

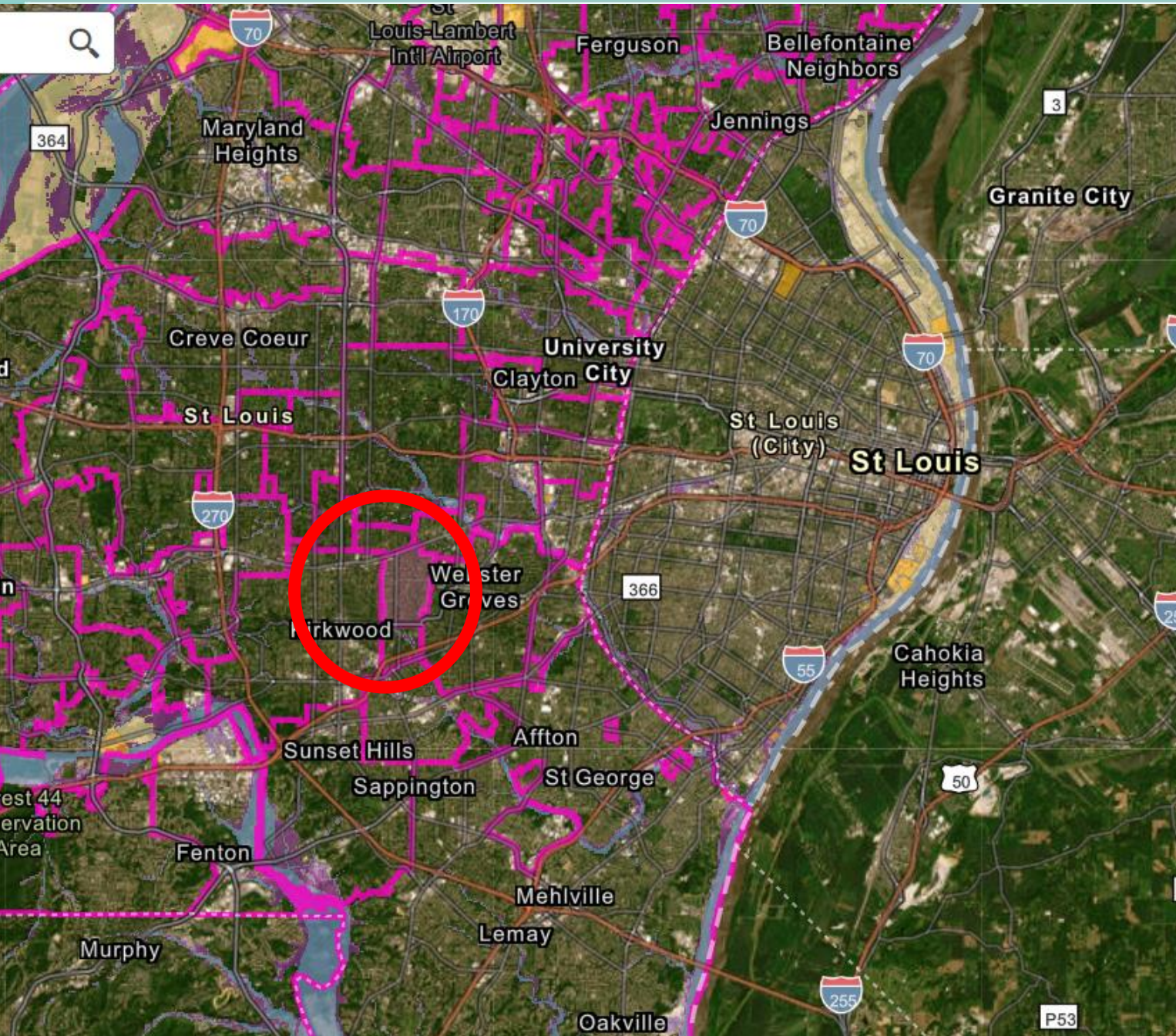


Stormwater Master Planning

Case Study: City of Glendale, MO

Allison Mannion

March 2024



CITY OF
Glendale
MISSOURI

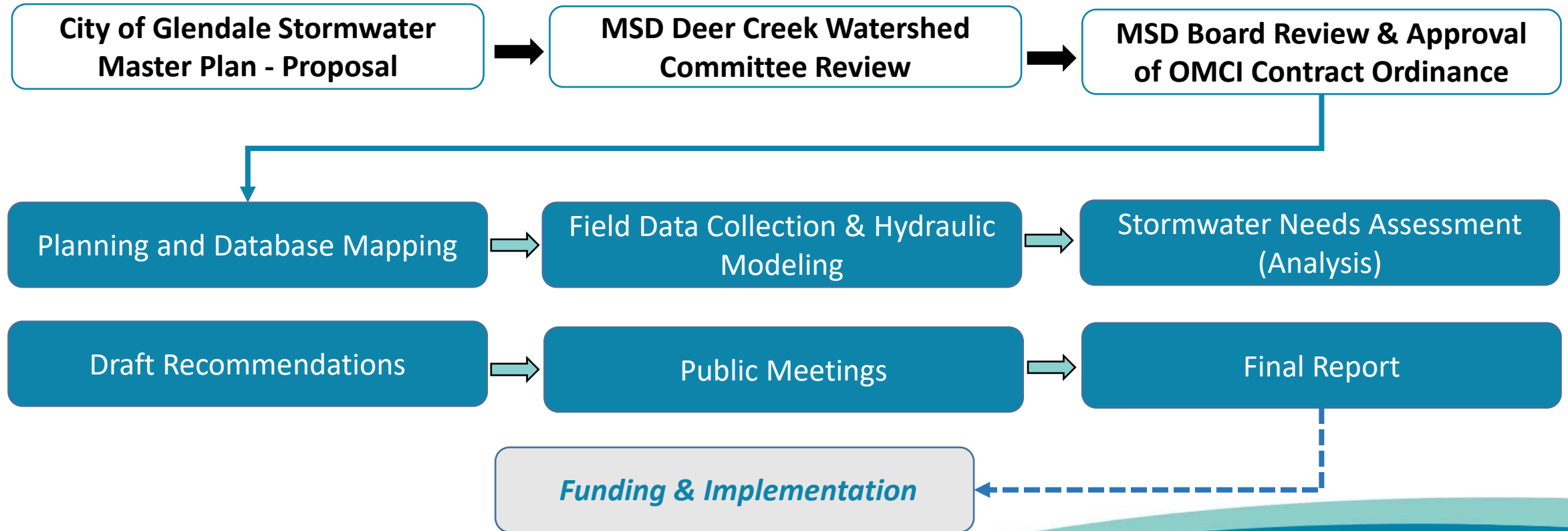
- St. Louis County
- MSD System
- Deer Creek Watershed
- Population: 6,200
- Residential

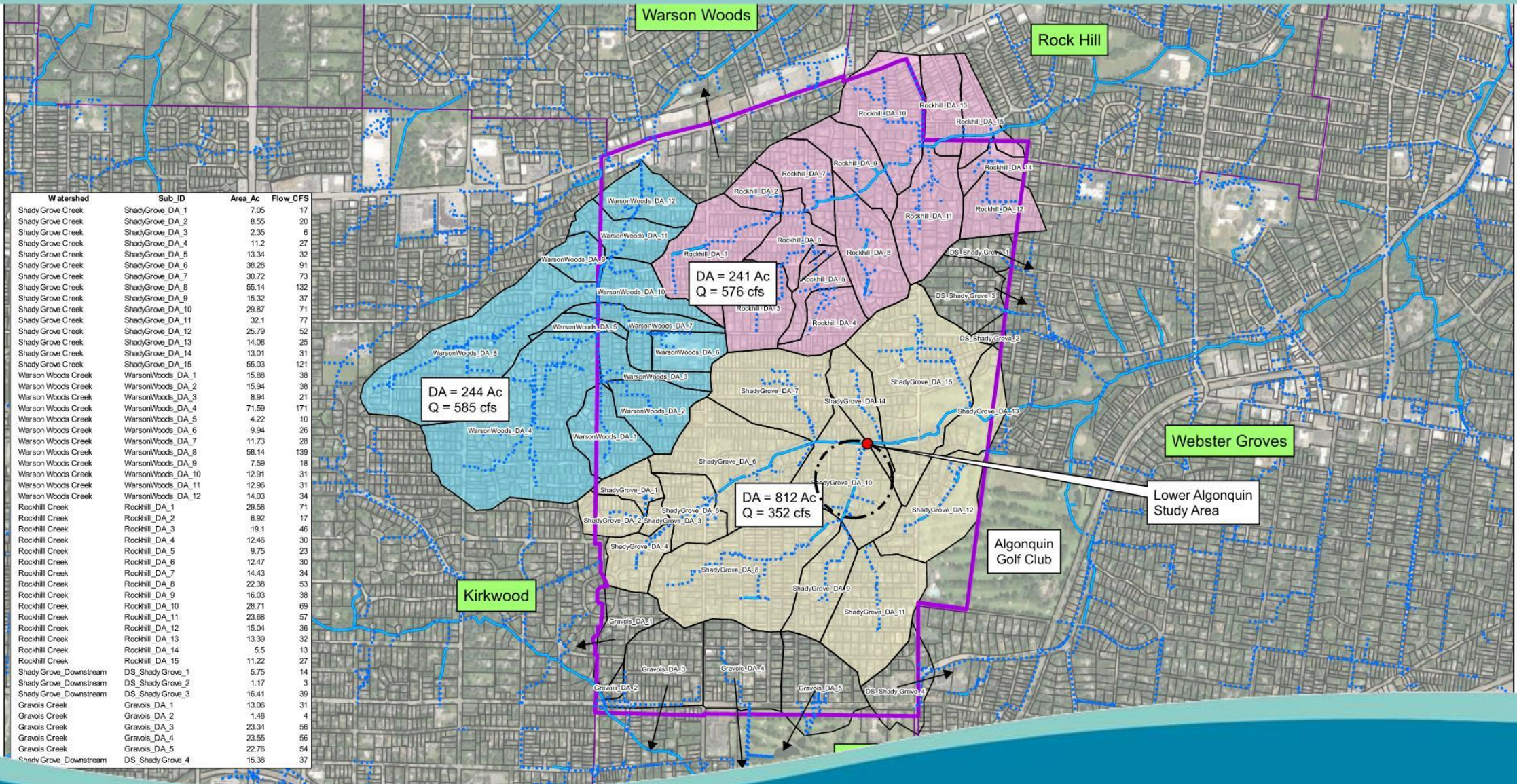


Elements of a SWMP

- Concerns of public *safety & roadway accessibility*
- Looking at system holistically
- Projects that a property owner would not be able to complete themselves due to involving other properties or agencies
- *Prioritize* recommendations for Capital Improvement Projects
- Over a planning period *address* infrastructure age, physical condition system capacity, community growth

SWMP Process



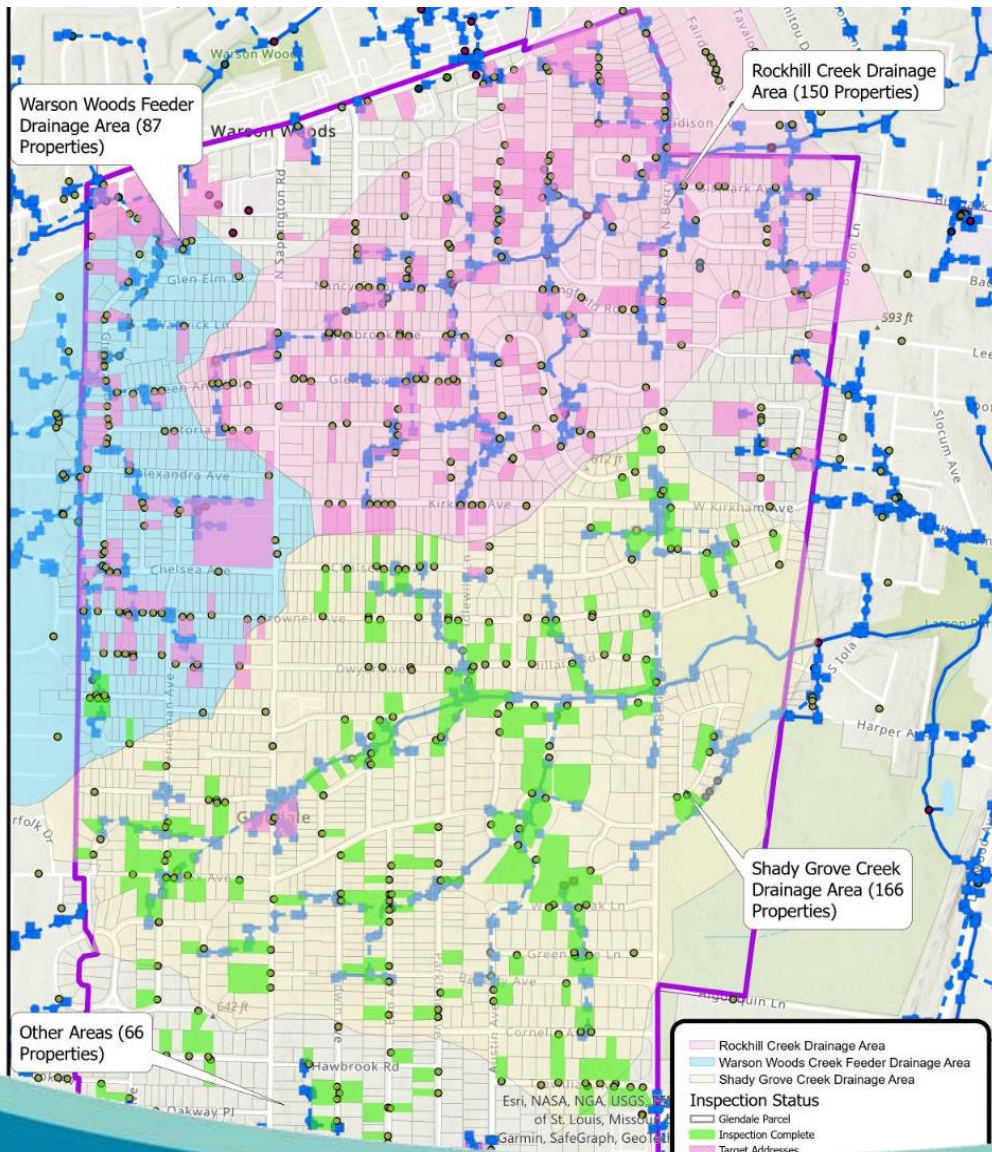


Watershed	Sub_ID	Area_Ac	Flow_CFS
Shady Grove Creek	ShadyGrove_DA_1	7.05	17
Shady Grove Creek	ShadyGrove_DA_2	8.55	20
Shady Grove Creek	ShadyGrove_DA_3	2.35	6
Shady Grove Creek	ShadyGrove_DA_4	11.2	27
Shady Grove Creek	ShadyGrove_DA_5	13.34	32
Shady Grove Creek	ShadyGrove_DA_6	38.28	91
Shady Grove Creek	ShadyGrove_DA_7	30.72	73
Shady Grove Creek	ShadyGrove_DA_8	55.14	132
Shady Grove Creek	ShadyGrove_DA_9	15.32	37
Shady Grove Creek	ShadyGrove_DA_10	29.87	71
Shady Grove Creek	ShadyGrove_DA_11	32.1	77
Shady Grove Creek	ShadyGrove_DA_12	25.79	52
Shady Grove Creek	ShadyGrove_DA_13	14.08	25
Shady Grove Creek	ShadyGrove_DA_14	13.01	31
Shady Grove Creek	ShadyGrove_DA_15	55.03	121
Warson Woods Creek	WarsonWoods_DA_1	15.88	38
Warson Woods Creek	WarsonWoods_DA_2	15.94	38
Warson Woods Creek	WarsonWoods_DA_3	8.94	21
Warson Woods Creek	WarsonWoods_DA_4	71.59	171
Warson Woods Creek	WarsonWoods_DA_5	4.22	10
Warson Woods Creek	WarsonWoods_DA_6	9.94	26
Warson Woods Creek	WarsonWoods_DA_7	11.73	28
Warson Woods Creek	WarsonWoods_DA_8	58.14	139
Warson Woods Creek	WarsonWoods_DA_9	7.59	18
Warson Woods Creek	WarsonWoods_DA_10	12.91	31
Warson Woods Creek	WarsonWoods_DA_11	12.96	31
Warson Woods Creek	WarsonWoods_DA_12	14.03	34
Rockhill Creek	Rockhill_DA_1	29.58	71
Rockhill Creek	Rockhill_DA_2	6.92	17
Rockhill Creek	Rockhill_DA_3	19.1	46
Rockhill Creek	Rockhill_DA_4	12.46	30
Rockhill Creek	Rockhill_DA_5	9.75	23
Rockhill Creek	Rockhill_DA_6	12.47	30
Rockhill Creek	Rockhill_DA_7	14.43	34
Rockhill Creek	Rockhill_DA_8	22.38	53
Rockhill Creek	Rockhill_DA_9	16.03	38
Rockhill Creek	Rockhill_DA_10	28.71	69
Rockhill Creek	Rockhill_DA_11	23.68	57
Rockhill Creek	Rockhill_DA_12	15.04	36
Rockhill Creek	Rockhill_DA_13	13.39	32
Rockhill Creek	Rockhill_DA_14	5.5	13
Rockhill Creek	Rockhill_DA_15	11.22	27
Shady Grove_Downstream	DS_Shady Grove_1	5.75	14
Shady Grove_Downstream	DS_Shady Grove_2	1.17	3
Shady Grove_Downstream	DS_Shady Grove_3	16.41	39
Gravois Creek	Gravois_DA_1	13.06	31
Gravois Creek	Gravois_DA_2	1.48	4
Gravois Creek	Gravois_DA_3	23.34	56
Gravois Creek	Gravois_DA_4	23.55	56
Gravois Creek	Gravois_DA_5	22.76	54
Shady Grove_Downstream	DS_Shady Grove_4	15.38	37

PLANNING & DATABASE MAPPING



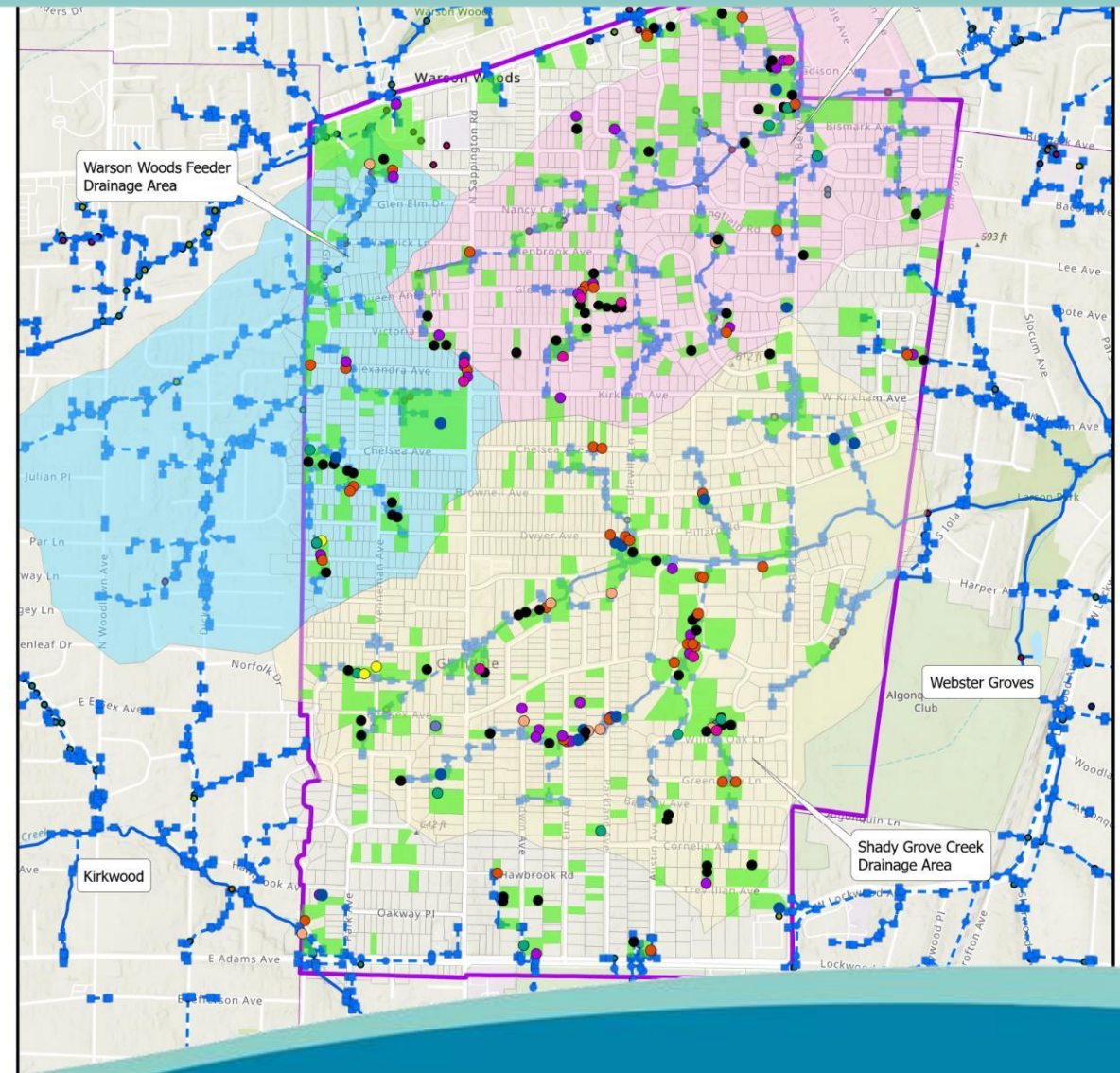
PILOT STUDY AREA

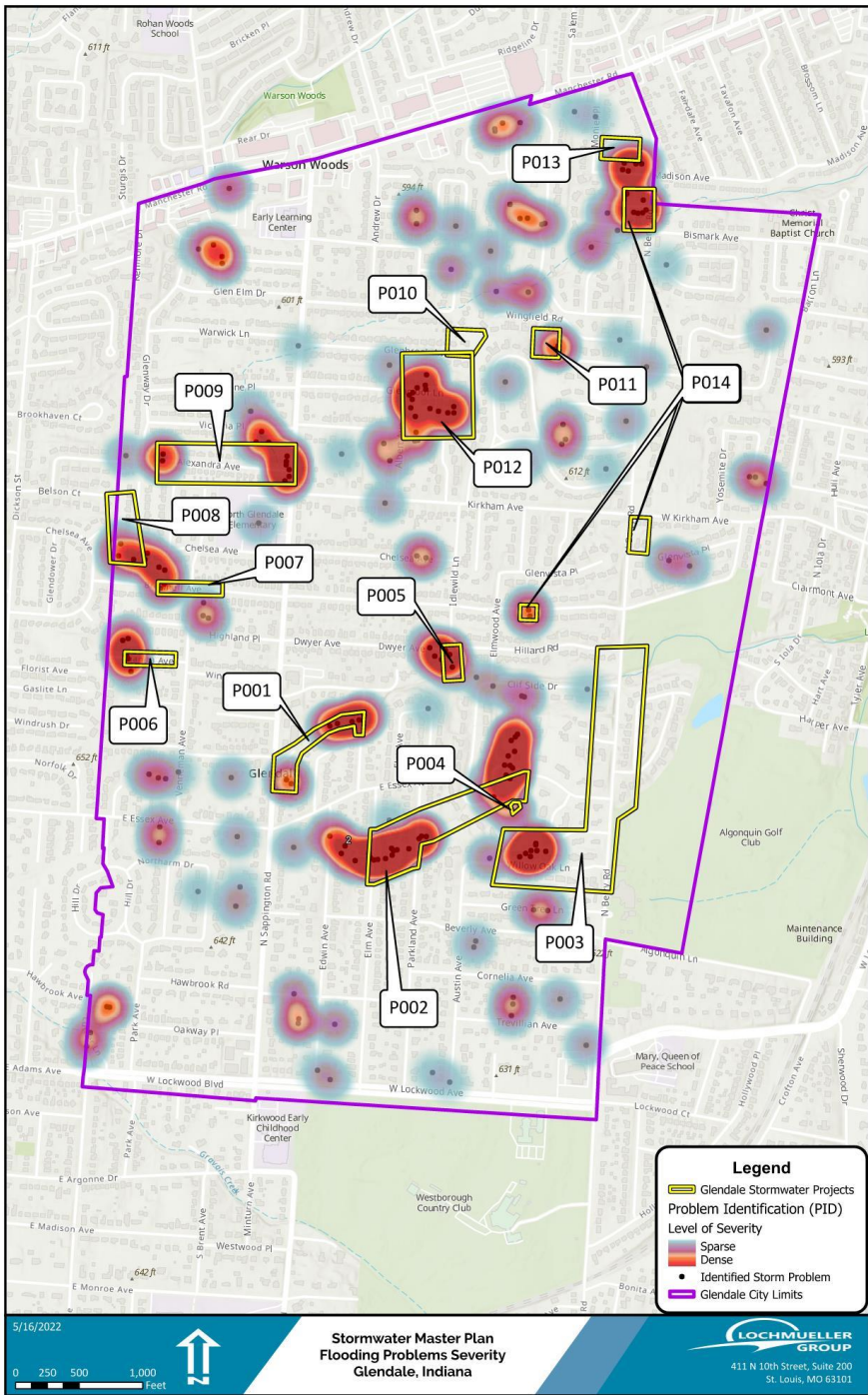


FIELD DATA COLLECTION & HYDRAULIC MODELING

Problem Identification

- Roadway Flooding
- Main Structure Building Flooding
- Backyard Flooding
- Basement Backups
- Driveway Flooding
- Sink Holes
- Storm System Deterioration
- Channel Ditch Erosion
- Other Property Damage

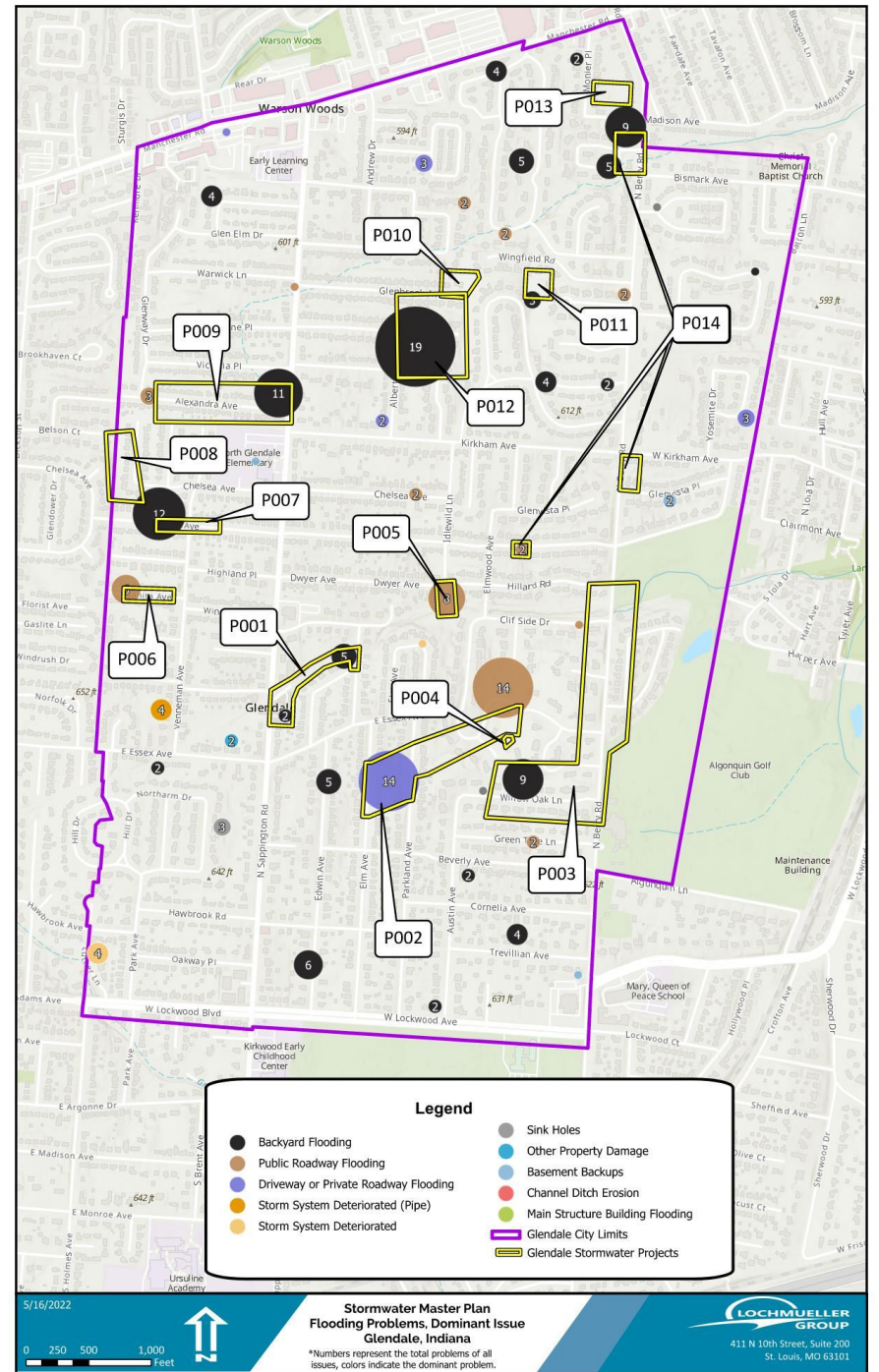




Indicates Severity
of Problems



Indicates Number
of Problems



PROJECT NAME: _____ DATE: _____

PROBLEM SOLVED CATEGORY	Chronic (<=2-Yr) Flooding		Frequent (>2<=15-Yr) Flooding		Infrequent (>15-Yr) Flooding		Total Points
	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
	<small>Note: Problem points are awarded only for those problems solved by the proposed solution.</small>						
1.1. FLOODING	1.1.1. Structure Flooding						
	Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300		150		25	
	Basement (1 lot per structure) Address:	200		100		15	
	Attached Garage (1 lot per structure) Address:	100		50		8	
	Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50		25		4	
	Industrial, office, commercial and warehouse (1 lot per 2,500 sq ft of floor space flooded) Address:	300		150		25	
	Yard Flooding (1 per lot) Address:	10		5		0	
	1.1.2. Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)						
	Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure Address:	200		100		15	
	Traffic obstruction (> 6" of water) on arterial street Address:	50		25		4	
Traffic obstruction (> 6" of water) on collector street Address:	25		12		2		
Traffic obstruction (> 6" of water) on residential street Address:	10		5		1		
1.2. EROSION	1.2.1. Threatening Structure (Ratio=Height of bank / distance from structure)						
	Habitable structures, residential (1 lot per structure) Address:	Pts. for Ratio > 0.70	No. Lots	Pts. for Ratio 0.36 - 0.70	No. Lots	Pts. for Ratio 0.15- 0.35	No. Lots
	Misc structures including pools, patio/decks, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	300		200		50	
	Industrial, office, commercial and warehouse (1 lot per structure) Address:	150		100		25	
	Industrial, office, commercial and warehouse (1 lot per structure) Address:	300		200		50	
	1.2.2. No. of lots (from 1.2.1) on outside of bend						
			lots			10 points per lot	
	1.2.3. Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)						
	Arterial Road: Address:	Pts. for Ratio > 0.70	No. Lots	Pts. for Ratio 0.36 - 0.70	No. Lots	Pts. for Ratio 0.15- 0.35	No. Lots
	Collector Road: Address:	75		50		12	
Residential Road: Address:	35		25		6		
Residential Road: Address:	20		12		3		



STORMWATER NEEDS ASSESSMENT

Storm Sewer Collection System

- Purpose: to intercept and convey
- Applicability: flooding, surcharged sewer system, roadway ponding
- Types of work included:
 - Inlet
 - Increase pipe sizes
 - Storm Sewer extension
 - Interception and diversion



Storage

- Purpose: To attenuate flow
- Applicability: High Intensity, Short Duration
- Above Ground
- Below Ground



Streambank Stabilization

- Purpose: To stabilize creek or channel banks that have erosion
- Applicability: Creek/Channel Banks
- Methods:
 - Gabion Baskets
 - Rip Rap
 - Rock Lining





Water Master Plan App

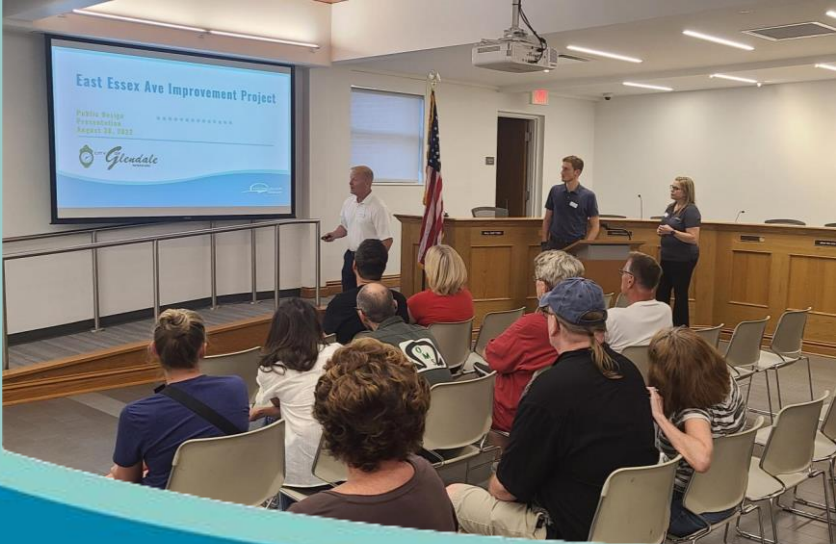
with ArcGIS Web AppBuilder

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Water Master Plan App

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CONSTRUCTABILITY & PUBLIC INVOLVEMENT



Project # P002

Parkland, Elm and Algonquin Stormwater Storage

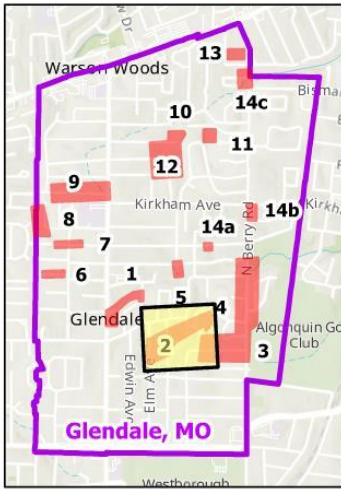
Install underground detention systems and stormwater BMP cells along Parkland Ave, Elm Ave and Algonquin Estates.
The project will benefit 217 properties and 1 permanent easements will be required.

Storm Water Project Summary of Quantities and Engineer's Cost Estimate

Project Name: Parkland, Elm and Algonquin Stormwater Storage

Project Number: P002

Pay Item	Item Description	Unit	Unit Cost	Quantity	Extended Cost
418000000000ST	Inlet - Street	EA	\$2,050	1	\$2,050
412000150000ST	Pipe Sewer 15" (storm)	LF	\$95	60	\$5,745
412000180000ST	Pipe Sewer 18" (storm)	LF	\$100	359	\$35,855
412000240000ST	Pipe Sewer 24" (storm)	LF	\$105	97	\$10,174
412000300000ST	Pipe Sewer 30" (storm)	LF	\$150	2	\$369
	Underground Detention	SF	\$125	35978	\$4,497,219
3H50000000000C	Excavation	CY	\$28	7287	\$204,035
41130000000000	Granular Backfill	CY	\$55	4587	\$252,303
8H40000000000BG	Sodding - Bluegrass	SY	\$13	2074	\$26,961
9D400000000000	Street Pavement - Asphaltic Concrete Rem. and Rep.	SY	\$85	2914	\$247,721
				Subtotal:	\$5,282,432
1G6a00000000MOB	Mobilization	LS	3.5%	1	\$184,885
8H000000000000	Protection and Restoration	LS	14%	1	\$739,540
				Subtotal:	\$924,426
				Construction Costs:	\$6,206,857
	Engineering	LS	20%	1	\$1,241,371
	Easements and Land Acquisition	LS		1	\$122,900
	Contingency	LS	10%	1	\$757,113
				Total Costs:	\$8,328,241

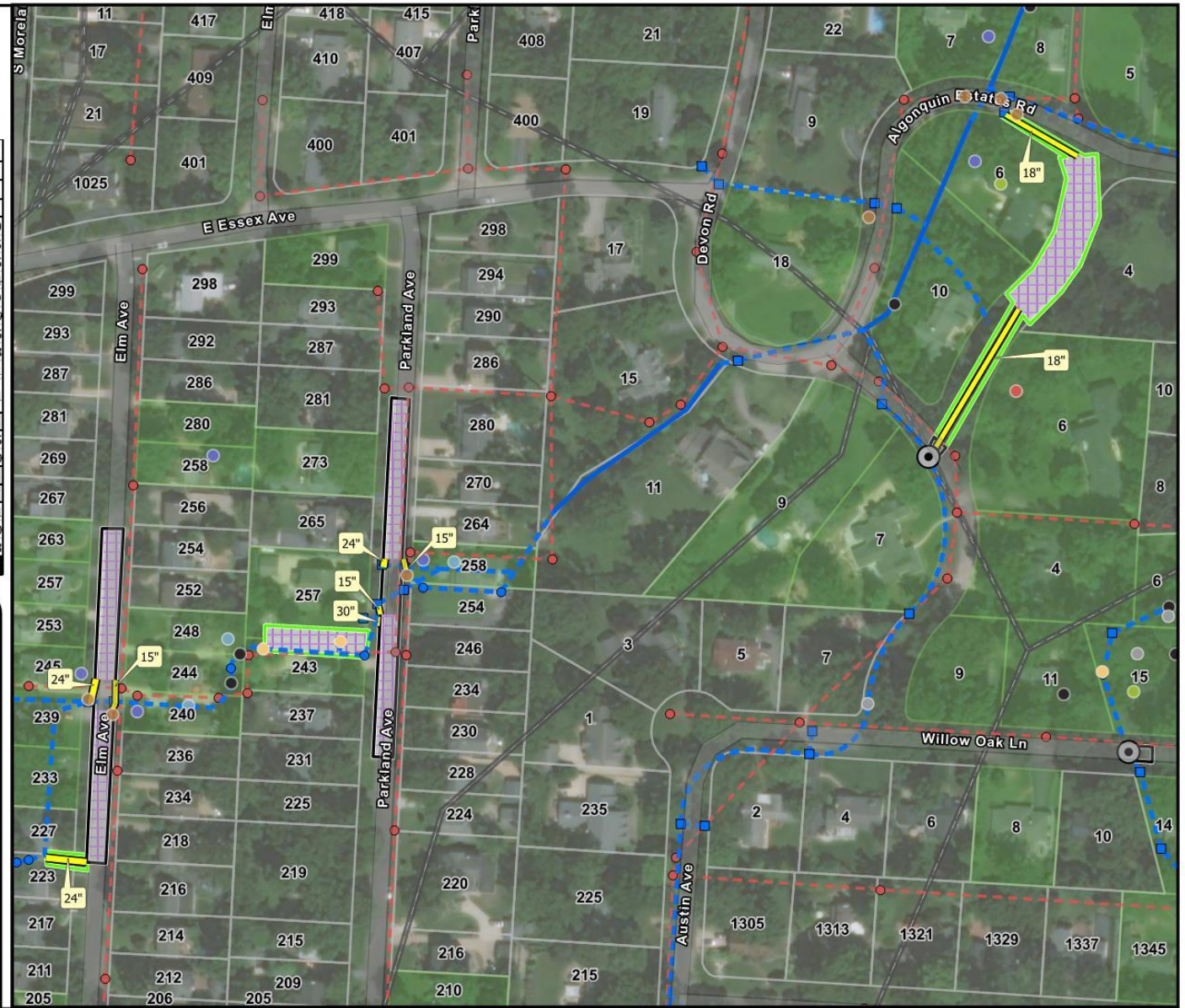


Legend

- Pipe Sewer 15" (Storm)
- Pipe Sewer 18" (Storm)
- Pipe Sewer 24" (Storm)
- Pipe Sewer 30" (Storm)
- Underground Detention
- Sodding Bluegrass
- Street Pavement
- Existing Storm Water Inlet
- Existing Storm Water Manhole
- Existing Stormwater Network
- Stormwater Channel
- Existing Sewer Manhole
- Existing Sanitary Sewer Network

Problem Identification (PID)

- Backyard Flooding
- Basement Backups
- Channel Ditch Erosion
- Driveway or Private Roadway Flooding
- Main Structure Building Flooding
- Public Roadway Flooding
- Sink Holes
- Storm System Deteriorated
- Storm Survey Parcels, House #
- Drainage Areas and Subwatersheds



Stormwater Master Plan Project #: P002 Parkland, Elm and Algonquin Stormwater Storage Glendale, Missouri

7/6/2022



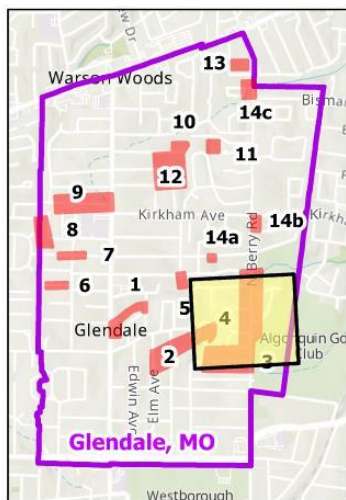
411 N 10th Street, Suite 200
St. Louis, MO 63101



Project # P003 Willow Oak Diversion Sewer

Construct 2,100 LF of 36-inch storm sewer from Willow Oak Lane, with a diversion structure on Willow Oak Lane. The project will benefit 33 properties and no permanent easements will be required.

Storm Water Project Summary of Quantities and Engineer's Cost Estimate					
Project Name: Willow Oak Diversion Sewer					
Project Number: P003					
Pay Item	Item Description	Unit	Unit Cost	Quantity	Extended Cost
418000000000ST	Inlet- Street	EA	\$2,050	6	\$12,300
460000000000OSX	Outlet Structure	LS	\$6,500	1	\$6,500
70200036000000X	Pipe in Tunnel 36"	LF	\$170	2093	\$3,589,325
3H500000000000C	Excavation	CY	\$28	29	\$813
9D4000000000000	Street Pavement - Asphaltic Concrete Rem. And Rep.	SY	\$85	328	\$27,896
				Subtotal:	\$3,636,834
1G6a00000000MOBX	Mobilization	LS	3.5%	1	\$127,289
8H0000000000000	Protection and Restoration	LS	14%	1	\$509,157
				Subtotal:	\$636,446
				Construction Costs:	\$4,273,280
	Engineering	LS	20%	1	\$854,656
	Contingency	LS	10%	1	\$512,794
				Total Costs:	\$5,640,729

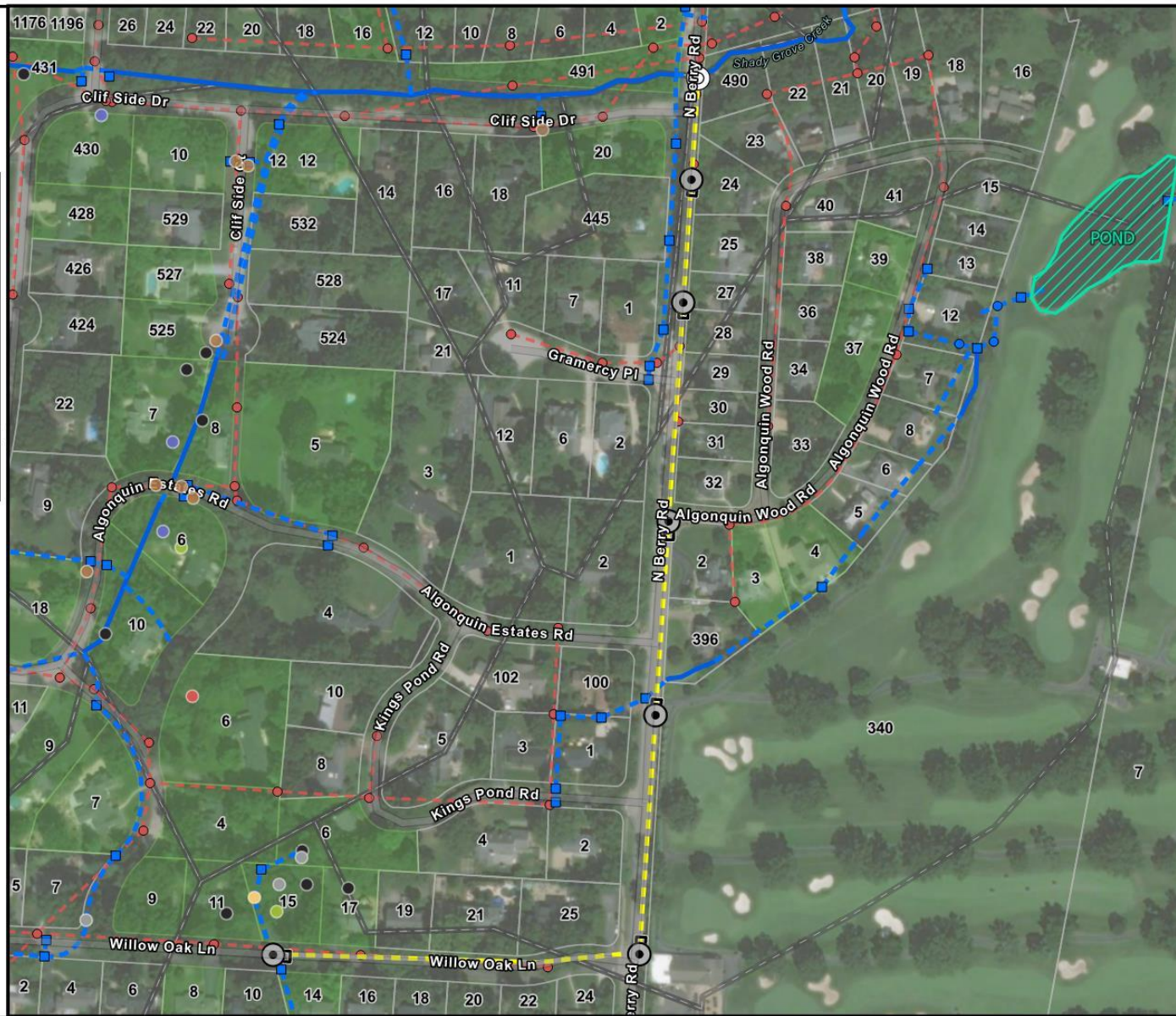


Legend

- Outlet Structure
- Inlet-Street
- Pipe in Tunnel 36"
- Street Pavement
- Existing Storm Water Manhole
- Existing Storm Water Inlet
- Existing Stormwater Network
- Stormwater Channel
- Existing Sewer Manhole
- Existing Sanitary Sewer Network

Problem Identification (PID)

- Backyard Flooding
- Channel Ditch Erosion
- Driveway or Private Roadway Flooding
- Main Structure Building Flooding
- Public Roadway Flooding
- Sink Holes
- Storm System Deteriorated
- Storm Survey Parcels, House #
- Drainage Areas and Subwatersheds



7/6/2022

0 50 100 200 300 400 Feet



Stormwater Master Plan Project #: P003 Willow Oak Diversion Sewer Glendale, Missouri



411 N 10th Street, Suite 200
St. Louis, MO 63101



**Project # P015
Glenhaven Storm Sewer Relief**

Construct 300 LF of 18 to 27 inch diameter storm sewer and inlets.
The project will benefit 7 properties and 2 permanent easement
will be required.

Storm Water Project Summary of Quantities and Engineer's Cost Estimate					
Project Name: Glenhaven Storm Sewer Relief					
Project Number: P015					
Pay Item	Item Description	Unit	Unit Cost	Quantity	Extended Cost
4180000000000A1	Inlet - Area	EA	\$2,050	2	\$4,100
4180000000000D	Inlet - Street	EA	\$2,050	2	\$4,100
412000180000ST	Pipe Sewer 18" (storm)	LF	\$100	254	\$25,409
412000270000ST	Pipe Sewer 27" (storm)	LF	\$150	45	\$6,715
3H50000000000C	Excavation	CY	\$28	258	\$7,217
41130000000000	Granular Backfill	CY	\$55	241	\$13,263
9D6c0000000000	Sidewalks & Driveways - Asphaltic Concrete	SY	\$162	41	\$4,134
9D400000000000	Street Pavement - Asphaltic Concrete	SY	\$85	31	\$2,652
8H4000000000BG	Sodding - Bluegrass	SY	\$13	600	\$7,795
				Subtotal:	\$75,385
1G6a00000000MOBX	Mobilization	LS	3.5%	1	\$2,638
8H000000000000	Protection and Restoration	LS	14%	1	\$10,554
				Subtotal:	\$13,192
				Construction Costs:	\$88,578
	Engineering	LS	20%	1	\$17,716
	Easements and Land Acquisition	LS		1	\$51,340
	Contingency	LS	10%	1	\$15,763
				Total Costs:	\$173,397

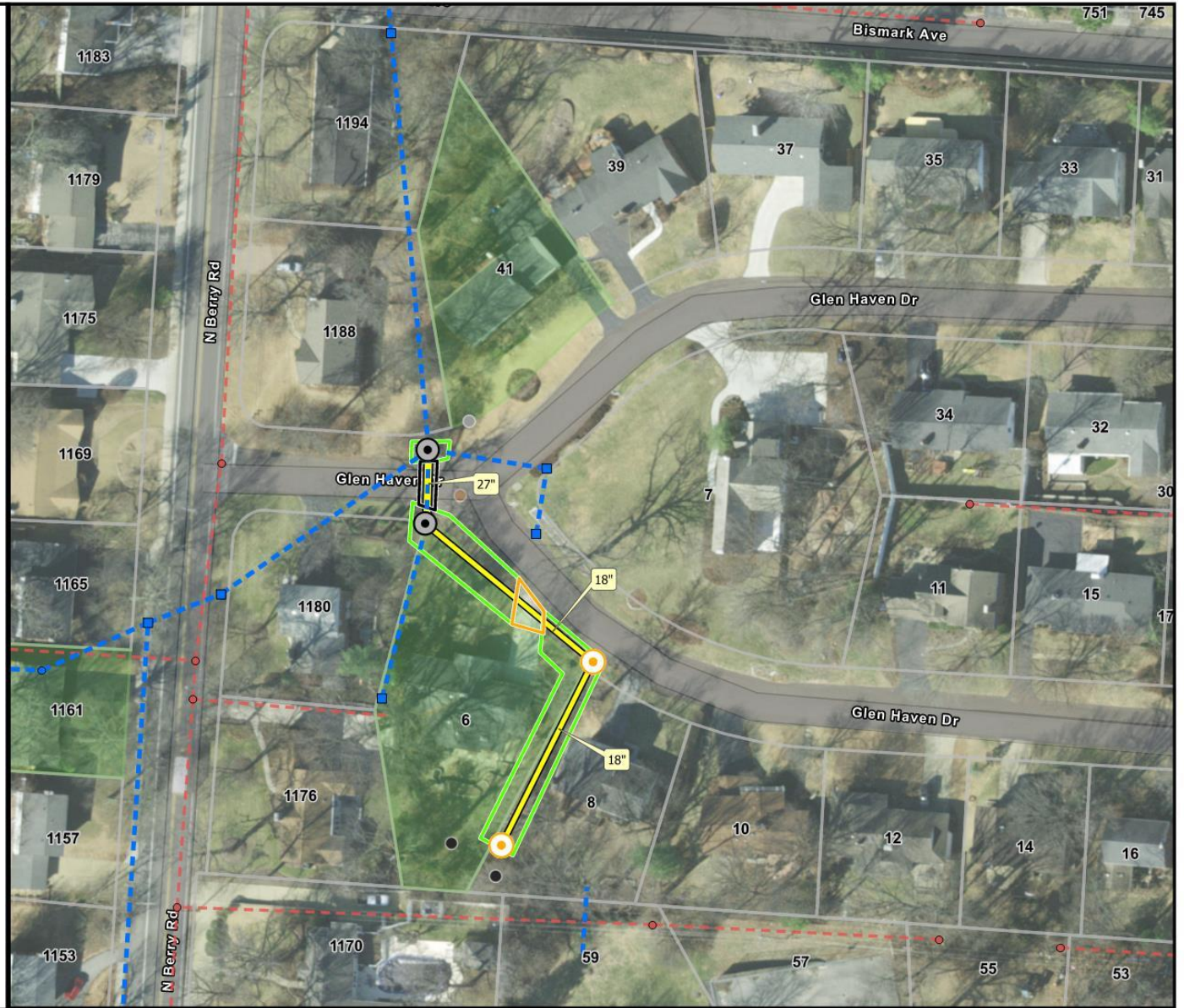


Legend

- Inlet-Area
- Inlet-Street
- Sodding Bluegrass
- Street Pavement
- Sidewalks & Driveways
- PIPE SEWER 18 INCH (STORM)
- PIPE SEWER 27 INCH (STORM)
- Existing Storm Water Inlet
- Existing Storm Water Manhole
- Existing Stormwater Network
- Existing Sewer Manhole
- Existing Sanitary Sewer Network

Problem Identification (PID)

- Backyard Flooding
- Public Roadway Flooding
- Sink Holes
- Storm Survey Parcels, House #



11/11/2022



0 25 50 100 Feet

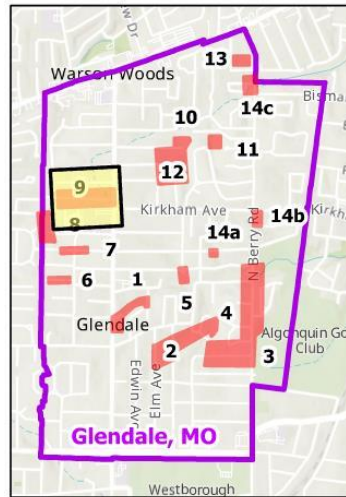
**Stormwater Master Plan
Project # P015
Glenhaven Storm Sewer Relief
Glendale, Missouri**



Project # P009
Alexandra Ave Storm Sewer
(From Sappington Road to Glenway Drive)

Construct 1,000 LF of 24-inch storm sewer and inlets.
 The project will benefit 35 properties and no permanent easement will be required.

Storm Water Project Summary of Quantities and Engineer's Cost Estimate					
Project Name: Alexandra Ave Storm Sewer (From Sappington Road to Glenway Drive)					
Project Number: P009					
Pay Item	Item Description	Unit	Unit Cost	Quantity	Extended Cost
418000000000ST	Inlet - Street	EA	\$2,050	5	\$10,250
412000240000ST	Pipe Sewer 24" (Storm)	LF	\$105	1005	\$105,517
3H50000000000C	Excavation	CY	\$28	933	\$26,113
41130000000000	Granular Backfill	CY	\$55	911	\$50,107
9D400000000000	Street Pavement - Asphaltic Concrete Rem. and Rep.	SY	\$85	1442	\$122,575
Subtotal:					\$314,562
1G6a00000000MOBX	Mobilization	LS	3.5%	1	\$11,010
8H000000000000	Protection and Restoration	LS	14%	1	\$44,039
Subtotal:					\$55,048
Construction Costs:					\$369,611
	Engineering	LS	20%	1	\$73,922
	Contingency	LS	10%	1	\$44,353
Total Costs:					\$487,886

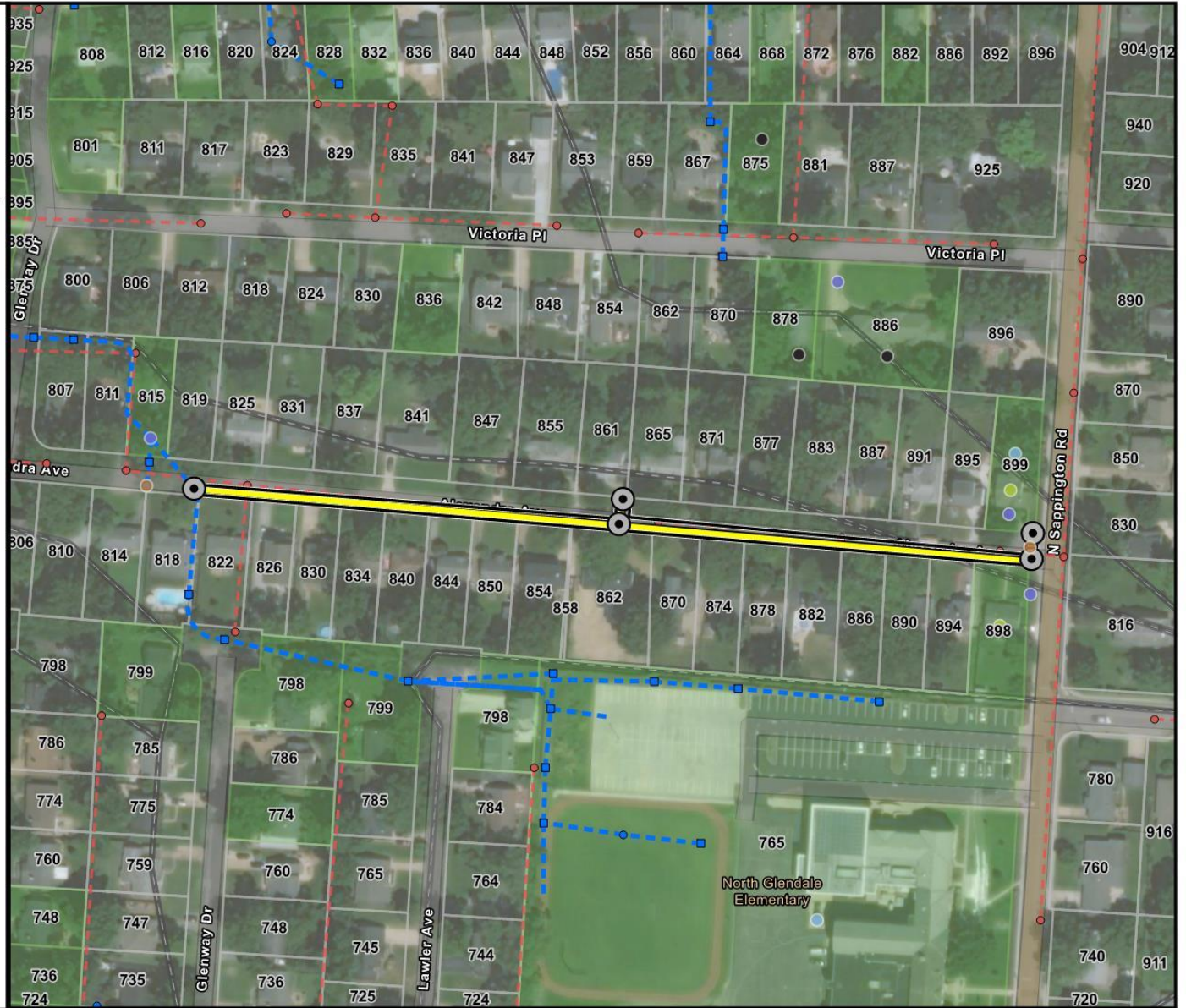


Legend

- Inlet-Street
- Street Pavement
- Pipe Sewer 24" (Storm)
- Existing Storm Water Manhole
- Existing Storm Water Inlet
- Existing Stormwater Network
- Existing Sewer Manhole
- Existing Sanitary Sewer Network

Problem Identification (PID)

- Backyard Flooding
- Basement Backups
- Driveway or Private Roadway Flooding
- Main Structure Building Flooding
- Public Roadway Flooding
- Storm Survey Parcels, House #
- Drainage Areas and Subwatersheds



7/6/2022



0 50 100 200 Feet

Stormwater Master Plan
Project # P009
Alexandra Ave Storm Sewer
(From Sappington Road to Glenway Drive)
Glendale, Missouri



Non Construction Projects

Risk assessment/flood mapping

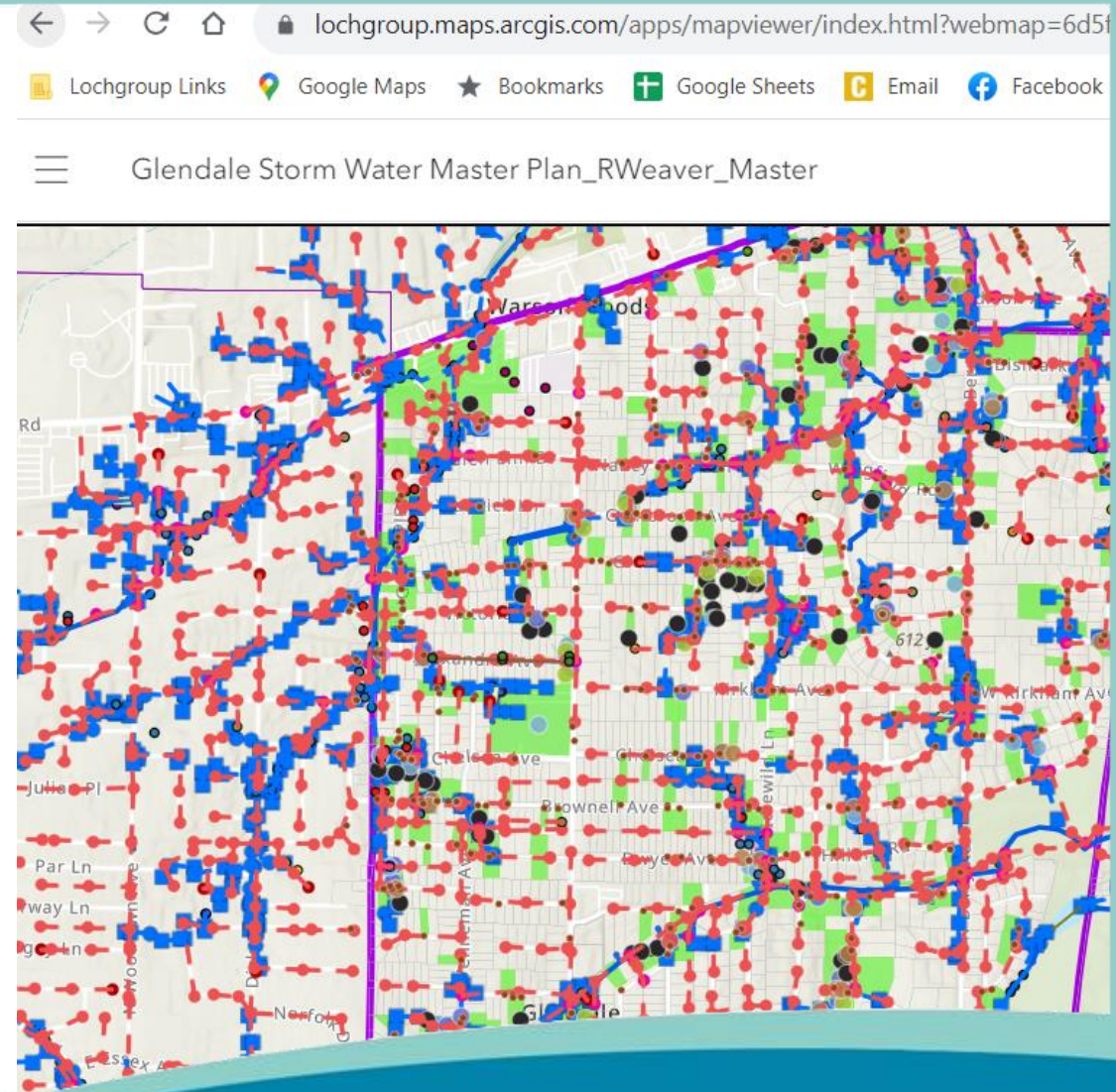
Stormwater Ordinance

MS4 Minimum Control Measures

- Public Education and Outreach
- Public Participation
- Illicit Discharge Detection and Elimination
- Management of Construction Site Runoff
- Management of Post Construction Site Runoff
- Good Housekeeping in Municipal Operations

After the Final Draft

- GIS Webmap – continued use
- City is prepared, understands issues. Has a SWMP Document available for any funding that comes out
- Priority of projects
 - Projects that can be completed immediately



Questions?

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