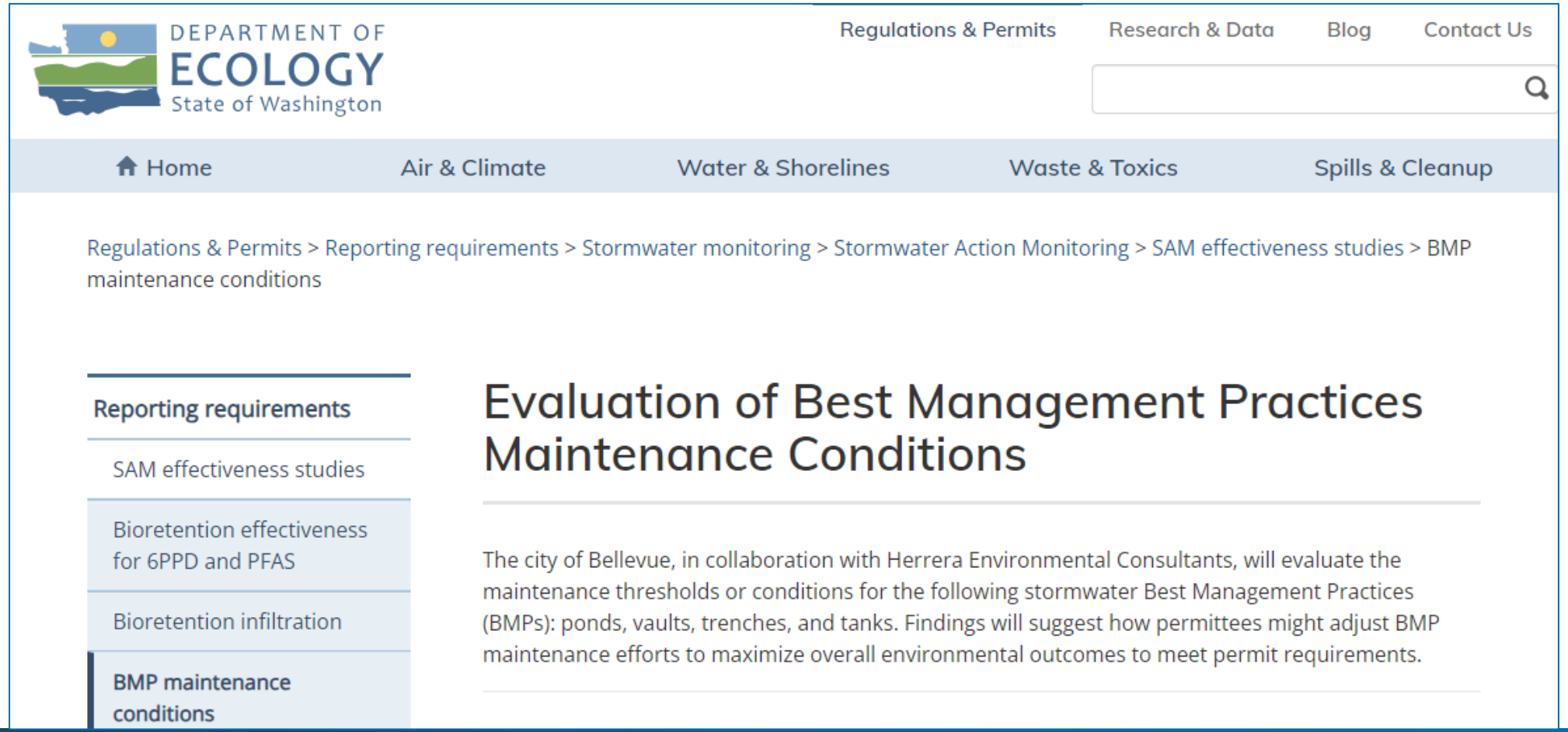


SAM Study: Stormwater BMPs Maintenance Conditions Evaluation

Central NPDES Permit Coordinators Forum

February 20, 2025

SAM Stormwater Action Monitoring

City of Bellevue Washington

HERRERA Science + Planning + Design

Study Purpose

Evaluate stormwater BMP maintenance standards.

- Includes ponds, trenches, & tanks
  - Trenches include swales
  - Tanks include vaults (non-CBs)
- What BMPs are in use by permittees
- What maintenance standards do permittees use
- What maintenance issues occur for these BMPs
- How do permittees keep records of BMP O&M

Technical Advisory Committee

- City of Bellevue
- City of Redmond
- City of Sumner
- City of Woodinville
- City of Tacoma (Phase I)

 June 2022

 November 2022

 August 2023

 November 2024

 February 2025

Study Tasks

Task 1: Technical Advisory Committee and Project Management

Task 2: Survey of Municipal Stormwater O&M Programs

Task 3: Published Data Review/Literature Review

Task 4: Interviews with Ecology

Task 5: Pilot Data Analysis

Task 6: White Paper

Task 7: Communications Plan

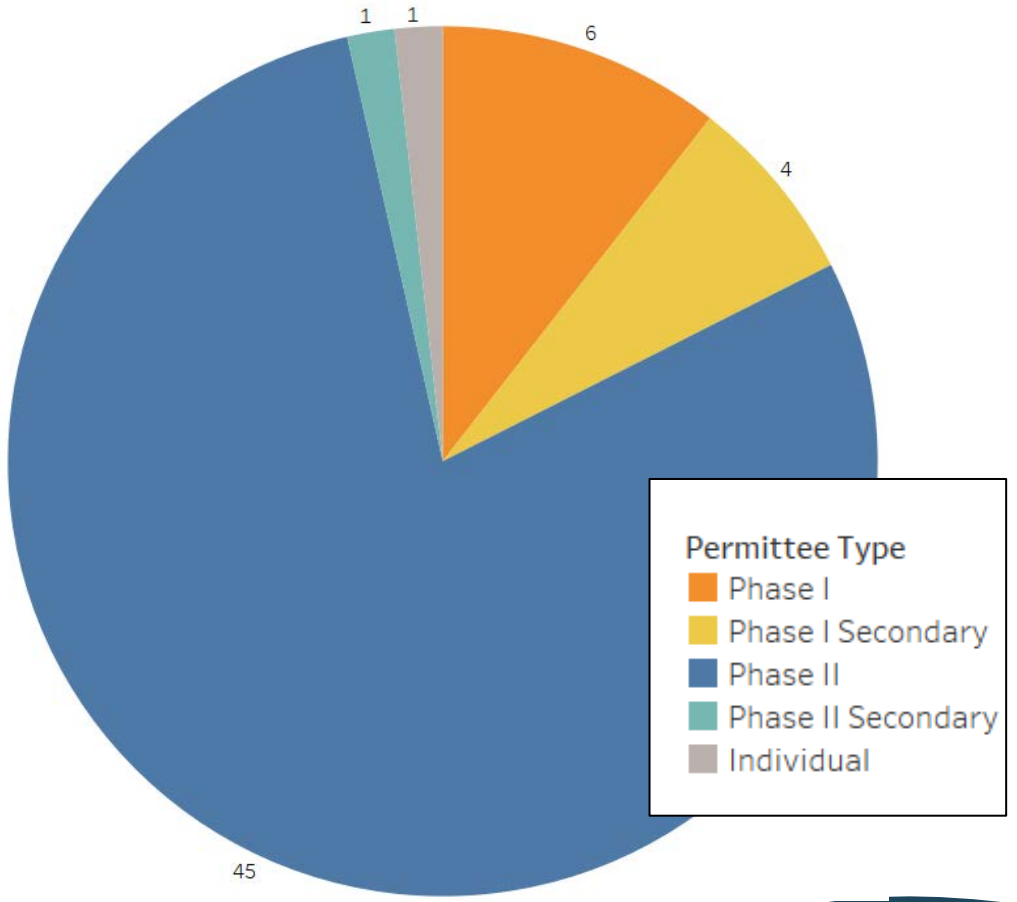
Task 2. Survey of Municipal O&M Programs

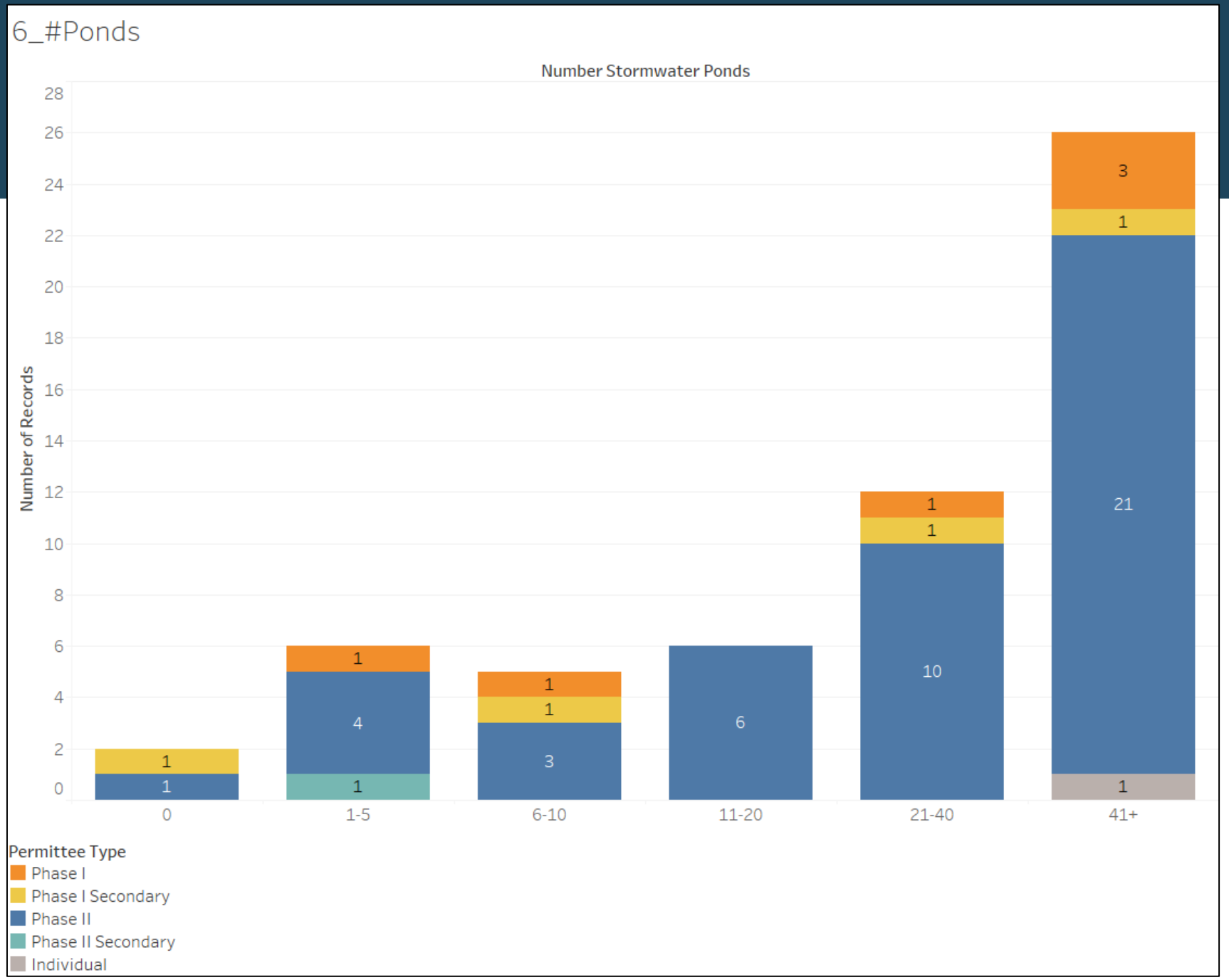
SURVEY

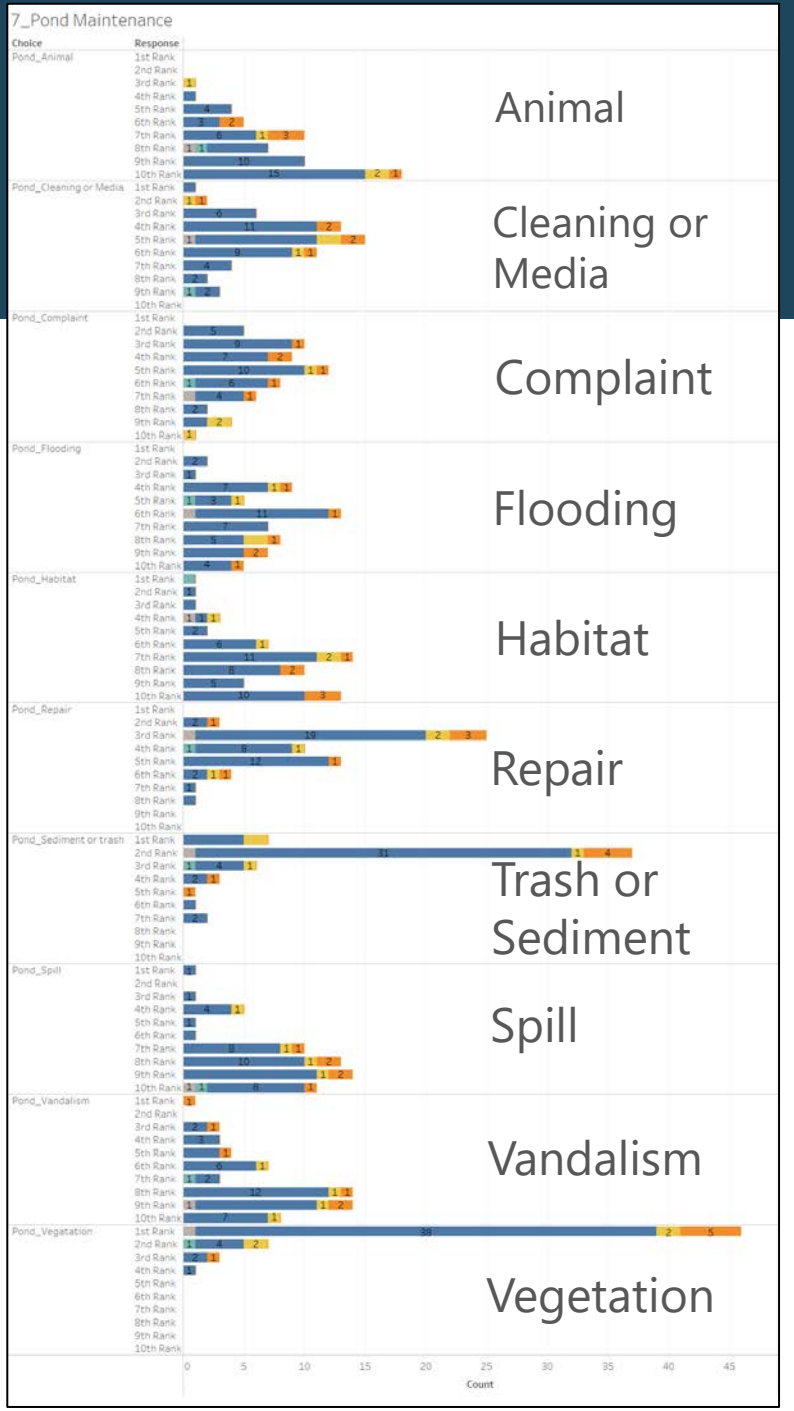
- Targeted to municipal stormwater permittees
- Learn about operations and maintenance programs for BMPs

17 QUESTIONS

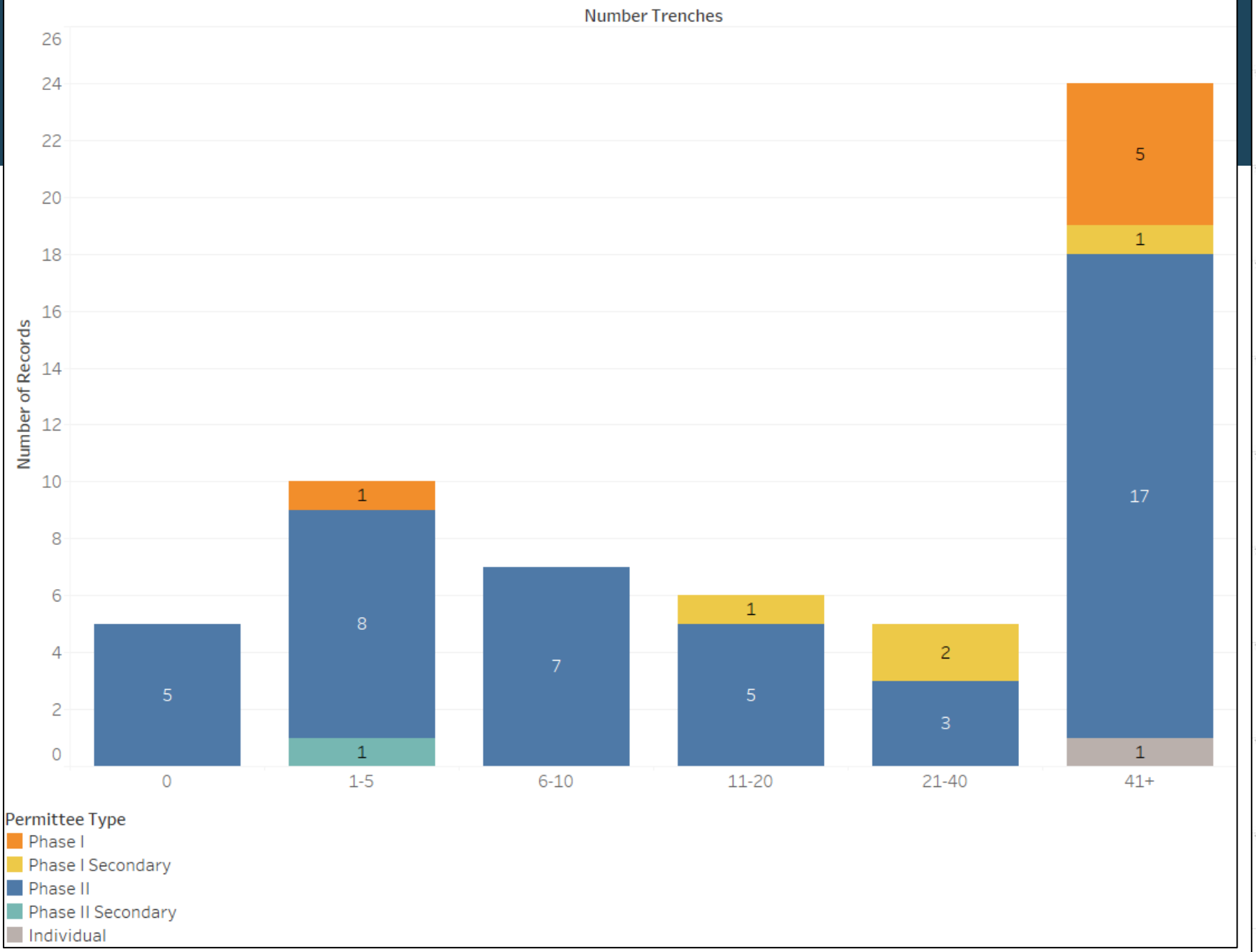
- What BMPs are in use
- Program staffing and budgets
- Stormwater manuals and maintenance standards used
- Recordkeeping methods

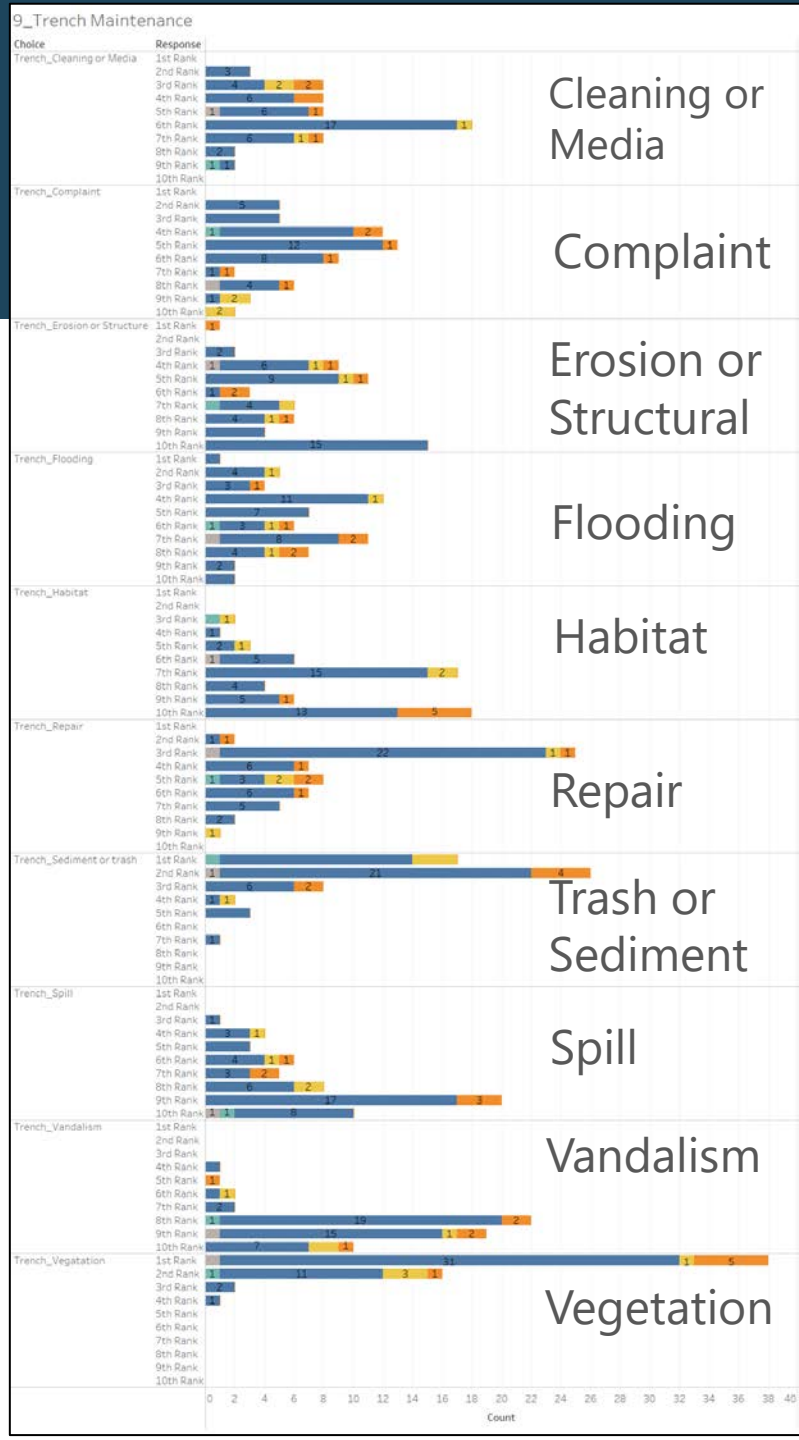


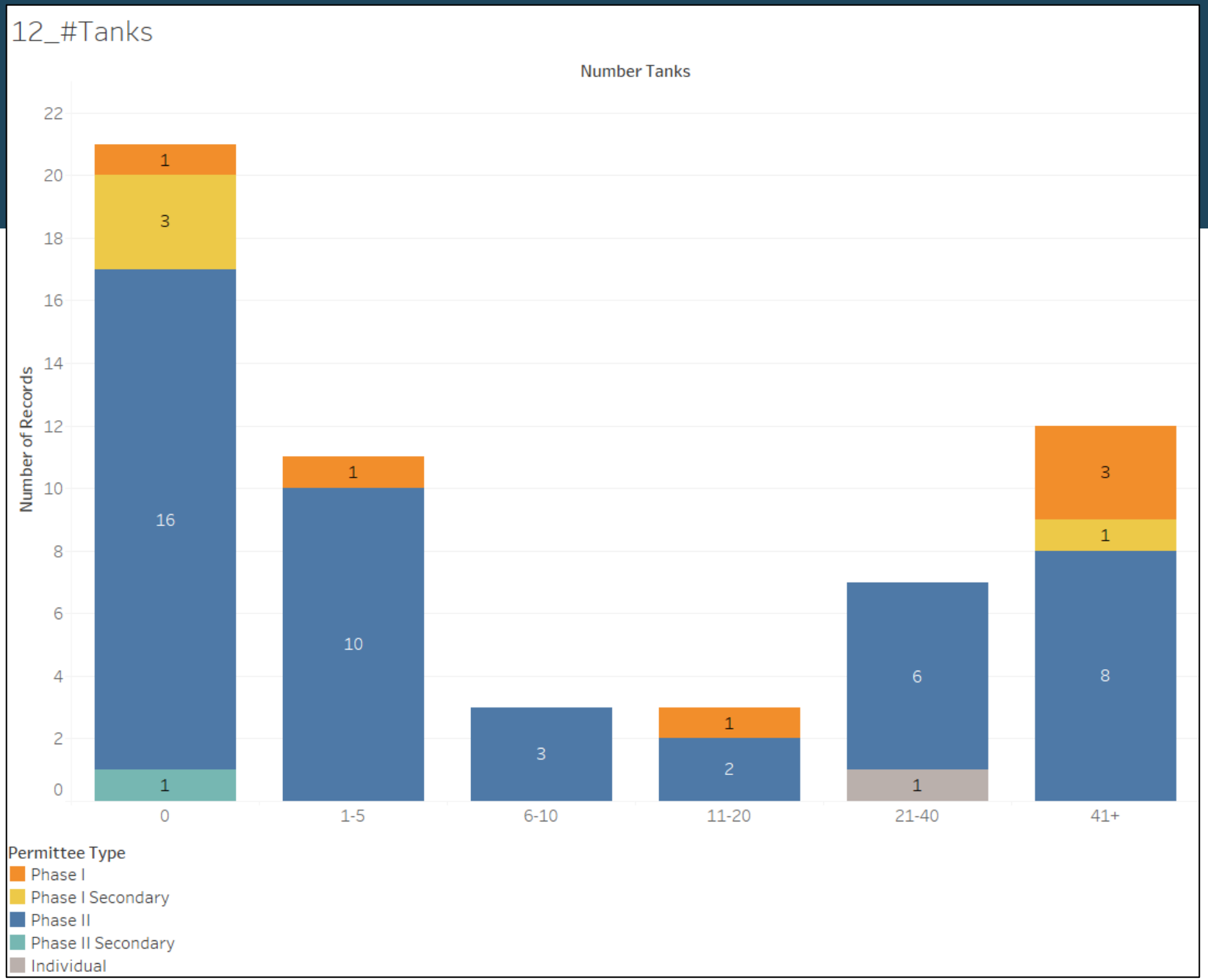

6_#Ponds
Number Stormwater Ponds
Number of Records
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
0
1-5
6-10
11-20
21-40
41+
1
1
1
4
1
1
3
1
6
1
1
10
3
1
21
1
Permittee Type
Phase I
Phase I Secondary
Phase II
Phase II Secondary
Individual


7_Pond Maintenance
Choice
Response
Pond_Animal
Pond_Cleaning or Media
Pond_Complaint
Pond_Flooding
Pond_Habitat
Pond_Repair
Pond_Sediment or trash
Pond_Spill
Pond_Vandalism
Pond_Vegetation
1st Rank
2nd Rank
3rd Rank
4th Rank
5th Rank
6th Rank
7th Rank
8th Rank
9th Rank
10th Rank
Count
Animal
Cleaning or Media
Complaint
Flooding
Habitat
Repair
Trash or Sediment
Spill
Vandalism
Vegetation

8_#Trenches


Number Trenches
Number of Records
0
2
4
6
8
10
12
14
16
18
20
22
24
26
5
1
8
1
7
1
5
2
3
5
1
17
1
0
1-5
6-10
11-20
21-40
41+
Permittee Type
Phase I
Phase I Secondary
Phase II
Phase II Secondary
Individual


9_Trench Maintenance
Choice
Response
Trench_Cleaning or Media
Cleaning or Media
Trench_Complaint
Complaint
Trench_Erosion or Structure
Erosion or Structural
Trench_Flooding
Flooding
Trench_Habitat
Habitat
Trench_Repair
Repair
Trench_Sediment or trash
Trash or Sediment
Trench_Spill
Spill
Trench_Vandalism
Vandalism
Trench_Vegatation
Vegetation
Count


12_#Tanks
Number Tanks
Number of Records
0
1-5
6-10
11-20
21-40
41+
Permittee Type
Phase I
Phase I Secondary
Phase II
Phase II Secondary
Individual


13_Tank Maintenance
Choice
Response
Tank_Cleaning
Cleaning or Media
Tank_Complaint
Complaint
Tank_Damage or Repair
Damage or Repair
Tank_Parts or Equip
Equipment
Tank_Seepage or Structure
Seepage or Structural
Tank_Spill
Spill
Tank_Testing
Testing
Tank_Vandalism
Vandalism
Tank_Ventilation
Ventilation
Count

Task 3. Published Data/Literature Review

INITIAL TASK

- Search for, compile, and analyze published BMP maintenance data
  - Existing databases, BMP performance publications, gray literature
  - Data available focused on BMP performance and cost.
  - Data on maintenance not published.

EVOLVED TASK

- Review of stormwater manuals and comparison of maintenance standards.
- History of stormwater BMP maintenance standards in western WA.
- Informed by input from Ecology on Task 4.

Task 4. Ecology Interviews

PURPOSE

- Interview current Ecology engineers and permit writers
  - Learn about the origins of the BMP Maintenance Tables in the SWMMWW
    - How maintenance conditions were identified
    - What publications or references were used
    - What standards need more input

INTERVIEW QUESTIONS

- Bibliography for maintenance standards
- How ranges of values for quantitative standards were determined
- Recommended maintenance frequencies

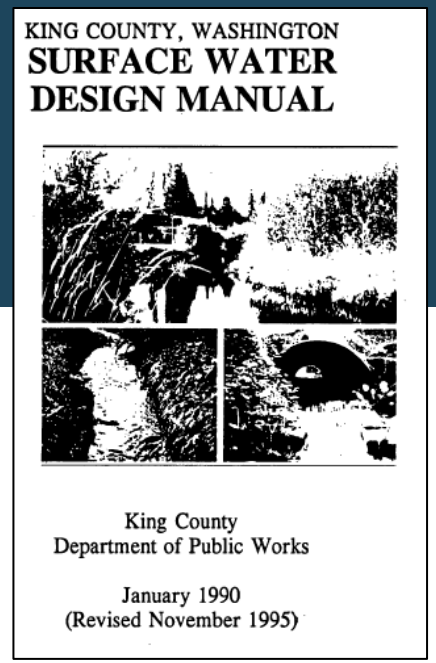
RESPONSES

- Today's standards based on 2001 Ecology SWMMWW
- Specific references not known for most maintenance standards

Literature Review

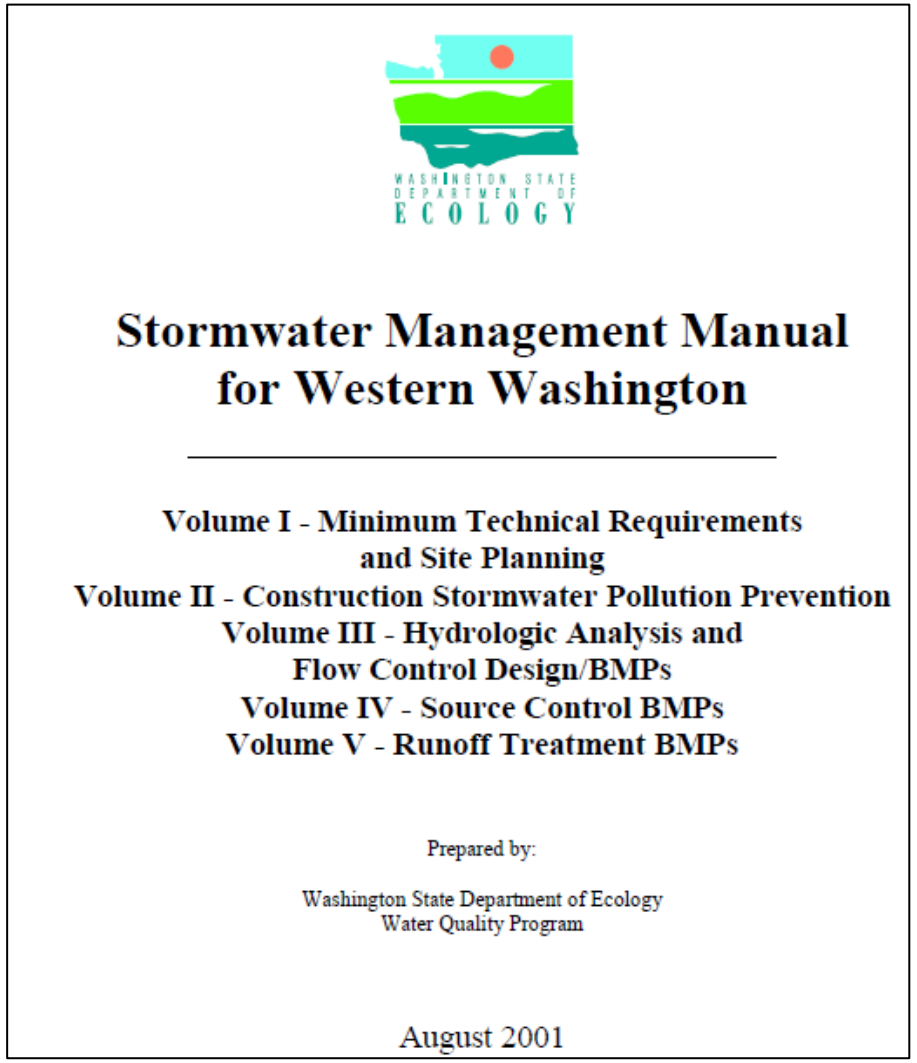
HISTORY OF BMP MAINTENANCE STANDARDS

- 1990 King County Surface Water Design Manual
- 1992 Ecology Stormwater Management Manual for the Puget Sound Basin
- 2001 Stormwater Management Manual for Western Washington (SWMMWW)


KING COUNTY, WASHINGTON
SURFACE WATER DESIGN MANUAL

King County
Department of Public Works

January 1990
(Revised November 1995)

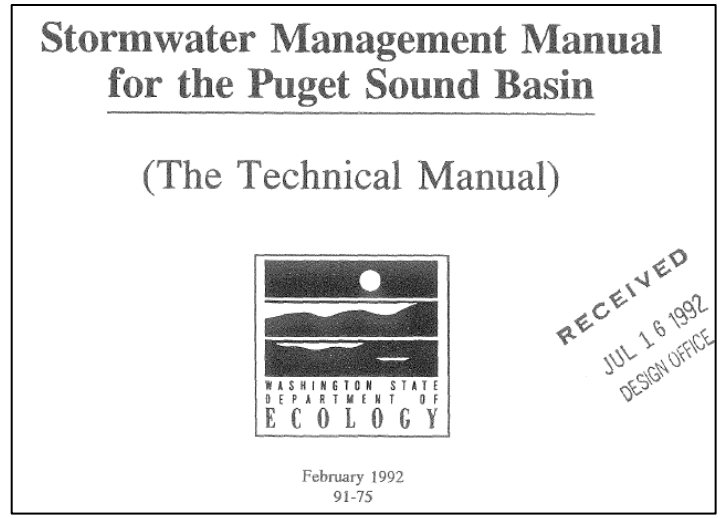

Stormwater Management Manual for Western Washington

Volume I - Minimum Technical Requirements and Site Planning
Volume II - Construction Stormwater Pollution Prevention
Volume III - Hydrologic Analysis and Flow Control Design/BMPs
Volume IV - Source Control BMPs
Volume V - Runoff Treatment BMPs

Prepared by:

Washington State Department of Ecology
Water Quality Program

August 2001

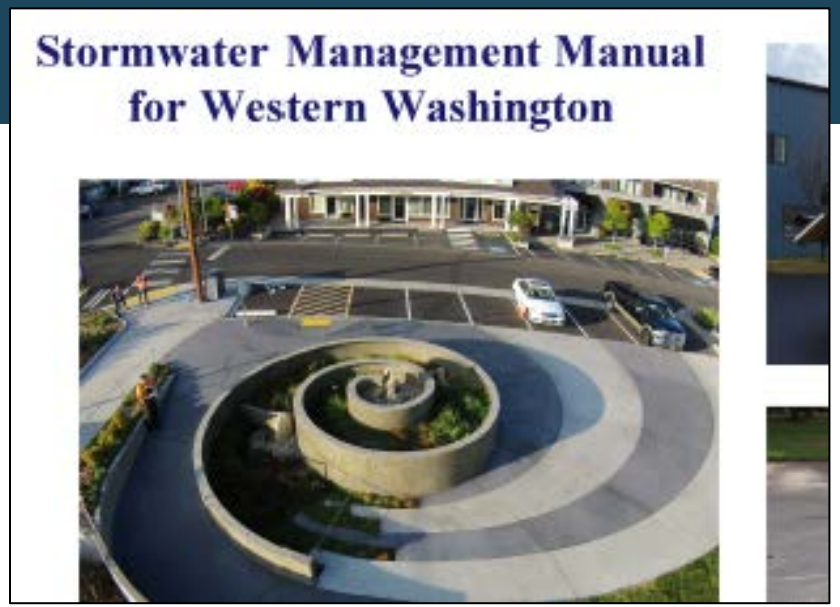

Stormwater Management Manual for the Puget Sound Basin

(The Technical Manual)

RECEIVED
JUL 16 1992
DESIGN OFFICE

February 1992
91-75

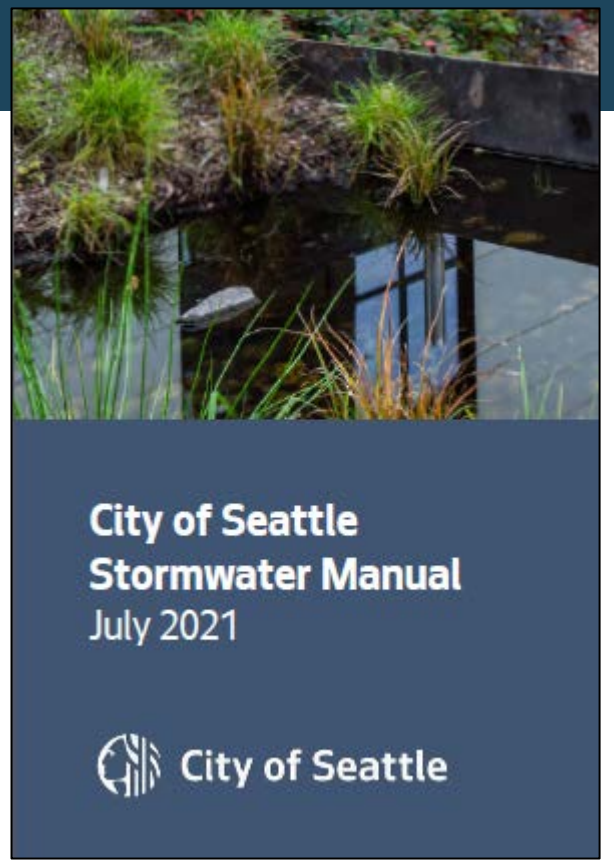
Comparison of Maintenance Standards



KING COUNTY, WASHINGTON
SURFACE WATER DESIGN MANUAL

King County
Department of Natural Resources and Parks

July 23, 2021



Washington State Department of Transportation

Highway Runoff Manual

M 31-16.05
April 2019

City of Tacoma
Environmental Services

Stormwater Management Manual
July 2021 Edition

Comparison of Maintenance Standards

COMPARED

18 Maintenance Elements

1. Access
2. Animals
3. Berms
4. Bollards
5. Energy Dissipators
6. Fence/Gate
7. Filterbag Full
8. Inlet/Outlet
9. Liner or Structure
10. Noxious Weeds
11. Overflow Spillway
12. Pollution
13. Slope/Erosion
14. Storage Capacity Reduction
15. Trash Racks
16. Trash/Debris/Sediment
17. Trees
18. Vegetation Blockage

KEY DIFFERENCES

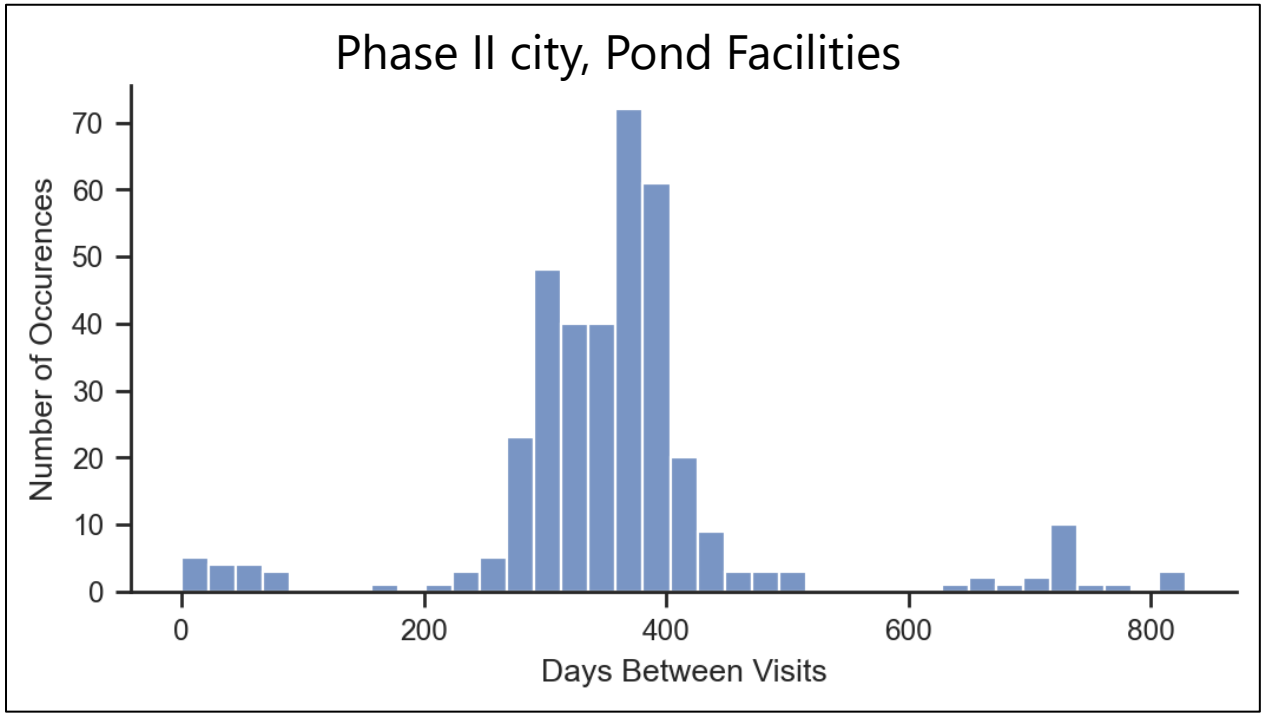
- **Grass cover height** (nonaquatic)
- **Pond liner** integrity
- **Sediment accumulation**: ponds and pipes
- **Standing water** in ponds
- **Blockage**: pipes, air vents, treatment media, and filters
- **Cracks** or structural issues: vaults and tanks
- **Sludge:** settled (solids) versus floating (oil)

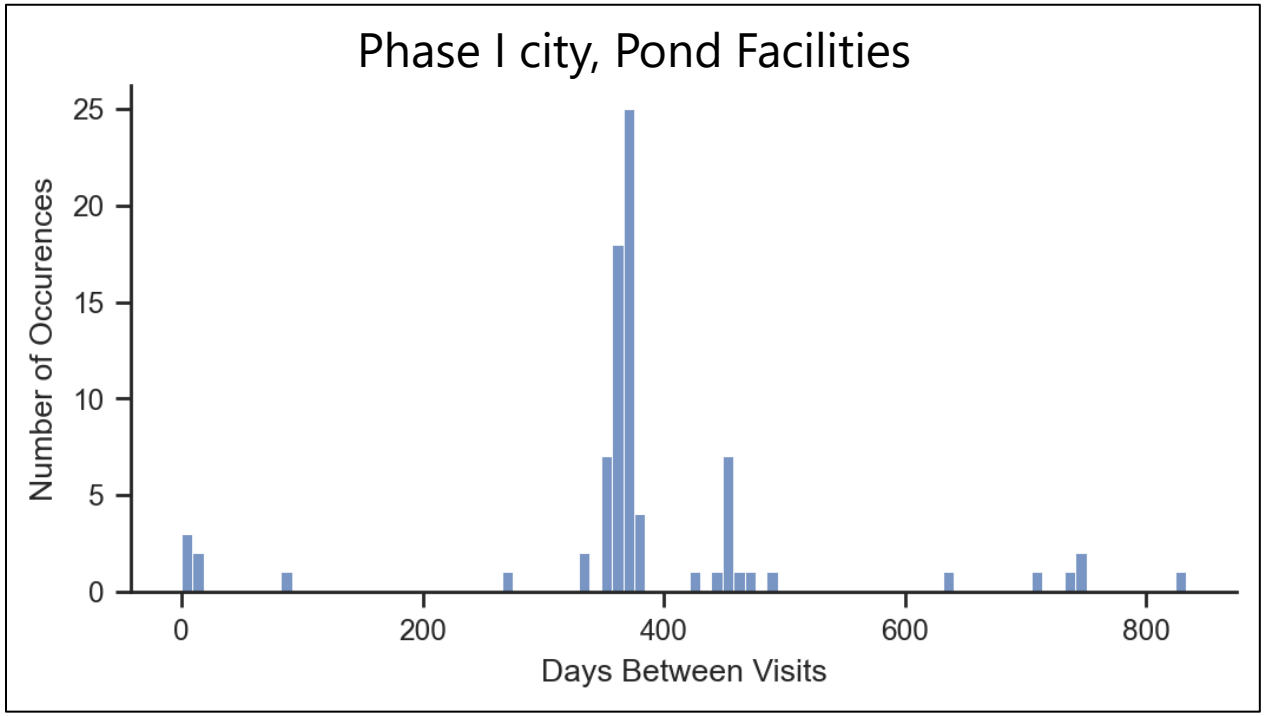
Task 5. Pilot Data Analysis

PURPOSE

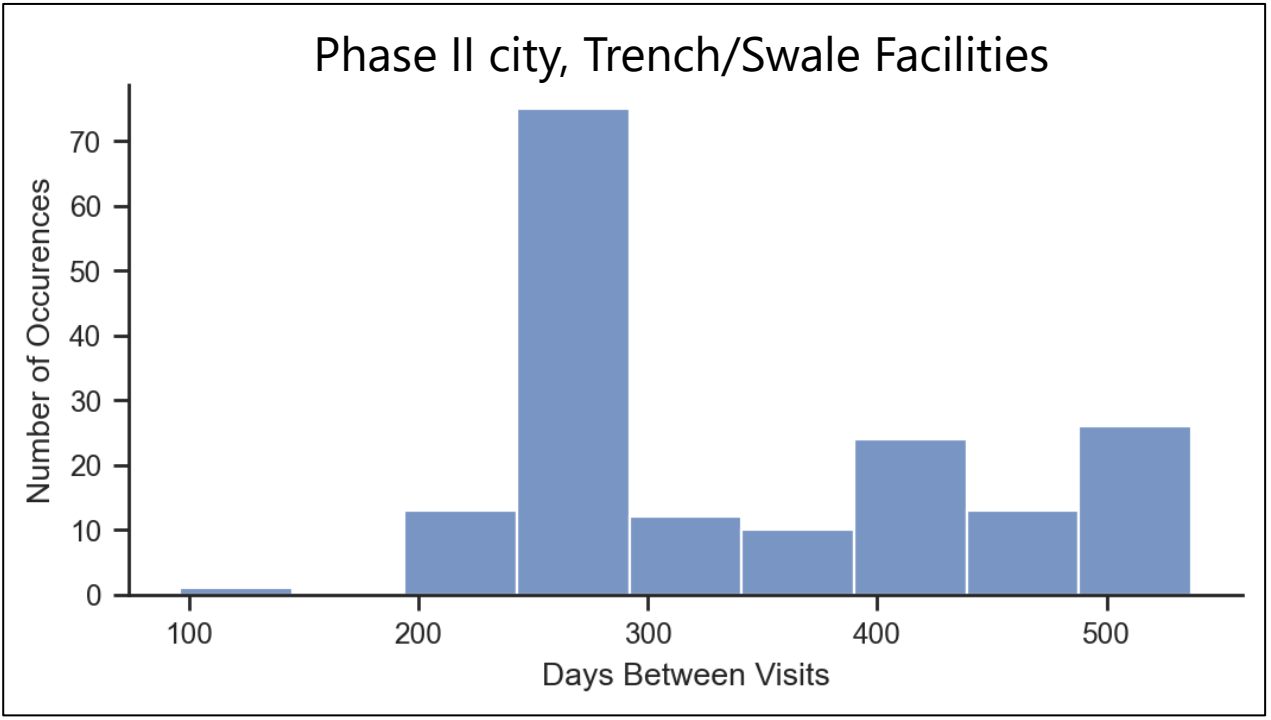
1. **Exploratory Pilot-level Effort**
   - How do BMP maintenance data compare to the maintenance standards?
   - What BMP inspection and maintenance data are collected by permittees?
   - Data from just three permittees – one Phase I and two Phase IIs
2. **Analysis**
   - Inspection and maintenance frequencies
   - Maintenance outcomes
   - Differences in recordkeeping

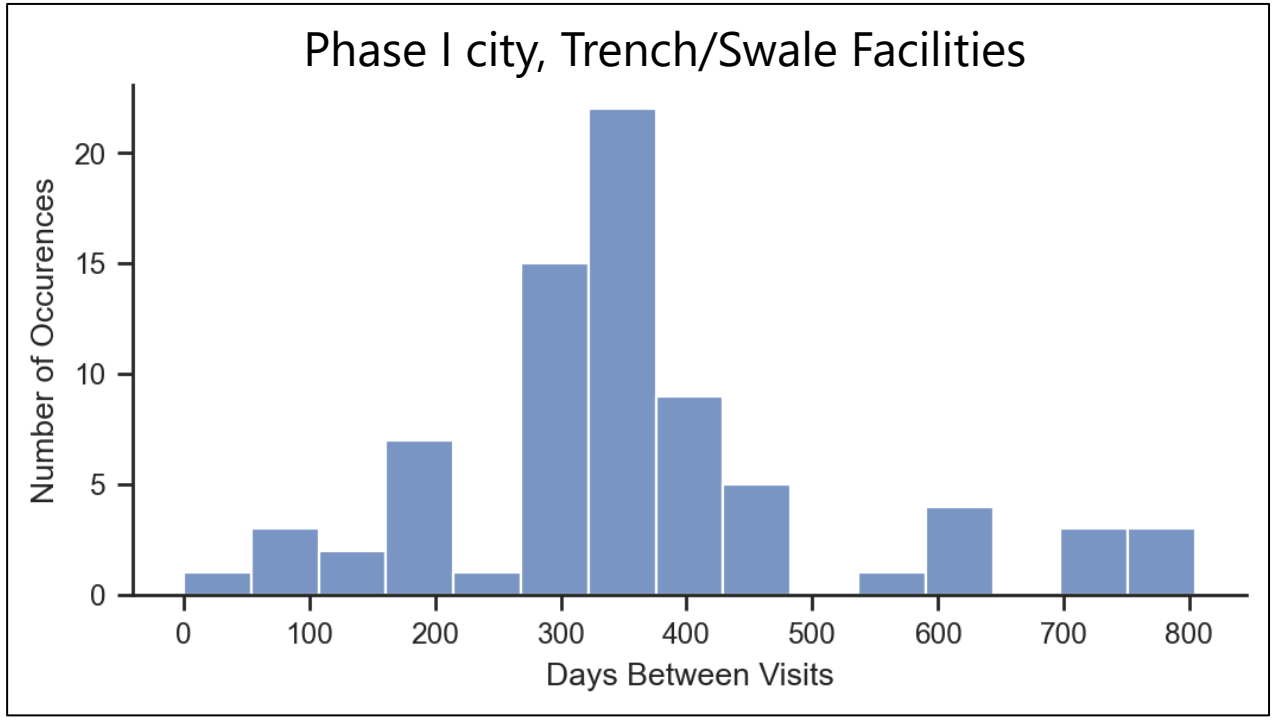
PONDS


Phase II city, Pond Facilities
Number of Occurences
0
10
20
30
40
50
60
70
0
200
400
600
800
Days Between Visits

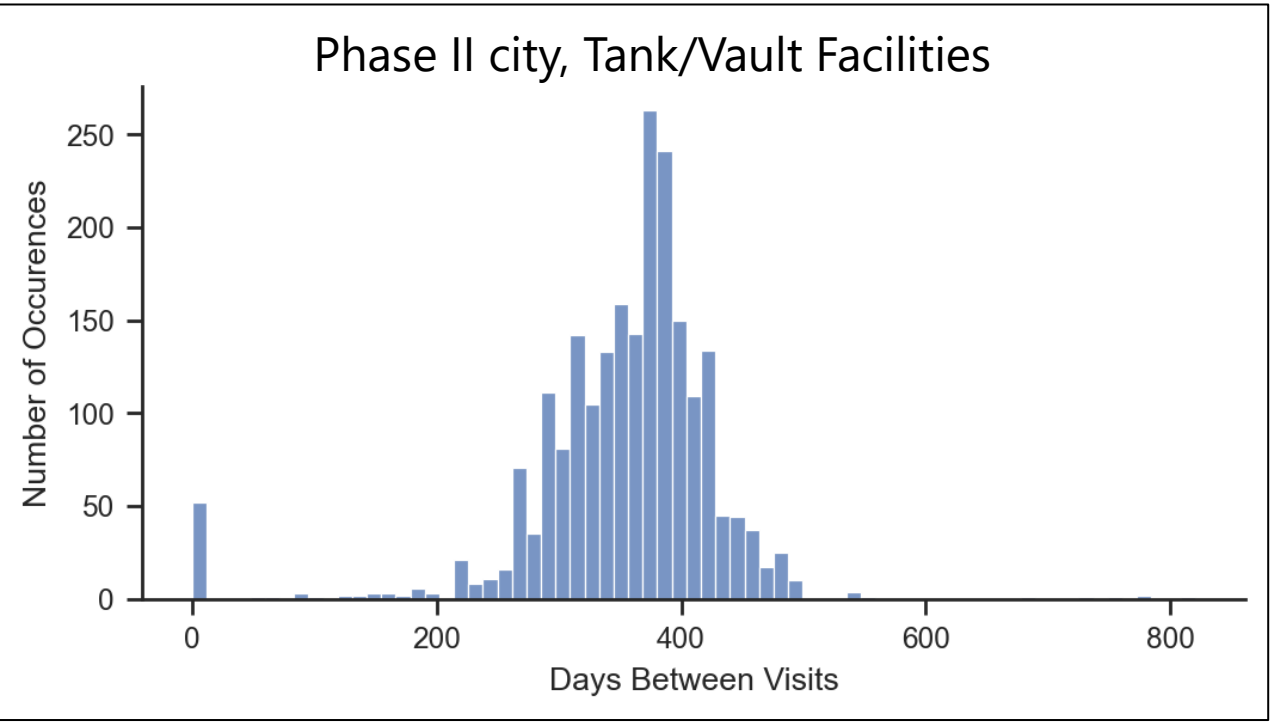

Phase I city, Pond Facilities
Number of Occurences
0
5
10
15
20
25
0
200
400
600
800
Days Between Visits

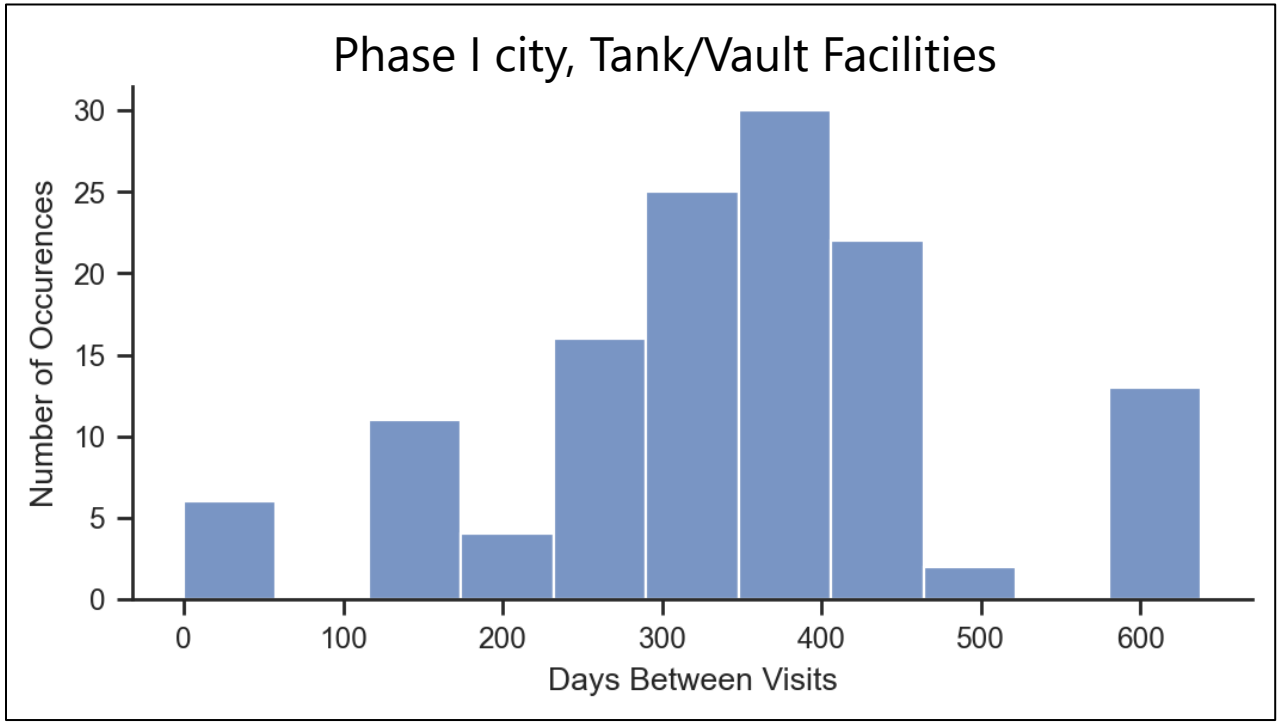
TRENCHES/SWALES



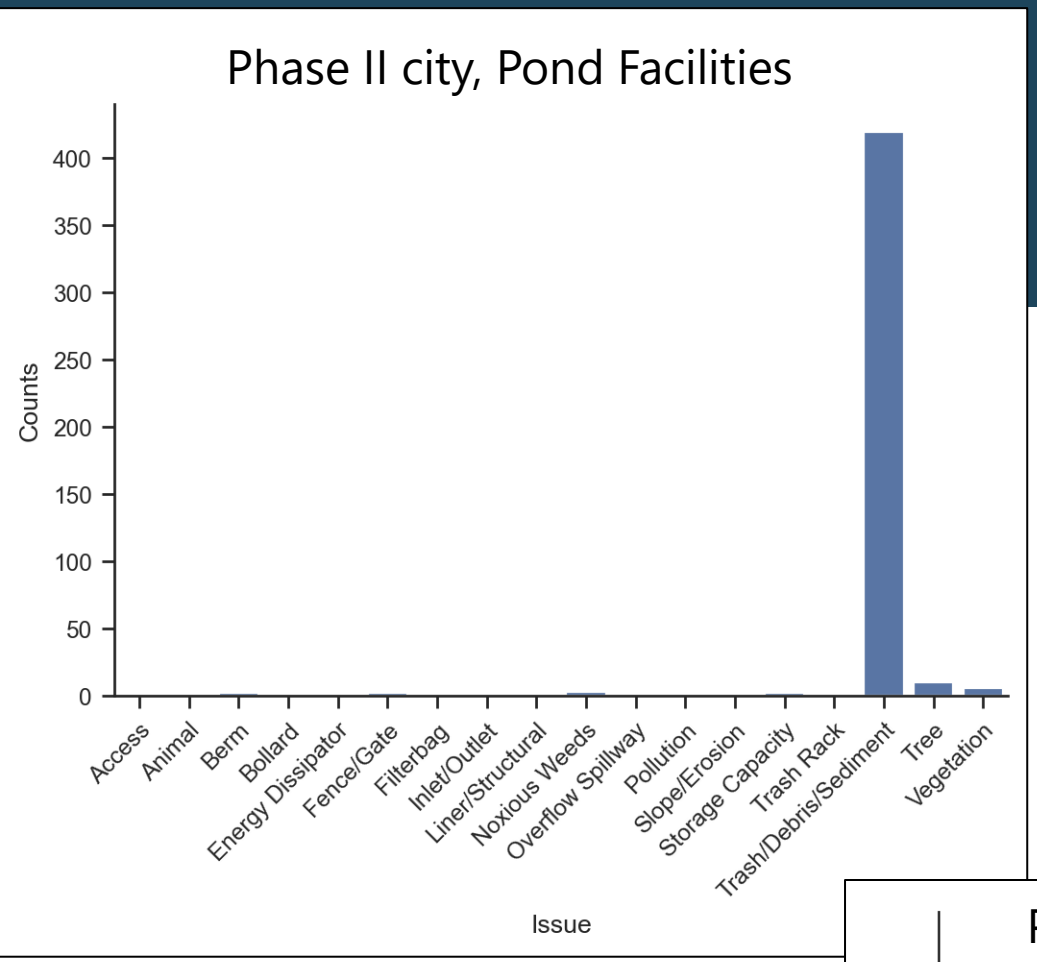


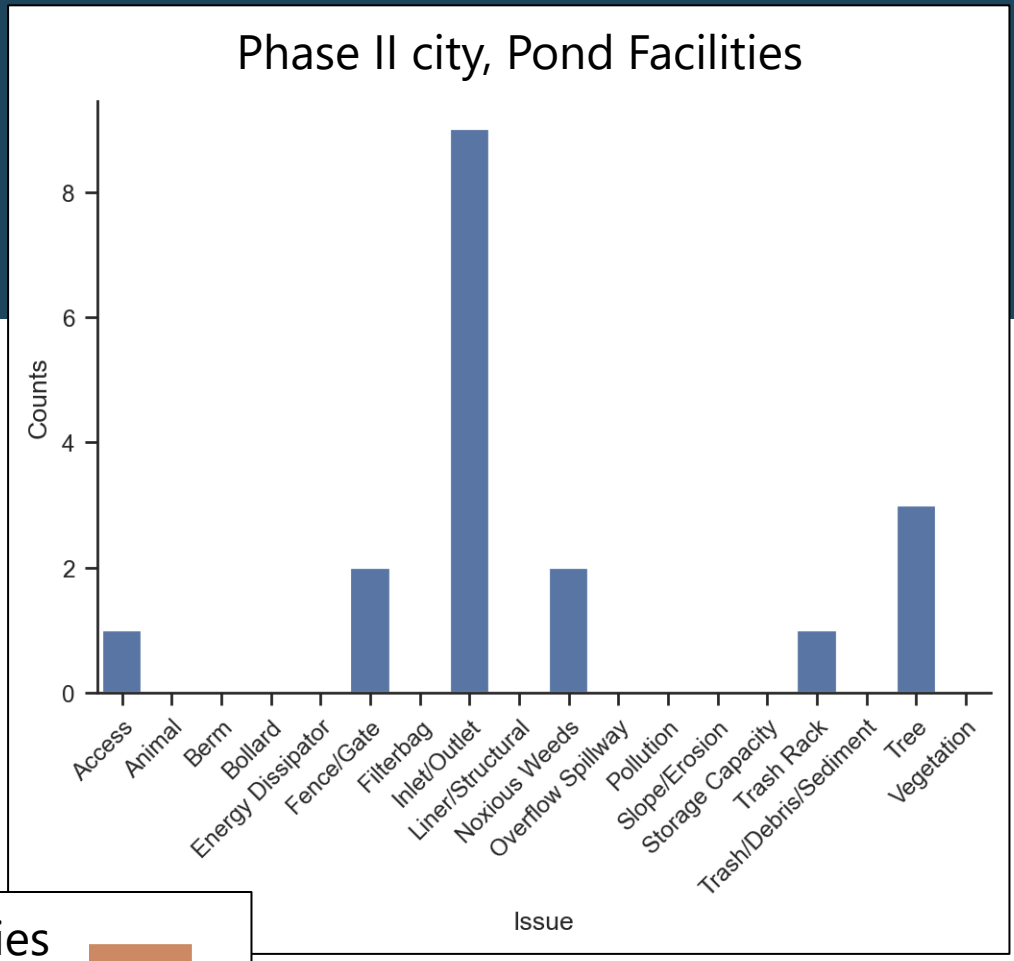
TANKS/VAULTS

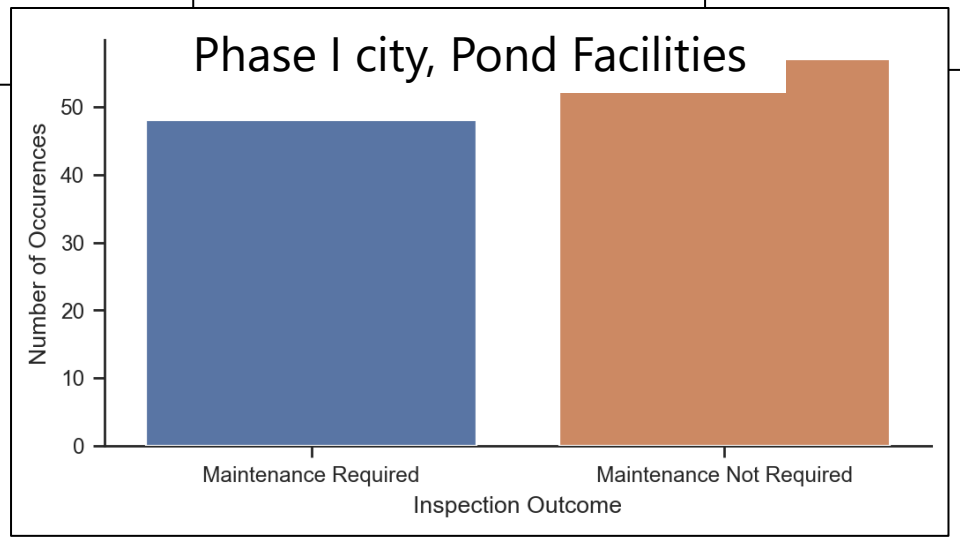




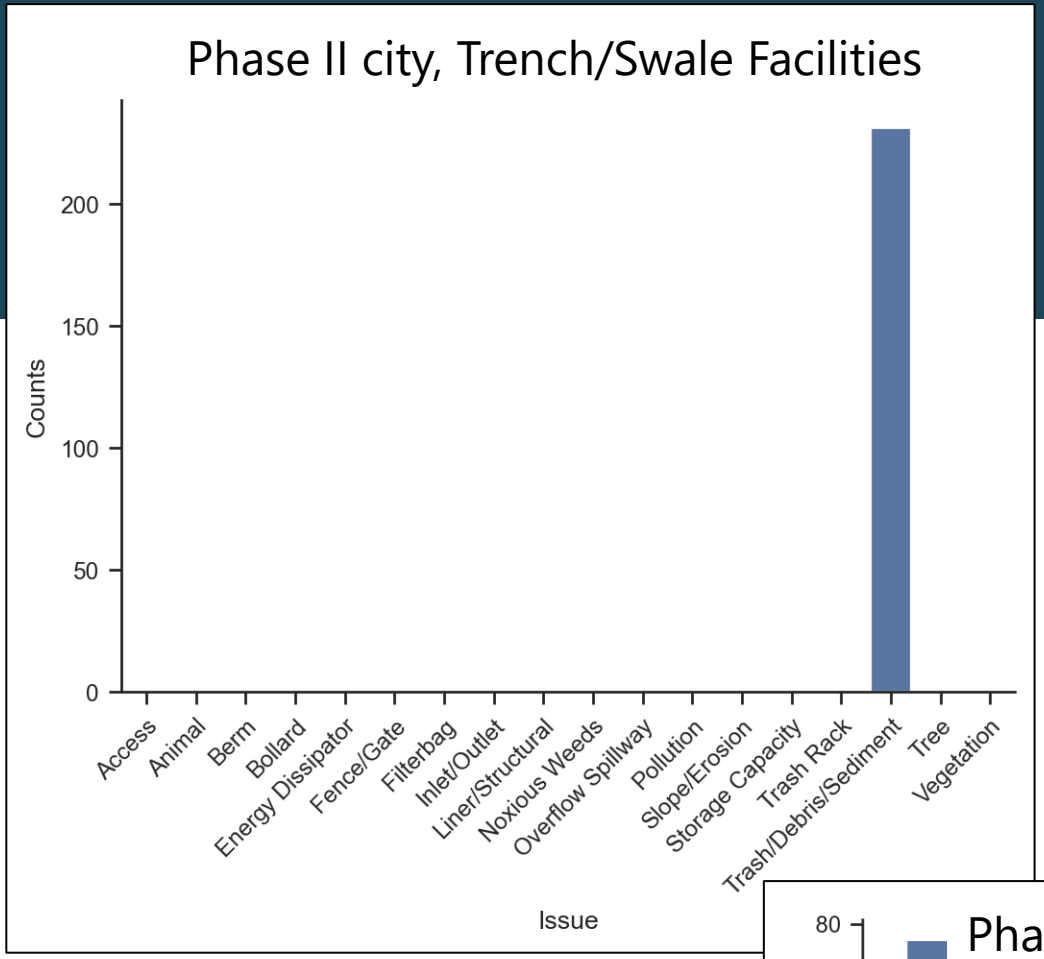
PONDS

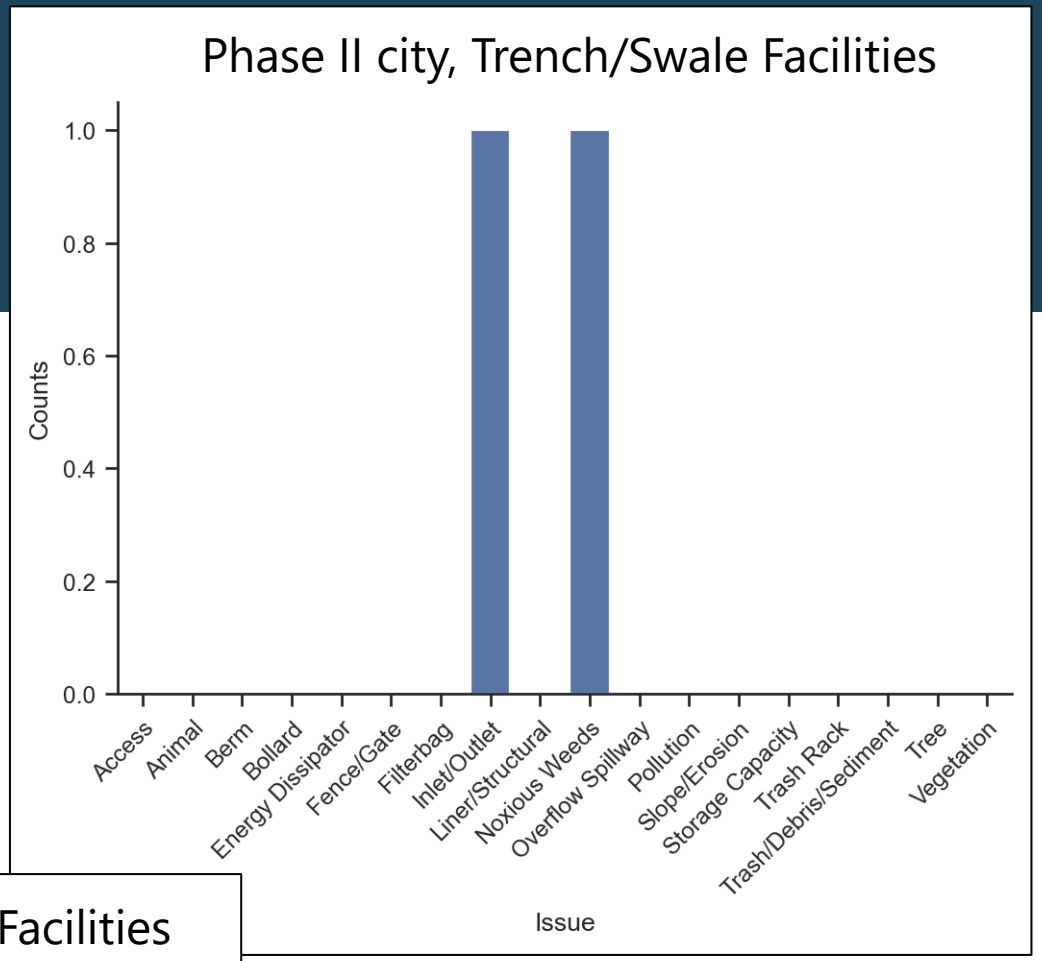

Phase II city, Pond Facilities
Counts
0
50
100
150
200
250
300
350
400
Access
Animal
Berm
Bollard
Energy Dissipator
Fence/Gate
Filterbag
Inlet/Outlet
Liner/Structural
Noxious Weeds
Overflow Spillway
Pollution
Slope/Erosion
Storage Capacity
Trash Rack
Trash/Debris/Sediment
Tree
Vegetation
Issue

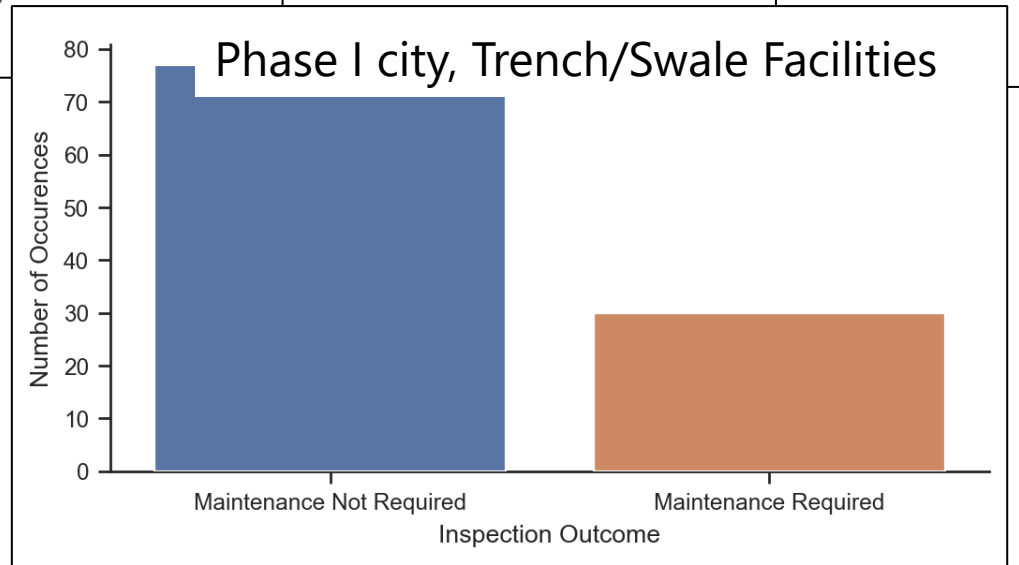

Phase II city, Pond Facilities
Counts
0
2
4
6
8
Access
Animal
Berm
Bollard
Energy Dissipator
Fence/Gate
Filterbag
Inlet/Outlet
Liner/Structural
Noxious Weeds
Overflow Spillway
Pollution
Slope/Erosion
Storage Capacity
Trash Rack
Trash/Debris/Sediment
Tree
Vegetation
Issue


Phase I city, Pond Facilities
Number of Occurences
0
10
20
30
40
50
Maintenance Required
Maintenance Not Required
Inspection Outcome

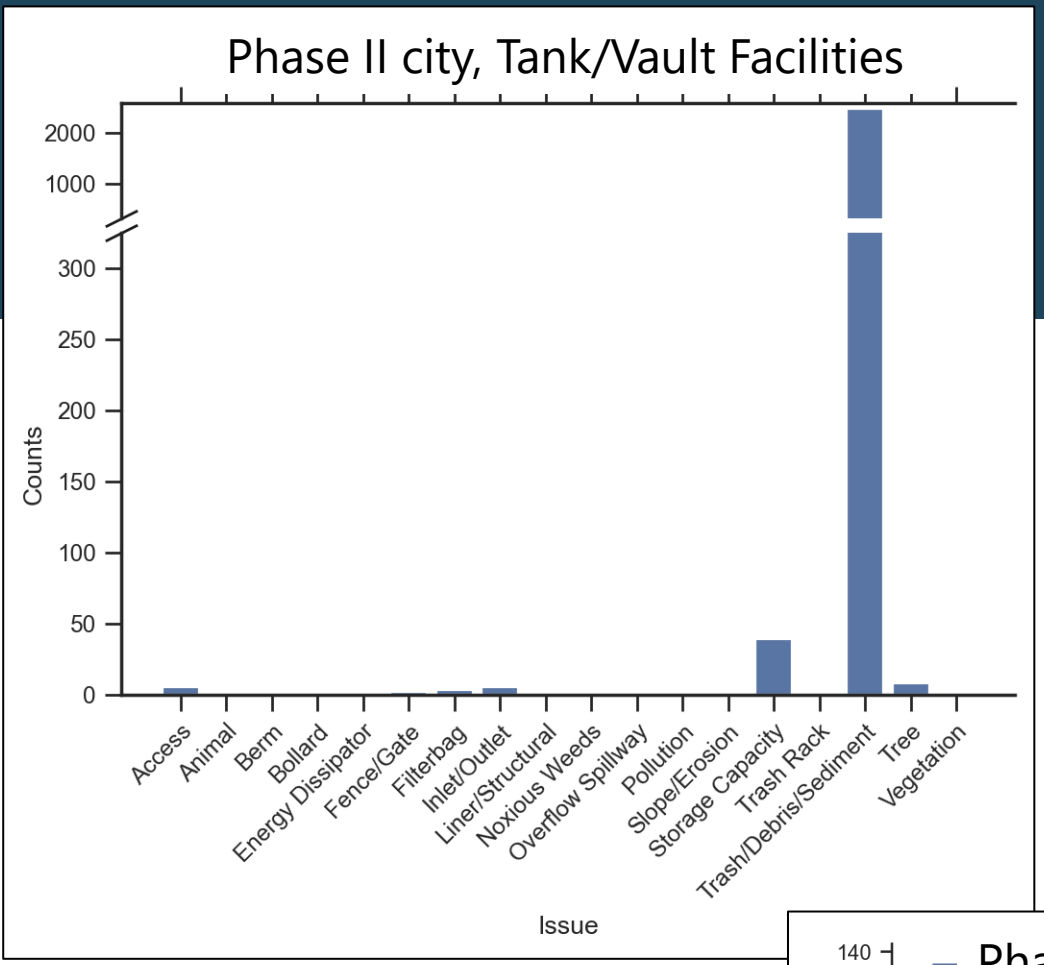
TRENCHES/ SWALES

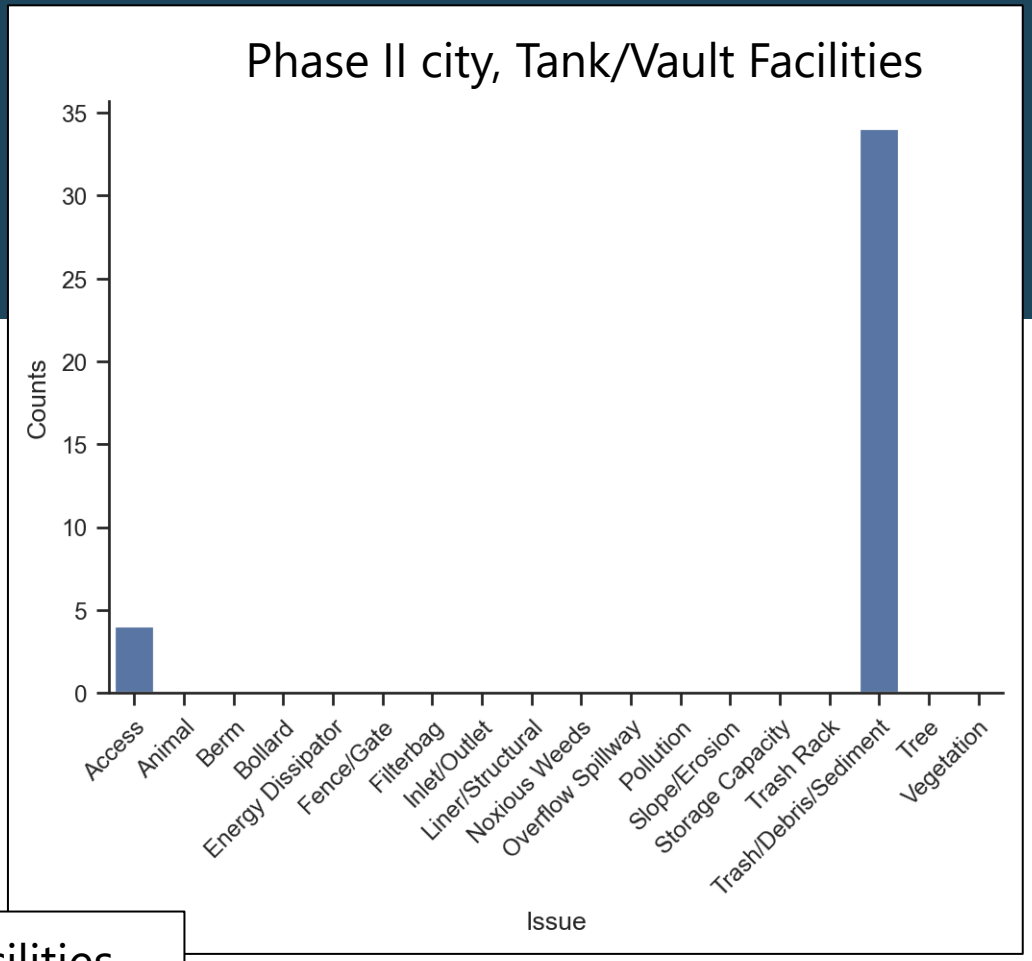


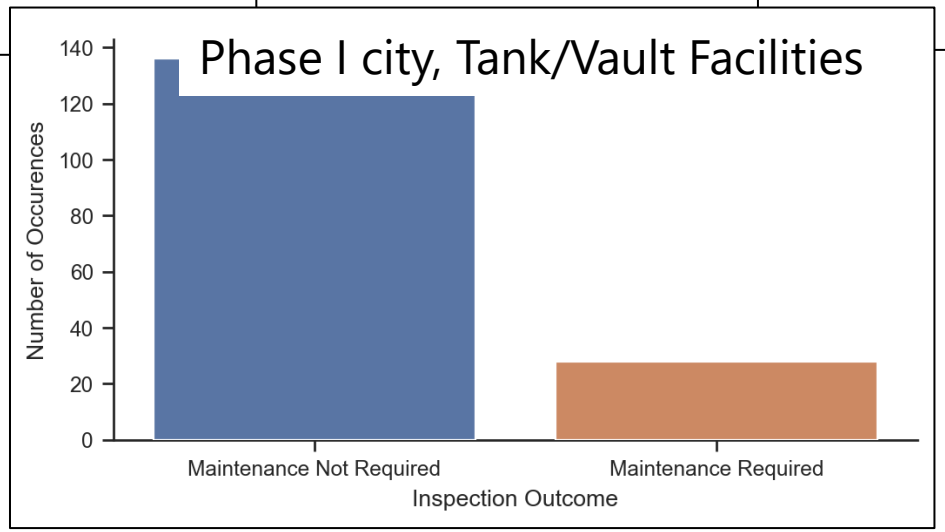




VAULTS/ TANKS







Task 6. White Paper: Conclusions and Recommendations

BMP Maintenance Standards in Western WA

1. Derived from the 2001 Ecology stormwater manual (SWMMWW).
   - Based on the 1992 *Stormwater Management Manual for the Puget Sound Basin* and 1990 King County *Surface Water Design Manual*.

2. Bibliography in SWMMWW is extensive
   - Some references are old and from local studies and could use verifying or updating
   - Add citations for references in BMP Maintenance Tables

3. Field testing of maintenance standards in controlled setting
   - Sediment: accumulation in pipes, vaults, ponds
   - Vegetation growth, tall grasses, trees
   - Blockage: pipes, inlets, outlets
   - Water ponding: acceptable fluctuations in water storage

Conclusions and Recommendations

BMPs and Maintenance Needs

1. BMPs in use consistent between Survey (task 2) and Pilot Data Analysis (task 5)
2. Most common BMP maintenance needs:
   - Vegetation management, sediment or trash removal
3. Noted issues:
   - Pipe blockage, noxious weeds, access.
4. Least common:
   - BMP structure, slope erosion, overflow/spillway concerns, damage to a pond liner.
5. BMP visit frequencies for inspection or maintenance
   - Most common: once per year
   - Secondary frequencies: approximately 100 days and 250-300 days, especially for ponds and trenches/swales
   - Pilot data analysis data limitations
     - Represents just 3 cities
     - Could not tie specific maintenance need to reason for visit

Conclusions and Recommendations

Adjusting BMP Maintenance Frequencies

1. Secondary BMP visit frequencies: 100 days, 250-300 days
   - Examine what drives non-yearly visits
   - How do they affect maintenance outcomes and BMP functionality?

2. Tie maintenance outcomes to the maintenance standards
   - Demonstrate BMP performance relative to standards

3. Regular analysis of maintenance frequencies
   - Information about BMP performance and cost for maintenance
   - Once per permit cycle?

4. Preventative maintenance approach
   - Routine maintenance actions for prevention of issues
   - Balance between higher routine cost vs. lower risk for failure events

Conclusions and Recommendations

Recordkeeping

1. Variable approaches, methods, and software
   - Ranges from paper/pen to tablets
   - Mix of software: asset management, permit compliance, spreadsheet

2. BMP Status
   - Pass/fail
   - Tied to maintenance standards

3. Notes and comments in O&M records
   - Use sparingly
   - Capture status from searchable standardized responses (drop-down menu/picklist)

4. Terminology
   - Use common terms for BMPs from stormwater manuals

Questions

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Operations Manager
DMcQuilliams@bellevuewa.gov
425-452-7865

SAM website and Study webpage

James Packman
Herrera Environmental Consultants
Associate Scientist
JPackman@herrerainc.com
206-787-8329

https://ecology.wa.gov/regulations-permits/reporting-requirements/stormwater-monitoring/stormwater-action-monitoring/sam-effectiveness-studies/bmp-maintenance-conditions