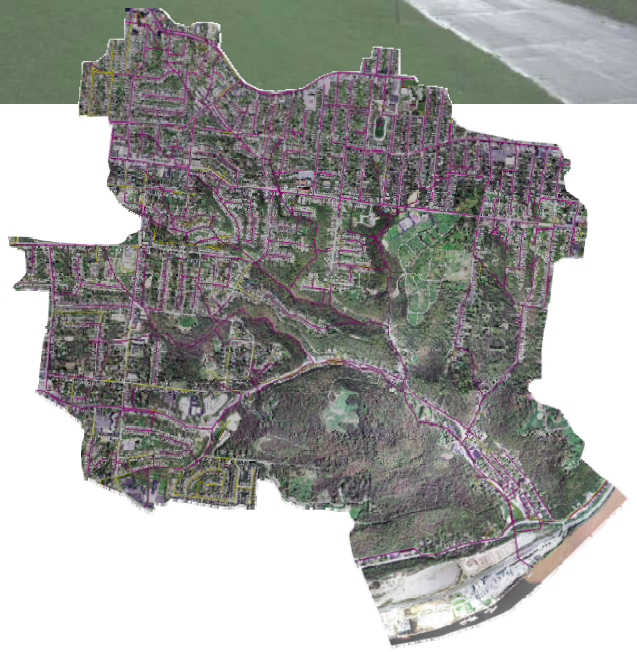
CSO 419
Stream Separation

Green Infrastructure Master Planning



OWEA Annual Conference

June 16, 2010

Leslie Schehl, PE, LEED AP

METROPOLITAN SEWER DISTRICT of greater CINCINNATI

Clifford A. Shrive, PE, BCEE

Stantec

CSO 419 – Stream Separation

Presentation Overview

- Project Background
- Project Approach
  - Methodology
  - Examples
  - Cost / Benefit Analysis
- Review of Alternatives
- Next Steps
- Recommendations Highlights

Project Background

The Solution

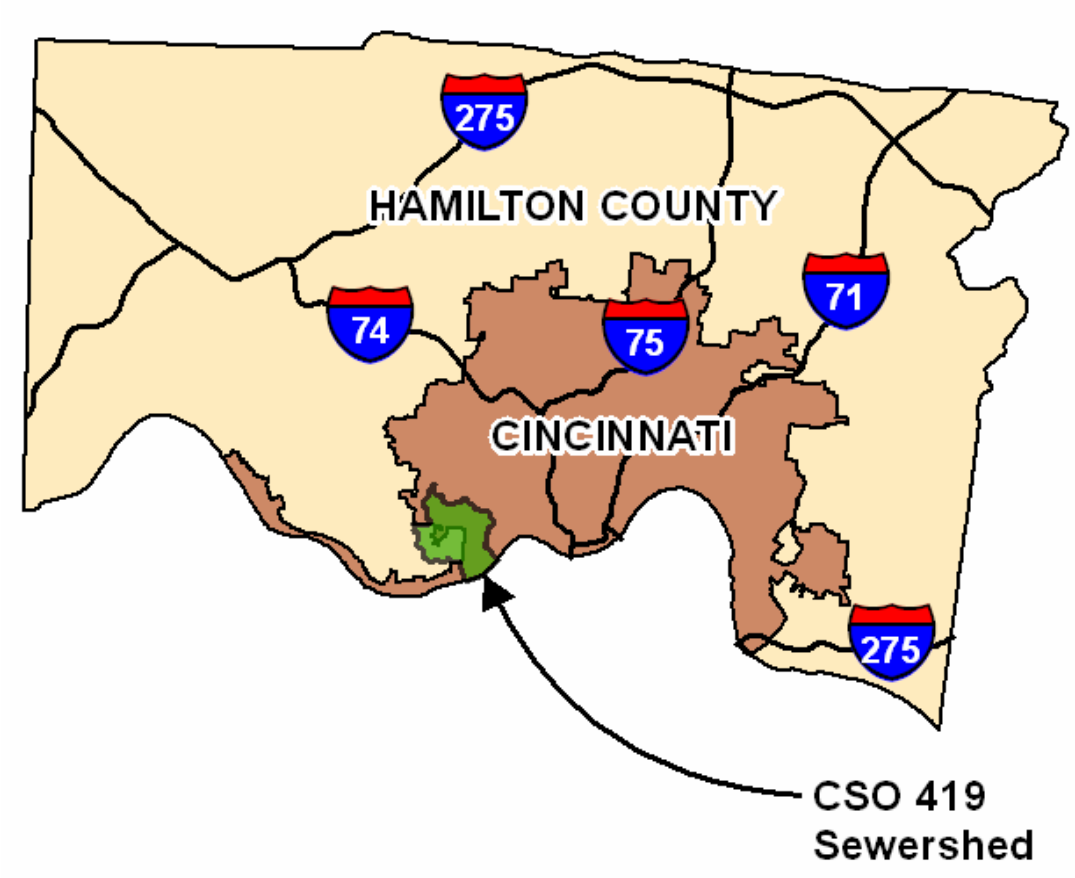
- Comply with Consent Decree Obligations
- Reduction of Combined Sewer Overflows
- Evaluation of CSO Control Techniques
- Potential for Sustainable Infrastructure
  - Stormwater Separation
  - Stream Daylighting

PROJECT GROUNDWORK
your pipeline to clean water

Project Background

Service Area

- Located on the West Side of Cincinnati
- Delhi Township and City of Cincinnati
- Part of the Lower Mill Creek Treatment Area



Project Background

Sewershed

- 3.6 sq miles
- Steep Topography
  - High Pt: 920 ft
  - Ohio River: 460 ft
  - Length: 16,000 ft
  - Slope: 150 ft / mile
- No Streams, Ponds, Lakes or Wetlands

Project Background

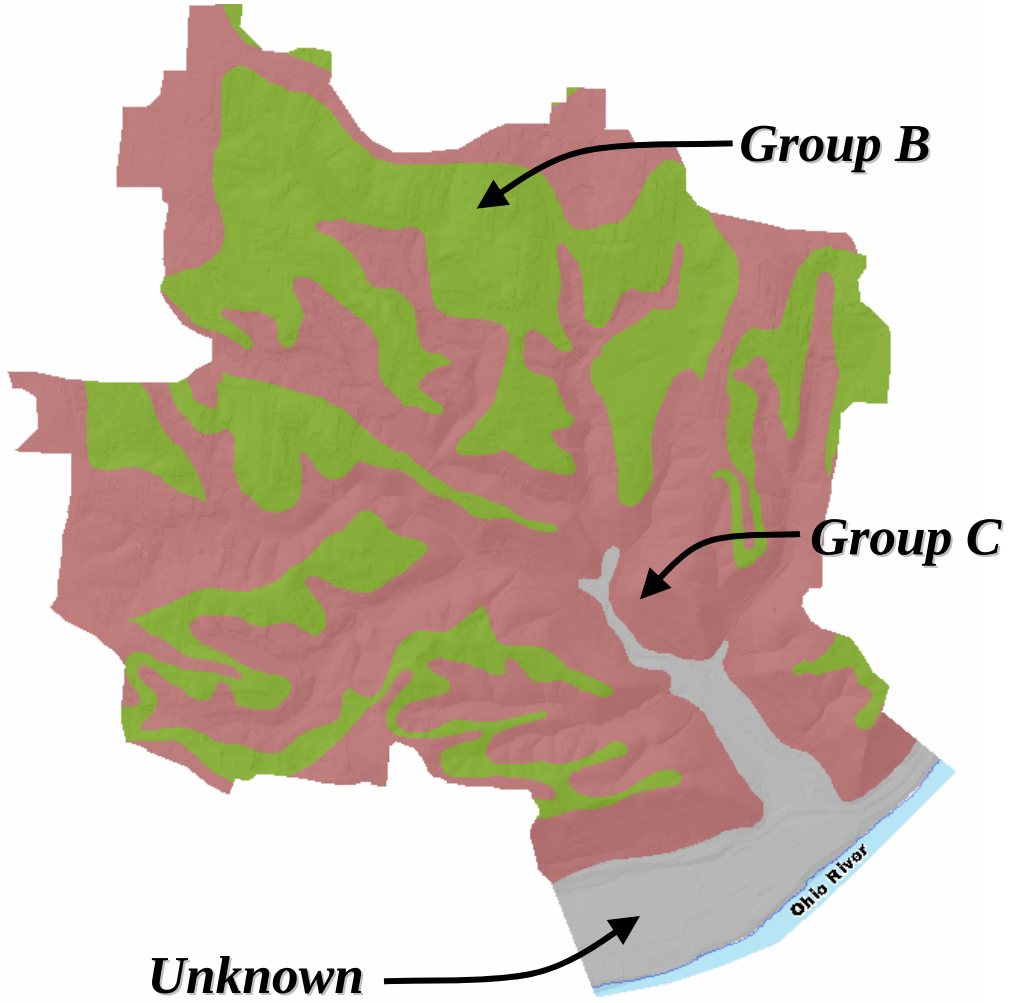
Sewershed

- Primarily Residential Development
- Upstream 50% Mostly Dense Residential with High Impervious Percentage
- Downstream 50% Mostly Forested Pervious Slopes

Project Background

Sewershed

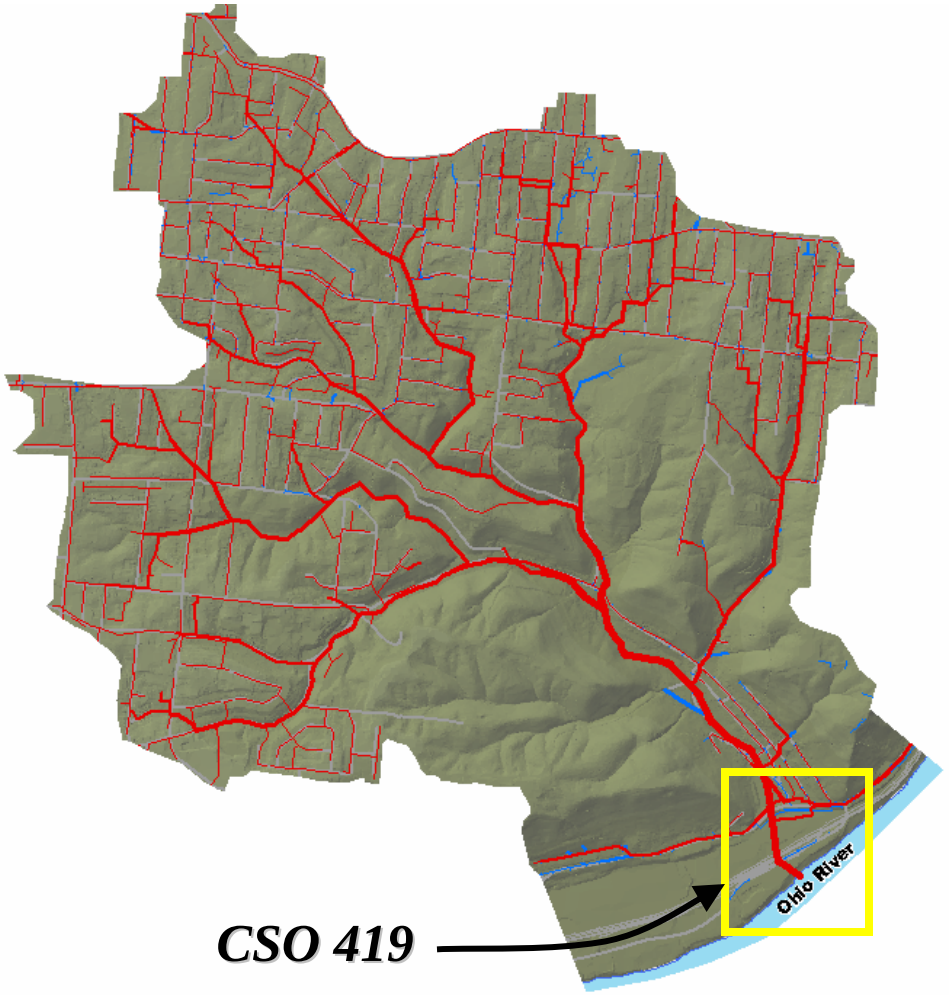
- Primarily Type B and C Hydraulic Soil Groups
- Well-Drained Silt Loams or Silt Clay Loams
- Bedrock Primarily Interbedded Limestone and Shale Formation



Project Background

Sewershed

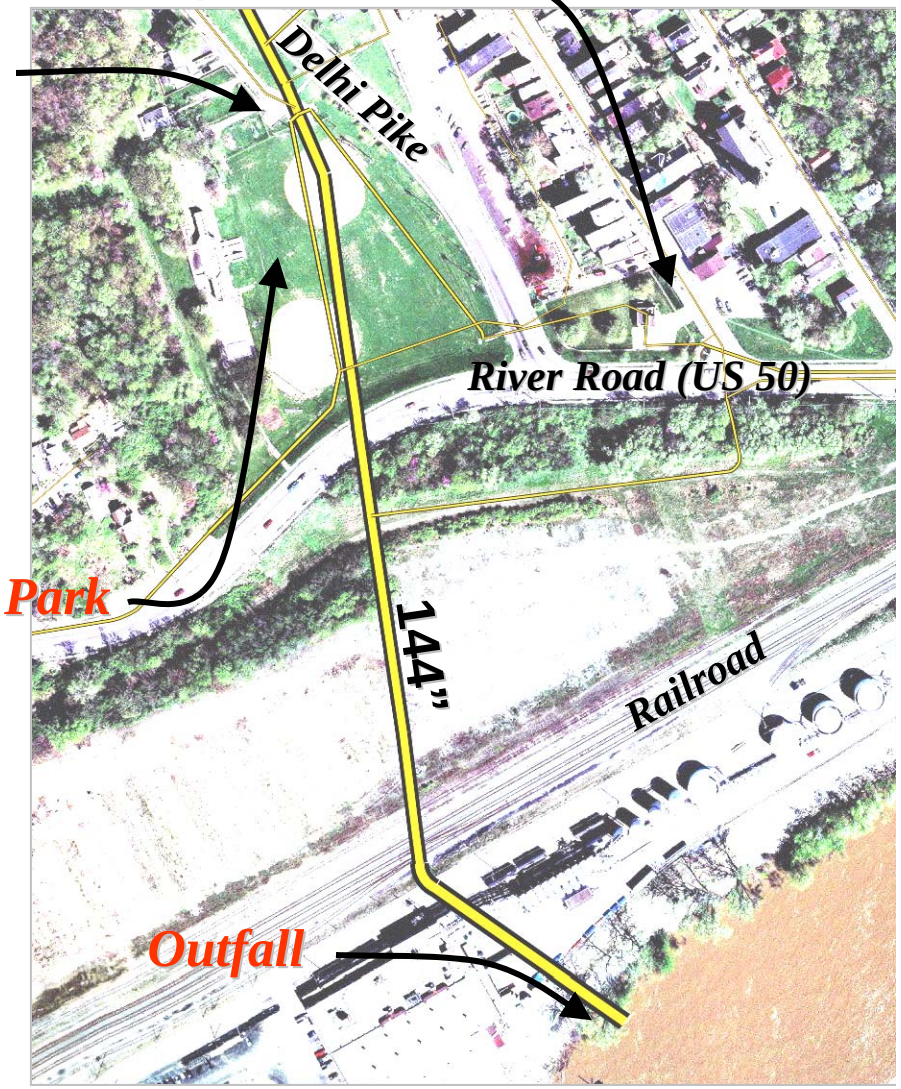
- Combined Sewer System Installed Between 1887 and the 1960s
- All Streams Have Been Piped
- Combined Sewer Trunks Located In Original Stream Beds



Project Background

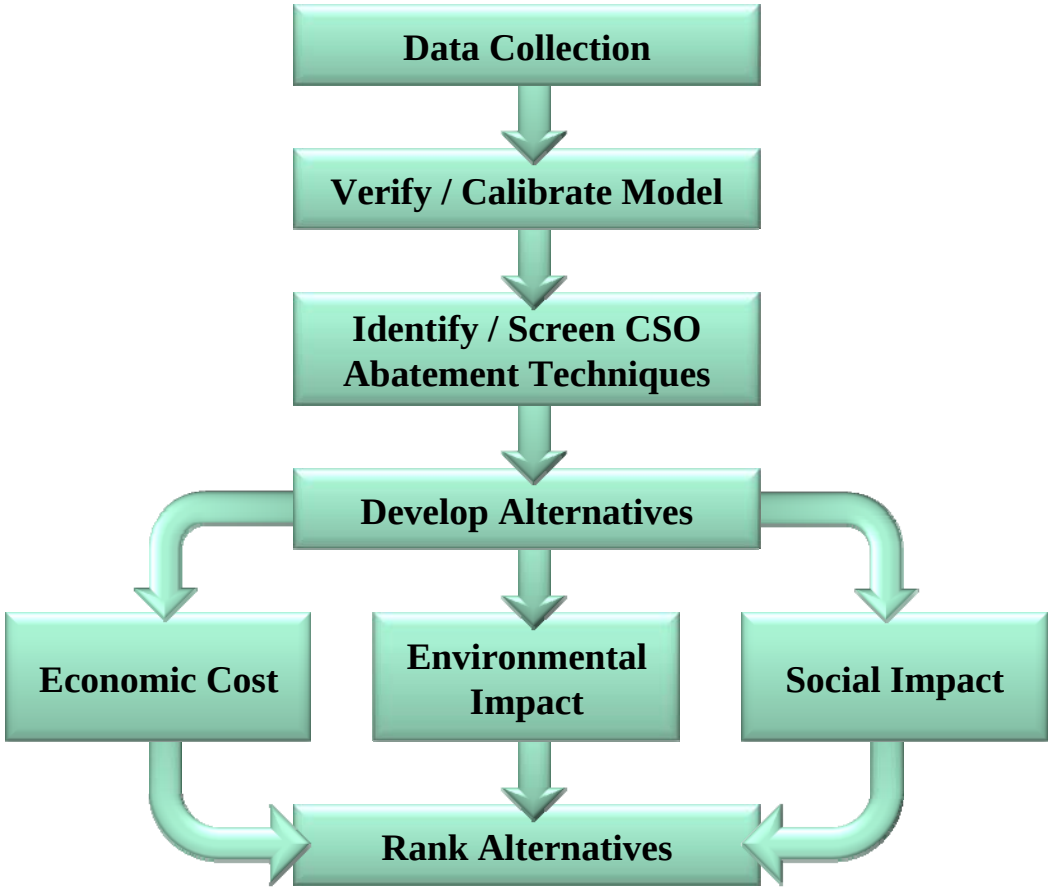
Combined Sewer Overflow

- Overflow Structure
  - 2’ Tall Diversion Dam
  - 24” Gravity feed to LS
  - 144” Overflow to River
- Typical Year
  - 136 Overflow Events
  - 733 Million Gallons



Project Approach

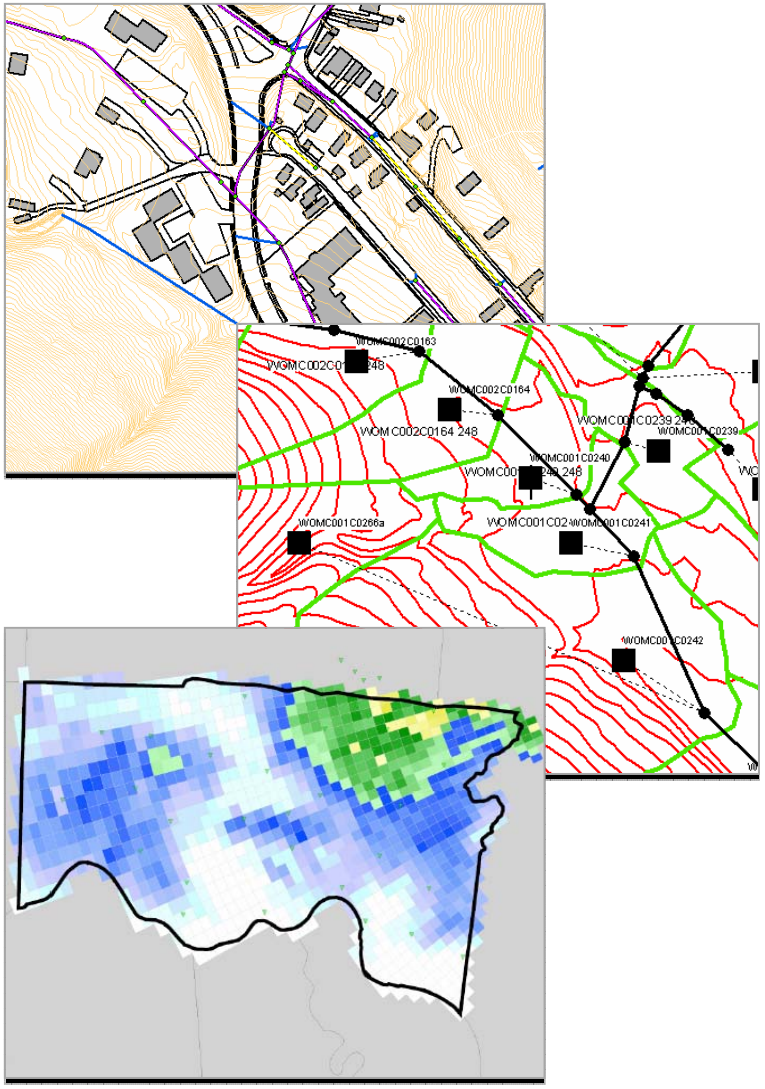
Alternatives Analysis – Methodology Overview



Project Approach

Data Collection

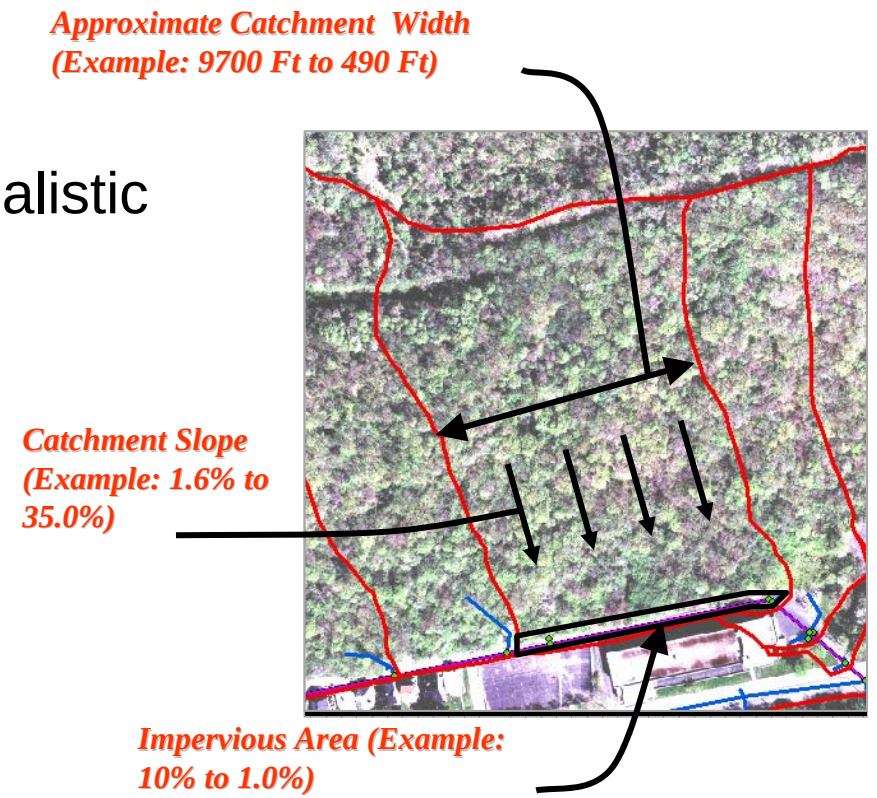
- GIS data provided by MSD for topography and existing system layout
- SWM in EPA SWMM for system hydrology and hydraulics
- Rain gauge data and flow monitoring data for design criteria and calibration purposes



Project Approach

Model Verification and Calibration

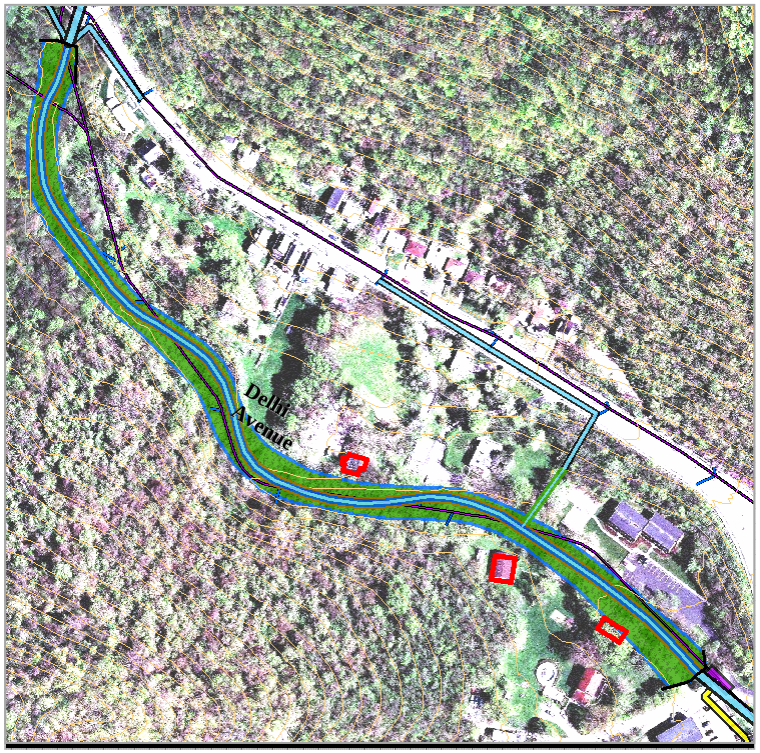
- Existing model
  - Sewershed – accurate
  - Individual Catchments - unrealistic
- Reattributed lower 50% of sewershed to improve realism of catchment attributes
- Adjusted attributes sewershed wide to match monitoring data



Project Approach

Identify and Screen CSO Abatement Techniques

- Identify potential CSO or stormwater control techniques
- Rule out those which don't work for the project area or project goals
- Identify promising options:
  - Storm Sewers *gray separation*
  - Stream Daylighting *green separation*
  - CSO Storage (inline or offline)
  - Treatment (EHRT)
  - Stormwater Detention



Project Approach

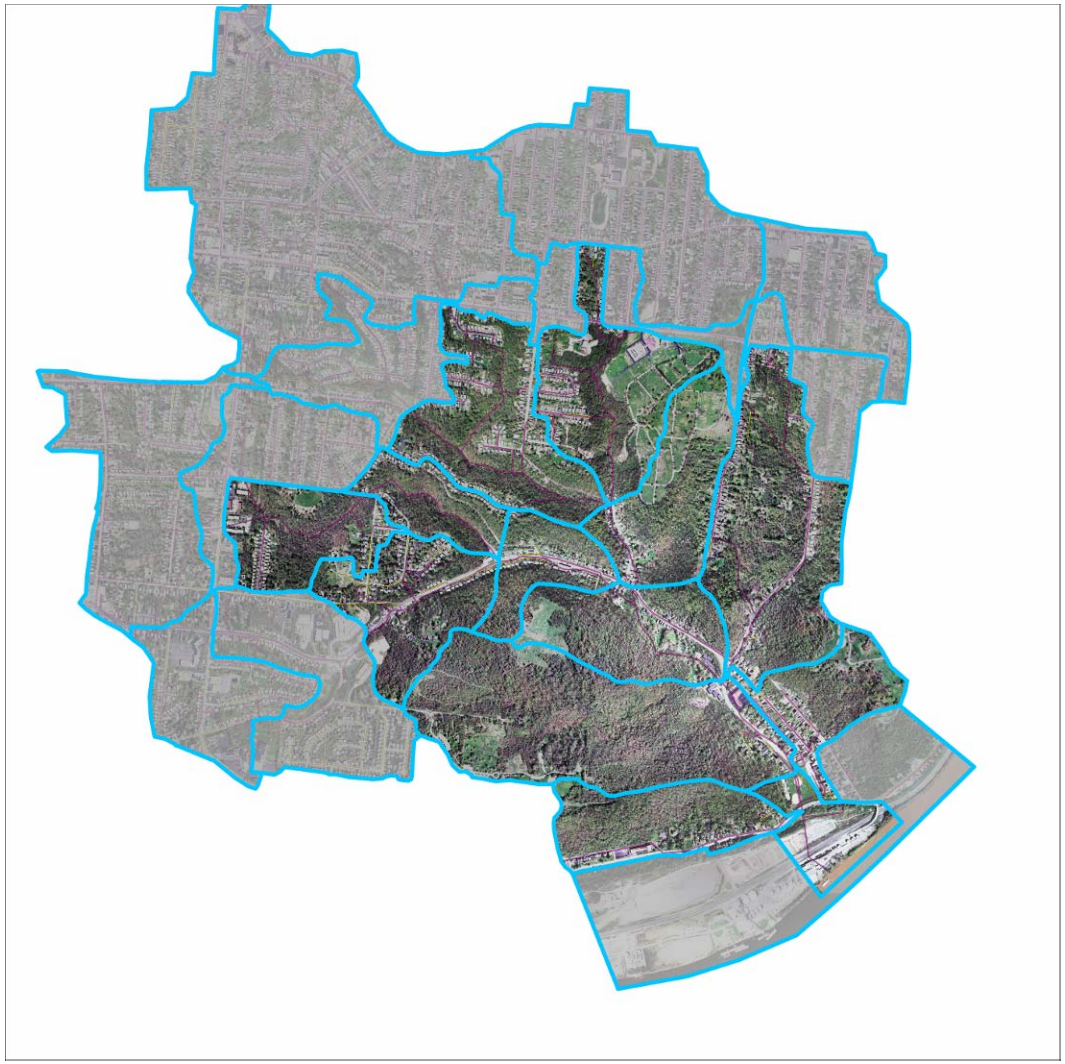
Start with the Full Watershed

Project Approach

Subdivide into Smaller Basins

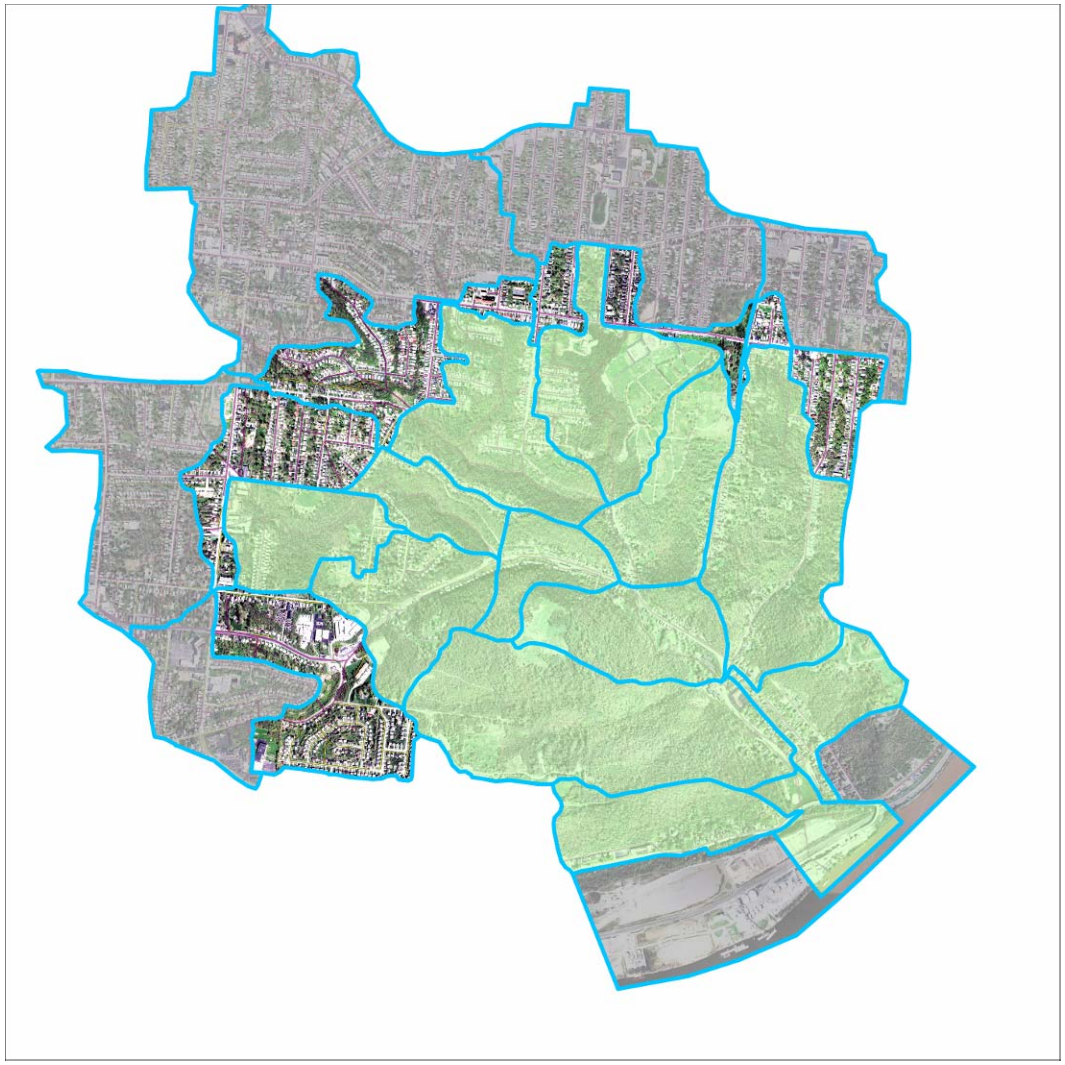
Project Approach

Identify Potential for Stream Daylighting



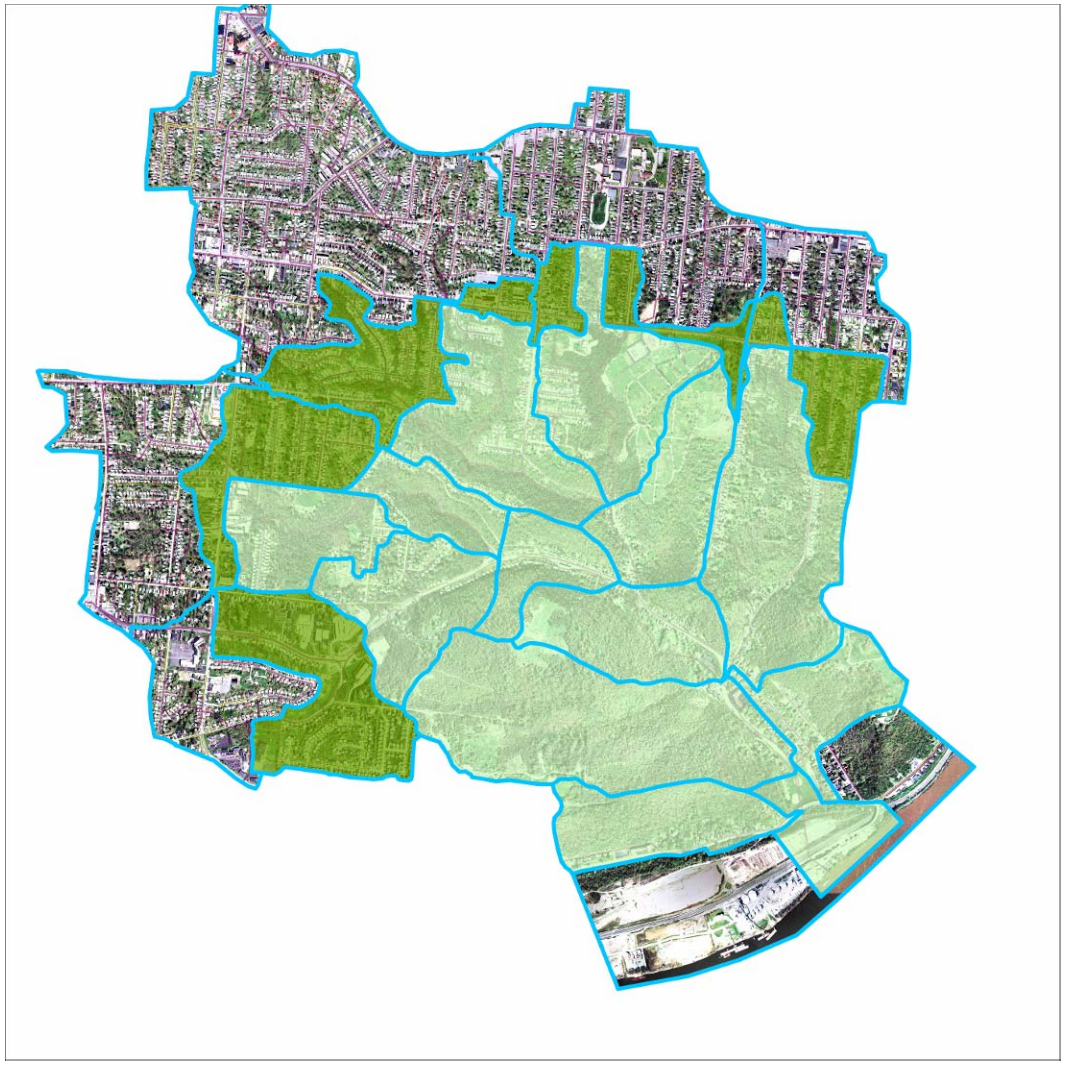
Project Approach

Extend Separation to the Next Tier



Project Approach

Position MSDGC for the Next Level of Wet Weather Solutions

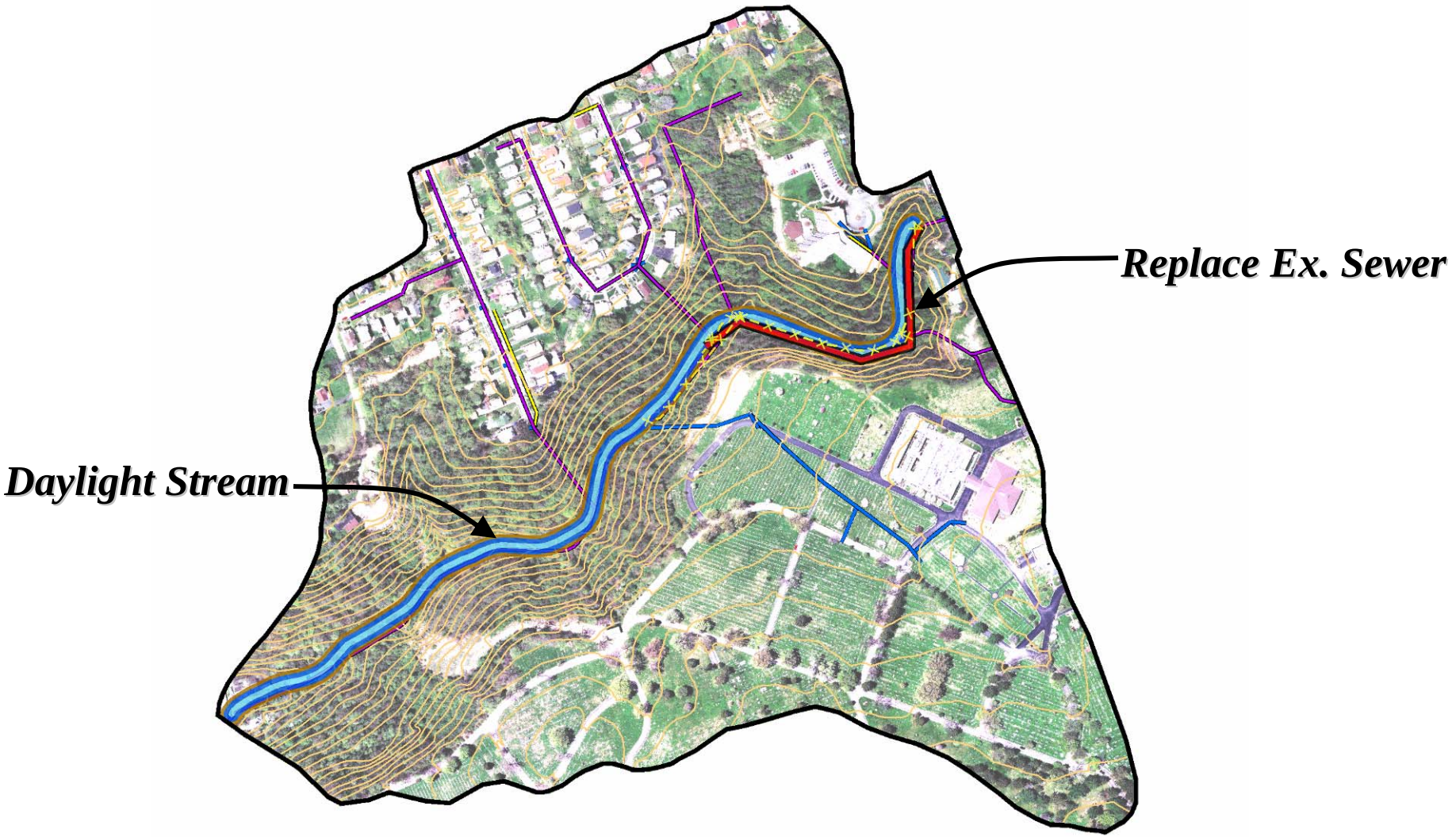


Project Approach

Subbasin Example - Rosemont

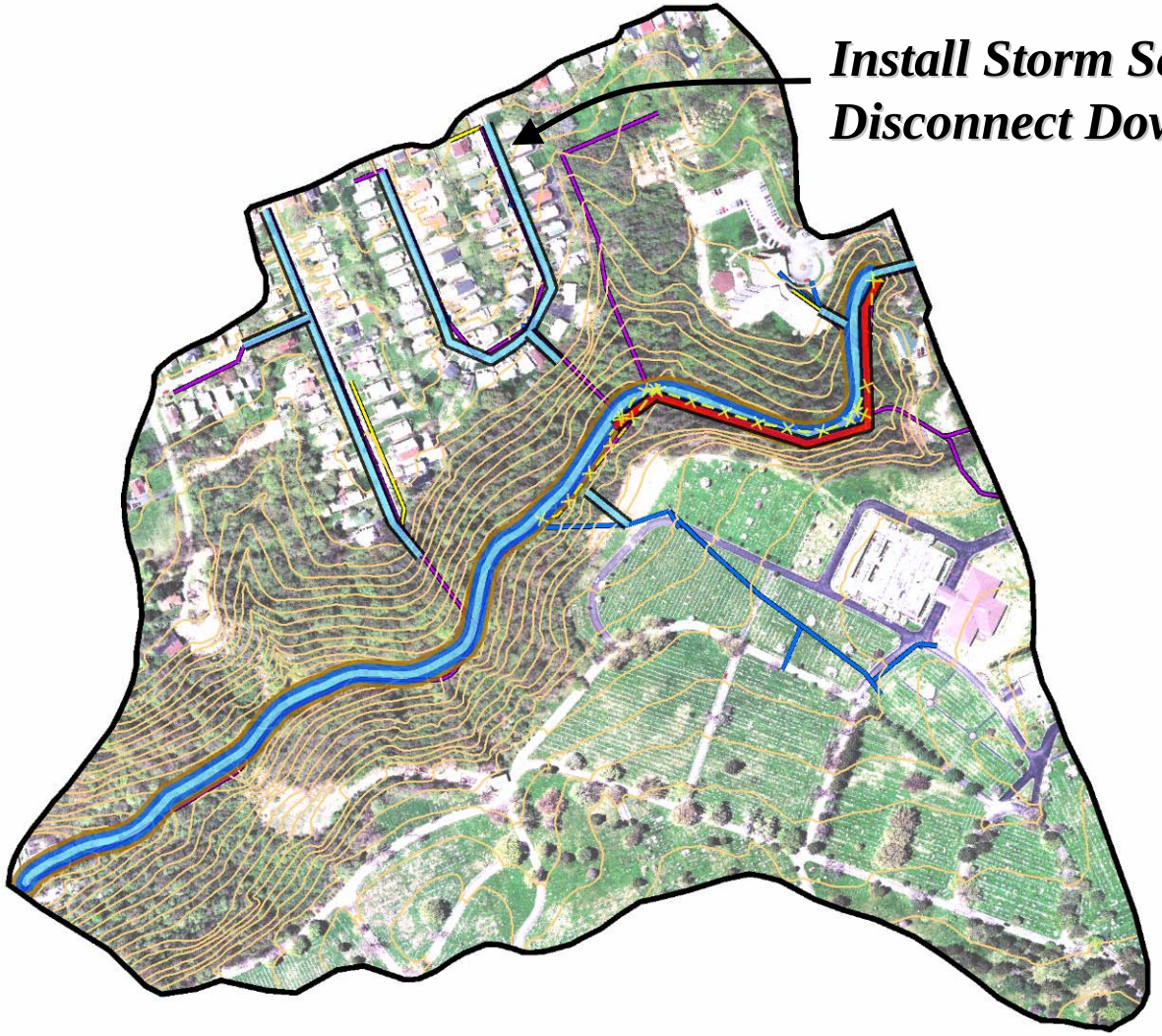
Project Approach

Subbasin Example - Rosemont



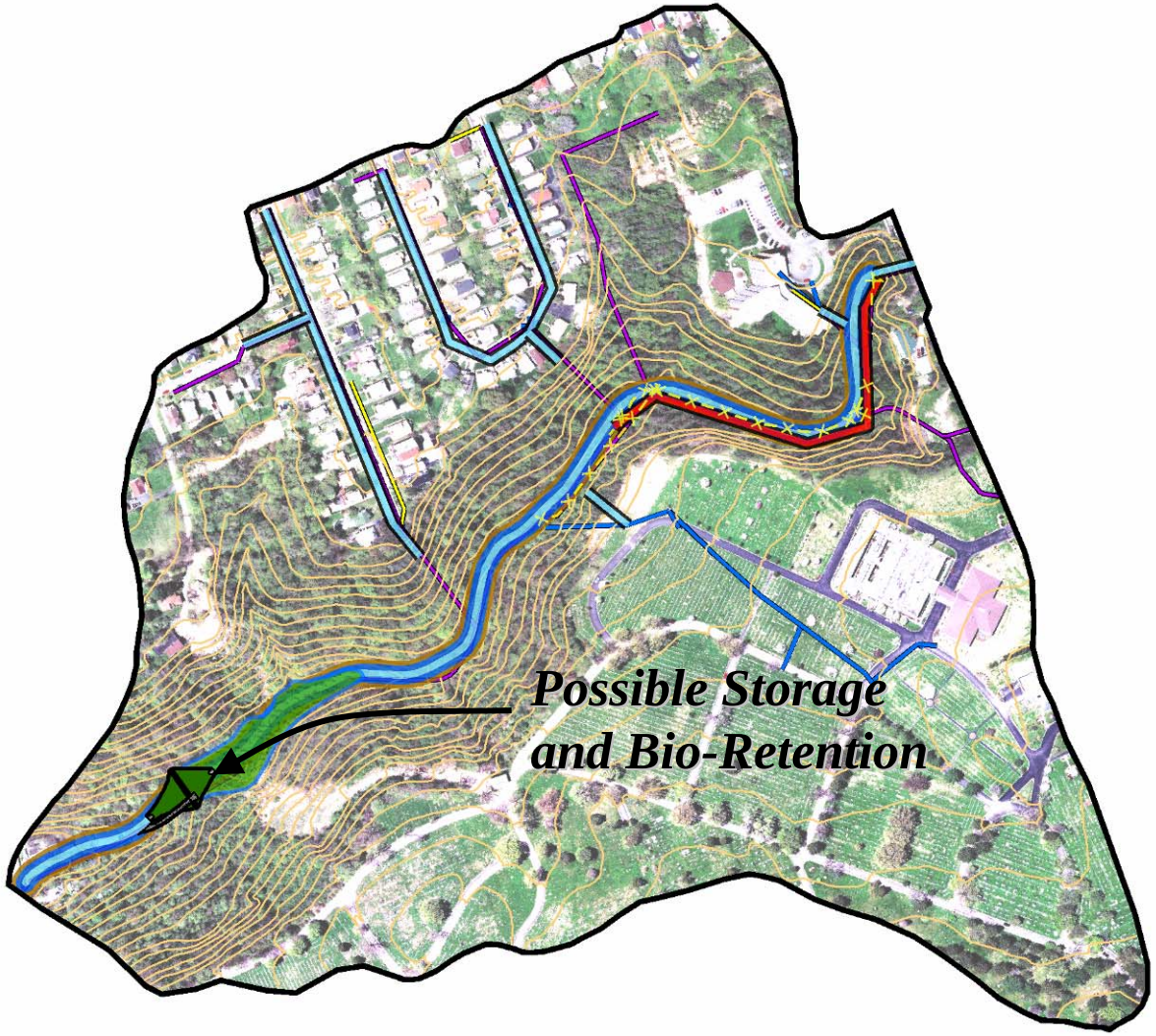
Project Approach

Subbasin Example - Rosemont



Project Approach

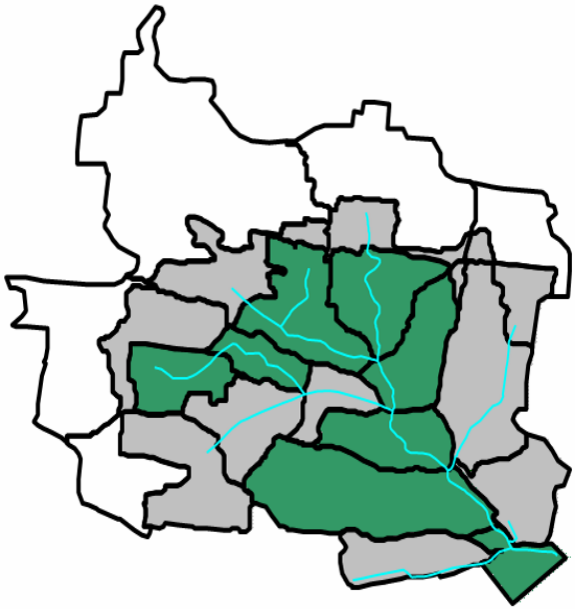
Subbasin Example - Rosemont



Planning Level Design

Alternatives Comparison Tool

User Input			
Sub-Basin Name	Selection Options		
	Separated/Not Separated	Storage Basins	Green/Gray
River	Separated		Gray: Sanitary Sewer
Fairbanks and Delhi	Separated		Gray: Storm Sewer
Delhi at Eatondale	Separated		Green
Fairbanks	Separated		Gray
Delhi above Fairbanks	Separated	None	Green: Avoid Apartment
Rosemont at DelhiDS	Separated		Green
Rosemont at DelhiUS	Separated	None	Green
Rosemont	Separated	None	Green
Delhi at Roebling	Separated		Gray
RoeblingDS	Separated	None	Green
RoeblingUS	Separated	None	Green
Delhi at Mayhew	Separated		Gray
CSO	Separated		Green
Southwest Area (Tier 2)	Separated		Gray
Westcentral Area (Tier 2)	Separated		Gray
Northwest Area (Tier 2)	Separated		Gray
Northcentral Area (Tier 2)	Separated		Gray
Northeast Area (Tier 2)	Separated		Gray: Storm Sewer



Separation Costs							
Separation Construction Costs	Contingency (%)	Total Opinion of Probable Cost	Cost/Gal	Annualized Construction Cost	Annual O/M Cost	Total Annualized Cost	Present Worth Cost
$39,040,518	20	$46,848,621	$0.113	$2,909,060	$253,261	$3,162,321	$48,593,884

Gray Water Storage And Treatement Costs							
Storage Construction Costs	Treatment Capital Costs	Contingency (%)	Total Opinion of Probable Cost	Annualized Construction Cost	Annual O/M Cost (Including Additional Treatment)	Total Annualized Cost	Present Worth Cost
$25,979,250	$161,548	20	$31,368,957	$2,041,382	$643,752	$2,685,135	$41,261,192

Environmental Enhancement Costs						
Park Construction Costs	Contingency (%)	Total Opinion of Probable Cost	Annualized Construction Cost	Annual O/M Cost	Total Annualized Cost	Present Worth Cost
$2,632,158	20	$3,158,590	$205,550	$19,611	$225,161	$3,459,936

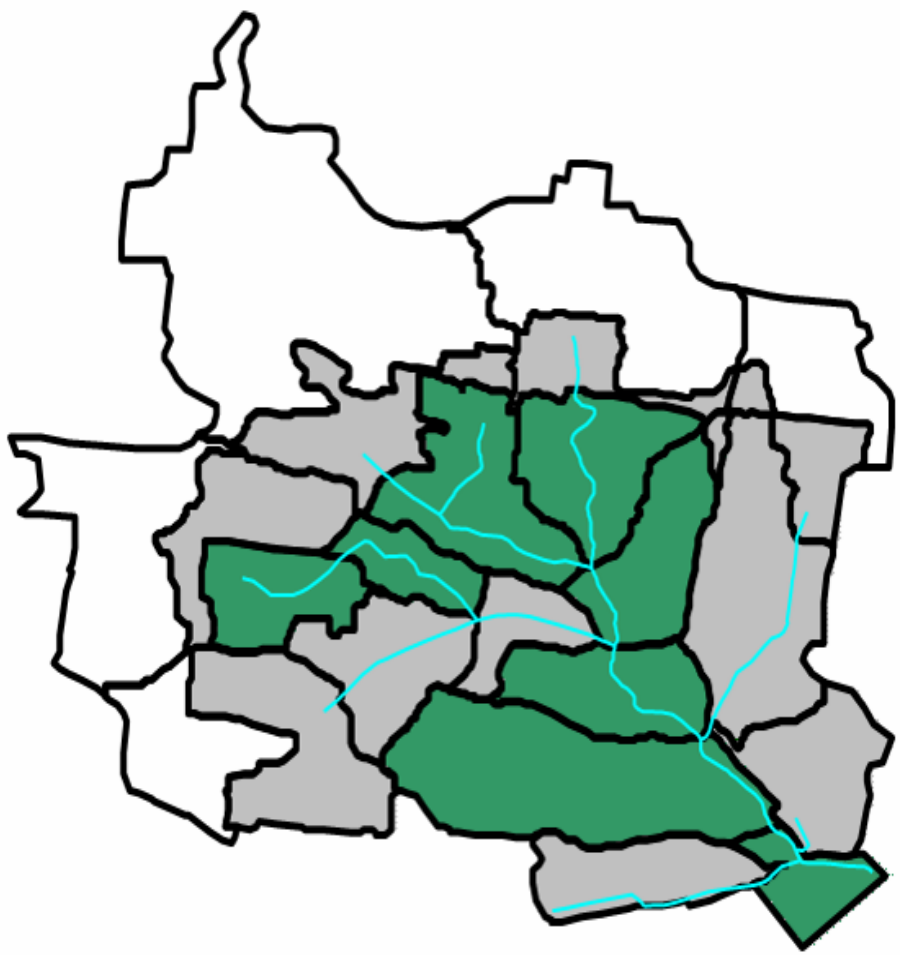
User Input Page of ACT

Total Annualized Cost	$6,072,616
Total Present Worth Cost	$93,315,012

Alternatives Review

Cost Analysis and Expected Control

Item No.	Description	
1	No. of Annual Overflows to River	
3	Annual Vol. Separated	MG
4	Annual Vol. Controlled	MG
5	Overflow Volume Reduction	%
10	Total Separation Capital Cost	$ M
11	Total Storage and Treatment Capital Cost	$ M
12	Environmental Enhancement Capital Cost	$ M
13	Total Capital Cost	$ M
14	Total Annual O, M & R Cost	$ M/Yr
15	Present Worth Cost	$ M
16	Cost per Gallon Separation	$/G
17	Cost per Gallon CSO Control	$/G
18	Environmental Impact Score	
19	Social Impact Score	



Alternatives Review

Cost Analysis and Expected Control

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13	Total Capital Cost	$ M
14	Total Annual O, M & R Cost	$ M/Yr
15	Present Worth Cost	$ M
16	Cost per Gallon Separation	$/G
17	Cost per Gallon CSO Control	$/G
18	Environmental Impact Score	
19	Social Impact Score	

Alternatives

Enhanced High Rate Treatment

Combined Effluent Storage Tank

Regulator Modification

Regulator Relocation / Pump Bypass

Separation Only

Alternatives Review

Cost of Alternative Designs

Alternative Description		Percent Separation by Area	Annual Overflow Events	Present Worth Cost (2010)			Cost Per Gallon CSO Control
				Capital	O&M	Total	
		%	-	$ M	$ M	$ M	$ / G
Alt. 1 - EHRT	Gray	0.0	unknown	163.9	11.1	175.0	0.294
Alt. 2 - Storage Tank and Separation	Green	64.4	33	93.9	15.7	109.5	0.184
	Gray	64.4	33	85.6	10.0	95.7	0.161
Alt. 3 - Bold Face Regulator Modification and Separation	Green	73.9	52	82.5	12.8	95.3	0.160
	Gray	73.9	52	73.5	7.1	80.6	0.135
Alt. 4 - Regulator Relocation / Pump Bypass and Separation	Green	74.9	70	70.6	8.3	79.0	0.133
	Gray	74.9	70	68.1	6.9	75.0	0.126
Alt. 5 - Separation Only	Green	83.1	67	97.9	8.6	106.5	0.179
	Gray	83.1	67	88.7	2.8	91.5	0.154

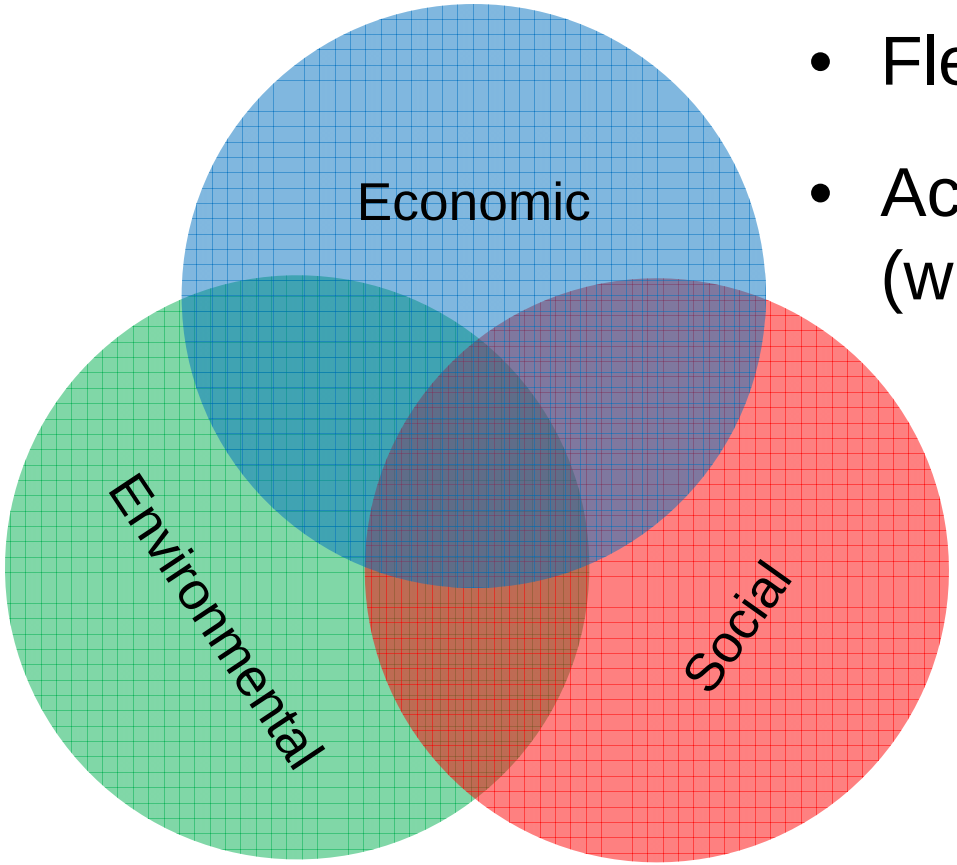
Alternatives Review

Alternative Design Rank

Alternative Description		Impact Score			Total Score
		Economic	Social	Environmental	
		(1-10)	(-10 to 10)	(-10 to 10)	(1-30)
Alt. 4 - Regulator Relocation / Pump Bypass and Separation	Green	9.6	2.4	5.5	18.0
Alt. 3 - Bold Face Regulator Modification and Separation	Green	8.2	2.3	5.5	16.6
Alt. 5 - Separation Only	Green	7.2	2.3	5.5	15.6
Alt. 2 - Storage Tank and Separation	Green	6.9	2.3	5.5	15.3
Alt. 4 - Regulator Relocation / Pump Bypass and Separation	Gray	10.0	-0.7	1.3	10.6
Alt. 3 - Bold Face Regulator Modification and Separation	Gray	9.5	0.3	1.3	11.1
Alt. 5 - Separation Only	Gray	8.5	0.3	1.3	10.1
Alt. 2 - Storage Tank and Separation	Gray	8.1	0.3	1.3	9.7
Alt. 1 - EHRT	Gray	1.0	-0.7	1.3	1.6

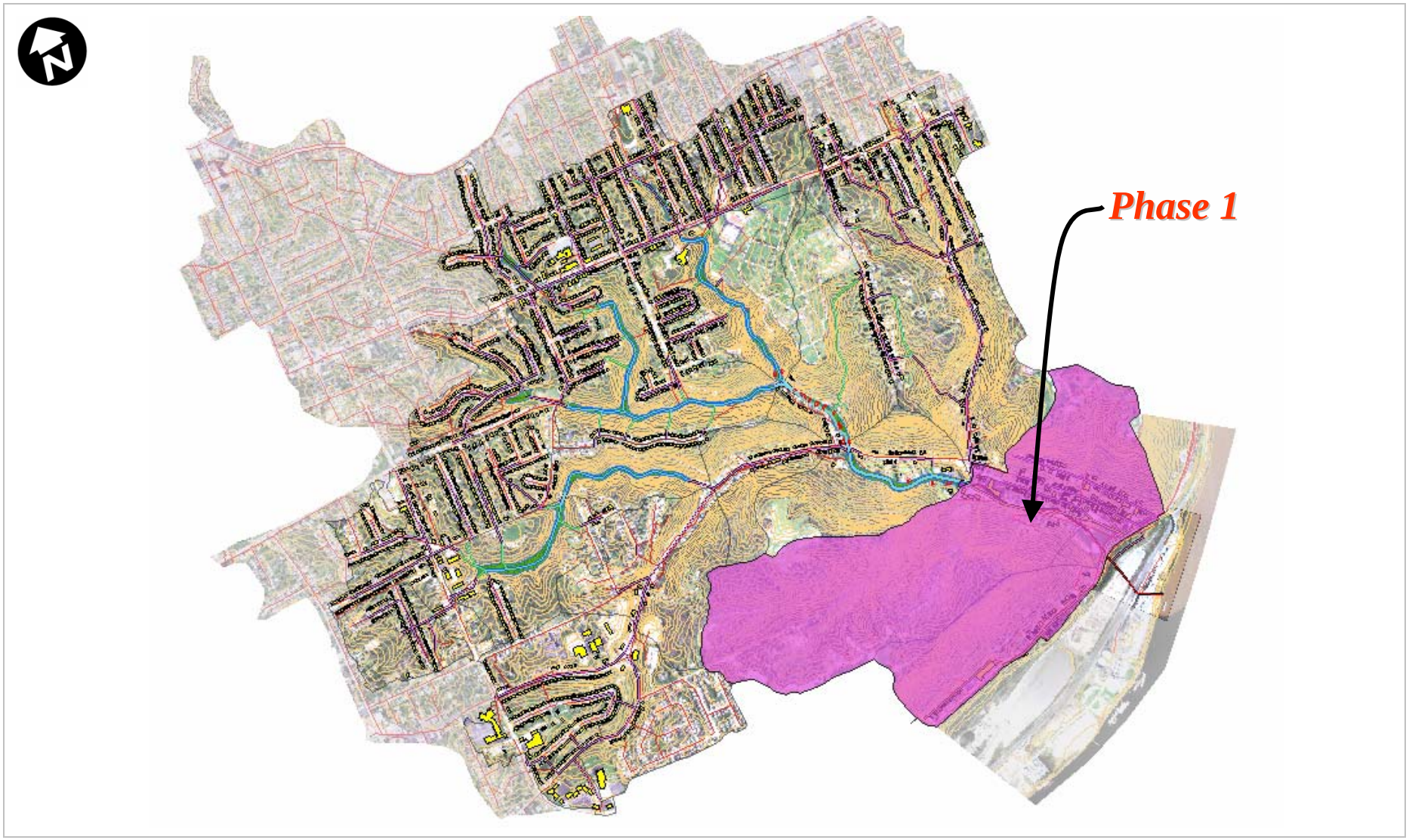
Next Steps

Design and Construction – Phased Approach



- Involve Stakeholders
- Flexible Phasing
- Achieve Measurable Success (within short time-frame)

Construction Phasing



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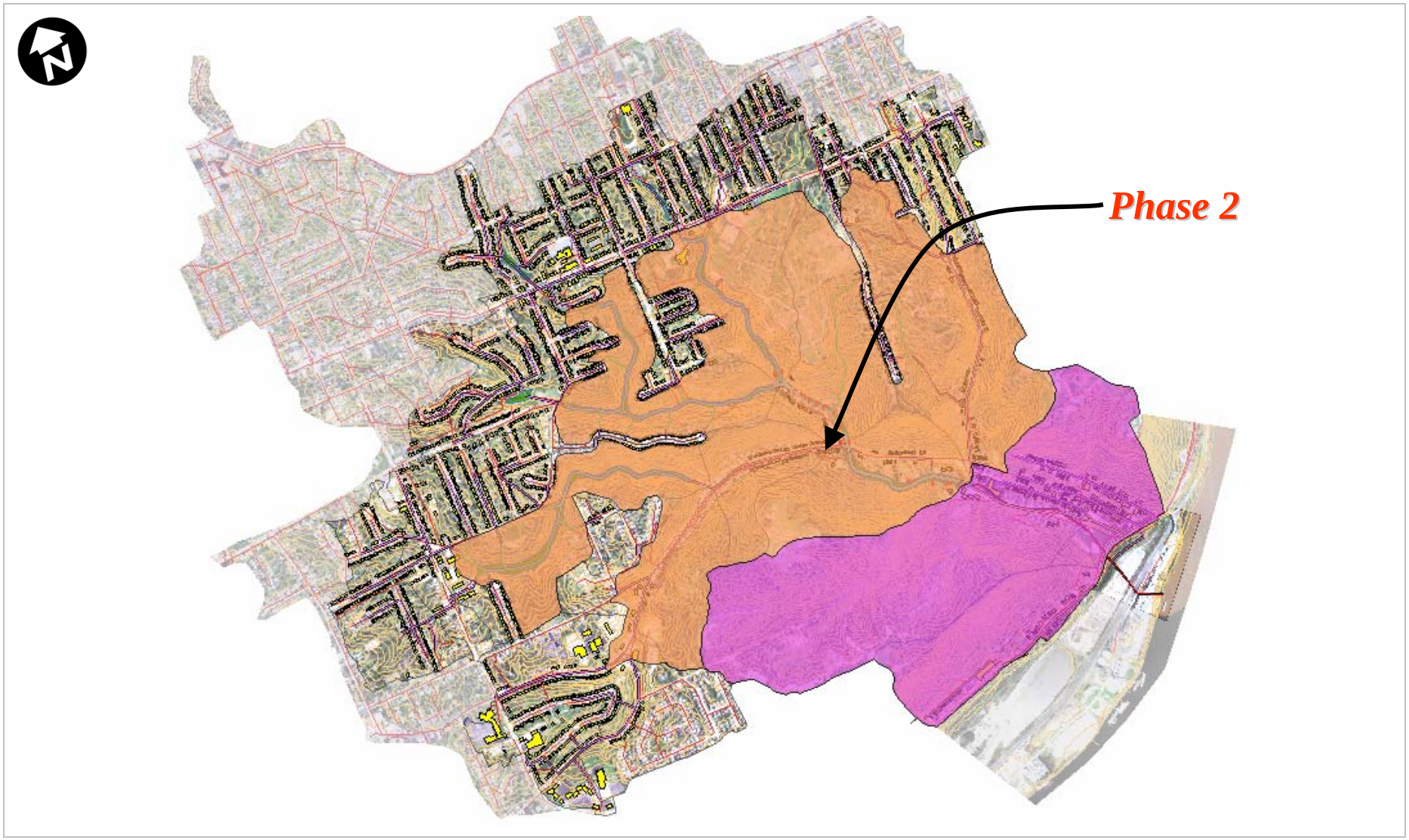
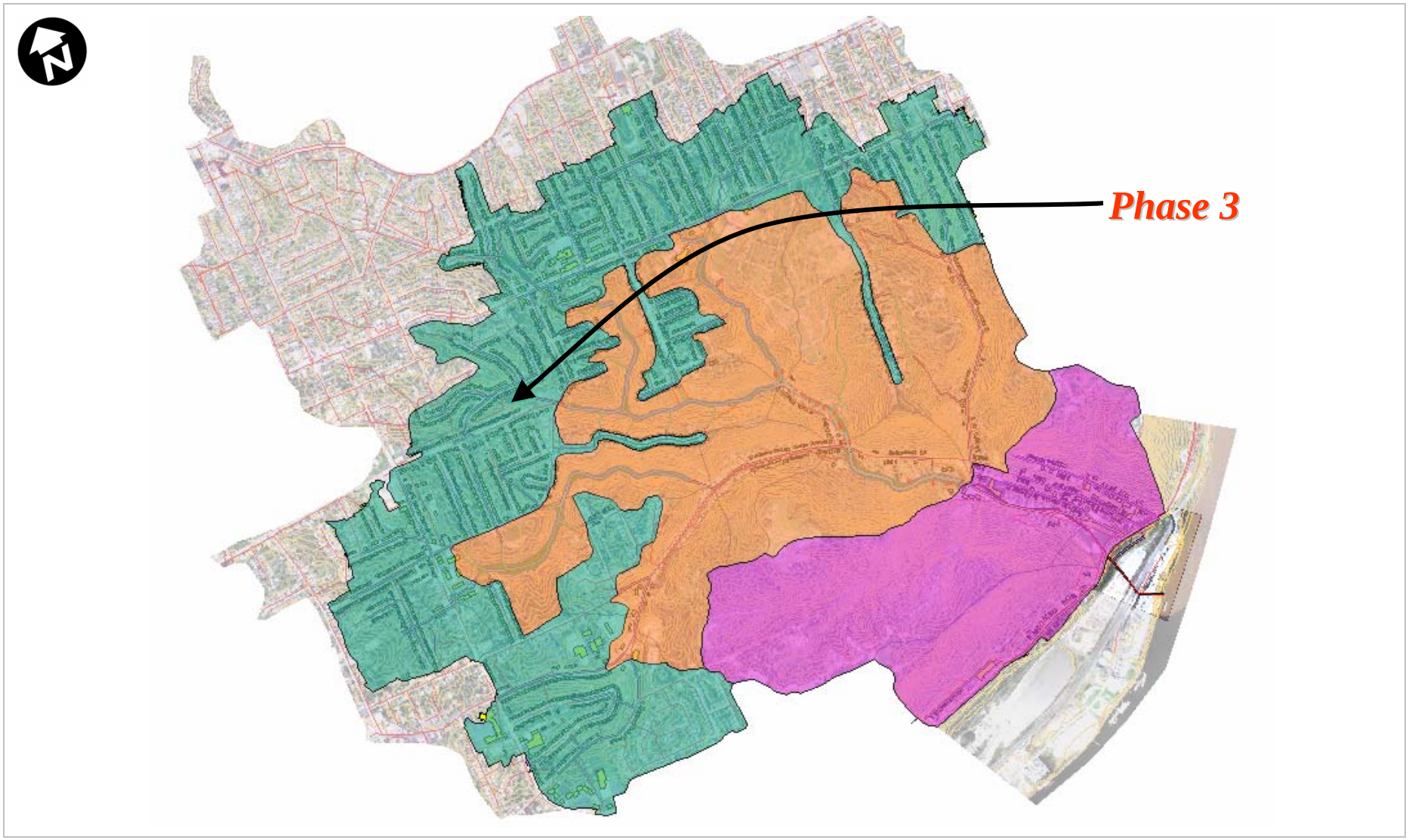


Construction Phasing



Recommendations

Highlights

- Accomplishes volume reduction goals
- Most inexpensive “green” alternative examined
- Restores nearly 3 miles of streams
- Potential park and habitat connectivity
- Avoids major property acquisition
- Flexible construction phasing
- Eliminates long-term pump station operation
- Allows for future stream daylighting and neighborhood revitalization

questions and answers

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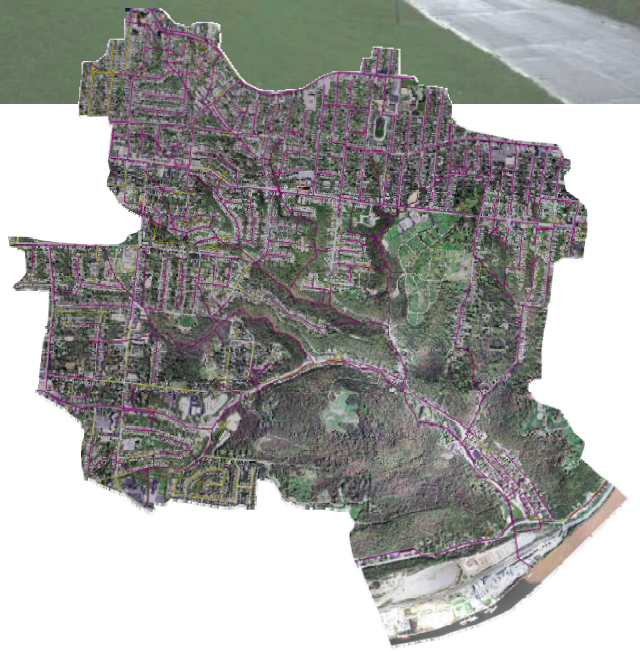
Stream Separation

Green Infrastructure Master Planning



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