

Digital Solutions for Implementing a Watershed Program

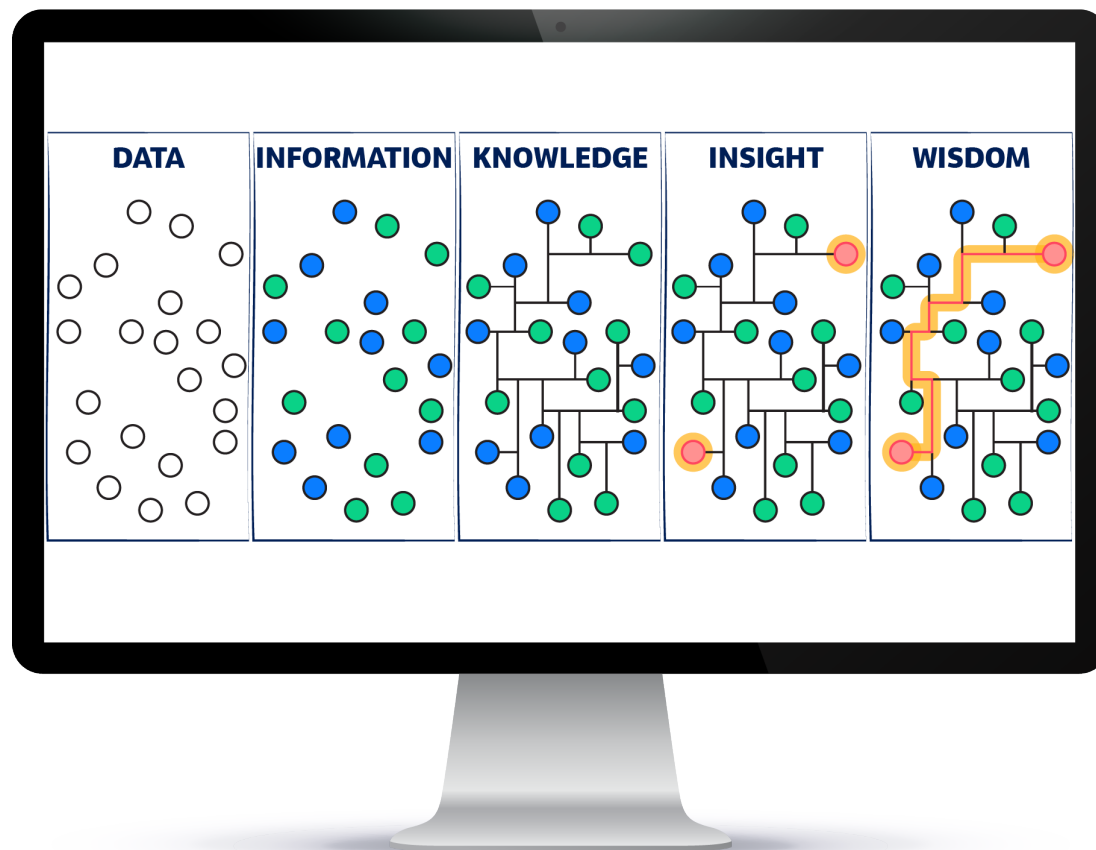
Brent Brown, PE
Natalie Lenz, PE

September 8, 2022

Jacobs



How do we use data?



Challenges with watershed data

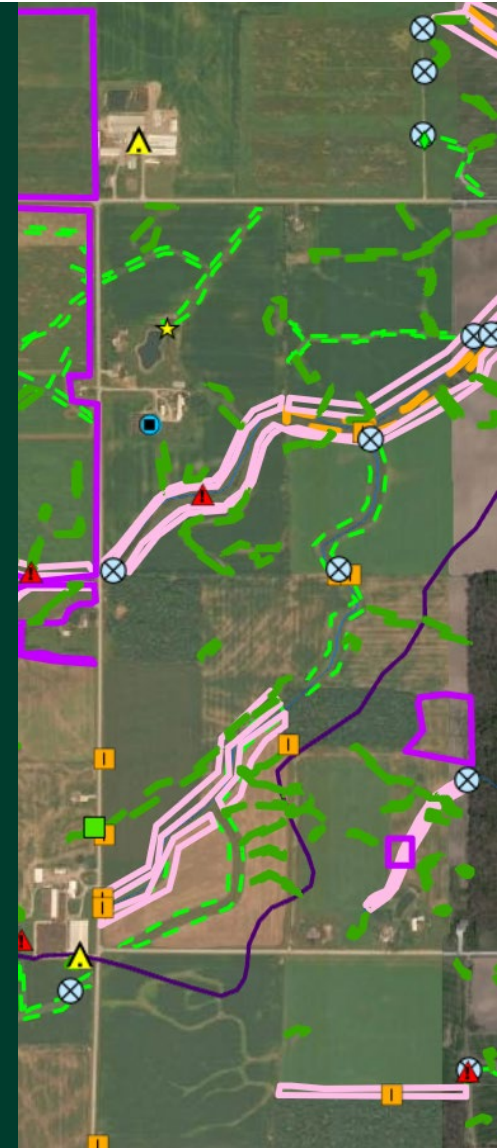
- Limited 'off-the-shelf' solution for watersheds
- Each watershed Program is unique
 - Questions to answer
 - Stakeholders
 - Partners
 - Initiatives
 - Reporting and grant requirements
 - Workflows among team and external partners
 - External events that trigger a Program action
- Evolution of Program needs
- Require timely implementation

Don't get hung up on the specific example, think about the approach and application of technology



Case Study

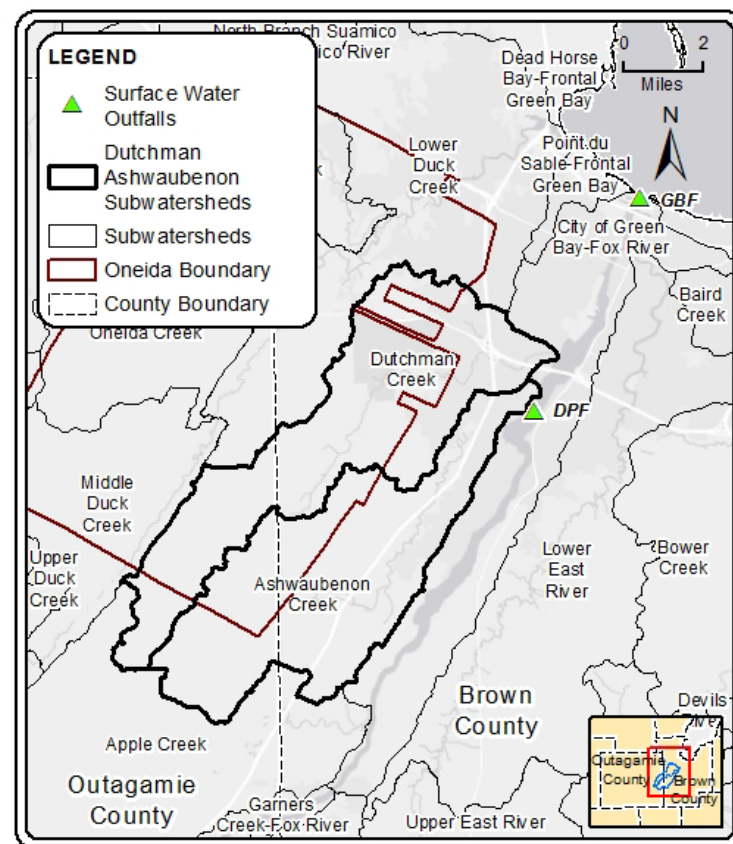
Building a data management system to implement Green Bay Metropolitan Sewerage District's NEW Watershed Program for Adaptive Management



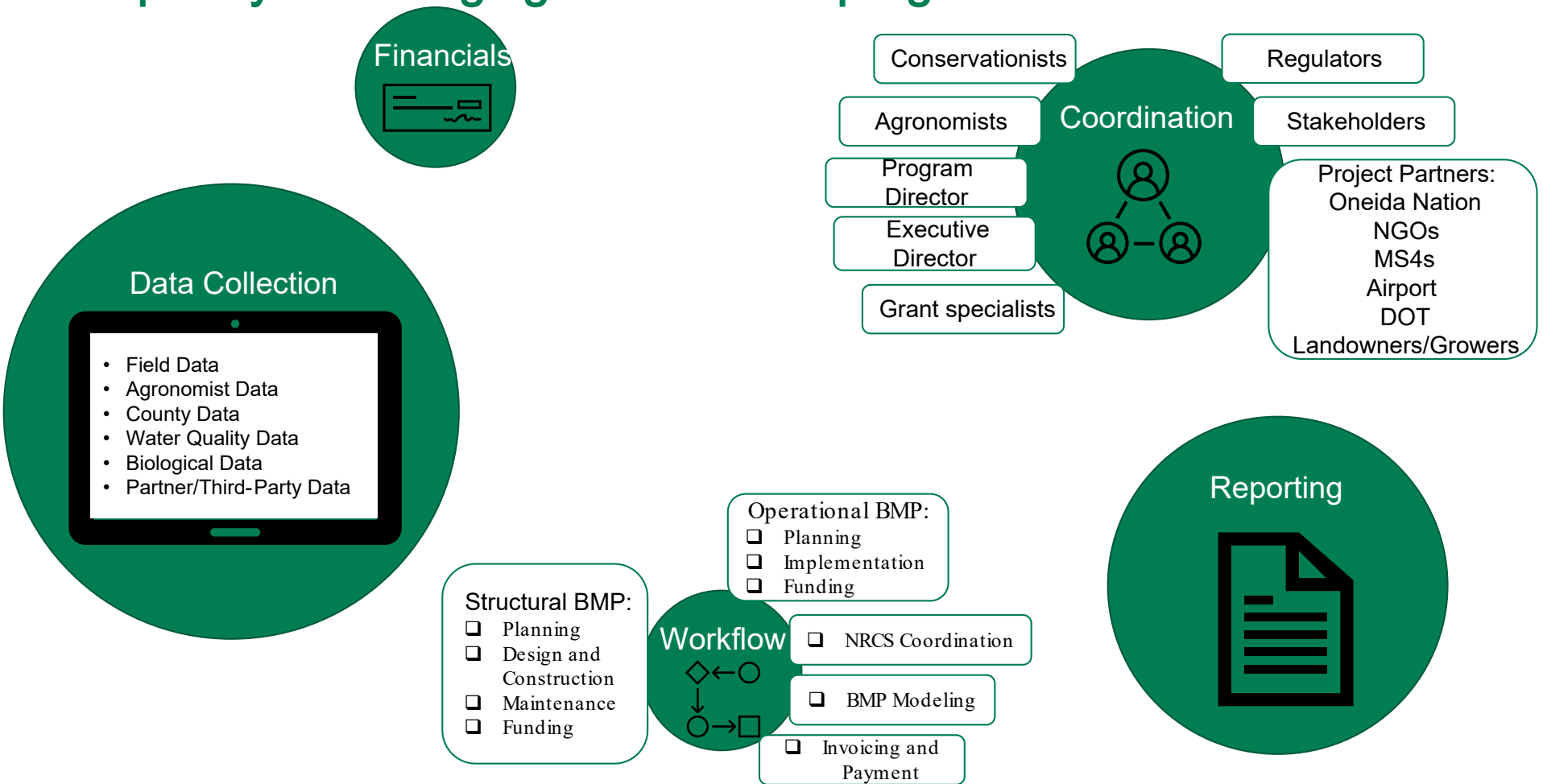
Adaptive Management: Ashwaubenon and Dutchman Creeks

- Permit effective April 1, 2022
- Install best management practices (BMPs) for nutrient reductions
- Watershed area 59 square miles
- Southwest = agricultural
- Northeast = urban with 5 MS4s

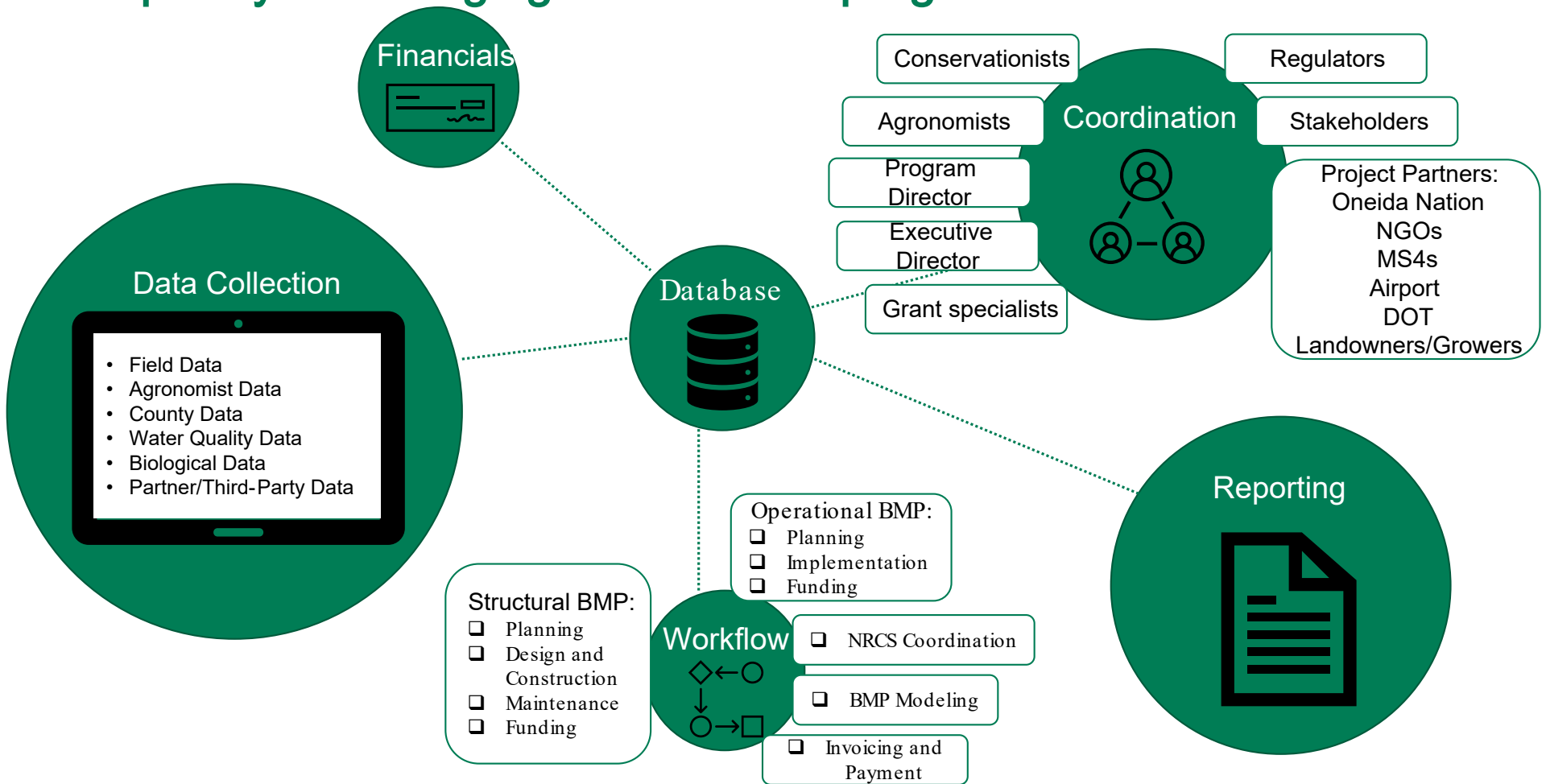
Permit Term	Phosphorus (lbs/year)	TSS (lbs/year)	% of Total Action Area TMDL Reduction
1	4,727	985,935	25%
2	13,238	2,760,618	70%
3	17,965	3,746,553	95%
4	18,911	3,943,740	100%



Complexity of managing a watershed program



Complexity of managing a watershed program



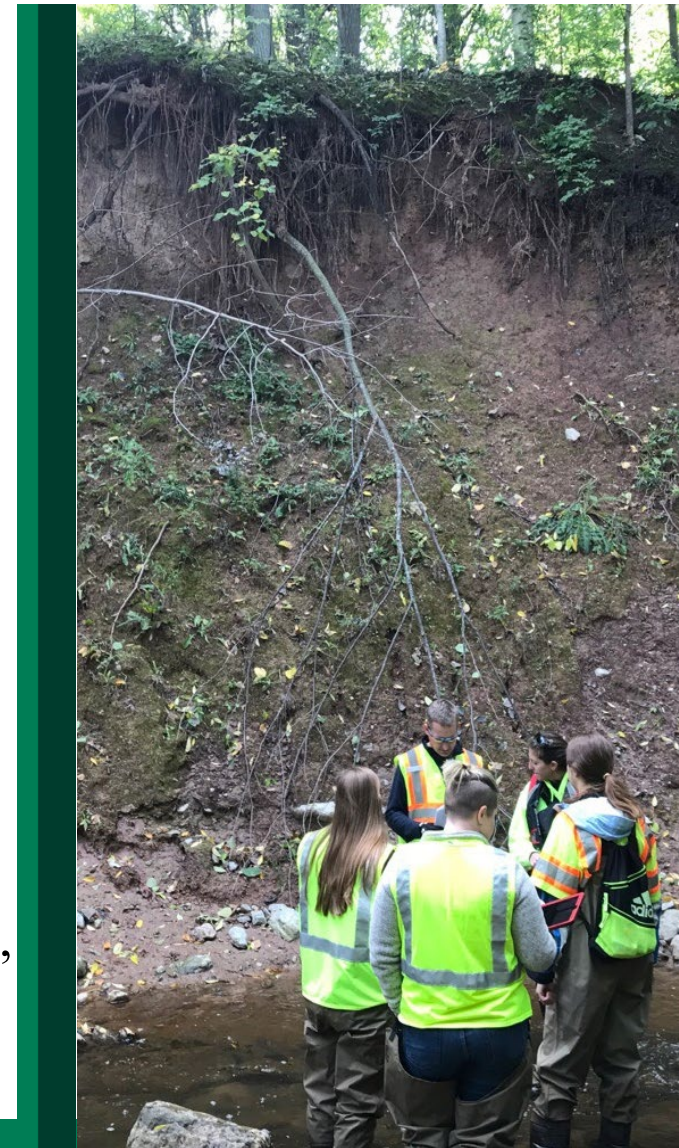
Data storage in a centralized and commonly used database

- Spatial Database Engine (SDE) using Microsoft SQL Server (or others)
- Interface with off-the-shelf and custom software – not limited to one solution
- Ability for multiple entities to access data in a controlled and secure way



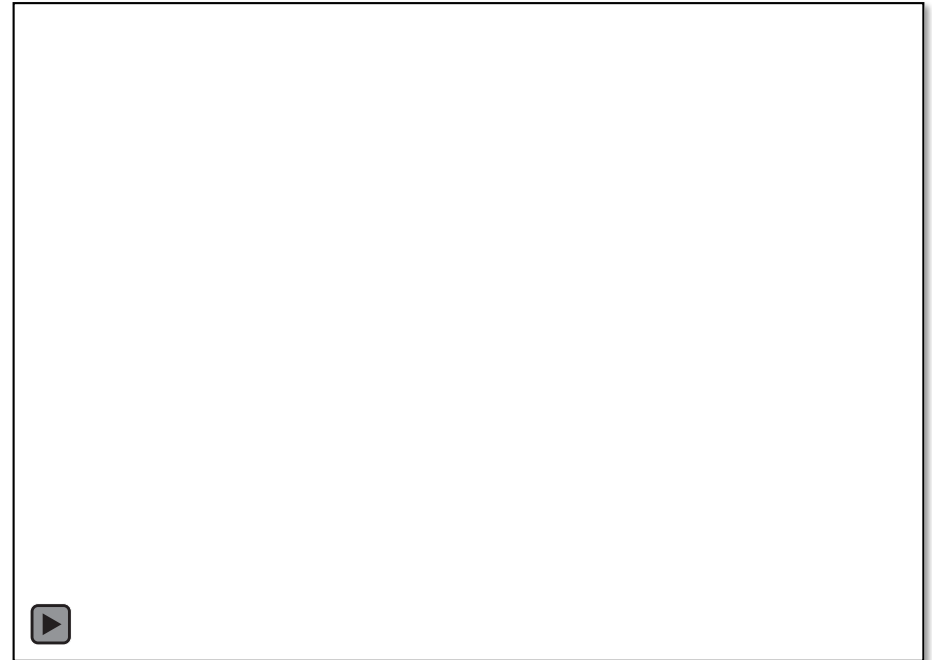
Progress to date

- By year 1 of the Permit Term:
 - 28 miles of stream corridor inventoried
 - 218 agricultural fields (7,362 acres) inventoried
 - >1,300 individual BMPs and resource concerns logged
 - 3,000+ photos taken
 - 439 unique watershed contacts
 - Completed 40 structural and 155 operational BMPs
 - 1,607 lbs/yr phosphorus reduction (structural)
 - 2,389 lbs/yr phosphorus reduction (structural & oper.)
 - 100% BMPs fully designed through June 2023
- Digital tools enabled efficient planning, implementation, verification, and reporting.



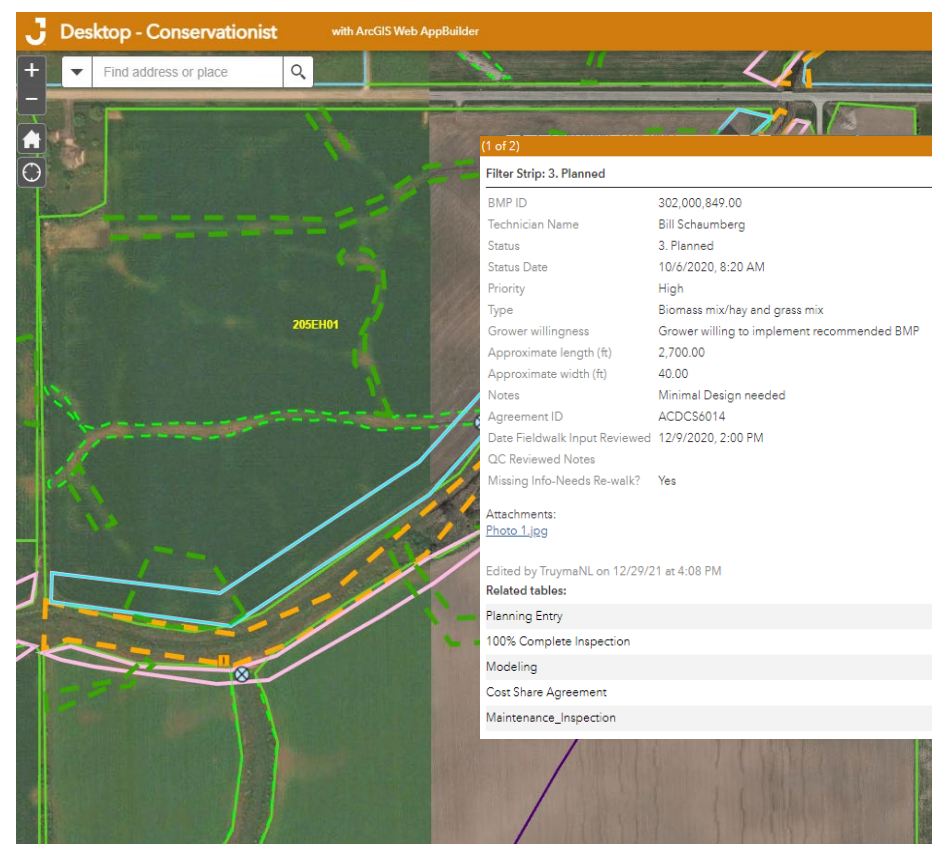
How do we identify resource concerns & opportunities for BMPs?

- Core feature is spatial– but supporting data is not
- Utilize ESRI AGOL– but hosted through Jacobs servers to minimize cost and have direct control over services
- Traditional points/lines/polygons, but more critically *related tables*
 - Multiple entries to single asset (e.g. buffer) or asset class (e.g. field #1234)
 - Efficient data management and minimizes conflicting spatial assets



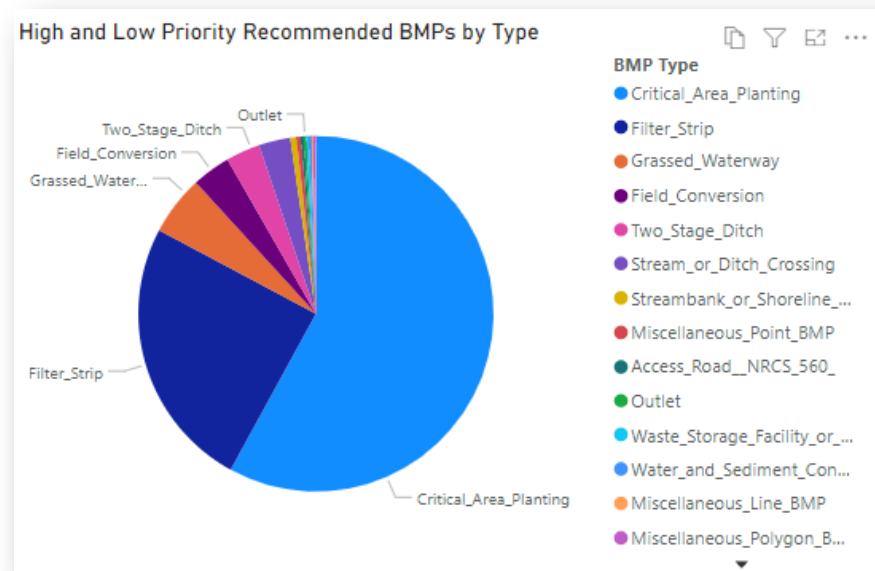
Related tables efficiently manage data to spatial features

- Related tables to every structural BMP
 - **Planning Entry** for readying a BMP for construction
 - **100% Complete** to verify construction is finished
 - **Modeling** to track reductions
 - **Cost Share Agreement** to track contracting and financials
 - **Maintenance Inspection** to complete annual or event-based maintenance and track corrective actions (if needed)
- Additional tables for field boundaries and operational BMPs
- Defined a table for a specific set of actions associated with the asset and asset class

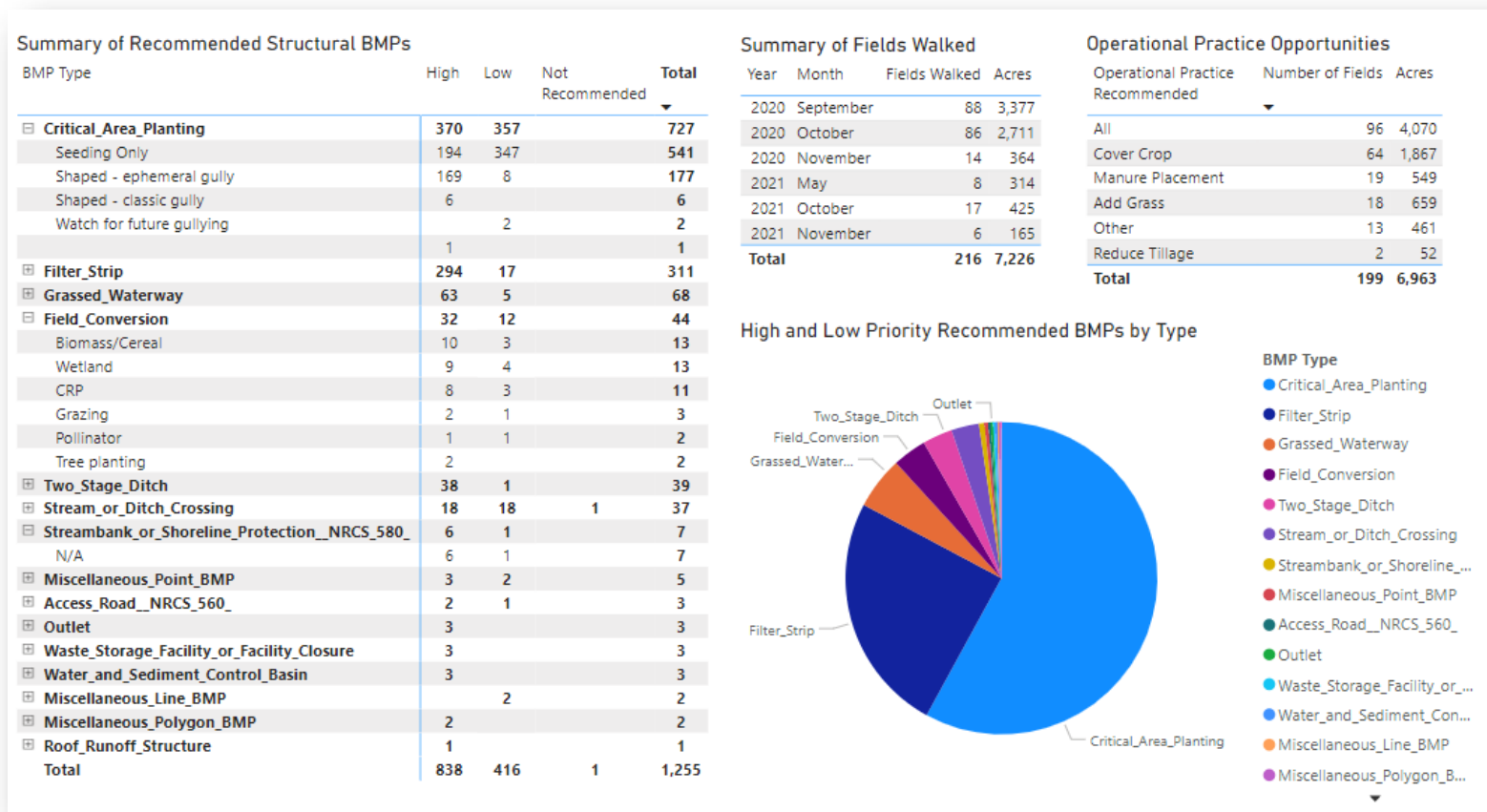


How do we strategically plan for >1,300 BMPs in just this first phase?

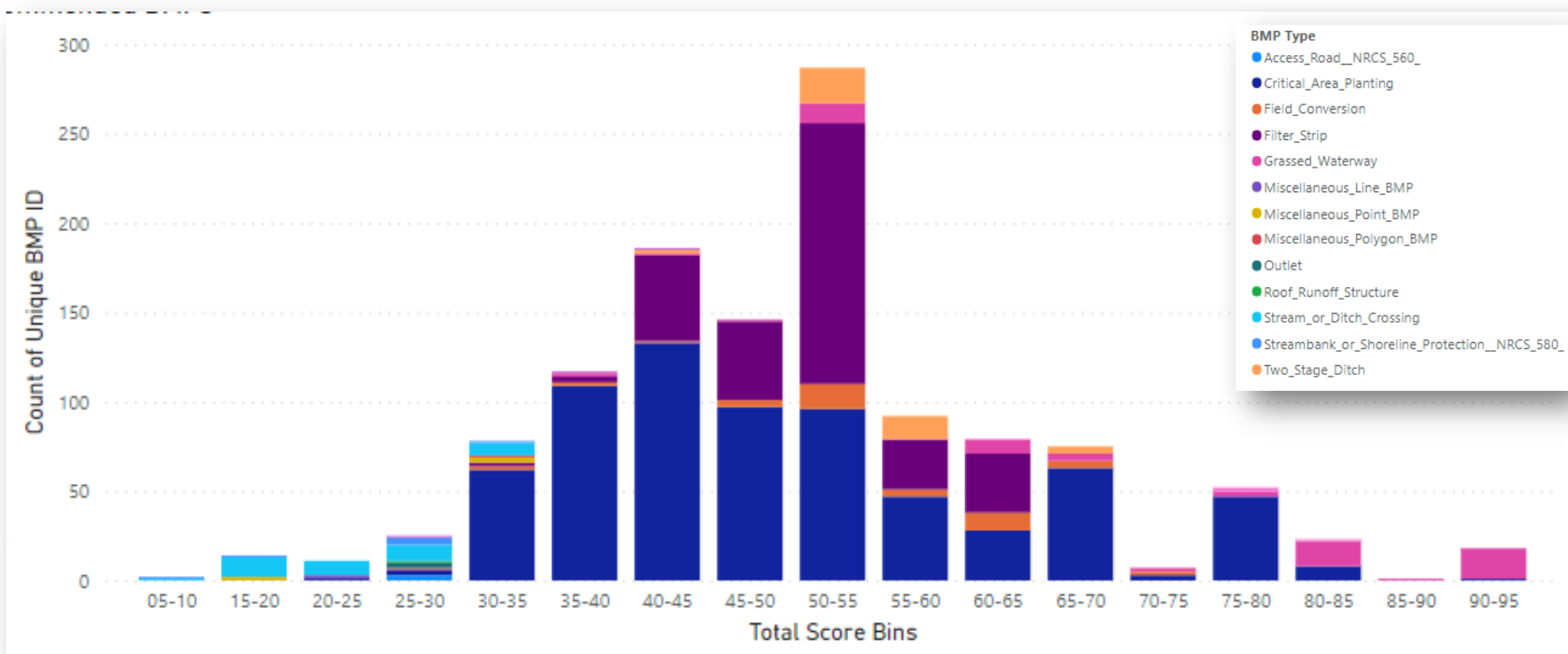
- Identify criteria important to implementation
 - Cost
 - BMP certainty
 - Desktop priority
 - Program priority
 - BMP Priority
 - Phosphorus reduction
- Rank and weight each criteria
- Apply criteria to each BMP within database (GIS) real-time



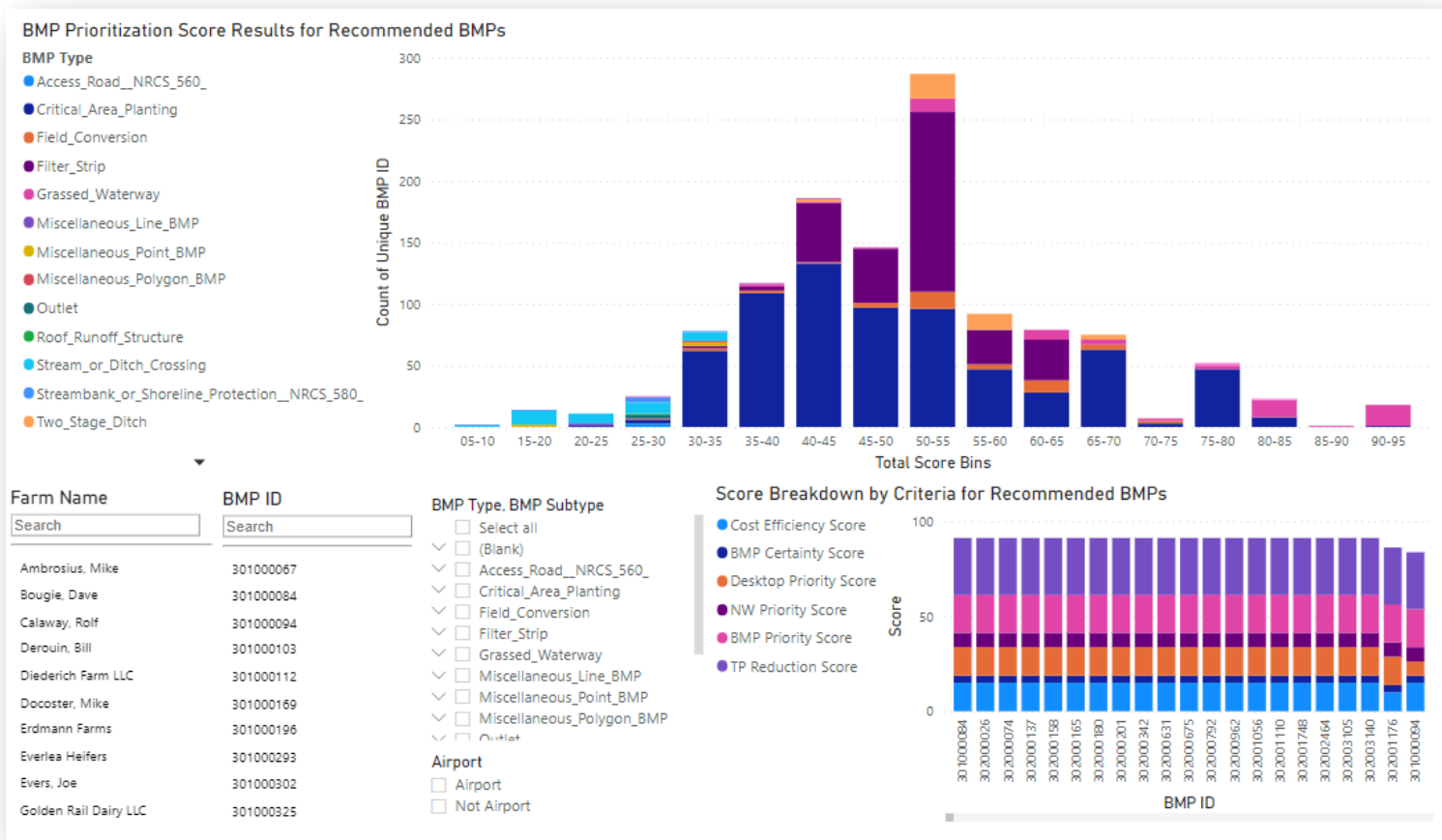
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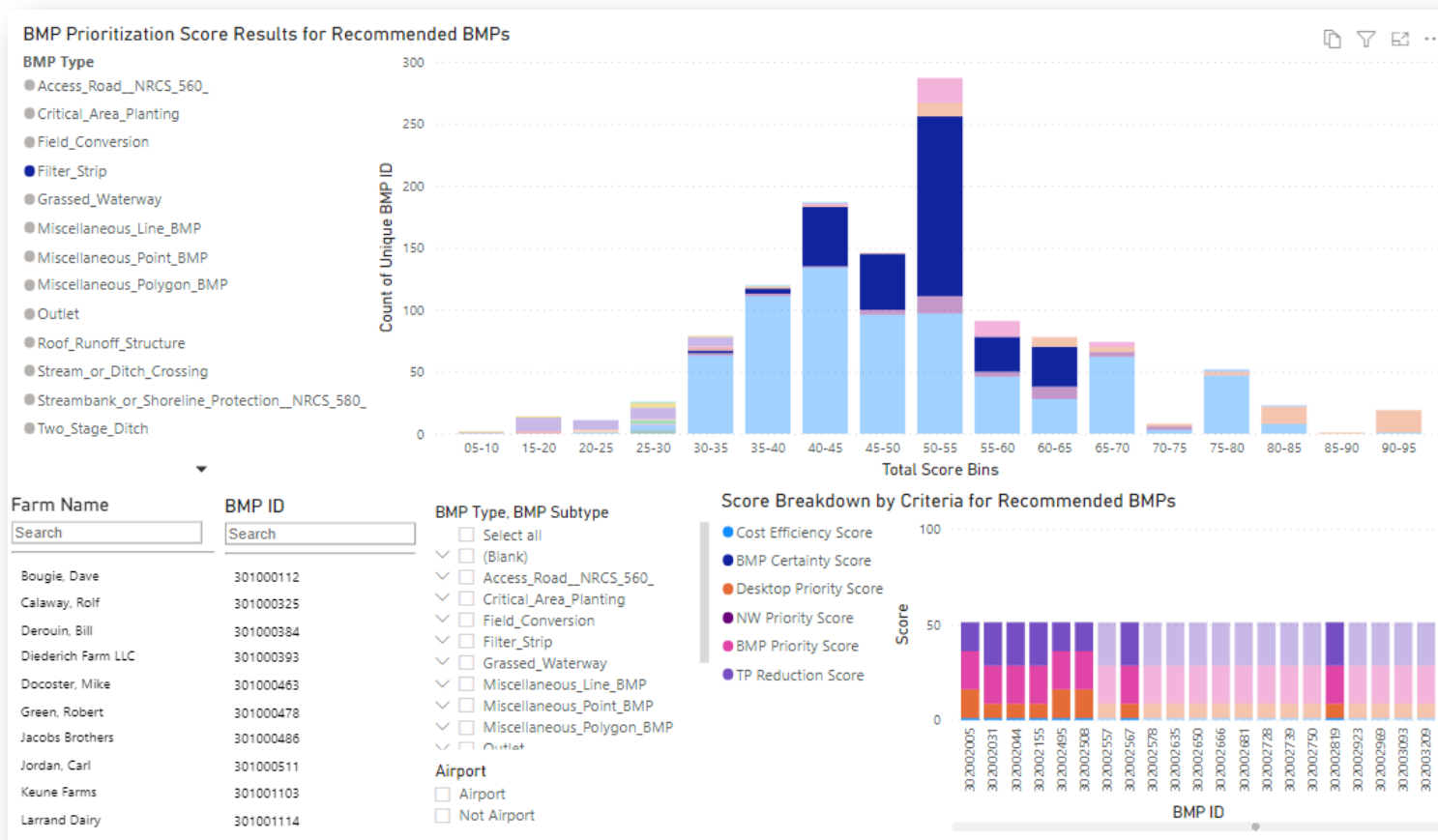
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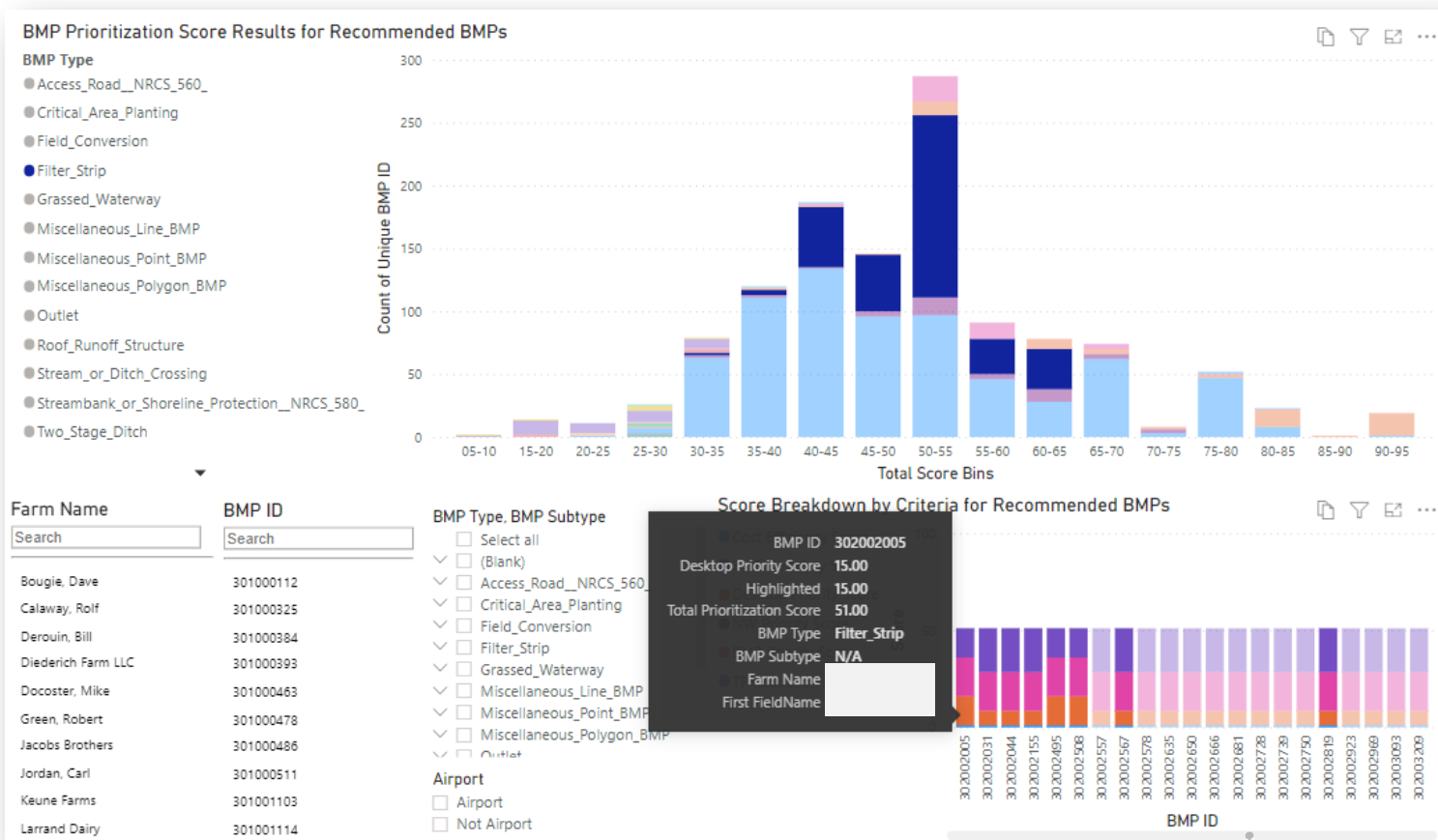
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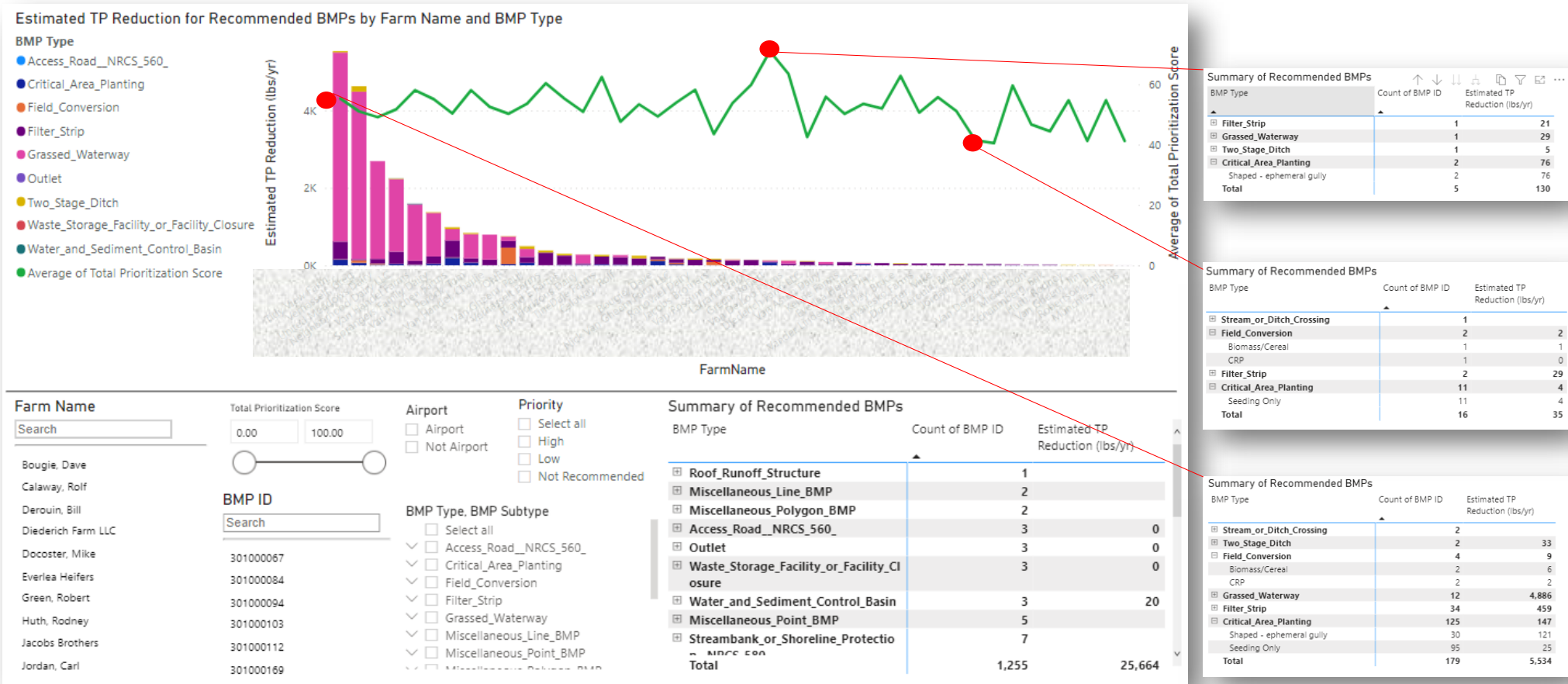
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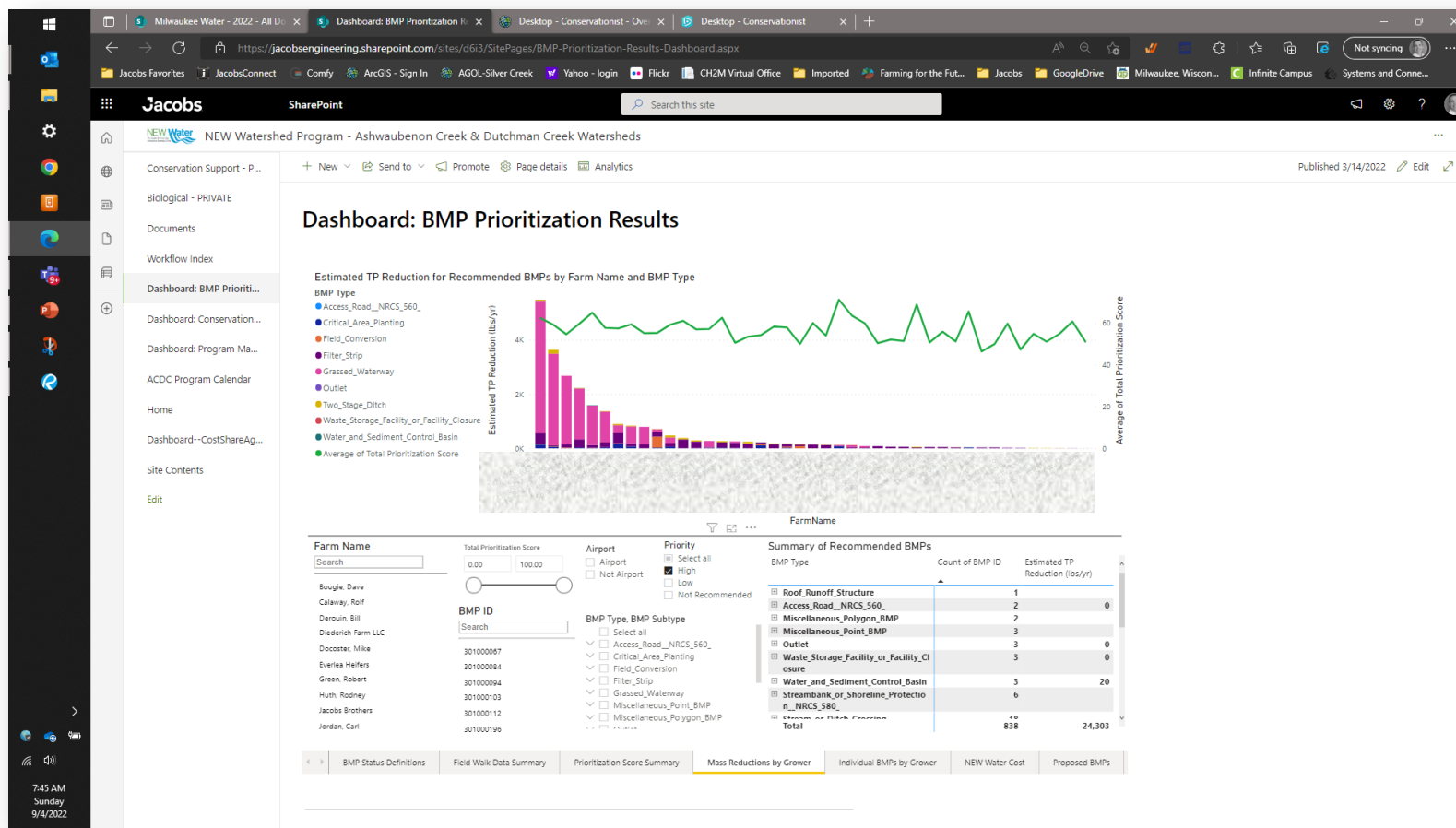
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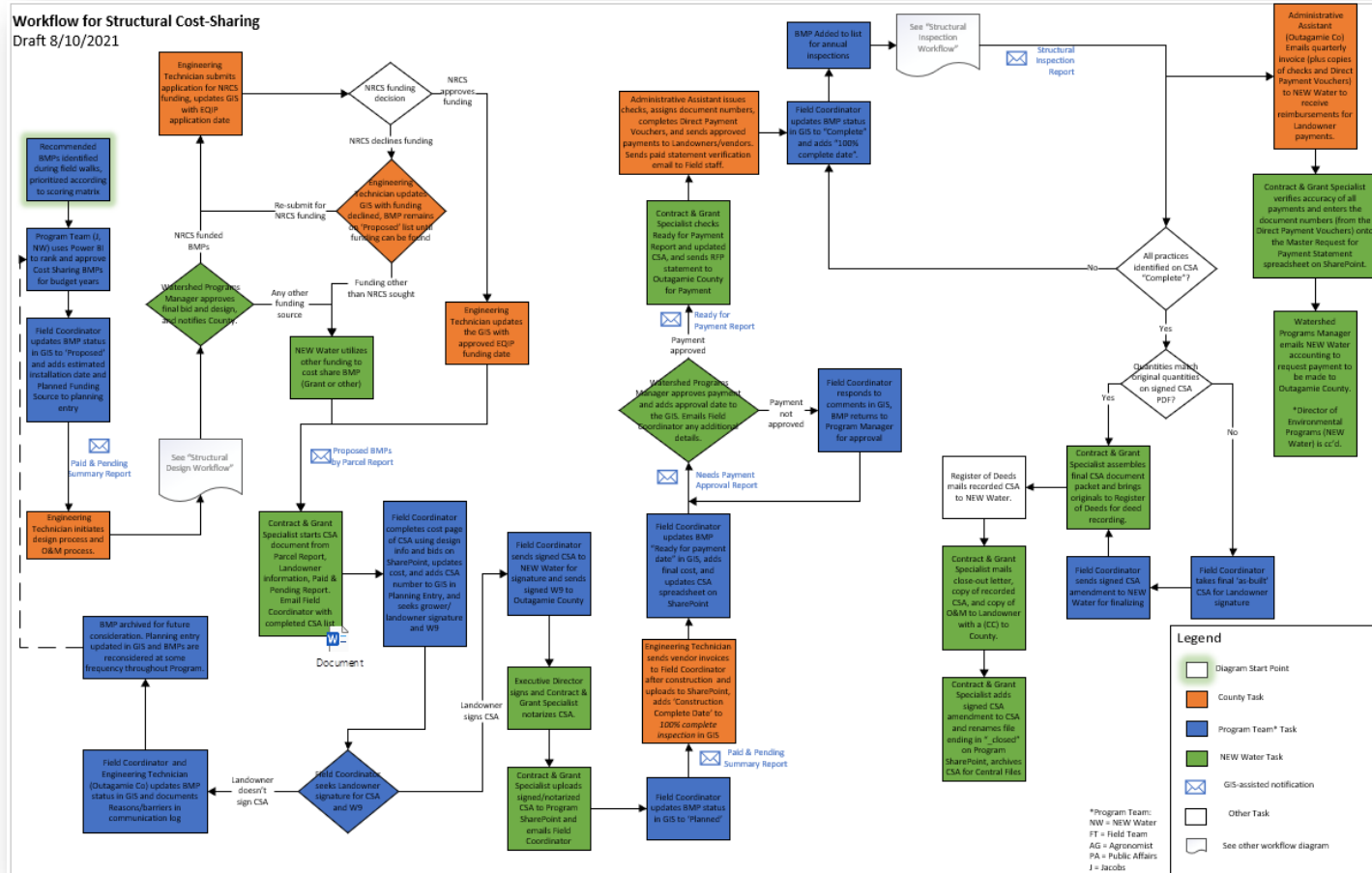
How do we strategically plan for >1,300 BMPs in just this first phase?



How do we strategically plan for >1,300 BMPs in just this first phase?



How can we manage form-based data for spatial assets?




A simple landing page to choose activity

The screenshot shows a SharePoint web page titled "Dashboard: CostShareAgreement" under the "NEW Watershed Program - Ashwaubenon Creek & Dutchman Creek Watersheds". The page features a navigation sidebar on the left with options like "Conservation Support - P...", "Biological - PRIVATE", "Documents", "Workflow index", and "Dashboard: CostShareA...". The main content area is titled "Cost Share Agreements Menu" and is organized into three columns:

- PowerApps Editors** (highlighted with a red box):
 - CSA Document Editor
 - CSA Overview Editor
- Printable Pages**:
 - Informing Admin Services
 - RFPS Printout
 - Exhibit 1 Printout
- Dashboards**:
 - Payment Tracking
 - CSA Status
 - Document Tracking
 - ACDC Paid

At the bottom of the page, there is a "Landing Page" breadcrumb, social sharing options (Like, Comment, 141 Views, Save for later), and a "Comments" section with a text input field and a "Post" button. The page is published on 3/21/2022 by Hobbs, Marshall.

Form-based data entry focuses workflow

 Home

CSA ID
ACDCS5555

Ambrosius, Mike
1234 Main Street
Mt. Zion, IL 62549

CSA Status
Exec Director Signed
Notify Administrative
Services Supervisor










RFPS Printout

Exhibit 1 Table

Invoices | Costs

CSA Data Review

Exhibit 1 - Invoices

BMP	302004095	302004281	302004282
Date	7/6/2022 	12/31/2001 	12/31/2001 
Invoice #	ACDCS5555-1	ACDCS5555-2	
Vendor	John Doe		
Service Provided	TEST		
OC Doc #	1234ABCD-1		
Total Cost	\$ 0.00	\$ 0.00	\$ 0.00
Date GBMSD Approved	7/6/2022 	12/31/2001 	12/31/2001 
Date OC Paid	12/31/2001 	12/31/2001 	12/31/2001 
[Other] Share Paid	\$ 0.00	\$ 0.00	\$ 0.00
GBMSD Share (\$)	\$ 401.00	\$ 0.00	\$ 0.00
Notes	<input style="width: 100%; height: 40px;" type="text"/>		

Save

Cancel

Insert New Record

Update Existing Record(s)

Print CSA


Pages
1 2
3 4

Parcel ID	BMP ID
VA-7-1	302004095
VA-7-1	302004281
VA-213-2	302004281
VA-213-2	302004282

Field Names
230JV LAM/ASH

Parcel ID	Deed Doc #	Legal Desc.
VA-213-2	DCBA-322	Lot 3.1
VA-7-1	ABCD-123	Lot 4

Ability to “print” to report template

 Home

CSA ID
ACDCS555

Ambrosius, Mike
1234 Main Street
Mt. Zion, IL 62549

CSA Status
Exec Director Signed
Notify Administrative
Services Supervisor

RFPS Printout

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Date OC Paid	12/31/2001	12/31/2001	12/31/2001
[Other] Share Paid	\$ 0.00	\$ 0.00	\$ 0.00
GBMSD Share (\$)	\$ 401.00	\$ 0.00	\$ 0.00
Notes			

Save

Cancel

Insert New Record

Update Existing Record(s)

Print CSA

Pages

1 2

3 4

Parcel ID **BMP ID**

VA-7-1 302004095

VA-7-1 302004281

VA-213-2 302004281

VA-213-2 302004282

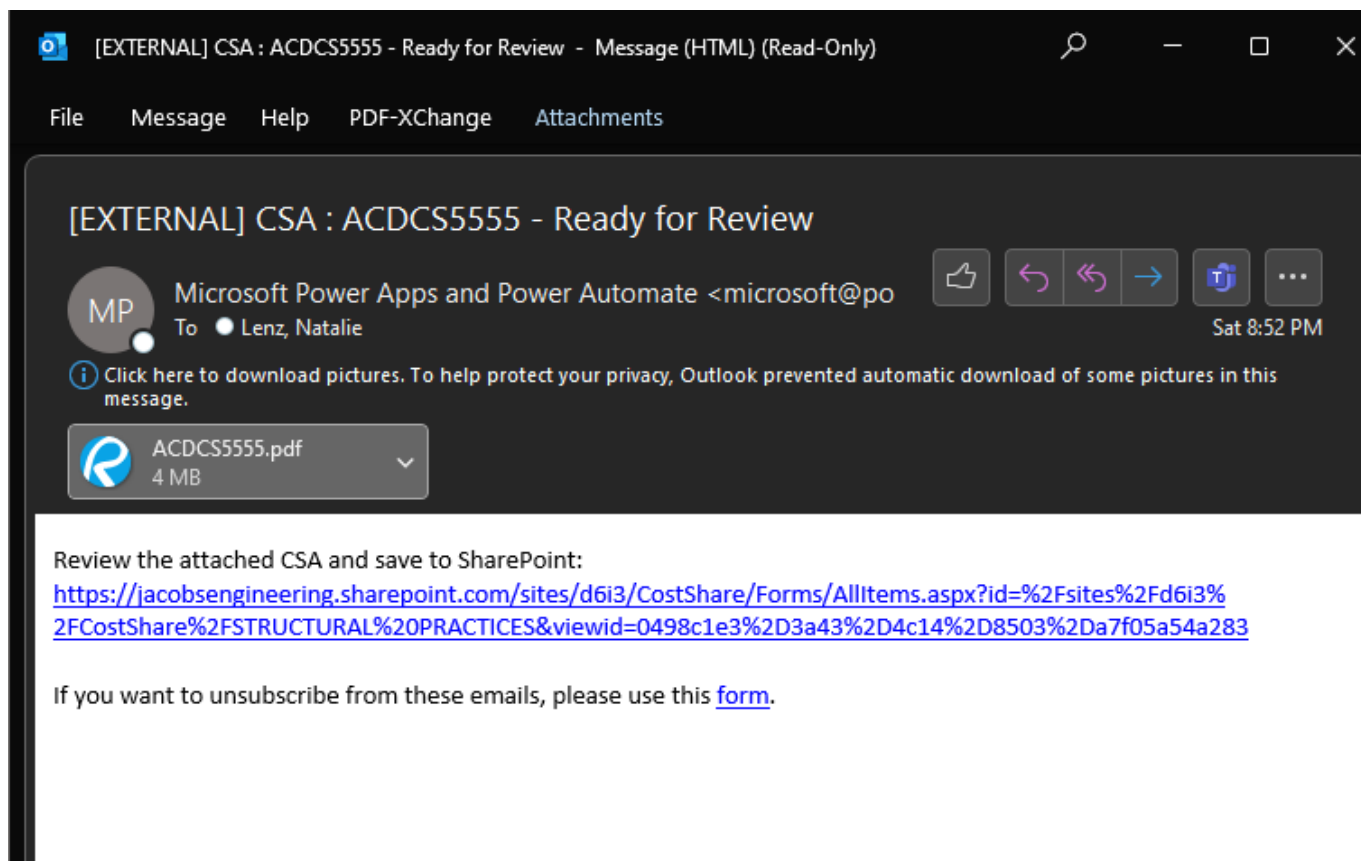
Field Names

230JV LAM/ASH

Parcel ID	Deed Doc #	Legal Desc.
VA-213-2	DCBA-322	Lot 3.1
VA-7-1	ABCD-123	Lot 4


✓ Preparing the CSA document. An email will arrive in a few minutes. ✕

Email-generated report instantly created




Data populates standard report templates

COST SHARE AGREEMENT NO.
ACDCS5555



COST SHARE AGREEMENT
Ashwaubenon Creek / Dutchman Creek
Adaptive Management Program

NAME AND RETURN ADDRESS



NEW Water
Green Bay Metropolitan Sewerage District
Attn: Contract and Grant Specialist
2231 N Quincy Street
Green Bay, WI 54302

This agreement ("Agreement") is made and entered into by and among Green Bay Metropolitan Sewerage District ("GBMSD") and the below-referenced landowner(s) of the property (the "Cost Share Recipient").

The person identified below is receiving cost share funds provided through GBMSD. As described in the Best Management Practices Plan (Exhibit 1), cost share funds will be provided to the Cost Share Recipient in return for the design, installation, and operation & maintenance of best management practices ("BMPs") designed to achieve certain water quality standards. For good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Cost Share Recipient, their respective heirs, successors and assigns, agree and commit to fulfill the terms and conditions of the cost-share arrangement set forth in this Agreement and Exhibit 1.

The design, BMP cost, installation schedule, and operation & maintenance plan are also maintained on file with the Outagamie County Land Conservation Department (the "Technical Service Provider") and GBMSD. This Agreement relates to the land legally described in the "Property Information" section below (the "Property").

Parcel Identification Number(s)
VA-213-2, VA-7-1

Cost Share Agreement Information	
Landowner/Cost Share Recipient Name: Ambrosius, Mike	
Field Name: 230JV LAM/ASH	
For more information regarding this Cost Share Program and/or for cost share payment assistance, call or contact: Green Bay Metropolitan Sewerage District Erin Houghton, Watershed Programs Manager 2231 North Quincy Street Green Bay, Wisconsin 54302 Phone: 920-438-1071	For more information regarding technical assistance, call or contact: Outagamie County Land Conservation Department Luke Hickey, Engineering Technician 3365 West Brewster Street Appleton, Wisconsin 54914 Phone: 920-209-2620

NEW Water, the brand of the Green Bay Metropolitan Sewerage District
2231 North Quincy Street | Green Bay, WI 54302
Phone (920) 432-4893 | Fax (920) 432-4302 | www.newwater.us

Page 1 of 13

EXHIBIT 1 - Best Management Practice(s) BMP Plan: Practices, Costs, Installation, Approvals, and Payments
 Ashwaubenon Creek & Dutchman Creek Cost Share Agreement: ACDCS5555

Name of Person Preparing Technical Design: Luke Hickey **Representing:** Outagamie County Land Conservation Department (OCLCD)

By signing on the Signature Page on Page 7 of the CSA the Landowner agrees:
 1) with the BMP practices, specifications, eligible costs, cost share amounts, operation & maintenance (O&M) plan, and installation schedule set forth below.
 2) to receive certain cost share funds in exchange for the installation and O&M of BMP(s) designed to be maintained in perpetuity in order to achieve certain water quality standards.
 3) to notify any field specific operator/grower of the required O&M activities associated with each installed BMP. And, to notify the OCLCD and GBMSD if there is a change in operator/grower.
 4) that this Exhibit 1 - BMP Plan will be updated and finalized as the BMP projects progress.

Name of Cost Share Recipient: Ambrosius, Mike
 Date of Initial Estimate: 7/1/2022 12:00:00 AM

Note: the final cost share amounts may be more or less based on the actual cost of the BMP(s) installed

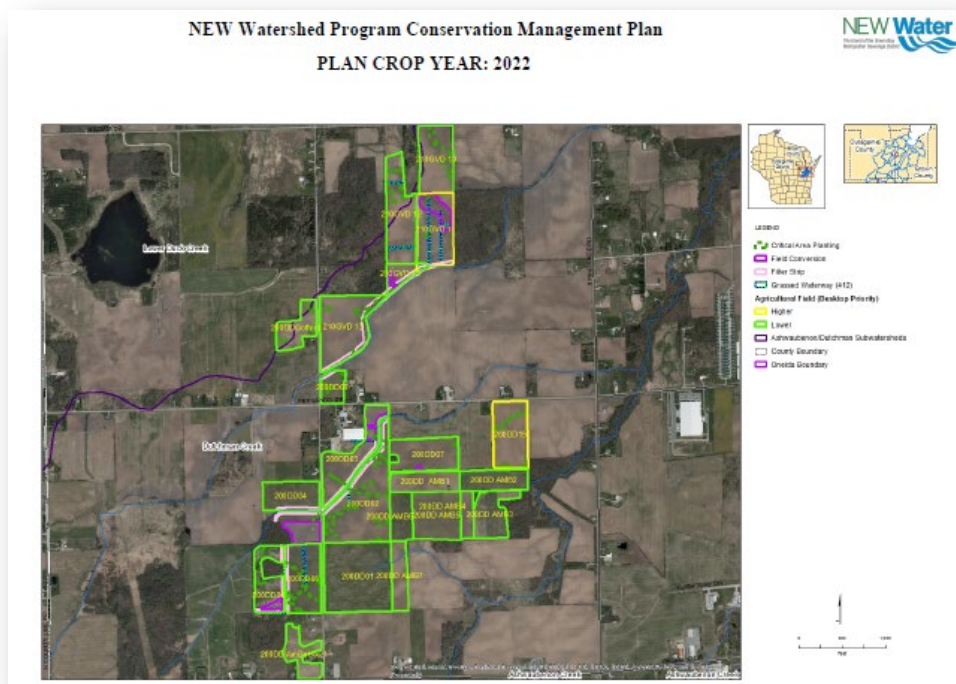
Unique ID (shown on map)	BMP	Estimated Quantity	Units (ft, sec, etc)	Implementation Date	Initial Cost (B Estimate)	Other Cost Share	GBMSD Cost Share Estimate	FINAL QUANTITY	TOTAL Final Cost (\$)	EQUIP Cost Share	GBMSD Cost Share	Other Cost
302004096	CRITICAL AREA PLANT PIG				\$2,200.00	\$1,169.30	\$1,030.70	2.20	\$1,501.00	\$1,100.00	\$401.00	
302004282	GRASSES WATERWAY				\$9,953.60	\$2,266.30	\$7,687.30	655.90	\$2,500.00	\$500.00	\$2,000.00	
302004281	FIELD CONVERSION				\$1,299.35	\$909.55	\$389.80	2.50	\$5,000.00	\$0.00	\$5,000.00	\$0.00
Total:					\$13,452.95	\$4,345.15	\$9,057.80	659.70	\$9,001.00	\$1,600.00	\$7,401.00	\$0.00

Unique ID #	Date	Invoice #	Vendor	Service Provided	Cost	Date GBMSD approved	Date OC Paid	Other Share Paid	GBMSD Share \$	Notes
302004281		ACDCS5555-2			\$0.00			\$0.00	\$0.00	
302004095	7/6/2022	ACDCS5555-1	John Doe	provided seed	\$0.00	7/6/2022		\$0.00	\$401.00	
302004282					\$0.00			\$0.00	\$0.00	
TOTAL									\$401.00	

NEW Water, the brand of the Green Bay Metropolitan Sewerage District
Ashwaubenon Creek & Dutchman Creek, Cost Share Agreement. ACDCS5555

Page 9 of 13

How can we communicate BMP opportunities in a simple report?






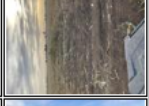



Date of First Implementation of Operational BMPs: None
Grower interested in Pay for Performance Practices? Yes

Field Summaries

Fieldname	Ag Field Group	Current Year Crop	Previous Year Crop	Field Cover	Field Cover Other	Operational Practices Needed	Operational Practices Needed On	Field Walk Completed Date	Field Photo	Notes	Acres
20000AM01	None	None	None	None	None	None	None		None	None	11.6
20000AM02	None	None	None	None	None	None	None		None	None	11.6
20000AM03	None	None	None	None	None	None	None		None	None	12.9
20000AM04	None	None	None	None	None	None	None		None	None	5.2
20000AM05	None	None	None	None	None	None	None		None	None	19.2
20000AM06	None	None	None	None	None	None	None		None	None	21.0
20000AM07	None	None	None	None	None	None	None		None	None	21.3
2000001	None	None	None	None	None	None	None		None	None	39.1
2000002	None	None	None	Other	Planted to Winter Wheat	All	Field is planted into Winter Wheat	09/28/2020		Field will have fall and spring cover this year	39.2
2000003	None	None	None	Other	Woods and grass, part in forage mix (south), rest was forage oats (north) now left overgrown	All	No tillage currently, will likely have mature	10/05/2020		Should revisit when crop changes	19.9
2000004	None	None	None	Alfalfa	3rd year alfalfa	Manure Placement	If manure surface or LDMA	10/12/2020		Should stay alfalfa 1 more year: no-til the alfalfa in the fall of 2020 and use LDMA with seeding	13.6
2000005	None	None	None	Alfalfa	New seeded fall 2020	Manure Placement	If manure applied would need surface or LDMA.	10/12/2020		Should stay in alfalfa for a few years.	20.5
2000006	None	None	None	Alfalfa	None	None	None	10/12/2020		This is a new seeding hay. Environmental checking for caps and possible buffers when set back to silage corn	13.1

How can we communicate BMP opportunities in a simple report?

Recommended Structural Practices



Fieldname	Ag Field Group	BMP Id	BMP Type	Grower Willingness	Priority	Notes	BMP Prioritization Score	Estimated Phosphorus Reduction Lbs Yr	BMP Photo
205EH01	None	302000853	Critical_Area_Planting-Seeding Only	Grower unaware of recommended BMP	Low	None	50.0	0.3	
205EH01	None	302000855	Critical_Area_Planting-Seeding Only	Grower unaware of recommended BMP	Low	None	50.0	0.2	
205EH01	None	302000856	Critical_Area_Planting-Seeding Only	Grower unaware of recommended BMP	High	None	49.0	0.1	
205EH01	None	302000848	Critical_Area_Planting-Seeding Only	Grower unaware of recommended BMP	High	None	67.5	1.3	
205EH01	None	302000854	Critical_Area_Planting-Seeding Only	Grower unaware of recommended BMP	High	None	55.0	0.9	
205EH01	None	302003015	Two_Stage_Ditch-Dutchman Creek	Grower unaware of recommended BMP	High	None	66.0	60.1	None
205EH02	None	302003471	Critical_Area_Planting-Shaped - ephemeral gully	Grower unaware of recommended BMP	Low	None	44.8	0.6	
									

How can we communicate BMP opportunities in a simple report?

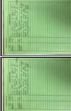

Proposed Structural Practices

There are currently no "Proposed Structural Practices" records for Everlea Heifers.

Planned Structural Practices

Fieldname	Ag Field Group	BMP Id	BMP Type	Cost Share Agreement Id	Planned Implementation Date	Estimated Nw Cost	Estimated Eqp Cost	Estimated Other Cost	Planning Notes	Total Score	Estimated Phosphorus Reduction Lbs Yr	Total Cost	BMP Photo
205EH01	None	302000849	Filter_Strip-N/A	ACDCS6014	06/30/2023			\$15500	None	62.5	32.0	\$15371	
205EH02	None	302003025	Filter_Strip-N/A	ACDCS6014	06/30/2023			\$12400	None	67.5	32.0	\$12639	
205EH02	None	302003390	Filter_Strip-N/A	ACDCS6013	05/29/2023	0.0	0.0	\$2480	None	65.0	3.2	\$1878	None

Implemented Structural Practices

Fieldname	Ag Field Group	BMP Id	BMP Type	Type	Cost Share Agreement Id	Construction Completed Date	Inspection Type	Inspection Date	Inspection Notes	Inspection Picture	Total Final Cost	As Built Modeled Phosphorus Reduction
205EH01	None	302000851	Grassed_Waterway-Grassed Waterway (412)	Grassed Waterway (412)	ACDCS6021	10/20/2021	Complete 100% Inspection	12/01/2021	9/Verified implementation and annual inspection		None	None
205EH01	None	302000850	Stream_or_Ditch_Crossing-N/A	N/A	ACDCS6021	10/20/2021	Complete 100% Inspection	12/01/2021	9/Verified implementation and annual inspection		None	None

Planned Operational Practices

There are currently no "Planned Operational Practices" records for Everlea Heifers.

Implemented Operational Practices

There are currently no "Implemented Operational Practices" records for Everlea Heifers.

Summary by Farm Name

Structural BMP Count		Estimated Reductions		Estimated Contribution to Watershed	
Total # of Recommended Structural BMPs	16	Sum of Phosphorus (lbs/yr) for recommended structural practices	1143.4	Phosphorus required in ACDC Watershed (lbs/yr)	472.7
Total # of Implemented Structural BMPs	1	Sum of Phosphorus (lbs/yr) for implemented structural practices	0	Phosphorus % contribution	0.0
% of Implemented BMPs	0.1%	Sum of sediment (tons/yr) for recommended structural practices	190.9	Sediment required in ACDC Watershed (tons/yr)	493
		Sum of sediment (tons/yr) for implemented structural practices	0	Sediment % contribution	0.0

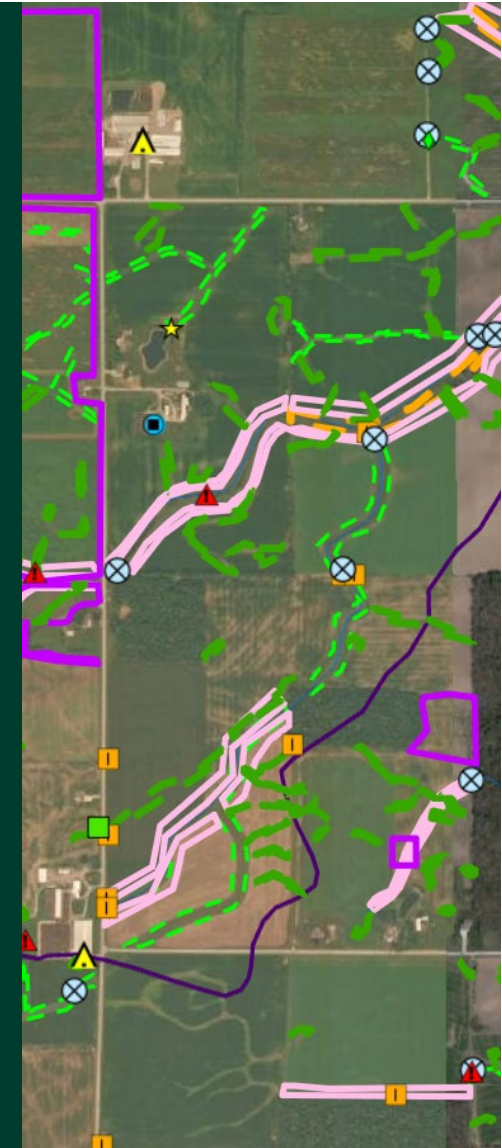
How can partners contribute without a software license?

- Let's move on to another case study example.



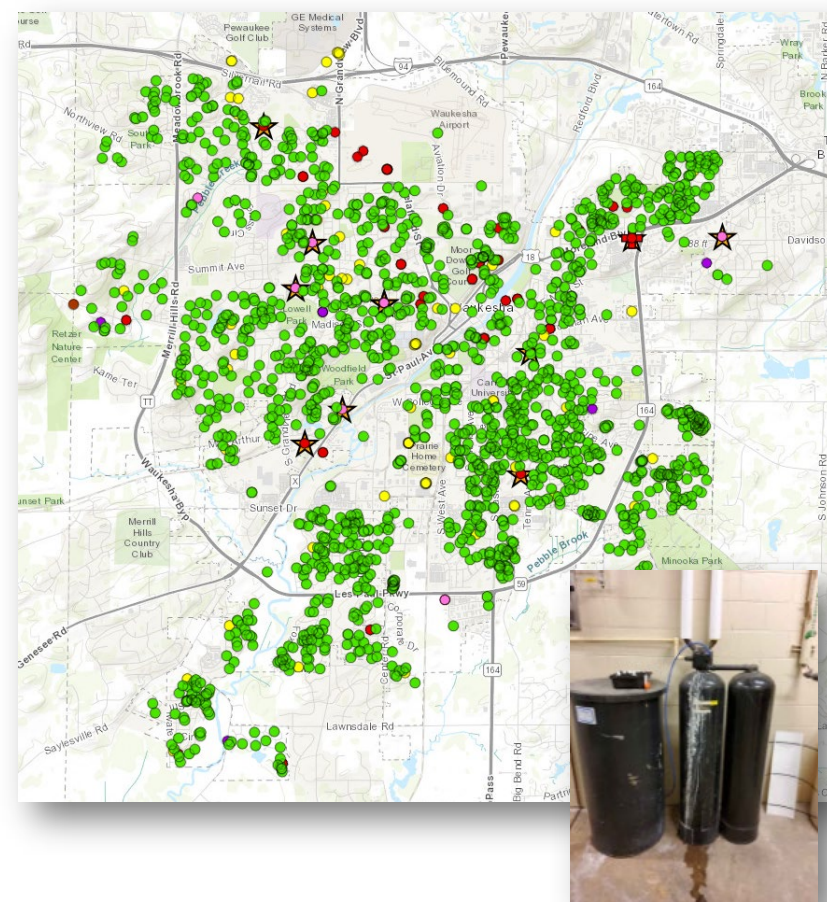
Case Study

Building a data management system to implement a chloride reduction program in Waukesha, WI

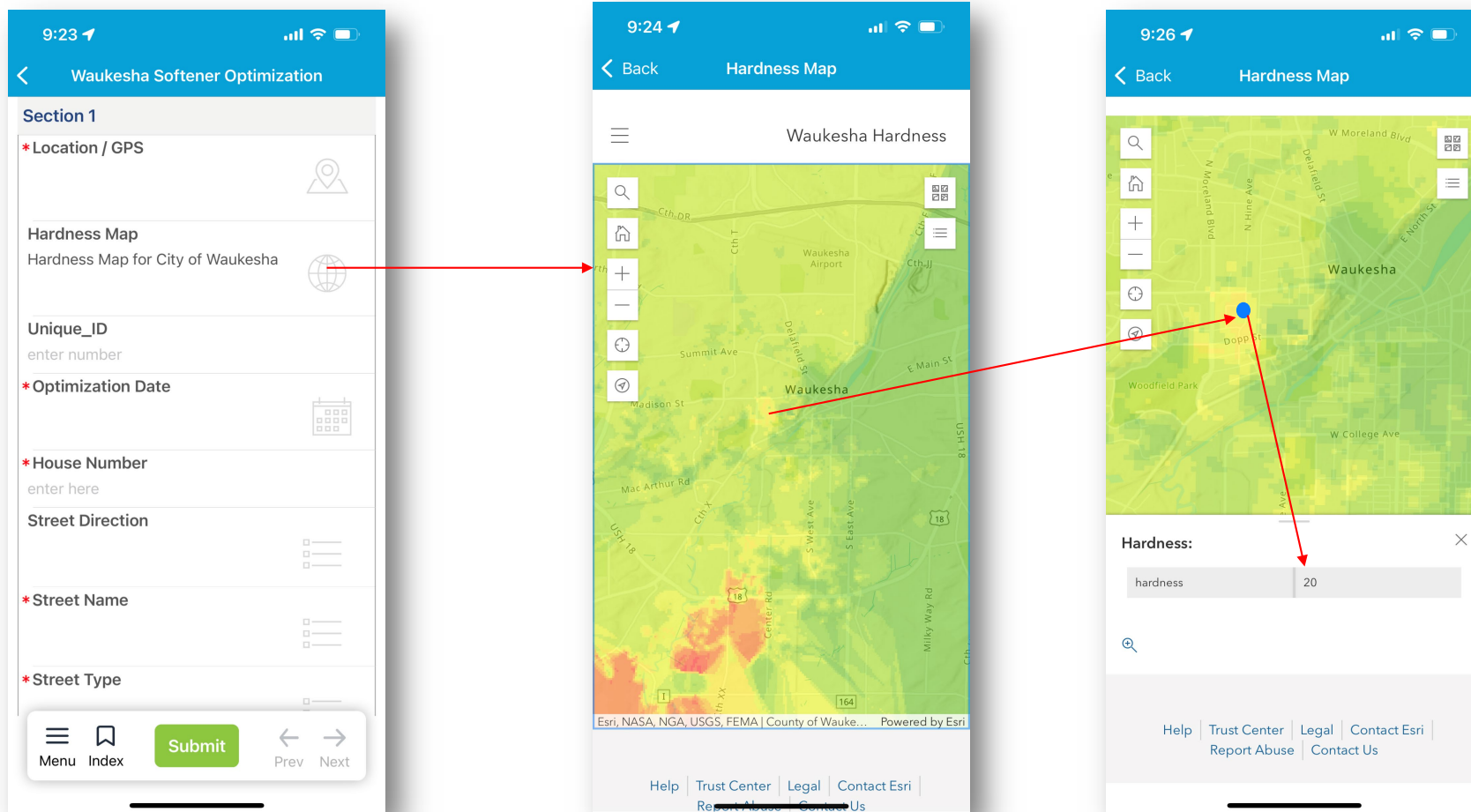


Private partnerships were required to meet WPDES permit limits

- Challenge
 - Chlorides exceed water quality standards
 - Reductions from all sectors, but water softeners reduced >60%
- Solution
 - Partnerships with water softener dealers (e.g. Culligan, Water Doctors, etc.)
 - Need a tool
 - Works with no GIS experience or licenses
 - Eliminate repeat trips
 - Contribute quality data, limit editing, only see their own records



Form-based Omni provides a simple platform to contribute data



Form-based Omni paired with python scripts ensures quality

- On-the-fly QC scripts eliminated quality control issues
 - Specific hardness values
 - Calculations for resin efficiency
 - Picture
 - Resin cleaner
 - Within sewer service area
 - Missing required field (e.g. softener model)

The image shows two screenshots of a mobile application form titled "Waukesha Softener Optimization".










Left Screenshot: Shows the initial form with several required fields marked with an asterisk (*):

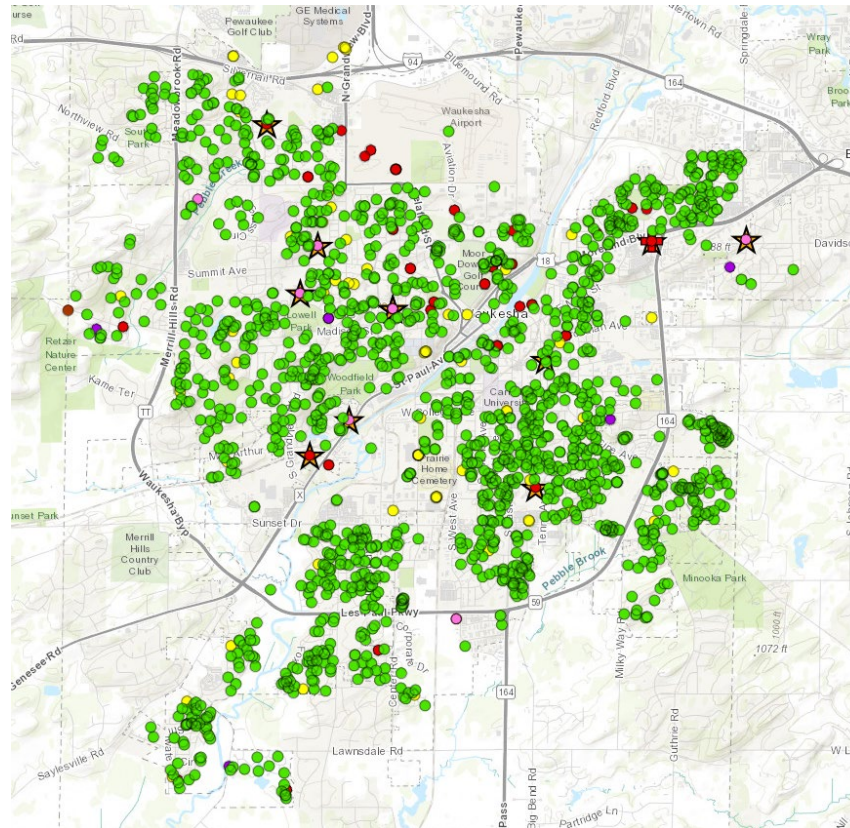
- * Reserve capacity type (dropdown menu)
- * Initial Reserve Capacity Gallon (text input, "enter number")
- * Optimized Reserve Capacity Gallon (text input, "enter number")
- * Add resin cleaner (Yes/No buttons)
- * Time clock override initial settings (dropdown menu)
- What time is the softener set to regenerate at? (clock icon)
- * Is the time shown on the softener the actual time? (N/A, Yes, No buttons)
- * Does the current softener appear to be working? (Yes, No buttons)

Right Screenshot: Shows the form after data entry and validation. The "Optimized Reserve Capacity Gallon" field is highlighted in red and contains the value "2". The "Add resin cleaner" field is set to "Yes". The "Time clock override initial settings" field is set to "No". The "What time is the softener set to regenerate at?" field is set to "12:00". The "Is the time shown on the softener the actual time?" field is set to "N/A". The "Does the current softener appear to be working?" field is set to "Yes". The "Are repairs needed to the system?" field is set to "No".

A red arrow points from the left screenshot to the right screenshot, indicating a transition or validation step.

Centralized data allows City to authorize payment for cost share

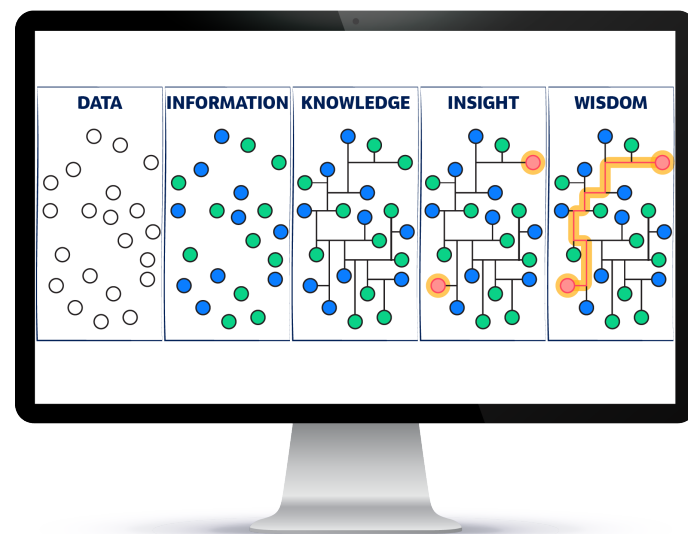
- Optimization Paid For 
- Passed QC - Ready for Payment 
- Did not add Resin Cleaner 
- Invalid Location 
- Incorrect Entry 
- Missing Required Field 
- Optimization setting does not match hardness at location 
- Failed Geocode QC 
- Missing Photo Attachment 



Broader Impacts

Data management considerations for a watershed program

- No cost to the client, besides labor to manage.
- Efficiency through small team: project engineers/scientists to understand the needs, data manager(s) to develop
- Solutions must consider accessing data, both input and output, from/to multiple entities in multiple formats
- Solutions must consider scaling with Program size— data collection, workflows, and reporting.
- Solutions must consider data privacy amongst stakeholders and partners
- Technology is always evolving— consciously evaluate when to integrate, evolve, or stay the course.



Thank you



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