

Development of Multi-objective Optimization Procedure for Efficient BMP Allocation

(April 2020 - March 2026)

Development Team:

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Pouyan Nejadhashemi, Kalyanmoy Deb



Delivered Document 1: Installation Manual

December 5, 2025

- Step-by-step instruction manual for developers to set up the web interface:
[EPA Code Documentation v2.docx](#)
- The process requires a reserved website access and hosting
- The memory consumption scales linearly with the number of users and the number of scenarios – an approximation should be considered for the memory allocation

1. Uninstall Old Versions (if any)

```
sudo apt-get remove docker docker-engine docker.io containerd runc
```

2. Update Package Index and Install Required Dependencies

```
sudo apt-get update
sudo apt-get install -y ca-certificates curl gnupg lsb-release
```

3. Add Docker's Official GPG Key

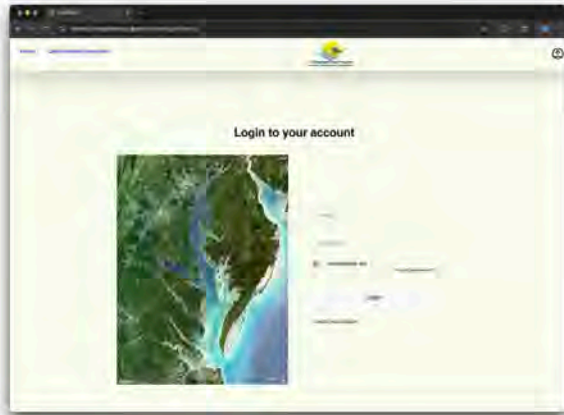
```
sudo mkdir -p /etc/apt/keyrings
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo gpg --dearmor -o /etc/apt/keyrings/docker.gpg
```

4. Set Up the Docker Repository

```
echo \
"deb [arch=$(dpkg --print-architecture) signed-by=/etc/apt/keyrings/docker.gpg] \
https://download.docker.com/linux/ubuntu \
$(lsb_release -cs) stable" | \
sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
```

Delivered Document 2: User's Manual

December 5, 2025



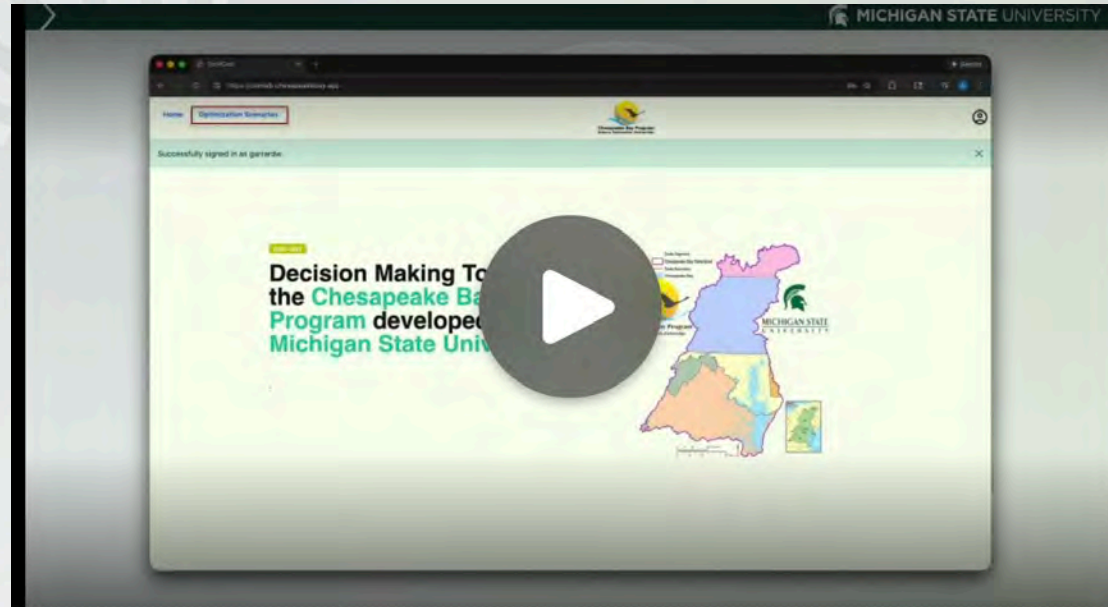
- **Email Field**
 - Users enter their registered email address to access their account.
- **Password Field**
 - Secure password entry for account authentication.
- **Forgot Password Link**
 - Allows users to recover their accounts if they have forgotten their login credentials.
- **Login Button**
 - Submits credentials and grants access to the Dashboard upon successful authentication.
- **Create New Account Link**
 - Located below the Login button, this directs new users to the account creation process

- Comprehensive summary of each component of the web interface
- Instructions to prepare a scenario, create an optimization setup, run the algorithm and analyze results
- Instruction for verification through CAST interface
- Super user access is available for the developers

Delivered Document 3: Project Summary in Video

February 11, 2026

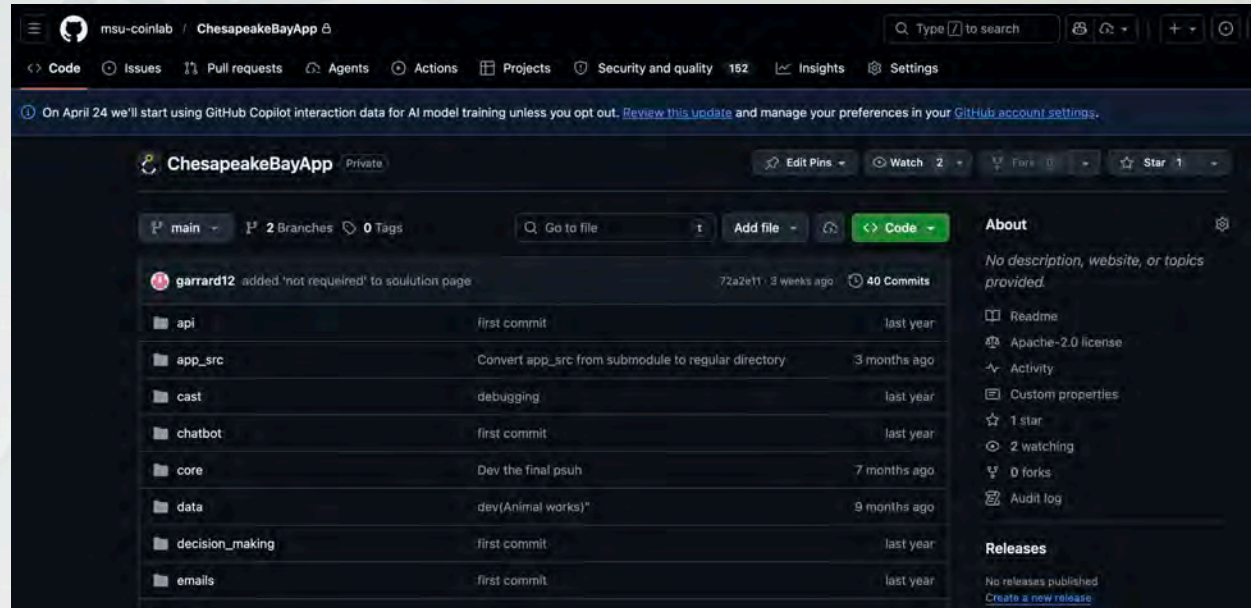
- Walkthrough video for the entire project:
[video demo](#)
- Video starts with the motivation for the work
- Then it dives into the necessary concepts
- It ends with the dashboard details and exploration of the optimization results



Delivered Document 4: Codebase

March 12, 2026

- Access to the entire codebase through Github: <https://github.com/msu-coinlab/ChesapeakeBayApp>



msu-coinlab / ChesapeakeBayApp

On April 24 we'll start using GitHub Copilot interaction data for AI model training unless you opt out. [Review this update](#) and manage your preferences in your [GitHub account settings](#).

ChesapeakeBayApp Private

main 2 Branches 0 Tags

garrard12 added 'not required' to solution page 72a2e11 · 3 weeks ago 40 Commits

api	first commit	last year
app_src	Convert app_src from submodule to regular directory	3 months ago
cast	debugging	last year
chatbot	first commit	last year
core	Dev the final psuh	7 months ago
data	dev(Animal works)*	9 months ago
decision_making	first commit	last year
emails	first commit	last year

About

No description, website, or topics provided.

- Readme
- Apache-2.0 license
- Activity
- Custom properties
- 1 star
- 2 watching
- 0 forks
- Audit log

Releases

No releases published

[Create a new release](#)

Communication Timeline with EPA

- Handover Discussion started: 12/05/2025
- Access to code and documents: 12/05/2025 to 03/12/2026
- First Feedback: 12/12/2025
- First Follow-up: 01/22/2026
- Second Feedback: 01/28/2026
- Third Feedback: 02/26/2026
- Project completion email from MSU: 03/18/2026
- Consent from Megan Thyng on receipt of all documents from MSU:
04/01/2026

A Brief Introduction to the Optimization Software

Project Objective



Opt4Cast


https://coinlab.chesapeakebay.app/accounts/login/?next=/

Home Optimization Scenarios

Chesapeake Bay Program
Science. Restoration. Partnership.

Developed a User-friendly Optimization Platform

Login to your account



email

password

REMEMBER ME [Forgot password?](#)

Login

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Opt4Cast x + Gemini

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25 ENTRIES PER PAGE SEARCH:


ID ↑	Optimization Scenario Name	Base Scenario	Counties	Date modified (EST)	Status	Actions
333	Mathews, Virginia \$1,000,000 constrain	2023 Progress	VA: [Mathews]	11/18/2025 1:57 p.m.	Optimization Complete	 
334	Delaware (Kent, New Castle, Sussex); No Forest BMP; Manure Transport: No Chester PA	2023 Progress	DE: [Kent, New Castle, Sussex]	12/15/2025 10:34 a.m.	Optimization Evaluating	 
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337	Maryland	WIP 3 CAST-2023 version	MD: [Worcester, Baltimore, Carroll, Cecil, Frederick, Harford, Howard, Montgomery, Anne Arundel, Calvert, Caroline, Charles, Dorchester, Kent, Prince Georges, Queen Annes, St. Marys, Somerset, Talbot, Wicomico, Allegany, Garrett, Washington, Baltimore City]	11/14/2025 2:31 p.m.	Base Evaluating	 

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Base Evaluating
 Optimization Pending
 Optimization Evaluating
 Optimization Complete

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https://dev-coinlab.chesapeakebay.app/scenario/create/

New Optimization Scenario

OPTIMIZATION SCENARIO NAME*

DESCRIPTION*
Enter description here...

BASE SCENARIO* **BASE YEAR*** **BASE CONDITION***

----- Select Base Year Select Base Condition

BMPs AVAILABLE* **COST PROFILES AVAILABLE*** **WASTEWATER DATASET***

Select BMPs Available Select Cost Profile Select Wastewater Data Set

Available Counties **Selected Counties**

Search... Search...

- Delaware**
 - Kent
 - New Castle
 - Sussex
- District Of Columbia**
 - Washington
- Maryland**
 - Allegany
 - Anne Arundel
 - Baltimore
 - Baltimore City
 - Calvert
 - Caroline
 - Carroll
 - Cecil
 - Charles

»»
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««

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/scenario/create/

New Optimization Scenario

OPTIMIZATION SCENARIO NAME*
 Mathews, Virginia; \$1,000,000 constrain

DESCRIPTION*
 Enter description here...

BASE SCENARIO* **BASE YEAR*** **BASE CONDITION***
 ----- Select Base Year Select Base Condition

BMPs AVAILABLE* **COST PROFILES AVAILABLE*** **WASTEWATER DATASET***
 Select BMPs Available Select Cost Profile Select Wastewater Data Set

Available Counties **Selected Counties**

Search... Search...

Delaware
 Kent
 New Castle
 Sussex

District Of Columbia
 Washington

Maryland
 Allegany
 Anne Arundel
 Baltimore
 Baltimore City
 Calvert
 Caroline
 Carroll
 Cecil
 Charles

»
 »
 <
 <<

Step 1:
 Enter Unique
 Scenario Name

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/scenario/create/

New Optimization Scenario

OPTIMIZATION SCENARIO NAME*
Mathews, Virginia; \$1,000,000 constrain

DESCRIPTION*
County: Mathews, Virginia
Cost Constraint: \$1,000,000

BASE SCENARIO* ----- **BASE YEAR*** Select Base Year **BASE CONDITION*** Select Base Condition

BMPS AVAILABLE* Select BMPS Available **COST PROFILES AVAILABLE*** Select Cost Profile **WASTEWATER DATASET*** Select Wastewater Data Set

Available Counties Search...

- Delaware
 - Kent
 - New Castle
 - Sussex
- District Of Columbia
 - Washington
- Maryland
 - Allegany
 - Anne Arundel
 - Baltimore
 - Baltimore City
 - Calvert
 - Caroline
 - Carroll
 - Cecil
 - Charles

Selected Counties Search...

>>>
 >
 <
 <<<

Step 2:
Enter Scenario
Description

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/scenario/create/

New Optimization Scenario

OPTIMIZATION SCENARIO NAME*
Mathews, Virginia; \$1,000,000 constrain

DESCRIPTION*
County: Mathews, Virginia
Cost Constraint: \$1,000,000

BASE SCENARIO* 2023 Progress **BASE YEAR*** 2023 **BASE CONDITION*** Current Zoning

BMPs AVAILABLE* Select BMPs Available **COST PROFILES AVAILABLE*** Select Cost Profile **WASTEWATER DATASET*** Select Wastewater Data Set

Available Counties **Selected Counties**

Search...

- Delaware**
- Kent
- New Castle
- Sussex
- District Of Columbia**
- Washington
- Maryland**
- Allegany
- Anne Arundel
- Baltimore
- Baltimore City
- Calvert
- Caroline
- Carroll
- Cecil

➡
➤
⬅
⬅⬅

Step 3:
 Select Base Scenario, Year,
 and Condition

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https://dev-coinlab.chesapeakebay.app/scenario/create/

New Optimization Scenario

OPTIMIZATION SCENARIO NAME*
Mathews, Virginia; \$1,000,000 constrain

DESCRIPTION*
County: Mathews, Virginia
Cost Constraint: \$1,000,000

BASE SCENARIO* 2023 Progress

BASE YEAR* 2023

BASE CONDITION* Current Zoning

BMPS AVAILABLE*

- Select BMPS Available
- Official BMPS
- Planning BMPS

COST PROFILES AVAILABLE* Select Cost Profile

WASTEWATER DATASET* Select Wastewater Data Set

Selected Counties

Search...

- Delaware**
 - Kent
 - New Castle
 - Sussex
- District Of Columbia**
 - Washington
- Maryland**
 - Allegany
 - Anne Arundel
 - Baltimore
 - Baltimore City
 - Calvert
 - Caroline
 - Carroll
 - Cecil
 - Charles

Navigation buttons: >>, >, <, <<

Step 4:
Select BMPS Available

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https://dev-coinlab.chesapeakebay.app/scenario/create/

New Optimization Scenario

OPTIMIZATION SCENARIO NAME*
Mathews, Virginia; \$1,000,000 constrain

DESCRIPTION*
County: Mathews, Virginia
Cost Constraint: \$1,000,000

BASE SCENARIO* 2023 Progress **BASE YEAR*** 2023 **BASE CONDITION*** Current Zoning

BMPs AVAILABLE* Select BMPs Available **COST PROFILES AVAILABLE*** **WASTEWATER DATASET*** Select Wastewater Data Set

Available Counties **Selected Counties**

Search...

Delaware
Kent
New Castle
Sussex

District Of Columbia
Washington

Maryland
Allegany
Anne Arundel
Baltimore
Baltimore City
Calvert
Caroline
Carroll
Cecil
Charles

Cost Profiles Available:

- ✓ Select Cost Profile
- Delaware
- District Of Columbia
- Maryland
- New York
- Pennsylvania
- Virginia
- West Virginia

> < <<

Step 5:
Select Cost Profile and
Wastewater Data

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DESCRIPTION*
 County: Mathews, Virginia
 Cost Constraint: \$1,000,000

BASE SCENARIO* 2023 Progress **BASE YEAR*** 2023 **BASE CONDITION*** Current Zoning

BMPs AVAILABLE* Official BMPs **COST PROFILES AVAILABLE*** Virginia **WASTEWATER DATASET*** 2023

Available Counties Search...

- Delaware
 - Kent
 - New Castle
 - Sussex
- District Of Columbia
 - Washington
- Maryland
 - Allegany
 - Anne Arundel
 - Baltimore
 - Baltimore City
 - Calvert
 - Caroline
 - Carroll
 - Cecil
 - Charles
 - Dorchester
 - Frederick
 - Garrett

Selected Counties Search...

Cancel Create

Step 6:
Type in county searching for

Opt4Cast Gemini

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DESCRIPTION*
 County: Mathews, Virginia
 Cost Constraint: \$1,000,000

BASE SCENARIO* 2023 Progress **BASE YEAR*** 2023 **BASE CONDITION*** Current Zoning

BMPS AVAILABLE* Official BMPS **COST PROFILES AVAILABLE*** Virginia **WASTEWATER DATASET*** 2023

Available Counties

 Virginia
 Mathews

Selected Counties

→
 >
 <
 ←

Cancel Create

Step 7:
 Use the arrows to move
 the county over

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/scenario/create/

DESCRIPTION*

County: Mathews, Virginia
 Cost Constraint: \$1,000,000

BASE SCENARIO* 2023 Progress

BASE YEAR* 2023

BASE CONDITION* Current Zoning

BMPs AVAILABLE* Official BMPs

COST PROFILES AVAILABLE* Virginia

WASTEWATER DATASET* 2023

Available Counties

Search...

- Delaware
 - Kent
 - New Castle
 - Sussex
- District Of Columbia
 - Washington
- Maryland
 - Allegany
 - Anne Arundel
 - Baltimore
 - Baltimore City
 - Calvert
 - Caroline
 - Carroll
 - Cecil
 - Charles
 - Dorchester
 - Frederick
 - Garrett

Selected Counties

Search...


- Virginia
 - Mathews

Cancel Create

Step 8:
 Create Scenario

Opt4Cast
Gemini

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Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/step_2/340

1
 Loads

2
 BMP Selection

Wastewater Dataset:
2023 Progress

Selected Counties:
Mathews

Pollution Load and Implementation Cost Specification

POLLUTION REDUCTION TARGET: EDGE OF STREAM

	Pollutant	Initial Load (lbs/year)	Removal Percentage (%)	Expected Load (lbs/year)
<input checked="" type="checkbox"/>	Nitrogen	254,375	30	178,063
<input type="checkbox"/>	Phosphorus	22,624	30	15,837
<input type="checkbox"/>	Sediments	23,244,804	30	16,271,363

DO YOU HAVE A LIMIT ON THE ALLOCATED BUDGET FOR BMP IMPLEMENTATION?: YES NO

[Next](#)

Opt4Cast
+
Gemini

← → ↻ 🔍 ☆ 📄 🗑️ 📄 📄 📄

1
Loads

2
BMP Selection

Wastewater Dataset:

2023 Progress

Selected Counties:

Mathews

Pollution Load and Implementation Cost Specification

POLLUTION REDUCTION TARGET: EDGE OF STREAM

	Pollutant	Initial Load (lbs/year)	Removal Percentage (%)	Expected Load (lbs/year)
<input checked="" type="checkbox"/>	Nitrogen	254,375	30	178,063
<input type="checkbox"/>	Phosphorus	22,624	30	15,837
<input type="checkbox"/>	Sediments	23,244,804	30	16,271,363

DO YOU HAVE A LIMIT ON THE ALLOCATED BUDGET FOR BMP IMPLEMENTATION?: YES NO

Next

Opt4Cast
Gemini

https://dev-coinlab.chesapeakebay.app/step_2/340/

1
2

Wastewater Dataset:

2023 Progress

Selected Counties:

Mathews

Pollution Load and Implementation Cost Specification

POLLUTION REDUCTION TARGET: EDGE OF STREAM

Pollutant	Initial Load (lbs/year)	Removal Percentage (%)	Expected Load (lbs/year)
<input checked="" type="checkbox"/> Nitrogen	254,375	30	178,063
<input type="checkbox"/> Phosphorus	22,624	30	15,837
<input type="checkbox"/> Sediments	23,244,804	30	16,271,363

DO YOU HAVE A LIMIT ON THE ALLOCATED BUDGET FOR BMP IMPLEMENTATION?: YES NO

\$ 0

Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/step_2/340/

1
 Loads

2
 BMP Selection

Wastewater Dataset:
Selected Counties:

2023 Progress
Mathews

Pollution Load and Implementation Cost Specification

POLLUTION REDUCTION TARGET: EDGE OF STREAM

Pollutant	Initial Load (lbs/year)	Removal Percentage (%)	Expected Load (lbs/year)
<input checked="" type="checkbox"/> Nitrogen	254,375	30	178,063
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<input type="checkbox"/> Sediments	23,244,804	30	16,271,363

DO YOU HAVE A LIMIT ON THE ALLOCATED BUDGET FOR BMP IMPLEMENTATION?: YES NO

\$ 0

LIMIT

Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/step_2/340

1
 Loads

2
 BMP Selection

Wastewater Dataset:
Selected Counties:

2023 Progress

Mathews

Pollution Load and Implementation Cost Specification

POLLUTION REDUCTION TARGET: EDGE OF STREAM

Pollutant	Initial Load (lbs/year)	Removal Percentage (%)	Expected Load (lbs/year)
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<input type="checkbox"/> Sediments	23,244,804	30	16,271,363

DO YOU HAVE A LIMIT ON THE ALLOCATED BUDGET FOR BMP IMPLEMENTATION?: YES NO

\$ 1000000

Next

1
 Loads

2
 BMP Selection

Wastewater Dataset:

2023 Progress

Selected Counties:

Mathews

Pollution Load and Implementation Cost Specification

POLLUTION REDUCTION TARGET: EDGE OF STREAM

	Pollutant	Initial Load (lbs/year)	Removal Percentage (%)	Expected Load (lbs/year)
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<input type="checkbox"/>	Phosphorus	22,624	30	15,837
<input type="checkbox"/>	Sediments	23,244,804	30	16,271,363

DO YOU HAVE A LIMIT ON THE ALLOCATED BUDGET FOR BMP IMPLEMENTATION?: YES NO

\$ 1000000

Next

Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/step_3/340/

1 Loads 2 **BMP Selection** 3 County Selection for Manure

Wastewater Dataset: **2023 Progress** Selected Counties: **Mathews**

BMP Selection

Available BMPs

Search...

Selected BMPs

Search...

Efficiency

- Advanced Grey Infrastructure Nutrient Discovery Program (IDDE)
- Advanced Sweeping Technology - 1 pass/12 weeks
- Advanced Sweeping Technology - 1 pass/2 weeks
- Advanced Sweeping Technology - 1 pass/4 weeks
- Advanced Sweeping Technology - 1 pass/8 weeks
- Advanced Sweeping Technology - 1 pass/week
- Advanced Sweeping Technology - 2 pass/week
- Advanced Sweeping Technology - fall 1 pass/1-2 weeks else month
- Advanced Sweeping Technology - spring 1 pass/1-2 weeks else mo
- Agricultural Stormwater Management
- Barnyard Runoff Control
- Bioretention/raingardens - A/B soils, no underdrain
- Bioretention/raingardens - A/B soils, underdrain
- Bioretention/raingardens - C/D soils, underdrain
- Bioswale
- Conservation Landscaping Practices
- Cover Crop Commodity Early
- Cover Crop Commodity Late

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Type in BMP to remove

Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/step_3/340/

1 Loads 2 **BMP Selection** 3 County Selection for Manure

Wastewater Dataset: **2023 Progress** Selected Counties: **Mathews**

BMP Selection

Available BMPs

Search...

Selected BMPs

Forest

Efficiency

- Forest Buffer Nitrogen Upland Acres
- Forest Buffer Phosphorus and Sediment Upland Acres
- Forest Buffer-Streamside with Exclusion Fencing Nitrogen Upland
- Forest Buffer-Streamside with Exclusion Fencing Phosphorus and S
- Forest Harvesting Practices
- Urban Forest Buffer Upland Acres

Developed

- Forest Buffer Urban
- Forest Conservation
- Forest Planting
- Urban Forest Buffer Upland Acres

Land

- Forest Buffer
- Forest Buffer - Narrow
- Forest Buffer Nitrogen Upland Acres
- Forest Buffer Phosphorus and Sediment Upland Acres
- Forest Buffer Urban
- Forest Buffer-Narrow with Exclusion Fencing

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Select BMPs and move over with arrows

Opt4Cast
+
Gemini

https://dev-coinlab.chesapeakebay.app/step_3/340/

1
Loads

2
BMP Selection

3
County Selection for Manure

Wastewater Dataset:

2023 Progress

Selected Counties:

Mathews

BMP Selection

Available BMPs

Search...

- Efficiency**
- [Forest Buffer Nitrogen Upland Acres](#)
- [Forest Buffer Phosphorus and Sediment Upland Acres](#)
- [Forest Buffer-Streamside with Exclusion Fencing Nitrogen Upland Acres](#)
- [Forest Buffer-Streamside with Exclusion Fencing Phosphorus and Sediment Upland Acres](#)
- [Forest Harvesting Practices](#)
- [Urban Forest Buffer Upland Acres](#)
- Developed**
- [Forest Buffer Urban](#)
- [Forest Conservation](#)
- [Forest Planting](#)
- [Urban Forest Buffer Upland Acres](#)
- Land**
- [Forest Buffer](#)
- [Forest Buffer - Narrow](#)
- [Forest Buffer Nitrogen Upland Acres](#)
- [Forest Buffer Phosphorus and Sediment Upland Acres](#)
- [Forest Buffer Urban](#)
- [Forest Buffer-Narrow with Exclusion Fencing](#)

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Selected BMPs

Forest

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/step_3_5/340/

Wastewater Dataset **2023 Progress**

Selected Counties **Mathews**

County Selection for Manure Transport

Available Counties

Search...

Selected Counties

Search...

VA
Gloucester
Middlesex
Northampton
York

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Previous Optimize

Select County to remove and move over with arrows

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/step_3_5/340/

Wastewater Dataset **2023 Progress**

Selected Counties **Mathews**

County Selection for Manure Transport

Available Counties

Search...

VA
York

Selected Counties

Search...

VA
Gloucester
Middlesex
Northampton

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Previous Optimize

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/scenario/list/

Home Optimization Scenarios 











Optimization Scenarios


New Optimization Scenario

SEARCH:

25 ENTRIES PER PAGE

ID	Optimization Scenario Name	Base Scenario	Counties	Date modified (EST)	Status	Actions
334	Delaware (Kent, New Castle, Sussex); No Forest BMP; Manure Transport: No Chester PA	2023 Progress	DE: [Kent, New Castle, Sussex]	12/15/2025 12:34 p.m.	Optimization Complete	 
335	Washington, DC	2023 Progress	DC: [Washington]	11/14/2025 1:59 p.m.	Optimization Pending	 
337	Maryland	WIP 3 CAST-2023 version	MD: [Worcester, Baltimore, Carroll, Cecil, Frederick, Harford, Howard, Montgomery, Anne Arundel, Calvert, Caroline, Charles, Dorchester, Kent, Prince Georges, Queen Annes, St. Marys, Somerset, Talbot, Wicomico, Allegany, Garrett, Washington, Baltimore City]	11/14/2025 2:31 p.m.	Base Evaluating	 
340	Mathews, Virginia; \$1,000,000 constrain	2023 Progress	VA: [Mathews]	12/15/2025 1:46 p.m.	Optimization Evaluating	 

Showing 1 to 4 of 4 entries 1



Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/scenario/list/

Optimization Scenarios

[New Optimization Scenario](#)

25 ENTRIES PER PAGE SEARCH:

ID	Optimization Scenario Name	Base Scenario	Counties	Date modified (EST)	Status	Actions
334	Delaware (Kent, New Castle, Sussex); No Forest BMP; Manure Transport; No Chester PA	2023 Progress	DE: [Kent, New Castle, Sussex]	12/15/2025 12:34 p.m.	Optimization Complete	
335	Washington, DC	2023 Progress	DC: [Washington]	11/14/2025 1:59 p.m.	Optimization Pending	
337	Maryland	WIP 3 CAST-2023 version	MD: [Worcester, Baltimore, Carroll, Cecil, Frederick, Harford, Howard, Montgomery, Anne Arundel, Calvert, Caroline, Charles, Dorchester, Kent, Prince Georges, Queen Annes, St. Marys, Somerset, Talbot, Wicomico, Allegany, Garrett, Washington, Baltimore City]	11/14/2025 2:31 p.m.	Base Evaluating	
340	Mathews, Virginia; \$1,000,000 constrain	2023 Progress	VA: [Mathews]	12/15/2025 2:11 p.m.	Optimization Complete	

Showing 1 to 4 of 4 entries 1

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/scenario/list/

Chesapeake Bay Program
Science, Restoration, Partnership

Optimization Scenarios

[New Optimization Scenario](#)

25 ENTRIES PER PAGE SEARCH:

ID	Optimization Scenario Name	Base Scenario	Counties	Date modified (EST)	Status	Actions
334	Delaware (Kent, New Castle, Sussex); No Forest BMP; Manure Transport; No Chester PA	2023 Progress	DE: [Kent, New Castle, Sussex]	12/15/2025 12:34 p.m.	Optimization Complete	
335	Washington, DC	2023 Progress	DC: [Washington]	11/14/2025 1:59 p.m.	Optimization Pending	
337	Maryland	WIP 3 CAST-2023 version	MD: [Worcester, Baltimore, Carroll, Cecil, Frederick, Harford, Howard, Montgomery, Anne Arundel, Calvert, Caroline, Charles, Dorchester, Kent, Prince Georges, Queen Annes, St. Marys, Somerset, Talbot, Wicomico, Allegany, Garrett, Washington, Baltimore City]	11/14/2025 2:31 p.m.	Base Evaluating	
340	Mathews, Virginia; \$1,000,000 constrain	2023 Progress	VA: [Mathews]	12/15/2025 2:11 p.m.	Optimization Complete	

Showing 1 to 4 of 4 entries 1

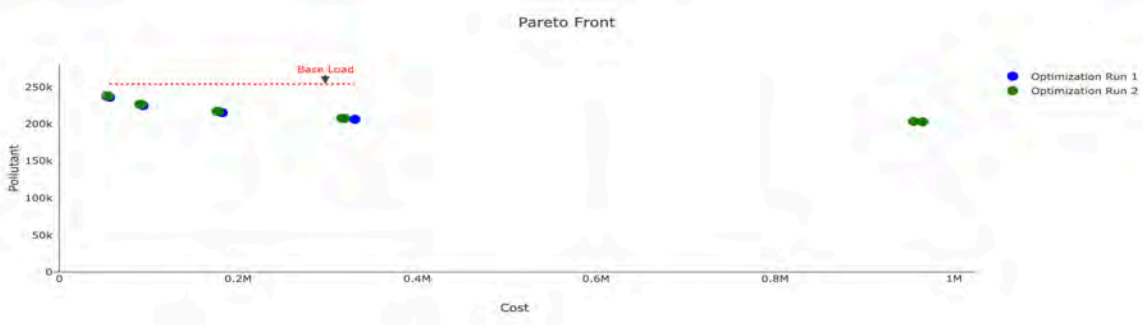
Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/execution/list/340

Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load
254,376

Pareto Front



Legend: ● Optimization Run 1, ● Optimization Run 2

25 ENTRIES PER PAGE SEARCH:

id <small>▲</small>	# Optimization Run <small>▼</small>	# Solutions <small>▼</small>	Actions <small>▼</small>
334	2	15	
335	1	9	

Showing 1 to 2 of 2 entries 1

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/execution/list/340

Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front

25 ENTRIES PER PAGE SEARCH:

id <small>↑</small>	# Optimization Run <small>↓</small>	# Solutions <small>↓</small>	Actions <small>↓</small>
334	2	15	
335	1	9	

Showing 1 to 2 of 2 entries 1

Opt4Cast + Gemini

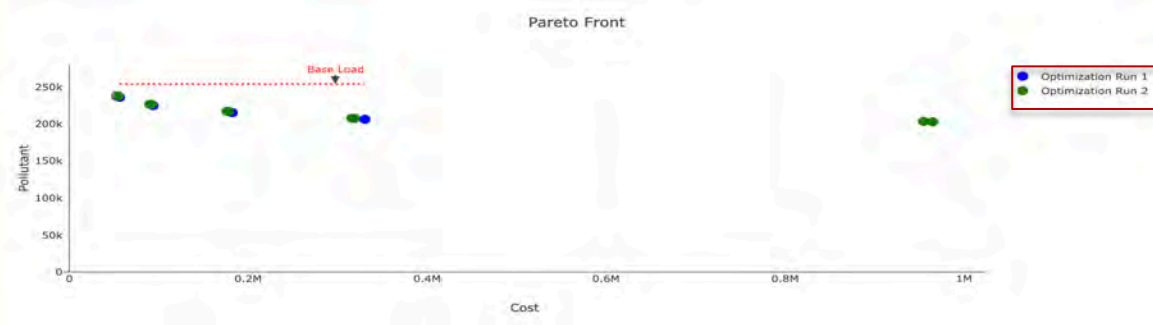
https://dev-coinlab.chesapeakebay.app/execution/list/340

Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front



25 ENTRIES PER PAGE
SEARCH:

id ↑	# Optimization Run ↓	# Solutions ↓	Actions
334	2	15	
335	1	9	

Showing 1 to 2 of 2 entries 1

Opt4Cast
Gemini


https://dev-coinlab.chesapeakebay.app/execution/list/340/

Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front



25 ENTRIES PER PAGE

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id	# Optimization Run	# Solutions	Actions
334	2	15	
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Showing 1 to 2 of 2 entries

1

Opt4Cast Gemini

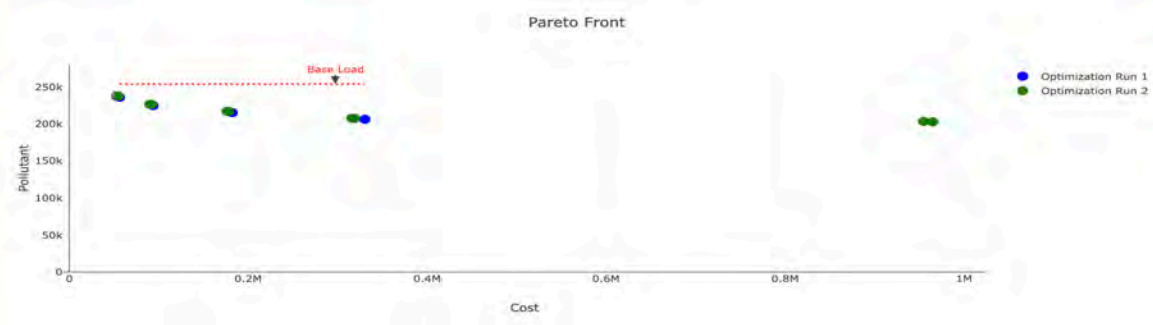
https://dev-coinlab.chesapeakebay.app/execution/list/340/

Optimization Runs for Mathews: 2023 Progress





Base Nitrogen Load

254,376

Pareto Front



25 ENTRIES PER PAGE SEARCH:

id [▲]	# Optimization Run [▼]	# Solutions [▼]	Actions
334	2	15	 
335	1	9	 

Showing 1 to 2 of 2 entries 1

Opt4Cast + Gemini

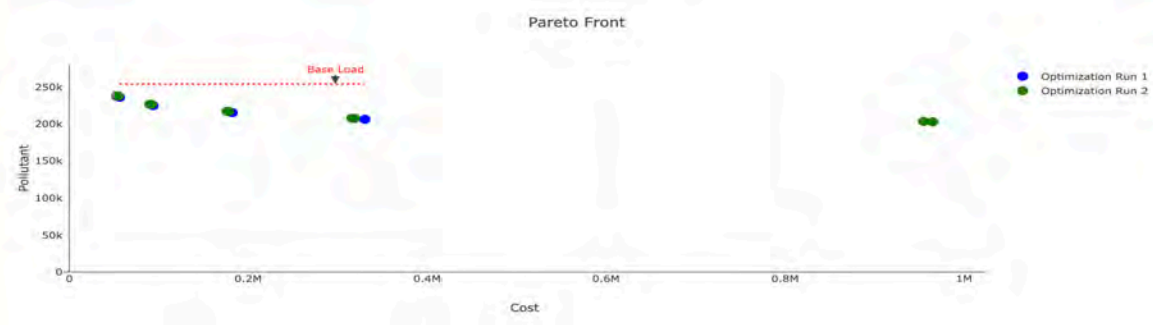
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Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front



25 ENTRIES PER PAGE

SEARCH:

id ▲	# Optimization Run ▼	# Solutions ▼	Actions ▼
334	2	15	
335	1	9	

Showing 1 to 2 of 2 entries 1

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/execution/list/340/

Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front

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334	2	15	
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Showing 1 to 2 of 2 entries

1

Opt4Cast + Gemini

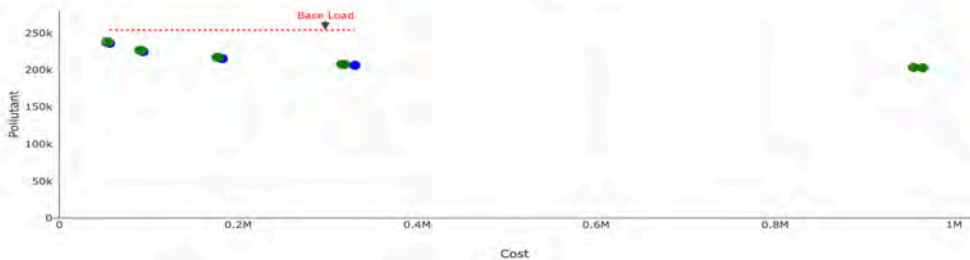
https://dev-coinlab.chesapeakebay.app/execution/list/340

Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front



25 ENTRIES PER PAGE

SEARCH:

id <small>↑</small>	# Optimization Run <small>↓</small>	# Solutions <small>↓</small>	Actions <small>↓</small>
334	2	15	
335	1	9	

Showing 1 to 2 of 2 entries

1

Opt4Cast Gemini

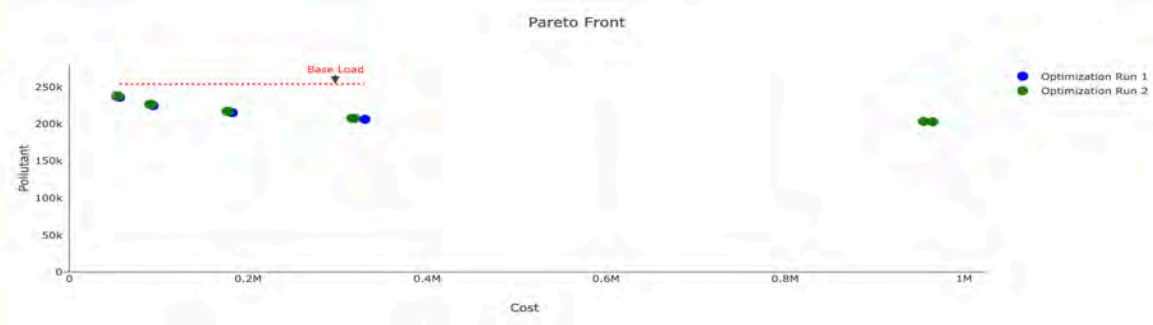
https://dev-coinlab.chesapeakebay.app/execution/list/340/

Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front



25 ENTRIES PER PAGE

id ↑	# Optimization Run ↓	# Solutions	Actions
334	2	15	<div style="display: flex; gap: 5px;"> 📄 📌 </div>
335	1	9	<div style="display: flex; gap: 5px;"> 📄 📌 </div>

Showing 1 to 2 of 2 entries

SEARCH:

1

Opt4Cast + Gemini

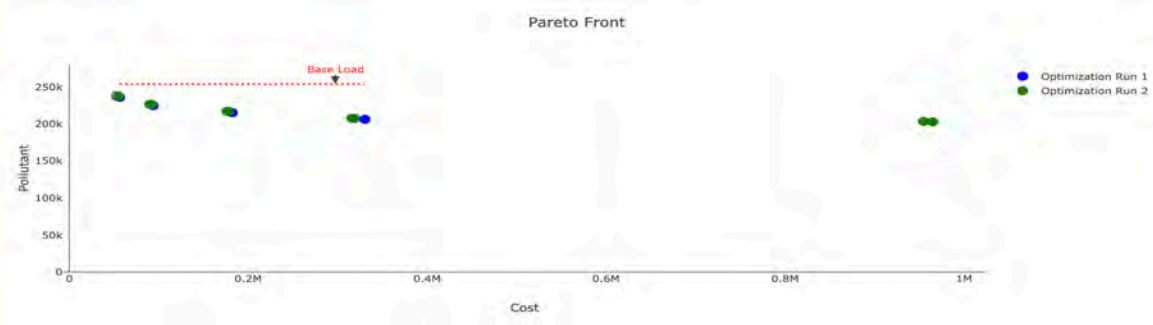
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Optimization Runs for Mathews: 2023 Progress

Base Nitrogen Load

254,376

Pareto Front

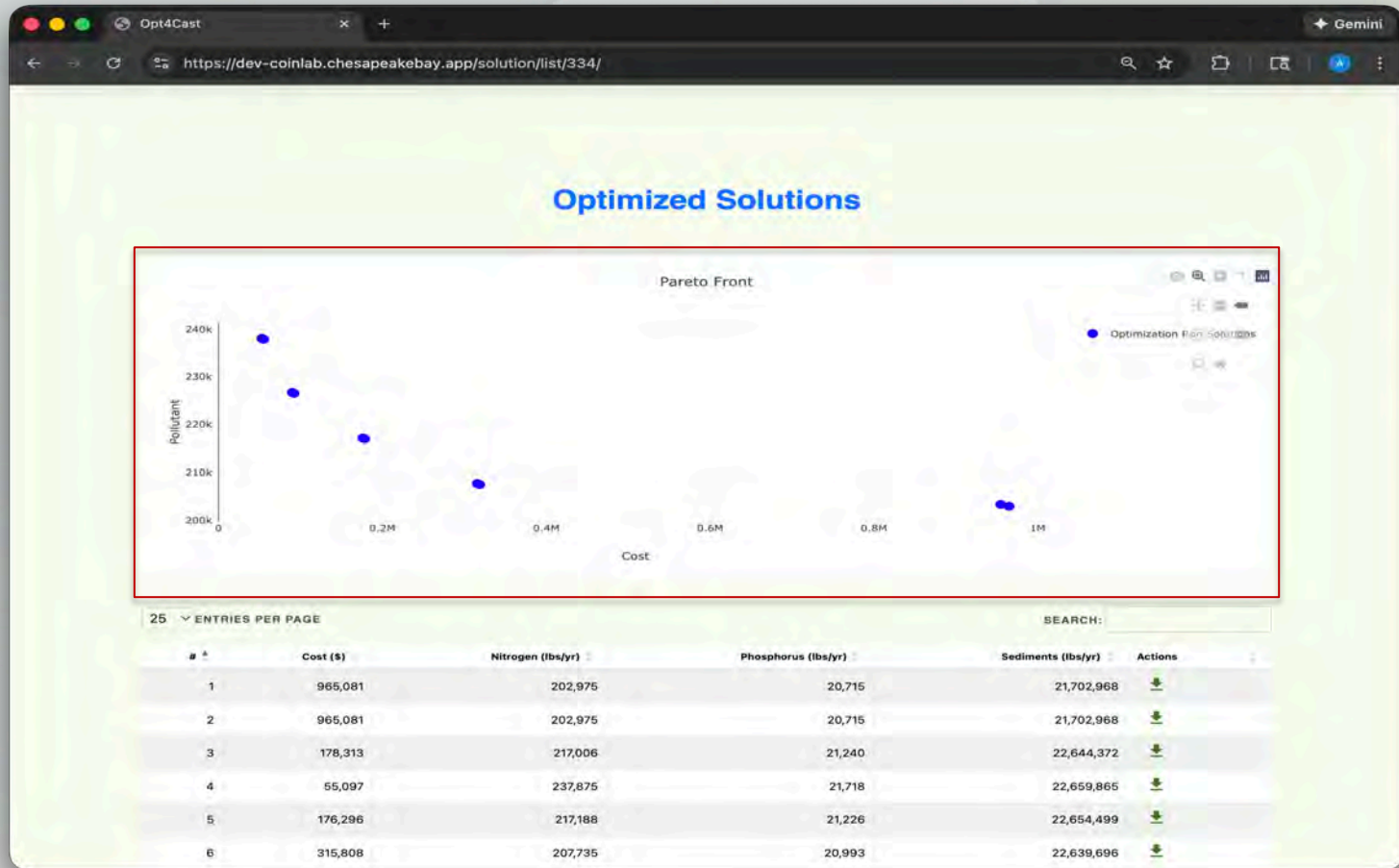


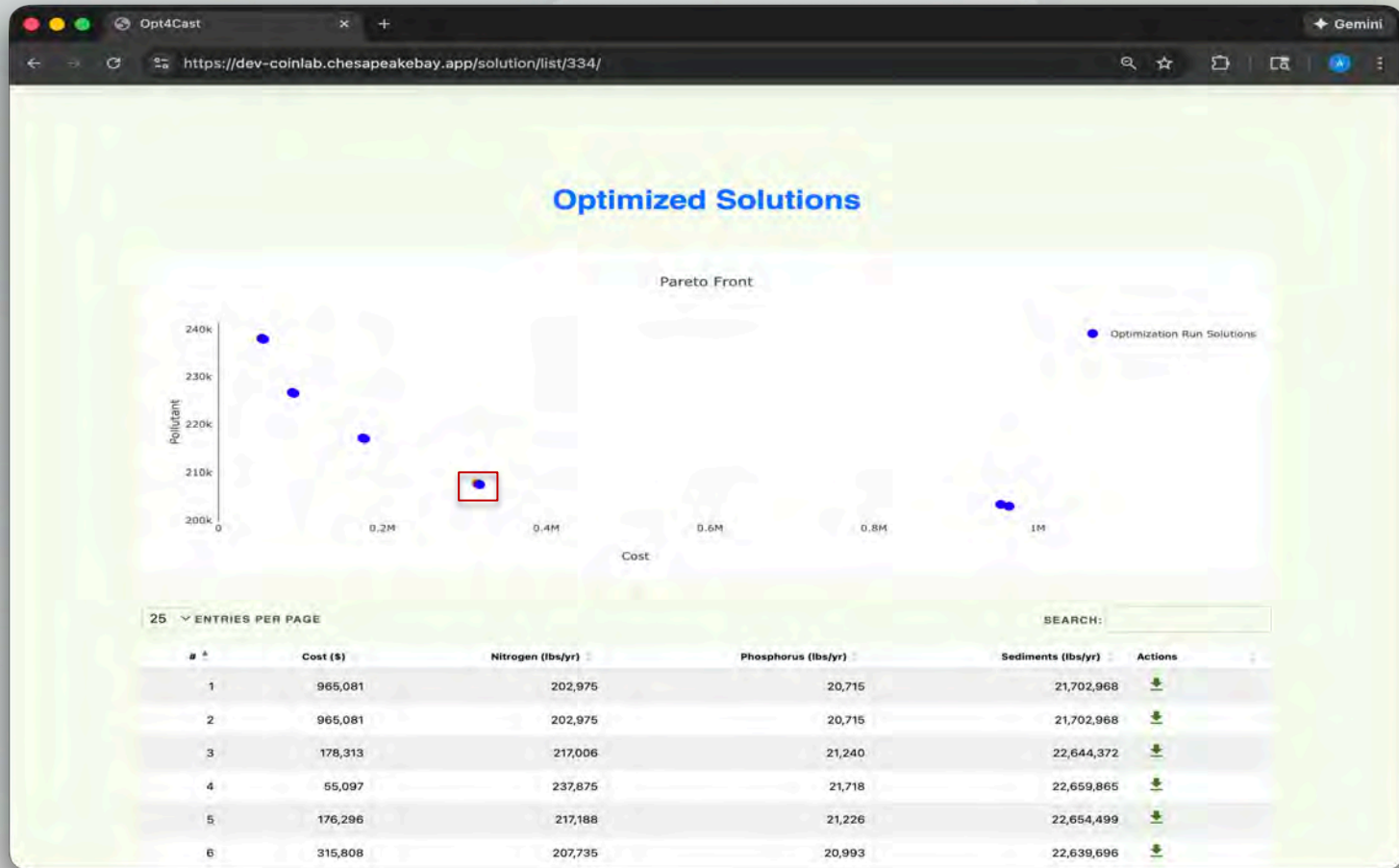
25 ENTRIES PER PAGE
SEARCH:

id ▲	# Optimization Run ▲	# Solutions ▲	Actions ▲
334	2	15	📄 📌
335	1	9	📄 📌

Showing 1 to 2 of 2 entries

◀ 1 ▶
⬆️





Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/solution/list/334/

200k | 0.2M | 0.4M | 0.6M | 0.8M | 1M

Cost

25 ENTRIES PER PAGE SEARCH: _____

#	Cost (\$)	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediments (lbs/yr)	Actions
1	965,081	202,975	20,715	21,702,968	
2	965,081	202,975	20,715	21,702,968	
3	178,313	217,006	21,240	22,644,372	
4	55,097	237,875	21,718	22,659,865	
5	176,296	217,188	21,226	22,654,499	
6	315,808	207,735	20,993	22,639,696	
7	92,178	226,528	21,311	22,645,406	
8	90,054	226,731	21,296	22,655,533	
9	954,874	203,371	20,723	22,000,806	
10	318,863	207,518	21,002	22,629,358	
11	92,178	226,528	21,311	22,645,406	
12	318,863	207,518	21,002	22,629,358	
13	52,795	238,092	21,702	22,670,022	
14	55,097	237,875	21,718	22,659,865	
15	178,313	217,006	21,240	22,644,372	

Showing 1 to 15 of 15 entries 1

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/solution/list/334/

200k | 0.2M | 0.4M | 0.6M | 0.8M | 1M

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25 ENTRIES PER PAGE SEARCH:

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Showing 1 to 15 of 15 entries 1

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/solution/list/334/

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Showing 1 to 15 of 15 entries 1

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/solution/list/334/

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Showing 1 to 15 of 15 entries 1

Opt4Cast Gemini

https://dev-coinlab.chesapeakebay.app/solution/list/334/

200k | 0.2M | 0.4M | 0.6M | 0.8M | 1M

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15	178,313	217,006	21,240	22,644,372	

Showing 1 to 15 of 15 entries 1

Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/solution/list/334/

200k | 0.2M | 0.4M | 0.6M | 0.8M | 1M

Cost

25 ENTRIES PER PAGE

SEARCH:


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8	90,054	226,731	21,296	22,655,533	
9	954,874	203,371	20,723	22,000,806	
10	318,863	207,518	21,002	22,629,358	
11	92,178	226,528	21,311	22,645,406	
12	318,863	207,518	21,002	22,629,358	
13	52,795	238,092	21,702	22,670,022	
14	55,097	237,875	21,718	22,659,865	
15	178,313	217,006	21,240	22,644,372	

Showing 1 to 15 of 15 entries

1

Opt4Cast + Gemini

https://dev-coinlab.chesapeakebay.app/solution/download/2870/

Home Optimization Scenarios 

Sector	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediments (lbs/yr)
Agriculture	32,308	1,489	408,659
Developed	80,060	8,647	1,146,361
Natural	75,139	10,719	21,078,945
Septic	19,731	0	0
Total	207,736	20,993	22,639,697
Wastewater	497	138	5,732

BMP Type

Land File

Animal File


Manure File

Actions

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BMP Type	Actions
Land File	Generate
Animal File	Generate
Manure File	Generate

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BMP Type	Actions
Land File	Download
Animal File	Download
Manure File	Download






Validation with CAST

CAST - Scenarios + Gemini

https://cast.chesapeakebay.net/Scenario



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SCENARIOS

My Scenarios ?

[Add New Scenario](#) Clear Filters [View Documentation](#)

Scenario Name	Scenario Status	Date Modified	Edit	Run	Delete
No records available.					

Shared Scenarios ?

Clear Filters Refresh

Scenario Name	Scenario Status	Author	Date Modified
2020 Progress	Run Finished	CBP Admin	2025-03-13 02:05:56 PM
2021 Progress	Run Finished	CBP Admin	2025-03-13 02:05:25 PM
2022 Progress	Run Finished	CBP Admin	2025-03-13 02:04:34 PM
2023 Progress	Run Finished	CBP Admin	2025-06-05 05:53:52 PM
2024 Progress previous rerun	Run Finished	CBP Admin	2025-02-21 12:00:00 AM
Conowingo WIP CAST-2023 version	Run Finished	Deb Caraco	2024-09-27 03:45:09 PM
Conowingo WIP Baseline CAST-2023	Run Finished	Deb Caraco	2024-09-27 03:45:25 PM

CAST - Add Scenario

https://cast.chesapeakebay.net/Scenario/AddScenario

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ADD SCENARIO

Required field

Scenario Name *

Scenario Description *

(Max. characters 500)

Base Year *

Base Condition *

Wastewater Data Set *

BMPs Available *

Cost Profile *

Version: CAST-2023

Check to view geographies located only in the Chesapeake Bay Watershed Area

Geographic Scale *

Copy/Upload BMPs

Existing Scenario


Single
 Sector
 State

Copy BMPs History

Scenario Name	Type	For	Date

CAST - Compare Scenarios x + Gemini

https://cast.chesapeakebay.net/ScenarioCompare/CompareResults/cb3a7111-639d-4b41-9d8a-90c694f56794



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COMPARE SCENARIOS

Compare Scenarios Load Source Acres Loads Loading Rate Percent Change

Nitrogen Loads (lbs/yr) ?

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Load Source	Mathews, Virginia; \$1,000,000 constrain (Edge of Stream)	1985 Progress (Edge of Stream)	Mathews, Virginia; \$1,000,000 constrain (Edge of Tide)	1985 Progress (Edge of Tide)
▶ Sector: Agriculture	32,552.84	84,673.42	27,906.84	72,616.61
▶ Sector: Developed	80,059.95	70,042.51	66,045.56	57,373.55
▶ Sector: Natural	75,165.38	87,536.50	110,858.63	124,466.56
▶ Sector: Septic	19,731.34	18,686.78	16,483.26	15,442.97
▶ Sector: Wastewater	496.71	13,214.66	477.18	13,061.73
	208,006.23	274,153.87	221,771.46	282,961.42

Download Nitrogen Loads

Phosphorus Loads (lbs/yr) ?

Load Source	Mathews, Virginia; \$1,000,000 constrain (Edge of Stream)	1985 Progress (Edge of Stream)	Mathews, Virginia; \$1,000,000 constrain (Edge of Tide)	1985 Progress (Edge of Tide)
▶ Sector: Agriculture	1,569.37	3,184.09	1,061.45	2,158.62

Search Cast...

Nitrogen Loads (lbs/yr) ?

[View Documentation](#)

Load Source Mathews, Virginia; \$1,000,000 constrain (Edge of Stream)

Sector	Load (lbs/yr)
► Sector: Agriculture	32,552.84
► Sector: Developed	80,059.95
► Sector: Natural	75,165.38
► Sector: Septic	19,731.34
► Sector: Wastewater	496.71
Total	208,006.23

[Download Nitrogen Loads](#)

Phosphorus Loads (lbs/yr) ?

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BMP Type

Actions

Land File	Download
Animal File	Download
Manure File	Download



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Phosphorus Loads (lbs/yr) ?

Load Source Mathews, Virginia; \$1,000,000 constrain (Edge of Stream)

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MSU Optimization with CoreCAST and Original CAST results match very well

Original Tasks Which Could not be Completed Due to Early Termination of the Project

- Human-understandable rule extraction for efficient BMP allocation (partially done)
- Faster completion of optimization run
 - Using parallel hardware (partially done)
 - Using rules and surrogate models
- Robust optimization
- Sustainable watershed optimization
- Not original proposed, but a direct integration of our optimization code with CAST may be helpful as well

Finally

- Thank you and EPA for this opportunity
- We sincerely hope the MSU optimization platform will be beneficial to EPA's work
- Pouyan and I are available for any extension or another project opportunity in the near future