MassDCR Catch Basin Cleaning Optimization

Presented by
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January 24, 2023

Agenda

Project Background

Existing Inspection Strategy

Inspection Optimization Goals

Existing GIS Setup

Inspection Optimization Solutions

Project Overview

- **Massachusetts Department of Conservation and Recreation (DCR) Stormwater Program**
  - Municipal Separate Storm Sewer System (MS4) Permit Compliance

dcr
Massachusetts

MS4 Permit Overview

- Requires permitees develop a stormwater management program that controls the quality of storm water discharged to the storm drains and thence waters of the United States
  - Specific requirements outlined in 6 minimum control measures

MCM 1: Public Education and Outreach

MCM 2: Public Participation

MCM 3: Illicit Discharge Detection and Elimination

MCM 4: Illicit Discharge Detection and Elimination

MCM 5: Management of Construction Site Runoff

MCM 6: Good Housekeeping in Municipal Operations

MS4 Permit Overview

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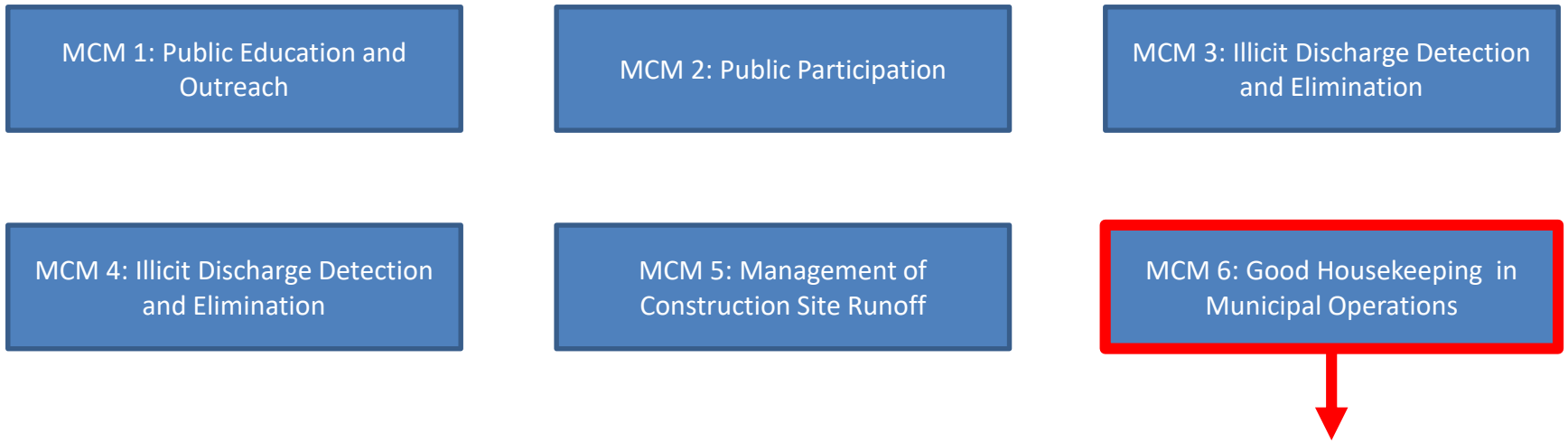
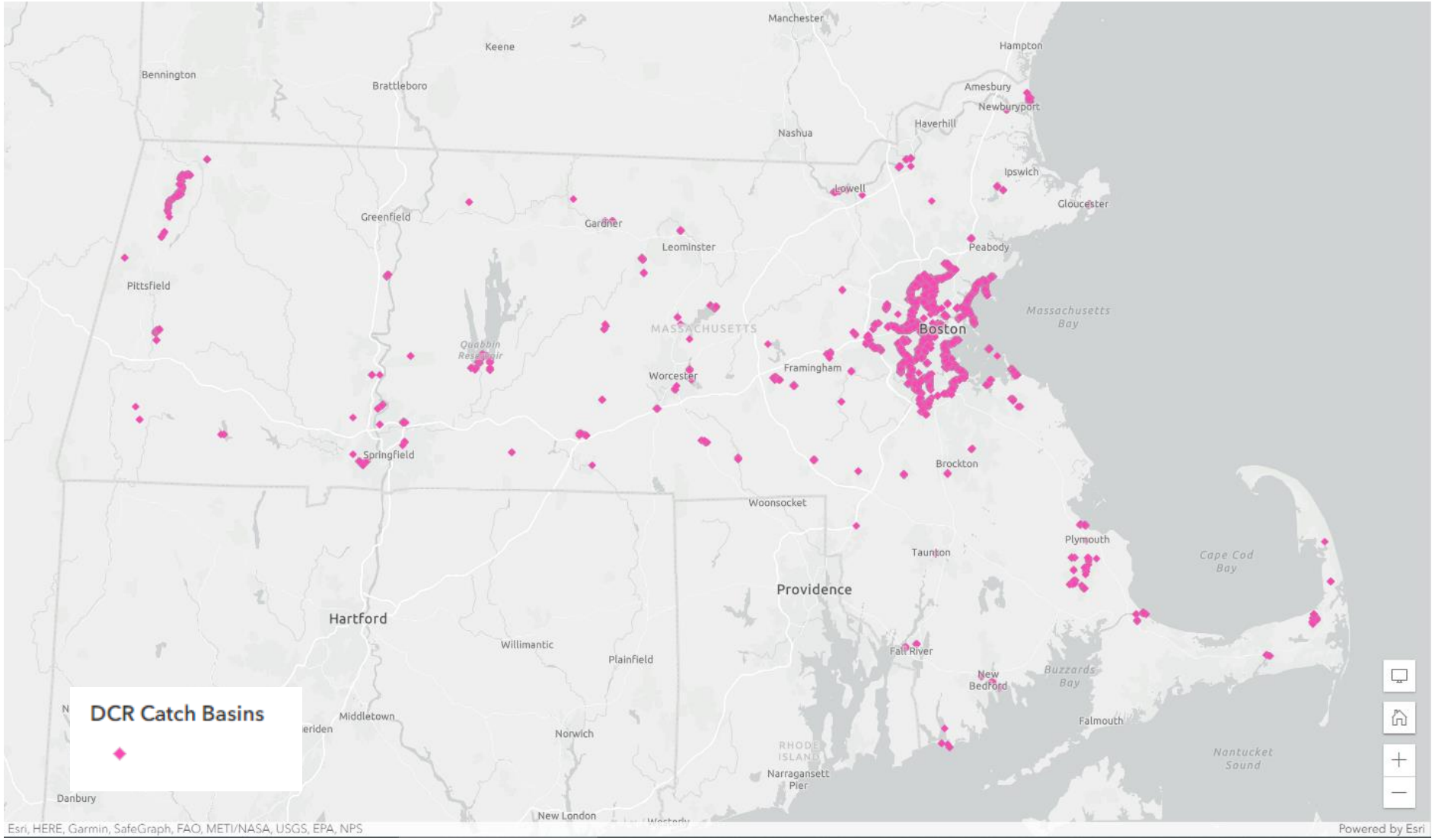


“optimization of catch basin cleaning”

Regular cleaning of catch basins to ensure their sumps are never >50% full

Existing Conditions

- 55,000+ Acres of regulated DCR property statewide
- 7500+ Catch Basins Statewide
- DCR regularly cleaned catch basins
  - Prioritized areas with **high sediment loading** and areas with a **history of flooding**

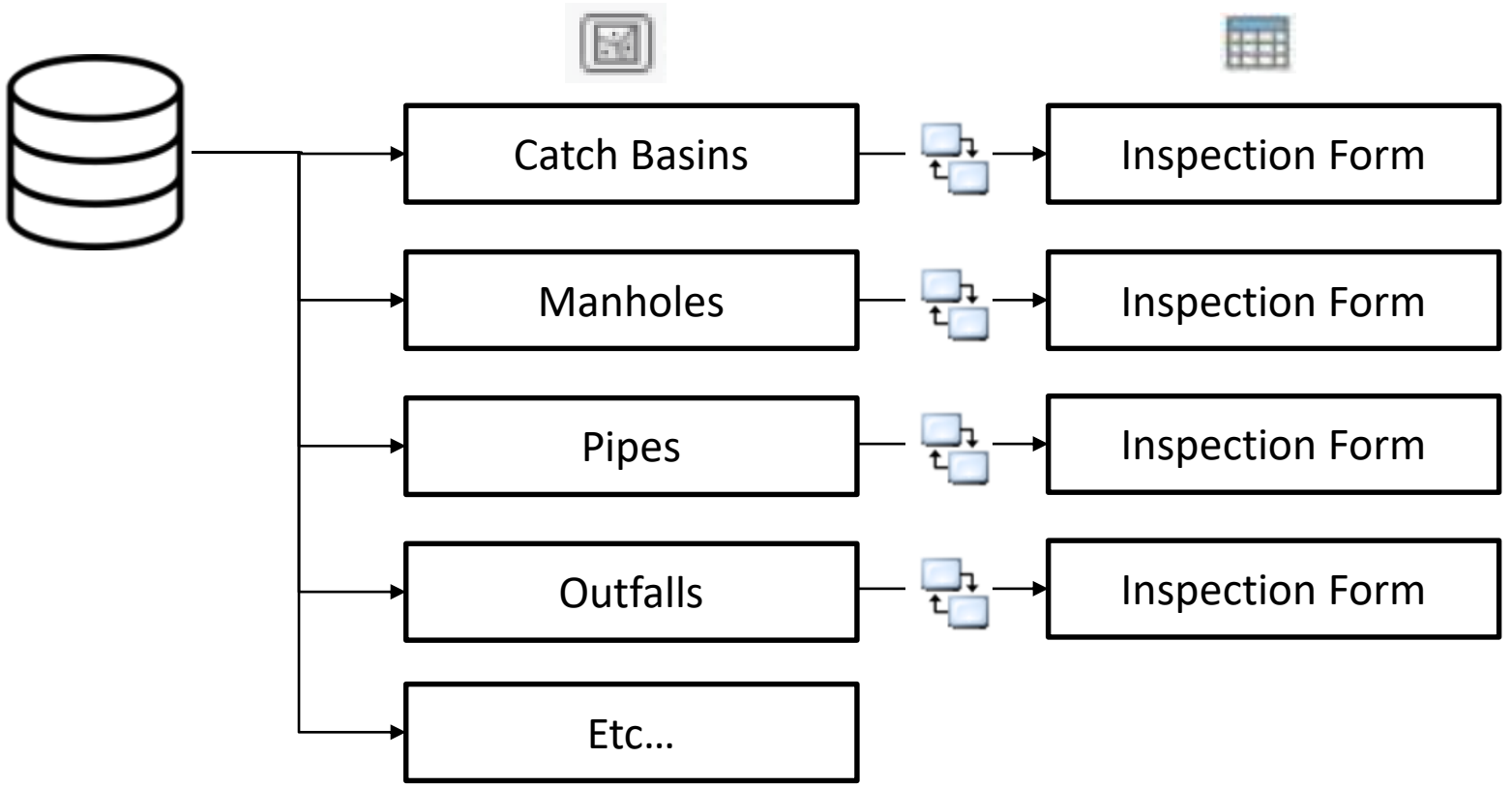


Catch Basin Cleaning Optimization Goals

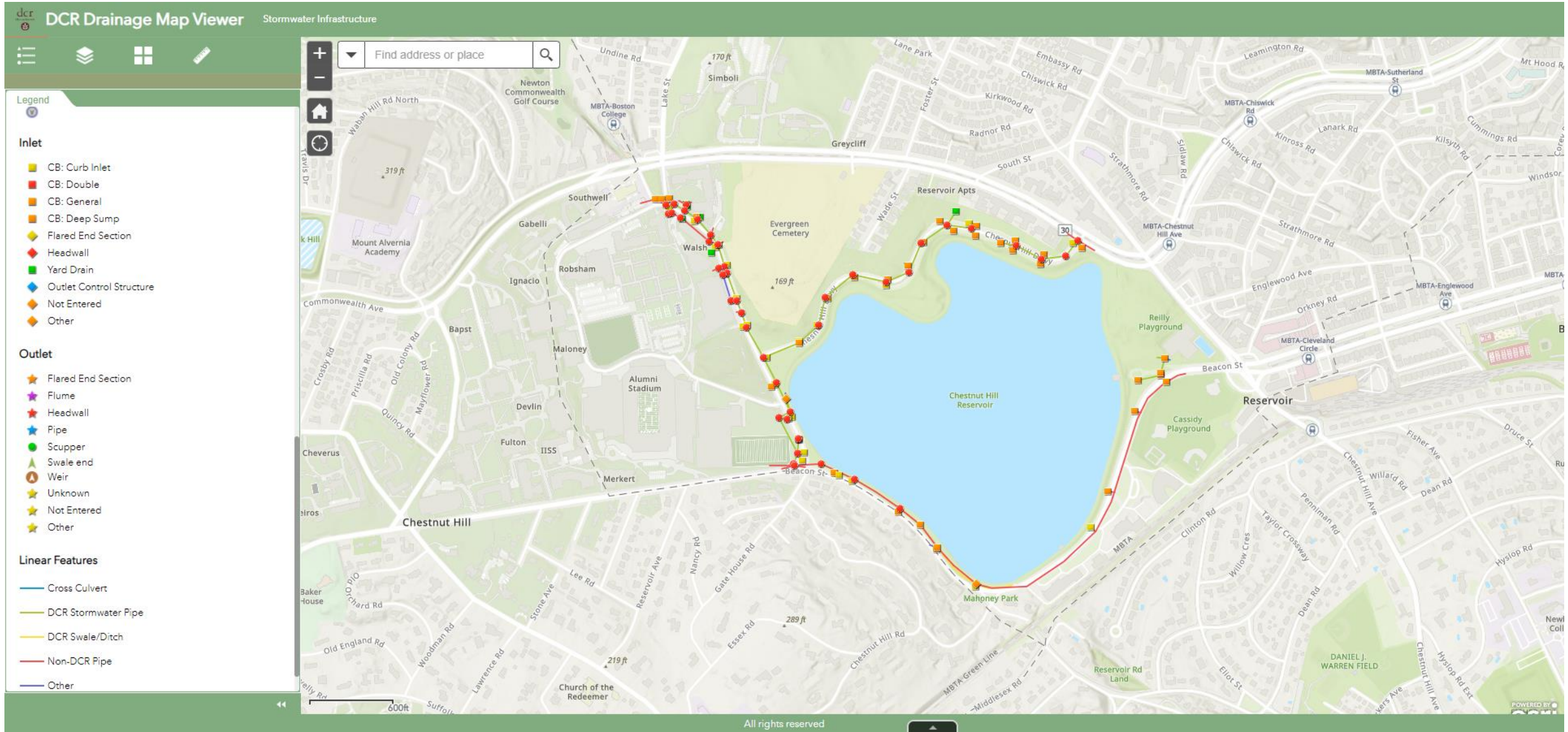
- Improve water quality by reducing sediment loading to receiving waterbodies
  - Regular cleaning of catch basins to ensure their sumps are never >50% full
- Maximize use of limited resources
  - Optimize efficiency by only visiting catch basins when needed
  - Leverage historic and real-time data
  - Create a user-friendly application for planning and tracking

DCR GIS Drainage Geodatabase

- Enterprise geodatabase hosted by VHB containing DCR Stormwater Assets and Inspection and Maintenance Data



- Data published to ArcGIS Server and used in online content for field data collection and analysis, and public use
  - Utilizes shared ArcGIS Online group where VHB, DCR Staff, and Subcontractors can access and update data



Catch Basin Prioritization System

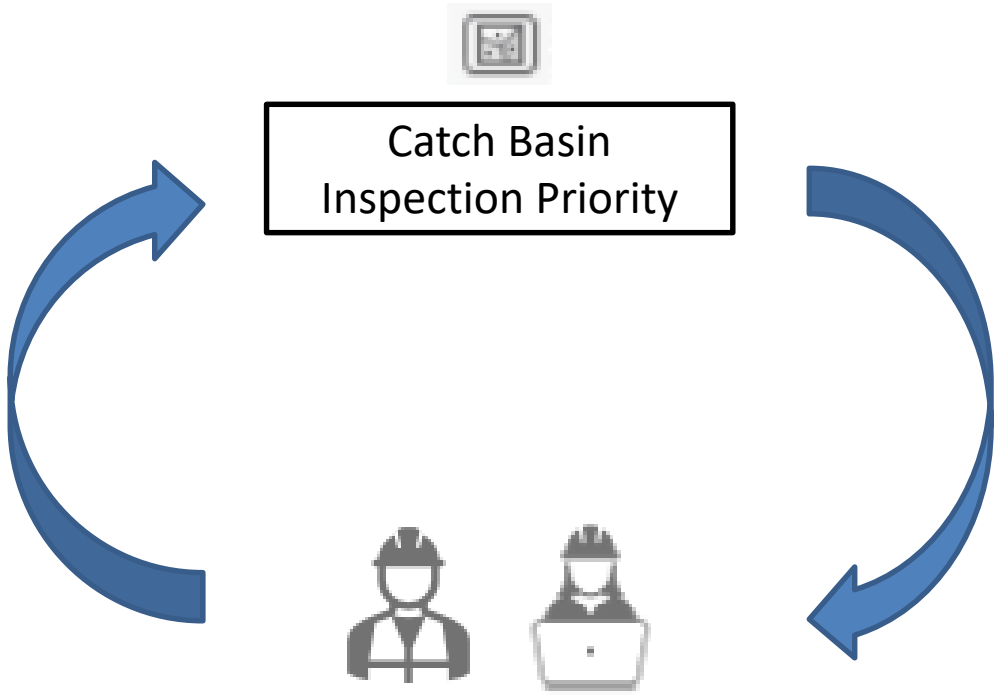
Goal: Prioritize catch basins in need of cleaning using historical inspections and on-going field data collection

- Use **last 5 year of inspection** data and **recorded sediment level** to assign catch basins a priority and associated inspection frequency
  - Priorities 1 & 2: Inspect Once Per Year
    - Catch Basins in **flood concern** areas
    - Catch Basins with **high sediment loading** based on inspection data
    - Catch Basins with **no inspection data**
  - Priorities 3: Inspect Once Every 2 Years
    - Catch Basins with **moderate sediment loading** based on inspection data
  - Priorities 4 & 5: Inspect Once Every 3 Years
    - Catch Basins with **low sediment loading** based on inspection data

Automated Prioritization Strategy

Goal: Update catch basin prioritization and inspection status in real-time

- Update prioritization when
  - New inspections are added
  - Catch basin data is updated
    - Ownership
    - Flood Concern
    - Inlet Type



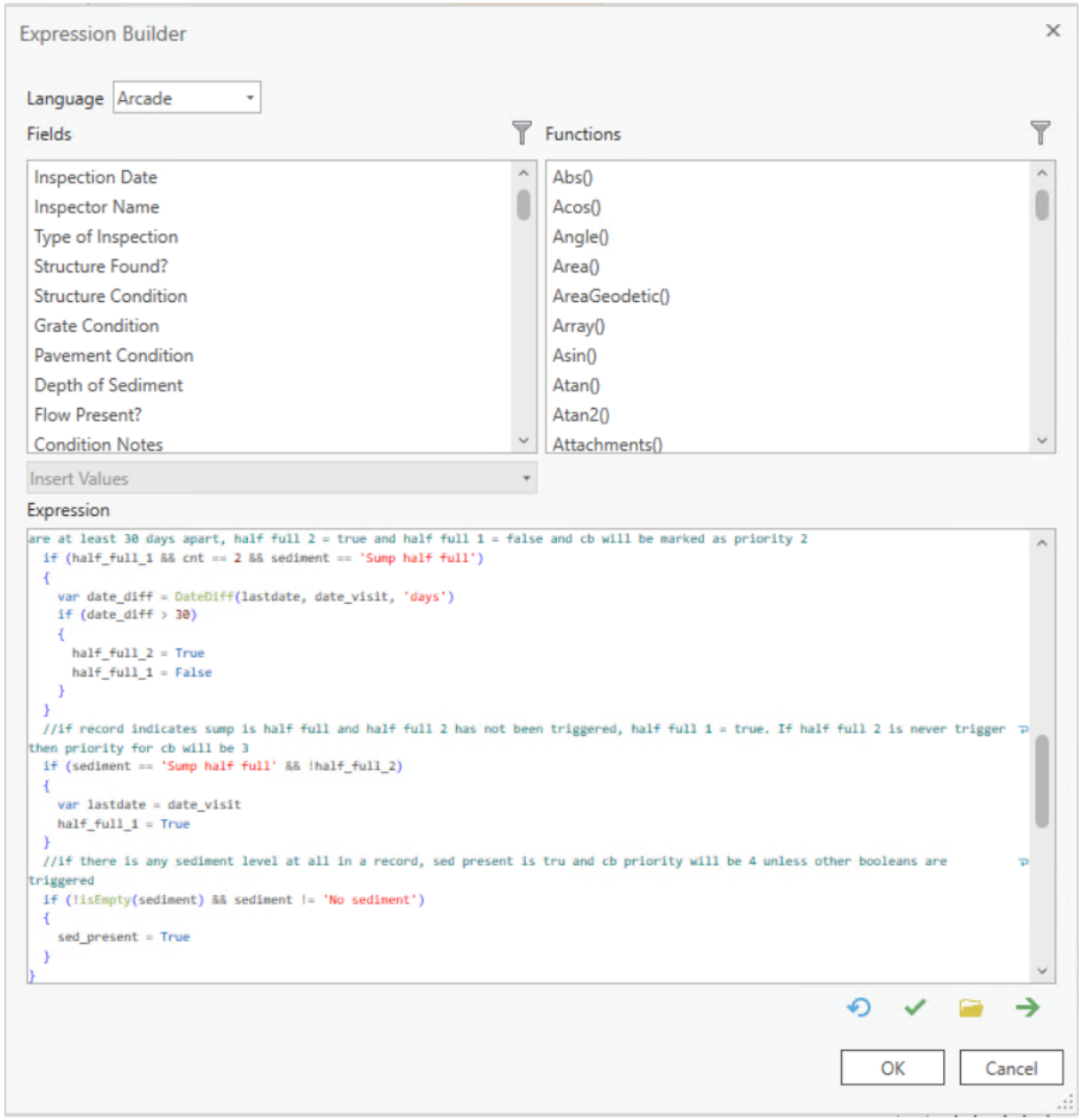
Automated Python Script

- Initially used python script tool that automatically ran every 30 minutes via Windows Task Scheduler

- Drawbacks:
  - Not “Real-Time”
  - Negatively Impacted database performance

Attribute Rules

- Transitioned to Calculation Attribute Rules
  - Arcade scripts that populate attribute values
  - Triggered automatically when features are inserted, updated, or deleted

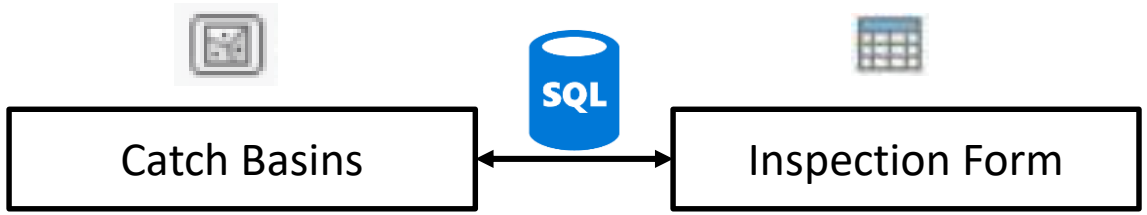


Inspection Tracking Layer

Goal: Create spatial data layer that can summarize and track inspection status

- Need to join catch basin geometry with and inspection data
  - Needs to be live (i.e., continuously updated)
- Need to track whether most recent inspection satisfies the catch basin's inspection requirement

Solution: Created SQL view layer in enterprise geodatabase

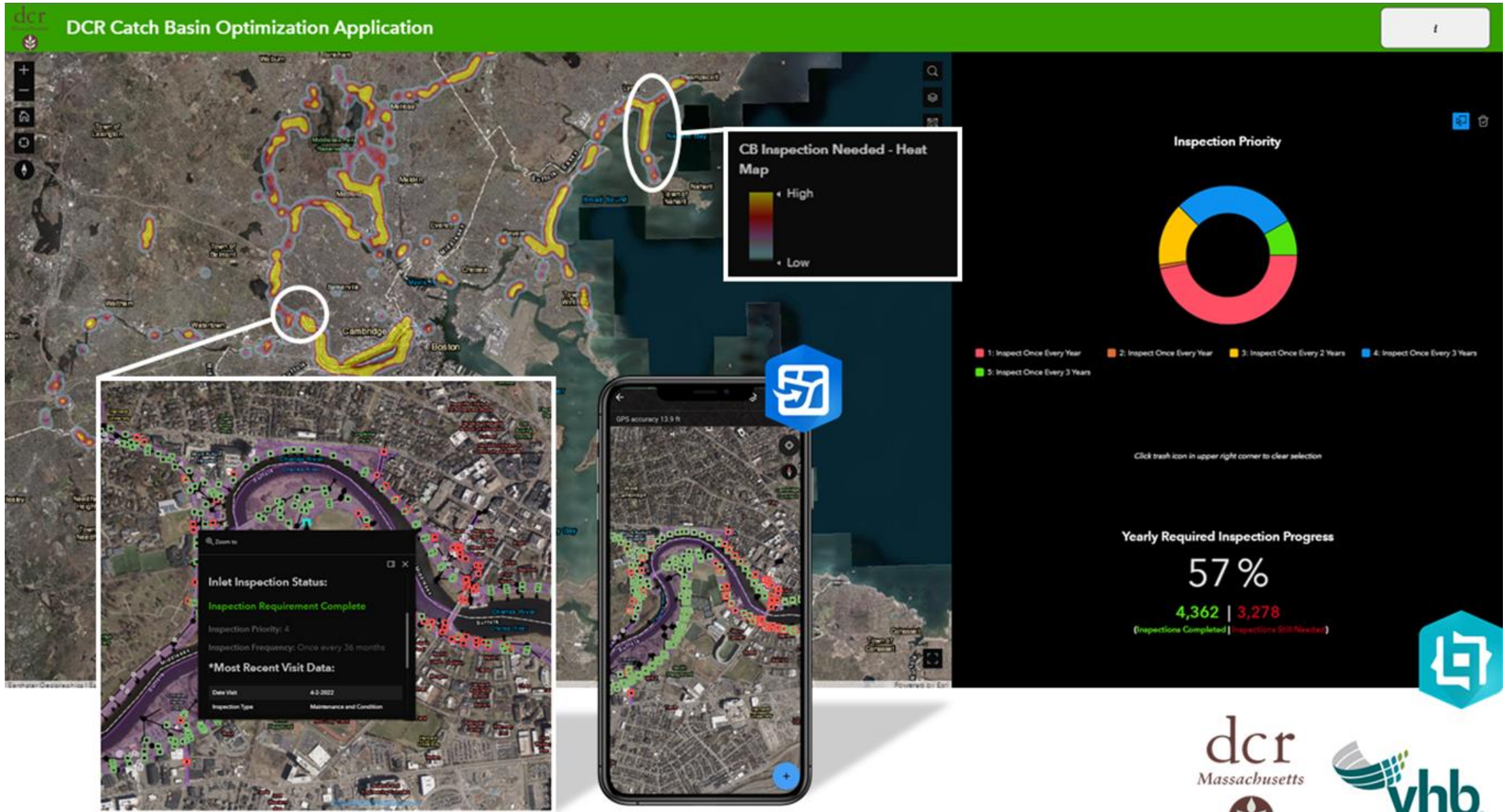


SQL View Layer

- Created in SQL Server Management Studio (SSMS)
  - Joins Catch Basin with most recent inspection record
  - Includes fields from both catch basin layer and inspection table
  - Assigns inspection frequency based on inspection priority
  - Calculates if most recent inspection falls within frequency window
    - *If True: INSP_STATUS (Inspection Status) = 1*
    - *If False: INSP_STATUS (Inspection Status) = 0*

```
WITH insp AS (SELECT *, ROW_NUMBER() OVER (PARTITION BY ASSETGUID
ORDER BY DATE_VISIT DESC) AS ASSETSORT
FROM    DCR_INLET_FORM_EVW
WHERE  (INSPECT_TYPE NOT IN ('IDDE Dry Weather', 'IDDE Wet Weather', 'IDDE Catchment Investigation') OR
            INSPECT_TYPE IS NULL) AND (DEPTH_OF_SEDIMENT <> 'Not observed' AND DEPTH_OF_SEDIMENT IS NOT NULL))

  SELECT vw.*, DATEDIFF(month, vw.DATE_VISIT, DATEFROMPARTS(YEAR(GETDATE()), 12, 1)) AS DATE_DIFF,
               CAST(CASE WHEN INSPECTRANGE IS NULL THEN NULL WHEN DATEDIFF(month, vw.DATE_VISIT,
               DATEFROMPARTS(YEAR(GETDATE()), 12, 1)) <= vw.INSPECTRANGE THEN 1 ELSE 0 END AS INT) AS INSP_STATUS

  FROM    (SELECT inlet.SHAPE, inlet.OWNER, inlet.GDB_GEOMATTR_DATA, inlet.OBJECTID AS INLET_OBJECTID, inlet.INLET_TYPE, inlet.INSPECT_PRIORITY, inlet.FLOOD_PRIORITY, inlet.SEARCH_ID,
                          inlet.STRUCTURE_ID AS STRUCTURE_ID_Inlet, inlet.Date_Added, insp.INSPECTOR, insp.INSPECT_TYPE, insp.STRUCTURE_FOUND, insp.ACCESSIBLE, insp.ACCESSNOTES,
                           insp.STRUCTURE, insp.GRATE, insp.PAVEMENT,  insp.DEPTH_OF_SEDIMENT, insp.DRY_WEATHER_FLOW, insp.CNOTES, insp.CLEANED, insp.FIXED, insp.NEEDS_SERVICE, insp.NEEDS_CLEANING,
                           insp.BROKEN_PIPE, insp.FNOTES,  insp.INSP_AFFILITATION AS INSP_AFFILIATION, insp.DATE_VISIT, inlet.INSPECT_COUNT, insp.GlobalID AS insp_GlobalID, insp.ASSETGUID, inlet.GlobalID AS Inlet_GlobalID,

                          CAST(CASE WHEN inlet.INSPECT_PRIORITY = '1' OR
                          inlet.INSPECT_PRIORITY = '2' THEN 12 WHEN inlet.INSPECT_PRIORITY = '3' THEN 24 WHEN inlet.INSPECT_PRIORITY = '4' OR
                          inlet.INSPECT_PRIORITY = '5' THEN 36 END AS INT) AS INSPECTRANGE

               FROM     DCR_INLET_EVW inlet LEFT JOIN
                          insp ON inlet.GlobalID = insp.ASSETGUID AND ASSETSORT = 1) AS vw
  WHERE  INLET_TYPE IN ('CB: Curb Inlet', 'CB: Deep Sump', 'CB: Double', 'CB: General') AND (OWNER IN ('DCR', 'Unknown') OR
               OWNER IS NULL)
```

Experience Builder App



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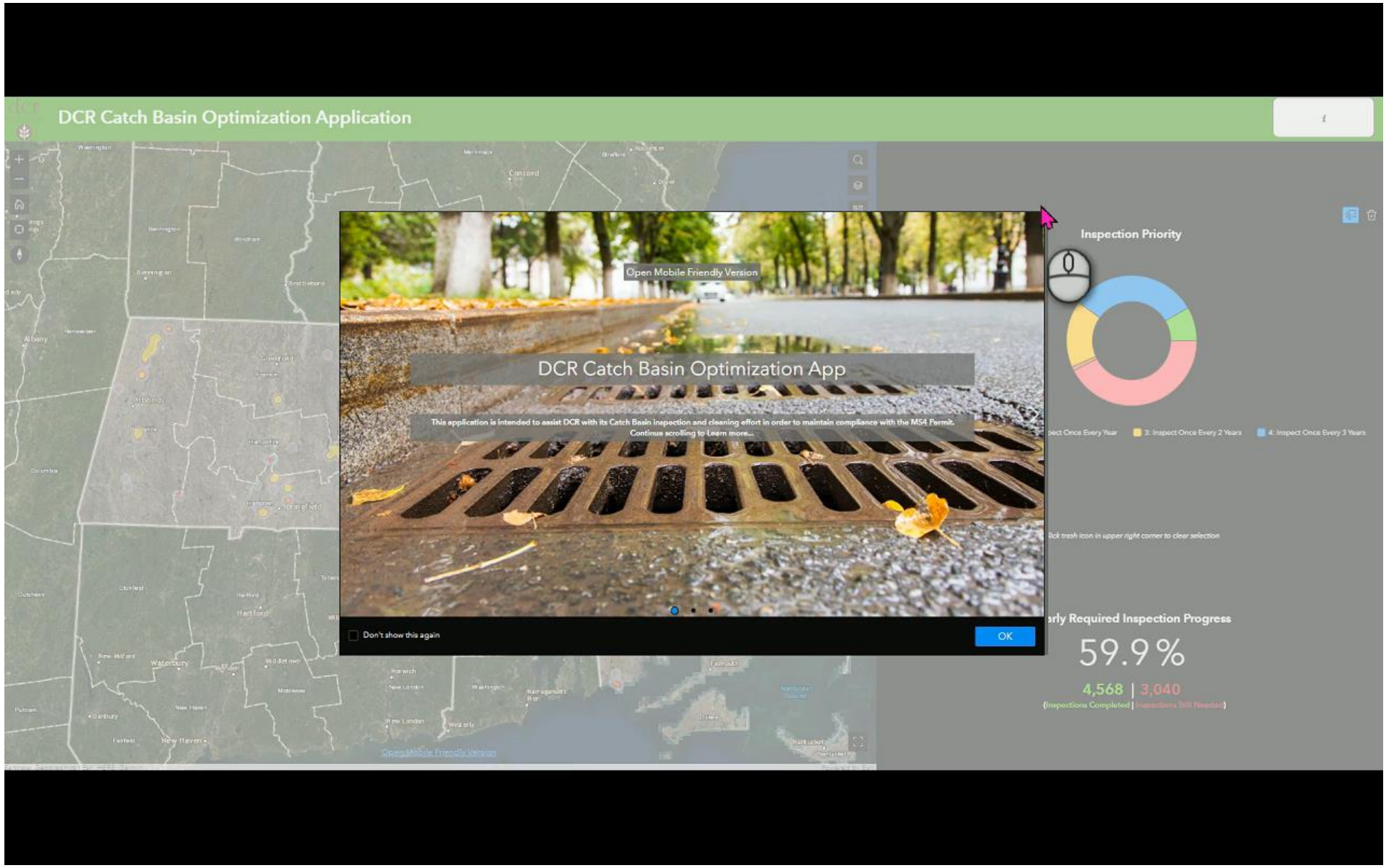
Demo


DCR Catch Basin Optimization Application
Open Mobile Friendly Version
DCR Catch Basin Optimization App
This application is intended to assist DCR with its Catch Basin inspection and cleaning effort in order to maintain compliance with the MS4 Permit.
Continue scrolling to Learn more...
Don't show this again
OK
Inspection Priority
59.9 %
4,568 | 3,040

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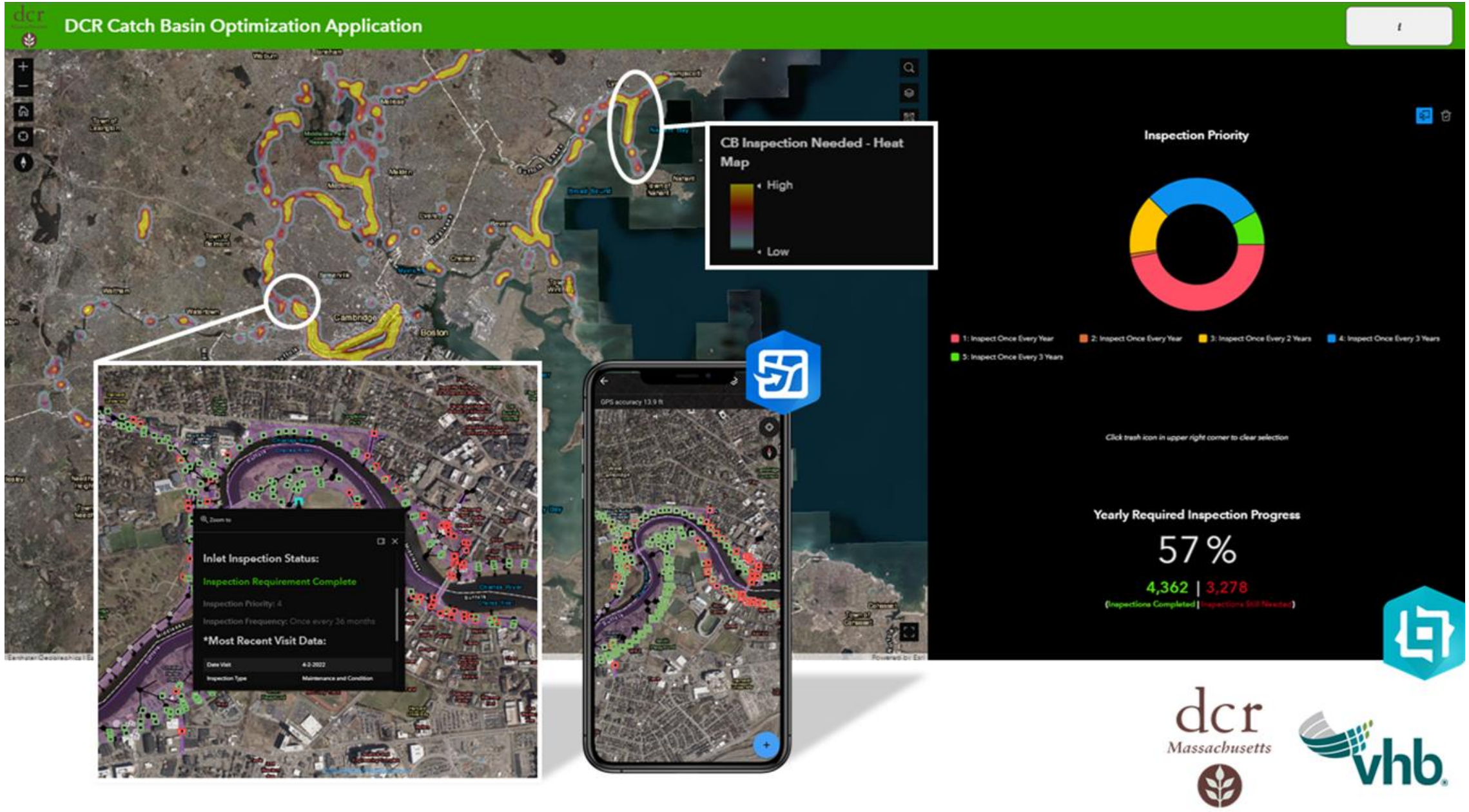
	2022	2023
Inspections Needed	5300	4600

Q&A


DCR Catch Basin Optimization Application
CB Inspection Needed - Heat Map
High
Low
Inspection Priority
1: Inspect Once Every Year
2: Inspect Once Every Year
3: Inspect Once Every 2 Years
4: Inspect Once Every 3 Years
5: Inspect Once Every 3 Years
Click trash icon in upper right corner to clear selection
Yearly Required Inspection Progress
57 %
4,362 | 3,278
Inlet Inspection Status:
Inspection Requirement Complete
*Most Recent Visit Data: