



SIMPLE POLLUTANT LOAD ANALYSIS

How to Use CAST to Answer Questions about Your Community




Abstract

This simple “How-To” document will walk you through 10 scoping questions that can be used to determine what information is in the Phase 6 Chesapeake Watershed Model for your community and help you build an effective and efficient pollutant reduction plan or implementation plan.


Olivia Devereux and David Wood


Q1. What is the current land use 🌿 in my jurisdiction and where can I quickly access these data?


Using [CAST](#), you can download a table of the land use for any year between 1985 and 2025 for many geographic scales.

1. Log in to [CAST](#)
2. Select Results > Reports from the ribbon at the top.
3. Select Report type = “Base Conditions” 
4. Name your report whatever you’d like. (We recommend making it a name that tells you something about what is in it)
5. Select the desired Geographic Scale and Geographic Area. There are many options, but for most purposes, we recommend choosing the county you are located within. We will discuss how to parse your localized land use data (i.e. township or city) in Qx.
6. Select the desired scenario. Annual scenarios are named like “2017 Progress” . If you are looking for your current land use, select the most recent year available.
7. Click the “Submit Report” button
8. You will be emailed a copy of your report. You can download the report from your email or switch to the “Download Reports” tab next to the Create Reports tab and click “Download”.
9. In the Excel spreadsheet, go to the tab titled “Land Use Acres” and you will find the acres of each land use before and after BMPs.  The acres are also broken out by the agency that owns the land (i.e. Non-Federal or Department of Defense). From here, you can create subtotals or otherwise manipulate the data to view it however is most convenient.

If you prefer, you can view the spatially explicit land cover data by going to the [USGS Land Viewer](#). GIS files may be downloaded for each state in the Chesapeake Bay Watershed. Note that these data are not the final land data used in the model.

 **Land Use** categories represent how humans use the land. For example, roads or buildings as opposed to impervious.

 **Base Condition** reports show you the land use acres with and without the impact of BMPs

 A **Progress Scenario** shows you the land uses before and after accounting for all the BMPs reported by the state for the year indicated

[illegible]

Q2. How do I find out how my pollutant loads and land uses are projected to change for various 2025 development scenarios for my community?

Using [CAST](#), you can compare your current pollutant loads and land uses to your 2025 projected loads and land uses. To do this, you create two scenarios for your geographic area, the first scenario will be your baseline and the second will be for a future year. You can then download both scenarios in a single report to easily compare them. 🌿

➤ Login to [CAST](#), select Add New Scenario

1. This scenario is your first point of comparison and is a baseline condition.
2. Name your first scenario and add a description that will be useful to you. This scenario will represent your current pollutant loads and land uses.







3. For BMPs Available, select “Planning BMPs” 🌿
4. For Geographic Scale, select what makes sense for your area. If you’re not sure, we recommend starting with “county”. We can apply the results to a more local result later on.
5. Once Geographic Scale is selected, choose your Geographic Area. Multiple areas may be selected.
6. Select the Base Year. This is the year you want to use as your first point of comparison. You probably want to select the current year.
7. Select the Base Condition. 🌿 There are two base conditions available. A description of each pops up when you hover over it. If you aren’t sure, we recommend “Historic Trends”.
8. Select a Wastewater Dataset. Typically, you will use the same year you used for your Base Year in Step 6.
9. Select Cost Profile. Costs are estimated for each state as well as a watershed average. You also have the option to create

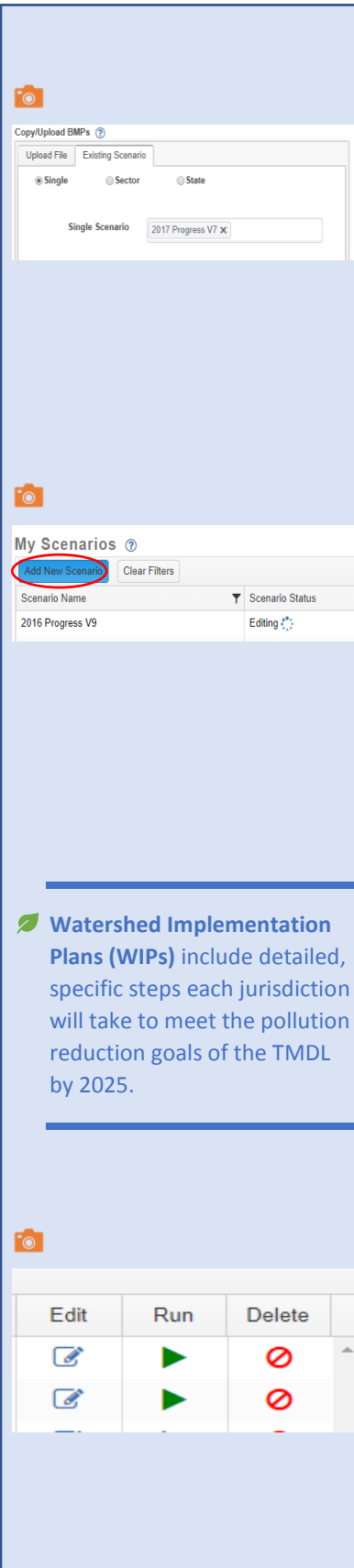
🌿 Acres of turf and acres of impervious surface are expected to increase in most parts of the watershed. Knowing the projected changes in your community can help you plan to offset that growth.

🌿 **Planning BMPs** include some BMPs that are not eligible for Chesapeake Bay TMDL reductions because they are either still under review or have not been approved by the Bay Program partnership.


🌿 **Base Conditions** define the land use, number of septic systems, and number of animals for the selected year.

your own cost-profile with more locally-appropriate data if you have it. That will not be covered in this document.

10. "Share this Scenario" and "Notes" are not required. You can skip these sections.
 11. Copy BMPs from an existing scenario.  This option is under "Copy/Upload BMPs" below the "Notes" box. "Existing Scenario" is on the second tab. Select "single" and select the Base Year that you are used in Step 6. This allows you to see what your pollutant loads and land uses are with all the BMPs that you have already implemented and reported to the Chesapeake Bay Program.
 12. Click Save.
- Now, create your second scenario for comparison by clicking Add New Scenario button. 
1. Click on the button at the top that says Copy Existing Scenario Without BMPs.
 2. Select the scenario that you just created from the list. Rename your second scenario something like Township2025 and add a description that will be useful to you. This scenario will show how your pollutant loads and land uses are projected to look like in 2025.
 3. Change Base Year to 2025.
 4. Change Wastewater dataset to WIP2. WIP2 represents the projected pollutant caploads from wastewater plants under the Phase 2 Watershed Implementation Plans . The Phase 3 WIPs are under development and not available yet.
 5. Copy BMPs from an existing scenario exactly as you did for your first scenario. If you selected the 2017 Progress, then do so again. Keeping the BMPs the same means that you will be assessing the effect solely of land use change and Combined Sewer Overflow (CSO) connections.
 6. Click Save.
- Click run on both scenarios once they are done validating. 
- When both have a scenario status of Run Finished, go to the Results>Compare Scenarios item in the top ribbon menu.
- Select the same Geographic Scale that you did in your two scenarios.
- Select the Agencies of interest. Unless you are a federal agency, you likely will select "Non-federal".
- Select the two scenarios you just created. You can add in others if you like, but it is not necessary.



The screenshot shows two parts of the software interface. The top part is a 'Copy/Upload BMPs' dialog box with tabs for 'Upload File' and 'Existing Scenario'. The 'Existing Scenario' tab is active, showing radio buttons for 'Single', 'Sector', and 'State'. The 'Single' option is selected, and a text box shows '2017 Progress V7.X'. The bottom part is a 'My Scenarios' table with a table header and one row of data.

| Scenario Name | Scenario Status |
|------------------|---|
| 2016 Progress V9 | Editing  |

Below the table, there is a section titled 'Watershed Implementation Plans (WIPs) include detailed, specific steps each jurisdiction will take to meet the pollution reduction goals of the TMDL by 2025.'

At the bottom of the screenshot, there is a table with three columns: 'Edit', 'Run', and 'Delete'. Each column has a corresponding icon: a pencil for 'Edit', a green play button for 'Run', and a red prohibition sign for 'Delete'.

- Select Compare Scenarios
- There are three tabs with results. You can explore the comparison of the acres, loads, and even see the percent change in loads. Tables can be downloaded from these pages.
- If you prefer to see the data all in one place on an excel spreadsheet, go to Results>Reports and download a Loads report. When you select the scenarios, just add both and they will be side-by-side in the downloaded report.

Q3. Can we earn additional pollutant reductions due to our local planning and zoning efforts and land development regulations? 🌱

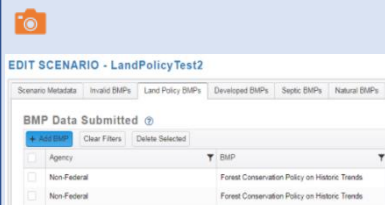
Yes! Land Policy BMPs reflect land management policy decisions such as zoning. To use these BMPs when editing a scenario, simply select the land policy option and then select the state or county where the selected Land Policy BMP will be implemented 📍. There are three primary Land Policy BMPs available with more being developed. Descriptions are below and more information is available on the [CAST User Documentation](#) page under Edit Scenarios, Land Policy BMPs.

Forest Conservation-Organizations and governments proactively pursuing a variety of actions to conserve forests and wetlands which provide the greatest benefits to wildlife, human safety, and water quality. Example priority areas include riparian zones, shorelines, large contiguous forest tracts, and other high-priority forest conservation areas.

Growth Management-Organizations and governments proactively pursuing a variety of actions to encourage growth in areas with supporting infrastructure. Example priority areas include undeveloped or under-developed areas with adequate existing roads, wastewater, and water supply infrastructure.

Agriculture and Soil Conservation-Organizations and governments proactively pursuing a variety of actions to conserve farmland and productive soils. Example priority areas include agricultural districts, prime farmland, farmland of state importance, floodplains, and other high-priority farmland conservation areas.

🌱 **Land Policy BMPs must be proactive and implemented between 2018 and 2025.** Existing planning and development regulations are already accounted for in 2025 land use change and pollutant load projections.



Q4. Which BMPs are we currently receiving pollutant reductions for in the Chesapeake Bay Model/CAST?

Using [CAST](#), you can download a report with all the BMPs for the geographic area in which you are interested. 🌿

- If you would like a BMP report for your geographic area, log in to [CAST](#).
- 1. Using the ribbon at the top of the screen, select Results > Reports.
- 2. Choose a “Report Type”. “BMP Summary” will provide you with the basics, or “BMP Submitted vs. Credited” will give you more detail. 📷
- 3. Name your report.
- 4. Select Geographic Scale and Geographic Area.
- 5. Select the scenario. There are reports for every year from 1985 to 2017 along with the Phase 2 WIP. 🌿
- 6. Click the “Submit Report” button.
- 7. You will get an email with a link to the report. You may also see the report by clicking on the second tab on that page named Download Report and clicking the download icon. Open the excel file.

Part 2. Knowing Your Commitments

Q5. How much load reduction is voluntary and how much is mandated under our local MS4 stormwater permit?

Communities that are within a municipal separate storm sewer system (MS4) boundary are modeled as separate load sources in CAST. Reports that do not aggregate load sources allow you to tally loads, costs and areas for the MS4 areas separate from the combined sewer system (CSS) and nonregulated areas. BMPs can be specified for MS4, CSS, or nonregulated areas as well.

MS4 Developed Load Sources:

- Regulated Construction
- MS4 Buildings and Other
- MS4 Roads

🌿 Details with definitions of BMP names and load sources are available under [Source data](#) on the home page.




🌿 If you choose 2017 Progress, you will see all BMPs implemented in your selected geographic area as of the year 2017. Phase 2 WIP shows you the BMPs that were in the Phase 2 Watershed Implementation Plans for 2025.


- MS4 Tree Canopy over Impervious
- MS4 Tree Canopy over Turf Grass
- MS4 Turf Grass


States will also be developing [Local Planning Goals](#) in 2018 to help local governments coordinate and plan implementation efforts. Local Planning Goals can be compared against any pollutant load reductions required in your MS4 permit (if you have one) to see how much additional voluntary effort may be requested to help meet Chesapeake Bay TMDL goals.


Q6. How much sediment or phosphorus load is our community expected to reduce in the next ten years?

Reductions by 2025 should be provided to local partners by their state environmental agency. There are draft planning targets for each state's portion of a major river basin  available on the CAST homepage under [Develop A Plan](#). These will be replaced with final planning goals developed by the state when they are ready, anticipated mid-2018. Communities regulated under an MS4 permit already may be committed to reducing loads during their next permit term.

Q7. If pollutant loads in my community are expected to grow over the next decade, do I need to offset this growth with additional pollutant reductions?

Yes. The expectation in the [2010 Chesapeake Bay TMDL for Nitrogen, Phosphorus and Sediment](#) is that all new loads will be offset. As discussed in Q2 and Q3, high pollutant-loading land uses, like turf and impervious cover are expected to increase by 2025 as a result of a growing population. To help account for this, the Phase 3 Watershed Implementation Plans (WIPs) are being developed on a projected 2025 land use. Adding BMPs to a scenario on 2025 base conditions in CAST will show you how the nonpoint source loads will change based on the projected population changes. The planning goals will take into account any expected growth. If your 2025 plan meets your planning goals for 2025, then you have accounted for growth . Note that additional reductions can come from the wastewater sector.

 Draft planning targets establish the pounds of nutrients and sediments that must be achieved for each state major river basin, such as the Pennsylvania portion of the Susquehanna River, or the Maryland portion of the Potomac River.

 Accounting for growth refers to preventing an increase in pollutant loads that occur due to changes in land use caused by population changes. Population changes are projected based on data provided in part by local government partners.

Q8. What do my required nutrient and sediment reductions translate to in terms of my community's "treatment footprint"? 🌿

Many localities are required to treat a defined number of acres of impervious cover (IC) over a permit cycle. A "treatment footprint" may be a simpler way to describe stormwater implementation needs to local government officials. A quick calculation can provide an indication of the number of acres that may need to be treated with various BMPs to achieve planned pollutant load reductions.

You will need the following information:

- Total acres for your community and the amount that is pervious and impervious 🌿. These can come from CAST as described in Question 1. If they come from CAST, you can calculate pounds per acre. Otherwise, just use the watershed-wide averages of 9.36 for pervious and 16.08 for impervious land use pounds per acre.
- Planning goal or target load you need to achieve.

Know that BMPs can reduce as much as 85% nitrogen with an average of 33%, and as much as 85% phosphorus with an average of 40%, depending on the BMPs implemented. To determine the most effective BMPs, visit the [Develop a Plan](#) page in CAST.

Now you are ready to calculate the acres that need to be treated by following these steps.

1. Determine the total pervious load by multiplying your pervious acres by 9.36 (the average lbs/acre). Do the same for impervious acres; 16.08 is the average lbs/acre. If you have 68 acres of pervious and 32 acres of impervious, the total pounds are 1,151.
2. Determine the total reduction required as total load minus planning goal. If your goal is 1,000 lbs, then the total reduction required is 151 lbs.
3. Multiply the average pounds per pervious acre (9.36 in this example) by a ratio of pervious to impervious. That ratio is assumed to be 3:1 based on watershed-wide averages. This example results in 28.
4. Then add the average pounds per impervious acre (16.08 in this example) to the result of step 3. This example results in 44.

🌿 A **Treatment Footprint** is a shorthand way of describing approximately how many acres of urban land use will need to be treated with some form of urban BMP. This is not intended to represent precise treatment requirements for regulatory purposes.

🌿 Pervious and impervious land uses in CAST are:
MS4 Pervious
MS4 Turf Grass
MS4 Tree Canopy over Turf Grass
MS4 Impervious
Regulated Construction
MS4 Buildings and Other
MS4 Roads
MS4 Tree Canopy over Impervious

5. Next, multiply the average BMP reduction of 33% by the result of step 4. This example results in 15.
6. For the total impervious acres that need to be treated, divide the total reduction of 151, calculated in step 2, by the result of step 5. This example results in 10.36.
7. To determine the total pervious acres that need to be treated, multiply the impervious acres that need to be treated by 3. We are using 3 as the assumed ratio of pervious to impervious acres. This example results in 31.
8. So the total combined pervious and impervious acres that need to be treated in this example are 41. 🌱

This can also be written as:

$$A = \frac{D}{p * (PI + r * PP)} \quad \text{🌱}$$

Where:

PP = average pounds per pervious acre
 PI = average pounds per impervious acre
 D = total pounds of reduction desired (current total - goal)
 p = average percent reduction
 r = ratio of pervious to impervious to be treated
 A = acres treated for impervious
 r*A = acres treated for pervious

Part 3. Using CAST to Develop a Plan

Q9. How can I use CAST to get accurate pollutant loading rates for my community? 🌱

Using [CAST](#), you can determine the pollutant loading rates as pounds per acre. You can then multiply those loading rates by the land uses and acres that are just in your community to get the most accurate numbers for your pollutant reduction plan or implementation plan.

1. Log in to [CAST](#) and add a new scenario.
2. Copy the information from an existing scenario. We recommend using the most recent shared scenario that is labeled "Progress". This will probably be 2017 Progress.

🌱 Please note that several assumptions are made in this calculation, so the absolute results from CAST may not be equivalent. However, this is a good back-of-the-envelope calculation.

🌱 Using average loading rate and BMP performance assumptions, the equation can be simplified to:

$$A = \frac{D}{14.57}$$

🌱 "Community" is used here to describe any geographical or political scale that is not an available option within CAST. For example, a township or city.

3. Select the geographic scale. County is probably fine for this purpose because you will only be using the lbs./acre, not the total pounds.
4. Copy BMPs from the most recent Progress (2017 Progress or whatever you used in Step 2)
5. Save. At this point, you have two identical scenarios. The one you've just created in Steps 2-4, and one that is already stored in CAST's "Shared Scenarios", called 2017 Progress. 📷
6. Edit your scenario to add a few BMPs for the permit period. These are the BMPs that are part of your pollution reduction plan (PRP) or implementation plan. Tips for adding BMPs are in Question 10.
7. Run the Scenario to get the results.
8. On the results menu item in the ribbon at the top, select Results>Reports.
9. Select the report type as "Loads Report"
10. Select the same geographic scale that you used for creating the scenario in Step 3.
11. From the dropdown list on the reports page, select the scenario "2017 Progress", which is a Public Scenario. Also select the scenario you created, which is under "My Scenarios".
12. For aggregation 🌿, select Major Source - All Agencies. Also select Source - All Agencies. "Major Source" lumps all the MS4 land together and "Source" separates out the types of MS4 land. Agricultural land uses and a few other categories will also be included in the report. "Agency" refers to federal vs. non-federal land. Unless there is federally owned land in your county, you can use All Agencies to ignore that extra level of categorization. 📷
13. Submit Report. You will get an email with a report link. You can also go to the top of the screen and see another tab named Download Reports. You can download the report from Download Reports or from the email, whichever you prefer.
14. Once you download the report and open the Excel file, take a look at the tabs. If you do not want the level of detail for the MS4 area, then use the Major Source - All Agencies tab. If you like the level of detail, use the Source - All Agencies tab.
15. In the tab with the level of detail you like, add a column next to the two NLoadEOS columns. You are inserting next to column J. Calculate pounds per acre by dividing the NLoadEOS by the Amount column for that scenario. The formula in Excel should look like: =I4/G4. Do the same for both scenarios for N, P and Sediment. Copy that formula for all rows. 📷

Aggregation determines how the data in your report will be grouped and displayed.

| Scenario Name | Scenario Status | Author |
|---------------------------------|------------------|--------|
| 2016 Progress V9 | Editing Finished | |
| 2017 Progress - street sweeping | Editing Finished | |
| DMV street sweeping | Editing Finished | |
| Webcast base | Editing Finished | |
| Webcast Scenario Retrofit | Editing Finished | |
| Stream Loads | Editing Finished | |

| Scenario Name | Scenario Status | Author |
|---------------------------------|------------------|--------|
| 2017 Progress V7 | Editing Finished | |
| 2017 Progress - street sweeping | Editing Finished | |

Public ☒ Shared With Me ☒ My Scenarios ☒

Scenarios *

2017 Progress V7 X

Aggregations *

Major Source - All Agencies X Source - All Agencies X

Submit Report

Excel formula: =I4/G4

| CASTRowTo Amount | 2017 Prog CASTRowTo_NLoadEOS | 2017 Progress V7_NLoadEOS |
|------------------|------------------------------|---------------------------|
| 17979.1 | 17996.1 | 26997.1 |
| 0.00 | 0.00 | 0.00 |
| 7070.31 | 7054.21 | 71052.80 |
| 96024.47 | 96307.03 | 1128720.80 |
| 131229.55 | 131665.43 | 345917.30 |

16. Filter the spreadsheet. The excel button for filter looks like a funnel and is under the Data tab of the menu. You will first need to select the rows and columns that have data. 📷
17. Click on the down arrow button for sector and select “Developed” only.
18. Click on the down button for Load Source and select only the load sources with the MS4 or regulated in the name.
19. You can now see the loading rate for the regulated load sources. You can see the change between the latest annual scenario and the one you created.
20. Multiply the acres that you know are in your township by the loading rates you calculated. If you don’t know the acres in your township, see Q1 in this How-To guide. A sample spreadsheet is available on CAST under How To>[User Documentation](#). Then click on “Getting Started” in the table of contents.

Q10. How can I use CAST to experiment with BMPs and see if they help me reach my pollutant reduction goals?

There are a number of ways to target reductions by location, load source and most effective, least expensive BMP. There is a webinar available on CAST under How To, [Webinars](#) that walks through these three methods. 📷 The webinar covers:

- To evaluate the best locations to target, add the same BMP to two different geographies and compare the results to determine the location with the greatest reduction.
- To determine the load source that carries the highest load, calculate the pounds per acre for each load source in your scenario, then sort to see the one that is highest.
- To select the most effective, least expensive BMP, use the spreadsheet that lists the cost per pound reduced for each BMP. This spreadsheet is on the [Develop a Plan](#) page on CAST's home page.

