Watershed Restoration Prioritization Project

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Course INFM 737: Information Management Capstone Experience

The University of Maryland– College Park

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PALS - Partnership for Action Learning in Sustainability

An initiative of the National Center for Smart Growth

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Project Overview

- Collaborative effort between PALS, the National Center for Smart Growth and UMD iSchool
- Partner with Stormwater Management Division of the Department of the Environment (DOE), Prince George's County, on an environmental challenge: to restore clean water to the Chesapeake Bay area
- Problem: County needs an automated tool to prioritize watershed restoration projects by Total Maximum Daily Load (TMDL) of pollutants
- Solution: Use current land use and TMDL datasets to calculate, aggregate and visualize three main TMDLs to standardize project prioritization decisions

Project Evolution

Planned

Fall: Planning Phase

- Project documents preparation
- Research and learning

Spring: Implementation Phase

- Task completion
- Handover deliverables

Actual

- Scope change: narrowed datasets to pollutant load and land use categories only
- Name change: from “Restoration Project Prioritization” to “Watershed Restoration Prioritization”
- Schedule change: new tasks to reflect shortened implementation time (8 weeks) and narrowed scope
- Documentation change: Rewritten to reflect scope and schedule changes

Deliverable: Automated Tool

Two parts

- Calculation Tool
  - Utilizes land use and TMDL data to calculate total TMDLs
- Visualization
  - Displays TMDL loads by type and by rank

Benefits

- More effective and efficient decision-making
- No existing tool of its kind
- Can be used immediately
- Scalable

Project Management

Implementation Team

- Calculation Tool:

  Binguan Zhang

  Xinyun Zhang

- Visualization:

  Sheryl Mathias

Work Flow Process

- Reported weekly to Derek Winogradoff via email
- Worked closely with Charles Walsh, GIS Specialist
- Met weekly with UMD project management team

Project Background

- The goal is to serve DoE's mission to **improve water quality** and **satisfy the Federal Mandate** to meet the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) requirement of reducing nitrogen, phosphorus, and sediment in Prince George's watersheds by 2025. The requirement is set by the EPA.
- Currently design teams **select projects on a site by site basis**, based on information sources such as SharePoint, MS Project, PGAtlas and field study. There is no existing visualization or scoring tool that prioritizes projects based on how much nitrogen, phosphorus, and sediment is produced in an area.
- This project's objective is to **prioritize areas for restoration based on the amount of pollutants a site is producing, thus saving energy, effort, time, and making the process more cost effective.**

Calculation Tool

Overview

- The tool calculated nitrogen, phosphorus, and sediment in a certain area based on the Chesapeake Bay Program land use classifications and the Maryland Department of Natural Resources 12-digit watershed as the analysis area.

- The calculation process can be implemented in any area to calculate pollutants generated by the amount of land use.

- It ranks pollutants produced in each watershed based on Chesapeake Bay Program land use.

- Users can change data input fordifferent analyses and configure data analysis mechanism to produce different results.

Calculation Tool

Input

- Datasets with the **same** format
- Given the amount of each land use classification within each watershed

	OBJECTID_1	gridcode	DNR12DIG	Land_Use	Acres	Shape_Leng	Shape_Area
0	1	1	21402010792	1	12.939163	8.603137e+04	5.636277e+05
1	2	1	21402010794	1	381.401959	1.252578e+06	1.661380e+07
2	3	1	21402010796	1	435.467062	1.322138e+06	1.896887e+07
3	4	2	21402010792	2	40.086592	2.316064e+05	1.746165e+06
4	5	2	21402010794	2	627.789741	3.236300e+06	2.734641e+07

Calculation Tool

Output

- TN, TP, TS for each watershed
- Using pollutant load as multiplier

Pollutant Load Parameters [1]

Annual Loads per Acre in lbs	
Urban Impervious Runoff Load	
Total Nitrogen (TN)	15.30
Total Phosphorus (TP)	1.69
Total Suspended Solids (TSS)	880.00
Urban Pervious Runoff Load	
Total Nitrogen (TN)	10.80
Total Phosphorus (TP)	0.43
Total Suspended Solids (TSS)	140.00

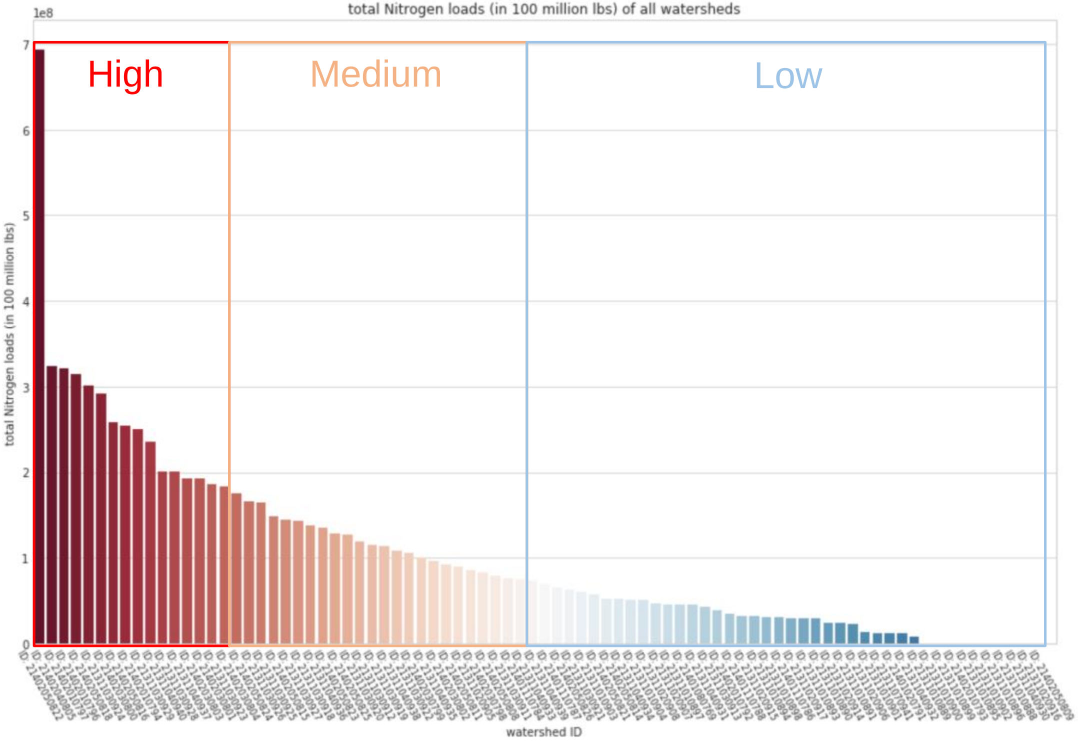
	watershed	total_N	total_P	total_S
0	21311010888	3.232984e+04	1.287207e+03	4.190906e+05
1	21311010889	3.353216e+05	1.335077e+04	4.346762e+06
2	21311010890	2.351276e+07	1.372645e+06	5.800823e+08
3	21311010891	2.257368e+07	1.293187e+06	5.413773e+08
4	21311010893	2.894397e+07	1.536511e+06	6.174537e+08

Calculation Tool

Determines low, medium, high by percentiles

Configurable

- Low: 0-50%
- Medium: 50-80%
- High: 80-100%



Calculation Tool

Output: once each watershed is assigned an HML for each pollutant, the watershed could be ranked by pollutant produced

- Rank = 1: if the watershed has 3 pollutant(s) considered high in regard to loads, 0 being medium, and 0 being low.
- Rank = 2: if the watershed has 2 pollutant(s) considered high in regard to loads, 1 being medium, and 0 being low.
- Rank = 3: if the watershed has 2 pollutant(s) considered high in regard to loads, 0 being medium, and 1 being low.
- Rank = 4: if the watershed has 1 pollutant(s) considered high in regard to loads, 2 being medium, and 0 being low.
- Rank = 5: if the watershed has 1 pollutant(s) considered high in regard to loads, 1 being medium, and 1 being low.
- Rank = 6: if the watershed has 1 pollutant(s) considered high in regard to loads, 0 being medium, and 2 being low.
- Rank = 7: if the watershed has 0 pollutant(s) considered high in regard to loads, 3 being medium, and 0 being low.
- Rank = 8: if the watershed has 0 pollutant(s) considered high in regard to loads, 2 being medium, and 1 being low.
- Rank = 9: if the watershed has 0 pollutant(s) considered high in regard to loads, 1 being medium, and 2 being low.
- Rank = 10: if the watershed has 0 pollutant(s) considered high in regard to loads, 0 being medium, and 3 being low.

Visualization Dashboard

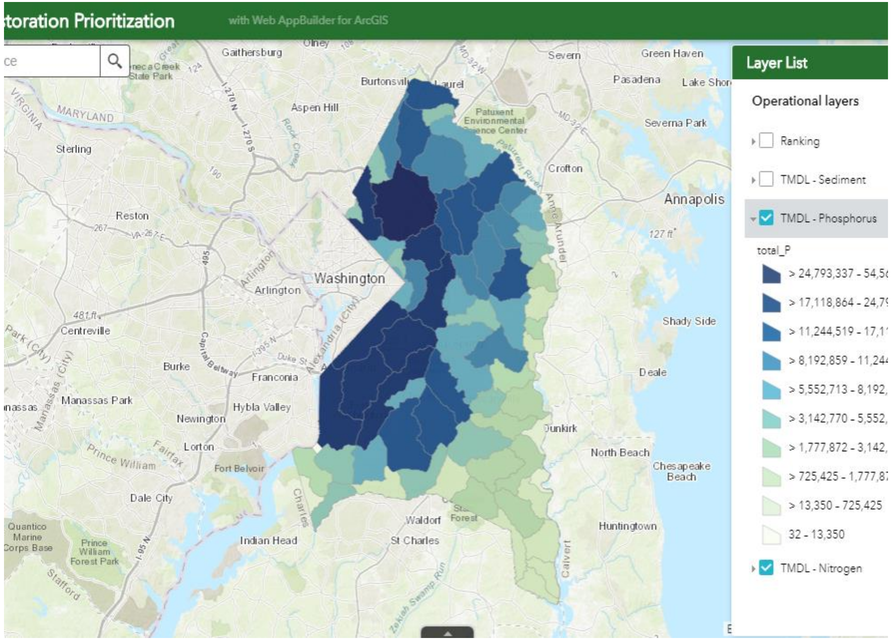
Overview

The data visualization dashboard is a web mapping application using ESRI ArcGIS. It enables the user to view watersheds in two displays: Simple Display and Ranking Display.

- Simple Display: shows nitrogen, phosphorus and sediment for each watershed as a separate item on the map.
- Ranking Display: is a map with layers for each watershed ranked based on the TMDL of pollutants in each watershed.

Simple Display - Phosphorus Layer

- The map represents all watersheds classified by the amount of phosphorus produced.
- The darker shades of blue represent watersheds that generate the highest amount of phosphorus analyzed by the tool.
- Color coding scheme for the three pollutants was provided by Derek Winogradoff and Charles Walsh.



Ranking Display

- The map represents all watersheds color-coded and categorized by rank.

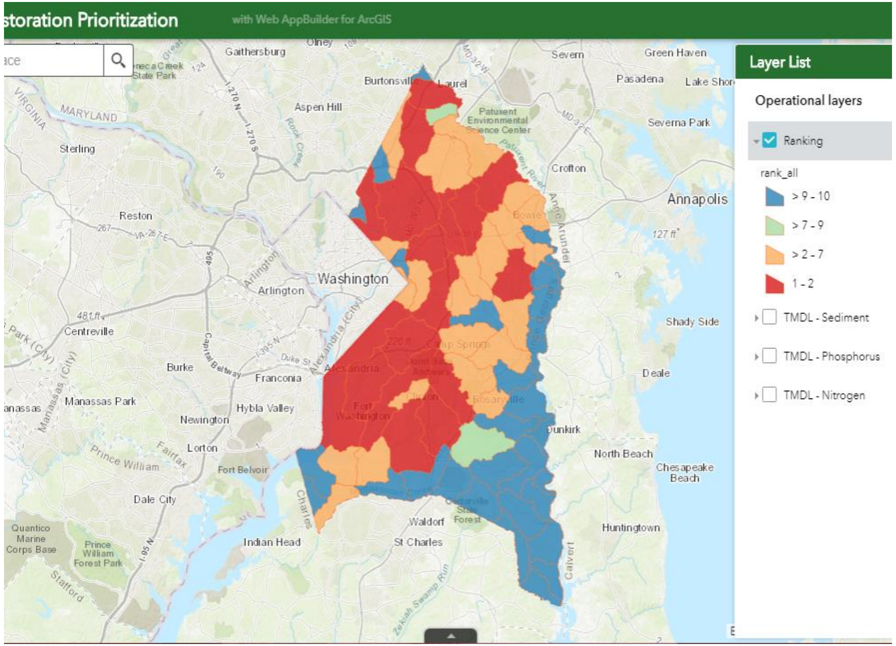
  Red: High (Ranks 1-2)

  Light Orange: Medium? (Ranks >2-7)

  Light Blue: Medium? (Ranks >7-9)

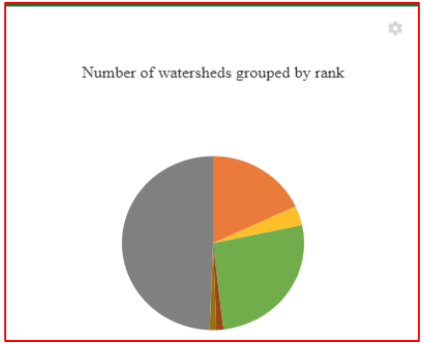
  Blue: Low (Ranks > 9-10)

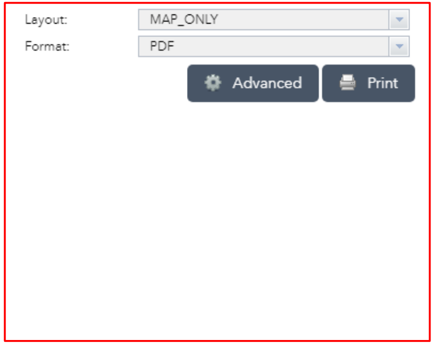
- When a user hovers over the pie chart, relevant watersheds are highlighted on the map.

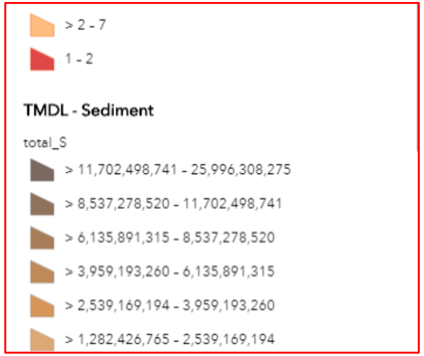


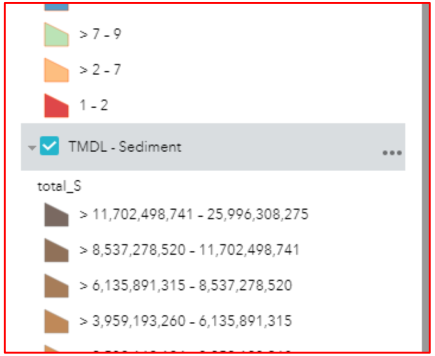
Use of Widgets

- This infographic widget displays a pie chart that categorizes watersheds by rank.
- Each pie slice is a subset of watersheds for a specific rank.
- Used Print widget, which allows the user to print the map in any format: PDF, JPG, GIF and PNG.
- Used the legend and layer widget to represent the three pollutants and ranks as four map layers.









Findings

1. The Anacostia watershed near College Park has a land use composition that generated the most pollutants

2. The watershed near the Washington Metropolitan area generates the most pollutants

3. The watersheds that produced high values for all three pollutants have similar land use compositions

Wrap-Up

- Handover of code for tool
- Thank you to DoE for consulting experience
- Thank you to Technical Staff for support
- Thank you to PALS and the National Center for Smart Growth for the opportunity to undertake real world solutions