

R Shiny Applications

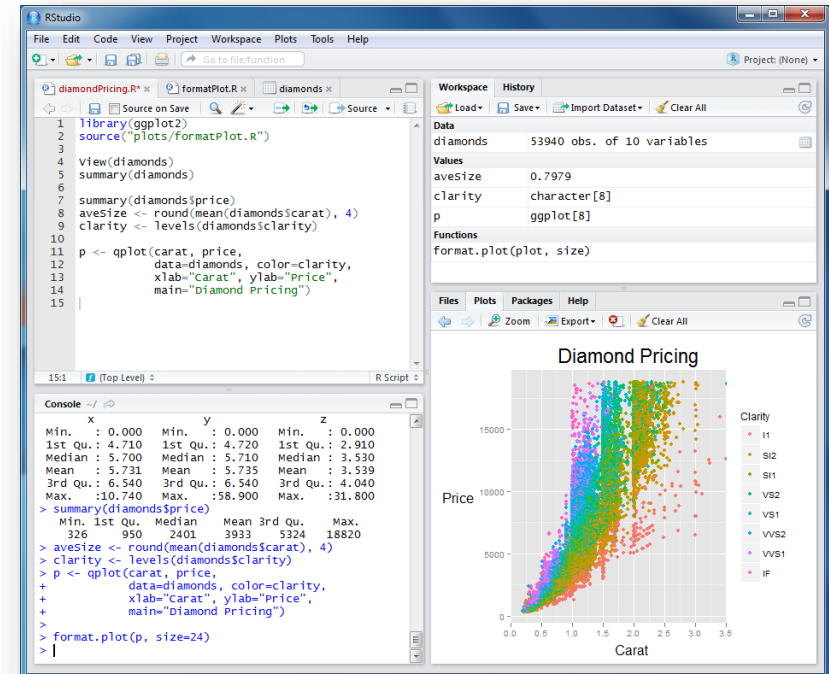
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What is R?

- Statistical Programming Language
- Free and Open Source
- Over 10,000 packages for both general-purpose statistical libraries and niche analytical methods.
- R can be used via it's native GUI or a third party software such as R Studio.



What is R Studio?



- R Studio is an Integrated Development Environment (IDE).
- An IDE is software where you can write lines of code, execute them in R*, and see the results.
- R Studio also develops its own libraries for specific functions for data science purposes.
- Both R and R Studio are free.

Geospatial data



- R has many packages available to manipulate and create geospatial data
- Plotting and mapping with mapview, leaflet, ggplot2
- ESRI integration

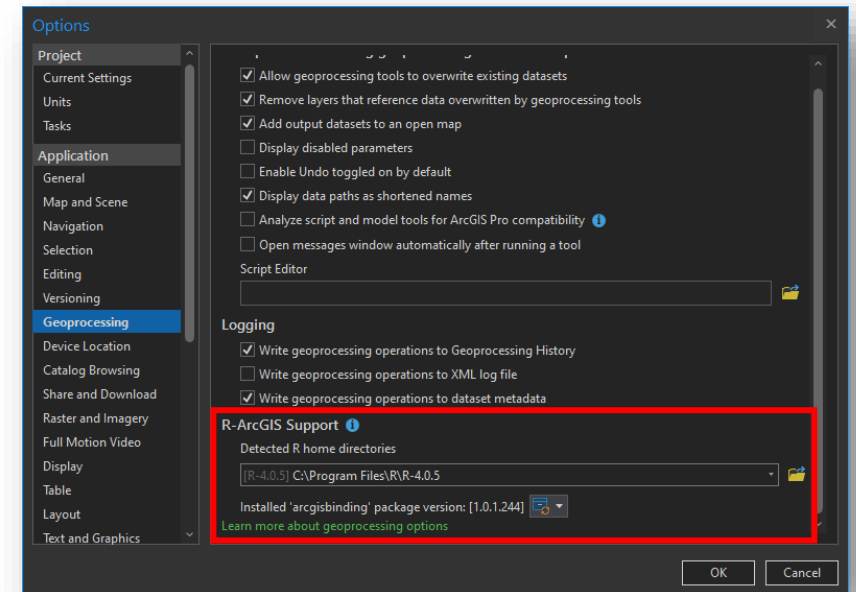


R – ArcGIS Bridge

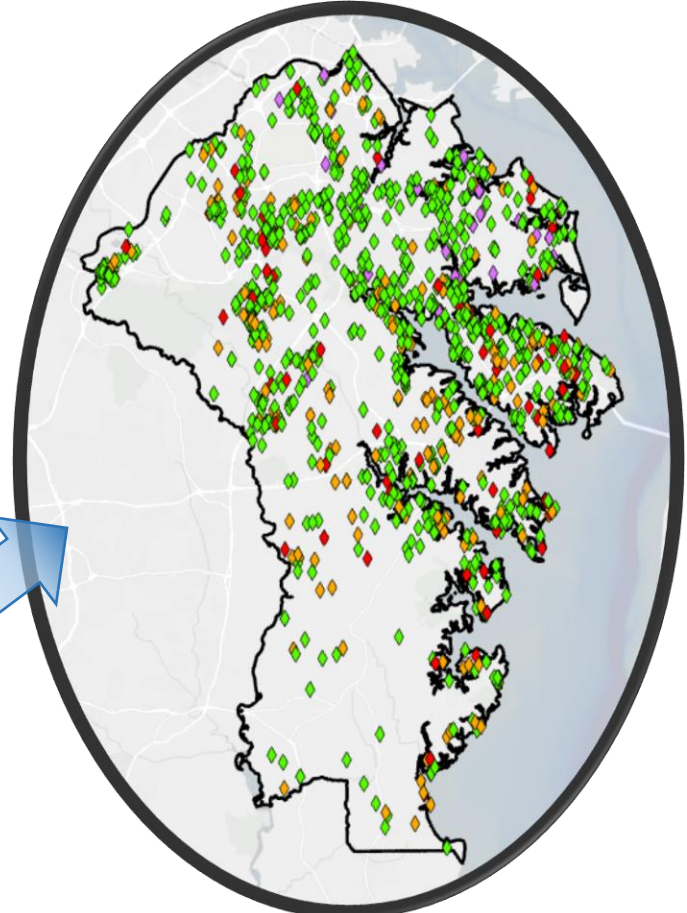
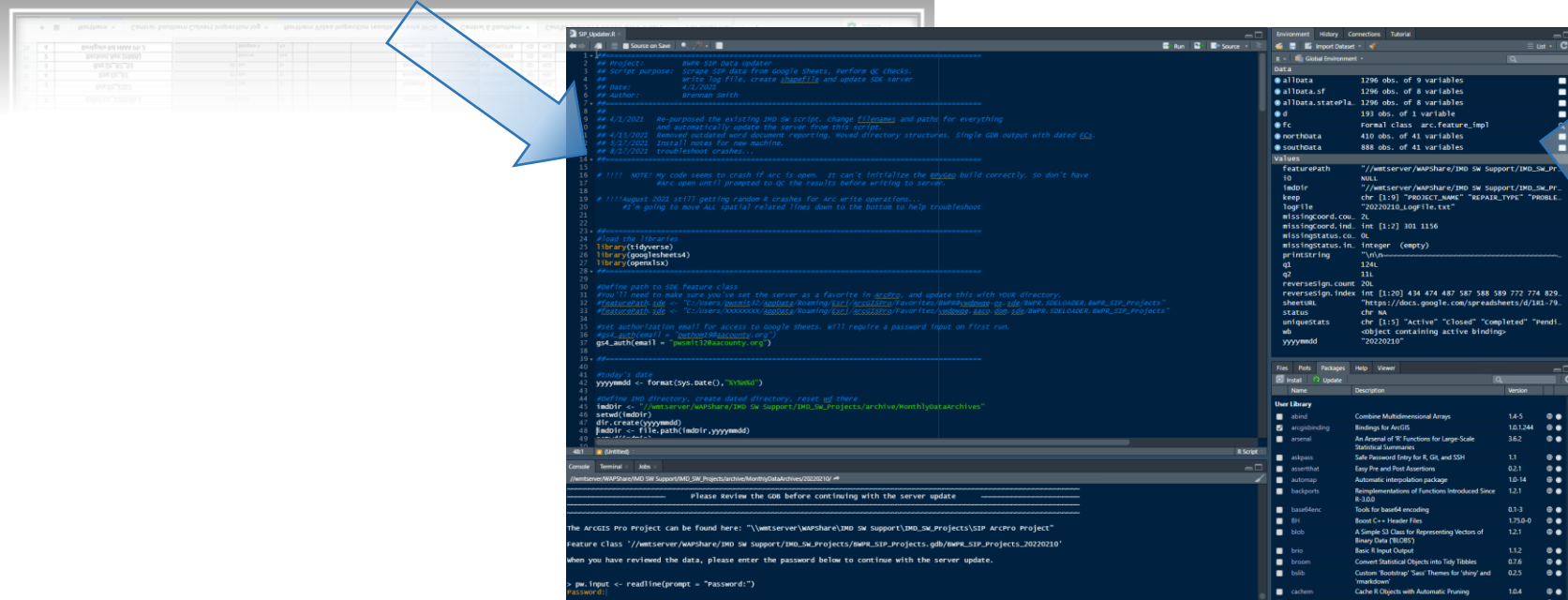
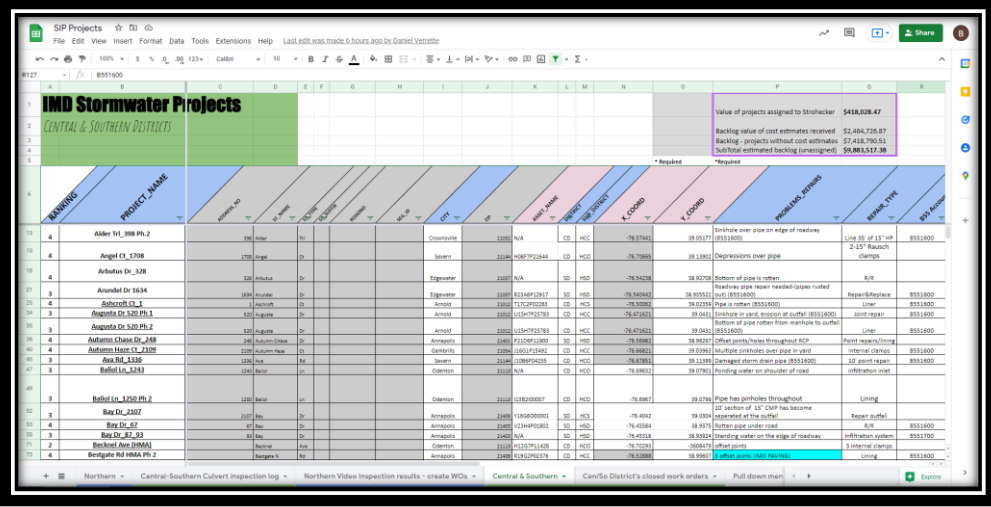
- Connects the two software packages
- Seamlessly convert and transfer data between R and ArcGIS
- R package 'arctgisbinding'



```
1 library(arctgisbinding)
2 arc.check_product()
```



R – Streamline Workflows

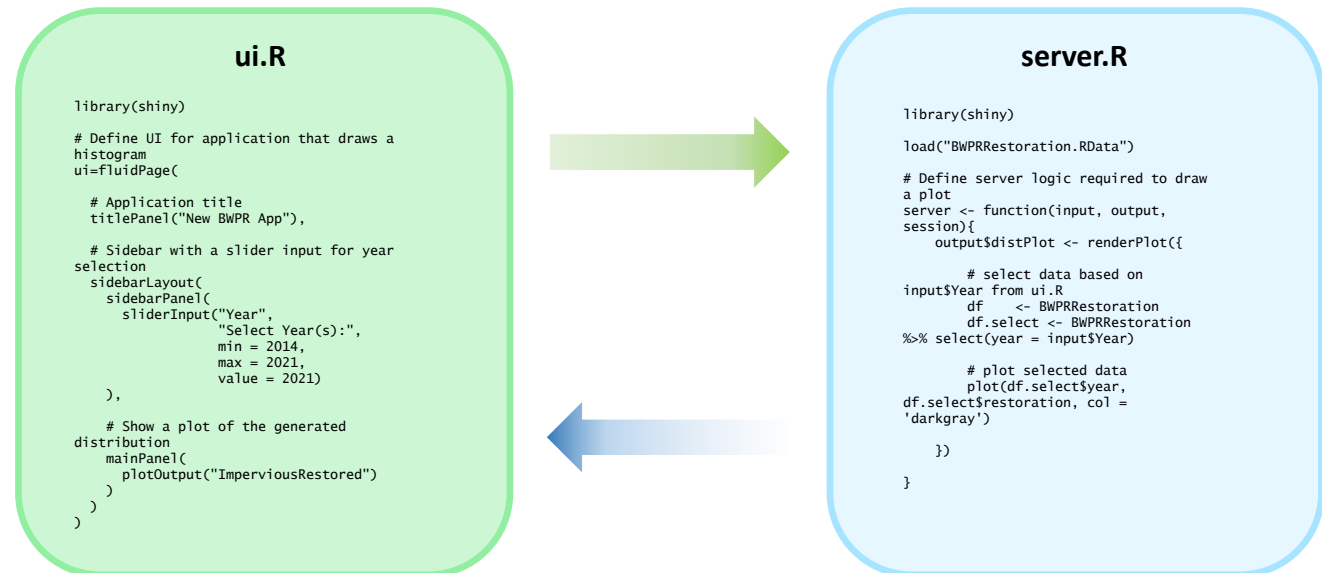


Shiny is a library, developed by R Studio



shinyapps.io

- Shiny allows you to build interactive web/desktop/mobile apps using R.
- Shiny works using two scripts, one controlling the interface, and one controlling the back end processes. The two scripts react to each other.



What kind of applications?

Web Form – Credit Calculator

- Standardized interpretation of regulations
- Updates can be pushed centrally, meaning the latest version will always be online.
- Popup boxes give help and prompt the user, meaning that the tool is self-explanatory.

The screenshot shows the Anne Arundel County Maryland website. The header includes the county logo, a search bar, and navigation links for GOVERNMENT, DEPARTMENTS, SERVICES & PROGRAMS, OPENARUNDEL, and BUSINESS. A blue breadcrumb trail shows the path: Home > Departments > Department of Public Works > Bureau of Watershed Protection and Restoration > BMP Credit Calculator.

BMP Credit Calculator

BWPR's credit calculator was developed to assist NGOs and others to estimate potential impervious restoration credit and TMDL reductions from their project. Please select the relevant tab to enter data and estimate the credit and reductions.

Note: this tool is provided 'as is' without warranty of any kind, either expressed, implied, or statutory. The user assumes the entire risk as to quality and performance of the data from this tool.

[Contact](#)

Navigation tabs: Structural BMP (selected), Stream Restoration, Outfall Stabilization or SPSC, Shoreline Restoration, Land Cover Conversion, Soil Compaction, Alternative Surfaces, Non-Structural BMP, Land River Segment Map, Shoreline Erosion Map.

Input values:

BMP type: [Please select an option below]

Drainage area (ac): [] **Impervious area (ac):** []

WQv (ac/ft): [] **C3 practice eligible for GSI?** [Please select an option below]

Land river segment: [Please select an option below]

Impervious and TMDL credit:

Impervious surface restored (ac):
Enter values to calculate EIA

Total nitrogen reduction (lbs):
Enter values to calculate TN Reduction

Total phosphorus reduction (lbs):
Enter values to calculate TP Reduction

Total suspended sediment reduction (lbs):
Enter values to calculate TSS Reduction

<https://www.aacounty.org/departments/public-works/wprp/bmp-credit-calculator>

Web Form – Geospatial Component

- Standardized interpretation of regulations
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The screenshot displays the Anne Arundel County Maryland website's navigation bar, including the county logo, a search bar, and menu items for Government, Departments, Services & Programs, OpenArundel, and Business. A blue breadcrumb trail shows the path: Home > Departments > Department of Public Works > Bureau of Watershed Protection and Restoration > BMP Credit Calculator.

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Navigation tabs include: Structural BMP, Stream Restoration, Outfall Stabilization or SPSC, Shoreline Restoration, Land Cover Conversion, Soil Compaction, Alternative Surfaces, Non-Structural BMP, **Land River Segment Map**, and Shoreline Erosion Map.

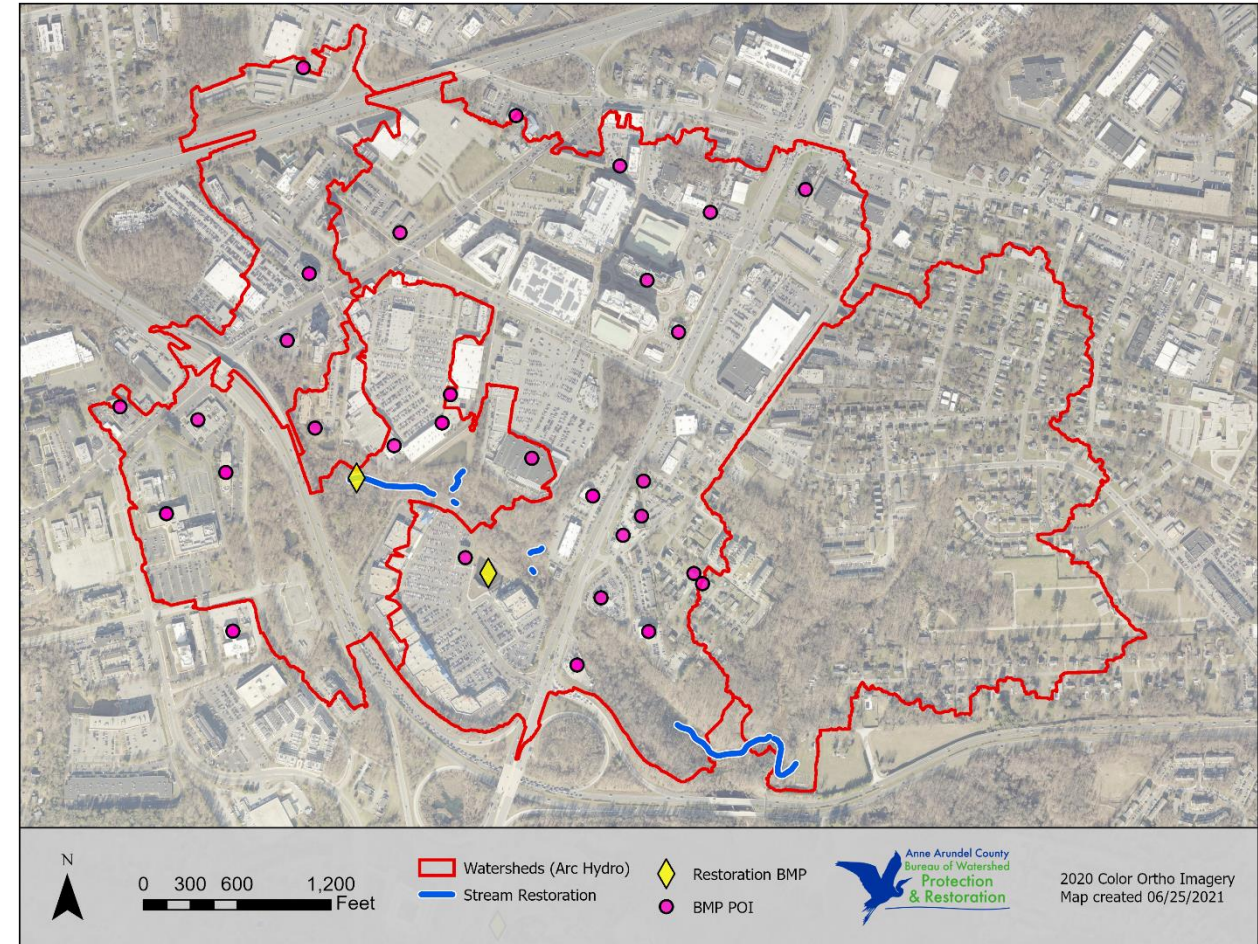
A light blue instruction box states: "Click on the land river segment in the location of the proposed BMP. Land River Segment ID will show in popup when clicking on the appropriate segment."

The main map shows a detailed view of the Annapolis area with various land river segments color-coded (yellow, orange, red, blue). Numerous locations are labeled, including Clarksburg, Columbia, Brooklyn Park, Edgemere, Riverside, Jessup, Fort George, G Mead Junction, Fort Meade, Pasadena, Arden on the Severn, Cape Saint Claire, Crownsville, Annapolis, Riva, Londontowne, Mayo, Kettering, Coral Hills, Washington, Merrifield, Vienna, Wolf Trap, Brookmont, Mount Rainier, Glenarden, Mitchellville, New Carrollton, Glenn Dale, Forest Glen, Kemp Mill, Calverton, Burtonsville, Rossmore, Darnestown, Travilah, Great Falls, and Stevensville. An inset map shows the location of the study area within the state of Maryland.

<https://www.aacounty.org/departments/public-works/wprp/bmp-credit-calculator>

Summarizing existing data

- Existing impervious treatment in a new BMP's drainage area needs to be accounted for when determining eligible credit.
- Determining the extent of existing treatment in an area of interest or a watershed can be laborious process.



Summarizing existing data

- Maps are interactive and data can be selected by drawing bounding boxes on the map.
- Shapefiles can be uploaded to summarize existing treatment within a drainage area.
- Selections are added to a summary table below the map, and added to a plot and table on the summary page.
- Reports are generated with Rmarkdown and LaTeX.

Restoration Summarizer Tool

BWPR's restoration summarizer tool was developed to assist BWPR and others to explore implemented restoration in Anne Arundel County. Please select the relevant tab to click on features and summarize the credit and reductions.

Note: this tool is provided 'as is' without warranty of any kind, either expressed, implied, or statutory. The user assumes the entire risk as to quality and performance of the data from this tool.

Contact

Summary

Restoration BMPs

Development BMPs

Guidance

The tool enables a user to summarize existing or planned impervious restoration credit and nutrient and sediment reductions across the County. Selecting a tab will load a map and table. Individual points can be selected and a summary popup will display. To summarize existing credit for an area, the user can zoom in and click the drawing tool bar on the left, draw a bounding shape to select features. The bounding shape can be drawn as a polygon, square, or circle. Selected features will turn yellow with a green outline and be added to a summary table below the map.

The total credit from all selected BMPs will be displayed on this page to the right, together with a graph that breaks down the credit by practice. This tool provides credit summaries to assist with data exploration.

Restoration BMPs

The Restoration BMPs tab contains all restoration BMPs that have been implemented in the County since the 2014 baseline year. The geometry of the BMPs in this tab are displayed as point features for ease of use. An option to select BMPs by upload a watershed shapefile is also included in this tab.

Development BMPs

The Development BMPs tab contains all BMPs that have implemented and are in the County's current inventory as of the end of fiscal year 2021. Some older stormwater BMPs may not be captured in this dataset due to incomplete County records. Likewise, recently implemented BMPs may not yet be refiled in this inventory.



Reset all selections

Download Report

Credit by BMP Type

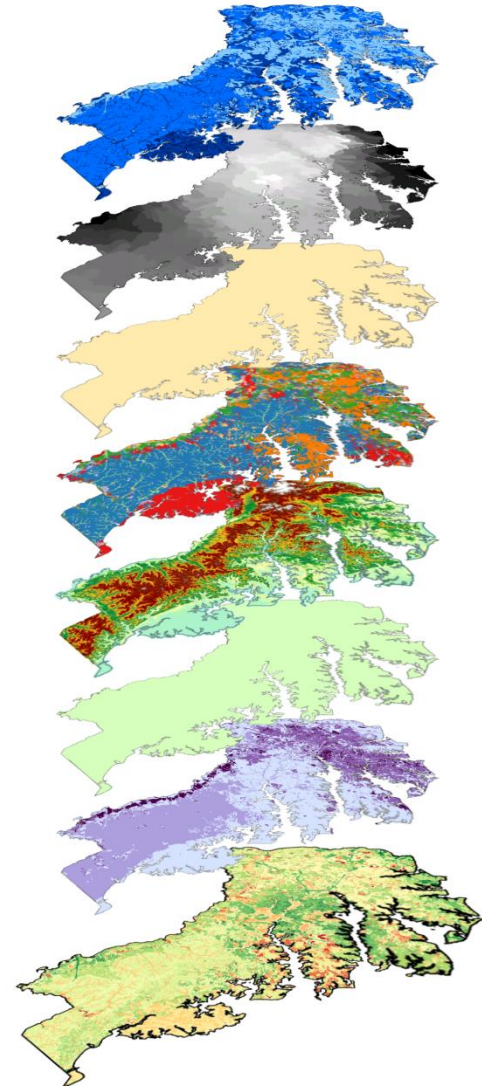
Select data to create plot.

Implemented Project Credit Summary

Select data to create table

Decision support tools

- Stormwater Best Management Practice implementation is typically reactive and opportunistic
- Decision support tools help find cost-effective opportunities to restore degraded watersheds and meet water quality goals
- Allowing the user to explore modeled data means that restoration opportunities can be scoped without waders



Decision support tools

- Restoration opportunities can be explored by clicking features.
- Selections are added to a summary table below the map, and added to a plot and table on the summary page.
- Reports are generated with Rmarkdown and LaTeX. Report sections are conditional on feature selections.

Restoration Estimator Tool

BWPR's restoration estimator tool was developed to assist NGOs and others to explore restoration opportunities, and estimate potential impervious restoration credit and TMDL reductions resulting from project implementation. Please select the relevant tab to click on features and estimate the credit and reductions.



Note: this tool is provided 'as is' without warranty of any kind, either expressed, implied, or statutory. The user assumes the entire risk as to quality and performance of the data from this tool.

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Summary

Stream Restoration

Riparian Planting

Shoreline Restoration

Upland Retrofits

Floating Treatment Wetlands

Guidance

The potential credit from different restoration measures were modeled across the County. Each of these practices has its own tab. Selecting a tab will load a map and table. To estimate potential credit for an area, the user can zoom in and click to select features.

Features can be selected by clicking directly on the feature or by selecting the Site ID from the dropdown box below the map. Selected features will turn red and be added to a summary table below the map. To deselect features, simply re-click or delete Site ID from the dropdown box.

The user can progressively work through the tabs to select potential restoration practices in their project area. The total credit from all BMPs will be displayed on this page to the right, together with a graph that breaks down the credit by practice. This tool provides estimates to assist with site selection, but field assessments must be conducted for official crediting. To reset all selections, click the 'Reset all selections' button to the right.

Stream Restoration

The stream restoration tab contains modeled credit available for ~200-ft segments of non-tidal streams across the County. The model uses LiDAR data collected in 2017 and 2020 and computes the volume changes in a 40-ft buffer around the stream network.

TSS was calculated by converting the annual volume loss by a bulk density value of 87.5 lb per cu ft. Restoration efficiency was assumed to be 50%, and therefore, the amount of TSS credit was halved. TN and TP credit were calculated by multiplying the TSS credit, at 50% efficiency, by default rates outlined in the Chesapeake Bay Expert Panel guidance. These values were 2.28 and 1.05 lbs per ton for TN and TP, respectively.

Only projects with Equivalent Impervious Area (EIA) treatment above 0.02 ac per linear foot for each 200-ft segment are displayed, as these are likely to be in need of restoration. Credit estimates only use Protocol 1. Projects with Protocol 2, 3, and 4 will likely have a higher total credit.

Riparian Planting

The riparian planting tab contains modeled credit for riparian areas within 100-ft of a perennial stream. Areas within the 100-ft buffer were selected if they were either owned by Anne Arundel County or its affiliates, within 100-year FEMA floodplain, or already

Reset all selections

Download Report

Credit by BMP Type

Once data are selected, the chart below displays the relative proportions of impervious acres restored, and the total nitrogen, total phosphorus, and total suspended solid reductions by BMP type.

Select data to create plot.

Summary Credit Table

Select data to create table

Thanks!



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