The Evolution of NEORSD's Stormwater Inspection & Maintenance Program

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Presentation Overview

Stormwater Program 1. Introduction 2. Stormwater GIS & Work Order Management Stormwater 3. Inspections Stormwater 4. Maintenance







NEORSD Background

- The Northeast Ohio Regional Sewer District was created as a Political Subdivision of Ohio in 1972 by Court Order
- The Regional Stormwater Management Program (RSMP): implemented in 2013, suspended in 2013, reaffirmed by the Ohio Supreme Court in 2015, and restarted in 2016







To provide a best-in-class level of service along the regional stormwater system, the Stormwater Inspection and Maintenance team focuses on proactive and predictive inspection and maintenance, response activities, stormwater asset operations, and asset and project tracking.





Stormwater Program Intro Stormwater Inspection & Maintenance (SWIM)

Vision

Safe conveyance of stormwater along healthy streams.

Mission

Validated Predictive, Preventative, and Proactive SWIM Activities & Recommendations by following a Field-Focused, Function & Risk-Based Stormwater Master Planning Approach to Asset Management





Stormwater Program Intro Watershed Boundaries

5 Watersheds -Chagrin River -Cuyahoga River East -Cuyahoga River West -Lake Erie Direct Tributaries -Rocky River

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Subwatershed Boundaries

101 Subwatersheds in the Stormwater Service Area

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Stormwater Program Intro Asset Counts

Responsible for the inspection and maintenance of:

- 350 Miles of Open Stream
- 84 Miles of Culverted Stream Pipes
- 1,066 Roadway Crossings
- 23 Major Structures
- 90 Basins
- 7 Green Infrastructure Sites
- 24 Debris Racks
- 4,549 BTUs (3,624 buildings, 675 transportation, and 250 utility assets)





Stormwater GIS & Work Order Management







SWIM Uses Both GIS and WAM Programs

- SWIM has been using WAM and ESRI ArcGIS On-line since 2013
- WAM is an Oracle flat-file CMMS used to record work orders, inspection and maintenance hours, and condition scores
- WAM doesn't have a spatial component, so a separate GIS program was also selected (AGOL)





SWIM Uses Both GIS and WAM Programs cont.

- AGOL is used for spatial asset creation, field forms (inspection and maintenance), and work order tracking
- Both AGOL and WAM require data synching to ensure both programs are referencing the same assets and work orders, which requires regular data maintenance
- A new GIS-Centric CMMS is planned for 2020





Stormwater GIS Asset Delineation

Culverted Streams

Public

Crossings

Section - Car

ANA PARALPHIL

Streams



Stormwater GIS Asset Inventory Standards

Developed standards to consistently: -Create RSS assets -Manage inventory properties



STORMWATER INSPECTION AND MAINTENANCE

Asset Inventory Standards



Version Date: April 30, 2018

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Stormwater GIS Defining a Parent vs Child Crossing

Private Residential Footbridge

- <u>Child</u> Transportation Asset

Arterial Road Culvert - Parent Crossing Asset







Stormwater GIS Lesson Learned: Defining Crossing vs. Culverted Stream

- Crossings: any structure designed to support superimposed loads of earth or other fill material plus a live load
- Culverted Stream: any structure designed to support superimposed loads of earth or other fill material. Does not serve as transportation for live loads. Can be daylighted.

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Stormwater GIS Lesson Learned: Defining a Stream Asset



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Stormwater Work Order Management Types of Inspection Planning

BC00362 BC

 Reach-Based Inspections: Use when inspecting many assets in proximity to another (e.g., tributary assets)



BCA0366

Stormwater Work Order Management Types of Inspection Planning

2. <u>Spot-Based Inspections:</u> Use to inspect single asset (e.g., monitoring problem)

SWIM Inspection 2018/2017	
Inspection Type	PM Insp. zt yn-W
Inspectors	Silea, Walsh
Crew Number	Crew 2
Crew Leader	Silea Inspection A(g() Form
Community	Cleveland
Subwatershed	Big Creek
Inspection Date	2/27/2019
Inspection Time	1050
Asset Type	BTU
Asset Number	BC00032_T002
Inspection WO#	1733315.01
Inspection ID	038423
Work Order Status	Inspection WO Completed
Priority	2-Trouble Asset
Service Request Number	
Location Details	John Nagy Blvd at Brookside Reservation
Structural Details	Similar condition as previous inspection. Gabions along toe of masonry retaining wall are in a state of failure, with the entire toe row missir
Condition Rating Structural	4
Distance to Infrastructure	
Condition Rating BTU	
Hydraulic Details	Normal flow conditions were observed at the time of inspection.
Condition Rating Hydraulic	1
Debris/Sediment Details	Channel clear of debris at the time of inspection.
Condition Rating Debris/Sediment	1
Debris Volume (cuyds)	
Sediment Volume (cuyds)	Follow a first state of the following state is a set of the second state of the second
	Follow up inspection to monitor failing masonry retaining wall along KK bank near parking lot/road. Gabions are in a state of failure, comp
Monitor (Dava)	Swill follow up inspection in Tyear to monitor. Carry forward further analysis recommendation.
Mainton (Days)	No.
Maintenance Structural	
wantenance streambank	

ALC: NOT THE

Stormwater Inspection







Stormwater Inspection Overview

• Assets Condition Scores • Trail Camera Monitoring • Maintenance Recommendations Small-Scale Project Recommendations • Lessons Learned





Stormwater Inspection Overview

 Conduct Field-Focused Inspections
 Evaluate Stormwater Assets for 3 Stormwater Management Properties:

 Structural Integrity
 Hydraulic Performance
 Sediment & Debris Accumulation





Stormwater Inspection Condition Scores

- Assets scored on a 1-5 Scale, excellent to failed, for three categories:
- Structural
 - Condition of asset
- Hydraulic
 - Water surface elevation
- Debris & Sediment
 - Flow area impacts









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Stormwater Inspection *Crossing Methodology & Standards*

STATE OF OHIO DEPARTMENT OF TRANSPORTATION CULVERT INSPECTION REPOR CR-86 07-13 SPAN MATERI ROADWAY NUMBER OF CELI LATITUE LONGITUDE FEATURE INTERSECTION CULVERT 1 General Culvert Alignment . Shape Seams or Joint 5 Slab 6. Abutments Headwalls³ 8. End Structure CHANNEL 9. Channel Alignmen 10. Protection 12. Scour* 11. Culvert Waterway Blockag APPROACHES OHIO DEPARTMENT OF TRANSPORTATIO 14. Guardrail 13 Pavement CULVERT MANAGEMENT MANUAL 15. Embankmen Level of Inspection GENERAL APPRAIS Only a bold box for structures that are Headwall or Scour critical. These items sh determined to be critical upon the judgment of the inspector COMMENTS (use back of form if additional space if needed) INSPECTED I DATE REVIEWED B DATE

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Utilize existing standards from ODOT for the inspection of crossings.



New construction, rated '1'



CMP pipe has failed, rated `5'

Stormwater Inspection Open Stream Methodology & Standards

- Quick method utilizes a modified BEHI & NBS procedure and form
- BANCS method for long-term monitoring – Bank Assessment for Non-point source Consequences of Sediment



Streambank erosion, rated '4'



Date:				File Number:		
Inspector(s):				Asset Number:		
Bank Height (ft):				Bank Length (ft):		
Distance to BTU Asse	et (ft):			BTU Type:		
Pre-Screening: If "Yes" to 2 or more of the following questions. perform BEHL If not, BEHL = Low. 1 - Does the bank exhibit less than or equal to 50% protection at the toe? 2 - Does 50% or more of the bank exhibit ratification where at least one layer is erodible material? 4 - Does 50% or more of the bank chabit stratification where at least one layer is erodible material? 4 - Does 50% or more of the bank chabit stratification where at least one layer is erodible material? 5 - Does 50% or more of the bank have a bank height of 10 feet or more with 50% or more soil exposure? 5 - Does 50% or more of the bank void of rooted vegetation?						
BEHI Metrics and Scoring						
			Bank Material	Description		
Root Depth/Bank H	leight	Score	Root Density	Score	Material Adjustment*	Score
Bank Angle		Score	Surface Protection	Score	Number of Stratified Layers**	Score
BEHI Total Score:	re: Ranking (Very Low to Extreme):					

Material adjustments can be made based on the erodibility of the material. Up to 10 points can be subtracted for nonerosive material (i.e. cobble) to 10 points can be added for extremely erodible materials (i.e. sand). A mixture of material (i.e. sand with some gravel or silty, sand with trace away!) is more often found in strema systems so an average score would be more appropriate (i.e. add 6 points instead of 10). Typically there are a adjustments made for clay, silt, or bedrock. This is not a mandatory adjustment.

Low: 7.75 - 15.5

/ery High: 31.75 - 36

Verv Low: < 7.5

High: 23.75 - 31.5

" Stratification adjustments can be made if erosion is enhanced due to the stratified layers. Adjust only if one of the layers is an erodible material sand/gravek not bedrock/clay). Up to 10 points can be added for multiple layers of stratification. Up to 5 points can be added for a sigle layer of stratification. Consider where the layers are in relation to water when making adjustments. This is not as nandatory adjustment.



Moderate: 15.75 - 23.

Stormwater Inspection Open Stream Methodology & Standards

Methods used to estimate bank erosion

- Bank profile
- Toe and Bank pins
- Compare to past inspection photos
- Historical imagery (NearMap, Bing, Google Earth)
- Aerial imagery drone flights
- Spherical Imagery (QSI)









Stormwater Inspection BTU Methodology & Standards

- Building, Transportation, Utility
- Scored 1-5
- Assigning Risk:
 - Distance to infrastructure/bank height=infrastructure slope
 Ratio guides score



Rated '5' for risk of failure.

-Determines risk of failure and urgency





Stormwater Inspection *Basin Methodology & Standards*

AGIN STRUCTURAL CONDITION ASSESSMENT

Northeast Ohio Regional Sewer District Stormwater Inspection & Maintenance Basin Inspection Manual



1|Page

STORMWATER INSPEC	TION & MAINTENANCE - NEORSD
ASSET ID WO#	WET/DRY DATE
COMMUNITY	SUBWATERSHED
ASSET COMPONENTS	
INLET WORKS (Section 1.1)	
1. Primary Inlet Type	2. Primary RSS Inlet Channel / Pipe Condition
3. Primary Inlet Endwall(s) Condition	4. Primary Inlet Trash Rack Condition
5. Secondary Inlet Type	6. Secondary Inlet Condition
7. Inlet Scour Condition	8. Forebay Condition
BASIN INTERIOR (Section 1.2)	
9. Interior Slope Gen Erosion / Stability Condition	10. Rodent Activity
11. Interior Basin Floor Vegetation Condition	
IMPOUNDING STRUCTURE (DAM) (Section 1.3)	
12. Material Type:	
Upstream Face	
13. Interior Slope Seepage Condition	14. Gen Erosion / Stability Condition
15. Rodent Activity	16. Vegetation Condition (Earthen)
17. Joint / Alignment Condition (Concrete/Masonry)	
Downstream Face	
18. Interior Slope Seepage Condition	19. Gen Erosion / Stability Condition
20. Rodent Activity	21. Vegetation Condition (Earthen)
22. Joint / Alignment Condition (Concrete/Masonry)	
Crest	
23. Gen Erosion Condition (Earthen)	24. Rodent Activity
	•

OUTLET WORKS (Section 1.4)			
27. Primary Outlet Condition	28. Primary Outlet Stilling Basin Condition		
29. Primary Outlet Trash Rack Condition	30. Primary Outlet Scour Condition		
31. Secondary Outlet Condition	32. Secondary Outlet Stilling Basin Condition		
33. Secondary Outlet Trash Rack Condition	34. Secondary Outlet Scour Condition		
35. Lake Drain Condition	36. Emergency Spillway Rodent Activity (Earthen)		
37. Emergency Spillway Vegetation Cond. (Earthen)	38. Emergency Spillway Gen Condition (Concrete)		
39. Emergency Spillway Gen Condition (Earthen)			
MISCELLANEOUS (Section 1.5)			
40. Fencing / Gates	41. Aesthetics		
42. Sediment Condition	43. Debris Condition		

COMMENTS



Where standards did not exist, we adopted our own.





Stormwater Inspection Basin Condition Examples: Structural

Rated `1', no issues observed throughout.

Rated `3', for ruts, seepage, and retaining wall failure in areas.

Stormwater Inspection Basin Condition Examples: Sediment

Rated '4' for sediment due to significant sediment visible within 1' of water surface over most of the basin area.

Rated '5' for sediment due to sediment above water surface elevation, and vegetation growth.

Stormwater Inspection Basin Condition Examples: Debris

Rated `2' for debris accumulation at outlet, 25% blockage.

Rated `3' for debris accumulation at outlet, 50% blockage.

Stormwater Inspection Trail Camera: Remote Monitoring







Stormwater Inspection Trail Camera: Remote Monitoring











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Stormwater Inspection *Maintenance Recommendations*

Large Woody Debris

Sedimentation



Rated '4' due to >50% and <75% of the flow area was blocked with accumulated debris.

Rated `5' due to >75% of the flow area was blocked with accumulated sediment.

Stormwater Inspection *Maintenance Recommendations*

Rated `4' due to 75% of the flow area was blocked with accumulated debris.

Stormwater Inspection Small-Scale Project Recommendations

Streambank Stabilization

Structural Repairs



Rated `2' for structural condition: exposed rebar and joint separation.

Stormwater Inspection Urgent Storm Response



Rated `1' due to Water Surface Elevation is <50% of channel flow area.



Rated `3' due to peak WSE exceeded crown and adjacent road is <2' from flooding.



Rated '1' due to water surface elevation is <50% of channel flow area.



Rated '3' due to <50% of flow area blocked by large woody debris.



Rated '5' due to peak WSE exceeded culvert and adjacent road is flooded.

Stormwater Inspection Urgent Storm Response





Stormwater Inspection Urgent Storm Response



Stormwater Inspection Lessons Learned

Improved Data Collection Methods
Improved Our Target Areas
Use of Trail Cameras to Monitor Specific Sites





Stormwater Maintenance







Stormwater Maintenance Overview

- How Maintenance Program has Evolved
- Contract Types / Maintenance Activities
 - Debris and Sediment Removal
 - Tree Removal
 - HydroVac Services / CCTV
 - Grounds Maintenance

- Small-Scale
 - Structural Repair
 - Streambank Stabilization
 - Basin Dredging
- Storm Event-Driven Maintenance
- Overall Program Metrics
- Lessons Learned





Stormwater Maintenance How Program has Evolved

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From large woody debris removal

To small scale projects





Stormwater Maintenance How Program has Evolved







Single contract to specialized contracts





Stormwater Maintenance Debris and Sediment Removal



Cleveland - Blockage at debris rack – routine maintenance





Stormwater Maintenance Debris and Sediment Removal



Cleveland – Culvert Inlet debris blockage – storm-driven maintenance





Stormwater Maintenance Debris and Sediment Removal



North Randall – Culvert removed – 15 CY Corrugated Metal Pipe





Stormwater Maintenance Tree Removal



North Royalton, Baldwin Creek – Trees threatening infrastructure (house)





Stormwater Maintenance HydroVac Services / CCTV



Specialized contracts for sediment removal and for inspecting storm and sanitary sewers

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Stormwater Maintenance Grounds Maintenance



Puritas Basin, Cleveland – Mowing to access culvert for inspection & maintenance





Stormwater Maintenance *Small-Scale Streambank Stabilization*





- Restored eroding streambank
- > Established riparian buffer



Stormwater Maintenance Small-Scale Structural Repair



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To Extend Life of Culvert: > Invert lined > Rusting seams sealed

Stormwater Maintenance Small-Scale Dredging



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Kerruish Basin, Warrensville Heights, Mill Creek Dredged 13,000 CY sediment



Stormwater Maintenance Urgent Storm Response



Debris found by inspection

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Debris found by drone flyover

Macedonia, Indian Creek 430 CY of debris removed

12 properties affected

9 day turnaround

Calendar of Events:
> 11/5/17 –Storm event hit
> 11/6/17 –Inspections began
> 11/8 – 11/14/17 – Maintenance Contractor Debris Clean-up



Stormwater Maintenance Maintenance Program Metrics

Sediment & Debris Removal Projects 2016-Present

510 Projects to Date

(*58 non-sed/debris projects* -568 total projects)

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Stormwater Maintenance Maintenance Program Metrics

Sediment and Debris Removal 2016-Present



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34,410 CY of sediment and debris removed total

=8,480 Tons of material

Northeast Ohio Regional Sewer District Stormwater Maintenance Lessons Learned

Temporary access easement process
Regulatory
Small scale projects
Overall timeline and complexity of projects







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Thank you!

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