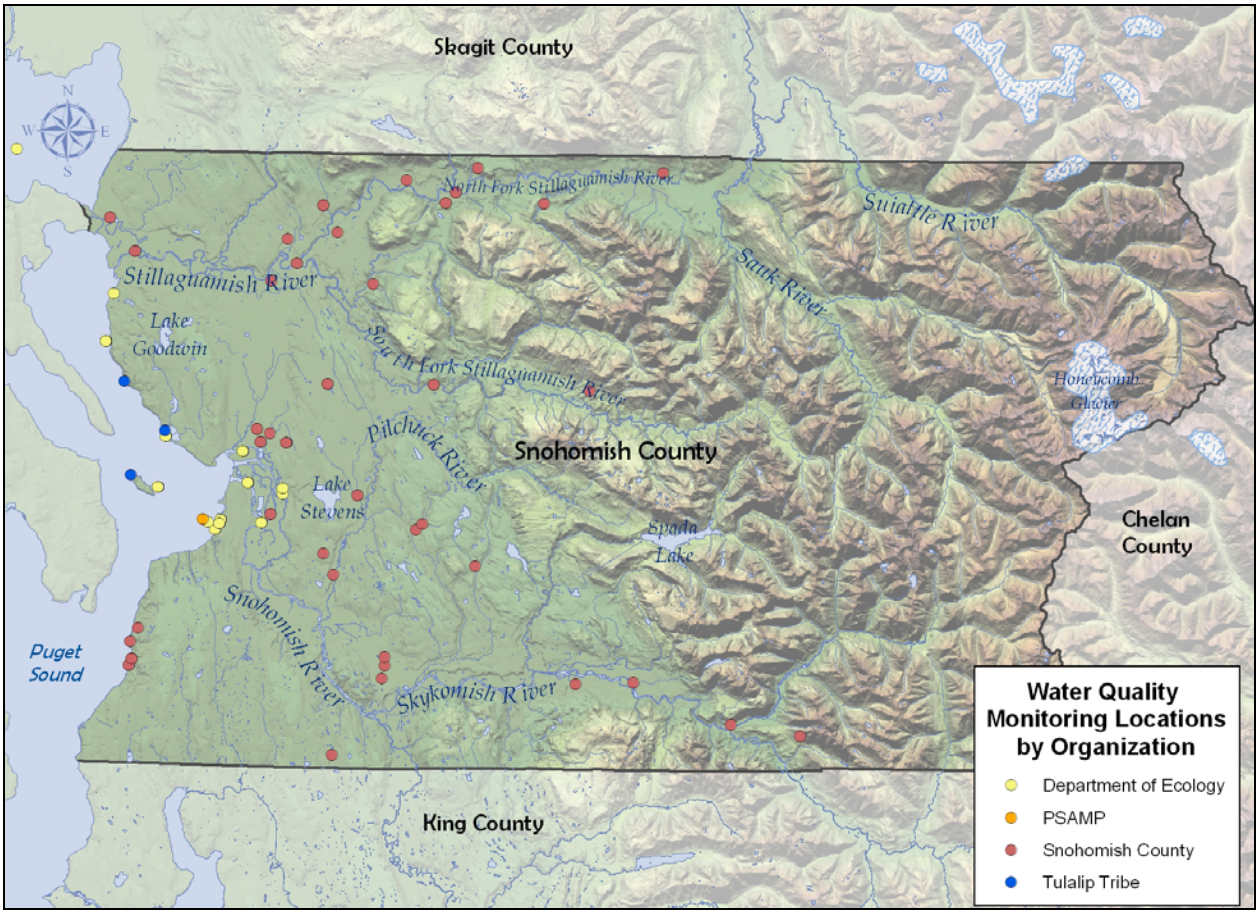


*Figure 1. Marine and Freshwater Water Quality Sampling Locations in Snohomish County*

## Location of Data/Sources

During this assessment, the Washington Department of Ecology and Snohomish County were two sources identified as having extensive, easily acquired, high quality data holdings that are highly applicable to the goals of this project. Ecology provides data through two sources, the Environmental Information Management Database and the 303(d) List. All Snohomish County data are available from the Surface Water Management (SWM) online data application. Both of these sources serve as large clearinghouses of data that have been sampled for various water-related studies within Snohomish County. The data available from these sources includes marine water quality, water quality of Puget Sound small stream tributaries, and Puget Sound outfalls. A summary of these data sources follows:

- **Washington State Department of Ecology EIM Database (Ecology 2009a)**—The EIM database houses a variety of environmental data parameters collected in water, air, and land throughout Washington State. In this database, water quality data are subcategorized by discrete water environments such as estuary, lake/pond/reservoir/ ocean, spring, stream/river, etc. Due to time constraints, the focus of this analysis was on water quality monitoring data that was collected in Snohomish County estuaries. An overview of the datasets sampled in other water environments revealed the structure of these datasets to be the same as that for estuaries. A sample of the water quality monitoring data collected in Snohomish County estuaries is available in the table template.
- **Washington State Department of Ecology Water Quality Assessment 303(d) (Ecology 2009b)**—Washington State's Water Quality Assessment describes the status of water quality for any location, freshwater or marine, using categories of ranking from 1 to 5 as recommended by the U.S. EPA. This assessment represents the integrated report for Sections 303(d) and 305(b) of the federal Clean Water Act. Categories 1 to 4 represent the status of waters for the 305(b) report, while Category 5 represents waters placed on the 303(d) list. Category 5 is defined as "polluted waters that require a total maximum daily load (TMDL)." The 303(d) list is the traditional list of impaired water bodies. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. TMDLs are required for the water bodies in this category. The table template lists the bodies of water in Snohomish County that are on the 303(d) list and the associated pollutant.
- **Snohomish County Surface Water Management Division (SWM) online data application (Snohomish County 2009)**—The Surface Water Management Division of Snohomish County provides a comprehensive approach to managing surface water in order to preserve streams, lakes, and other water bodies; protect water quality; control, accommodate, and discharge storm runoff; provide for groundwater recharge; control sediment; stabilize erosion; establish monitoring capability; and rehabilitate stream and drainage corridors for hydraulics, aesthetics, and fisheries benefits. Snohomish County has developed an online database of water quality data collected by SWM's Ambient Water Quality Monitoring Program, which assesses the biological, chemical, and physical health of streams in the County. Biological health is assessed annually by identifying communities of benthic invertebrates (stream bugs) living in the stream beds. Chemical and physical health is assessed monthly by collecting data at 29 established sampling sites in the County. Much of the available data from other data sources has been captured and is available from SWM.

## Other Potential Data Sources

Several other data sources were assessed and it was found that these sources provided data of limited usefulness, limited data, or no data. Sources that provided data of limited usefulness or no data are cited but no data are summarized in the table template. Datasets were identified of limited usefulness most often because they were not formatted for a database and therefore, would require extensive effort to incorporate into the table template. The status of the data from these sources, however, is described below. This information will allow Snohomish County to acquire and format this data in the future, if desired. The sources that provided only limited data were summarized in the table template. At times, multiple data sources offered the same datasets; only one of the redundant datasets was summarized in the table template. The dataset from the primary researching organization, when obvious, was always listed as the "ORGANIZATION" in the table template. Though some datasets were not summarized in the table template, it is important to note that they still may be useful and could be summarized in the future when time allows. A brief discussion of each potential data source follows:

- **Puget Sound Partnership (PSP) (PSP 2009)—**The Puget Sound Partnership is a community effort of citizens, governments, tribes, scientist, and businesses working together to restore and protect Puget Sound. The Puget Sound Action Team and Puget Sound Water Quality Authority (predecessors to PSP) founded the Puget Sound Assessment and Monitoring Program (PSAMP) in 1989, which continues to provide essential science for conservation, recovery, and management of the Puget Sound ecosystem. PSAMP is a multi-agency effort to monitor the health of Puget Sound. The Puget Sound Action Team coordinates the PSAMP program. Members of PSAMP include: Ecology, WDFW, Washington Department of Natural Resources, Washington Department of Health, NOAA Northwest Fisheries Science Center, U.S. Fish and Wildlife Service (USFWS), University of Washington's Applied Physics Laboratory, and EPA. For the most part, various types of data collected by PSAMP are not readily available online. However, Ecology does offer PSAMP marine sediment monitoring data through their website (Ecology 2009d), some of which was summarized in the table template. Fish and Wildlife provide limited data on toxin monitoring of Puget Sound fishes and macro-invertebrates. Their data, however, is only readily available through reports and would be difficult to assimilate into a database.
- **National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center (CSC) (NOAA 2009a)—**The NOAA CSC works with various branches of NOAA and other federal agencies to bring information, services, and technology to the nation's coastal resource managers. The Center is a partner in over 100 ongoing projects geared to resolve site specific coastal issues. The CSC is dedicated to working with state and local coastal programs to determine data needs and deliver not only the data, but also the tools and training needed to turn these data into useful information. All of this can be found on the CSC's website. Currently, spatial data are only available from the CSC. However, the future addition of a regional ecosystem data portal may provide additional data that would benefit the goals of Snohomish County.
- **NOAA's Center for Coastal Monitoring and Assessment (CCMA) (NOAA 2009b)—**The CCMA's mission is to assess and forecast coastal and marine ecosystem conditions through research and monitoring. CCMA conducts field observations on regional and national scales. The center provides the best available scientific information for resource managers and researchers, technical advice, and accessibility to data. CCMA's science addresses five major environmental stressors: pollution, land and resource use, invasive species, climate change, and extreme natural events. Reports and summaries are the only resources available from this wide-ranging group. Data are present in these documents, although much of it does not apply to Snohomish County and is not in database format. Data from this source was therefore, not summarized in the table template.
- **NOAA's Mussel Watch Program (MWP) (NOAA 2009c)—**The MWP is the longest continuous contaminant monitoring program in United States coastal waters. The project analyzes chemical and biological contaminant trends in bivalve tissue collected at over 280 coastal sites from 1986 to present. The database includes bivalve tissue chemistry for over 100 organic and inorganic contaminants; bivalve histology; and Clostridium perfringens data. MWP has long-term data collected in the marine waters of Snohomish County (Everett Harbor) available. However, these data were not readily transferable into a database and therefore, were not summarized in the table template. Data provided by MWP, however, may still be of value to Snohomish County if desired.
- **National Marine Fisheries Service (NMFS); Northwest Fisheries Science Center (NMFS 2009)—**The Northwest Fisheries Science Center studies living marine resources and their habitats in the Northeast Pacific Ocean, primarily off the coasts of Washington and Oregon and in freshwater rivers and streams in Washington, Oregon, Idaho, and Montana. The Center

seeks to better understand living marine resources and their ecosystems to assist resource managers in making sound decisions that build sustainable fisheries, recover endangered and threatened species, and sustain healthy ecosystems, and reduce human health risks. NMFS data are managed by the Scientific Data Management Team. Data available from this agency are not applicable to the goals of this assessment. They include spatial data, data related to salmon fisheries, and data collected outside of Snohomish County. As a result, no data from NMFS; Northwest Fisheries Science Center was summarized in the table template.

- **U.S. Army Corps of Engineers (USACE); Dredged Material Management Office (DMMO) (USACE 2003)—**The DMMO is the main point of contact for the interagency Dredged Material Management Program (DMMP). The DMMP includes all dredged material management programs in the State of Washington: Puget Sound Dredged Disposal Analysis (PSDDA); Grays Harbor/Willapa Bay; the Washington side of the lower Columbia River (with the exception of port districts); and other marine and freshwater locations. The DMMO provides evaluations of the DMMP Disposal Sites pertaining to the Endangered Species Act (ESA). No data are directly available from the DMMO at this time and therefore, none was summarized in the table template.

- **Stillaguamish Tribe of Indians (STI) (STI 2009)—**The STI through the Stillaguamish Tribe Research Activities, have invested heavily in managing, protecting, and conserving natural resources that are required to sustain healthy populations of fish, shellfish, and wildlife within the Stillaguamish Tribe's "usual and accustomed fishing areas" (Stillaguamish Watershed). Through this effort, they have performed various surveys of water-related habitats in Snohomish County. These surveys, however, only have limited data that would add little to the objectives of this assessment. The spatial coverage of water quality characterizations are limited as well as the small number of water quality variables that were measured. No data from the STI was therefore, summarized in the table template. The STI's continued efforts to survey water-related habitats in Snohomish County may result in additional data being available in the future that would add to the effort of Snohomish County to better understand marine water quality. Further explanation of STI's research efforts, including estuary habitat use and nearshore mapping is available on-line at their website (stillaguamish.nsn.us/research.htm).

- **Tulalip Tribes (Tulalip Tribes 2009)—**The Tulalip Tribes Tulalip Natural Resources program is intended to carry out the tribes' co-management responsibilities of its natural resources in a manner consistent with treaty rights as well as protection and perpetuation of the resources upon which the people have long depended. Like with the STI, through this effort, the Tulalip have performed various surveys of water-related habitats in Snohomish County. These surveys, however, only have limited data that would not add significantly to the objectives of this assessment. Water quality monitoring effort by the Tulalip Tribe focuses on health of shellfish beds and the indicators like bacteriological contamination that determine harvestability. The Tulalip Tribes continued efforts to survey water-related habitats in Snohomish County may result in additional data being available in the future that would add to the effort of Snohomish County to better understand marine water quality. More information on the Tulalip Tribes Natural Resources program can be found on-line at their website, http://www.tulalip.nsn.us/index.html.

- **Snohomish County Sewage Treatment Plants—**The Snohomish County sewage treatment plants provided very limited data applicable to this assessment. The available datasets were mostly incomplete and in various formats that were difficult to incorporate into the table template. Water quality variables are limited to permit monitoring requirements of the waste stream. Currently, receiving water monitoring is not a permit requirement in the State of Washington. The data from the Snohomish County sewage treatment plants was therefore,

not summarized in the table template. Precise point source locations are described in NPDES permits and fact sheets for all sewage treatment plants in Snohomish County. NPDES permits for these facilities do not require ambient monitoring. Effluent monitoring is required and used to determine if water quality-based effluent limits are needed after consideration of permitted dilution. King County DNR will have water quality data collected for siting the marine outfall off Point Wells for the Brightwater treatment plant that is currently under construction.

- **Washington State Department of Health (DOH); Sentry Internet Data (SID); Beach Environmental Assessment (DOH 2009b), Communication and Health Program (BEACH) (DOH 2009a)—**The DOH works with its federal, state, and local partners to help people in Washington stay healthier and safer. Their programs and services help prevent illness and injury, promote healthy places to live and work, provide education to help people make good health decisions and ensure our state is prepared for emergencies. Potential sources of data include the Office of Drinking Water (ODW), Sentry Internet Data (SID) and the Beach Environmental Assessment, Communication and Health Program (BEACH) co-sponsored by Ecology. The ODW uses a searchable database to provide a summary of information pertaining to Public Water Systems. Data presented by ODW is thorough albeit limited to water resources related to drinking water. The ODW data is focused solely on drinking water and not streams. As a result, its applicability to this assessment is limited and no data were summarized in the table template. The BEACH Program is led by The Washington State Departments of Ecology and Health. It is comprised of county and local agencies, tribal nations, and volunteers. They monitor Washington beaches for fecal bacteria, notifying the public when the results are high, and educating people about what they can do to avoid getting sick from saltwater. Fecal bacteria are the only parameter monitored by BEACH and the data are presented in a format not readily compatible with a database. As a result, data from BEACH was not summarized in the table template.
- **Everett Community College; Ocean Research College Academy (ORCA) (Everett Community College 2009)—**ORCA is the only early college in the nation that uses the local marine environment as the unifying theme to integrate the core academic disciplines. Funded initially by the Bill and Melinda Gates Foundation, ORCA seeks to provide opportunities for all students to engage in active inquiry and in-depth study in a supportive environment. Data available from ORCA covers a sporadic array of parameters and is not easily accessible. The majority of these studies examined parameters not readily applicable to this assessment. Limited water quality data collected at Port Gardner and South Saratoga Passage was collected through the ORCA program. This data, however, wasn't available online and its quality is unclear. As a result, no data from ORCA was summarized in the table template.
- **Washington Department of Fish and Wildlife (WDFW); Puget Sound Ambient Monitoring Program (PSAMP) (WDFW 2009)—**PSAMP is a multi-agency effort to monitor the health of Puget Sound. Along with WDFW, other agencies that play a role in PSAMP include Ecology, Washington Department of Natural Resources, DOH, NOAA Northwest Fisheries Science Center, USFWS, University of Washington's Applied Physics Laboratory, and EPA. In its role, WDFW assesses the health of Puget Sound fishes and macro-invertebrates. Under the direction of PSAMP, WDFW's Fish Component assesses the status and trends of chemical contamination in Puget Sound fish and macro-invertebrates, the effects of contamination on the health of these resources. They primarily monitor recreationally and commercially important species of fish and crabs of differing life history and feeding patterns to provide a broad overview of contamination in marine biota inhabiting Puget Sound. Data from WDFW is directly available via published reports making their transfer to a database very difficult; as a result, WDFW data were not summarized in the table

template. WDFW data are also limited to water quality estimates based on toxin levels found in tissue samples and have few datasets collected in Snohomish County. However, the data WDFW has collected is high quality and thorough, therefore providing some potentially good data on Snohomish County marine water quality if additional time is invested in the future.

## Available Parameters

The City of Everett Stream Assessment lists parameters that may serve as indicators of water quality and are available from a number of data sources. The parameters and data sources are summarized in Table 2.

## Data Gaps

The extent of data gaps across all available datasets examined in this assessment is not fully understood at this time. Time constraints limited the assessment of data to only an overview that was summarized as a representative sample in the table template. The true extent of data gaps will not be made clear until all appropriate data are compiled into a GIS database and assessed. However, despite the time limitations of this assessment, some trends of data gaps were noted as follows (some of these data gaps may be shown to be false on assessment of the completed GIS database):

- **Parameters with Limited Data Availability or Short Period of Record**—In the Ecology and Snohomish County data sets, gaps were noted in certain parameters because of limited data availability, short period of record, or both. Benthic indicator studies were typically short-term, one time samples. This sampling regime limited the ability for the data to capture any long-term fluctuations that may have occurred at each sample site. Long-term studies that are ongoing or have been completed in the recent past are limited. It will be difficult to assess long-term changes in water quality up to the present in various sampling locations.
- **Many Studies Were Completed More Than Three Years Ago**—Though many water quality-related studies have occurred in Snohomish County, many of those were sampled multiple years ago. This may be only the case for readily available datasets. Newer datasets may exist but have not been made easily available.
- **Other Data Gaps in Sampled Parameters**—Further research on the water quality monitoring could be assessed from the EIM database for lake/pond/reservoir, ocean, spring, and stream/river in Snohomish County in order to determine the parameters monitored for varying water body types. Other available sources of data are sediment and benthic indicator studies in the EIM database for water quality assessment. Additional time can be invested to search Ecology for TMDL, QAPP, and SOP studies on water bodies in Snohomish County.

Additional data that would contribute to the understanding of marine water quality of Snohomish County may be available from the sources providing data difficult to access and transfer to a database. These sources, outlined above, would require additional time and effort in order to extract and format the data to render it useable. These data sources included WDFW (PSAMP), Everett Community College (ORCA), DOH (SID and BEACH), City of Everett WWTP, Snohomish County Sewage Treatment Plants, Tulalip Tribes, STI, USACE, NOAA (NMFS, MWP, CCMA, and CSC), and PSP.

**TABLE 2.**
**AVAILABLE PARAMETERS SAMPLED AND ORGANIZATIONS THAT GENERATED THE DATA**

| Parameter monitored | Snohomish County | Ecology | PSAMP | Stillaguamish Tribe of Indians (STI) | Tulalip Tribes |
|---|---|---|---|---|---|
| **Conventionals** | | | | | |
| Ammonia | | X | | | |
| Ammonia, un-ionized | | X | | | |
| Ammonium (N) (total) | | X | | | |
| Ammonium-Ammonia (dissolved) | | X | | | |
| Conductivity | X | X | | | |
| Conductivity | | X | | | |
| Density | | X | | | |
| Dissolved oxygen | X | X | | | X |
| Dissolved oxygen saturation | | X | | | |
| Flow rate | X | | | | |
| Light transmission | | X | | | |
| Nitrate | | X | | | X |
| Nitrate - nitrite | X | | | | |
| Nitrite-nitrate (dissolved) | | X | | | |
| Nitrate (dissolved) | | X | | | |
| Nitrite | | X | | | |
| Nitrite (total) | | X | | | |
| Nitrite (dissolved) | | X | | | |
| Nitrogen (total) | | X | | | |
| Ortho-phosphate | | X | | | X |
| Ortho-phosphate (dissolved) | | X | | | |
| Ortho-phosphate (total) | | X | | | |
| pH | X | X | | | X |
| Phosphorous (total) | X | X | | | |
| Salinity | | X | | | |
| Secchi disk depth | | X | | | |
| Staff depth | X | | | | |
| Suspended solids | X | X | | | |
| Temperature | X | X | | | X |
| Organic carbon (total) | | X | X | | |
| Turbidity | X | X | | | X |
| Beam_c @ 67Xnm | | X | | | |

**TABLE 2 (continued).**
**AVAILABLE PARAMETERS SAMPLED AND ORGANIZATIONS THAT GENERATED THE DATA**

| Parameter monitored | Snohomish County | Ecology | PSAMP | Stillaguamish Tribe of Indians (STI) | Tulalip Tribes |
|---|---|---|---|---|---|
| **Organics** | | | | | |
| Base Neutrals, Low Molecular Weight PAH | | | X | | |
| Chlorinated Alkanes | | | X | | |
| Chlorinated and nitro-substituted phenols | | | X | | |
| Chlorinated aromatic compounds | | | X | | |
| Chlorinated pesticides | | | X | | |
| Ethers | | | X | | |
| High-Molecular Weight, Polycyclic Aromatic Hydrocarbons | | | X | | |
| Organonitrogen compounds | | | X | | |
| PAH | | | X | | |
| PCBs | | | X | | |
| Pesticides | | | X | | |
| Phthalate Esters | | | X | | |
| Polychlorinated Biphenyls | | | X | | |
| Semivolative Organics, Acid Extractable Phenols | | | X | | |
| **Trace Metals and Hardness** | | | | | |
| Aluminum | | | X | | |
| Antimony | | | X | | |
| Arsenic | | X | X | | |
| Barium | | | X | | |
| Beryllium | | | X | | |
| Cadmium | | | X | | |
| Calcium | | | X | | |
| Chromium | | | X | | |
| Cobalt | | | X | | |
| Copper (total) | X | X | X | | |
| Hardness | X | | | | |
| Iron | | | X | | |
| Lead (total) | X | X | X | | |
| Magnesium | | | X | | |
| Manganese | | | X | | |
| Mercury (total) | | X | X | | |
| Nickel | | | X | | |
| Selenium | | | X | | |
| Silicate (SIOH4) (dissolved) | | X | | | |

**TABLE 2 (continued).**
**AVAILABLE PARAMETERS SAMPLED AND ORGANIZATIONS THAT GENERATED THE DATA**

| Parameter monitored | Snohomish County | Ecology | PSAMP | Stillaguamish Tribe of Indians (STI) | Tulalip Tribes |
|---|---|---|---|---|---|
| **Trace Metals and Hardness (continued)** | | | | | |
| Silver | | | X | | |
| Sodium | | | X | | |
| Thallium | | | X | | |
| Vanadium | | | X | | |
| Zinc | | | X | | |
| Zinc (total) | X | | | | |
| Miscellaneous Extractable Compounds | | | X | | |
| **Bacteriological** | | | | | |
| Enterococci | | X | | | |
| Fecal coliform bacteria | X | X | | X | X |
| **Biological** | | | | | |
| Benthic invertebrate index | X | | | | |
| Benthic macrofauna | | | X | | |
| Chlorophyll a | | X | | | |
| Phaeopigment | | X | | | |
| **Other parameters** | | | | | |
| Guaiacols | | | X | | |
| Resin Acids | | | X | | |

Guiacols and Resin Acids are products released in the manufacturing of wood pulp. Measurements of these compounds are made near pulp and paper facilities, and are not associated with either the pharmaceutical industry or the wood preservative industry.

# CHAPTER 4.
# DISCUSSION

Location of existing water quality information and evaluation of comparability among existing data sets were completed in order to address the MRC objectives in Section 2.1. The volume of available and applicable data that could be used in this review was selected based on quality of information, quantity of observations, and purpose for data generation. Results from data review provided an insight into the utility of reviving and using past and current monitoring efforts as the basis for one or more monitoring programs that will address the MRC's information needs.

## 4.1 ASSESSMENT

### Evaluation of the Protocol Strategy

The assessment of existing marine water quality data was a necessary first step to accomplish the major objective, which is to identify available local marine water quality data and data gaps relevant to the County and the MRC. This exercise proved to be highly useful in that it resulted in a summary database, the table template, which allows for data to be compiled and assessed. Despite the time constraint of this assessment, the subsample of data summarized in the table template was able to reveal potential data gaps. The data gaps include parameters with limited data availability, a short period of record, or date collected more than three years ago. However, these gaps may prove to be a product of assessing only a subsample of data, and they may be filled when an assessment of all the data has been completed.

The addition of data from the EIM database for lake/pond/reservoir, ocean, spring, and stream/river in Snohomish County would determine the parameters monitored for varying water body types. Furthermore, adding sediment and benthic indicator studies from the EIM database would allow for additional water quality assessment. Additional time can be invested to search Ecology for TMDL, QAPP, and SOP studies on water bodies in Snohomish County.

Additional data may also be available from the sources providing data that were found to be difficult to access and transfer to a database. Many of these sources house data that would contribute to the understanding of marine water quality of Snohomish County. Investing additional time to obtain and format these data would be worthwhile. The true extent of data gaps will not be fully understood until all appropriate data are compiled into a GIS database and properly assessed.

The data quality has been only partially evaluated. EIM QA is incorporated into the table template wherever their data are summarized. Data not collected by EIM does not have a QA rating because of time constraints. QA elements would probably be appropriate for assessing the quality of these datasets though this possibility has not been examined to date. Assessing non-EIM data and giving it an appropriate QA score would take additional effort and time.

### Further Data Acquisition Opportunities (Stakeholders, Potential Partners)

A major finding from this assessment was that two main data sources facilitate data accessibility: the Washington Department of Ecology and Snohomish County. In general, these sources serve as clearinghouses of both the agency data and data from other organizations (as required through state grants and federal funding). The high degree of communication that apparently occurs between organizations

researching effects from environmental degradation of resources in Snohomish County has facilitated partnerships and coordination among the research groups.

A good example is the coordinated effort of the PSAMP program that characterizes conditions in all media of the Puget Sound (e.g., surface water, sediment quality, and tissue analysis). Through this program, organizations such as Ecology, Washington Department of Natural Resources, DOH, NOAA Northwest Fisheries Science Center, USFWS, University of Washington's Applied Physics Laboratory, and EPA contribute expertise in assessing the health of Puget Sound. An extensive amount of data that characterizes status of contaminants in media and conditions of the resource is available through this coordinated effort within Snohomish County. Though some of the data are difficult to access, it is available in various forms (e.g., hardcopy data forms, reports, etc.). With further investment of time, however, it will provide insight on marine water quality in Snohomish County.

It is important to note that monitoring is continually occurring within organizations, and tracking ongoing efforts is essential for maintaining efficiency in Snohomish County's monitoring efforts. Data generated by other organizations that are not directly comparable to the County's efforts can be combined by assessing status of aquatic resources using a tiered system (e.g., poor, fair, or good) and then aggregating information into a single report. An example for use of categorical assessment information can be found in the "State of Salmon Report" where combinations of data generated from multiple organizations produces spatially extensive evaluations of aquatic resources.

## 4.2 RECOMMENDATIONS

### Assessment of Data

Ecology and Snohomish County provided the largest, most comprehensive data resources of all the organizations assessed. In addition, they served as a clearinghouse for stored data from a variety of monitoring programs. Other data sources proved to have limited data, inaccessible data given time limitations in this survey effort, or non-existent data from organizations considered in this survey. Data sources with limited data or data that was difficult to access can still be used if it provides some insights to marine water quality conditions in Snohomish County. All data sources may be updated in the future and, therefore, should be tracked in order to maintain current knowledge about marine water quality monitoring efforts.

### Justification for Project Continuation

This assessment is essential as an initial step in defining the identity of water quality issues in Snohomish County and to begin an effort that coordinates monitoring program products among multiple agencies and organizations throughout the County, whenever possible. The generation of monitoring data will be necessary in order to address the increasingly complex environmental regulation required of local governments. Past monitoring activities, whether short- or long-term, are a beginning step in determining the utility for use of existing information and for coordinating efforts with newly established organizations that are currently attempting to coordinate at a larger scales than the County.

Developing a monitoring program should consider specific uses for data prior to adopting a sampling design. The complexity of the regulatory mandates for Snohomish County will require the development of multiple monitoring strategies that address the following:

- Assessing long-term trends for measuring overall water quality improvement efforts,
- Determining success in meeting TMDL targets for water body segments or immediately outside of designated mixing zones from point-source outfalls,

- Determining effectiveness of prescribed BMP (Best Management Practices) implementation strategies for improving water quality in receiving waters,
- Measuring effectiveness of Detailed Implementation Plans (DIPs) for completed TMDLs and approved by the U.S. Environmental Protection Agency, Region 10,
- Describe progress in abating non-point pollution originating from storm water runoff (to meet requirements in the municipal storm water permit), and other regulatory requirements.

The volume of information generated from increasingly large monitoring programs that could be developed and implemented by Snohomish County governmental organizations will require a data management application that is linked with the ability to display results spatially (e.g., Geographic Information System application). This data management strategy will meet the rigorous data usage demands reflected in existing data portals like that of the Washington Department of Ecology's Environmental Information Management (EIM) on-line application. One of the primary reasons that monitoring programs fail to meet expectations is that data retrieval becomes exceedingly difficult in simplistic or two-dimensional (flat-file) data systems.

Tetra Tech, Inc. (Fairfax, VA Division) has developed data management systems that serve data storage, analytical products, and interpretive reports for TMDL programs as well as for multiple lines of data (e.g., chemical, physical habitat, and biological; EDAS Version 3.2). These customized data management systems can either use existing platforms with modifications or begin with a new application that communicates with other data portals maintained by the federal and state agencies. Many of these primary data management systems with easy on-line access are routinely used by federal and state agencies that prepare summary reports describing general environmental conditions that support endangered species recovery at the watershed and salmon recovery region scales.

Development of monitoring programs will need to directly address specific information needs as outlined in the points above, but will also require detailed documentation that describes quality assurance elements (e.g., Quality Assurance Project Plan). Both state and federal grants that will assist Snohomish County implement monitoring programs that address regulatory requirements through permits require development of Quality Assurance Project Plans (QAPPs). Each of the monitoring programs adopted by the County will be able to use examples for preparing QAPPs like that for Lake Spokane (prepared by Tetra Tech, Inc. for Spokane County). This is an example of a description for multiple monitoring programs that address the source and dynamics of non-point source pollution and result in dissolved oxygen sags. Each of the monitoring programs was designed to be implemented in a specific order so that costs would not be prohibitive.

Monitoring activities have specific goals that include improvements or conservation of water quality conditions. Each of the goals is addressed from information generated by individual monitoring programs that have associated objectives. The objectives determine the type of monitoring (e.g., frequency of observations and spatial coverage) required and that will answer questions based on regulatory requirements for meeting water quality expectations. Several monitoring programs may be necessary to address objectives from all of the regulatory requirements and will have differences in sample locations and frequency of sample collection (Table 3). In some cases, samples collected for one of the monitoring programs may be used to supplement information to another monitoring program (e.g., monthly samples collected for trend analysis can be selectively used to supplement a longitudinal profile of water quality conditions in a large river). In many instances, a single sampling event can be useful to information needs for multiple monitoring programs and depends on timing of sample collection and location of sample collection.

**TABLE 3.**
**MONITORING PROGRAMS WITH INFORMATION REQUIREMENTS THAT CAN BE SATISFIED USING A SINGLE SAMPLE COLLECTION EFFORT (DEPENDENT ON COLLECTION TIME AND LOCATION)**

| | Year 1 Location and Sampling Time | | | | | |
|---|---|---|---|---|---|---|
| Monitoring Purpose | Site #1 | Site #2 | Site #3 | Site #4 | Site #5 | Site #6 |
| 1. Trend Analysis | Monthly | — | — | — | — | Monthly |
| 2. Longitudinal Profile | Once/year | Once/year | Once/year | Once/year | Once/year | Once/year |
| 3. BMP Effectiveness | — | 2 /month | 2 /month | — | — | — |
| 4. Stormwater Impacts | — | — | — | Continuous | Continuous | — |

Endangered Species Act issues require consultation with NOAA-Fisheries where presence of individual species and the life stages are affected by habitat degradation and pollutants in both marine and freshwater environments. These consultations are required by NOAA-Fisheries when permits are being issued for control of storm water effluent, coordinated with TMDLs, and where habitat modifications are proposed (e.g., urban and industrial development). These assessments are useful for coordinating the needs of endangered species and water quality impairments in specified water body segments. Tetra Tech, Inc. recently prepared a biological evaluation of threatened and endangered species from storm water impacts on federal facilities throughout Puget Sound and addressed a variety of toxics and assessed the effects on species and life stages. Much of the available information for rivers/streams and marine water quality was used to determine background environmental conditions for a variety of pollutants originated from the Snohomish River basin and adjoining marine resources area. Preparation of this report revealed the historically rich monitoring efforts that have been conducted in Snohomish County.

Finally, coordination of this effort with newly formed government organizations like the Puget Sound Partnership will be advantageous for adopting analytical and interpretive tools for data evaluation. The development of indicators for measuring conditions of freshwater, marine water, and biological condition is currently underway. Adoption of useful indicators for addressing objectives developed by the Marine Resources Committee (Snohomish County) and aligned with larger scale efforts will expedite meaningful interpretations recognized by the regulatory agencies and legitimize the Snohomish County marine and freshwater monitoring programs.

Several needs have been outlined here and continuation of this work in a deliberate order will enable the development of useful and cost-effective monitoring programs. These programs are guided by objectives that outline a path for a stratified monitoring program that begins with: evaluation of existing data, how to use this data for meeting regulatory requirements and for decision-making that improves environmental conditions, and identify the type of monitoring effort needed to achieve current and future goals for healthy marine and freshwater aquatic resources. As a reminder, the following are the objectives originally outlined by the Snohomish County MRC as useful and achievable efforts for reaching these specific goals:

- Create a document that clearly identifies available data (spatial and non-spatial) and data-gaps that must be addressed and pursued in the future.
- Outline a clear path for further data development and acquisition opportunities, including a list of stakeholders, potential partners, and possible data resources.

- Justify the continuation of the study to funding agencies, the County Council, and the County Executive.

## Next Steps

Following review of available information reported in this document, some suggestions are provided on next steps in acquiring information needs of the Marine Resources Committee:

- Determine identity of reliable data sources and aggregate available water quality information into a flat-file (spreadsheet) format,
- Prioritize information needs and clearly define the regulatory policy or requirement the information will address,
- Construct the necessary monitoring program(s) that will address information needs,
- Identify, modify, or construct a data management system that will store historic, current, and future data generated for use by the MRC (customize reports through the data management system useful for review by the MRC).

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# APPENDIX A.
# TABLE TEMPLATE OVERVIEW

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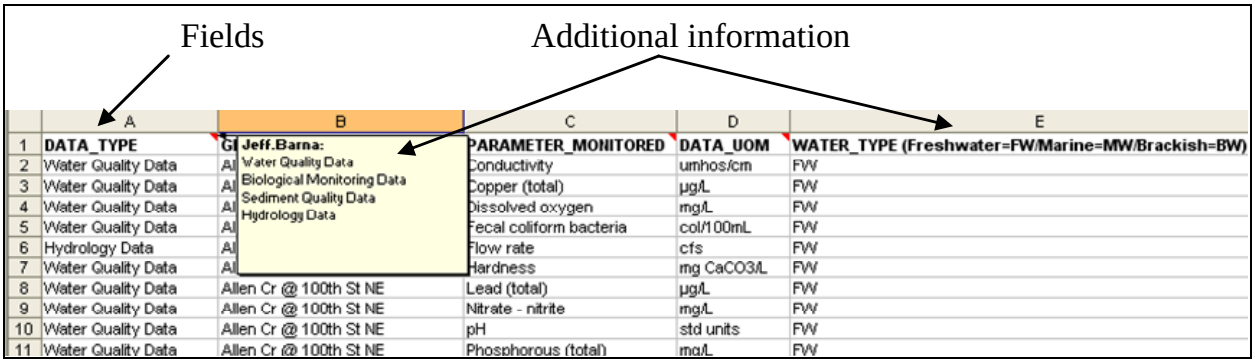
# APPENDIX A.
# TABLE TEMPLATE OVERVIEW

The spreadsheet titled "Table Template" (Table) was created as the foundation for recording marine water quality data resources in Snohomish County, Washington. The Table was constructed using Microsoft Office Excel 2003 which will allow maximum flexibility for future changes or import into an Access or GIS database. The data entered in the Table is meant to provide a representative sample of the available marine water quality data for Snohomish County and is not an exhaustive list.

The Table contains a series of fields to describe each data resource investigated and is structured to allow for sorting through the data records by the most relevant fields (Figure 1). Fields are arranged in order of decreasing relevance across the table to meet data needs of Snohomish County and the Marine Resources Committee (MRC).




| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | DATA_TYPE | GI | PARAMETER_MONITORED | DATA_UOM | WATER_TYPE (Freshwater=FW/Marine=MW/Brackish=BW) |
| 2 | Water Quality Data | Al | Conductivity | umhos/cm | FW |
| 3 | Water Quality Data | Al | Copper (total) | µg/L | FW |
| 4 | Water Quality Data | Al | Dissolved oxygen | mg/L | FW |
| 5 | Water Quality Data | Al | Fecal coliform bacteria | col/100mL | FW |
| 6 | Hydrology Data | Al | Flow rate | cfs | FW |
| 7 | Water Quality Data | Al | Hardness | mg CaCO3/L | FW |
| 8 | Water Quality Data | Allen Cr @ 100th St NE | Lead (total) | µg/L | FW |
| 9 | Water Quality Data | Allen Cr @ 100th St NE | Nitrate - nitrite | mg/L | FW |
| 10 | Water Quality Data | Allen Cr @ 100th St NE | pH | std units | FW |
| 11 | Water Quality Data | Allen Cr @ 100th St NE | Phosphorous (total) | mg/L | FW |

*Figure A-1. Location of Fields and Additional Information Found in the Table*

Additional information about each field is available either in the heading itself; written in parentheses, or in a comment box attached to the cell of the heading (Figure 1). This additional information provides either a list of possible entries or notes pertaining to the field in order to clarify the types of data captured.

The information in the Table can be sorted according to water type (marine, estuary, or fresh water) and by water quality parameter. Data sorting in a specific format will enable a reviewer to examine the extent and distribution of water quality data in all water types. Additional information associated with existing data will also indicate the longevity of monitoring effort (e.g., long-term, project, compliance with permits, etc.) and the type of data collected. Documentation accompanying existing data will also be useful in determining the comparability among data sets and whether existing monitoring or project efforts should be continued by the County and other stakeholders.

The fields found in the Table are listed and described below:

- **303d LISTINGS/TMDL:** Identifies if the study is listed on the 303d water quality list or completion of a Total Maximum Daily Load study:
  - (See Washington State's Water Quality Assessment 303(d) in Results section)
  - Valid Values: Y=Yes, N=No

- **ASSESSMENT INDEX:** multi-matrix index that aggregates information from multiple parameters and is expressed as a single number. The number is compared to condition ranges for example poor, fair, good:
  - Valid values- Poor, Fair, Good
- **CONTACT:** Name of study contact person.
- **CONTACT INFORMATION:** Contact information of entity responsible for the study.
- **DATA FORMAT:** File type format of original sampling data:
  - Valid Values: Excel/Spreadsheet/Access
- **DATA LOCATION:** Location of original sampling data:
  - Valid Values: URL/Electronic/Hardcopy)
- **DATA TYPE:** Description of the type of data sampled; Valid Values: Water Quality Data Biological Monitoring Data, Sediment Quality Data
- **DATA UNITS:** unit of measure of sampled parameter:
  - Valid Values: Ammonia mg/L, Arsenic mg/L, Benthic invertebrate index B-IBI, Chemistry, Chlorophyll mg/L, Conductivity umhos/cm, Conventional, Copper (total) µg/L, Copper (total) mg/L, Density mg/L, Dissolved oxygen mg/L, Emerging chemicals mg/L, Endocrine disruptors mg/L, Escherichia coli cfu/100 mL, Fecal coliform bacteria col/100 mL, Flow rate cfs, Hardness mg CaCO3/L, Hazardous algal blooms, Hydrocarbons mg/L, Invasive species, Kjeldahl nitrogen mg/L, Lake level ft, Lead (total) µg/L, Lead (total) mg/L, Light transmission % Mercury (total) mg/L, Metals, Microbiological, Nitrate mg/L, Nitrate - nitrite mg/L, Nitrite mg/L, Nitrogen (total) Unknown, Non-invasive species, Organics, Ortho-phosphate mg/L, PCBs mg/L, pH std units, Phaeopigment µg/L, Phosphorous (total) mg/L, Pressure mm/Hg, Salinity ppt, Secchi disk depth m, Silicate mg/L, Staff depth ft, Suspended solids mg/L, Temperature Degree C, Tin mg/L, Toxicity, Toxin accumulation, Turbidity NTU, Zinc (total) µg/L
- **DATE(S) OF STUDY:** Start and end date of study.
- **EASTING:** Easting coordinates of sampling site.
- **GENERAL LOCATION:** general location description of where sampling occurred
- **GENERAL NOTES:** Additional notes about data.
- **LATITUDE:** Latitude coordinates of sampling site.
- **LOCATION NAME:** Name of sampling location.
- **LONGITUDE:** Longitude coordinates of sampling site.
- **NO. YEARS:** Number of years sampling occurred for study.
- **NORTHING:** Northing coordinates of sampling site.
- **ORGANIZATION:** The organization responsible for performing the sampling.
- **PARAMETER MONITORED:** List sampling parameter measured:
  - Valid Values: Ammonia mg/L, Arsenic mg/L, Benthic invertebrate index B-IBI, Chemistry, Chlorophyll mg/L, Conductivity umhos/cm, Conventionals, Copper (total) µg/L, Copper (total) mg/L, Density mg/L, Dissolved oxygen mg/L, Emerging chemicals mg/L, Endocrine disruptors mg/L, Escherichia coli cfu/100 mL, Fecal coliform bacteria

col/100 mL, Flow rate cfs, Hardness mg CaCO3/L, Hazardous algal blooms, Hydrocarbons mg/L, Invasive species, Kjeldahl nitrogen mg/L, Lake level ft, Lead (total) µg/L, Lead (total) mg/L, Light transmission %, Mercury (total) mg/L, Metals, Microbiological, Nitrate mg/L, Nitrate - nitrite mg/L, Nitrite mg/L, Nitrogen (total) Unknown, Non-invasive species, Organics, Ortho-phosphate mg/L, PCBs mg/L, pH std units, Phaeopigment µg/L, Phosphorous (total) mg/L, Pressure mm/Hg, Salinity ppt, Secchi disk depth m, Silicate mg/L, Staff depth ft, Suspended solids mg/L, Temperature Degree C, Tin mg/L, Toxicity, Toxin accumulation, Turbidity NTU, Zinc (total) µg/L

- **PHYSICAL DESCRIPTION SAMPLE AREA:** description of sample area environment:
  - Valid Values: Atmospheric deposition, Domestic outfall, Domestic storm drain, Industrial outfall, Industrial storm drain, Marina, Marine vessel, Rainfall, River/Stream, Septic system, Surface water run-off, Fresh/surface water, Fresh/sub-surface water, Estuary, Nearshore/surface water, Nearshore/sub-surface water, Offshore/surface water, Offshore/sub-surface water, Slough, Lake
- **PROJECT IDENTIFIER:** Unique identifier code of study locations; could be used as unique identifier in a GIS attribute field.
- **PROJECT STATUS:** Current status description of the study:
  - Valid Values: Ongoing, Completed
- **QAPP (Y/N):** Identifies if the sampling study has a Quality Assurance Project Plan; which must follow the guidance of Ecology document 04-03-030, Guidelines for Preparing Quality Assurance Project Plans for Environmental studies or EPA document 841-B-96-003, The Volunteer Monitor's Guide to Quality Assurance Project Plans:
  - Valid Values: Y= Yes; N= No
- **QUALITY RATING:** Numeric quality rating assigned by Washington State Department of Ecology to assess the quality of monitoring data:
  - Valid Values: 1, 2, 3, 4
- **SAMPLING FREQUENCY:** Number of samples per unit of time during the period of study:
  - Example. 1/Month, Once, 20/year
- **SEASON(S) MONITORED:** Identifies season in which sampling occurred, Dry season=June- September, Wet season = October-May:
  - Valid Values: Dry, Wet, Dry/Wet
- **SOP/SAP (Y/N):** Identifies if the sampling study follows a Sampling and Analysis Plan (SAP); which must follow Model Toxics Control Act WAC 173-340-820 or Standard Operating Procedures:
  - Valid Values: Y=Yes, N= No
- **STUDY NAME:** Name of sampling study.
- **TISSUE/SEDIMENT SAMPLE:** Media sampled for aggregation of toxic pollutants; other than surface water:
  - Valid Values: TISSUE (e.g., fish or benthic macroinvertebrate), SEDIMENT
- **TYPE OF MONITORING:** Purpose for performing monitoring study, for long term monitoring, status purposes, or permitting:

  - Valid Values: Long-term, Status, Permit
- **WATER TYPE:** Type of water sampled:
  - Valid Values: Freshwater=FW/Marine=MW/Brackish=BW

The format of the data has been retained from the source database in order to reflect the organization of the stored information. It should be noted that the term 'Unknown' was used to describe data that was not immediately available from its source database. Data entries with the 'Unknown' designation indicate that additional searches were not performed to clarify whether the data gap exists as a result of: 1) data not being collected, or 2) data that was un-reported, but may be available elsewhere.

For presentation purposes only, the complete Table has been sorted and divided into three Excel worksheets (results, locations, & studies). Each of these worksheets is presented in Appendix B. The three worksheets are logically divided into three tables to describe the water quality monitoring data by the physical location of sampling (latitude/longitude, northing/easting, etc.), study information (organization responsible for monitoring, type of monitoring, etc.) and data results (parameters sampled, sampling dates, sampling frequency, etc.). The complete Table is submitted as a separate Excel file in an electronic format along with this report. The complete Table has been formatted to be easily imported into GIS to spatially display Snohomish County water quality monitoring data.

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# APPENDIX B.
# TABLE TEMPLATES

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