

# Using GIS to Inform and Manage Water Quality Improvement Actions

## Introduction

The Washington State Department of Ecology's Water Quality Program has authority for implementing the Federal Clean Water Act, including:

- Maintaining and updating the state water quality standards
- Conducting a water quality assessment
- Developing and implementing Total Maximum Daily Load (TMDL) projects
- Implementing the National Pollutant Discharge System (NPDES)

Ecology is accountable to the U.S. Environmental Protection Agency (EPA) for the regulatory work we do, and also to the public, to efficiently use public funds to improve water quality and provide information to residents about how the work we do affects them.

The Water Quality Program is investing in and improving its GIS assets. This may enable Ecology to better use its regulatory information to manage water quality improvement actions, and to communicate that information with stakeholders and the public throughout the state.

The process of improving water quality is complex and involves interpreting large amounts of data. This poster generally describes how these GIS assets are used to get from the identification of a polluted water body, to understanding where the pollution comes from, and then connecting the point and non-point sources of pollution to regulatory actions for clean up.

## 1 Water Quality Data Collection

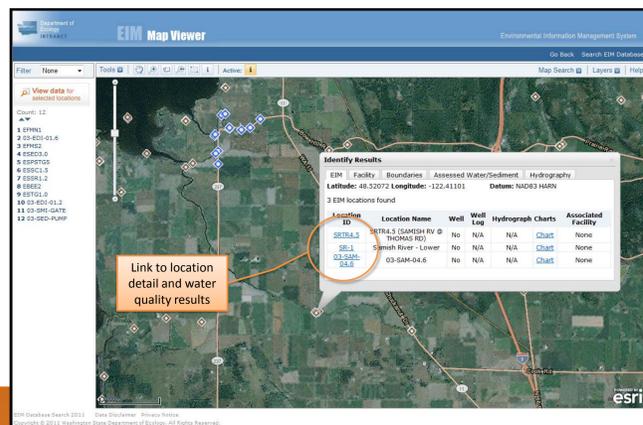
Everything begins with collecting water quality data. Ecology maintains the Environmental Information Management (EIM) system that houses all of the data (water, soil, air, and other types of environmental measurements) collected by Ecology and many other stakeholders throughout Washington State, and allows a user to query water quality data using a web form as well as the EIM Map Viewer.

EIM is publicly accessible on the internet ([www.ecy.wa.gov/eim/](http://www.ecy.wa.gov/eim/)).

Available EIM data includes:

- Project information
- Monitoring station locations<sup>1</sup> and descriptions
- Monitoring results, collection information, and data quality assurance information

Many of Ecology's databases utilize EIM's data for water quality investigations. Data from projects conducted by Ecology and paid for by Ecology grant money are required to be entered into EIM.



Link to location detail and water quality results

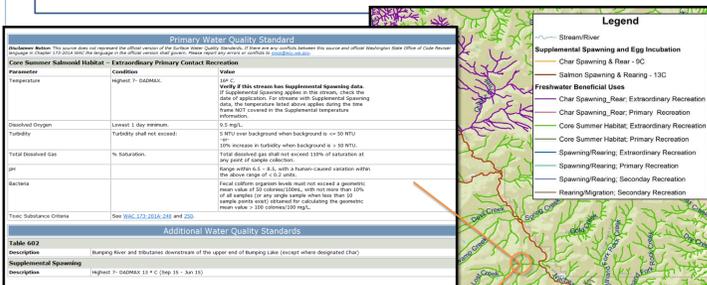
With the EIM Map Viewer, a user can search for an address location, the name of a city or county, latitude/longitude coordinates, and more to navigate to that area in the map window. The user queries data to find and display locations with results for certain pollutants or within a specific area. There are multiple GIS layers the user can turn on/off to help with their understanding of the landscape and resources

## 2 Surface Water Quality Standards

The surface water quality standards are the basis for protecting and regulating the quality of surface waters in Washington State such as rivers, lakes, estuaries and coastal waters. The standards specify designated and potential uses of water bodies in the state and set numeric criteria to protect those uses. Every surface water body has a set of designated uses that must be maintained to specific swimmable and fishable levels.

Ecology has GIS features representing the numeric water quality criteria for designated uses and special conditions. These features are used by Ecology staff to:

- Determine the effluent limits placed on NPDES permits
- Determine the numeric criteria on which to base a TMDL allocation
- Determine if water quality data shows a violation of the standards or not



Each stream segment has a beneficial use associated with it and a link to a web page with a table explaining the numeric criteria for that segment.

Identifying a stream will show the user the numeric criteria that apply to it

## 3 Water Quality Assessment

Every 2-4 years, Washington's Water Quality Assessment compiles a list of the status of water bodies in the state based on water quality data in EIM. The assessed waters are grouped into categories describing the water quality status compared to regulatory pollution control levels in the state's surface water quality standards. The impaired waters list (Category 5) is comprised of those waters that do not meet minimum pollution levels and are therefore not supporting the designated uses assigned to that waterbody (such as aquatic habitat, swimming, fishing, or shellfish harvesting). To determine impairments:

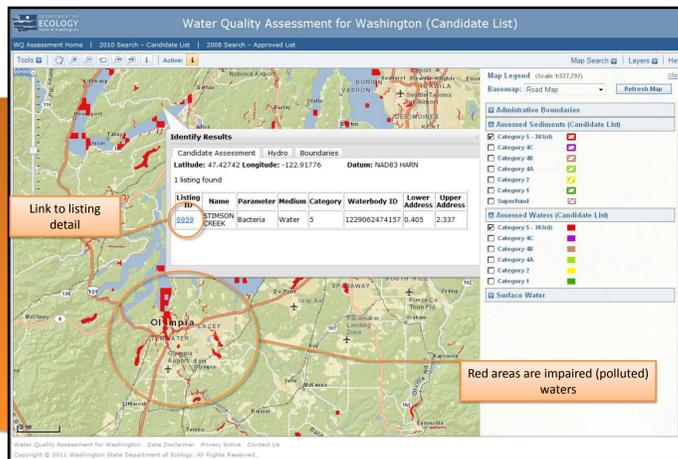
- A statewide call for water quality data to be submitted to EIM is made
- High quality data is analyzed and compared to the water quality standards. This work is completed using the Water Assessment Tracking System (WATS), a customized database and web map application
- NHD stream reaches are categorized by their level of impairment (range from good to polluted or "impaired") for specific pollutants

The water quality assessment GIS features<sup>1</sup> show the location and extent of all assessment listings, the pollutant, the category of impairment, the basis for the listing, and references to the source data in EIM.

These tools are available at: <http://www.ecy.wa.gov/programs/wq/303d/2010/index.html>

The public web map and data query form includes the capability to send Ecology comments on proposed listings during each assessment cycle.

The publicly available web map for the water quality assessment allows the user to find impaired waters near their area of interest. When features are identified, a link will take the user to more detailed information about the selected listings.



Link to listing detail

Red areas are impaired (polluted) waters

## 4 TMDL Project Development

GIS is an important tool for developing a TMDL project and is part of how Ecology identifies where TMDLs apply as regulatory features. The foundational water quality study for a TMDL project usually involves hydrologic modeling with inputs derived from GIS including: digital elevation models (DEMs), soil and geology features, stream channel geometry, precipitation, and land cover to name a few.

Some of the ways GIS is used in the development of TMDLs include:

- Designing water quality monitoring networks using GIS to determine the best monitoring locations. Land ownership boundaries, stormwater permit boundaries, and locations of NPDES permits are some of the key GIS features considered in the design of a monitoring network.
- Delineating riparian vegetation along river corridors and quantifying inputs to models that calculate the amount of riparian shade over a river or stream.
- Conducting analyses of land use and land cover data to identify current land uses that could be contributing to non-point source pollution in areas where water quality monitoring shows impairments. We use land use designations from the Statewide tax parcel GIS feature to inventory the land use types within a TMDL project area.



Stream locations and water quality results will also be uploaded into EIM as points.

Riparian mapping for a Stream Temperature TMDL Analysis to assess current conditions

Land use/cover analysis to determine what types of BMPs are needed

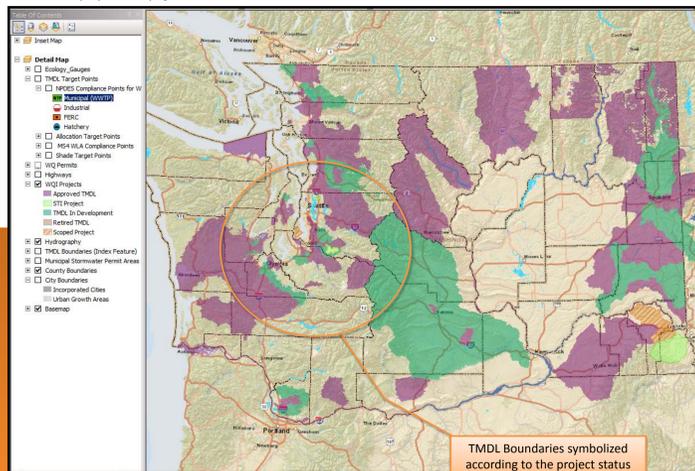
## TMDL GIS Features

Once a TMDL has been approved by the EPA, the TMDL boundary<sup>1</sup> becomes the key GIS feature showing the area where the TMDL applies. Land owners and stakeholders within that boundary will need to implement Best Management Practices (BMPs) to address land use problems that contribute to pollution; or NPDES permittees may need to apply further treatment to their effluent to reduce or eliminate their pollution from the water body.

Ecology utilizes TMDL boundaries in several ways:

- Identify where special conditions may apply to NPDES permittees
- Guide implementation of the TMDL and WQ improvement actions in the watershed
- Plan where new projects should be started next

TMDL Boundary features include attributes for the type and status of the project, the pollutants the project covers, and a link for the project web page where more detailed information can be found.



TMDL Boundaries symbolized according to the project status

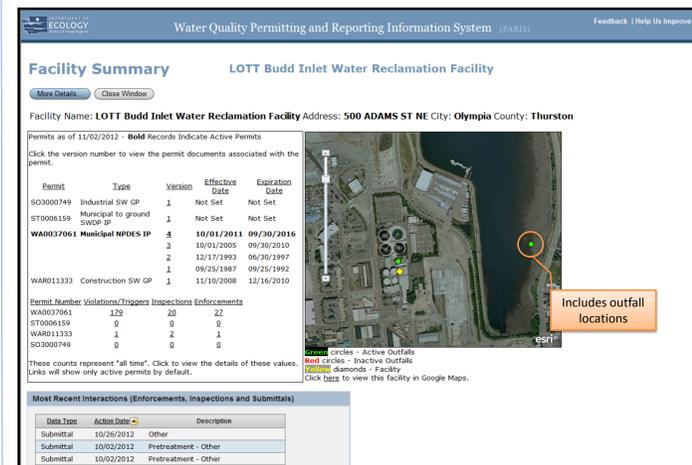
## 5 Permitting and Reporting Information System (PARIS)

PARIS is the database system Ecology uses to track and share information related to National Pollution Discharge Elimination System (NPDES) for individual permits and general permits including:

- Construction, Industrial, and Sand & Gravel Stormwater
- Concentrated Animal Feeding Operations (CAFOs)
- Fish Hatcheries
- Aquatic Pesticides

A user can search for a specific facility or type of permit and retrieve a report that includes a GIS-based map showing the facility location (available as the Facility/Site GIS feature<sup>1</sup>) and its outfalls. This information is valuable both to Ecology staff for regulatory business needs and to the public to determine what point sources affect their water bodies of interest.

PARIS is available at: <http://www.ecy.wa.gov/programs/wq/permits/paris/index.html>



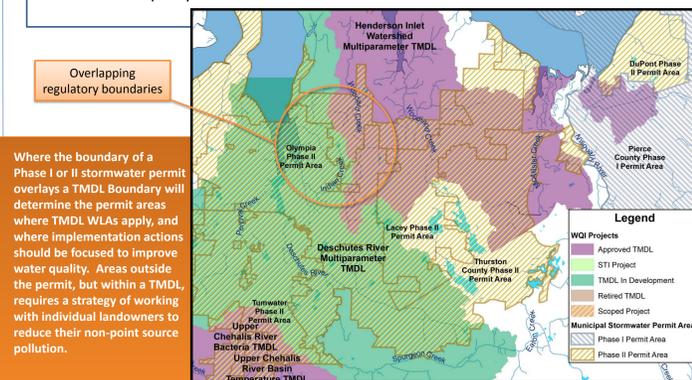
Includes outfall locations

Facility Reports include inset webmaps showing the facility and outfall locations along with vital facility information.

## Municipal Stormwater Permits

The municipal stormwater permit boundary feature is important for:

- Defining the area of responsibility for pollution reduction activities required under the Phase I and II Municipal Stormwater General Permit.
- Comparing with TMDL boundaries to identify areas where additional permit limits and actions (called wasteload allocations or WLAs) to protect water quality apply. A TMDL project sets pollutant WLAs so that stormwater discharges will not result in violations of water quality standards.



Overlapping regulatory boundaries

Where the boundary of a Phase I or II stormwater permit overlays a TMDL Boundary will determine the permit areas where TMDL WLAs apply, and where implementation actions should be focused to improve water quality. Areas outside the permit, but within a TMDL, requires a strategy of working with individual landowners to reduce their non-point source pollution.

Legend  
WQI Projects  
Approved TMDL  
STI Project  
TMDL in Development  
Retired TMDL  
Scoped Project  
Municipal Stormwater Permit Area  
Phase I Permit Area  
Phase II Permit Area

## Future Plans

While not all of this information is publicly available at this time, over the next several years the Water Quality Program will continue to improve its public web maps and data query tools to put this data into the hands of the public, watershed stakeholders, and state and local government. This will better inform decisions that prevent, control, and reduce water pollution in the state.

Future improvements and additional GIS data will include:

- A public version of the Water Quality Atlas
- TMDL related GIS features including waste load allocation target points and numeric
- Expansion of Municipal Stormwater Permittee information in PARIS
- GIS features for the water quality standards including the beneficial uses and supplemental spawning period features
- GIS features depicting groundwater nitrate impacted areas

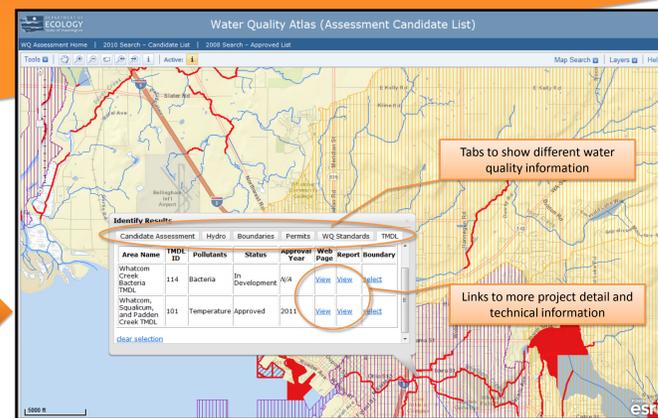
## 6 Water Quality Atlas

In 2012, the Water Quality Atlas was released to Ecology staff. It is a webmap tool that combines all of the GIS features discussed above and allows an Ecology user to identify multiple water quality regulatory attributes for a user-specified location.

The atlas is used by permit managers, TMDL coordinators, and others at Ecology to identify the regulatory features that must be considered for:

- Administering permits
- Developing TMDL projects
- Identifying polluted waters that affect their project areas

When a point is identified on the map, a pop up box opens, and the user can click on the different tabs to view summaries of those data layers, and link to more detailed information on the web.



Tabs to show different water quality information

Links to more project detail and technical information

The Water Quality Atlas gives map users a summary of water quality regulatory information for any location on the map.

## Footnote:

<sup>1</sup> GIS data features can be downloaded at: <http://www.ecy.wa.gov/services/gis/data/data.htm>