

“Purdue Load Duration Curve Tool (P-LDC) using WQX and USGS data flows.”

**Larry Theller , Bernie Engel, Youn Shik Park
for**

Purdue University ABE and Office of Indiana State Chemist
September 27–28, 2012

**EPA Grant Number – Program Code, Number, and Amendment Number:
OS – 83609801 – 0**

Quotes from the grant text:

Abstract:

This project will connect the Purdue *Flow and Load Duration Curve* tool, which is a tool used in constructing TMDLs, to data from WQX.

This enhancement to an existing tool will allow users to simultaneously consume USGS flow data, WQX water quality data, EPA Waters web services (GIS data)...

The project meets strategic goals for EPA, and in particular for the Exchange Network ...

Define some Terms:

STORET and WQX

<http://www.epa.gov/storet/wqx/>

Water Quality Portal USGS/EPA/NWQMC

<http://www.waterqualitydata.us/index.jsp>

STEP-L

<http://it.tetrattech-ffx.com/steplweb/>

LOADEST

<http://water.usgs.gov/software/loadest/>

The STORET Data Warehouse is EPA's repository of the water quality monitoring data collected by water resource management groups across the country.

These organizations, including states, tribes, watershed groups, federal agencies, volunteer groups and universities, submit data to the STORET Warehouse in order to make their data publically accessible.

Data can then be re-used for analysis. WQX is the framework by which organizations submit data to the Warehouse.

What is WQX?

The Water Quality Exchange (WQX) is a new framework that makes it easier for States, Tribes, and others to submit and **share** water quality monitoring data over the Internet.

States, Tribes and other organizations can submit data directly to the publicly-accessible STORET Data Warehouse using the WQX framework.

Several methods exist to have map-based query access to this data.

My WATERS Mapper | WATERS | US EPA - Mozilla Firefox

File Edit View History Bookmarks Tools Help

LOADEST My WATERS Mapper | WATERS | US E... x +

watersgeo.epa.gov/mwm/ my waters mapper

Streets Imagery Topography

Go To: State, zip, address Go

Address or Location

Latitude: 41.6140 Longitude: -87.3583

Water Impairments

Water Monitoring Data

Other EPA Water Data

- ☒ Watershed Boundaries (WBD)
- ☐ Legacy Watersheds
- ☐ National Wetland Inventory (NWI)
- ☐ Impaired Waters
- ☐ Assessed Waters
- ☐ Waters with TMDLs
- ☐ Beaches

Water Quality Monitoring

- ☒ STORET Water Monitoring Stations

Permitted Facilities

Layer Details

Watershed Boundaries (WBD)

Watershed boundaries define the area where surface water will drain to a certain point. This map displays data from the national Watershed Boundary Dataset, which establishes a standard drainage boundary framework for the whole U.S. At lower zoom levels, users will see successively smaller watersheds.

Watershed Boundaries HUC2 through HUC12

This layer is visible at all map scales

0% Transparency 100%

Go To Program Website Turn Off this Layer

Text View of Data

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Last updated on Wednesday, May 09, 2012

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UNITED STATES • EPA

<http://watersgeo.epa.gov/mwm/>

The Water Quality Portal (WQP) is a cooperative service sponsored by the United States Geological Survey (USGS), the Environmental Protection Agency (EPA) and the National Water Quality Monitoring Council (NWQMC) that integrates publicly available water quality data from the USGS National Water Information System (NWIS) and the EPA STORage and RETrieval (STORET) Data Warehouse.

The screenshot shows a web browser window displaying the NWQMC Water Quality Portal. The browser's address bar shows the URL <http://www.waterqualitydata.us/index.jsp>. The page features a blue header with the NWQMC logo on the left and the text "NATIONAL WATER QUALITY MONITORING COUNCIL" on the right. Below the header is a large banner image of a sunset over water. The main content area has a large "WQP" watermark and the title "Water Quality Portal". A descriptive paragraph states: "The Water Quality Portal (WQP) is a cooperative service sponsored by the United States Geological Survey (USGS), the Environmental Protection Agency (EPA), and the National Water Quality Monitoring Council (NWQMC)." Below this, there are three main sections: "DOWNLOAD DATA" with a link to download data in Excel, CSV, TSV, and KML formats; "HOW TO USE THE WQP" with links to User Guide, Web Services Guide, FAQs, and Upload Data; and "NATIONAL RESULTS COVERAGE" with a link to view water-quality data in your state. A fourth section, "ABOUT THE WQP", is partially visible at the bottom.

Most Visited Theller, GIS Specialist Driftwatch - Home HEM Tool MyCDX Compiling on Unix ...

NWQMC

NATIONAL WATER QUALITY MONITORING COUNCIL

Working Together

WQP

Water Quality Portal

The Water Quality Portal (WQP) is a cooperative service sponsored by the United States Geological Survey (USGS), the Environmental Protection Agency (EPA), and the National Water Quality Monitoring Council (NWQMC).

DOWNLOAD DATA

Download water-quality data in Excel, CSV, TSV, and KML formats.

HOW TO USE THE WQP

- User Guide
- Web Services Guide
- FAQs
- Upload Data

NATIONAL RESULTS COVERAGE

Water-quality data in your state.

ABOUT THE WQP

<http://www.waterqualitydata.us/index.jsp>

NATIONAL WATER QUALITY MONITORING COUNCIL



Working Together for Clean Water

WQP

Water Quality Portal

WQP Home
[Download Data](#)
How to use the WQP
[User Guide](#)
[Web Services Guide](#)
[FAQs](#)
[Upload Data](#)

National Results Coverage
About the WQP

[What is the WQP?](#)
[Contributing organizations](#)
[Contact us](#)

LOCATION

Country: [select](#)
 State: [select](#)
 County: [select](#)

Point location: ?

Within: miles from:
 Lat: Long:
[my location](#)

Bounding box: ?

North:
 West: East:
 South:

SITE PARAMETERS

Site Type: [select](#)
 Organization ID: [select](#)
 Site ID: ?
 HUC: ?

SAMPLING PARAMETERS

Sample Media: [select](#)
 Characteristic Group: [select](#)
 Characteristics: [select](#)
 Parameter Code: (NWIS ONLY) ?
 Date range: from to (mm-dd-yyyy)

DOWNLOAD

Select database: ☒ All databases ☐ USGS NWIS only ☐ EPA STORET only
 Select data: ☒ Sites only ☐ Sample results only

Water Quality Portal - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Water Quality Portal

www.waterqualitydata.us/portal.jsp#

Most Visited Theller, GIS Specialist Driftwatch - Home HEM Tool MyCDX Compiling on Unix — ...

Water Quality Portal

WQP Home
Download Data
How to use the WQP

User Guide
Web Services Guide
FAQs
Upload Data

**National Results Coverage
About the WQP**

What is the WQP?
Contributing organizations
Contact us

LOCATION

Country: [select](#)
 State: [select](#)
 County: [select](#)

Point location: ?

Within: miles from:
 Lat: Long:
[my location](#)

Bounding box: ?

North:
 West: East:
 South:

SITE PARAMETERS

Site Type: [select](#)
 Organization ID: [select](#)
 Site ID: ?
 HUC: ?

SAMPLING PARAMETERS

Sample Media: [select](#)
 Characteristic Group: [select](#)
 Characteristics: [select](#)
 Parameter Code: (NWIS ONLY) ?
 Date range: from to (mm-dd-yyyy)

DOWNLOAD

Select database: ☒ All databases ☐ USGS NWIS only ☐ EPA STORET only
 Select data: ☒ Sites only ☐ Sample results only

Download tabular data:
 File format:

☐ Comma-separated
☐ Tab-separated
☒ MS EXCEL (Excel 2003 and earlier versions have a limit of 65,536 rows. If your download exceeds this limit, only the first 65,536 rows will open.)

Download map data:
 File format:

☐ KML (Keyhole Markup Language - this is available for Sites only)

[Show data on Google Maps](#) Google Maps limits the number of sites shown to a maximum of 1000. It will also time out if the query is slow.

DOWNLOAD



United States Environmental Protection Agency

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STEPL Data Server for
Sample Input Data

Models and
Documentation

Frequently Asked
Questions

You are here: [EPA Home](#) » STEPL

Share

Welcome to STEPL and Region 5 Model



Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses.

It calculates the load reductions that would result from the implementation of various best management practices (BMPs).



LOAD ESTimator (LOADEST) is a FORTRAN program for estimating constituent loads in streams and rivers.

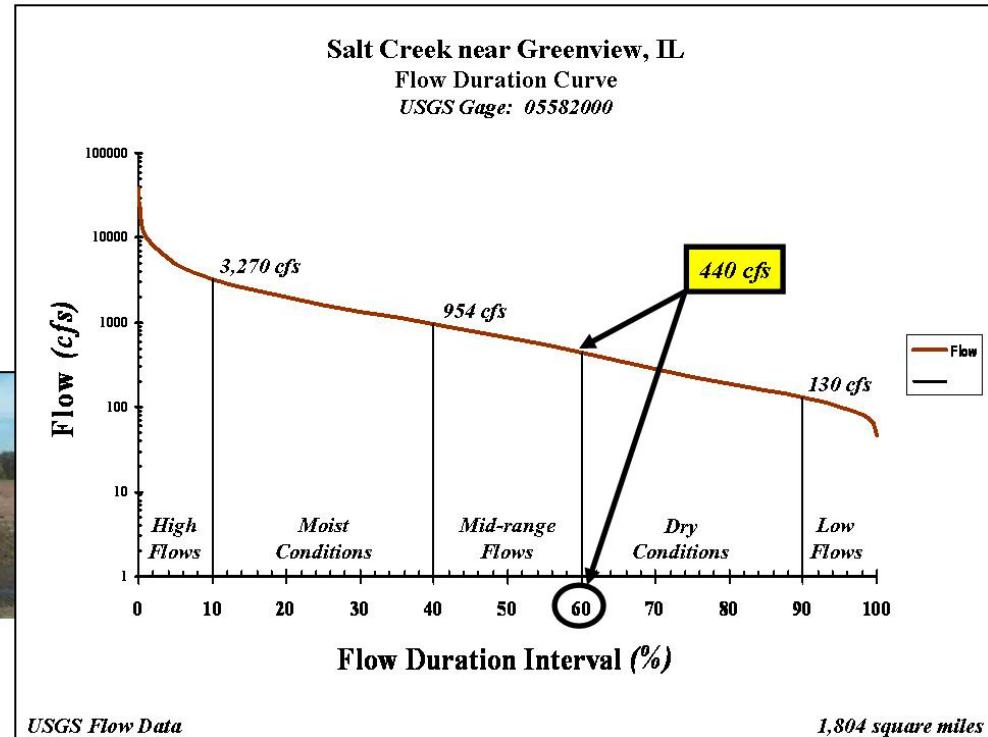
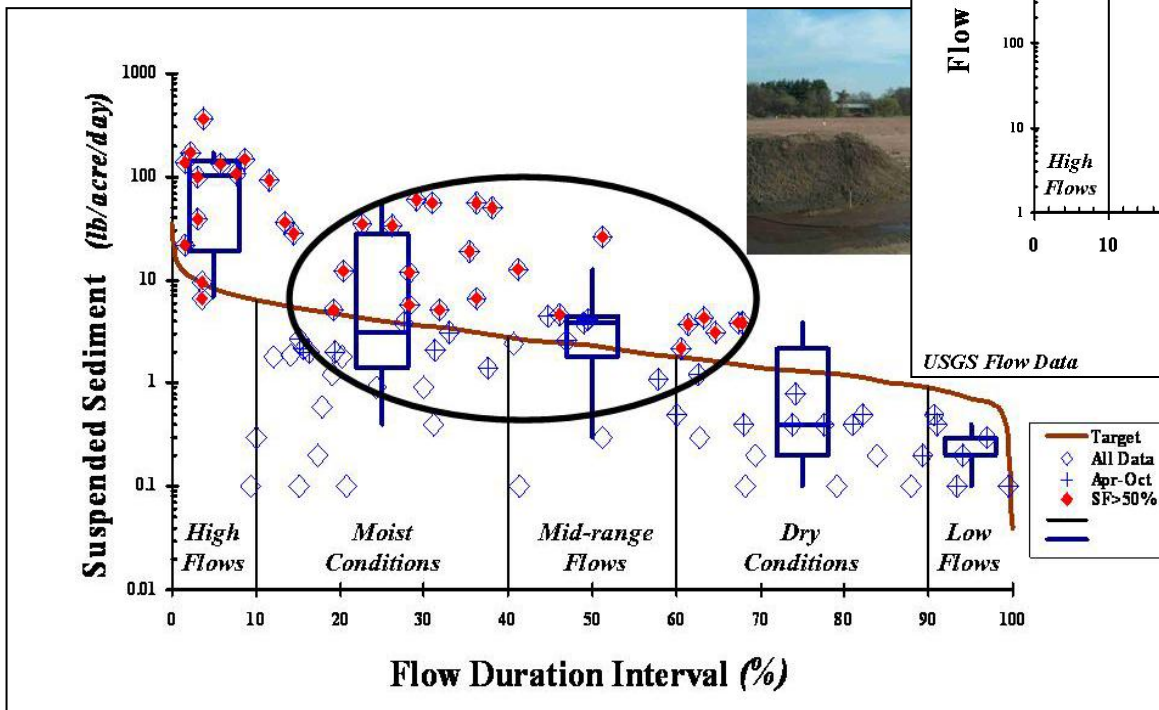
Given a time series of streamflow, additional data variables, and constituent concentration, LOADEST assists the user in developing a regression model for the estimation of constituent load (calibration).

The formulated regression model then is used to **estimate loads over time** .

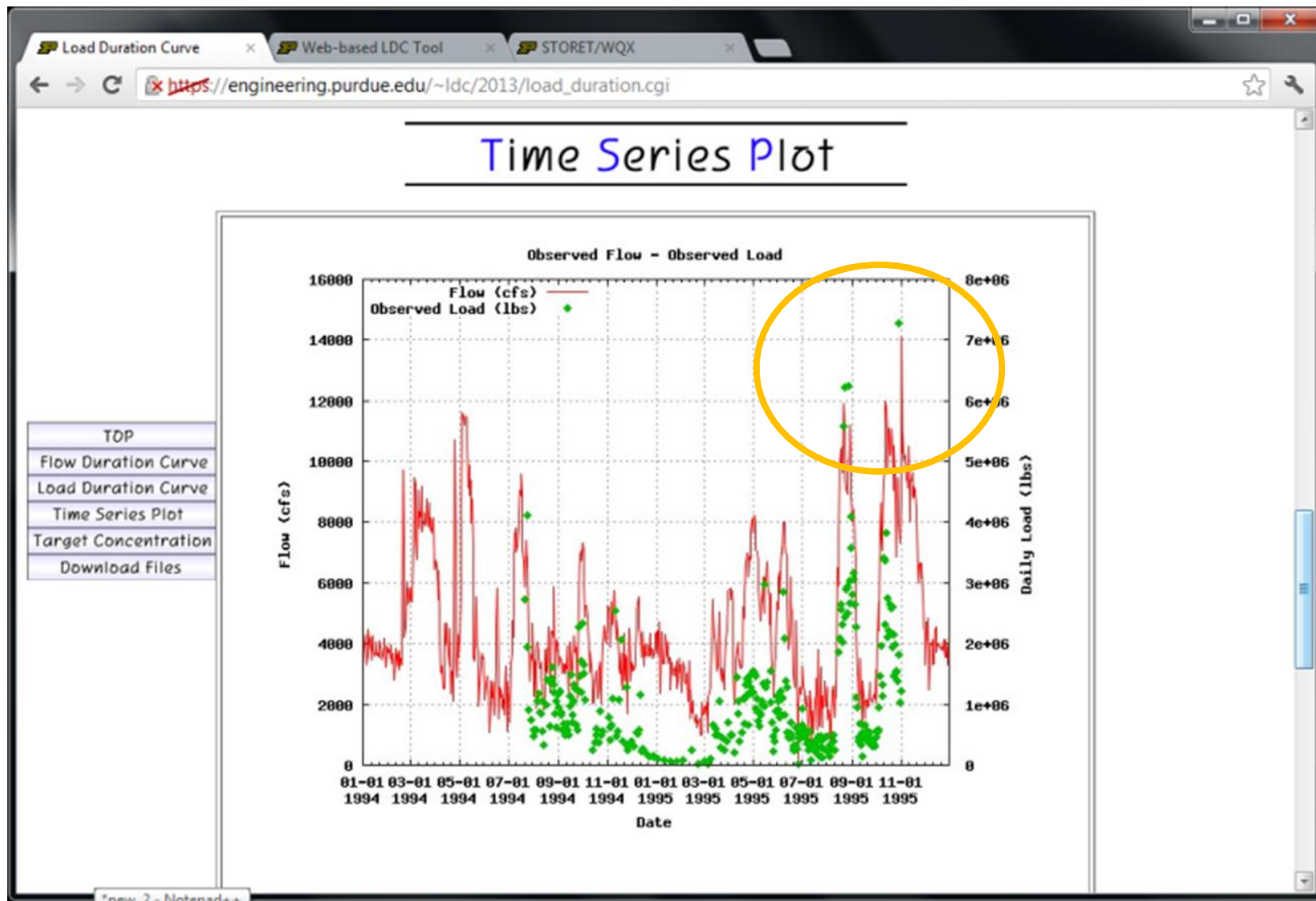
Mean load estimates, standard errors, and 95 percent confidence intervals are developed on a monthly and(or) seasonal basis.

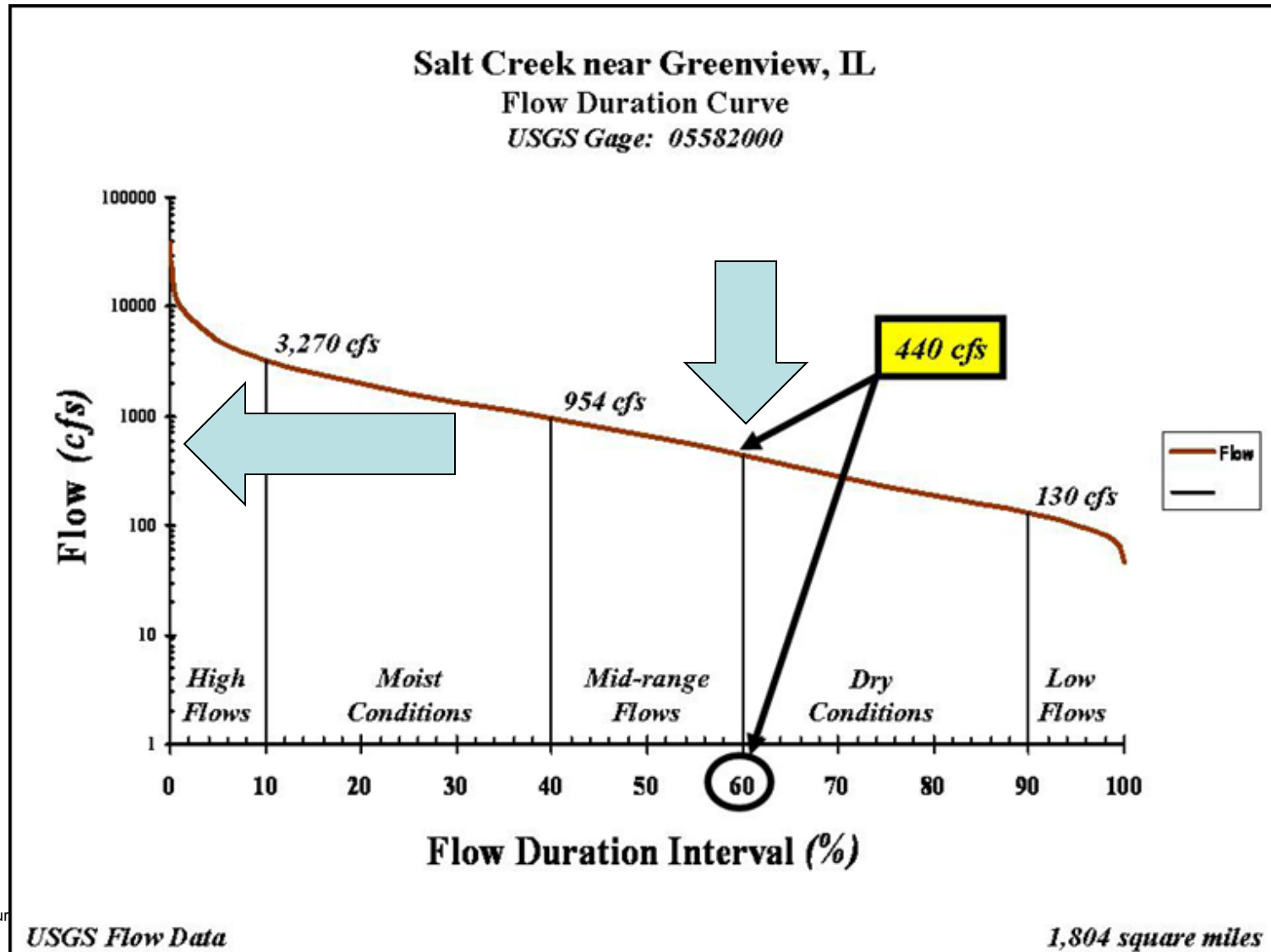
Flow and Load Duration Curves

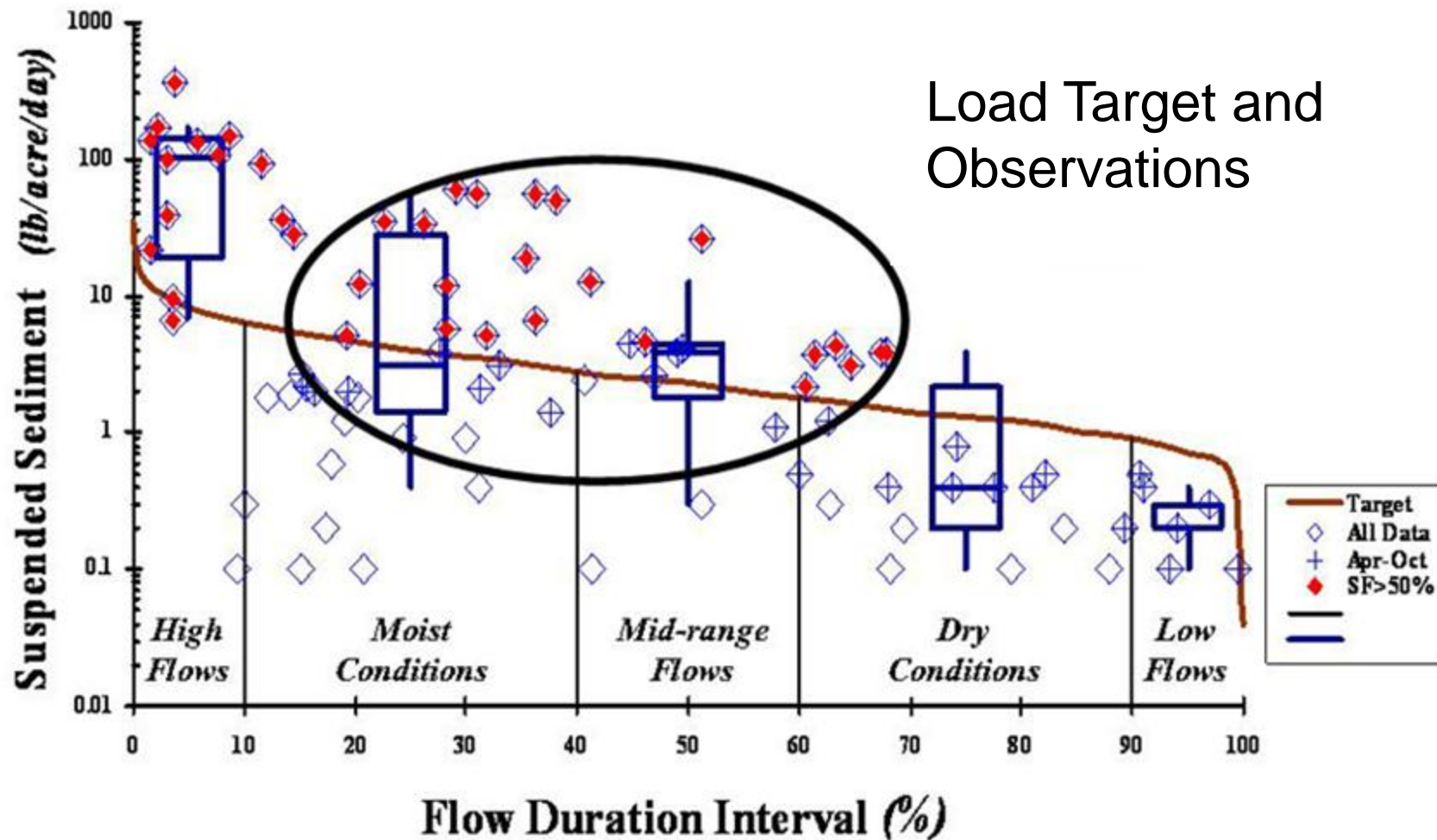
- Simple, quick, and statistical approach
- Cumulative frequency of historic data over a specified period

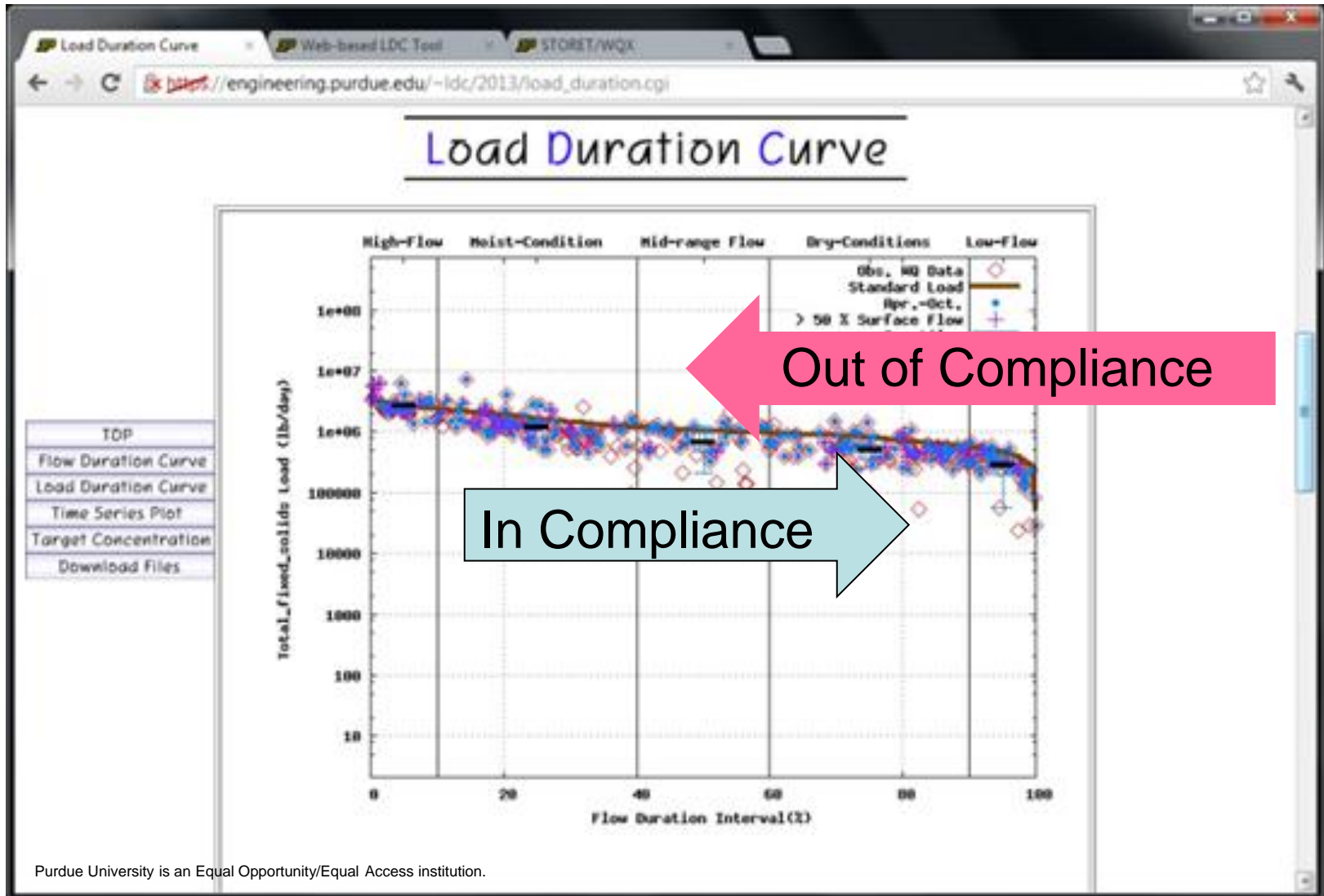


* USEPA, 2007. An approach for using load duration curves in the development of TMDLs. U. S. Environmental Protection Agency

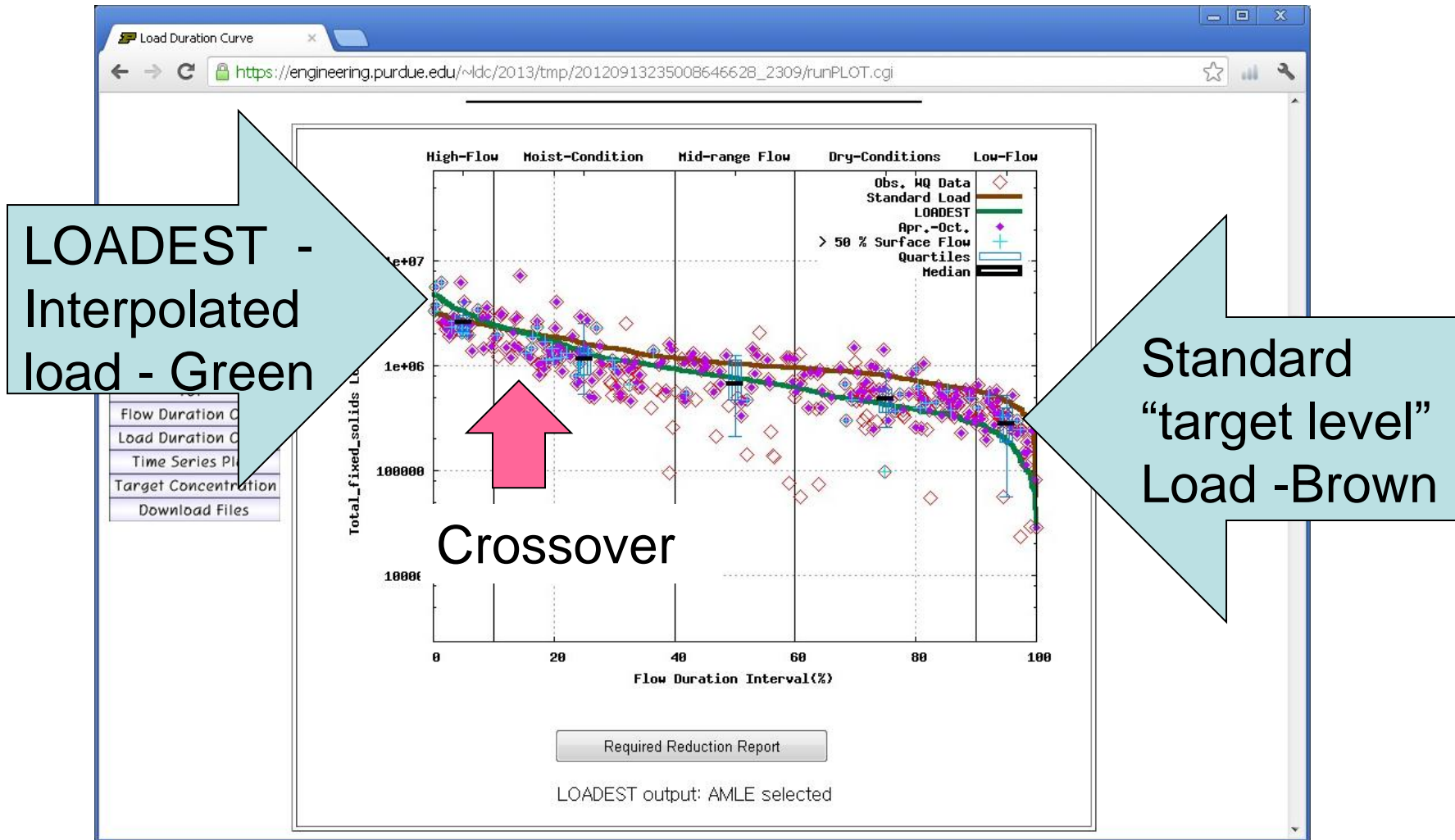








STEPL BMP Advisor Module for Web-based LDC Tool



Web-based LDC Tool and STORET/WQX

Form:

- Column 1: Date [yyyy-mm-dd hh:mm:ss] m/d/yyyy-mm-dd/yyyy-mm-d
- Column 2: Time in 24-hour clock [hh:mm]
- Column 3: Concentration in selected unit
- If the dataset doesn't have Time information, use only Date and Concentration

Date (Time) Concentration: mg/l

Opt. 1a. EPA My WATERS Mapper

Opt. 1b. Upload File from EPA

or

Opt. 2. USGS Gage Location Tool

or

Opt. 3. Upload Your File

or

Opt. 4. STORET

Parameter Name:

Target Concentration: 0.5 mg/l

Flow Data Table

Form:

- Column 1: Date [yyyy-mm-dd hh:mm:ss] m/d/yyyy-mm-dd/yyyy-mm-d
- Column 2: Flow in selected unit

Date Flow: cfs

Opt. 1. USGS Gage Location Tool

or

Opt. 2. Upload Your File

Drainage Ratio: 1.0

Flow Duration Curve (only)

Continue (Select Dates)

Developed by the Agricultural and Biological Engineering Department at Purdue University and the Department of Regional Infrastructure Engineering at King Fahd University of Petroleum & Minerals

Contact Dr. Benita Egan for more details (began code and help for the same LDC Tool)

Prepared by Linda D. Pyle, Purdue University Research Assistant

STORET Data Warehouse Access

About STORET / WQX

Data download

Online Tutorials

Data Submittal

Useful Internet Links

Support

Tools/ Web Services

Frequent Questions

Helpdesk

Sitemap

STORET data available on the Internet is divided into two separate databases, according to when it was originally supplied to EPA, and to which of our two STORET databases it was originally archived. We call the more current database the **STORET Data Warehouse** and the older of these two databases the **STORET Legacy Data Center** (LDC for short).

Features

- EnviroMapper for Water Watershed Summary
- Surf your Watershed
- EPA Substance Registry System
- Latest on Data Warehouse

The STORET Data Warehouse

All data supplied to EPA since January 1, 1999 have been placed in the STORET Data Warehouse. A full description of the design of this system can be examined on our [introduction](#) page.

The STORET Data Warehouse is currently receiving new data on a regular basis, including data being submitted via WQX, and will continue to do so for the foreseeable future. Downloads performed for the same sites may differ over time as a result of the addition of new data by their owners.

**Browse or Download
Modernized STORET Data**

STORET Legacy Data Center

Data supplied to EPA before 1999 were all placed in Legacy STORET. This system, designed in the 1960s, was a pioneer in the long term archival of field water monitoring results.

Web-based LDC Tool

https://engineering.purdue.edu/~ldc/2013/

PURDUE UNIVERSITY

Web-based LDC Tool

Web-based Load Duration Curve Tool ver. 2013

KNU KANGWON NATIONAL UNIVERSITY

Water Quality Data Table

Format :

- Column 1: Date (yyyy-mm-dd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d)
- Column 2: Time in 24-hour clock (hh:mm)
- Column 3: Concentration in selected unit
- If the dataset doesn't have 'Time' information, use only 'Date' and 'Concentration'.

Date	Time	Concentration	mg/l

Opt. 1a. EPA My WATERS Mapper

Opt. 1b. Upload File from EPA

or

Opt. 2. USGS Gage Location Tool

or

Opt. 3. Upload Your File

or

Opt. 4. STORET

Parameter Name :

Target Concentration : 0.5 mg/l

Flow Data Table

Format :

- Column 1: Date (yyyy-mm-dd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d)
- Column 2: Flow in selected unit

Date	Flow	cfs

Opt. 1. USGS Gage Location Tool

or

Opt. 2. Upload Your File

Drainage Ratio : 1.0

Flow Duration Curve (cfs)

Continue (Select Dates)

Developed by the Agricultural and Biological Engineering Department at Purdue University and the Department of Regional Infrastructures Engineering at Kangwon National University in South-Korea
Contact [Dr. Bernie Engel](#) for more details if you need any help for Web-based LDC Tool.
Programmed by [Youn Shik Park](#), Purdue University Research Assistant

To plot Load Duration Curve (LDC), two data sets are required.

- **water quality (WQ)**
- **flow data.**

This table is for **WQ** data.

This table is for **flow** data.

Water Quality Data Table

- Column 1: Date [yyyy/mm/dd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Time in 24-hour clock [hhmm]
- Column 3: Concentration in selected unit
- If the dataset doesn't have 'Time' information, use only 'Date' and 'Concentration'.

Date	(Time)	Concentration	mg/l
------	--------	---------------	------

Opt. 1a. EF/M

Opt. 1b. Upload

Opt. 2. USGS Gage Location Tool

Opt. 3. Upload

Opt. 4. STORET

Parameter Name

Target Concentration :

Option 1.

Use EPA MyWaters:
Download the data from
EPA WQP, and load it into
LDC tool.

Option 2.

Find the location on *LDC Window to USGS Map*, which will access USGS WQ and flow at once.

Option 3.

Upload your own formatted CSV file.

Option 4.

Use EPA STORET Data Warehouse

Option 5.

“Copy and paste” your own observed data from a formatted spreadsheet. (e.g. Microsoft Excel)

Option 1. EPA **WQ** data



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SEARCH

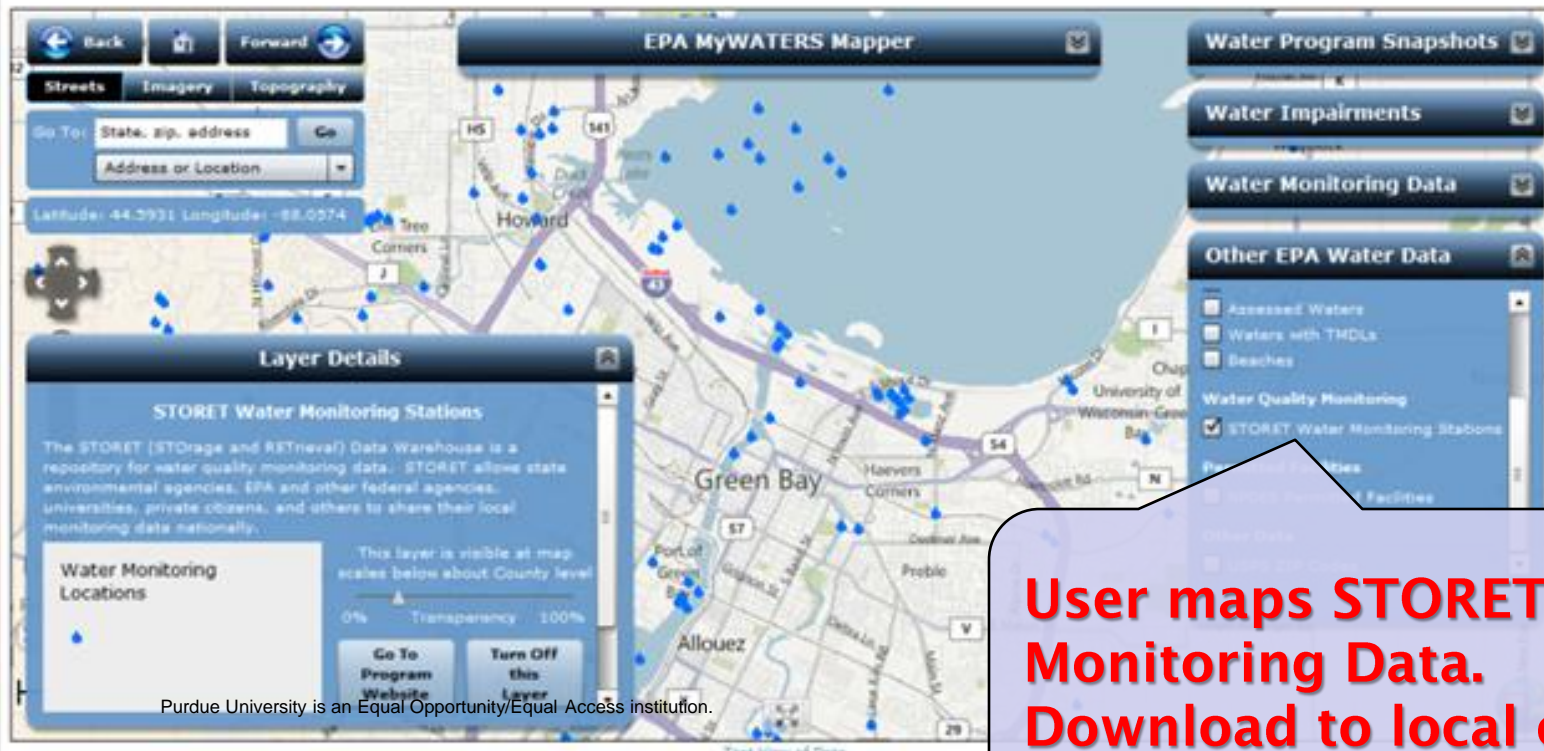
Contact Us Share

WATERS

You are here: [EPA Home](#) » [WATERS](#) » [My WATERS Mapper](#)

My WATERS Mapper

MyWATERS Mapper dynamically displays snapshots of EPA Office of Water program data. This version of MyWATERS Mapper depicts the status of NPDES permits for each State, summary information from the Clean Watershed Needs [Survey](#), and water quality assessments. Future versions will include other Office of Water Program Snapshots. MyWATERS Mapper also contains water-related geographic themes such as 12-digit watersheds, the national stream network known as the National Hydrography Dataset, and other water-related map layers. MyWATERS Mapper enables you to create customized maps at national and local scales.



Purdue University is an Equal Opportunity/Equal Access institution.

**User maps STORET Water
Monitoring Data.
Download to local computer.**

Option 1. EPA WQ data

Water Quality Data Table

Format :

- Column 1: Date [yyyy/mmdd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Time in 24-hour clock [hhmm]
- Column 3: Concentration in selected unit
- If the dataset doesn't have 'Time' information, use only 'Date' and 'Concentration'.

Date	(Time)	Concentration mg/l
20000223	1300	0.015
20000315	1310	<0.028
20000406	1240	0.026
20000419	1300	<0.024
20000511	1320	0.013
20000511	1410	0.021
20000511	1400	0.013
20000611	1320	0.042
20000721	1210	0.032
20000811	1410	0.015
20001030	1230	0.052
20001128	1230	0.032
20010110	1240	0.010
20010207	1145	0.016
20010306	1330	0.013

Opt. 1a. EPA My WATERS Mapper

Opt. 1b. Upload File from EPA

or

Opt. 2. USGS Gage Location Tool

or

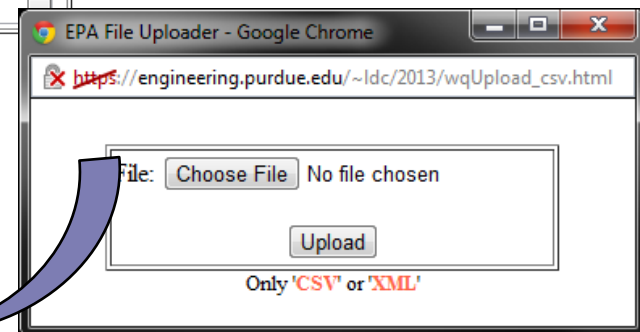
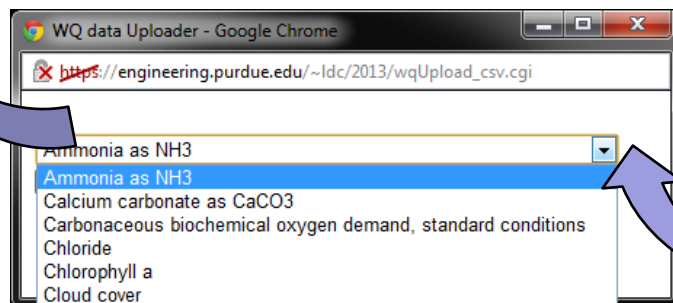
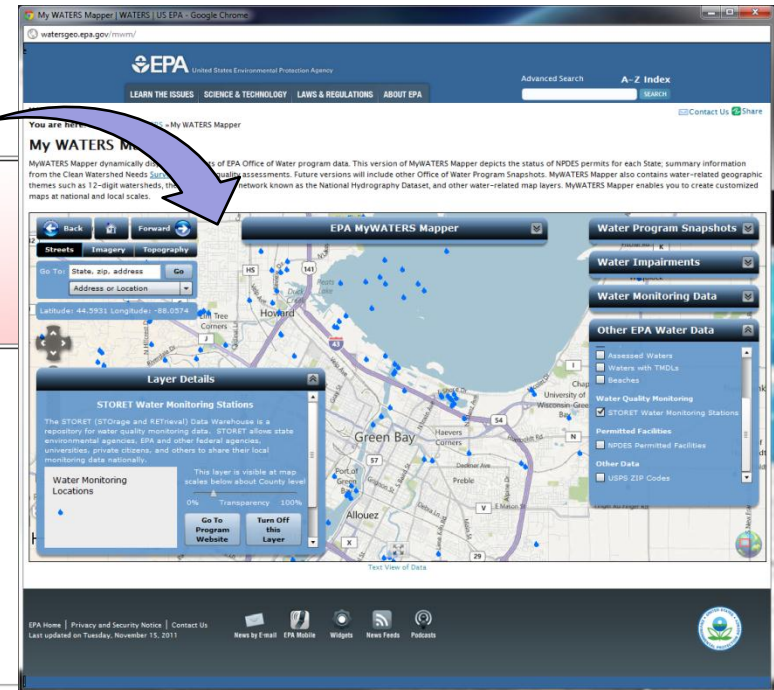
Opt. 3. Upload Your File

or

Opt. 4. STORET

Parameter Name :

Target Concentration : 0.5 mg/l



Select WQ parameter.

Load the downloaded file.

Option 2. USGS **WQ** data

Water Quality Data Table

Format :

- Column 1: Date [yyyy-mm-dd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Time in 24-hour clock [hhmm]
- Column 3: Concentration in selected unit
- If the dataset doesn't have 'Time' information, use only 'Date' and 'Concentration'.

Date	(Time)	Concentration	mg/l
20000223	1300	0.015	
20000315	1310	<0.028	
20000406	1240	0.026	
20000419	1300	<0.024	
20000511	1320	0.013	
20000524	1410	0.021	
20000609	1400	0.013	
20000621	1320	0.042	
20000721	1210	0.032	
20000811	1410	0.015	
20001030	1230	0.052	
20001128	1230	0.032	
20010110	1240	0.010	
20010207	1145	0.016	
20010306	1330	0.013	

Opt. 1a. EPA My WATERS

Opt. 1b. Upload File from

Opt. 2. USGS Gage Location Tool

Opt. 3. Upload Your File

or

Opt. 4. STORET

Parameter Name :

Target Concentration : 0.5 mg/l

USGS Water Quality data Map

Select State Enter Address or ZIP:

Map Satellite Hybrid

OHIO RIVER AT CANNELTON DAM AT CANNELTON, IN

Enter USGS Station Number :

Flow Data Table

Format :

- Column 1: Date [yyyy-mm-dd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Flow in selected unit

Date	Flow	cfs
20000101	46	
20000102	48	
20000103	72	
20000104	184	
20000105	109	
20000106	85	
20000107	75	
20000108	68	
20000109	66	
20000110	66	
20000111	64	
20000112	58	
20000113	58	
20000114	55	
20000115	57	

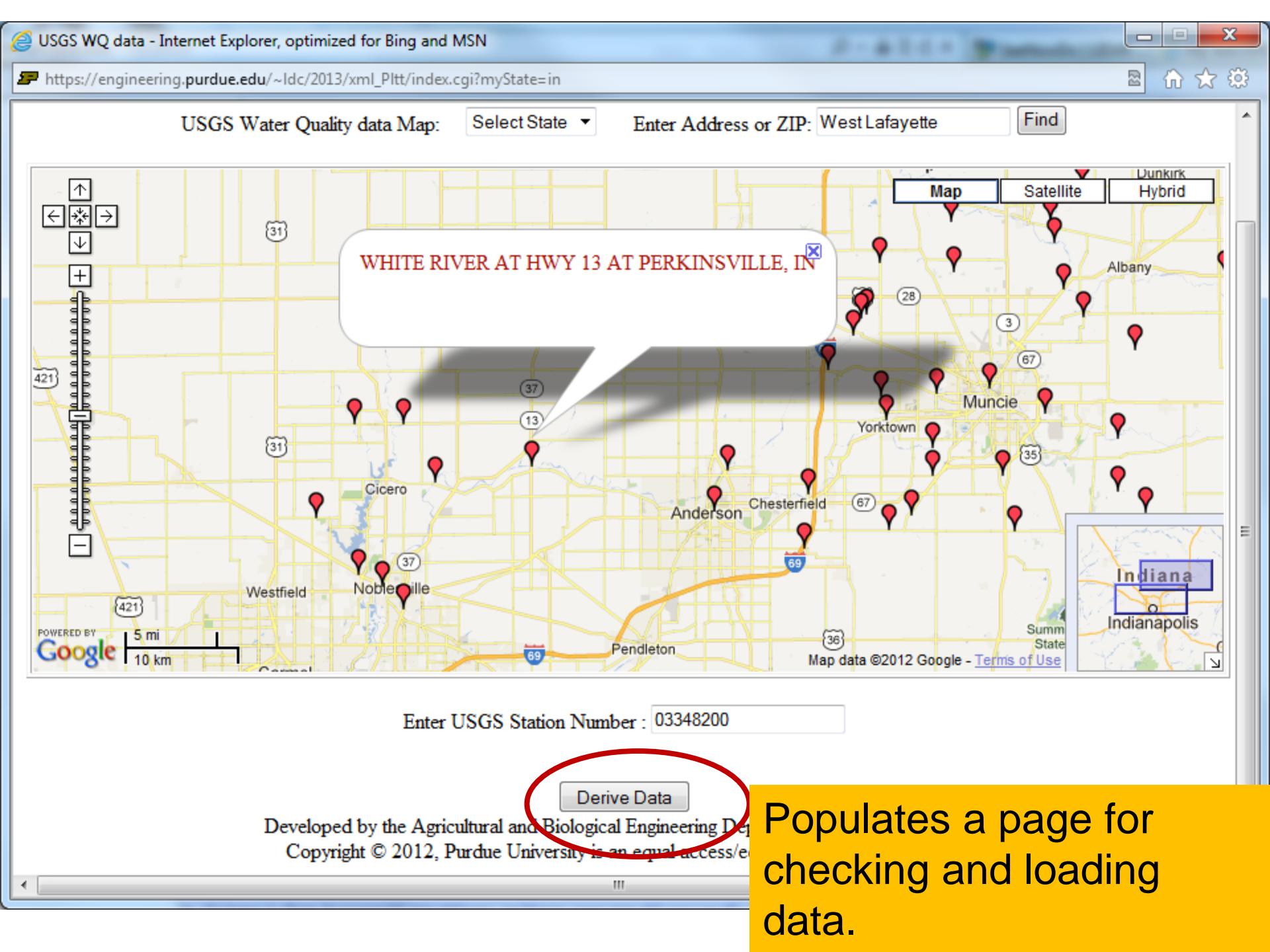
Opt. 1. USGS Gage Location Tool

or

Opt. 2. Upload Your File

Drainage Ratio : 1.0

Select WQ parameter and set time period in the following page.



USGS Water Quality data Map:

Select State

Enter Address or ZIP: West Lafayette

Find

WHITE RIVER AT HWY 13 AT PERKINSVILLE, IN

Enter USGS Station Number : 03348200

Derive Data

Developed by the Agricultural and Biological Engineering Dept.
Copyright © 2012, Purdue University is an equal access/e

Populates a page for
checking and loading
data.

Option 3. Load the file or “Copy–Paste”

Water Quality Data Table

Format :

- Column 1: Date [yyyymmdd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Time in 24-hour clock [hhmm]
- Column 3: Concentration in selected unit
- If the dataset doesn't have 'Time' information, use only 'Date' and 'Concentration'.

Date	(Time)	Concentration mg/l
20000223	1300	0.015
20000315	1310	<0.028
20000406	1240	0.026
20000419	1300	<0.024
20000511	1320	0.013
20000524	1410	0.021
20000609	1400	0.013
20000621	1320	0.042
20000721	1210	0.032
20000811	1410	0.015
20001030	1230	0.052
20001128	1230	0.032
20010110	1240	0.010
20010207	1145	0.016
20010306	1330	0.013

Opt. 1a. EPA My Waters Mapper

Opt. 1b. Upload file from EPA

Opt. 2. USGS Gauge Location Tool

Opt. 3. Upload Your File

Opt. 4. STORET

Parameter Name :

Target Concentration : 0.5 mg/l

Available File Format

Tab Delimited Format [Example1](#)

Space Delimited Format [Example2](#)

Comma-Separated Values Format [Example3](#)

File: Choose File No file chosen

Upload

Option 4 STORET. Use the Water Quality Portal

The screenshot shows a web browser window with the address bar displaying "www.waterqualitydata.us". The page features a header with the "NATIONAL WATER QUALITY MONITORING COUNCIL" logo and a banner image of a sunset over water. The main content area is titled "Water Quality Portal" and includes a description: "The Water Quality Portal (WQP) is a cooperative service sponsored by the United States Geological Survey (USGS), the Environmental Protection Agency (EPA), and the National Water Quality Monitoring Council (NWQMC)." Below this, there are three main sections: "DOWNLOAD DATA" (with a map background), "HOW TO USE THE WQP" (with a book icon), and "NATIONAL RESULTS COVERAGE" (with a map icon).

Water Quality Portal Home x

www.waterqualitydata.us

NATIONAL WATER QUALITY MONITORING COUNCIL

Water Quality Portal

The Water Quality Portal (WQP) is a cooperative service sponsored by the United States Geological Survey (USGS), the Environmental Protection Agency (EPA), and the National Water Quality Monitoring Council (NWQMC).

DOWNLOAD DATA

Download water-quality data in Excel, CSV, TSV, and KML formats.

HOW TO USE THE WQP

- User Guide
- Web Services Guide
- FAQs
- Upload Data

NATIONAL RESULTS COVERAGE

Water-quality data in your state.

User Side

Purdue

WQP

Map-based
User Interface
(HTML/CGI)

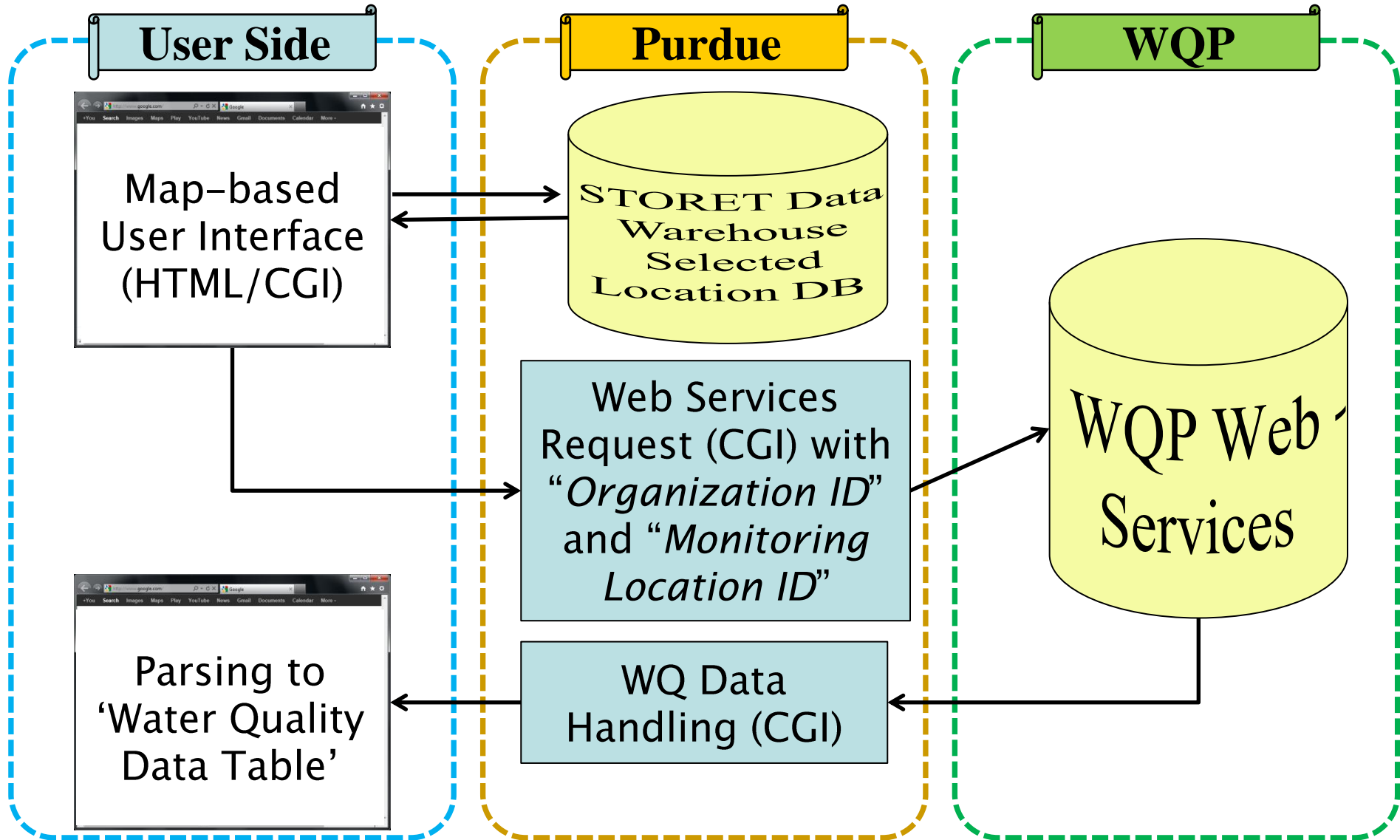
STORET Data
Warehouse
Selected
Location DB

Web Services
Request (CGI) with
“*Organization ID*”
and “*Monitoring
Location ID*”

WQP Web
Services

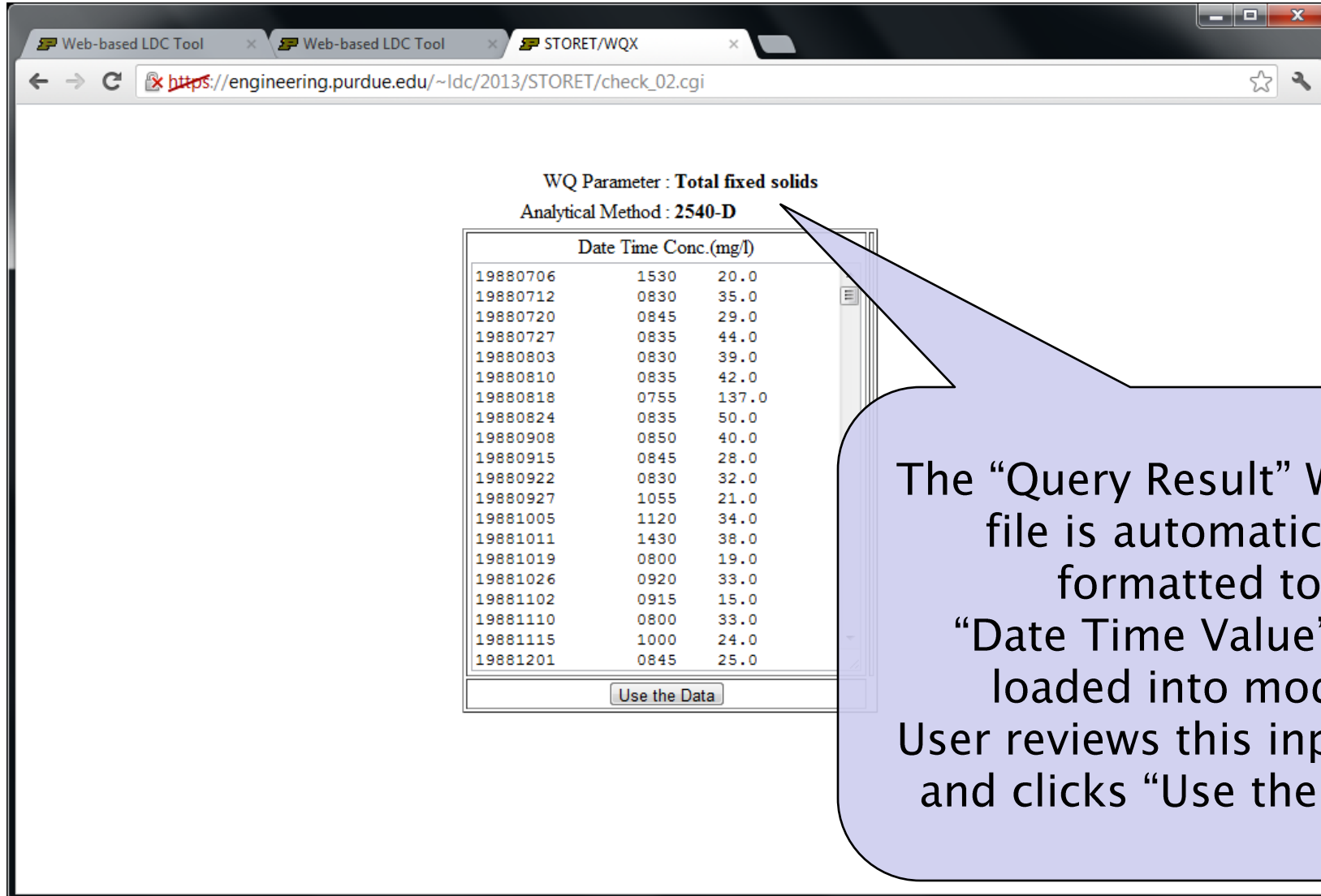
Parsing to
‘Water Quality
Data Table’

WQ Data
Handling (CGI)



Map Display of STORET data locations for Web-based LDC tool
Developed by the Agricultural and Biological Engineering Department
Copyright © 2012, Purdue University is an equal access/equal opportunity university

Preparing WQ data: Confirm WQ data selected



Web-based LDC Tool x Web-based LDC Tool x STORET/WQX

← → ↻ https://engineering.purdue.edu/~ldc/2013/STORET/check_02.cgi ☆ 🔍

WQ Parameter : **Total fixed solids**
Analytical Method : **2540-D**

Date	Time	Conc.(mg/l)
19880706	1530	20.0
19880712	0830	35.0
19880720	0845	29.0
19880727	0835	44.0
19880803	0830	39.0
19880810	0835	42.0
19880818	0755	137.0
19880824	0835	50.0
19880908	0850	40.0
19880915	0845	28.0
19880922	0830	32.0
19880927	1055	21.0
19881005	1120	34.0
19881011	1430	38.0
19881019	0800	19.0
19881026	0920	33.0
19881102	0915	15.0
19881110	0800	33.0
19881115	1000	24.0
19881201	0845	25.0

Use the Data

The “Query Result” WQ data file is automatically formatted to “Date Time Value” and loaded into model. User reviews this input data and clicks “Use the Data”.

Preparing WQ data: WQ data now appears in the “Water Quality Data Table”

The screenshot shows a web browser window with the URL <https://engineering.purdue.edu/~ldc/2013/>. The page title is "Water Quality Data Table".

Format :

- Column 1: Date [yyyymmdd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Time in 24-hour clock [hhmm]
- Column 3: Concentration in selected unit
- If the dataset doesn't have 'Time' information, use only 'Date' and 'Concentration'.

Date	(Time)	Concentration	mg/l
19950819	1100	48.0	
19950820	1100	41.0	
19950821	1100	67.0	
19950821	1200	39.0	
19950822	1100	87.0	
19950823	1100	103.0	
19950824	0904	44.0	
19950824	1100	48.0	
19950825	1100	59.0	
19950826	1100	61.0	
19950827	1100	48.0	
19950828	1100	116.0	
19950829	1100	59.0	
19950830	1100	59.0	
19950830	1137	46.0	
19950830	1200	42.0	

Opt. 1a. EPA My WATERS Mapper

Opt. 1b. Upload File from EPA

or

Opt. 2. USGS Gage Location Tool

or

Opt. 3. Upload Your File

or

Opt. 4. STORET/WQX

Parameter Name : Total fixed solids

Target Concentration : 50 mg/l

Data has now been loaded into model.

Flow Data Table

Format :

- Column 1: Date [yyyymmdd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Flow in selected unit

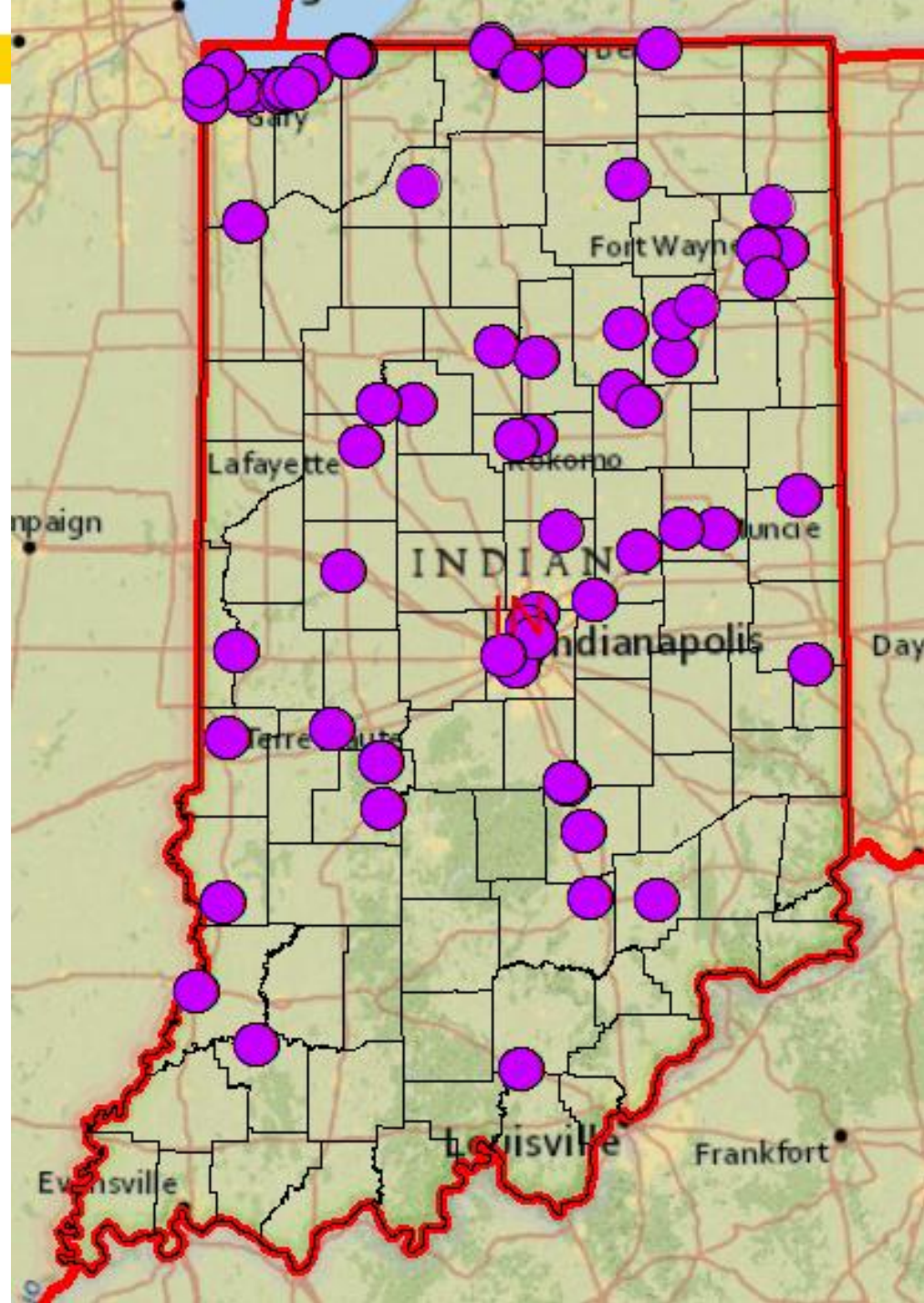
Date	Flow	cfs
------	------	-----

Using Additional WQ Data

- LDC needs STORET locations with
~ 10 years of data and near a flow gage
- Currently rare in Indiana
- Access to Fixed Station dataset would
provide more than 150,000 usable
readings near gages.

Fixed Station
network has
these locations
near flowgages.

Many contain
multiple-year
readings which
will be useful to
LDC.



Prepare Flow data

- USGS Gage
- Your data logger

Preparing Flow data: Click “Opt. 1 USGS Gage Location Tool”

There are two “flow data” options.

1. Select USGS stream gage from map *or*
2. Upload local flow from datalogger.

Web-based LDC Tool

Parameter Name : Total fixed solids
Target Concentration : 50 mg/l

Flow Data Table

Format :

- Column 1: Date [yyyy-mm-dd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Flow in selected unit

Date	Flow
19950830	1100 59.0
19950830	1137 46.0
19950830	1200 42.0

Opt. 1. USGS Gage Location Tool
or
Opt. 2. Upload Your File

Drainage Ratio : 1.0

Flow Duration Curve (only)

Continue (Select Dates)

Developed by the Agricultural and Biological Engineering Department at Purdue University and the Department of Regional Infrastructures Engineering at Kangwon National University in South-Korea
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Contact [Dr. Bemie Engel](#) for more details if you need any help for Web-based LDC Tool.
Programmed by [Youn Shik Park](#), Purdue University Research Assistant

Web-based LDC Tool

Duration Curve Tool ver. 2.0

Enter Address or Green Bay Find

Map Satellite Hybrid

Green Bay

Enter USGS Station Number : 03303280

Preparing Flow data: Find the station

USGS Station Location Tool

Select State : Enter Address or ZIP: West Lafayette

Map Satellite Hybrid

FOX RIVER AT OIL TANK DEPOT AT GREEN BAY, WI
 Station Number : 040851385
 Drainage Area : 6330 sq. mi
[Load this flow data](#)

Station Description

Site Name :	FOX_RIVER_AT_OIL_TANK_DEPOT_AT_GREEN_BAY_WI
Station Number :	040851385
Lat. :	44.52860355
Lng. :	-88.0101039
HUC :	04030204
Area (square miles) :	6330

Flow Data

Date	Flow (cfs)
19881001	2730
19881002	1860
19881003	2580
19881004	3480
19881005	3170
19881006	3670
19881007	3920
19881008	3910
19881009	3850
19881010	3430

Map-based selection currently supported for all USGS flow locations.

Preparing Flow: USGS Flow data loads automatically.

The screenshot shows a web browser window with the URL <https://engineering.purdue.edu/~ldc/2013/>. The page contains a table of flow data and several interactive elements.

Flow Data Table

Format :

- Column 1: Date [yyymmdd, mm/dd/yyyy, m/d/yyyy, yyyy-mm-dd, yyyy-m-d]
- Column 2: Flow in selected unit

Date	Flow
19881001	2730
19881002	1860
19881003	2580
19881004	3480
19881005	3170
19881006	3670
19881007	3920
19881008	3910
19881009	3850
19881010	3430
19881011	2600
19881012	3090
19881013	3750
19881014	3260
19881015	3530

Parameter Name : Total fixed solids
Target Concentration : 50 mg/l

Opt. 1. USGS Gage Location Tool
or
Opt. 2. Upload Your File

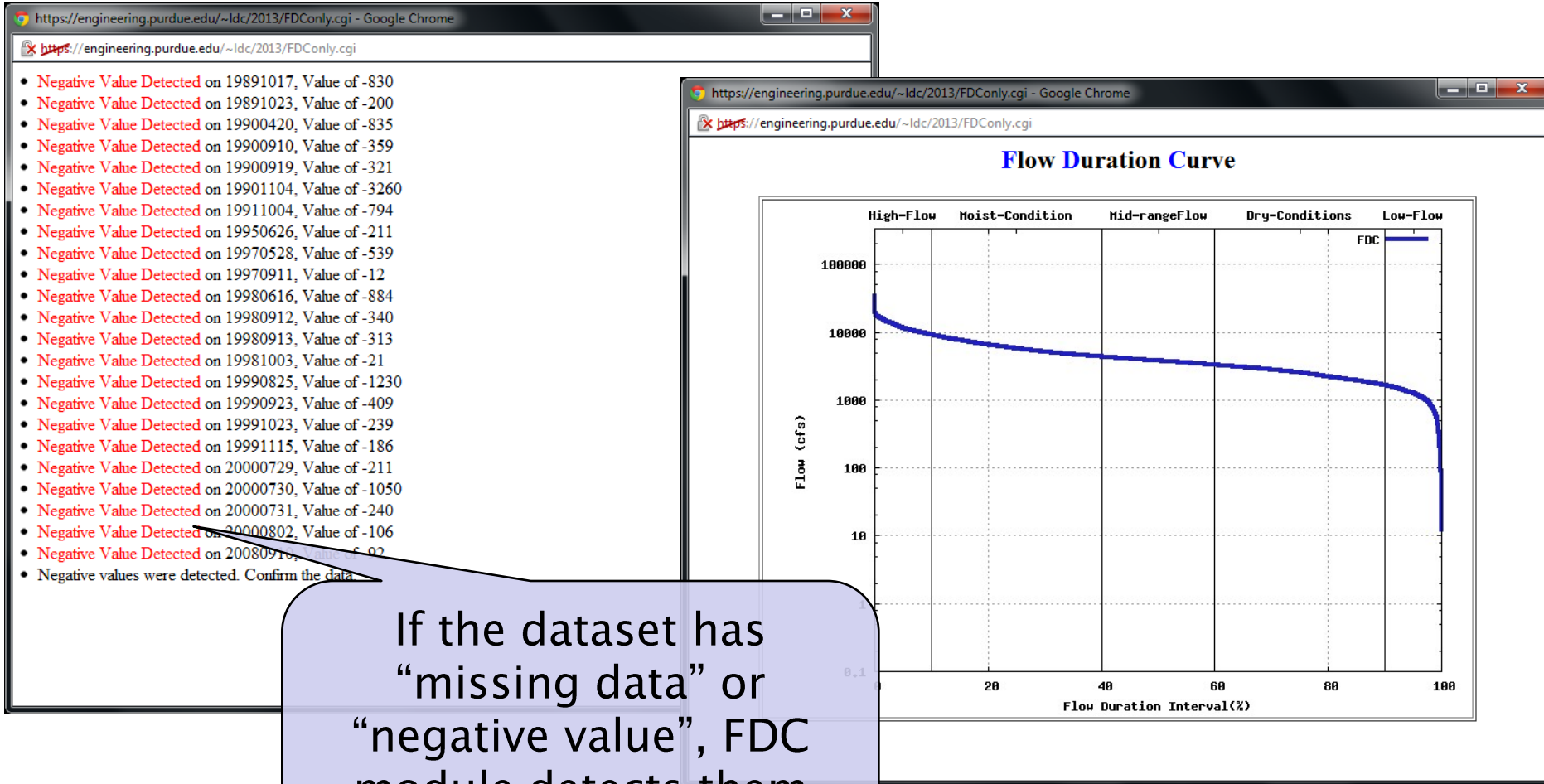
Drainage Ratio : 1.0

Flow Duration Curve (only)

Continue (Select Dates)

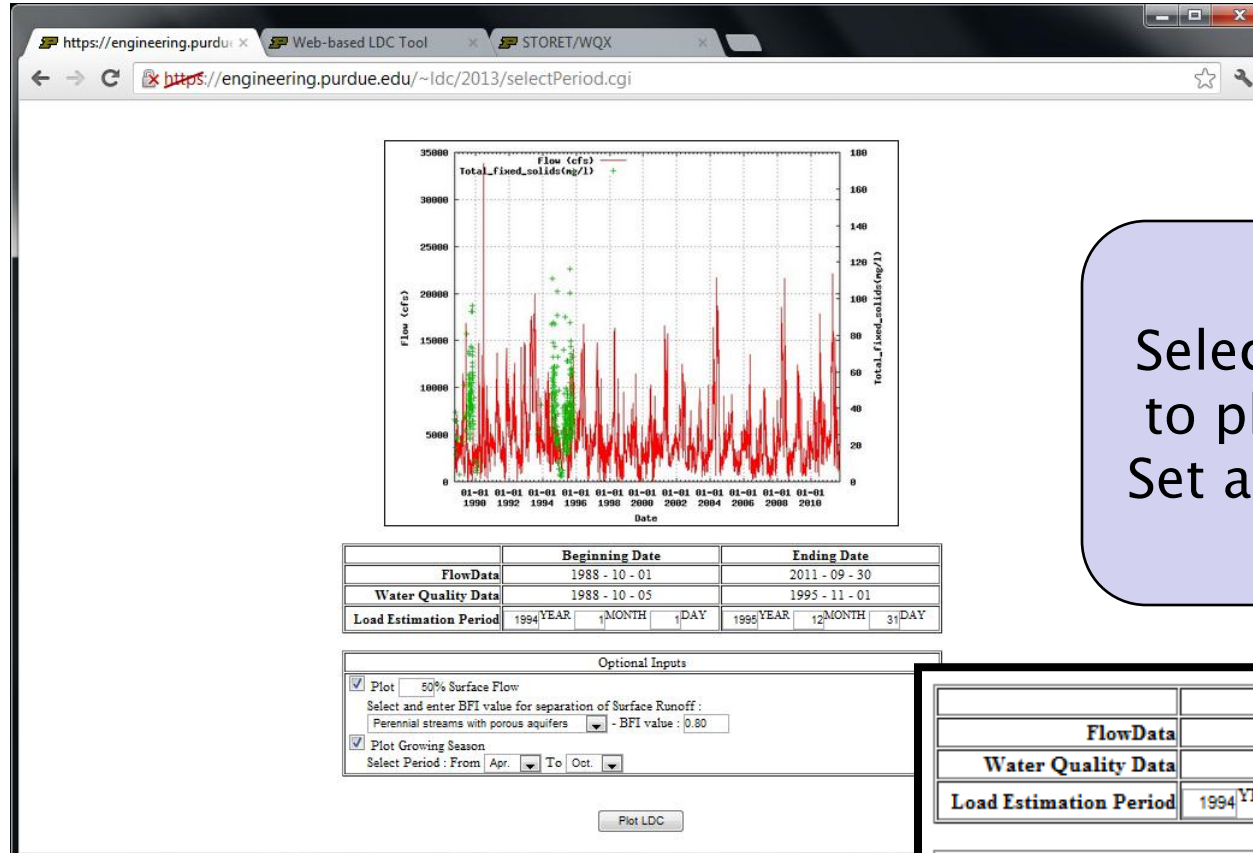
Developed by the Agricultural and Biological Engineering Department at Purdue University and the Department of Regional Infrastructures Engineering at Kangwon National University in South-Korea
Copyright © 2012, Purdue University and Kangwon National University, all rights reserved.
Contact [Dr. Bernie Engel](#) for more details if you need any help for Web-based LDC Tool.
Programmed by [Youn Shik Park](#), Purdue University Research Assistant

Flow data checking (gap analysis) by FDC module



If the dataset has
“missing data” or
“negative value”, FDC
module detects them
and alerts user.

Set options



Select the time period
to plot FDC and LDC.
Set additional options.

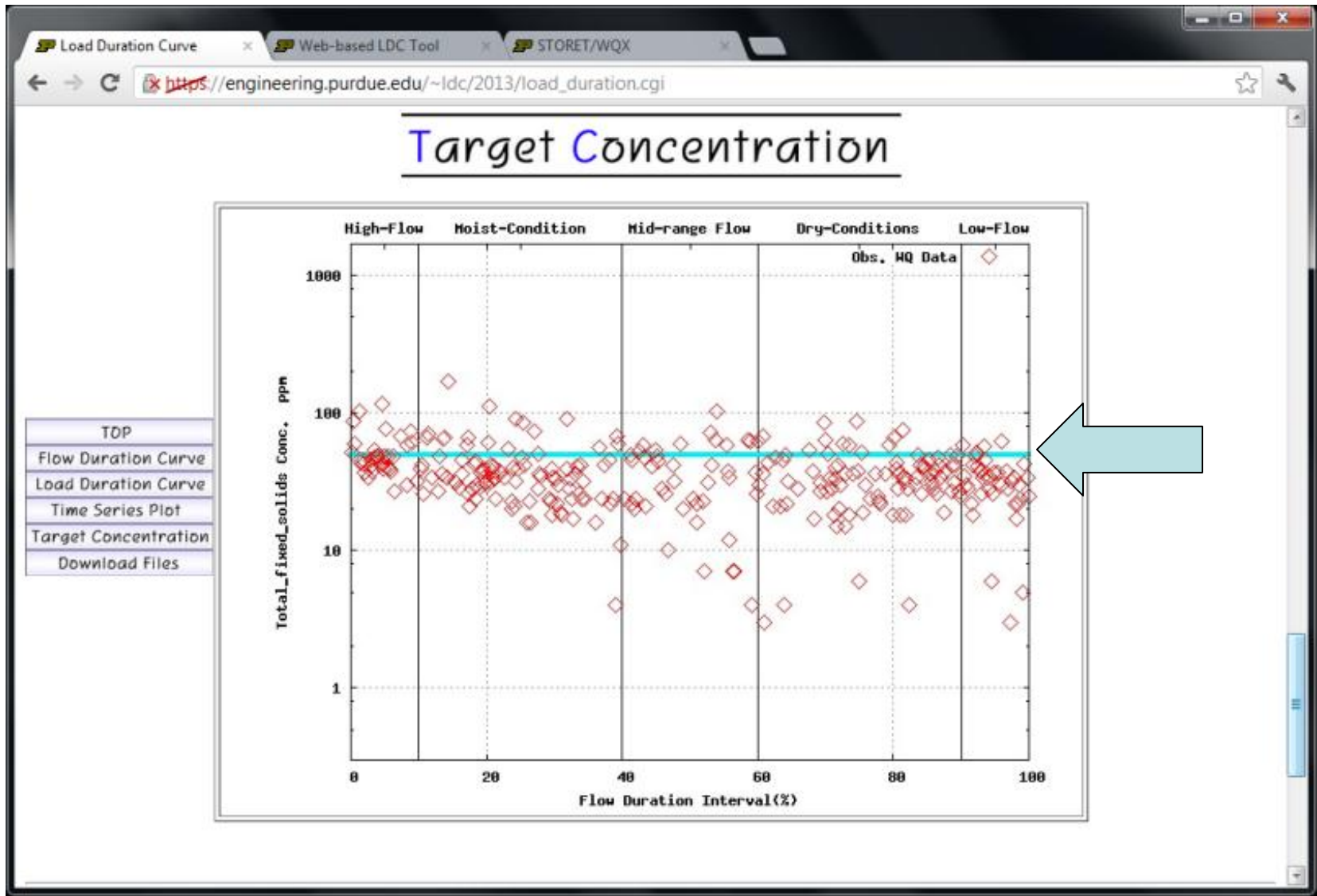
	Beginning Date	Ending Date
FlowData	1988 - 10 - 01	2011 - 09 - 30
Water Quality Data	1988 - 10 - 05	1995 - 11 - 01
Load Estimation Period	1994 YEAR 1 MONTH 1 DAY	1995 YEAR 12 MONTH 31 DAY

Optional Inputs

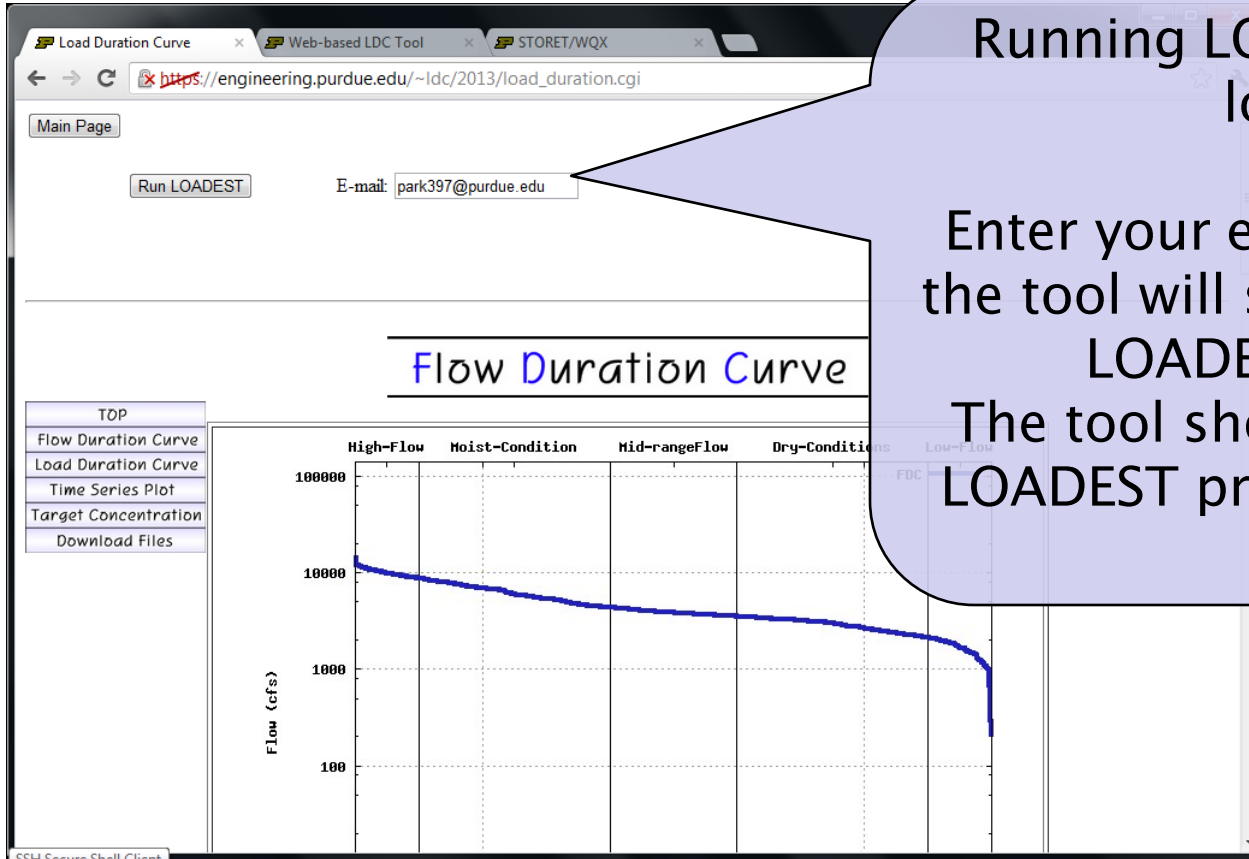
☒ Plot 50% Surface Flow
Select and enter BFI value for separation of Surface Runoff :
Perennial streams with porous aquifers - BFI value : 0.80

☒ Plot Growing Season
Select Period : From Apr. To Oct.

Results before LOADEST Execution



LOADEST Execution



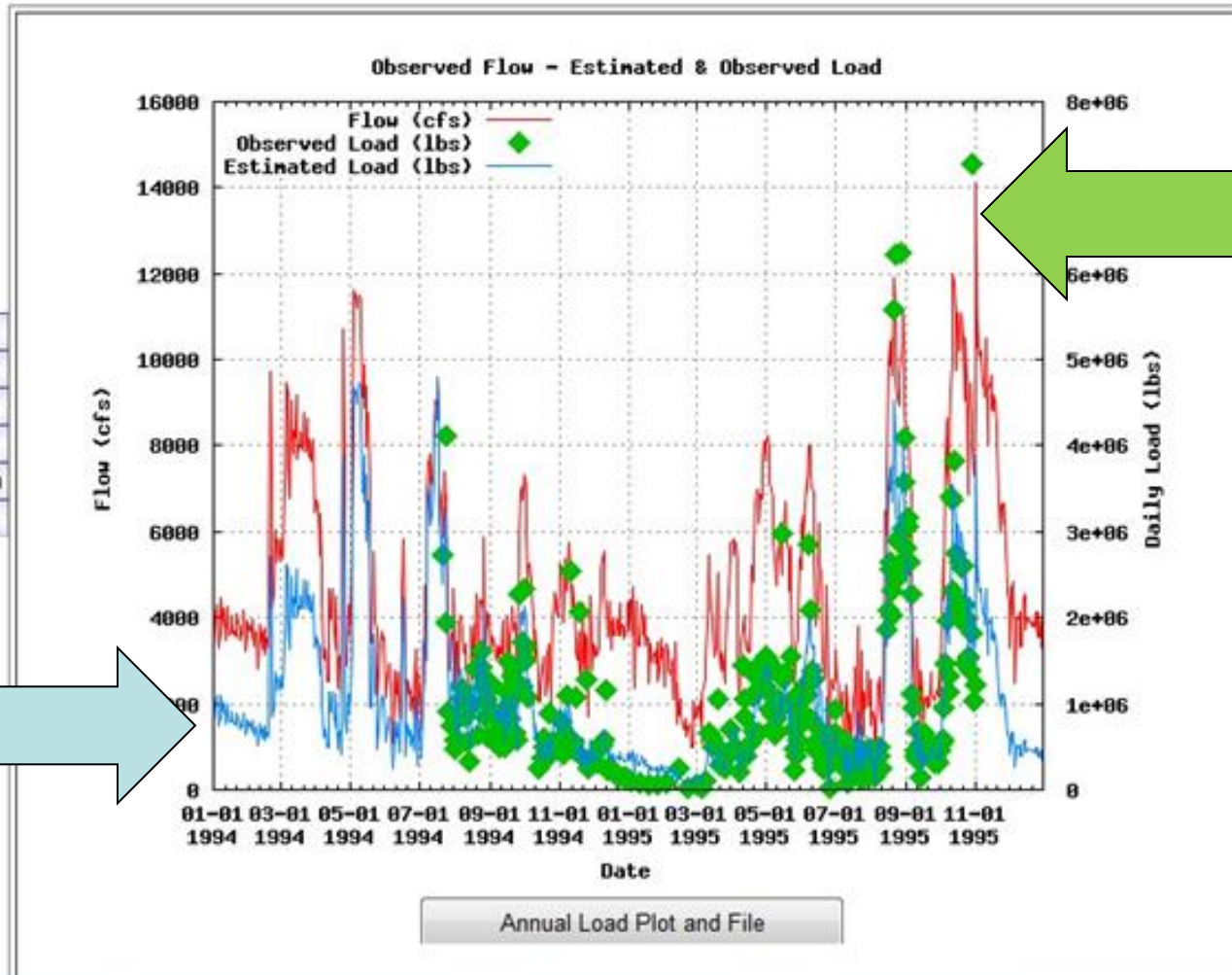
Running LOADEST may take a long time.

Enter your e-mail address here, the tool will send an e-mail when LOADEST is finished.

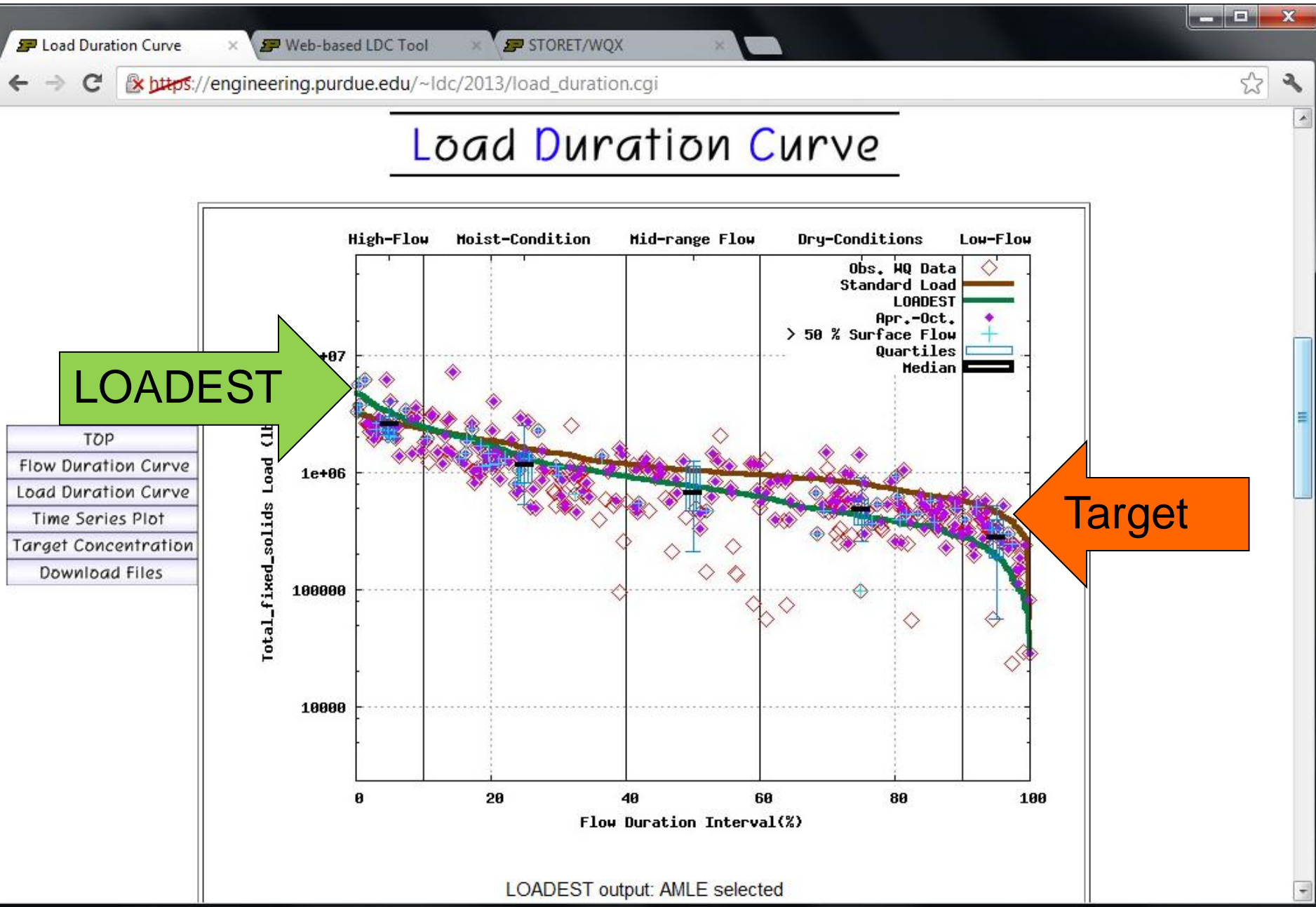
The tool shows progress of the LOADEST process on the server.

Estimated load (blue) versus Observed WQ data (green) – Results after LOADEST Execution

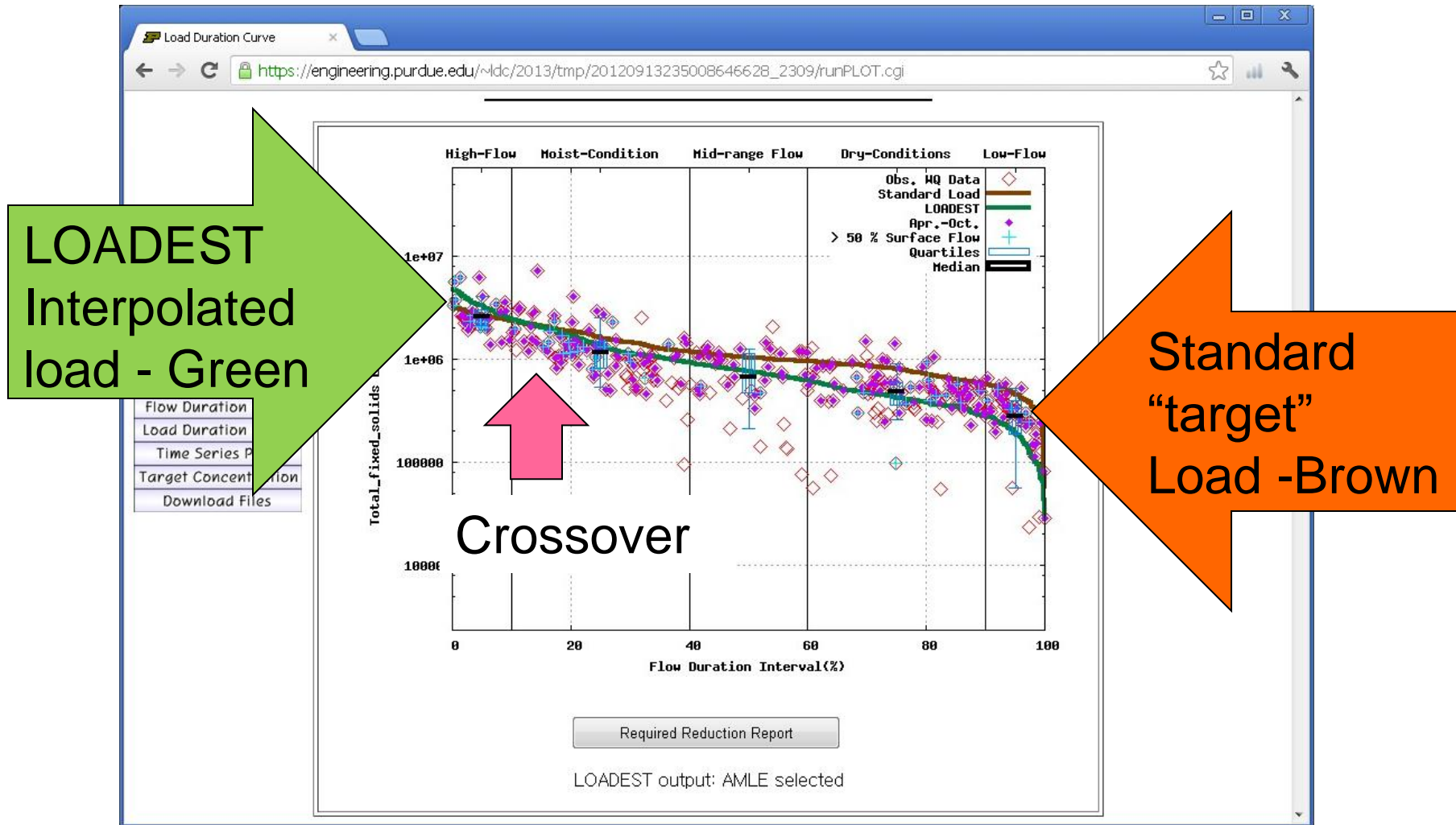
Time Series Plot



Load Results after LOADEST Execution



STEPL BMP Advisor Module for Web-based LDC Tool



After LOADEST execution is finished, we are exceeding pollutant loads only in “High-Flow” regime.

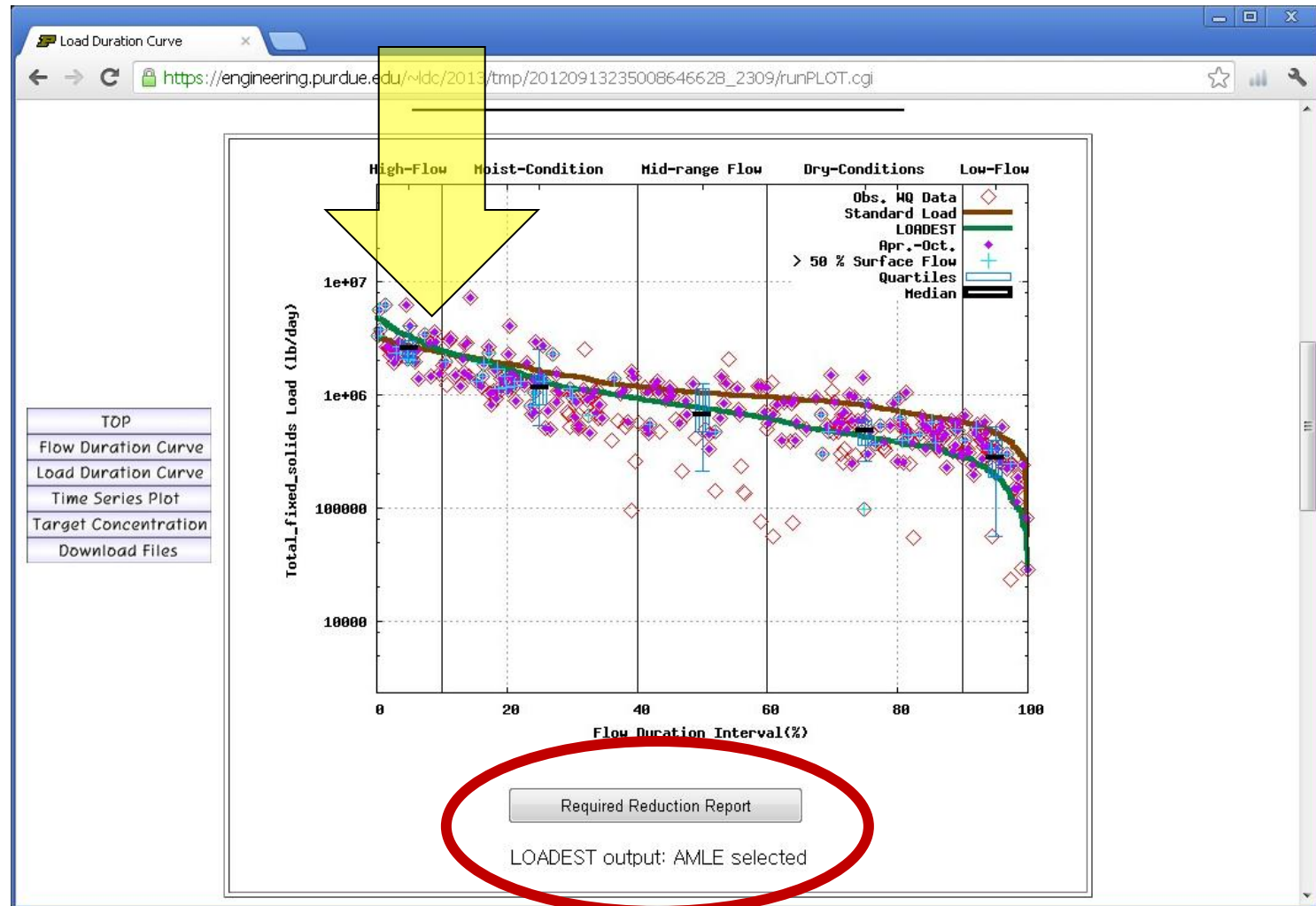


Table B-4. Middle Fork LeBuche River TMDL Summary

STEPL BMPs

TMDL SUMMARY	Loads expressed as <i>(tons per day)</i>				
	High	Moist	Mid-Range	Dry	Low
TMDL ¹	173.35	67.20	40.21	27.57	18.96
Allocations	118.32	48.24	34.47	21.83	6.90
Margin of Safety	55.03	18.96	5.74	5.74	12.06
Benchmark ²	20.35	7.89	4.72	3.24	2.22
Reduction Estimate ³	63%	27%	19%	0%	0%
Implementation Opportunities	Post Development BMPs				
	Streambank Stabilization				
	Erosion Control Program				
	Riparian Buffer Protection				
				Municipal WWTP	
Notes:	1. Expressed as a “daily load”; represents the upper range of conditions needed to attain and maintain applicable water quality standards				
	2. Based on annual average target identified in the applicable water quality standards				
	3. Developed using long-term fixed station ambient water quality monitoring data				

Source: *An Approach for Using Load Duration Curves in the Development of TMDLs.* US EPA. 2007

Based on the flow regimes, different BMPs need to be applied to reduce pollutant loads.

Logic and Program (cgi) flow

1. A BMP list for each flow regime requiring pollutant reduction is created from STEPL.
2. Program will select BMPs capable of producing the required reduction of pollutant load
3. Define the % of area to have BMP applied.
For example, the required reduction is 19.70 % :
If the BMP efficiency is 80%, the BMP needs to be applied to approximately 25% of the area.

BMPLIST - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J
	Landuse	BMP & Efficiency	N	P	BOD	Sediment	Type		Type	Classification
1	Cropland	Contour Farming	0.485	0.55	0	0.405	3			1 Post Development
2	Cropland	Diversion	0.1	0.3	0	0.35	3			2 Streambank Stabilization
3	Cropland	Filter strip	0.7	0.75	0	0.65	4			3 Erosion Control Program
4	Cropland	Reduced Tillage Systems	0.55	0.45	0	0.75	3			4 Riparian Buffer Protection
5	Cropland	Streambank stabilization and fencing	0.75	0.75	0	0.75	2			5 Municipal WWTP
6	Cropland	Terrace	0.2	0.7	0	0.85	3			
7	Forest	Road dry seeding	0	0	0	0.41	3			
8	Forest	Road grass and legume seeding	0	0	0	0.71	3			
9	Forest	Road hydro mulch	0	0	0	0.41	3			
10	Forest	Road straw mulch	0	0	0	0.41	3			
11	Forest	Road tree planting	0	0	0	0.5	3			
12	Forest	Site preparation/hydro mulch/seed/fertilizer	0	0	0	0.71	3			
13	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.69	3			
14	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.81	3			
15	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.95	3			
16	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.93	3			
17	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.83	3			
18	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.86	3			
19	Forest	Site preparation/hydro mulch/seed/fertilizer/transplants	0	0	0	0.86	3			
20	Feedlots	Diversio	0.45	0.7	0	0	3			
21	Feedlots	Filter str	0	0.85	0	0	4			
22	Feedlots	Runoff	0	0.825	0	0	5			

Selected BMP categories from STEPL

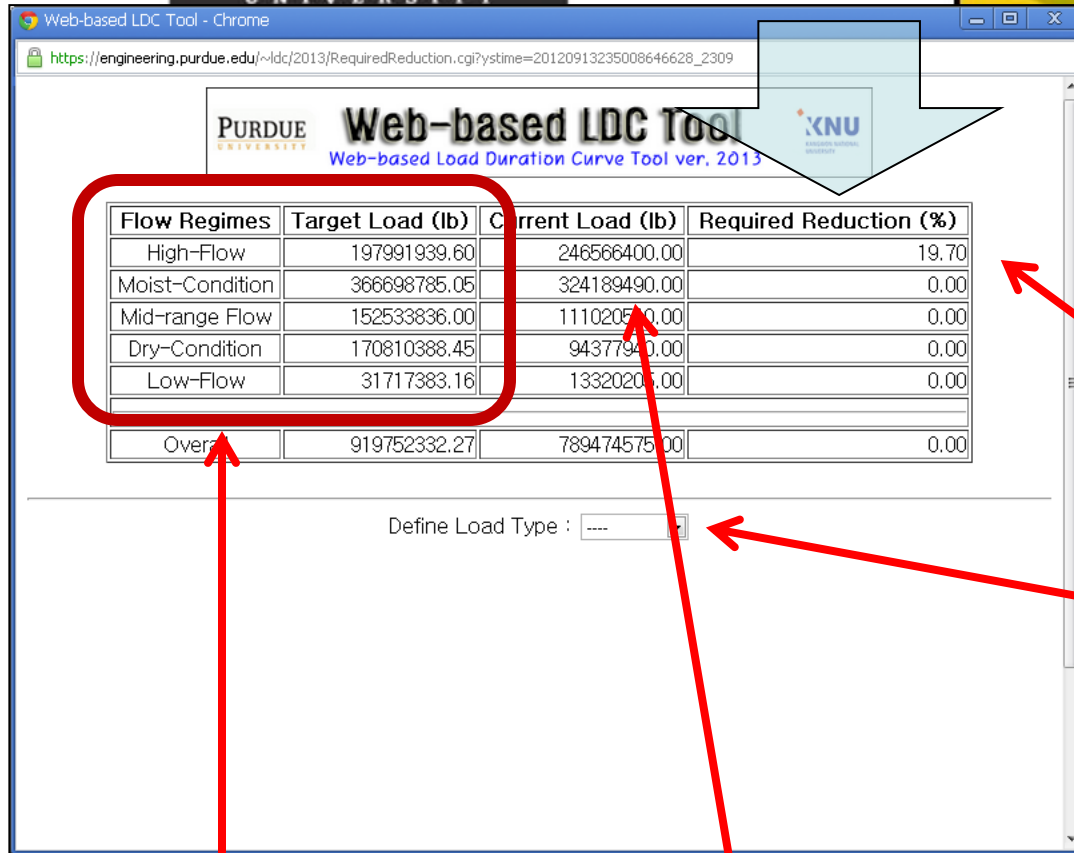
BMP Group 1: Post Development BMPs

BMP Group 2: Streambank Stabilization

BMP Group 3: Erosion Control Program

BMP Group 4: Riparian Buffer Protection

BMP Group 5: Municipal Wastewater Treatment Program



Required Reduction
Percentage

Pollutant
Constituent for
Load
(N, P, BOD, or Sediment)

Target Load in each
flow regime

Estimated Load by LOADEST in
each flow regime

Web-based LDC Tool - Chrome

https://engineering.purdue.edu/~ldc/2013/RequiredReduction.cgi?ystime=20120913235008646628_2309

Mid-range Flow	152533836.00	111020540.00	0.00
Dry-Condition	170810388.45	94377940.00	0.00
Low-Flow	31717383.16	13320205.00	0.00
Overall	919752332.27	789474575.00	0.00

Define Load Type : N

BMP options for Cropland

Number	BMP Name	ANA*(%)
Option 1	Contour Farming	40.62
Option 2	Reduced Tillage Systems	35.82
Option 3	Streambank stabilization and fencing	26.27
Option 4	Terrace	98.50

BMP options for Feedlots

Number	BMP Name	ANA*(%)
Option 1	Diversion	43.78
Option 2	Terrace	35.82

* The BMP suggestion in this page is based on
[An Approach for Using Load Duration Curves in the Development of TMDLs](#) (US EPA, 2007)
 and
 BMP Efficiencies of [EPA STEPL model](#).
 Note that this may differ from actual EPA STEPL simulation.

BMP List for **each** Landuse

The user needs to select an option in each landuse table.

Nitrogen
reduction
example

BMP List for each Landuse

The user needs to select an option in each landuse table for interactive results which may be used in models.

Web-based LDC Tool - Chrome

https://engineering.purdue.edu/~ldc/2013/RequiredReduction.cgi?ystime=20120913235008646628_2309

Mid-range Flow	152533836.00	111020540.00	0.00
Dry-Condition	170810388.45	94377940.00	0.00
Low-Flow	31717383.16	13320205.00	0.00
Overall	919752332.27	789474575.00	0.00

Define Load Type :

Number	BMP Name	ANA*(%)
Option 1	Contour Farming	35.82
Option 2	Diversion	65.67
Option 3	Reduced Tillage Systems	43.78
Option 4	Streambank stabilization and fencing	26.27
Option 5	Terrace	28.14

Option 1	Diversion	28.14
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* The BMP suggestion in this page is based on
[An Approach for Using Load Duration Curves in the Development of TMDLs](#) (US EPA, 2007)
and
BMP Efficiencies of [EPA STEPL model](#).

Phosphorus
reduction
example

The BMP suggestions were tested in STEPL.
Required Reduction percentage from LDC was found
to be similar to STEPL reductions.

Future Steps

- Seamless import from MyWaters to replace down-then-up load,
- Expand LDC – USGS WQ connection for geographic coverage beyond Region 5
- Add more non-WQX WQ data sets
- Add user-friendly dialogs in LDC
- Create ability to categorize scenarios by BMP costs



Indiana Water Monitoring Inventory

A central hub for water monitoring locations of Indiana streams, lakes, and groundwater.

[Introduction](#)[Fact Sheet](#)[Video Instructions](#)[Provide Feedback](#)[Monitoring
Protocol](#)[FAQs](#)[Newsletters](#)[Contact Us](#)[Map](#)[Terrain](#)[View Monitoring Locations](#)NHD Water Layer: ☐

d organizations

monitoring location (e.g., "Wabash")

clicking more than one parameter will result in monitoring locations that include any of the parameter types checked.

- | | |
|---|---|
| <input checked="" type="checkbox"/> All | <input type="checkbox"/> Habitat |
| <input type="checkbox"/> Aquatic Plants/Algal Biomass | <input type="checkbox"/> Lake Clarity |
| <input type="checkbox"/> Bacteriology/Microbiology | <input type="checkbox"/> Macroinvertebrates |
| <input type="checkbox"/> Fish | <input checked="" type="checkbox"/> Metals |
| <input type="checkbox"/> Flow/Stage | <input checked="" type="checkbox"/> Nutrients |
| <input type="checkbox"/> General Chemistry | <input type="checkbox"/> Organics/Pesticides |
| <input type="checkbox"/> Groundwater Level | <input type="checkbox"/> Radiological |
| <input type="checkbox"/> Groundwater Quality | |

Indiana:
Various long-term
nutrient/metals data
sets collected by
watershed groups

Some non-STORET datasets
could be loaded as services

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Map data ©2012 Google - [Terms of Use](#)

[Enter Your Monitoring Locations](#)

The End