City of Thomasville Stormwater Action Plan/ Stormwater Master Plan:

Part I – Watershed Prioritization, Drainage System Assessment & City Codes/Policies Review

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1. WATERSHED PRIORITIZATION & DRAINAGE CAPITAL IMPROVEMENT PROGRAM

A comprehensive Stormwater Master Plan sets the foundation of successful drainage capital improvement program (CIP). This tool enables a community to assess current and future drainage conveyance level of service issues and to identify and analyze potential capital improvements. In some situations, where drainage issues are common and/or complex, or substantial growth is expected, a detailed engineering analysis, or hydrologic and hydraulic (H&H) model, is necessary to determine the most cost-effective approach to enhance the drainage conveyance system with structural elements. As this type of analysis is expensive, the initial goal of the Stormwater Master Plan is to prioritize basins for future study and CIP implementation. The large, initial investment in detailed masterplanning by basin will result in future cost savings of long-term capital and O&M costs because the basin would see reduced flooding from optimal conveyance system sizing and reduced non-point source pollution discharge.

This chapter summarizes the efforts to delineate the subbasins within the City, assess stormwater issues within each basin, prioritize those basins for further detailed analysis, and identify a plan for CIP implementation. The following elements that were utilized in the watershed prioritization process and CIP development include:

- Watershed delineation and characteristics of major drainage basins and subbasins (Section 1.1)
- Water quality data from the City and Georgia EPD (Section 1.2)
- Analysis of existing and future land use conditions (Section 1.3)
- Drainage project list development and ranking (Section 1.4)
- Public outreach and engagement (Section 1.5) through an online survey (Section 1.5.1) and open house events (Section 1.5.2)

1.1. WATERSHED DELINEATION & CHARACTERISTICS

A goal of the delineations was to isolate main areas where the City has drainage issues. The City of Thomasville's LIDAR contours and drainage infrastructure data in GIS were used to delineate the City into 8 major drainage basins, which were based on named streams. The City's major culvert list was then used to establish relevant outlet points when delineating those into sub-watersheds (or subbasins). Overall, 40 drainage subbasins were delineated within the City. Of the 8 major basins, three were on the periphery of the City and only included one subbasin (Lees, Wards, and Watts). Two major basins, Gatling and Good Water, despite having multiple subbasins, made up 4% and 5% of the City, respectively. The three largest major basins were Oquina Creek with 12 basins and 42% of the City, Olive Creek with 10 basins and 30% of the City, and Bruces Branch with 6 basins and 14% of the City. Bruces Branch flows into Oquina Creek before exiting the City, so the outlet of Oquina Creek at the city limits drains 56% of the city. A summary of the major drainage basins characteristics is described in Table 1.1. Since several drainage basins extend outside of the city, 63% of the drainage basins delineated include area within the city limits.

Table 1.1: Major Drainage Basin Summary

Major Basin	Number of Subbasins	Basin Area (acres)	Area within City Limits (acres)	Portion within City Limits	Fraction of City
Bruces	6	1,416	1,407	99%	14%
Gatling	3	1,102	398	36%	4%
Good Water	6	1,165	517	44%	5%
Lees	1	740	69	9%	1%
Olive	10	4,275	2,934	69%	30%
Oquina	12	5,101	4,036	79%	42%
Wards	1	1,290	199	15%	2%
Watts	1	388	148	38%	2%
Total	**40**	**15,477**	**9,708**	**63%**	**100%**

The portion of subbasins within the city limits ranged in size from 20 to 922 acres, and the average area was 243 acres. Half of the subbasins were between 105 and 260 acres. A summary of each subbasin is included in Table 1.2. Based on the drainage project list in Section 1.4, the number of drainage projects in each subbasin is also shown in this table. This includes 24 of the 40 subbasins, and six only have one project.

Table 1.2: Drainage Subbasin Summary

Basin ID	Major Basin	Subbasin Area (acres)	Area within City Limits		Drainage Projects
			Acres	*Percentage*	
Br-1	Bruces	201	191	95%	2
Br-2	Bruces	416	416	100%	5
Br-3	Bruces	326	326	100%	8
Br-4	Bruces	152	152	100%	5
Br-5	Bruces	187	187	100%	2
Br-6	Bruces	134	134	100%	2
Ga-1	Gatling	695	34	5%	0
Ga-2	Gatling	128	98	77%	1
Ga-3	Gatling	279	266	95%	0
GW-1	Good Water	335	48	14%	0
GW-2	Good Water	114	106	93%	1
GW-3	Good Water	20	20	98%	0
GW-4	Good Water	264	139	53%	0
GW-5	Good Water	161	115	71%	1
GW-6	Good Water	269	89	33%	0
L-1	Lees	740	69	9%	0
Ol-1	Olive	1,225	259	21%	0
Ol-2	Olive	504	391	78%	1
Ol-3	Olive	417	417	100%	4
Ol-4	Olive	425	425	100%	2
Ol-5	Olive	193	193	100%	4
Ol-6	Olive	380	380	100%	4
Ol-7	Olive	123	123	100%	2
Ol-8	Olive	536	536	100%	6
Ol-9	Olive	403	182	45%	1
Ol-10	Olive	69	27	39%	0
Oq-1	Oquina	877	825	94%	3
Oq-2	Oquina	387	144	37%	0
Oq-3	Oquina	268	120	45%	0
Oq-4	Oquina	922	922	100%	0
Oq-5	Oquina	1,031	469	45%	0
Oq-6	Oquina	143	143	100%	2
Oq-7	Oquina	597	539	90%	1
Oq-8	Oquina	255	255	100%	5
Oq-9	Oquina	244	244	100%	3
Oq-10	Oquina	182	182	100%	4
Oq-11	Oquina	53	53	100%	0
Oq-12	Oquina	139	139	100%	4
Wd-1	Wards	1,290	199	15%	0
Wt-1	Watts	388	148	38%	0
Total		15,477	9,708	63%	73

1.2. WATER QUALITY DATA SUMMARY

Based on Georgia Environmental Protection Division (GAEPD)'s most recent version water quality report in Georgia, "2022 Integrated 305b/303d Report," there are two impaired waterways within the city limits – Oquina Creek and Olive Creek. Both are impaired for fecal coliform due to urban runoff. Oquina Creek also has an ammonia toxicity impairment, but that is due to a municipal point source, and it should be addressed through an NPDES permit. Olive Creek also has an impairment for dissolved oxygen due to urban runoff. Additionally, both creeks have an assessment pending until EPD clarifies specific criteria. Olive Creek had a narrative rank of "fair" for macroinvertebrates, but EPD needs to complete a reevaluation of metrics used to assess these data. Oquina Creek is pending assessment for dissolved oxygen until EPD determines the "natural DO" for the area. Additional details of the impairments and assessments pending are described in Table 1.3.

Table 1.3: Summary of Impaired (and Pending) Waterways within City Limits

Stream Segment	Location	Length (miles)	Impairment	Cause	Notes
Olive Creek	Headwaters to 0.7 miles upstream of US-19	3	Dissolved Oxygen, Fecal Coliform; *Pending for Macroinvert-ebrates (fair)*	Urban Runoff	TMDL completed for DO (2001) and FC (2006); *EPD needs to complete the reevaluation of metrics used to assess macroinvertebrate data*.
Olive Creek[1]	0.7 miles upstream of US-19 to Aucilla River	6.3	*Pending for Macroinvert-ebrates (fair)*		*EPD needs to complete the reevaluation of metrics used to assess macroinvertebrate data.*
Oquina Creek	Headwaters to tributary 700 ft downstream of Cassidy Rd	2	*Pending for Dissolved Oxygen*		*EPD needs to determine the "natural DO" for the area before a use assessment is made.*
Oquina Creek	Bruces Branch to Old Cassidy Rd	2	Ammonia Toxicity, Fecal Coliform	Municipal Point Source, Urban Runoff	TMDL completed for FC (2006); ammonia toxicity to be addressed through an NPDES permit (source is M); FC source is UR.

[1] This segment starts immediately at the edge of the city limits.
Data Source: GA EPD 2022 Integrated 305(b)/303(d) List of Waters

The City of Thomasville partnered with Carter & Sloope Consulting Engineers and Nutter & Associates, Inc., and prepared a Watershed Protection Plan (WPP) for the Oquina Creek Stationary Treatment Facility (STF) service area. The WPP was created in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements that were established by the GAEPD. A Watershed Assessment was conducted during 2009 and 2010 and water quality monitoring data was obtained at that time. Through the WPP Long-Term

Monitoring Plan, the City continued monitoring at four sites (OQC01, OC01, UT01, and WC01) and submitted an annual progress report each year. The 2020 WPP Annual Progress Report was available for review and contained a synopsis of data from the last ten years of data collection. The summary of long-term water quality trends is below:

- The history of human stream modification in the monitoring area caused stream bank instability, incised stream channels, and increased sediment deposition compared to the reference conditions. Stormwater inputs from urban areas exacerbated these conditions and had potential to transmit elevated nutrients and bacteria loads.
- Specific conductivity and bacteria counts were elevated at station OC01 (Olive Creek) since 2012. These conditions could indicate pollution entering the waterway, and Olive Creek drains residential areas located outside of the service area along with residential areas within the service area, a golf course, and Thomas University. All of these land-uses had potential to strongly influence the Creek's water quality. However, nutrients are not very high in Olive Creek. Various factors such as pet waste, general runoff from impervious surfaces, and/or leaking sewer system pipes from these areas could also have caused the bacteria and conductivity levels to increase in Olive Creek. Water quality monitoring and sewage leak inspections are recommended to continue and have the potential to help to understand why conductivities and bacteria counts are trending upward at OC01 in long term.
- Nutrient levels of nitrogen (TKN) and phosphorus (OP) were elevated during specific dry weather events, but normal rainfall brought overall lower nutrient concentrations sampled in recent dry weather monitoring events. TKN concentrations were elevated during the 2020 monitoring period during stormwater flow conditions, especially at Station OQC10 (Oquina Creek). TKN typically originates from impervious surfaces and the OQC10 station drains the majority of the downtown Thomasville area. The watershed for the station is mostly urban land use, with the highest percentage of impervious surface of any station. Urban stormwater runoff can cause higher frequency, larger scale, and shorter duration peak flows which have the potential to alter the channel morphology of this stream. This has led to an increase in sediment transport and deposition.
- The last significant water quality trend is the increased bacteria concentrations at station WC01 (Wards Creek). The watershed draining into Wards Creek is primarily forested and contains several private hunting clubs. The wildlife could be contributing to the increased bacteria counts in this creek. There are also residential areas in the watershed, but they are not serviced by the WPCP. Failing septic systems could be contributing to the increased bacteria loading.

Given the water quality data trends over the last ten years, as detailed in the Thomasville WPP Annual Progress Reports and the baseline data from the Aucilla River WMP, the implemented best practices provided some benefit, but they need wider implementation or more effective practices to fully address the water quality impairments. Efforts that could be implemented to improve water quality in the Aucilla Watershed and Thomasville area include: (1) control of stormwater runoff, especially during construction, (2) public education on the importance of water quality, septic system checks, education for private citizens who operate septic systems,

(3) dry weather screening of stormwater drainage, (4) sewage system leakage monitoring, and (5) stream bank restoration. A combination of mindful continuation of the stated BMPs and water quality monitoring has the potential to help improve the overall surface water quality in the area.

1.3. LAND USE ANALYSIS SUMMARY

A land use analysis was conducted for each major drainage basin and subbasin using the City's existing land use (Table 1.4/Figure 1.1) and future land use (Table 1.5/Figure 1.2) to assess current development and to see where future growth is expected. With growth and development, and depending on the type of redevelopment, impervious surfaces will increase which would lead to more stormwater runoff. Therefore, it is important to enhance post-construction stormwater management requirements before all of the future development occurs so that current flooding issues are not exacerbated. There was a sizable area identified as "Other" in each subbasin. This represented a combination of roadways, rights-of-ways, and area outside of city limits. In order to make direct comparisons between existing and future land uses, "Other" was removed from the comparison. Overall, the major basins that currently have a relatively large fraction of "Vacant" land are forecasted to see that land shifted directly to increases in "Suburban Neighborhood," as shown in Table 1.6. This will result in an increase in impervious surfaces and consequently stormwater runoff. The fractions of "Vacant" under existing land use is as follows: Lees 39%, Oquina 29%, Watts 29%, Olive 15%, Gatling 15%, and Ward 15%. Of these, Lees has a total vacant area of 23 acres, Watts 36 acres, and Ward 26 acres, so their overall impact is not as large as Oquina with 1,005 acres and Olive with 365 acres of vacant land.

Table 1.4: Existing Land Use by Major Basin

Existing Land Use	Bruces	Gatling	Good Water	Lees	Olive	Oquina	Ward	Watts
Commercial	5.7%	28.4%	24.6%		4.2%	4.6%		
Industrial		1.4%	13.3%		5.7%	22.4%		30.4%
Manufactured Housing Residential				24.5%				
Multi-Family Residential	1.3%	16.2%			2.5%	3.7%		
Office/Professional	1.4%	0.2%			1.0%	0.6%		
Parks/Recreation/Conservation	1.4%	15.3%			13.6%	12.0%		40.6%
Public Institution/Community Facility	15.7%	2.8%	11.9%		7.2%	8.1%		
Single Family Residential	66.6%	20.4%	37.1%	36.3%	50.7%	16.2%	85.5%	
Transportation/Communications/ Utilities	0.1%	0.2%	6.7%		0.3%	3.3%		
UNK		0.1%						
Vacant	7.6%	14.9%	6.5%	39.2%	14.8%	29.0%	14.5%	29.0%
Total Area (acres): Existing Analysis (w/o "Other")	*1,164*	*341*	*415*	*58*	*2,461*	*3,462*	*177*	*124*

Table 1.5: Future Land Use by Major Basin

Future Land Use	Bruces	Gatling	Good Water	Lees	Olive	Oquina	Ward	Watts
Community Commercial	6.5%	0.4%	8.3%		5.9%	8.3%		
Conservation/Green Space	5.6%	0.9%			6.4%	11.6%		5.3%
Downtown Mixed Use	2.7%				0.0%	6.2%		
Employment Industrial					3.5%	19.5%		58.8%
Highway Commercial		40.2%	47.2%		0.7%			
Medical District					2.0%	0.2%		
Office Institutional	2.6%		6.3%		0.8%	1.1%		
Suburban Neighborhood	65.6%	56.5%	38.2%	100.0%	54.0%	34.6%	100.0%	35.9%
Traditional Neighborhood	17.0%				25.6%	14.6%		
Urban Community		1.9%			1.0%	3.7%		
Total Area (acres): Existing Analysis (w/o "Other")	*1,166*	*340*	*409*	*58*	*2,462*	*3,457*	*174*	*124*

Table 1.6: Comparison of Existing and Future Land Use for Single-Family Residential to Suburban/Traditional Neighborhood

Basin	Existing	Future		Approx change in acreage	Comments
	Single Family Residential	*Suburban Neighborhood*	*Traditional Neighborhood*		
Bruces	66.6%	65.6%	17.0%	185	Filled in vacant (8%) and losses from Public Institution/Community Facility
Gatling	20.4%	56.5%		123	Filled in vacant (15%) and inclusion of multi-family (16%)
Good Water	37.1%	38.2%		5	Minor change
Lees	36.3%	100.0%		37	Filled in vacant (39%) and inclusion of manufactured-residential (25%)
Olive	50.7%	54.0%	25.6%	712	Filled in vacant (15%) and losses of Parks/Conservation (7%)
Oquina	16.2%	34.6%	14.6%	1,144	Filled in vacant (29%)
Ward	85.5%	100.0%		26	Filled in vacant (15%)
Watts		35.9%		44	Filled in vacant (29%)

"Commercial" areas (Table 1.7) are forecasted to increase in area from "Commercial" to "Highway or Community Commercial." The largest gains are in Good Water (128 acres) and Oquina (128 acres), followed by Olive (60 acres) and Gatling (41 acres). Therefore, these major basins can expect to see an increase in impervious surfaces.

Table 1.7: Comparison of Existing and Future Land Use for Commercial

Basin	Existing	Future		Approx change in acreage	Comments
	Commercial	*Highway Commercial*	*Community Commercial*		
Bruces	5.7%		6.5%	9	Minor change (most is Community)
Gatling	28.4%	40.2%	0.4%	41	Minor increase
Good Water	24.6%	47.2%	8.3%	128	Modest increase
Olive	4.2%	0.7%	5.9%	60	Minor increase (most is Community)
Oquina	4.6%		8.3%	128	Modest increase (most is Community)

"Industrial" areas (Table 1.8) are forecasted to decrease in area from "Industrial" to "Employment Industrial" for many of the basins except Watts, a small basin of 124 acres. Watts forecasts an increase of 35 acres that is currently "Vacant" land. The largest industrial losses are in Oquina (102 acres), followed by Good Water (55 acres) and Olive (55 acres).

Table 1.8: Comparison of Existing and Future Land Use for Industrial

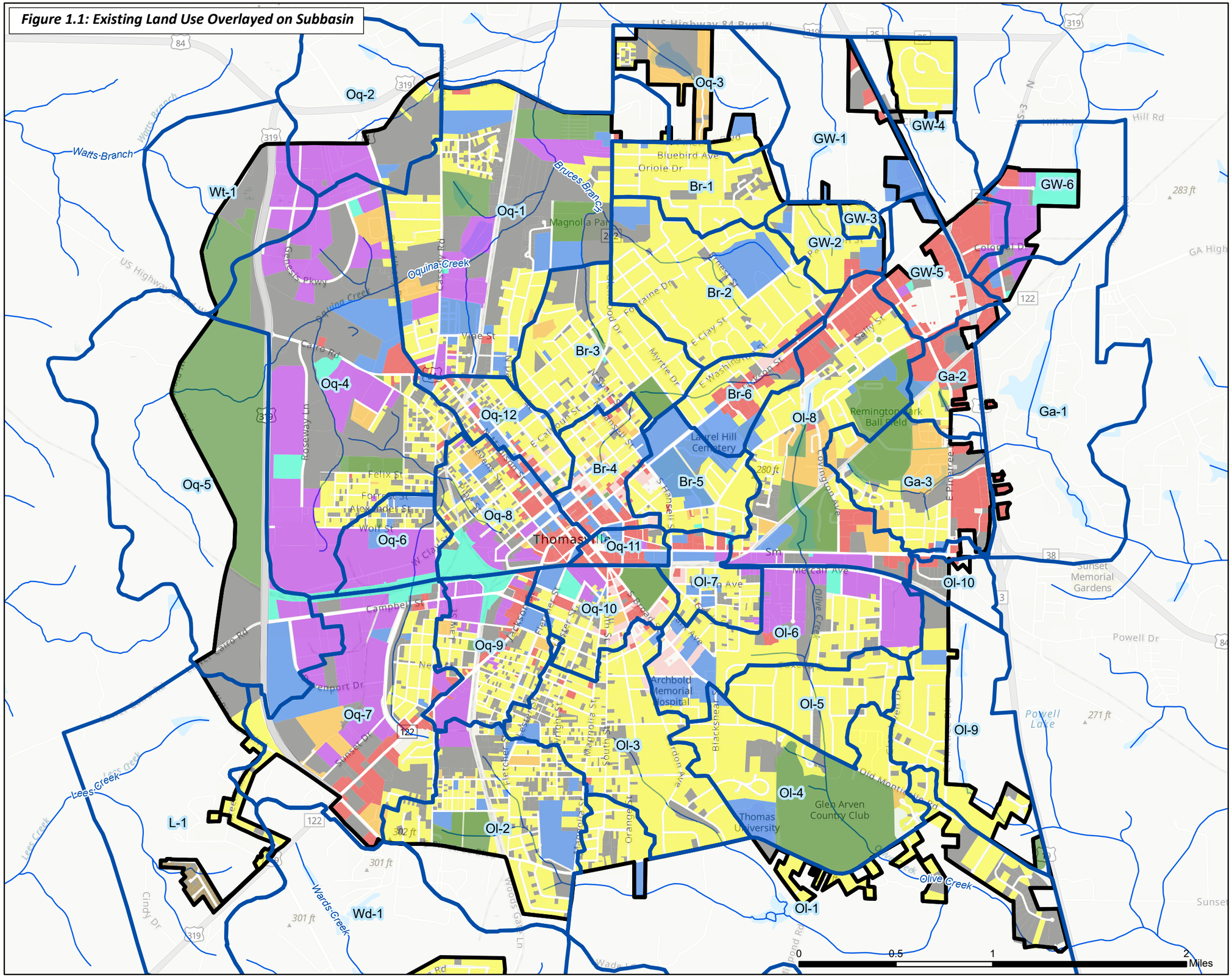
Basin	Existing	Future	Approx change in acreage	Comments
	Industrial	*Employment Industrial*		
Gatling	1.4%		-5	Minor decrease
Good Water	13.3%		-55	Shifted to highway commercial
Olive	5.7%	3.5%	-55	Minor decrease
Oquina	22.4%	19.5%	-102	Minor decrease
Watts	30.4%	58.8%	35	Filled in vacant (29%)

"Conservation/Green Space/Park" areas (Table 1.9) are forecasted to decrease in area from "Parks/Recreation/Conservation" to "Conservation/Green Space" for many of the basins except Bruces, which forecasts an increase of 49 acres. The largest losses are in Olive (177 acres), followed by Gatling (49 acres) and Watts (44 acres).

Table 1.9: Comparison of Existing and Future Land Use for Conservation/Green Space/Parks

Basin	Existing	Future	Approx change in acreage	Comments
	Parks/Recreation/ Conservation	*Conservation/ Green Space*		
Bruces	1.4%	5.6%	49	Slight increase (large basin)
Gatling	15.3%	0.9%	-49	Mostly removed
Olive	13.6%	6.4%	-177	Modest reduction (large basin); removed golf course
Oquina	12.0%	11.6%	-13	Minor change
Watts	40.6%	5.3%	-44	Mostly removed

Figure 1.1: Existing Land Use Overlayed on Subbasin



Existing Land Use City of Thomasville

Legend

- Municipal Boundaries
- Waterways

Existing Land Use

- Single Family Residential
- Multi-Family Residential
- Manufactured Housing Residential
- Public Insitution/Community Facility
- Commercial
- Office/Professional
- Industrial
- Transportation/Communications/Utilities
- Parks/Recreation/Conservation
- Vacant
- Unknown
- Not Classified

Drainage Basins

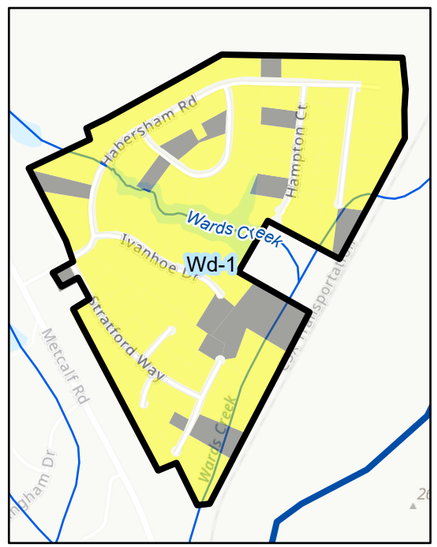


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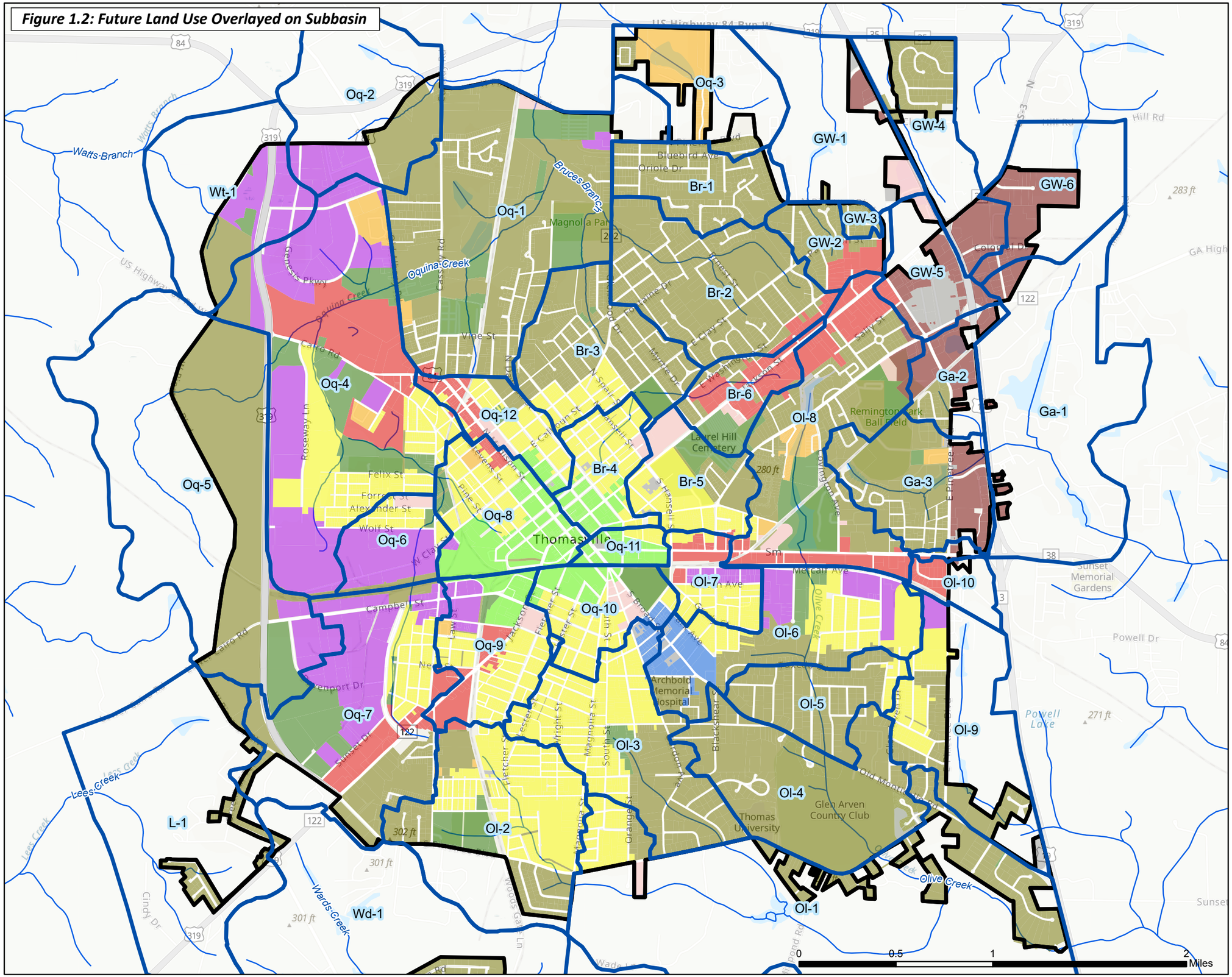
Figure 1.2: Future Land Use Overlayed on Subbasin



Future Land Use City of Thomasville

Legend

- Municipal Boundaries
- Waterways

Future Land Use

- Traditional Neighborhood
- Suburban Neighborhood
- Urban Community
- Downtown Mixed Use
- Office Institutional
- Community Commercial
- Medical District
- Highway Commercial
- Employment Industrial
- Conservation/Green Space
- Not Classified

Drainage Basins

GMC

1.4. DRAINAGE PROJECT LIST

A preliminary drainage project list was created based on reviewing the City's drainage work order and service request database and by meeting with staff in the Public Works and Engineering Departments to discuss areas with flooding and maintenance issues, as well as currently planned drainage projects. The staff meetings also included field visits. After visiting and assessing each site, a project description was prepared, and it was discussed with city staff and assigned one of five possible categories:

1. Drainage Capital Improvement Project; these were relatively straightforward and a defined structural solution could be developed.
2. Capital Projects Requiring Drainage Study; these would require a more detailed engineering analysis or H&H model to determine the specific solution.
3. Programmed/In-House Project; these were generally maintenance-related issues or small projects that the City could address, so they were scheduled in the upcoming fiscal year.
4. Projects to Monitor; these required further tracking to understand the root cause or to see if an issue was still present, as a nearby project may have addressed the issue.
5. Removed Projects; these were either already been resolved, under design/out to bid/under construction, or a private property issue.

The engineering consultant prepared proposed solutions for each project and shared these with the City for their review. Then, a preliminary opinion of probable cost was created for the projects classified as "Drainage Capital Improvement Projects" and an estimated cost was prepared to survey and model projects classified as "Capital Projects Requiring Drainage Study."

The consultant worked with city staff to develop criteria to objectively rank the capital drainage projects. The final prioritization matrix included nine factors with three weighting-tiers. The high-tier factors included a multiplier of 10, moderate of 5, and low of 3. The logic for high-tier factors included:

- *Ownership* is important because if the land is in a City ROW or easement, it is easier and quicker to implement.
- *Structure Flooding/Damage* is important because if flooding is regularly impacting a structure/building, the level of urgency is higher than if there is simply yard or street flooding. As there is frequent street flooding throughout the City, "Street Flooding" was assigned as a low-tier due to it impacting public safety but it was described that the flooding would recede quickly after a storm.
- *Road Resurfacing Timing* is also important because if there is a planned resurfacing project, it would be best to address drainage issues while the road is under construction.

The matrix factors and associated scoring is presented in Table 10. This matrix can only be applied for capital projects with a known solution. For the capital projects that require a drainage study, the resulting project recommendations can later be ranked using this matrix and approach.

Table 1.10: Prioritization Matrix Factors, including Descriptions, Scores, and Multipliers

Ownership (x10)	
5	In City ROW or City Easement
3	Portion of project in City ROW or Easement
1	City to pursue purchasing property and/or acquiring an easement
0	No portion of the project would be within a City ROW or Publicly Dedicated & Accepted Easement
Structure Flooding/Damage (x10)	
5	Documented structure flooding that occurs regularly (e.g., multiple times per year)
3	Documented structure flooding that occurs periodically (e.g., once every year or two)
1	Documented structure flooding that occurs infrequently (e.g., once every few years or more)
0	No structure flooding has occurred
Road Resurfacing Timing (x10)	
5	Project is on 0-2 year list
3	Project is on 3-5 year list
1	Project is on 6-10 year list
0	Project is not on list
Ease of Construction (x5)	
5	Simplistic or straightforward construction/permitting process
2	Difficult or extended effort construction/permitting process
0	Complex/time-consuming construction/permitting process
Cost Analysis (x5)	
5	Project would be cost effective in implementation, or value is less than $15,000
3	Project would have a moderate cost for implementation (price range of $15,000 - $50,000)
1	Project would have a moderate cost for implementation (price range of $50,000 - $100,000)
0	Project would have an elevated cost for implementation (price is greater than $100,000)
Interconnection Between Drainage Projects (x5)	
5	Does not require other drainage projects to be completed first
2	Needs at least 1 other drainage project completed prior
0	Needs multiple drainage projects completed prior
Street Flooding (x3)	
5	Documented street flooding that occurs regularly (e.g., multiple times per year)
3	Documented street flooding that occurs periodically (e.g., once every year or two)
1	Documented street flooding that occurs infrequently (e.g., once every few years or more)
0	No street flooding has occurred
City Plan Compatibility (x3)	
5	Project or problem area has been identified in City Plan or Report
3	Project or problem area has been discussed/suggested but not formally identified in a City Plan or Report
1	Project or problem area has not been previously addressed
0	Project is contrary to City goals/plans
Water Quality Benefits (x3)	
5	Project would improve water quality in an impaired waterway (on EPD's 303 (d) list of impaired waters)
3	Project would improve water quality in receiving stream or achieves the goals of the City's Watershed Protection Plan
1	Project would have no water quality impact
0	Project could have potential negative water quality impact

The drainage studies were also prioritized as high/medium/low based on some of the criteria listed in the prioritization matrix, specifically structure flooding/damage, street flooding, and city plan compatibility.

The prioritized list of CIPs, prioritized list of capital projects requiring a drainage study, programmed/in-house projects, areas to monitor, and areas removed from consideration are detailed in Appendix A, and also shown in Figure 1.3. As the City develops and implements the CIP, future hydrologic and hydraulic (H&H) studies be completed for priority basins to assess upstream and downstream impacts of the proposed CIP. Drainage H&H studies will also be conducted in areas where flooding issues are known but a specific solution cannot be created without calculations and modeling flow from and into adjacent areas and infrastructure. These models would then be utilized in the design and implementation of the various projects. The City may also wish to consider a regional detention approach within prioritized basins that will address existing drainage problems and also allow for future development without adversely impacting existing development or compromising the capacity of recently completed drainage CIPs. As the City moves forward with a more watershed-based approach to stormwater management, implementation of these recommendations will be an important step.

Overall, a total of 24 drainage CIPs were identified throughout the City where existing stormwater infrastructure, or lack of adequate stormwater infrastructure, creates an ongoing maintenance or flooding issue in the City. Estimated costs for each project ranged from $8,000 to $829,000 with a total estimated cost of approximately $3.2 million. Additionally, there were 12 capital drainage studies identified that would encompass 18 problem areas since several were combined at the subbasin level. The total estimated cost for the drainage studies was $538,500. The results from these studies are expected to produce additional drainage CIPs. Each of the drainage CIPs and drainage studies that have a cost are presented in Table 1.11. The Project Team also identified 21 problem areas, in which a solution was proposed that could be implemented in-house with City staff. These were programmed into the City's plans for the current year. Lastly, there were 10 areas identified for the City to monitor in order to determine if an adjacent or recent project will address the previously reported issue. For each individual project, a one-page summary sheet was prepared detailing the project description and proposed solution. It also includes an address, picture, project type, and cost (if applicable). For each CIP, a preliminary cost estimate is also included with the project summary sheet. The project summary sheets and preliminary cost estimates are included in Appendix A.

The City should be aware that the CIP list is based on drainage issues that the City is aware of at this time. The CIP should be a living document that is updated as new issues arise and new CIPs are identified. In addition, the CIP should be revised based on any additional needs discovered during the recommended, full condition assessment described in Chapter 2.

Table 1.11: Drainage CIP and Study Summary

Project ID #	Project Name	Estimated Project Cost	Rank
	Drainage CIPs		
9	106 Stewart St	$49,000	18
13	506 Junius St	$132,000	20
22	CSX Ditches	$196,000	24
25	Glenwood Drive between Artzi Dr and Oriole	$127,000	9
26	906 Glenwood	$223,000	11
28	531 Partridge Dr	$40,000	11
29	1401 Clay St	$53,000	7
30	1211 to 1505 N. Dawson St.	$829,000	16
31	215 and 313 Vine St	$156,000	1
32	206 Wolf St	$43,000	4
36	800 W Clay St	$196,000	15
37	Georgia Ave	$135,000	6
38	111 Lansing St	$42,000	3
39	1921 Fletcher St	$42,000	11
50	Campbell St	$199,000	19
53	Remington Ave	$141,000	17
56	Vine Steet at railroad	$36,000	5
59	Gordon Ave and W. Loomis St	$49,000	10
60	314 Ridgecrest Dr	$26,000	23
65	Georgia Ave Ditch	$263,000	2
67	401 Tanglewood Dr	$54,000	11
68	Tuxedo Dr	$117,000	21
69	129 Plantation Dr	$48,000	22
70	719 North Pinetree	$8,000	8
	Drainage Study		
2/51/64	Bruces 4 Basin Study (305 E. Jefferson; Monroe St; 116 N. Dawson St)	$61,500	High
4/27/47	Oquina 10 Basin Study (Jackson/Remington; Fetcher at CSX RR; 323 Wright St)	$74,000	High
10/58	Bruces 6 Basin Study (214 Glenwood; E. Jackson & Myrtle Dr)	$44,000	High
20	Olive 5 Basin/Tuxedo Ditch Study (333 Tuxedo Dr)	$25,000	Low
23	Olive 7 Basin Study (Smith Ave Farmers Market)	$56,000	High
34/35	Oquina 9 Basin Study (118 College St; 119 Campbell St)	$43,000	Medium
42	Good Water 5 Basin Study (15375 US Hwy 19 S)	$34,500	Low
43	Bruces 6 & Olive 8 Basins (E. Jackson Street Inlet and Trunkline Study)	$50,000	Low
46	Olive 4 Basin (Old Monticello Rd Drainage Study – Tuxedo to Turnberry Ditch Issues)	$34,500	Medium
57	Olive 6 Basin (Pastime Ave Drainage Study at Pastime and Junis)	$21,000	Low
63	Oquina 12 Basin (N. Broad St Trunkline Study)	$44,000	Medium
71	Olive Creek Basin (Watershed Study)	$51,000	Low
	Total Stormwater Capital Needs	**$3,742,500**	

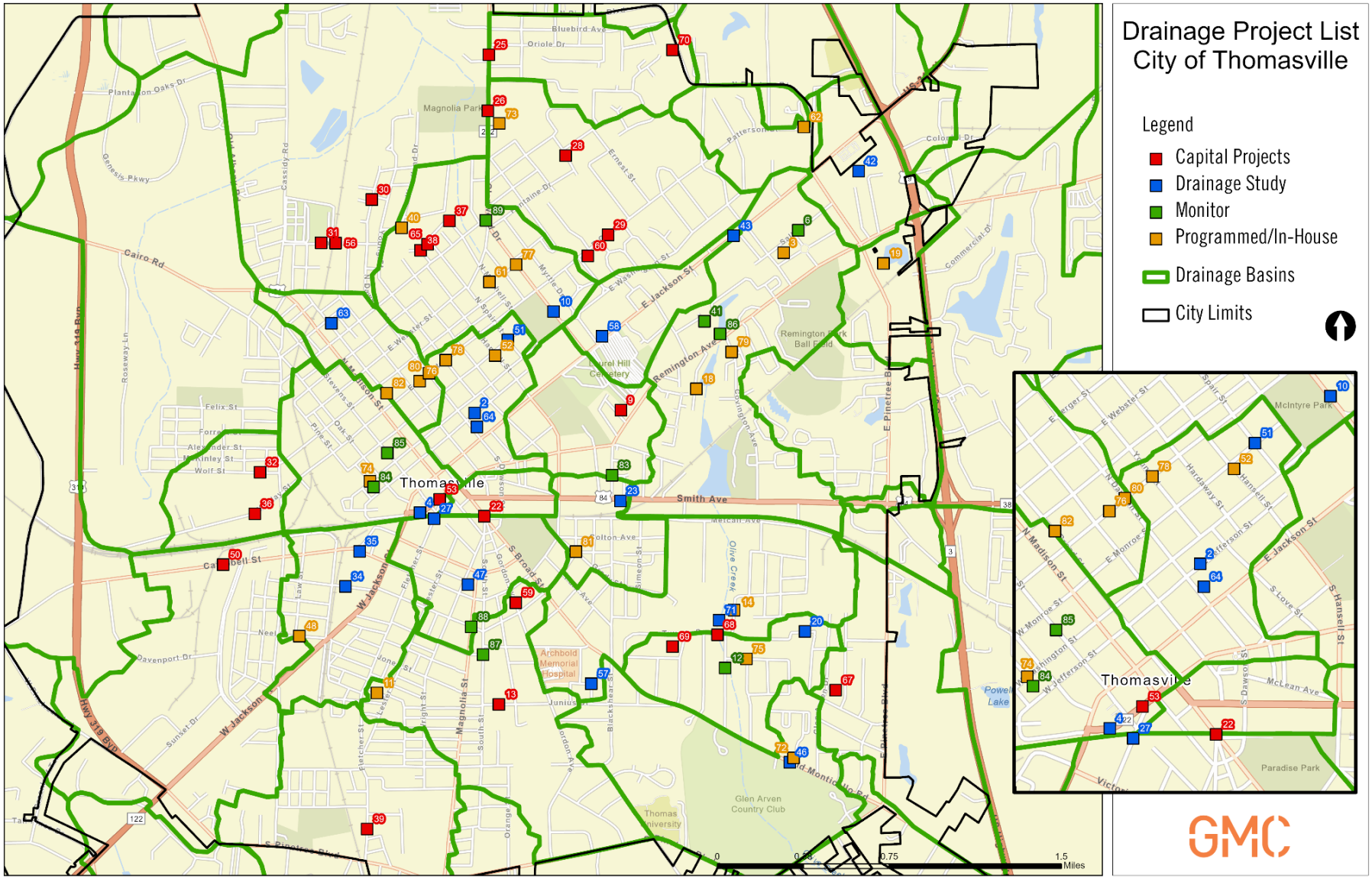


Figure 1.3: Drainage Project List Map

1.5. PUBLIC OUTREACH & COMMUNITY ENGAGEMENT

The Project Team conducted a public outreach process in order to educate the public on this project and stormwater issues throughout the City, and to get their feedback on locations and types of drainage issues in the community. This process included an online survey and series of public open house events. The flooding areas and issues identified through this engagement were assessed and included in the drainage project list described in Section 1.4.

1.5.1 Online Survey

A GIS-enabled online survey was created in ArcGIS Survey123 to allow participants to physically place a point on a map of known flooding, erosion, or water quality issues, and add comments. The online survey was open for two months (February and March), and it remained live during the public open house events in March. The link for the survey was shared on the City's webpage and social media, a QR code was included in a utility bill insert, and open house participants were given the opportunity to complete the survey using tablets provided at those events.

Overall, the survey received 70 responses. The results from the survey showed that the most common drainage issue experienced in the City was flooding (63%), as shown in Figure 1.4. For those that identified "flooding" issues, the majority noted that it was a frequent event – 51% listed "anytime it rains" and 12% listed "all the time" (Figure 1.5). Most of the flooding issues were noted to be within the street (60%) followed by yards (30%); very few flooding issues were identified at structures (5%) (Figure 1.6). The source of the floodwater was most commonly identified as coming from roadways (60%) followed by not knowing the source (19%) (Figure 1.7). A highlight from the survey was that many of the flooding issues identified in comments or on the map were already included in the City's preliminary drainage project list that was compiled earlier in the year. Any new site identified in the online survey was investigated by the consultant, discussed with City staff, and added to the final drainage project list.

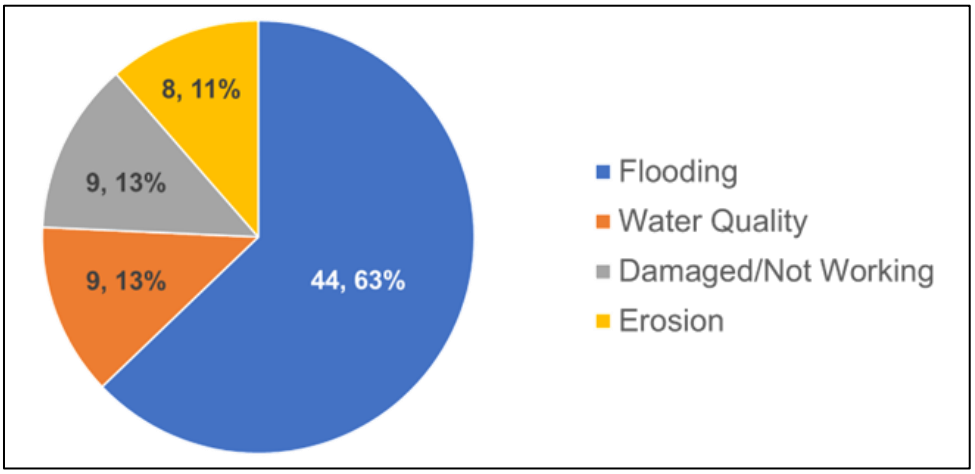


Figure 1.4: Type of Drainage Issue

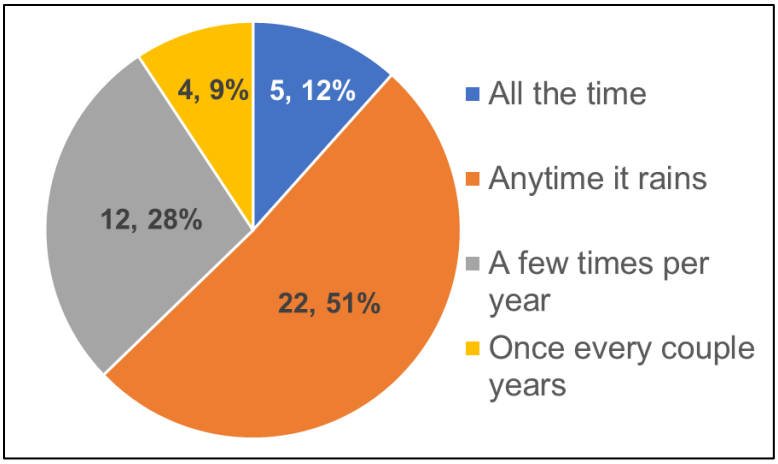


Figure 1.5: Flooding Frequency

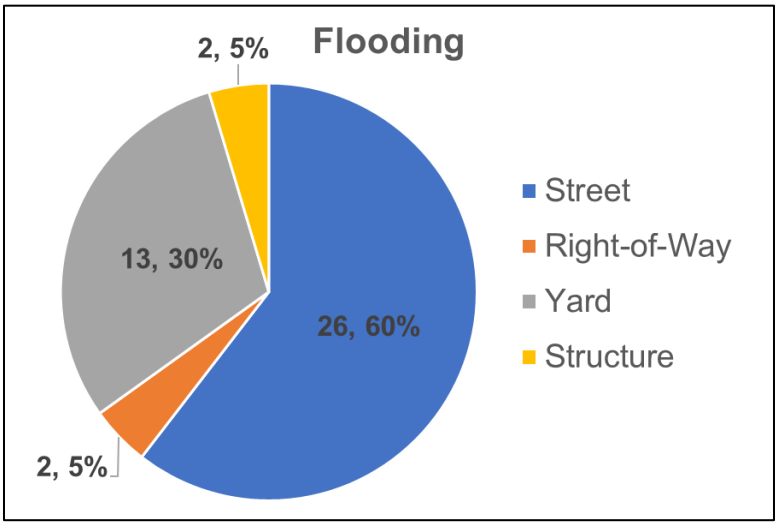


Figure 1.6: Flooding Location

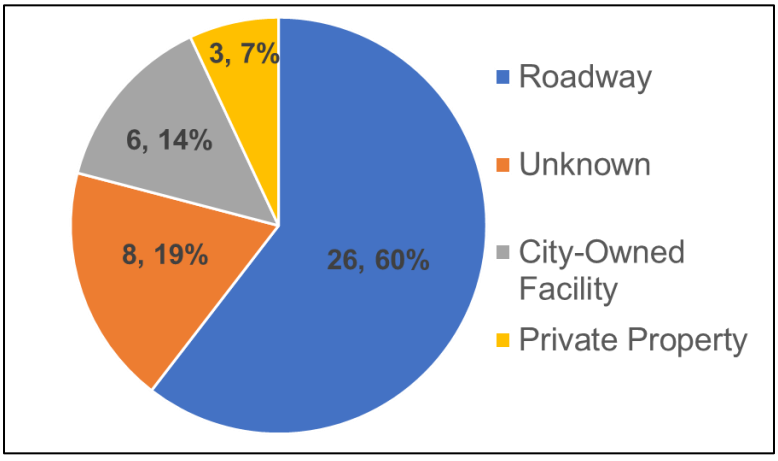


Figure 1.7: Flooding Source

Water quality issues were identified by 9 (13%) respondents, but only 6 provided details on type of the issue. The details included: 2 as illegal dumping, 2 as algae, 1 as oil/paint/chemical, and 1 as yard debris. Erosion issues were identified by 8 (11%) of respondents, and the frequency of responses on location were: ditch (4), stream/streambank (3), and around a structure (1).

An additional comments section was provided in the survey for participants to elaborate on the area identified or other comments. A few specific comments on the stormwater program included:

- *City needs to have a storm water utility so they can begin to fix some of the old pipes or upgrade the existing pipes*
- *Public Education program on yard debris, especially for landscape contractors to explain what happens to all of the yard debris that is blown into the City's storm inlets*
- *Adopt a comprehensive plan for flooding*
- *The City should adopt the Georgia Stormwater Management Manual*
- *Study Olive Creek to restore more vibrant ecological and recreation system*

1.5.2 Public Open House

A public open house event was held on March 21, 2022, and it was a joint event with the Parks Master Plan consultant team. The Stormwater Master Plan portion of the open house was designed to educate the public on this project and stormwater issues throughout the City. The event included several stations for residents to talk with City staff and members of the consultant team to learn about the project and express any concerns or feedback on known flooding or other stormwater issues. The preliminary drainage project list and map were set up at one station. New areas with flooding issues were added to this map with numbered sticky dots and a description was added to a corresponding, numbered table. Many of the points on the preliminary list were confirmed with residents; however, there were 5 new points identified. The City used these materials to lead three events the following week, and an additional 6 points were identified. These sites were reviewed with City staff and added to the drainage project list.

Two other stations at the open house included a computer display and projection to view all of the GIS datasets that they City and consultant had compiled, and a poster showing the linkage between parks and stormwater. The poster, from the National Recreation and Park Association (NRPA), is included in Figure 1.8, and it led to several discussions with residents on ways to incorporate green infrastructure techniques into these projects and that it was desirable to combine park upgrades with enhanced stormwater management.

Figure 1.8: Parks and Stormwater Poster used at Open House Event *(Source: NRPA)*

1.6. OVERALL WATERSHED PRIORITIZATION

Downtown Thomasville is mostly situated at the highest elevation of the City, so land and resulting runoff/flow travels outward in each direction. As a result, most of downtown is in the headwaters of Oquina Creek, Olive Creek, and Bruces Branch. The watersheds of these three segments comprise 86% of the City and they encompass the majority of the identified drainage issues. Therefore, they should be the focus of future drainage studies and CIPs. These watersheds are also the ones with water quality impairments. The five basins with 5% or less of the watershed, have very few drainage issues identified – one drainage study and one in-house project in Goodwater (5%); one in-house project in Gatling (4%); and no projects in Wards (2%), Watts (2%), or Lees (1%).

In addition to the water quality impairments in Oquina Creek (and Bruces Branch) and Olive Creek, these watersheds have the largest area of vacant land, per the existing land use map, so these areas will be the location of much of the future development and resulting increased impervious surfaces. Before full development, it is recommended to enhance the post-construction stormwater management standards to limit future flooding issues.

Overall, the four highest ranked basins requiring a drainage study include: Bruces 4, Oquina 10, Bruces 6, and Olive 7. These are all in the headwaters of their respective creeks, so improvements and exploring regional detention in these through a watershed model, will translate to additional benefits downstream. Two of the three basins ranked as medium that require the entire basin studied are also headwater watersheds – Oquina 9 and Oquina 12. With all of the headwater watersheds in need of study (6), total number of recommended studies (12), and total number of drainage issues identified (18), it is recommended to proceed with the drainage studies as an early task of implementing the Stormwater Master Plan. It is likely that many of the CIPs developed as part of these studies will be highly rated, due to the described flooding and impacts at many of these sites. Once the specific CIPs are developed, they are recommended to be entered into the prioritization matrix to determine rank versus the 24 projects identified through this original Stormwater Master Plan.

The watersheds with the highest ranked CIPs include: Oquina 1 ($1^{st}/5^{th}/16^{th}$), Bruces 3 ($2^{nd}/3^{rd}/6^{th}$), Oquina 6 ($4^{th}/15^{th}$), Bruces 2 ($7^{th}/11^{th}/11^{th}/23^{rd}$), and Bruces 1 ($8^{th}/9^{th}$). With multiple highly-rated CIPs, it is recommended to explore the other projects in a basin when starting one to see if there is benefit to combining any project.

2. DRAINAGE SYSTEM ASSET ASSESSMENT & MAINTENANCE PLAN

This chapter describes the data and process used to develop a proactive program and Standard Operating Procedures (SOP) for maintaining the City's drainage infrastructure. The process included a review of the following key datasets:

- Drainage operations and maintenance (O&M) work orders and service requests
- Stormwater system GIS inventory
- Pilot study stormwater system condition assessment

The results from each item noted above is detailed in the subsequent subsections.

2.1. DRAINAGE SYSTEM WORK ORDER/SERVICE REQUEST REVIEW

The City's existing work orders (WOs) and service requests (SRs) related to stormwater and drainage were reviewed to determine the types of issues experienced, frequency, and typical time to resolve the issue. A summary of the annual O&M request frequency for 638 WOs/SRs from September 20, 2019, to December 9, 2021, is described in Table 2.1. In total, 622 WOs/SRs were completed, while only 16 remained active. The City's response time for completing these tasks was calculated as an average and as quartiles. The 1st quartile (25th percentile) represents one-quarter of the WOs/SRs were completed in that number of days. The median (50th percentile) represents half of the WOs/SRs were completed, and the 3rd quartile (75th percentile) represents three-quarters of the WOs/SRs were completed. This is a better way to view data in case if there is a small number of WOs/SRs that take substantially longer than most of the WOs/SRs, as they would skew the average to look as if the typical response time is much longer than what it is taking City crews to complete the majority of the WOs/SRs. From the annual summary of data in Table 2.1, three-quarters of the WOs/SRs were closed within 32 days in 2019, and this decreased to 13 days in 2020 and 5 days in 2021, so the public works crews increased their response time during this period.

Table 2.1: Summary of Work Order/Service Request Frequency and Time to Complete

Year	WO/SR Total	Time to Complete WOs/SRs (Days)				Completed WOs/SRs	"Active" WOs/SRs
		Average	*25th Percentile (1st Quartile)*	*50th Percentile (Median)*	*75th Percentile (3rd Quartile)*		
2019	28	19	0	8	32	28	0
2020	281	32	0	2	13	273	8
2021	329	7	1	1	5	321	8

Figure 2.1 presents the monthly WOs/SRs frequency, which increased dramatically starting in 2020 due to a new system and updated protocols. Normalized over a 12-month period, 2019 had a rate of 102 WOs/SRs per year, and this increased to 281 in 2020 and 329 in 11 months of 2021. Figure 2.1 shows higher frequency of complaints and WOs/SRs during the spring and summer months that are typically associated with large, intense rainfall events.

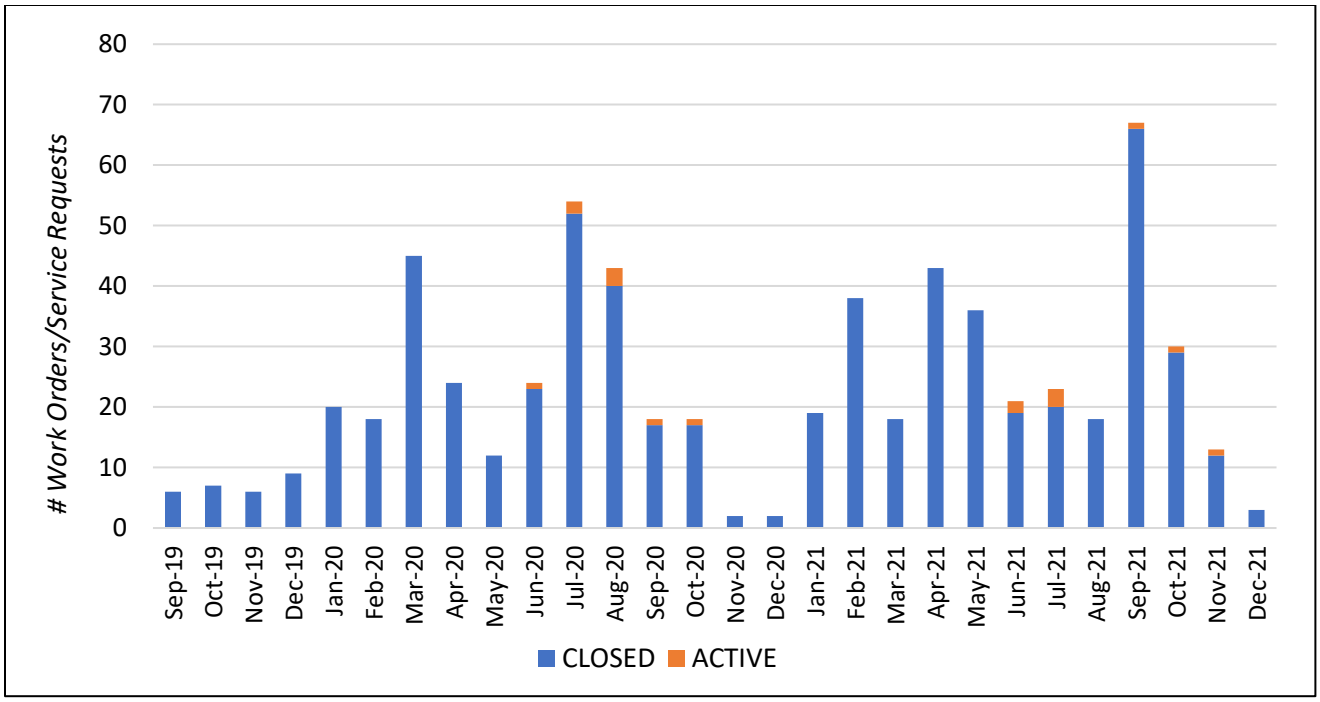


Figure 2.1: Monthly Work Order/Service Request Frequency 9/20/2019 – 12/9/2021

The City's response time to WOs/SRs has improved dramatically from 2020 to 2021. The new work order system and establishing a crew dedicated to drainage system O&M were likely responsible for this improvement. In 2020, there were 281 WOs/SRs submitted; 273 were completed with 96 listed as being completed within 24 hours from when it was initiated. Of the 177 closed WOs/SRs that took at least one day to complete, the average was 49 days, and the median response time was 8 days. This means half of the WOs/SRs that are not completed on the day that they are initiated are now being completed within about a week. In 2021, there were 329 WOs/SRs submitted; 321 were completed with 117 completed within 24 hours. Of the remaining 204 WOs/SRs that took at least one day to complete, the average was 10 days, and the median response time was 3 days. A summary of these results is shown in Table 2.2.

Table 2.2: Summary of WO/SR Frequency and Time to Complete for those Greater than One Day

Year	No. Closed WOs/SRs	WOs/SRs >1 Day		*Time (Days)*		
				Avg. Time, All (days)	*Avg. Time, WOs/SRs >1 day (days)*	*Median Time, WOs/SRs > 1 day (days)*
2019	28	20	71%	19	27	27
2020	273	177	66%	32	49	8
2021	321	204	64%	7	10	3

The City records and categorizes WOs/SRs using several "problem codes" which allows them to group similar issues together and provide a quick understanding of the problem identified. The problem codes and status for each are listed in Table 2.3. From the service request database of "broken inlet/repair storm drain," there was a total of 71 SRs over the 27-month period, which is

approximately 3 per month, and it had an even split of inlets and storm drains. From the "stormwater" work order database, there was a total of 208 issues, which is approximately 8 per month, and the majority of WOs (81%) were "clear/clean [ditch, inlet, gravity main, manholes]." For the service request database of "flooding drainage issue," there were a total of 359 SRs with a "flooding/drainage" issue, which is approximately 13 per month. The cause of flooding for these was split mostly into three main categories: 1) other (37%), 2) gutter/drain clogged (35%), and 3) ditch stopped up (26%). Since "other" is the most prevalent cause, there may need to be additional options to provide more context on the issues.

Table 2.3: Summary of Work Order/Service Request Frequency by Type/Code

Data Source	Problem Code	WOs/SRs Submitted	*WO/SR Status*	
			Closed	*Active*
SRs: Broken Inlet – Repair Storm Drain	Broken/Damaged Inlet	32	32	0
	Repair Storm Drain	39	38	1
WOs: Stormwater	Clear/Clean [Ditch, Inlet, Gravity Main, Manholes]	168	168	0
	Repair [inlets, culvert, etc.]	31	28	3
	Replace [inlet, gravity main]	5	4	1
	Stormwater analysis	1	1	0
	New Stormwater Culvert	1	0	1
	New Stormwater Gravity Main	1	1	0
	Camera Stormwater Gravity Main	1	0	1
SRs: Flooding Drainage Issue (Flooding Cause)	Ditch stopped up	93	92	1
	Gutter/drain clogged	126	126	0
	Other	134	129	5
	Blank	6	3	3
	Total	**638**	**622**	**16**

Due to the nature of how data was captured via problem codes, there are similar 'Problem Codes' listed for work orders and service requests related to inlet repairs and replacements from the respective databases. To reduce confusion, the statistical values for the City's response time to each of these similar codes are listed separately in Table 2.4. As a note, there were five WOs/SRs that have not been closed that are associated with these problem codes (as shown in Table 2.3) and thus were not included in the statistical analyses. Three of these active WOs/SRs were listed as "Pending," one as "Scheduled," and one as "Ready to Work." Examples of reasons for why these WOs/SRs were not closed include funding sources are still unknown and/or the City is awaiting a necessary easement. Overall, the highest median value for closing a WO/SR across this category did not exceed 12 days from the time it was opened/initiated. More than 75 percent of WOs/SRs listed in the replacement-related code, were completed within 6 days where the maximum response time was just 7 days. The maximum response time across these categories was 117 days. However, more than three-quarters of these WOs/SRs were addressed within/less than 30 days. A detailed breakdown for each of the problem codes is listed in Table 2.4.

Table 2.4: Summary of Work Order/Service Request Frequency by Type/Code

Problem Code	Count/ Frequency	Days to Completion				
		Average	*25th Quartile*	*Median*	*75th Quartile*	*Maximum*
SR: Broken/Damaged Inlet	32	21	2	12	30	101
SR: Repair Storm Drain	39	10	1	7	12	43
WO: Repair [Inlets, Culvert, etc.]	31	11	0	1	8	117
WO: Replace [Inlet, Gravity Main]	5	5	3	5	6	7

**The values depicted are not separated by year, thus the summations provided are representative of all relevant WOs/SRs submitted in 2019-2021.*

The remaining problem codes cover issues related to the cleaning of stormwater infrastructure, flooding/drainage issues, a stormwater analysis, addition of new structures, and a camera analysis, as listed in Table 2.5. This table includes a detailed statistical summary of the response time for these categories. There was only one WO submitted for each of the problem codes: "stormwater analysis," "new stormwater culvert," and "new stormwater gravity main." With the exception of these single items, three-quarters of the other WOs/SRs were addressed and completed within 16 days. For less complicated maintenance issues identified such as the "clear/clean" category, three-quarters of the WOs were closed within 6 days. The long timeframe for completing the "Stormwater Analysis" and "New Stormwater Gravity Main" WOs can be attributed to the nature of doing this type of work and the required input and inspections. As a note, the 11 WOs/SRs associated with these problem codes that had not been closed were not included in the statistical analyses.

Table 2.5: Summary of Work Order/Service Request Frequency by Type/Code

Problem Code	Count/ Frequency	Days to Completion				
		Average	*25th Quartile*	*Median*	*75th Quartile*	*Maximum*
WO: Clear/Clean [Ditch, inlet, culvert, gravity main, manholes]	168	7	0	1	6	386
WO: Stormwater analysis	1	329	329	329	329	329
WO: New Stormwater Culvert	1	ND	ND	ND	ND	ND
WO: New Stormwater Gravity Main	1	358	358	358	358	358
WO: Camera Stormwater Gravity Main	1	ND	ND	ND	ND	ND
SR: Flooding Drainage Issue, *Ditch stopped up*	93	9	1	2	14	52
SR: Flooding Drainage Issue, *Gutter/drain clogged*	126	26	0	1	4	489
SR: Flooding Drainage Issue, *Other*	134	30	0	2	7	489
SR: Flooding Drainage Issue, *Blank*	6	11	4	4	16	27

**ND stands for "No Data", and is only used for where there is only an "Active" Work Order in this category*

2.2. GIS INVENTORY AND CONDITION ASSESSMENT

The City has a comprehensive GIS inventory of their stormwater drainage system, and it includes 14,646 total structures (e.g., inlets, detention areas, pipes, ditches, etc.), as presented in Table 2.6. For many of the structures, the City has survey-grade information on spatial location and elevation. Based on the City's feedback, GMC completed a pilot condition assessment of approximately 20% of these structures in March 2022. The City provided guidance of problem areas that they wanted the pilot study to cover, GMC started in the upstream subbasins of Oquina Creek that included the downtown core and expanded to the upstream subbasins of Olive Creek and Bruces Branch near downtown (Figure 2.2). During the condition assessment, GMC staff trained City staff on the field assessment and data management procedure so that they can continue the assessment as time and funding allow.

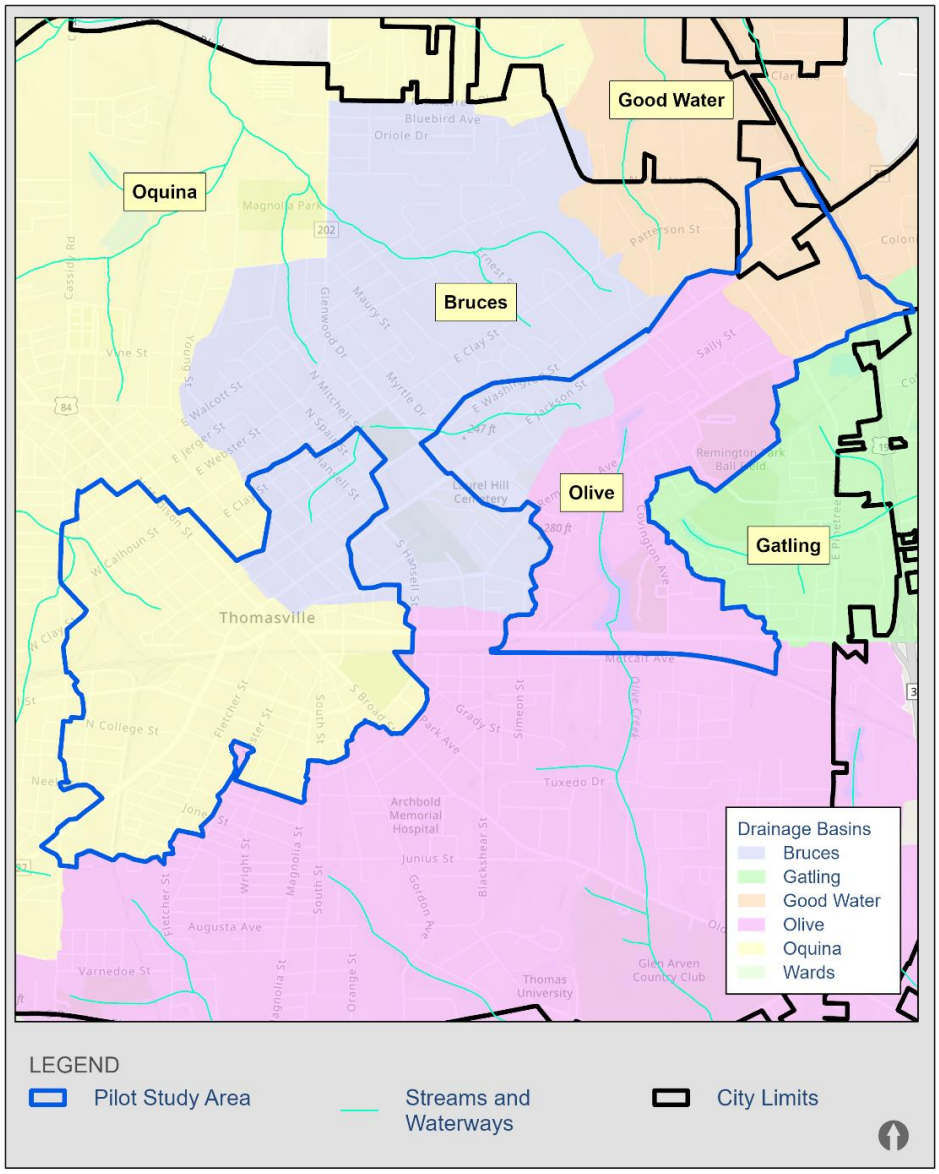


Figure 2.2: Map of Condition Assessment Pilot Study

Table 2.6: Stormwater GIS Inventory and Pilot Condition Assessment

Structure Type	*Structure Type*	*Total Count*	*Inspected (Pilot)*	*% Complete*
Points	Inlets	3,851	950	25%
	Manholes	603	214	35%
	Outfalls	75	29	39%
BMP	Detention Areas	86	22	26%
Lines	Pipes	5,158	1,288	25%
	Culverts	2,191	174	8%
	Ditches	2,684	206	8%
Total		**14,646**	**2,881**	**20%**

Based on the April 2020 Report, "*Proposed Linear Asset Condition Scoring in Cityworks AMS*," by Jones Edmunds & Associates, Inc., the City's stormwater inventory included a comprehensive representation of fields that included physical, spatial, and conditional properties. A scoring procedure was created to assess probability of failure (POF) and consequence of failure (COF). An overall risk score is based on POF multiplied by COF. POF generally included a combination of age, structural condition, other conditional items (sediment, debris, vegetation, erosion, water quality). COF generally included a combination of risk, customers serviced, land use, accessibility, road type, and infrastructure depth. Each of the items and their summary results are described in the subsections below by structure type. The assessment focused on the POF items that were associated with conditional assessments. During review of the options for each condition, a recommended ranking and prioritization for maintenance was included. This included four levels: 1) *immediate* (dark red), 2) *high* (red), 3) *medium* (orange), and 4) *low* (yellow). *Immediate* was set for a few conditions where the inspection noted immediate action was needed or a public safety concern was present. For many of the conditions, all four levels were not always assigned. The magnitude of the associated issues and urgency of a response guided the ranking. These criteria and rankings are described in detail in the subsequent subsections outline each structure type individually. Since the pilot study only assessed a subset of the City, the summary results were extrapolated to estimate of the total number of issues citywide, assuming that there was a constant distribution of issues in the unassessed areas.

A few examples of the condition assessment data that have similar maintenance needs (e.g., structural damage or sedimentation) are presented in the figures on the subsequent pages. In each of these, the ratings are color coded, where green is in good condition, and the severity of the issue increases as the color changes to yellow, orange, red, and dark red. Figure 2.3 includes the results from the structural condition fields for inlets and pipes in a section of the pilot area in downtown. This visual display highlights where the most pressing needs are for structural repair. Figure 2.4 includes the results for presence of sediment in inlets and pipes for the same geographic area. Figure 2.5 includes a summary of the most pressing needs for sediment removal in stormwater inlets and pipes in the downtown pilot study area. Only inlets and pipes that have maintenance needs of medium (orange) or worse (red or dark red), are presented in this figure.

Figure 2.3: Example Results Associated with Structural Damage in Pipes and Inlets.

Figure 2.4: Example Results Associated with Sediment/Debris Buildup in Pipes and Inlets.

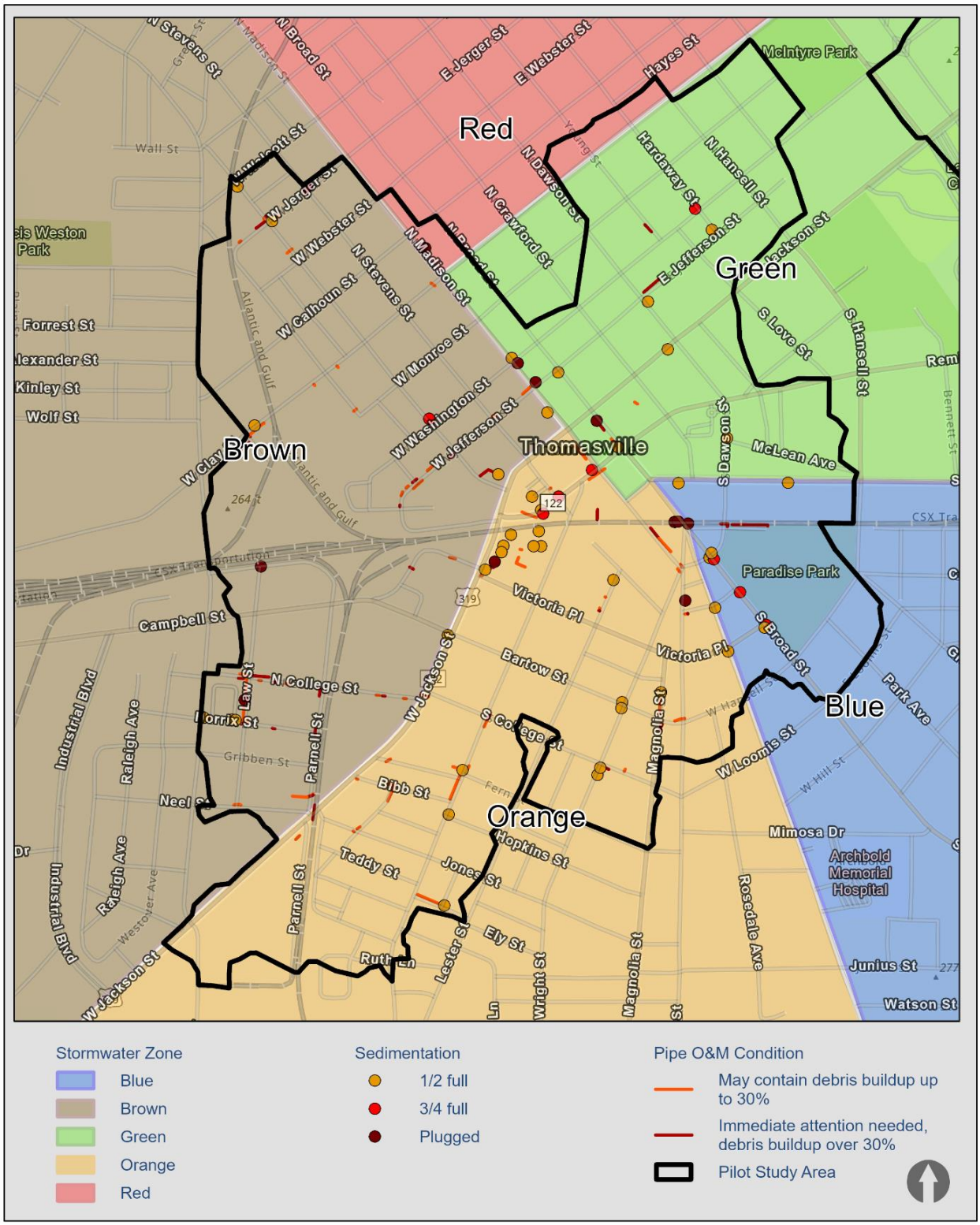


Figure 2.5: Sediment Buildup Maintenance Needs for Pipes and Inlets in Pilot Area.

2.2.1 Inlets

Inlets were assessed for structural conditions of the grate and structure itself, water quality indicators of odor, turbidity, and water sheet, as well as excessive vegetation and accumulation of sediment. A color-coded scheme of the conditions and associated priority level for maintenance are presented below.

Code	Grate Condition	Structure Condition	Odor	Turbidity	Water Sheen	Vegetation	Sedimentation
0	*New Installation or Blank (due to partial inspection) [mostly blank]*						
1	Serviceable/Fits	Good/satisfactory	None	None	None	None	None
2	Ill-Fitting/misaligned	Minor cracking/spalling		Cloudy	Oil Sheen	Minor	1/4 full
3	Cracked or corroded	Cracking/spalling/or some erosion	Noticeable Odor	Opaque	Grease/oil		1/2 full
4	Damaged/broken	Structurally Unsafe				Moderate	3/4 full
5	Unsafe/needs immediate replacement	Immediate attention needed	Powerful Odor			Excessive	Plugged

Overall, 950 inlets were inspected out of 3,851, which represents 25% of these features. These results are presented below. Of the 950 inlets inspected, 68 were noted as having a partial inspection (7%). Partial inspections generally had several incomplete fields due to issues with structure access, opening a lid, or obstructed views.

Code	Grate Condition	Structure Condition	Odor	Turbidity	Water Sheen	Vegetation	Sedimentation
0	156 (16%)	93 (10%)	105 (11%)	109 (11%)	111 (12%)	95 (10%)	96 (10%)
1	692 (73%)	628 (66%)	839 (88%)	782 (82%)	802 (84%)	614 (65%)	399 (42%)
2	60 (6%)	163 (17%)		46 (5%)	29 (3%)	176 (19%)	386 (41%)
3	16 (2%)	46 (5%)	4 (0%)	13 (1%)	8 (1%)		45 (5%)
4	18 (2%)	7 (1%)				36 (4%)	10 (1%)
5	8 (1%)	13 (1%)	2 (0%)			29 (3%)	14 (1%)

A summary of the maintenance priority level is presented in the table below. In cases where a structure had multiple issues, the highest-rated item was filtered to determine the maximum score for each structure. Overall, 3% of inlets inspected had at least one item of *immediate* priority, 7% at *high* priority, 11% at *medium* priority, and 47% at *low* priority. Assuming an even distribution of issues citywide, this would equate to 109 structures with *immediate* priority, 268 with *high*, and 430 with *medium*.

Priority Scoring	Grate Condition	Structure Condition	Odor	Turbidity	Water Sheen	Vegetation	Sedimentation	Max Score	Percentage
Low	60	163	4	46	29	176	386	**448**	**47%**
Medium	16	46				36	45	**106**	**11%**
High	18	7	2	13	8	29	10	**66**	**7%**
Immediate	8	13					14	**27**	**3%**

Since inlets had many features assessed, each were projected for the full dataset of 3,851 total inlets to estimate potential maintenance needs across the City, as shown below.

Priority Scoring	Grate Condition	Structure Condition	Odor	Turbidity	Water Sheen	Vegetation	Sedimentation
Low	243	661	16	186	118	713	1565
Medium	65	186				146	182
High	73	28	8	53	32	118	41
Immediate	32	53					57

2.2.2. Manholes

Manholes were assessed for structural conditions of the cover, interior, and presence of inflow and infiltration (I&I), as well as presence of debris and vermin. A color-coded scheme of the conditions and associated priority level for maintenance are presented below.

Code	Cover Condition	Cover Grade	Interior Condition	I & I	Debris/Surcharge	Vermin/Rodents
0	*New Installation or Blank (due to partial inspection) [mostly blank]*					
1	Serviceable/Fits	Flat with surface	Good/Satisfactory	None	Flowing/no debris present	None
2	Ill-Fitting/misaligned		Missing grout	Stain	Debris on bench	
3	Cracked or corroded	Needs to be raised or lowered - Schedule	Missing bricks and grout	Weeping	Debris/surcharge - cannot see bottom	Insects
4	Damaged/broken		Structurally unsafe	Running	Debris/surcharge - half full	
5	Unsafe/needs immediate replacement	Needs to be raised or lowered - Urgent	Immediate attention needed	Gushing	Debris/surcharge - > half full	Rodents/other animals

Overall, 214 manholes were inspected out of 603, which represents 35% of these features. These results are presented below. Of the 214 manholes inspected, 66 were noted as having a partial inspection (31%).

Code	Cover Condition	Cover Grade	Interior Condition	I & I	Debris/Surcharge	Vermin/Rodents
0	102 (48%)	95 (44%)	119 (56%)	122 (57%)	119 (56%)	119 (56%)
1	91 (43%)	111 (52%)	83 (39%)	87 (41%)	65 (30%)	84 (39%)
2	15 (7%)		7 (3%)	1 (0%)	12 (6%)	
3	2 (1%)	8 (4%)	2 (1%)	3 (1%)	17 (8%)	11 (5%)
4	2 (1%)		0 (0%)	1 (0%)	1 (0%)	
5	2 (1%)	0 (0%)	3 (1%)	0 (0%)	0 (0%)	0 (0%)

A summary of the maintenance priority level is presented in the table below. Overall, there were only 5 manholes with *immediate* priority and 2 with *high* priority, and due to manholes with multiple issues, these occurred in 5 manholes (2%).

Priority Scoring	Cover Condition	Cover Grade	Interior Condition	I & I	Debris/Surcharge	Vermin/Rodents
Low	15		7	4	12	11
Medium	2	8	2	1	18	
High	2	0	0	0	0	0
Immediate	2		3		0	

2.2.3. Outfalls

Stormwater outfalls were assessed for the presence of erosion and sedimentation/debris. A color-coded scheme of the conditions and associated priority level for maintenance are presented below. Overall, 29 outfalls were inspected out of 75, which represents 39% of these features. These results are presented below. Of the 29 outfalls inspected, 14 were noted as having a partial inspection (48%). None of the outfalls inspected had *immediate* or *high* priority conditions identified. However, there were 4 outfalls (14%) with *medium* priority conditions.

Erosion		**Sedimentation & Debris**	
New installation or blank (due to partial inspection) [mostly blank]	12 (41%)	*New installation or blank (due to partial inspection) [mostly blank]*	13 (45%)
No erosion	10 (34%)	Free flowing	14 (48%)
Minor erosion	4 (14%)	Light-negligible impact to flow	1 (3%)
Medium erosion	3 (10%)	Medium-some flow restrictions	1 (3%)
Major erosion	0 (0%)	Heavy-flow impeded	0 (0%)
Excessive erosion	0 (0%)	Plugged-flow blocked	0 (0%)
Total	**29**	**Total**	**29**

2.2.4. Detention Areas

Detention areas were assessed for the presence of debris/sediment and erosion, and the outlet condition was assessed from a structural perspective and debris buildup. It is suggested to separate the structure and debris assessment in this item in the future, as they have different approaches and equipment for maintenance. A color-coded scheme of the conditions and associated priority level for maintenance are presented below. Overall, 22 detention areas were inspected out of 86, which represents 26% of these features. These results are presented below. Of the 22 detention areas inspected, 2 were noted as having a partial inspection (9%). Only one detention area had an *immediate* priority condition identified. The one *immediate*, two *high*, and three *medium* condition categories were limited to three detention areas due to sites with multiple issues. Overall, there were only two detention areas (9%) with at least *high* priority conditions and a third was due to *medium* priority conditions.

Code	**Level of Debris/ Sediment**	**Vegetation**	**Outlet Condition**
0	*New Installation or Blank (due to partial inspection) [mostly blank]*		
1	None	Good/no erosion	Good, no debris buildup
2	Minor	Minor erosion	Fair, some debris buildup and/or structural wear
3	Rake/sweep	Medium erosion	Poor, medium debris buildup and structural wear
4	Mechanical removal	Major erosion/needs restoration	Structure clogged and/or major structural damage
5	Excessive	Excessive erosion/rebuild	Needs replacement

Code	Level of Debris/ Sediment	Vegetation	Outlet Condition
0	5 (23%)	4 (18%)	5 (23%)
1	8 (36%)	13 (59%)	11 (50%)
2	7 (32%)	3 (14%)	4 (18%)
3	0 (0%)	2 (9%)	1 (5%)
4	1 (5%)	0 (0%)	1 (5%)
5	1 (5%)	0 (0%)	0 (0%)

2.2.5. Pipes

Pipes were assessed for structural condition and buildup of debris. A color-coded scheme of the conditions and associated priority level for maintenance are presented below.

Code	Pipe Structural Condition	Pipe O&M Condition
0	*New Installation or Blank (due to partial inspection) [mostly blank]*	
1	Good/Satisfactory	No accumulation of debris
2	Minor Wear	Sand or debris <5% of pipe diameter
3	Major Wear	May contain debris buildup up to 15%
4	Structurally Unsafe, Buried Culvert	May contain debris buildup up to 30%
5	Immediate Attention Needed	Immediate attention needed, debris buildup over 30%
6		Unknown, no CCTV

Overall, 1,288 pipes were inspected out of 5,158, which represents 25% of these features. These results are presented below. Of the 1,288 pipes inspected, 143 were noted as having a partial inspection (11%). Based on pipe length, 21.9 out of 91.1 miles were inspected, which is 24%.

Code	Pipe Structural Condition	Pipe O&M Condition
0	194 (15%)	171 (13%)
1	716 (56%)	411 (32%)
2	338 (26%)	369 (29%)
3	31 (2%)	185 (14%)
4	4 (0%)	83 (6%)
5	5 (0%)	38 (3%)
6		31 (2%)

A summary of the maintenance priority level is presented in the table below. In cases where a structure had multiple issues, the highest-rated item was filtered to determine the maximum score for each structure. Overall, 3% of pipes inspected had at least one item of *immediate* priority, 11% at *high* priority, 14% at *medium* priority, and 35% at *low* priority. Assuming an even distribution of issues citywide, this would equate to 164 pipes with *immediate* priority, 553 with *high*, and 725 with *medium*.

Priority Scoring	Pipe Structural Condition	Pipe O&M Condition	Highest Rating
Low	338	369	447 (35%)
Medium		185	181 (14%)
High	31	114	138 (11%)
Immediate	9	38	41 (3%)

2.2.6. Culverts

Culverts used the same criteria as pipes. Overall, 174 culverts were inspected out of 2,191, which represents 8% of these features. These results are presented below. Of the 174 culverts inspected, 3 were noted as having a partial inspection (2%). Based on pipe length, 1.5 out of 14.3 miles were inspected, which is 10%.

Code	Pipe Structural Condition	Pipe O&M Condition
0	21 (12%)	23 (13%)
1	44 (25%)	35 (20%)
2	100 (57%)	55 (32%)
3	5 (3%)	18 (10%)
4	3 (2%)	25 (14%)
5	1 (1%)	18 (10%)
6		0 (0%)

A summary of the maintenance priority level is presented in the table below. In cases where a structure had multiple issues, the highest-rated item was filtered to determine the maximum score for each structure. Overall, 11% of culverts inspected had at least one item of *immediate* priority, 16% at *high* priority, 10% at *medium* priority, and 42% at *low* priority. Overall, there was a higher percentage of major issues at culverts than pipes. Assuming an even distribution of issues citywide, this would equate to 239 culverts with *immediate* priority, 353 with *high*, and 214 with *medium*.

Priority Scoring	Pipe Structural Condition	Pipe O&M Condition	Highest Rating
Low	100	55	73 (42%)
Medium		18	17 (10%)
High	5	25	28 (16%)
Immediate	4	18	19 (11%)

2.2.7. Ditches

Ditches were assessed for debris and erosion. A color-coded scheme of the conditions and associated priority level for maintenance and a summary of the results are presented below. Overall, 206 ditches were inspected out of 2,684, which represents 8% of these features. These results are presented below. Of the 206 ditches inspected, 2 were noted as having a partial inspection (1%). Based on ditch length, 4.8 out of 73.9 miles were inspected, which is 6%.

Rating	Debris	Erosion
Blank	20 (10%)	16 (8%)
None	84 (41%)	113 (55%)
Minor	74 (36%)	56 (27%)
Moderate	25 (12%)	21 (10%)
Severe	3 (1%)	0 (0%)
Total	**206**	**206**

In cases where a structure had multiple issues, the highest-rated item was filtered to determine the maximum score for each structure. Overall, 1% of ditches (3) inspected had at least one item of *high* priority and 17% (35 ditches) had *medium* priority. Assuming an even distribution of issues citywide, this would equate to 39 ditches with *high* priority and 456 with *medium*. The frequency of ditches with specific maintenance needs were projected based on the assumption of similar conditions citywide, and the results are presented below.

Rating	Debris	Erosion
Minor	964	730
Moderate	326	274
Severe	39	0

2.3. LONG-TERM DRAINAGE OPERATIONS & MAINTENANCE STANDARD OPERATING PROCEDURES (O&M SOP)

In the April 2020 Report, "*Proposed Linear Asset Condition Scoring in Cityworks AMS*," each category for POF and COF was assigned a weighting factor. While this is a good approach to evaluate the system citywide and gain an understanding of which structures are more prone to failure or the impact it will cause if it does fail, it does not describe the exact maintenance issue, and there are some issues that have high urgency and should not wait for action until the overall score reaches a target threshold value. Additionally, certain maintenance tasks utilize specialized equipment, so it is recommended to review the data based on type of maintenance issue when scheduling maintenance to address multiple structures within the same vicinity to avoid excess travel and mobilization.

The stormwater system condition assessment pilot study examined structures for structural defects/deterioration, sediment/debris buildup, excessive vegetation, erosion, and water quality observations, such as odor, sheen, and turbidity. This information has been incorporated into the Cityworks database and can be used to assist the City with implementation of a more proactive maintenance program. The recommended proactive maintenance plan involves:

- Dividing the City into O&M zones or sectors, and cycling through the zones on a monthly basis to broadly address more areas of the City and not focus on one geographic area.
- Establishing a prioritization guide of which conditional fields require the most urgent attention (*presented in Section 2.2*).
- Addressing the highest-level priority items first, while cycling through the zones. If a zone is complete for a given priority level, it can be skipped until all zones have been addressed.
- Once the highest priority level has been addressed, move onto the next priority level.

The preferred approach for scheduling maintenance and keeping an accurate status of condition is to create a system where field crews can view the data real-time and actively update it as sites are maintained and inspected. Displaying all stormwater features (e.g., points and lines) simultaneously, based on the color schemes described in this chapter, will facilitate creating a maintenance route to address the highest priority sites. This approach can be achieved through an ArcGIS web map and utilizing ArcGIS Field Maps, a GIS application on a smart-device, to view all features with similar types of issues (e.g., structural, sediment, vegetation, water quality). Other options to address current maintenance needs include creating a hardcopy map or a smaller-scale mapbook, but these static approaches limit the ability for real-time updates.

In order to implement the recommended program, the City needs to complete the condition assessment citywide, either in-house only or with contractor support. Approximately 20% of the City was assessed through the pilot study. It is also important to actively update the stormwater GIS database as maintenance is conducted to keep a real-time record of the system.

GMC developed a proactive drainage maintenance workplan for the City of Statesboro in 2017, as part of their Stormwater Master Plan project, that utilizes many of the same concepts. For Statesboro, the City and consultant completed a citywide condition assessment and the overall

results were used to create the proactive maintenance program that focused on the worst issues first. Anecdotally, within two years, the City's Stormwater Program Director commented that the frequency of citizen complaints of flooding issues decreased dramatically.

2.3.1 Schedule/Route

The Public Works Department previously established a five-zone approach for field activities, so it was recommended to utilize these boundaries as "Stormwater O&M Zones" for future inspections and maintenance of the stormwater system (Figure 2.6). The zones are labeled based on colors. Starting from the north and rotating clockwise, they are: red, green, blue, orange, and brown. The major boundaries used to separate the five zones included the following corridors:

- Red/Green boundary starts at N. Madison Street and Clay Street, and it continues to the northeast along E. Clay Street and then Patterson Street.
- Green/Blue boundary starts at Broad Street and Smith Avenue, and it continues to the east along Smith Avenue (Hwy 84).
- Blue/Orange boundary starts at Broad Street and Smith Avenue, and it continues to the southeast along Broad Street and then Gordon Avenue.
- Orange/Brown boundary starts at Jackson Street and Madison Street, and it continues to the southwest along W. Jackson Street (Hwy 319). On the northern edge (bordering Green), Orange includes the area south of S. Madison Street and Smith Avenue.
- Brown/Red boundary starts at Clay Street and N. Madison Street, and it continues to the northwest along N. Madison Street (Hwy 38) and then north on Cassidy Road. On the eastern edge (bordering Green), Brown includes the area west of N. Madison Street.

The condition assessment pilot study included inspections in all five O&M zones; however, they were most concentrated in the Green, Orange, and Brown zones.

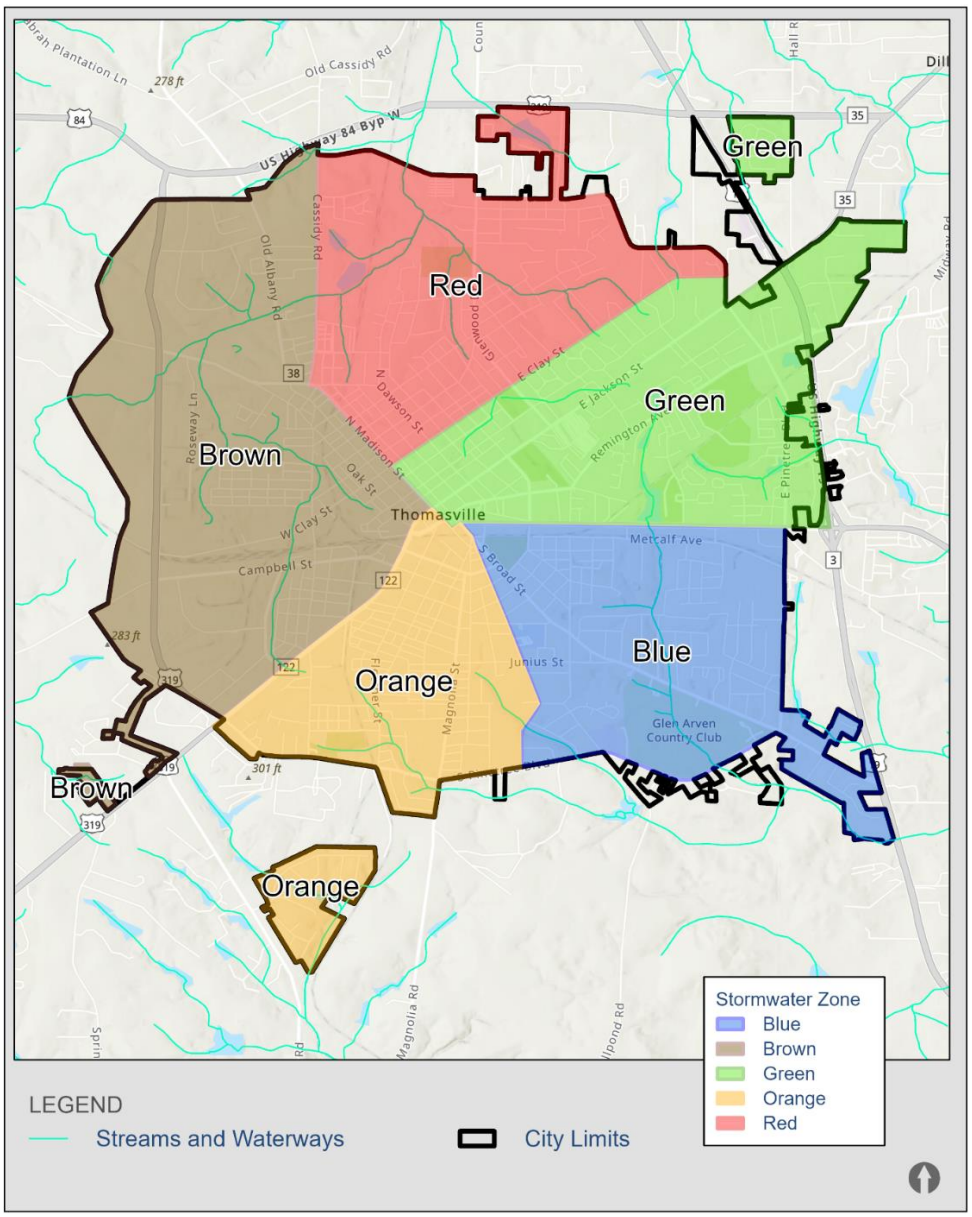


Figure 2.6: Recommended Drainage System O&M Zones

A zoning process is typically used by communities with a National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit. Permittees are required to inspect approximately 20% of their MS4 per year and 100% within a 5-year period, so they typically rotate through five zones, one per year. Establishing a zoning approach with stormwater system inspection and maintenance will help the City expand their stormwater program level of service and be ready if they become an NPDES MS4 permittee in the future.

Based on discussions with the Public Works Director in November 2022, he was going to schedule inspection staff to complete an entire zone before moving onto the next zone instead of rotating through the zones on a fixed-time interval. His goal is to complete an initial citywide assessment

and update the City's GIS and CityWorks databases, and he noted that they were nearly complete with inspections of inlets citywide. Therefore, the entire citywide assessment is expected to be completed at a rate quicker than one zone per year, which is the NPDES MS4 program standard. The City's planned approach for maintenance is that as the inspectors complete the assessment of a zone, maintenance crews will follow to address maintenance needs. It is recommended to follow the prioritization levels outlined in this chapter, and as maintenance is completed that the condition assessment is updated in the online database to keep a current record of the system.

The recommended long-term approach for maintenance is to cycle through one zone per month, with similar tasks addressed on the same day (e.g., erosion control, vegetation mowing, sediment/debris removal, source tracing of water quality issues, and inspections of structural maintenance issues). The order of the tasks will be assigned based on priority levels.

1. First, address all "*Immediate*" work orders, moving from zone to zone until all are completed.
    - Note: once a zone is complete, it can be skipped in future cycles until all work orders are complete with "Immediate" prioritization.
2. Next, move to "*High*" work orders and follow the same procedure.
    - Note: once a zone is complete, it can be skipped in future cycles until all work orders are complete with "High" prioritization.
3. Next, move to "*Medium*" work orders and follow the same procedure.
    - Note: once a zone is complete, it can be skipped in future cycles until all work orders are complete with "Medium" prioritization.
4. Finally, address the "*Low*" work orders. If one zone has been complete for the prioritization level being addressed, skip this zone until all of the same priority are completed.

Until a drainage system condition assessment is completed for the entire City, it is recommended to start addressing the *immediate* and *high* items from the pilot study, which are summarized in the table below. These counts represent the highest priority element from each structure, so structures with multiple *immediate* and *high* issues are only counted once. At that point, the City should prioritize additional condition assessment evaluations before moving onto *medium* items.

Priority	Inlets	Manholes	Outfalls	Detention Areas	Pipes	Culverts	Ditches	Total
Immediate	27	4	0	1	41	19	N/A	**92**
High	66	1	0	1	138	28	3	**237**

Using the inspection data from the pilot study and recommended criteria outlined in Section 2.2., the City created an ArcGIS web map with analysis tools to allow staff to view all of the stormwater features simultaneously that have similar issues (e.g., vegetation, structure condition, and debris/sediment issues). This tool sets the foundation for addressing current maintenance needs from the pilot study, viewing future inspections, sharing information and results among departments, and maintaining the database in real-time.

When maintaining an individual structure (inlet, manhole, outfall, pipe, ditch), any maintenance issues, regardless of prioritization, for connected sections of pipe (e.g., pipe with one inlet and outlet or collection of pipes joined by junctions and other inlets) should be addressed concurrently. This will ensure that maintenance activities will be addressing any underlying issues within the system before moving onto the next system or individual pipe. For example, erosion or debris issues could be contributing to a sediment problem. By examining all connected inlets and the outlet while in the area and removing the erosion/debris issue, the sediment problem at the opposite end of the pipe will not be perpetuated. This process of addressing the opposite end of the pipe or other inlets within a connected pipe network should be followed as crews move through each prioritization level.

2.3.2 Capital Maintenance Approach & Prioritization

Structural Issues

- Structure features and associated data fields to view
    - Pipes & Culverts
        - Pipe Structural Condition
    - Inlets
        - Grate Condition
        - Structure Condition
    - Detention Areas
        - Outlet Condition
    - Manholes
        - Cover Condition
        - Cover Grade
        - Interior Condition
        - I & I
- Approach
    - Inspect from highest priority to lowest, by cycling through the O&M zones
        - While inspecting a structure, if there is one in the vicinity that is one level less, assess at the same time.
    - Visit, assess condition, create work order or add to Capital Maintenance list with a level of urgency for replacement or reinspection (immediate, < 6 months, < 1 year, 1-2 years, 2-5 years, 5-10 years).
    - When funding and sufficient time are available, investigate completing capital maintenance projects based on priority level.
        - While City crews can resolve many of the structural damage issues, execution time may be accelerated by grouping multiple projects and using contractor support
- Priority Ratings
    - Level #1 / “Immediate” – items that noted immediate action or replacement
    - Level #2 / “High” – items that have major structural issues
    - Level #3 / “Medium” – items that have moderate structural issues
    - Level #4 / “Low” – items that have minor structural issues

Priority	Pipes & Culverts	Inlets	Inlets	Detention Areas
	Pipe Structural Condition	*Grate Condition*	*Structure Condition*	*Outlet Condition*
Immediate	5: Immediate Attention Needed	5: Unsafe/needs immediate replacement	5: Immediate attention needed	5: Needs Replacement
	4: Structurally Unsafe, Buried Culvert			
High	3: Major Wear	4: Damaged/ broken	4: Structurally Unsafe	4: Structure clogged and/or major structural damage
Medium		3: Cracked or corroded	3: Cracking/spalling/ or some erosion	3: Poor, medium debris buildup and structural wear
Low	2: Minor Wear	2: Ill-Fitting/ misaligned	2: Minor cracking/spalling	2: Fair, some debris buildup and/or structural wear

Priority	Manholes	Manholes	Manholes	Manholes
	Cover Condition	*Cover Grade*	*Interior Condition*	*I & I*
Immediate	5: Unsafe/needs immediate replacement		5: Immediate attention needed	
High	4: Damaged/broken	5: Needs to be raised or lowered - Urgent	4: Structurally Unsafe	5: Gushing
Medium	3: Cracked or corroded	3: Needs to be raised or lowered - Schedule	3: Missing bricks and grout	4: Running
Low	2: Ill-Fitting/misaligned		2: Missing grout	3: Weeping
				2: Stain

2.3.3 Operational Maintenance Approach & Prioritization

Sediment/Debris Issues

- Structure features and associated data fields to view
  - Inlets
    - Sedimentation
  - Manholes
    - Debris/Surcharge
  - Outfalls
    - Sedimentation & Debris
  - Detention Areas
    - Level of Debris/Sediment
  - Pipes & Culverts
    - Pipe O&M Condition

    - Ditches
        - Debris
- Approach
    - Maintain from highest priority to lowest, by cycling through the O&M zones
        - While maintaining a structure, if there is one in the vicinity that is one level less, conduct maintenance concurrently, while the equipment is on site.
- Priority Ratings
    - Level #1 / "Immediate" – items that noted immediate action or is plugged
    - Level #2 / "High" – items that have major sediment/debris issues
    - Level #3 / "Medium" – items that have moderate sediment/debris issues
    - Level #4 / "Low" – items that have minor sediment/debris issues

Priority	**Inlets**	**Manholes**	**Outfalls**	**Detention Areas**
	Sedimentation	*Debris/ Surcharge*	*Sedimentation & Debris*	*Level of Debris/Sediment*
Immediate	5: Plugged		5: Plugged-flow blocked	5: Excessive
High	4: 3/4 Full	5: Debris/surcharge -> half full	4: Heavy-flow impeded	4: Mechanical Removal
Medium	3: 1/2 Full	4: Debris/surcharge - half full	3: Medium-some flow restrictions	3: Rake/Sweep
		3: Debris/surcharge - cannot see bottom		
Low	2: 1/4 Full	2: Debris on bench	2: Light-negligible impact to flow	2: Minor

Priority	**Pipes**	**Ditches**
	Pipe O&M Condition	*Debris*
Immediate	5: Immediate attention needed, debris buildup over 30%	
High	4: May contain debris buildup up to 30%	Severe
	6: Unknown, no CCTV	
Medium	3: May contain debris buildup up to 15%	Moderate
Low	2: Sand or debris <5% of pipe diameter	Minor

<u>Vegetation Issues</u>

This category covers too much that blocks or obstructs flow or too little that causes erosion.

- Structure features and associated data fields to view
    - Inlets
        - Vegetation
    - Ditches
        - Erosion
    - Outfalls
        - Erosion

    - Detention Areas
        - Vegetation
- Approach
    - Maintain from highest priority to lowest, by cycling through the O&M zones
        - While maintaining a structure, if there is one in the vicinity that is one level less, conduct maintenance concurrently, while the equipment is on site.
        - Vegetation will require mowing and cutting, where erosion will require stabilization and planting.
- Priority Ratings
    - Level #1 / "Immediate" – items that have extreme vegetation/erosion issues
    - Level #2 / "High" – items that have major vegetation/erosion issues
    - Level #3 / "Medium" – items that have moderate vegetation/erosion issues
    - Level #4 / "Low" – items that have minor vegetation/erosion issues

Priority	**Inlets**	**Ditches**	**Outfalls**	**Detention Areas**
	Vegetation	*Erosion*	*Erosion*	*Vegetation*
Immediate			5: Excessive erosion	5: Excessive erosion/rebuild
High	5: Excessive	Severe	4: Major erosion	4: Major erosion/needs restoration
Medium	4: Moderate	Moderate	3: Medium erosion	3: Medium erosion
Low	2: Minor	Minor	2: Minor erosion	2: Minor erosion

Water Quality Issues

- Structure features and associated data fields to view
    - Inlets
        - Odor
        - Turbidity
        - Water Sheen
- Approach
    - Inspect from highest priority to lowest, by cycling through the O&M zones
    - Visit, confirm if the water quality issue is still present. If so, move up the drainage network to source trace the cause of the water quality issue.
    - *For Future Inspections*, inspect any site with "high" priority within 24 hours after the inspection to identify if there is an active source of pollution.
- Priority Ratings
    - Level #2 / "High" – items that have major water quality concerns
    - Level #4 / "Low" – items that have minor water quality concerns

Priority	**Inlets**	**Inlets**	**Inlets**
	Odor	*Turbidity*	*Water Sheen*
High	5: Powerful Odor	3: Opaque	3: Grease/oil
Low	3: Noticeable Odor	2: Cloudy	2: Oil Sheen

2.4. RECOMMENDATIONS

Based on the information presented in this chapter, the following items are recommended for updating current procedures and creating a proactive drainage maintenance work program:

- Existing Service Request Database
    - For the service request database labeled "Flooding Drainage Issue," the most common category for cause was "Other" so it is recommended to expand the options to provide more context on these issues.
- Stormwater Inventory Database
    - For Detention Areas, separate debris buildup from structure issues for the "condition of outlet" field as they trigger different maintenance approaches.
    - Pursue a system to marry Cityworks and GIS databases so that the inspection results from all stormwater features (e.g., points and lines) can be displayed simultaneously and based on the color schemes described in this chapter to see if similar issues exist nearby. The system should also be configured to allow for condition assessment updates in order to maintain a real-time dataset.
    - Add a field in the GIS or Cityworks database for maintenance date to track when a structure was last maintained.
        - On an annual basis, consider generating a report from either Cityworks or GIS by maintenance date to calculate the number of structures and length of pipes/ditches maintained.
- Stormwater System Condition Assessment
    - Continue with in-house inspections of the stormwater system, and consider additional contractor support to expedite completing the initial citywide assessment.
    - For future inspections, if either of the water quality fields for inlets return with high priority, conduct source tracing within 24 hours, but preferably immediately.
    - Develop a Capital Maintenance list based on structural issues that includes a photo and summary of the repair and urgency for repair or follow-up inspection (e.g., immediate, < 6 months, < 1 year, 1-2 years, 2-5 years, 5-10 years).
        - Pursue addressing these repairs in-house, as time and resources allow.
        - Batch multiple structures with a similar problem and a higher level of urgency for contractor support.
- Stormwater System Maintenance (*pursue in the following order*)
    - Continue addressing citizen complaints as they are received, but implement proactive program as time and staff resources allow.
    - Pursue maintenance scheduling in the following order:
        1. Conduct maintenance or follow-up visits on any *immediate* issue, rotating through the City one zone per month.
        2. Conduct maintenance or follow-up visits on any *high* issue, rotating through the City one zone per month.
        3. Complete the stormwater system condition assessment citywide, if it is not already completed.

4. As the stormwater system condition assessment is expanded, cycle back to *immediate* issues and follow the monthly cycle by zone, and proceed to *high* and then *medium*.
    - While addressing sites with maintenance needs, include maintenance of nearby sites if they are one priority category less than the level being addressed.
- Staffing
    - With the proposed additional condition assessments and resulting maintenance needs, both operational and capital, it is recommended to add a three-person stormwater crew to the Public Works Department that is dedicated entirely to drainage system maintenance activities.

Overall, the intent of the expanded stormwater system condition assessment and proactive maintenance program is that many of the areas with flooding issues are suspected to be associated with having maintenance needs due to accumulation of debris/sediment/vegetation. Therefore, restoring the original flow capacity of these systems through maintenance should improve flow capacity and decrease the frequency of flooding and citizen complaints.

3. CITY CODES & POLICIES

The City currently has adopted basic ordinances regulating land development within the City; however, they recognize that they are not sufficient to adequately address post-construction stormwater runoff as the City continues to experience development. As a result, a project goal for the Stormwater Master Plan was to review the post-construction stormwater runoff regulations and propose revisions needed that would better regulate stormwater runoff issues for new projects and redevelopment projects as well as the technical review process utilized by City staff related to stormwater management.

Stormwater management regulation requires an integrated approach that includes three primary components: (1) an ordinance to serve as the legal authority, (2) a local design manual to specify community specific policies and standards, and (3) a technical reference handbook to describe general standards and practices. Each of these three elements point to each other to guide the stormwater management design process, as shown in Figure 3.1. This chapter describes a summary of the recommended edits to the City's existing stormwater management ordinance and the recommended addition of a Stormwater Local Design Manual (LDM).

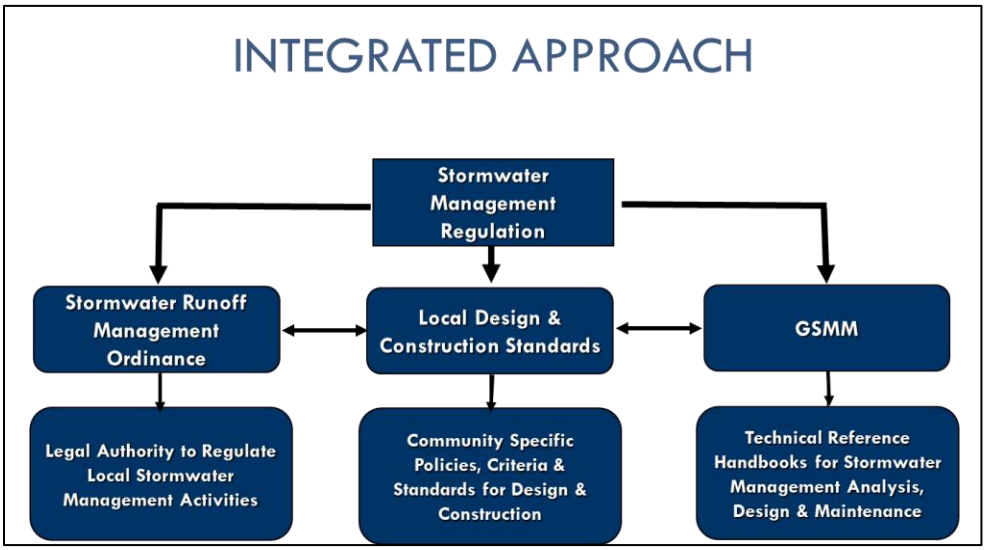


Figure 3.1: Integrated Approach for Stormwater Management Regulation

3.1. STORMWATER ORDINANCE

The City of Thomasville's stormwater management ordinance is currently included in Chapter 5, Section 5-310A to 5-326. GMC reviewed the existing ordinance and made suggestions for edits and additions based on feedback received from City staff. The recommended draft stormwater management ordinance is included in Appendix C. Overall, the City's future stormwater management ordinance should codify the City's applicable stormwater management policies and requirements to be applied citywide using ordinance language that accurately reflects the City's

short-term and long-term stormwater management goals as defined in the Stormwater Masterplan.

Some of the general updates included (number references are consistent with the version included in Appendix C):

- Section 1-2: Expanded the purpose/intent of the article. This included references to a Stormwater Local Design Manual (LDM) that would contain more details and specific requirements, and establishing special drainage districts to protect area with water quality and/or quantity management issues.
- Section 1-3: Expanded the definitions section based on text added to the article.
- Section 1-5: The city engineer or their designee is now listed to administer the provisions of the article.
- Section 1-6 & 1-7: Applicability was clarified to be all new development, redevelopment that adds new impervious area, or redevelopment that meets the "substantial improvement" threshold. Exemptions were added for single-family lots not part of a larger common development.
- Section 1-8: The design standards were enhanced to specify the overbank flood protection, extreme flood protection, and downstream analysis, as described in the Georgia Stormwater Management Manual (GSMM).
    - The downstream analysis standard was listed to be applicable to larger developments – mixed-use and non-residential development with greater than 5 acres impervious area and residential development with greater than 50 lots.
- The alternate procedure, formerly in Section 5-318, to pay $0.10 per square foot of impervious area was removed because it did not provide enough funding to cover the actual impacts.
- Section 1-8.6: Compliance via off-site management was added, and the criteria to be eligible for it is listed.
- Section 1-9: A detailed description of the process for the land disturbance permit and requirements for stormwater site plan submittals were added. Descriptions for maintenance agreement requirements and acceptable hydrologic methods were also added.
- Section 1-10: Certification forms were added for the licensed engineer to certify the stormwater plan as well as as-built conditions.
- Section 1-11: A section for waivers to stormwater management requirements was added, and it details the minimum requirements, conditions, and mitigation requirements.
- Section 1-12, 1-13, & 1-14: Detailed sections were added on stormwater facility maintenance (Section 1-12) in order to require property owners to maintain their stormwater facilities, inspections/right of entry (Section 1-13) to allow City staff the right to entry for inspection, and emergency maintenance (Section 1-14) to allow City staff to perform maintenance where emergency conditions exist and recover cost for said maintenance.

- Section 1-15: If there are violations to this article, a section was added to describe a notice of violation (NOV), penalties, and appeals. This is separate from NOVs and stop work orders as part of erosion and sediment control.
- Section 1-18: The performance bonds section was clarified and listed to be applicable to any site with a Land Disturbance Permit.
- Section 1-19: As a water quality measure, a section was added to address illicit discharges and illicit connections, which describes a list of what is prohibited and exempt. This section also includes a watercourse protection provision to keep property owners from blocking flow with trash, debris, or other obstacles.

3.2. STORMWATER LOCAL DESIGN MANUAL (LDM)

The City does not currently have a city-specific Stormwater LDM, so the recommended draft LDM that was prepared as part of this project is included in Appendix D. An LDM should include community-specific, technical information regarding design methods, design criteria, construction standards, recommended best management practices (BMPs), and maintenance requirements. In this document, the GSMM is identified as the primary technical reference for designers to utilize in complying with the requirements of the stormwater ordinance and the LDM. The primary sections of the draft LDM that is included in Appendix D include:

- Section 1: Introduction
- Section 2: Planning and Submission Requirements
- Section 3: Stormwater Management Standards
- Section 4: General Design Criteria
- Section 5: Special Drainage Districts
- Section 6: Construction Standards
- Section 7: Stormwater Maintenance Standards
- Appendix A: Plan Review Checklist
- Appendix B: Maintenance Agreement
- Appendix C: Green Infrastructure Inspection Procedures

As the City is looking to pursue more opportunities with GI/LID, an internal standard operating procedure (SOP) for assessing the most common GI/LID practices (bioretention and permeable pavement) was created, and it is included in Appendix D. This SOP also includes “best practices” to follow when conducting plan review and construction inspections for projects with GI/LID.

3.3. PATH FORWARD

The future level of service for land development should be expanded through the adoption of more comprehensive post-construction stormwater management regulations, engineering design criteria, and site plan review and approval procedures. The addition of staff or consulting resources will be required in order to facilitate the detailed, technical site plan reviews that will be necessary to ensure that future development meets the new guidelines. The City should consider budgeting for these additional resources, which may be in the form of a consulting engineer, or a staff engineer as funding allows.

The draft stormwater management ordinance and Stormwater LDM have been shared with the City as Word documents, so they are free to move forward with updating sections that can be administered with current staffing levels. If the City is not ready to fully implement the standards proposed in these drafts, a few standards could be reduced that would provide more benefit than existing ordinances. A few examples include:

- Special Drainage District "Downtown Core":
    - This boundary, as shown in Figure 3.2, was set to be inclusive of the entire subbasins that intersect the "Downtown Core." These subbasins are situated in the headwaters of Oquina Creek and Olive Creek, and they are the areas with the most pressing flooding issues. A reduced-criteria approach could be to apply the standards to the "Downtown Core" area only.
    - The proposed runoff reduction (infiltration) requirement is for the 1.0" rain event, but this could be reduced to 0.5" rain event.
    - As this area experiences a lot of flooding, the target peak flow reduction criterion was set to be 90% of predeveloped rates. This could be reduced by removing it, but the City may elect to enhance this standard and require greater reduction.
- Special Drainage District "Impaired Watersheds" (Oquina Creek & Olive Creek).
    - The current description would make the requirements for additional water quality treatment applicable to most of the City as Olive Creek and Oquina Creek (including Bruces Branch) watersheds comprise 86% of the city limits. If these additional requirements are too much for the City to initially adopt, they can be saved and considered at a later date as the City's level of service increases.
    - Another option is to reduce the required rainfall depth and make them target infiltration of a 0.5" event to get additional on-site management and runoff reduction.

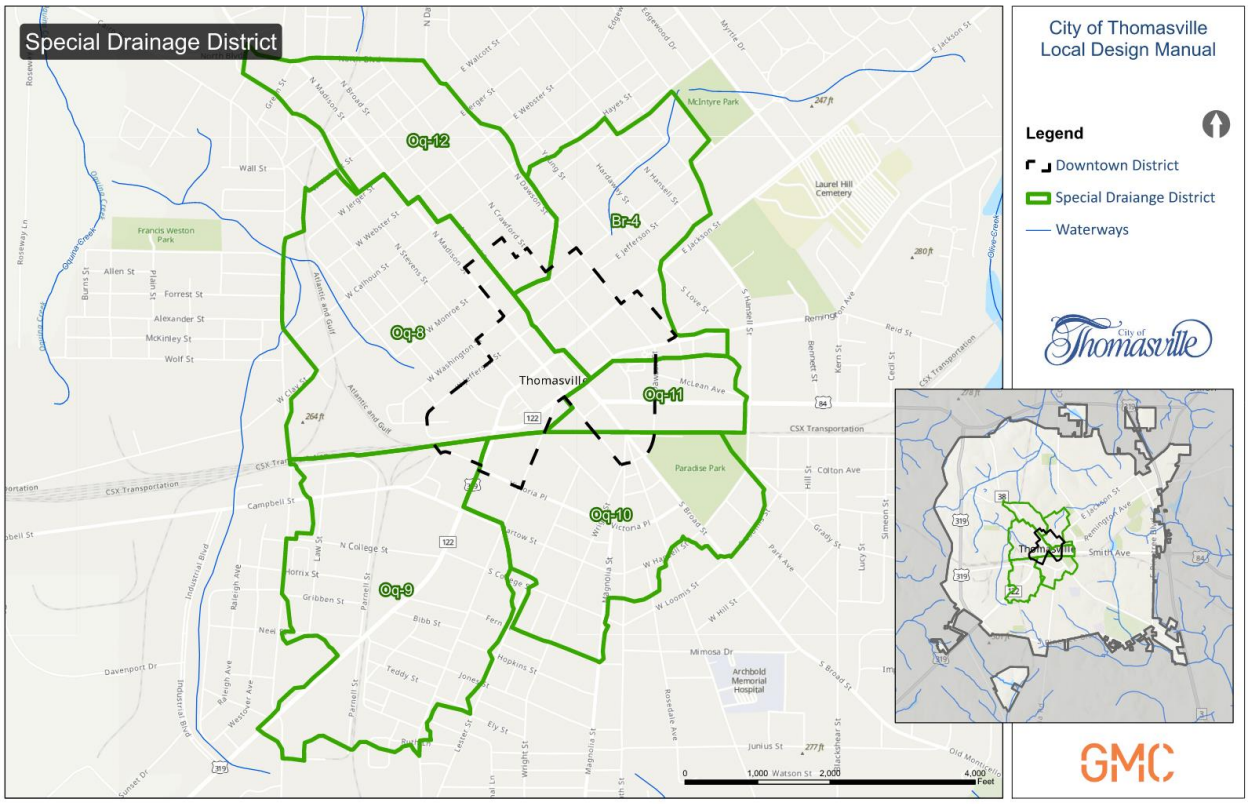


Figure 3.2: "Downtown Core" Special Drainage District Boundary.