

Pollutant Load Modeling Web Tool for Source Water Protection

Presenter:

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Motivations



- **Concerns:**
 - Contaminant risks to source water quality
 - Large multi-use watershed
 - Limited resources
 - Many landowners to engage on collaborative projects
- **Solution:**
 - Access to data-driven and cost-effective information to support planning efforts
 - Estimates for relative impacts of land use and BMPs on source water quality
 - Spatially aware to target various areas of the watershed

Overview



Project Setting



Model Components



User Inputs and Interface



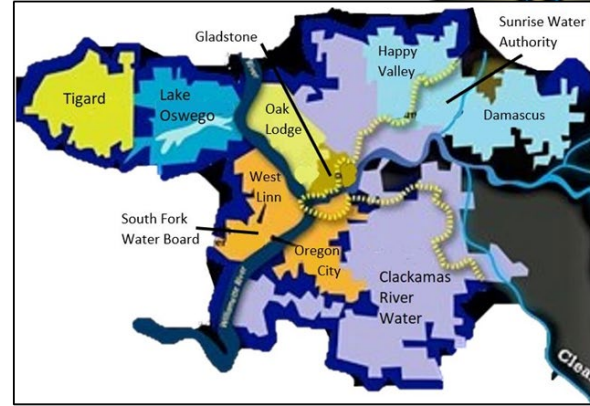
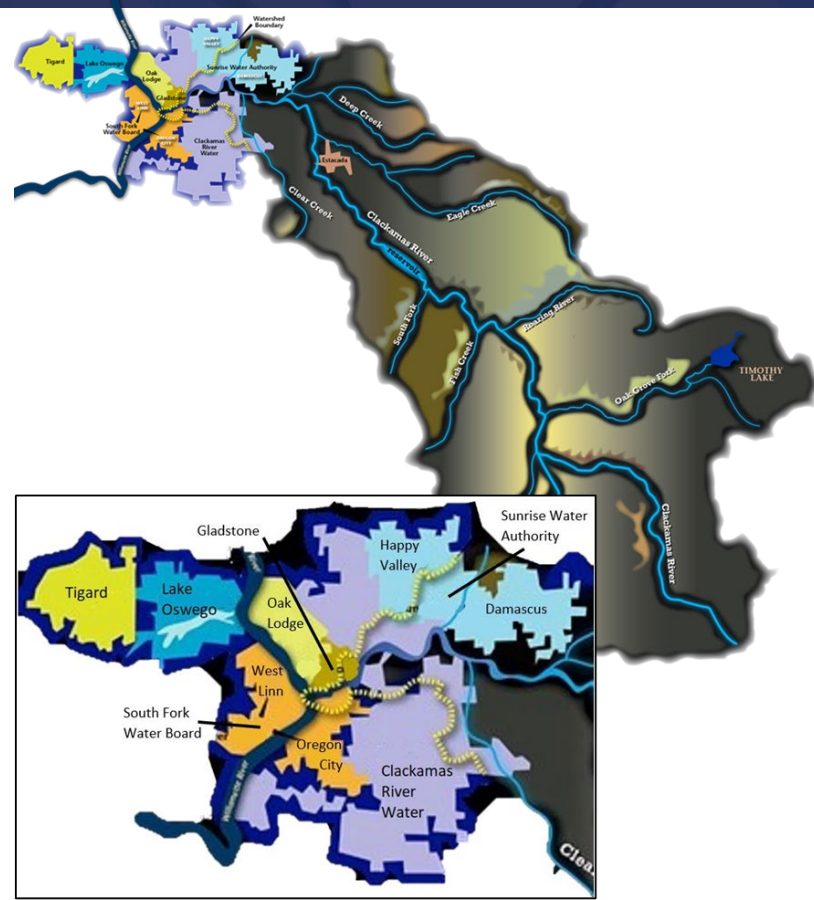
Live Demo



Takeaways

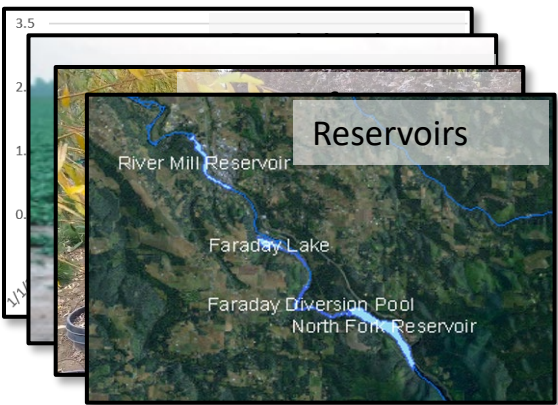
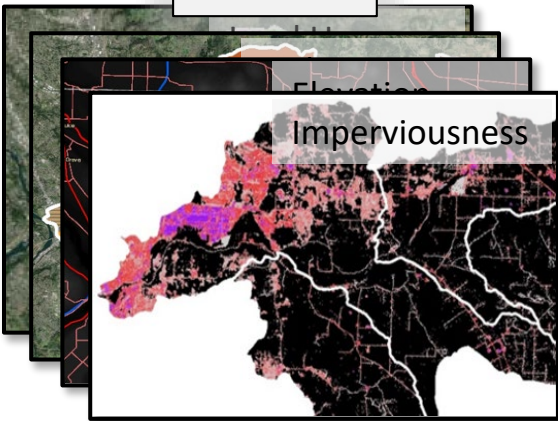
Project Setting

- Clackamas River Water Providers:
 - 8 municipal water providers on the Clackamas River
 - Serve over 300,000 people
- Watershed: over **940 square miles** (or over **600,000 acres**)
- Intakes: 4 of the 5 intakes are in the bottom **5 miles** of the **83 mile-long** river
- Drinking Water Protection Plan (DWPP) developed in 2010



Model Components

Data



User Input

- 1) Study Area
- 2) Pollutant of Concern
- 3) BMPs Used
- 4) BMP Extent

Calculations

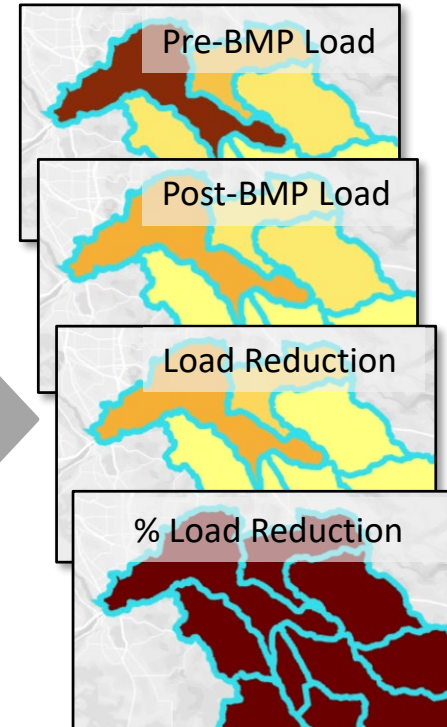


- 1) Runoff coefficients



- 2) 30-yr normal annual runoff volume
- 3) Pollutant load from land surface
- 4) Effectiveness of BMPs
- 5) Load reduction by reservoirs due to settling

Output



Model Components – Input Data

Data

- Land surface
 - Land use
 - Slope
 - Soils
 - Imperviousness
- Pollutants
 - Event mean concentrations
 - Partition coefficients
- Rainfall data
 - Historical hourly record
 - 30-year precipitation normals
- Best management practices
 - Hydraulics (% capture, % reduction)
 - Effluent quality or % removal
 - Minimum treatable concentrations
- Reservoirs
 - Full pool surface area
 - Daily average discharge

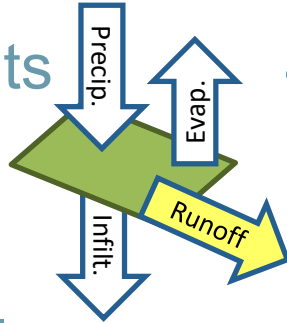
Sources

- Land surface
 - Regional Land Information System (RLIS)
 - USGS National Elevation Dataset (NED)
 - NRCS Web Soil Survey
 - USGS National Land Cover Database (NLCD)
- Pollutants
 - Various databases, literature, and best professional estimates
- Rainfall data
 - 4 local rain gages 2005/2007-2013
 - PRISM Climate Group
- Best management practices
 - International BMP Database
 - Best professional estimates
- Reservoirs
 - Existing CE-QUAL-W2 model
 - Powerhouse flows, fish flows, or USGS gages

Model Components – Calculations

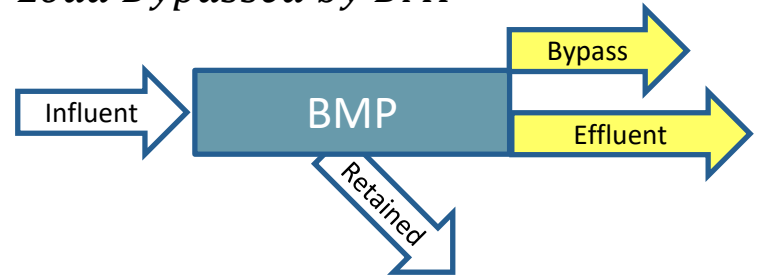
1) Runoff coefficients

$$= \frac{\text{Simulated Runoff}}{\text{Total Precipitation}}$$



4) Load after BMPs

= Load from Areas without BMPs +
Remaining Load in Treated Effluent +
Load Bypassed by BMP



2) Annual runoff volume

$$= \text{Runoff Coefficient} * \\ 30 \text{ yr Normal Precipitation} * \\ \text{HRU Area}$$

3) Load from land surface

$$= \text{Runoff Volume} * \\ \text{Pollutant Concentration}$$

5) Attenuation by reservoirs

$$= \% \text{ of Particles Removed by} \\ \text{Reservoir Due to Settling} \\ * \% \text{ Solids of Pollutant}$$

User Inputs and Interface

- Key features:
 - Easy to learn and use
 - Interactive map
 - No special software needed
 - Publicly available
 - Save results
- Key user inputs:
 - Study area
 - Pollutant of concern
 - BMP types
 - BMP implementation extents

The screenshot shows a web interface with a top navigation bar containing 'GETTING STARTED', 'BMP REFERENCE', and 'Pollutant Load'. The main content area is titled 'BMP Inputs' and includes the instruction 'Please Click on Subbasins to Define a Study Area'. Below this, there is a 'Select a BMP:' dropdown menu with options: 'Integrated Pest Management' (selected), 'Conservation Cover', 'Conservation Buffer', and 'Grass Border'. There are two filter fields: 'Filter by Applicable Pollutant: [Clear](#)' and 'Filter by Applicable Landuse: [Clear](#)'. At the bottom, there is a section 'Set BMP Landuse Allocations' with a help icon, containing four input fields: 'Agricultural' (0), 'Residential' (0), 'Open Space' (0), and 'Public Space' (0). On the left side of the interface, a map shows a watershed area with various colored subbasins (green, yellow, red) and a river network.

Example

- Question: “As a manager, I want to know what management scenarios provide the largest benefit for pesticides in a basin close to the intake with predominantly agricultural land uses?”
- Define question in tool:
 - Study Area: Lower Clear Creek (Basin #606) is a tributary to the Clackamas River not far upstream of the first intake and has significant agricultural land
 - Pollutant of concern: glyphosate
 - BMP types: organic farming and cover crops
 - Implementation extent: 25% of agricultural land
- Desired response: Reductions in pesticide load achieved by various management scenarios

Live Demo

[CRWP PLMT \(crwp-pollutant-load-model.azurewebsites.net\)](http://crwp-pollutant-load-model.azurewebsites.net)

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consultants

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Recorded Demo

The screenshot shows a web browser window with the address bar displaying `crwp-pollutant-load-model.azurewebsites.net/#`. The browser's address bar includes navigation icons (back, forward, refresh) and a search icon. Below the address bar, there is a row of application shortcuts: BST, ChromeRiver, FTP Client, FTP Internal, HR & Payroll, IT HelpDesk, MailExpress, Office 365 Outlook, Office 365 Portal, Sharepoint, and Imported From IE.

The main content area displays the Clackamas River Water Providers logo and navigation tabs: ABOUT, GETTING STARTED, and BMP REFERENCE. The page title is "Pollutant Load Modeling Tool v2.0". A "Layers" panel is open on the left, showing "User Input Layers" with checkboxes for "Landuse" and "Subwatershed", both of which are checked. A legend at the bottom left lists various land use categories with corresponding color swatches: Agricultural (green), Open Space (yellow), Residential (orange), Wetland (blue), Commercial (red), Public Space (brown), Transportation (grey), and Forest (dark green). A "BMP Inputs" panel is visible on the right side of the map.

A white modal dialog box is centered on the screen, containing the following text:

Welcome to the CRWP Pollutant Load Modeling Tool (PLMT)

The purpose of the Clackamas River Watershed Pollutant Modeling Tool is to provide an interactive framework for estimating the relative impacts of land use and best management practices on drinking water source quality in various parts of the watershed.

This tool can be used to assess baseline conditions and consider scenarios for land management and pollution reduction in accordance with the Clackamas River Watershed Drinking Water Protection and Source Water Assessment Plans.

The tool builds upon previous work designed to help prioritize implementation of best management practices (BMPs) for mitigating various land use-based threats to source water quality.

GET STARTED

At the bottom of the browser window, the Mapbox logo is visible on the left, and the copyright notice "© Mapbox © OpenStreetMap. Improve this map" is on the right.



Takeaways

- What's next?
 - Broaden user base and refine user experience
 - Implement cost estimation feature
- Other potential improvements:
 - Refine land uses (e.g. include specific crop types)
 - Allow user to model multiple BMPs in the same area
 - Your thoughts?

Contact Info

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engineers | scientists | innovators



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Example Screenshots

The screenshot shows a web browser window with the URL `crwp-pollutant-load-model.azurewebsites.net/#`. The browser's address bar and tabs are visible at the top. The page header includes the Clackamas River Water Providers logo and navigation links: ABOUT, GETTING STARTED, and BMP REFERENCE. A sub-header reads "Pollutant Load Modeling Tool v2.0 Management".

The main content area features a map with a "Layers" panel on the left and a "BMP Inputs" panel on the right. The "Layers" panel includes "User Input Layers" with checked options for "Landuse" and "Subwatershed". A legend at the bottom left identifies various land use types: Agricultural (green), Open Space (yellow), Residential (red), Wetland (blue), Commercial (orange), Public Space (brown), Transportation (grey), and Forest (dark green).

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[GET STARTED](#)

The footer of the page includes the Mapbox logo and copyright information: © Mapbox © OpenStreetMap Improve this map.

Example Screenshots

The screenshot displays the CRWP PLMT web application. The browser address bar shows the URL `crwp-pollutant-load-model.azurewebsites.net/#`. The application header includes the Clackamas River Water Providers logo and navigation links for ABOUT, GETTING STARTED, and BMP REFERENCE. The main content area features a map of the watershed with subbasins outlined in grey. A blue overlay box on the map contains the text: "BMP Inputs Please Click on Subbasins to Define a Study Area".

Layers (User Input Layers)

- Landuse
- Subwatershed Areas

Landuse Legend

<input type="checkbox"/> Agricultural	<input type="checkbox"/> Commercial
<input type="checkbox"/> Open Space	<input type="checkbox"/> Public Space
<input type="checkbox"/> Residential	<input type="checkbox"/> Transportation
<input type="checkbox"/> Wetland	<input type="checkbox"/> Forest

Map labels include: Management, Kleberry mess, and Mount Hood National Forest. The bottom of the page features the Mapbox logo and copyright information: © Mapbox © OpenStreetMap Improve this map.

Example Screenshots

The screenshot shows a web browser window with the address bar displaying `crwp-pollutant-load-model.azurewebsites.net/#`. The browser's taskbar includes icons for BST, ChromeRiver, FTP Client, FTP Internal, HR & Payroll, IT HelpDesk, MailExpress, Office 365 Outlook, Office 365 Portal, Sharepoint, and Imported From IE. The main content area features the Clackamas River Water Providers logo and a map interface. A modal window titled "Get Started" is centered on the screen, providing instructions on how to use the tool. The modal includes a "GET STARTED" button in the bottom right corner. The background map shows a legend with categories: Agricultural (green), Open Space (yellow), Residential (red), and Wetland (blue). The map also displays a "User Input Layer" with checkboxes for "Landuse" and "Subwatershed".

Get Started

How to Start:

1. [Select Study Area](#)
Using your mouse or trackpad, click on the mapped subbasins that you want to run a scenario for.
2. [Choose BMP\(s\)](#)
From the BMP Input menu select the BMP(s) you would like to run a scenario with. Optionally, filter the BMP list by pollutant or land use.
3. [Generate results](#)
Provide a Title and Project Description and confirm BMP allocation by land use. Optionally, select or confirm a primary pollutant of concern.
4. [Explore and export results](#)
 - Click on the Load Reduction Box to see the results by Result Layer Type and Pollutant.
 - Scroll over the map to see results by basin.
 - Click the Print Results to print scenario results or save as a pdf.

Click the layer icon on the top left of the screen to toggle layers on/off. Clicking on a layer's label will toggle its legend info. Refer to the full User Guide Manual [here](#) to learn more about the model and how to use the tool.

[GET STARTED](#)

Example Screenshots



BMP-Pollutant-Landuse Cross-Table

Use this table to find the appropriate BMP for a given pollutant and/or landuse

BMP Name	Description	Applicable Land Uses	Pollutants Affected
Nutrient Management Plan - Agriculture	Manage fertilizer application and irrigation to meet crop needs while minimizing nutrient loss	AGR	TP NO3 NH3
Nutrient Management Plan - Urban	Manage fertilizer and irrigation water application to meet landscaping needs while minimizing nutrient loss	COM RES PUB	TP NO3 NH3
Integrated Pest Management	Biological, cultural, physical, and chemical tools to minimize economic, health, and environmental risks	AGR OPS RES PUB	PESTICIDES
Incentive Program	Fee/cost reduction for connecting septic system to sewer and/or performing inspections and maintenance	RES	TP NO3 NH3 BOD E.COLI
Conservation Buffer	Strips of permanently vegetated land placed to trap and degrade pollutants from field runoff	AGR	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Conservation Cover	Permanent vegetation in orchards, vineyards, berry farms, and nurseries to reduce erosion and runoff	AGR	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Grassy Borders	Borders around fields to reduce erosion and runoff; may be harvested	AGR	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Buffer/Filter Strips	Planted along field borders, contours within field, and steep slopes to reduce erosion and runoff	AGR	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Riparian Buffers	Restore riparian vegetation to reduce erosion and runoff and promote nutrient uptake	AGR	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Critical Area Planting	Seed areas that were bare and without another purpose to reduce erosion and runoff	AGR	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Streamside Management Area	Restriction of activities and/or livestock near watercourses	AGR FOR	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Water Quality Basins	Storage of stormwater runoff in an excavated basin such as a detention pond, retention pond, or wetland	AGR COM RES PUB	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Bioretention/Biofilters	Engineered vegetated bed which filters influent such as a swale, media strip, or rain garden	COM RES PUB	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Media Filter	Bed of aggregate which filters influent	AGR COM RES PUB TRA	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Impervious Area Reduction	Minimize impervious areas through a technique such as porous pavement, green roof, or dry well	COM RES PUB	TSS TP NO3 NH3 METALS BOD E.COLI PESTICIDES OIL&GREASE
Organic Farming	No synthetic fertilizers or pesticides used	AGR	TP NO3 NH3 BOD PESTICIDES

CLOSE

Example Screenshots

CRWP PLMT

crwp-pollutant-load-model.azurewebsites.net/#

BST ChromeRiver FTP Client FTP Internal HR & Payroll IT HelpDesk MailExpress Office 365 Outlook Office 365 Portal Sharepoint Imported From IE

Clackamas River Water Providers

ABOUT GETTING STARTED BMP REFERENCE Pollutant Load Modeling Tool v2.0

Layers

User Input Layers

- Landuse
- Subwatershed Areas

Landuse

<input type="checkbox"/> Agricultural	<input type="checkbox"/> Commercial
<input type="checkbox"/> Open Space	<input type="checkbox"/> Public Space
<input type="checkbox"/> Residential	<input type="checkbox"/> Transportation
<input type="checkbox"/> Wetland	<input type="checkbox"/> Forest

BMP Inputs

Selected Basins: 607,606

Select a BMP:

- Integrated Pest Management
- Conservation Cover
- Conservation Buffer
- Grass Border

Filter by Applicable Pollutant: [Clear](#)

Glyphosate

Filter by Applicable Landuse: [Clear](#)

Agricultural

mapbox

Improve this map

Example Screenshots

The screenshot displays the Clackamas River Water Providers website, specifically the Pollutant Load Modeling Tool v2.0. The browser window shows the URL `crwp-pollutant-load-model.azurewebsites.net/#`. The navigation bar includes links for ABOUT, GETTING STARTED, and BMP REFERENCE. The main interface features a map of the Clackamas River watershed with various land use and basin overlays. A 'Layers' panel on the left shows 'User Input Layers' with 'Landuse' and 'Subwatershed Areas' checked. A 'Landuse' legend at the bottom left identifies colors for Agricultural, Open Space, Residential, Wetland, Commercial, Public Space, Transportation, and Forest. A 'BMP Inputs' panel on the right shows 'Selected Basins: 607,606' and a dropdown menu for 'Select a BMP:' with options like Media Filter, Organic Farming, Drinking Water Protection Zones, No-Till or Reduced Till, and Cover Crops. Below this are filters for 'Filter by Applicable Pollutant:' (set to Glyphosate) and 'Filter by Applicable Landuse:' (set to Agricultural). A 'Set BMP Landuse Allocations' section has a dropdown for 'Agricultural' set to '15'. A 'GENERATE RESULTS' button is at the bottom of the panel. The map is powered by Mapbox.

Example Screenshots

The screenshot shows a web browser window with the address bar displaying `crwp-pollutant-load-model.azurewebsites.net/#`. The browser's taskbar includes several open applications: BST, ChromeRiver, FTP Client, FTP Internal, HR & Payroll, IT HelpDesk, MailExpress, Office 365 Outlook, Office 365 Portal, Sharepoint, and Imported From IE.

The main content area displays the 'Clackamas River Water Providers' logo and a 'Pollutant Load Modeling Tool v2.0' interface. A 'Confirm Submission' dialog box is overlaid on the map, containing the following information:

Confirm Submission

Results can take up to 30 seconds to generate - are you ready to submit your landuse allocations?

Project Title
Name your BMP Scenario

Project Description
Describe your scenario

Pollutant of Concern
Glyphosate

BMP Allocations by Landuse

Land Use	BMP	Percent Implementation
AGR	Organic Farming	10
	Cover Crops	15

At the bottom right of the dialog box, there are two buttons: **CONFIRM** and **CANCEL**.

Example Screenshots

The screenshot displays the CRWP PLMT web application interface. The browser address bar shows the URL `crwp-pollutant-load-model.azurewebsites.net/#`. The application header includes the Clackamas River Water Providers logo and navigation links for ABOUT, GETTING STARTED, and BMP REFERENCE. The main content area features a map of watershed basins with a legend for Glyphosate Load Reduction Percentage (lbs) and a 'Load Reduction Results' panel. The legend shows color-coded ranges from 0.0 to >10.1. The 'Load Reduction Results' panel includes a 'Result Layer Type' dropdown set to 'Load Reduction Percentage', a 'Pollutant Load Reduction Layers' dropdown set to 'Glyphosate', and buttons for 'CLEAR RESULTS' and 'PRINT RESULTS'. A blue overlay box on the right indicates 'BMP Inputs' with 'Selected Basins: 607,606'. The map shows several basins highlighted in orange and brown, indicating higher load reduction percentages. The background map includes labels for 'Mount Hood Wilderness', 'Mount Hood National Forest', and 'Mount Hood National Recre Area - Mour Hood Unit'.

Load Reduction Results

Result Layer Type
Load Reduction Percentage

Pollutant Load Reduction Layers
Glyphosate

CLEAR RESULTS PRINT RESULTS

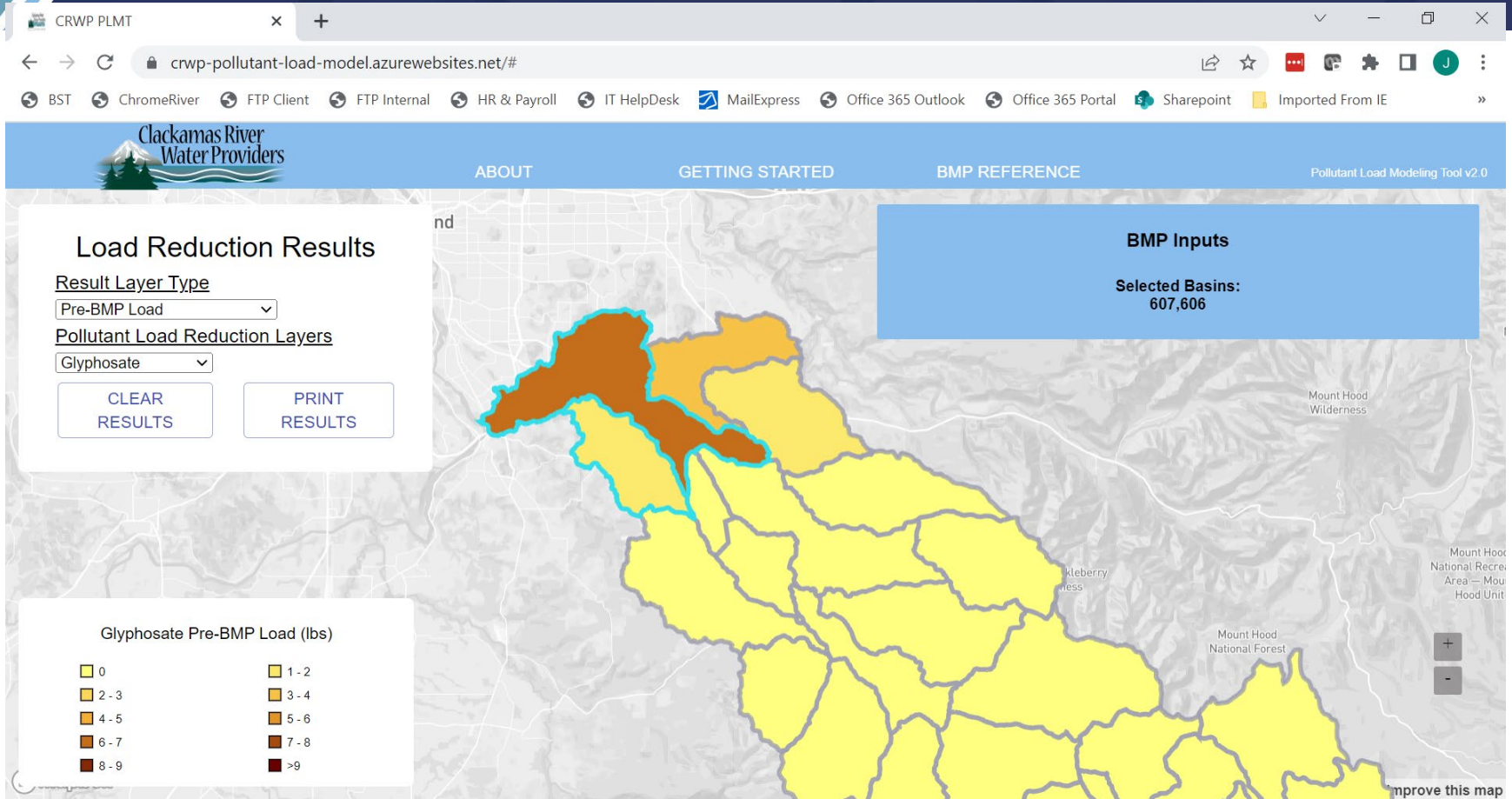
BMP Inputs

Selected Basins:
607,606

Glyphosate Load Reduction Percentage (lbs)

0.0	0.1-2.0
2.1-4.0	4.1-5.0
5.1-6.0	6.1-7.0
7.1-8.0	8.1-9.0
9.1-10.0	>10.1

Example Screenshots



Example Screenshots

The screenshot shows a web browser window with the URL `crwp-pollutant-load-model.azurewebsites.net/#`. The page content includes the Clackamas River Water Providers logo, a project title, a description, a table of BMP Allocations by Landuse, a map of GLY Load Reduction Percentage, and a table of GLY Load Results. A print dialog is open on the right side of the browser window.

Project Title
Project Description

BMP Allocations by Landuse

Land Use	BMP	Percent Implementation
AGR	Organic Farming	10
	Cover Crops	15

GLY Load Results

Subbasin	Pre-BMP Load	Post-BMP Load	Load Reduction	% Reduction
606	1.51	1.39	0.116	7.69
607	6.85	6.31	0.537	5.07

Print Dialog Settings:
Destination: Por-C5255-B&W on po
Pages: All
Copies: 1
Layout: Landscape
Color: Color
More settings: [dropdown arrow]

Buttons: **Print**, **Cancel**