



# 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.

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## 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?

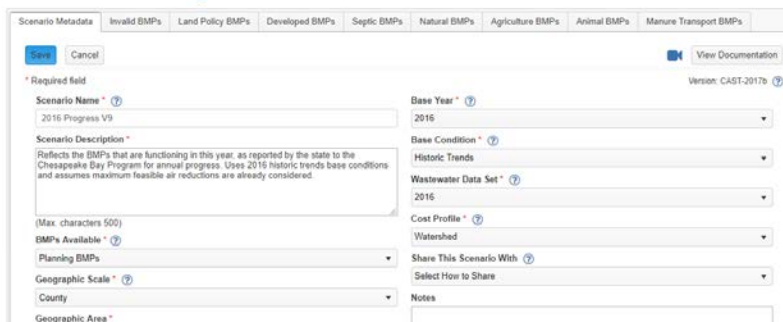
Using [CAST](#), you can compare your current pollutant loads and land uses to your 2025 projected loads and land uses. To do this, you create two scenarios for your geographic area, the first scenario will be your baseline and the second will be for a future year. You can then download both scenarios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



### EDIT SCENARIO - 2016 Progress V9



The screenshot shows the 'EDIT SCENARIO' form for '2016 Progress V9'. The form is divided into several sections: 'Scenario Metadata', 'Invalid BMPs', 'Land Policy BMPs', 'Developed BMPs', 'Septic BMPs', 'Natural BMPs', 'Agriculture BMPs', 'Animal BMPs', and 'Manure Transport BMPs'. The 'Scenario Name' field is filled with '2016 Progress V9'. The 'Scenario Description' field contains a detailed description: 'Reflects the BMPs that are functioning in this year, as reported by the state to the Chesapeake Bay Program for annual progress. Uses 2016 historic trends base conditions and assumes maximum feasible air reductions are already considered.' The 'Base Year' is set to '2016'. The 'Base Condition' is set to 'Historic Trends'. The 'Wastewater Data Set' is set to '2016'. The 'Cost Profile' is set to 'Watershed'. The 'Geographic Scale' is set to 'County'. The 'Geographic Area' is set to 'County'. The 'Share This Scenario With' dropdown is set to 'Select How to Share'. The 'Notes' field is empty.

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.
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.







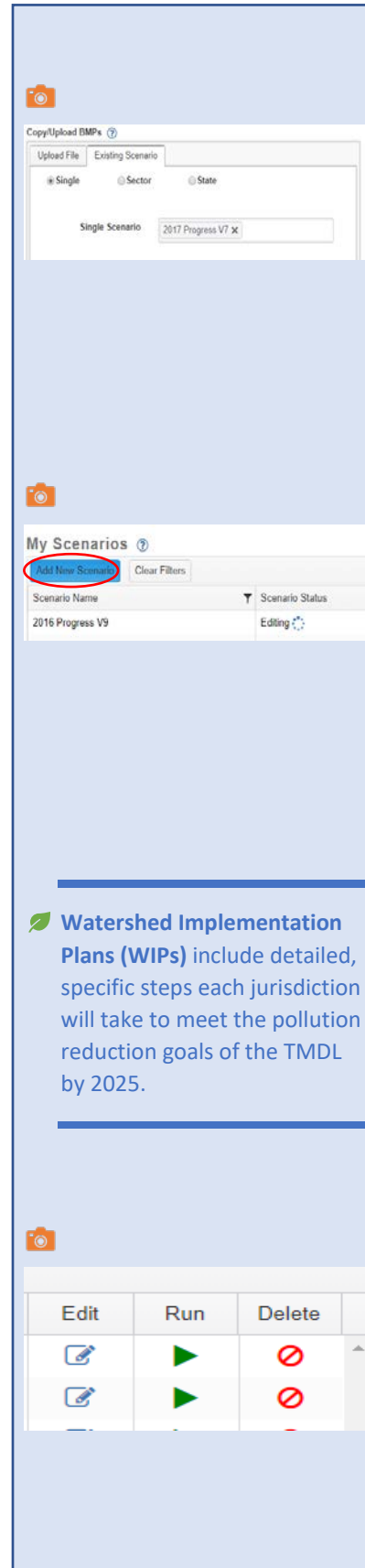
**Planning BMPs** include some BMPs that are not eligible for Chesapeake Bay TMDL reductions because they are either still under review or have not been approved by the Bay Program partnership.




**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 cap loads 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.



 **Watershed Implementation Plans (WIPs)** include detailed, specific steps each jurisdiction will take to meet the pollution reduction goals of the TMDL by 2025.

- 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? 🌿

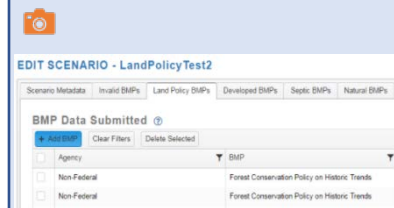
Yes! Land Policy BMPs reflect land management policy decisions such as zoning. To use these BMPs when editing a scenario, simply select the land policy option and then select the state or county where the selected Land Policy BMP will be implemented 📍. There are three primary Land Policy BMPs available 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.

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### *Part 2. Knowing Your Commitments*

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## 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.



REPORTS

Create Reports | Download Reports

Create Reports ⓘ

Submit Report

\* Required field

Report Type \*


BMP Submitted vs. Credited Report

🌿 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.

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🌿 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.

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🌿 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

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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

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### *Part 3. Using CAST to Develop a Plan*

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#### 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 in your community to get the most accurate loads for your pollutant reduction plan or implementation plan.

There are three options for calculating loading rates: 1) Using the Compare Scenarios tool; 2) Generating a Loads per Unit Report; and, 3) Calculating loading rates from a Loads Report. We will cover the necessary steps for all three options below.

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🍃 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.

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

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


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🍃 “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.

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### Using the Compare Scenarios tool

1. On the Results menu item in the ribbon at the top, select Results>Compare Scenarios.
2. Select the geographic scale. County is probably fine for this purpose because you will only be using the pounds per acre, not the total pounds.
3. Select the Agency. 📷 “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.
4. From the dropdown list on the Compare Scenarios page, select your scenario. For this example, we are using the shared CBP 2017 Progress scenario. Two scenarios are required for this tool; so, you will need to select another scenario. The results of Scenario 2 will not be used for our calculations (e.g., you can select a any CBP Progress scenario, such as 1984 Progress).
5. Click the Compare Scenarios blue button. 📷
6. Loading Rates for nitrogen, phosphorus, and sediment, in pounds per acre, at the edge of stream and edge of tide scales are provided by sector (e.g., Agriculture, Developed, Natural) and load source in the Loading Rate tab. 📷 These loading rates can be copied into an Excel spreadsheet.
7. Multiply the acres of each land use type in your community by the loading rates in the Loading Rates tab. If you don’t know the acres in your community, 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.

### Generating a Loads per Unit Report

1. On the Results menu item in the ribbon at the top, select Results>Reports.
2. Select the report type as “Loads Per Unit”. 📷 Type in your report name in the Report Name field.
3. Select the geographic scale. County is probably fine for this purpose because you will only be using the pounds per acre, not the total pounds.
4. Select your scenario. For this example, we are using the shared CBP 2017 Progress scenario.
5. 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-

The screenshot displays the software interface for generating reports. It is divided into two main sections: 'Compare Scenarios' and 'REPORTS'.

**Compare Scenarios Section:**

- Agency \*:** A dropdown menu with 'All Agencies X' selected.
- Scenario 1 \*:** A dropdown menu with '2017 Progress V9' selected.
- Scenario 2 \*:** A dropdown menu with '1984 Progress' selected.
- Loading Rate Tab:** A tabbed interface with three tabs: 'Loads', 'Loading Rate' (circled in red), and 'Percent Change'.

**REPORTS Section:**

- Buttons for 'Create Reports' and 'Download Reports'.
- Create Reports ?** section with a 'Submit Report' button.
- \* Required field** label above the 'Report Type \*' dropdown.
- Report Type \*:** A dropdown menu with 'Loads Per Unit' selected (circled in red).

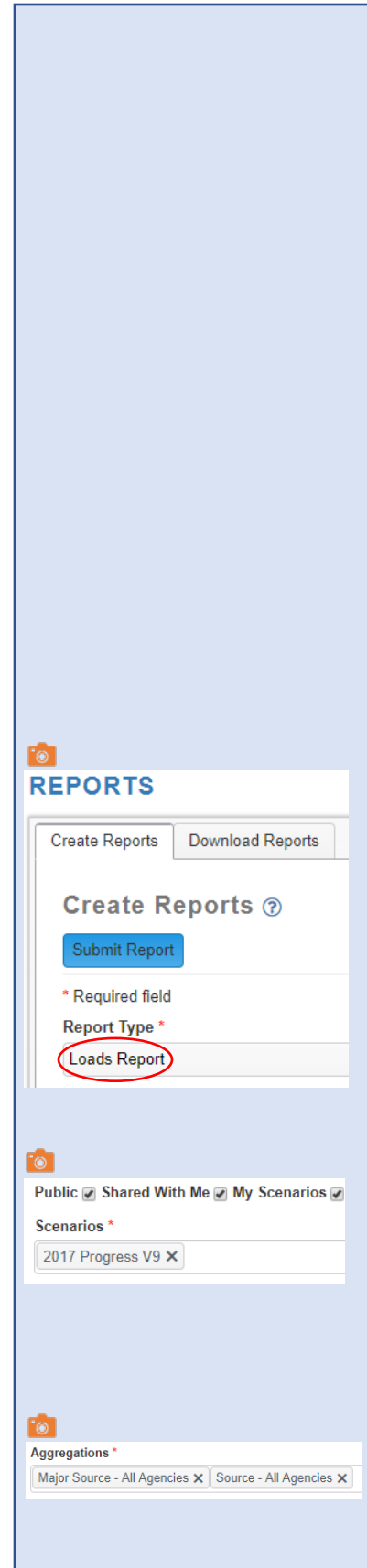
**Aggregation Note:** A green leaf icon followed by the text: "Aggregation determines how the data in your report will be grouped and displayed."


federal land. Unless there is federally owned land in your county, you can use All Agencies to ignore that extra level of categorization.

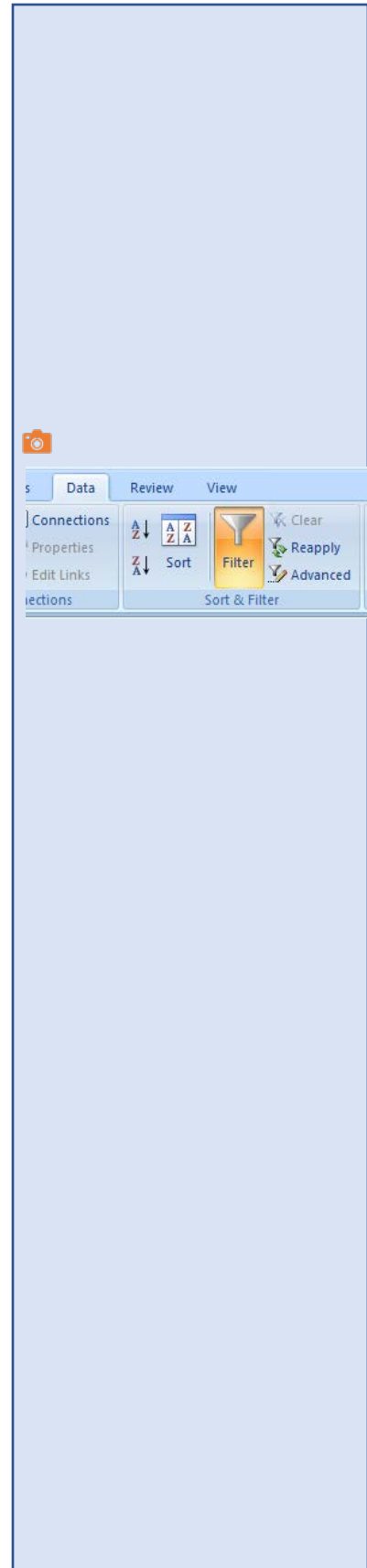
6. Submit Report. You will get an email with a report link. You can also go to the top of the Reports page and select the tab named Download Reports. You can download the report from Download Reports or from the email, whichever you prefer.
7. Once you download the report and open the Excel file, take 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. Both tabs provide loading rates in pounds per acre for nitrogen, phosphorus, and sediment at the edge of stream and edge of tide scales.
8. Multiply the acres of each land use type in your community by the loading rates provided in the report. If you don't know the acres in your community, 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.

#### Calculating loading rates from a Loads Report

1. On the Results menu item in the ribbon at the top, select Results>Reports.
2. Select the report type as "Loads Report".
3. Select the geographic scale. County is probably fine for this purpose because you will only be using the pounds per acre, not the total pounds.
4. Select your scenario. For this example, we are using the shared CBP 2017 Progress scenario.
5. 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.
6. Submit Report. You will get an email with a report link. You can also go to the top of the Reports page and select the tab named Download Reports. You can download the report from Download Reports or from the email, whichever you prefer.



7. 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.
8. In the tab with the level of detail you like, add a column next to the NLoadEOS column. You are inserting next to column H. Calculate pounds per acre by dividing the NLoadEOS by the Amount column (column G) for that scenario. The formula in Excel should look like: =H4/G4. Do the same for phosphorus and sediment. Copy that formula for all rows.
9. 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 the data you are trying to filter. 
10. Filter by Sector. In this example, we will filter to see records for the Developed sector. Click on the down arrow button for the sector column and select “Developed” only.
11. Click on the down button for Load Source and select only the load sources with “MS4” or “regulated” in the name.
12. You can now see the loading rates for the regulated load sources.
13. Multiply the acres of each land use type in your community by the loading rates you calculated. If you don’t know the acres in your community, 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 several 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.

