Recommendations and Tools for Developing TMDL Effectiveness Monitoring Plans

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“Effectiveness Monitoring”

- The process of measuring improvements in the water quality of a water body.
- Not to be confused with BMP effectiveness, which measures the success or effectiveness of the BMPs themselves.
- The primary goal of TMDL effectiveness monitoring is to identify water quality improvements (or lack thereof) that result from TMDL implementation.

Steps for Designing a TMDL Effectiveness Monitoring Plan

1. Review existing data and information.
2. Select monitoring sites, parameters, and study design.
3. Estimate sample size.
4. Develop TMDL effectiveness monitoring plan.

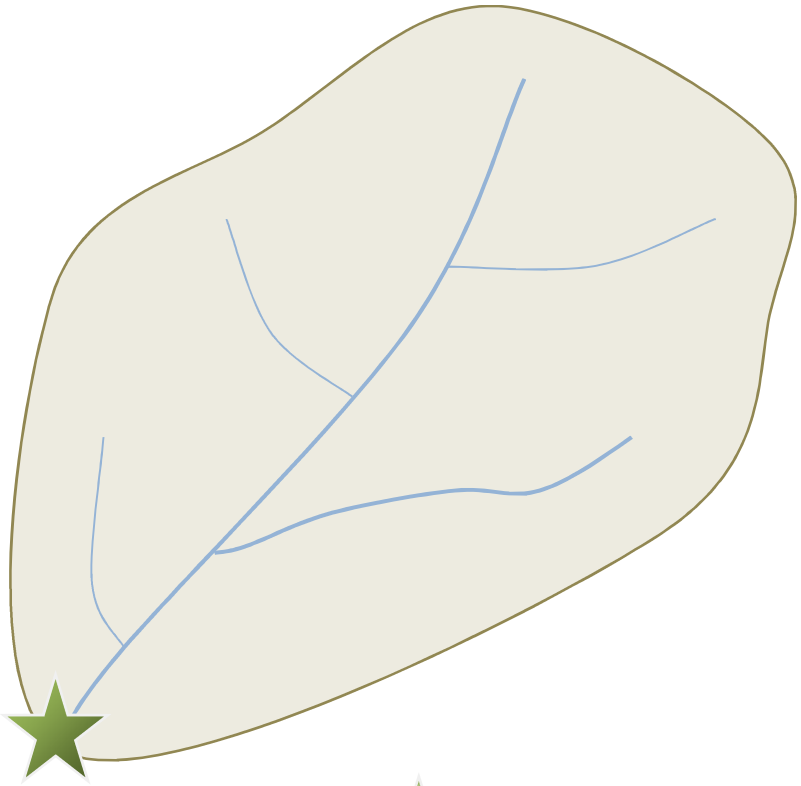
Review Existing Data and Information

- Begin with thorough review of all available information that may direct the process.
- Existing data and information will provide an understanding of:
  - Historical and current water quality conditions.
  - TMDL implementation activities.
- Involve stakeholders early.

Select Monitoring Sites, Parameters, and Study Design

- Design effectiveness monitoring projects at the watershed scale.
  - Specific project scale should be decided upon using information on the number and extent of impaired or threatened waters, project resources, and project partners.
- Watershed scale effectiveness monitoring:
  - Pour point method
  - Distributed sampling method

Site Selection Approach: Pour Point Method



Monitoring Site

Site Selection Approach: Distributed Sampling Method

Site Selection

- Locate monitoring sites where TMDL implementation is expected to have discernible water quality effects.
- Examples include sites on impaired/degraded water bodies that are downstream of:
  - WWTFs with new or revised WLAs.
  - Discontinued illicit discharges.
  - NPS that are managed through BMPs.
  - Stream channel restoration projects.
  - Improved onsite wastewater management or expansion of sanitary sewer service.
  - Other TMDL-related pollutant reduction measures.
- Evaluate existing monitoring network or sites.

Parameters

- Monitor the pollutants for which the TMDL was developed.
- Monitor for stressor and/or response variables, which provide additional information about the condition of a water body.
- Monitor parameters that may be covariates to the primary pollutants of interest.
  - Stream flow is a common covariate for pollutants in streams and rivers.

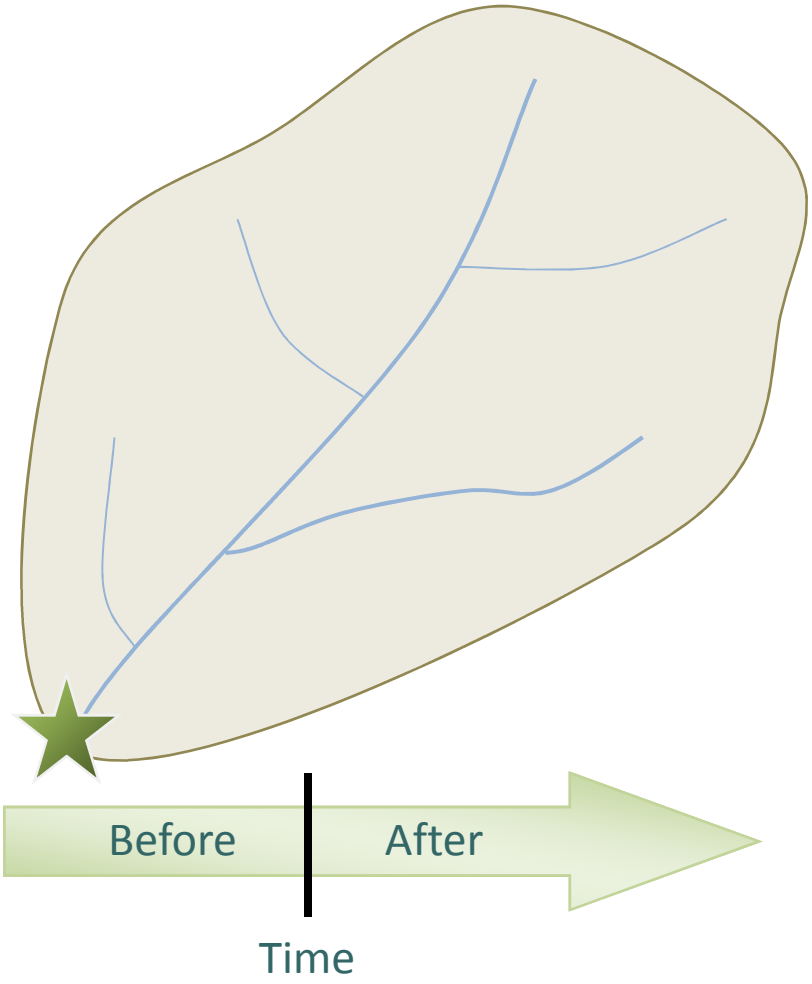
Study Design

- Outlines how water quality improvements will be demonstrated.
- Critical to ensuring the collection of the specific data needed to answer the study questions/goals.
- Selection is dependent on many factors, including:
  - Types of TMDL implementation actions.
  - Implementation schedule.
  - Availability and quality of previously collected data
  - Resources.
  - Existence of suitable reference sites.

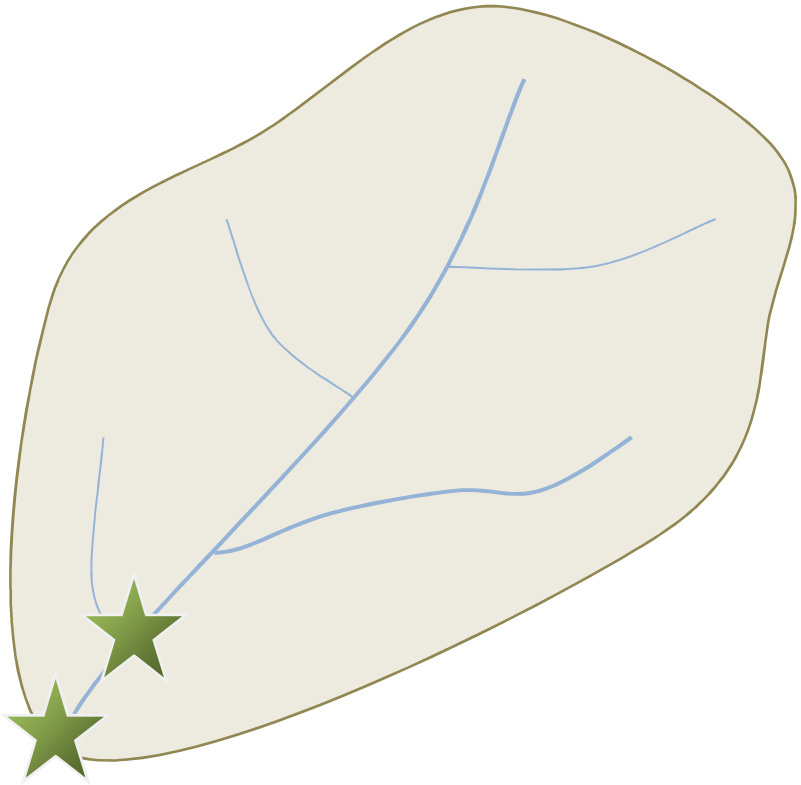
Study Design Examples

- Before & After
- Upstream/downstream
- Paired watersheds
- Trend monitoring

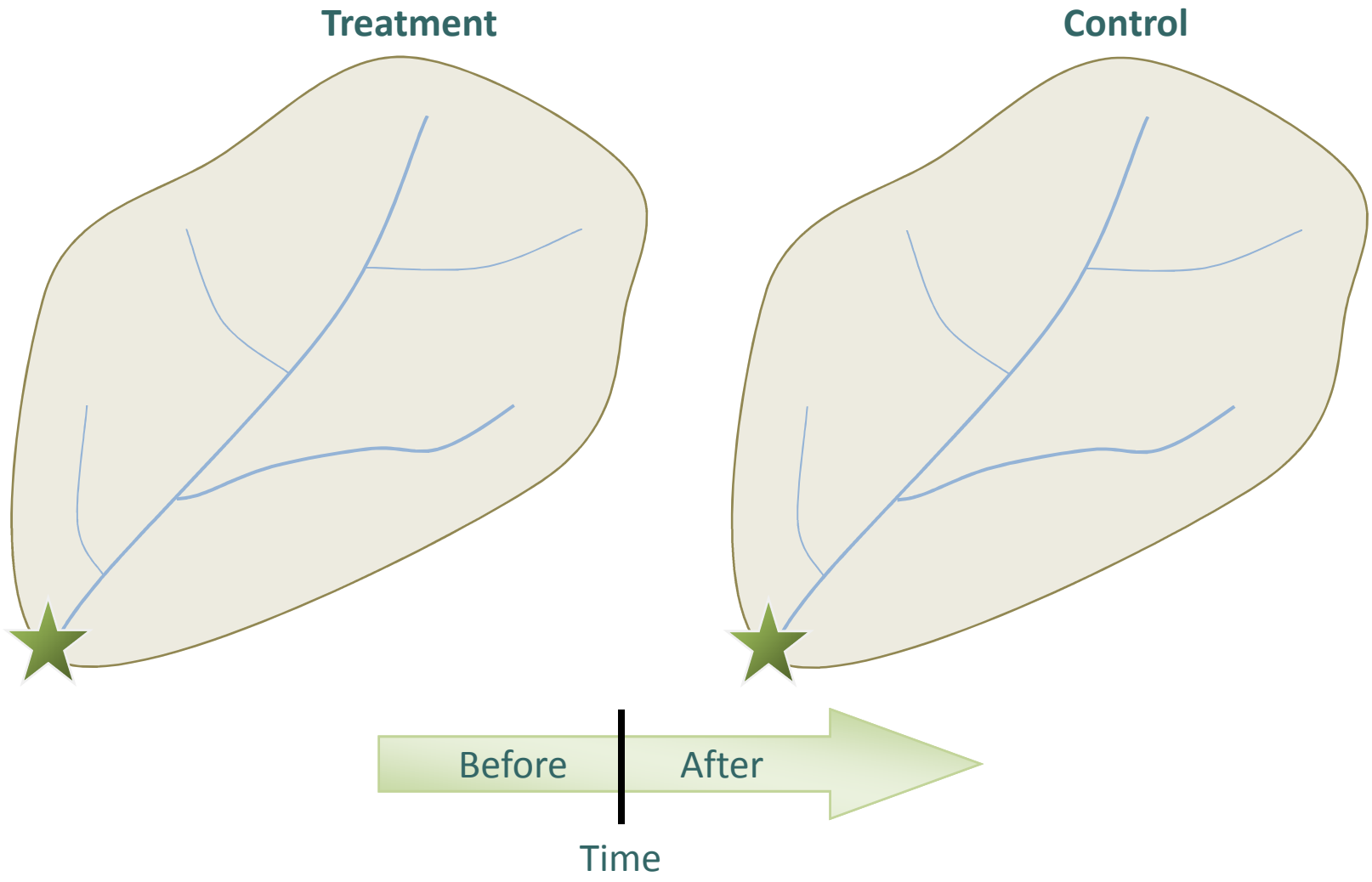
Study Design: Before/After Study



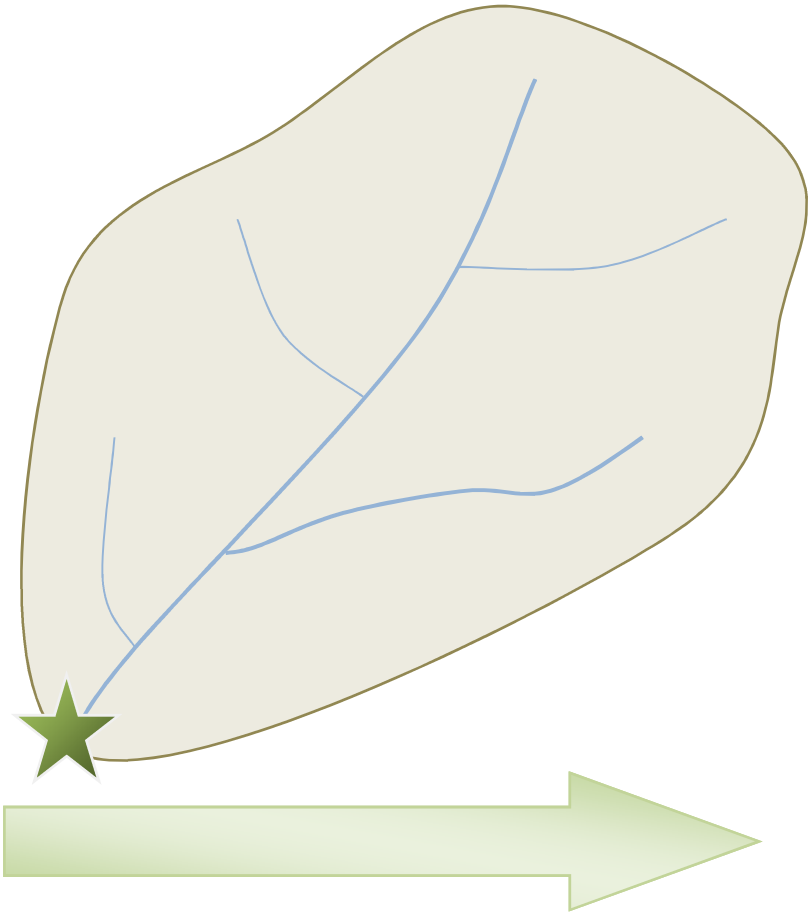
Study Design: Upstream/Downstream Study



Study Design:
Paired Watersheds Study



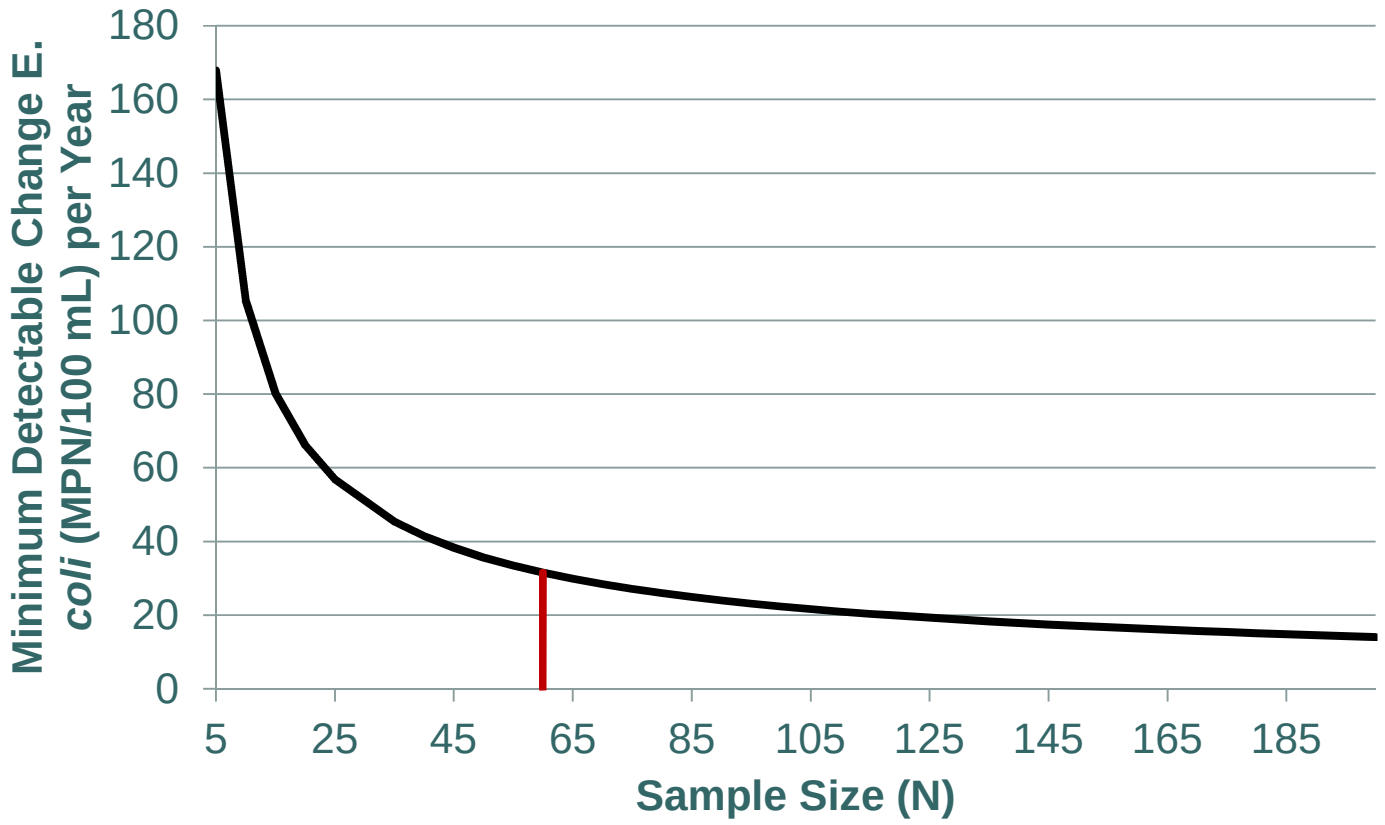
Study Design: Trend Monitoring



Estimate Sample Size

- Water quality data are often collected without considering the number of samples needed to demonstrate statistically significant changes.
- Objective and informed sample size decisions can be made using a statistical method known as power analysis.
- Power analysis uses information from pilot data to determine the optimal number of samples needed to identify statistically significant changes or trends.

Power Analysis



TMDL Effectiveness Monitoring Planning Tool

Data Exploration Worksheet - *Review pilot data summary statistics, histograms, seasonality, autocorrelation, and potential covariates.*

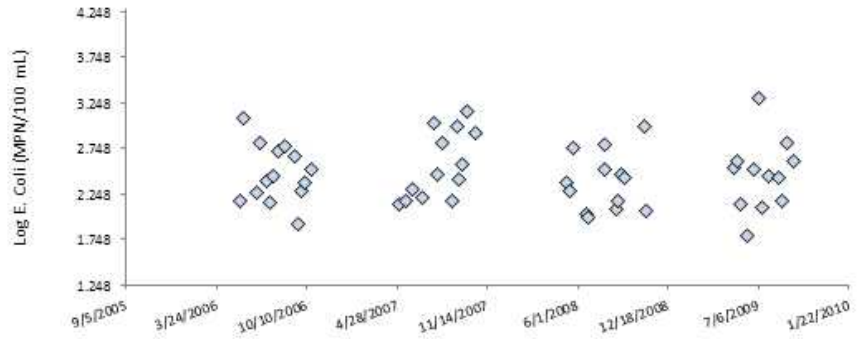
Step 1.

Select a Water Quality Parameter & Data Transformation Option - *Summary statistics and a time series plot for the selected parameter are provided below.*

Parameter: E. Coli

Data Transformation: ○ None ○ Log (x+1) ○ Square Root ◉ Logarithm ○ Square ○ Reciprocal Root

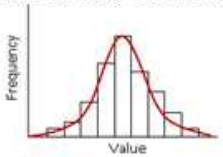
Number of Samples	52
Minimum	1.783
Maximum	3.298
Mean	2.4637
Median	2.426
25th Percentile	2.173
75th Percentile	2.725
Standard Deviation	0.3452



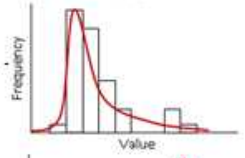
Step 2

Review the Histogram - *Does it take on the characteristic "bell" shape of normally-distributed data or appear highly-skewed? How does the skewness change when a data transformation is applied? If the data appear normally distributed, a parametric statistical test may be appropriate for evaluating post-TMDL water quality change.*

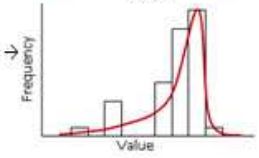
Histogram showing normal distribution →

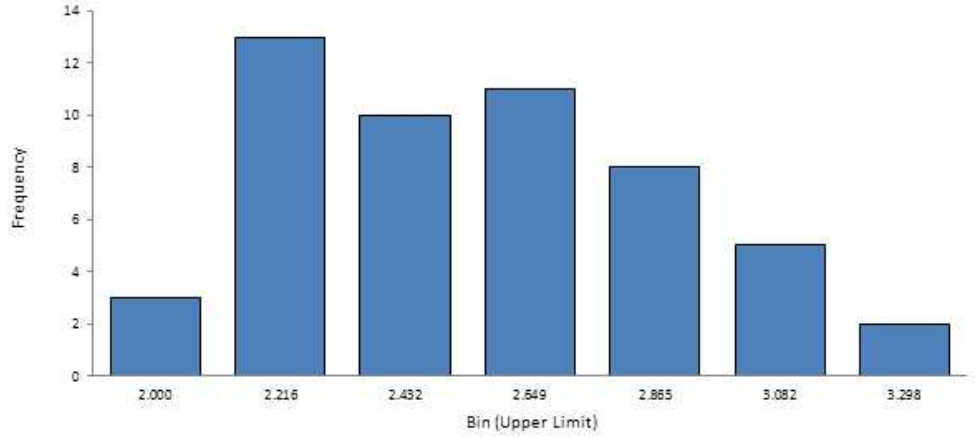


Histogram showing right-skewed distribution →



Histogram showing left-skewed distribution →





Develop TMDL Effectiveness Monitoring Plan

- Steps for planning a TMDL effectiveness monitoring project:
  1. Review existing data and information.
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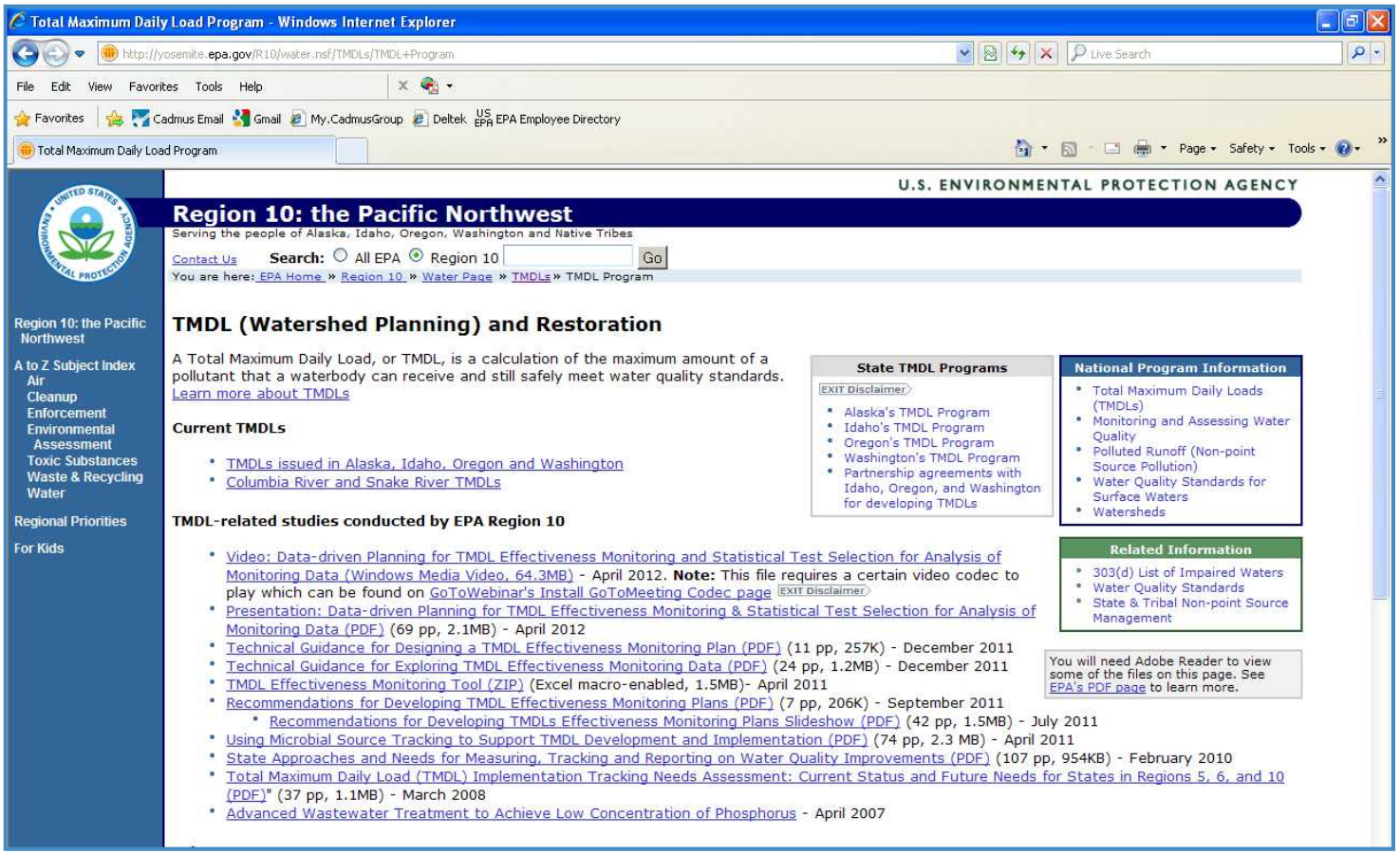
Develop TMDL Effectiveness Monitoring Plan (cont.)

- The planning document should include:
  - Relevant background information.
  - Project goals and objectives.
  - Where and when monitoring will occur.
  - List of parameters to be monitored.
  - Preliminary discussion of intended data analysis methods, including selected level of significance.
- The TMDL effectiveness monitoring plan can be incorporated into a QAPP.

More Information

EPA Region 10 website:

http://yosemite.epa.gov/R10/water.nsf/TMDLs/TMDL+Program



Questions?

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