MS4 Mapping is Not Magic!
Lessons Learned Updating GIS Mapping

Photo Credit: Dreamstime

Photo Credit: Dreamstime

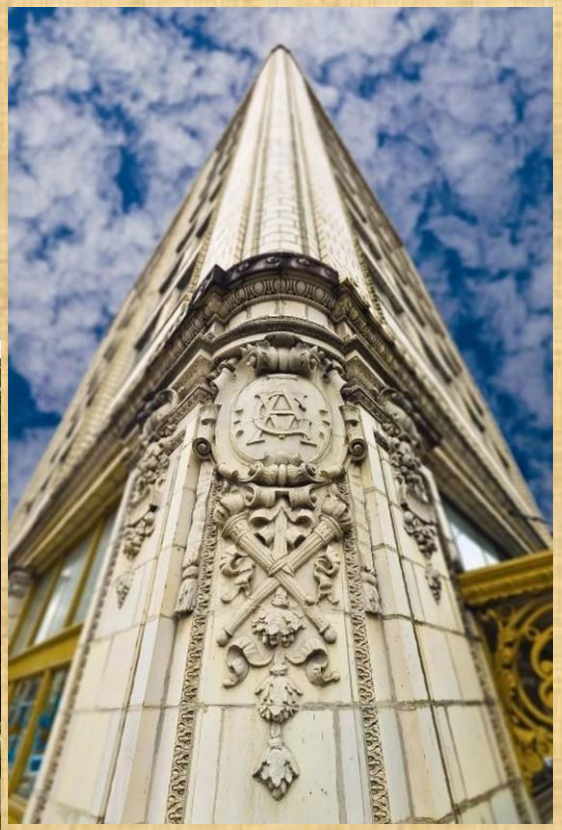
MOBILE
ALABAMA

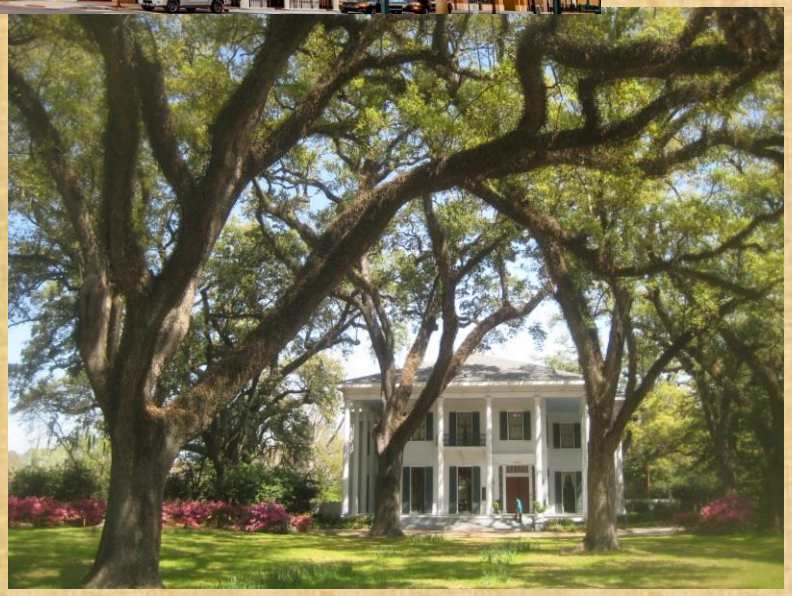
MS4 Mapping is Not Magic!
Lessons Learned Updating GIS Mapping

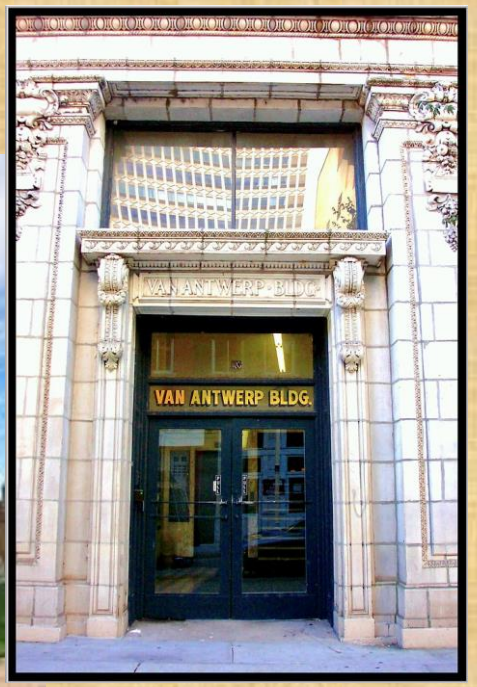
- Framework/Unique Attributes for City of Mobile
- GIS Stormwater Database Development Timeline
- Stormwater (SW) Mapping Project
- Pilot Sub-watershed Capacity Analysis Project
- Lessons Learned from SW Mapping & Pilot Project
- Where do we go from here?

MOBILE
ALABAMA

Historic City
Heritage Oak Trees

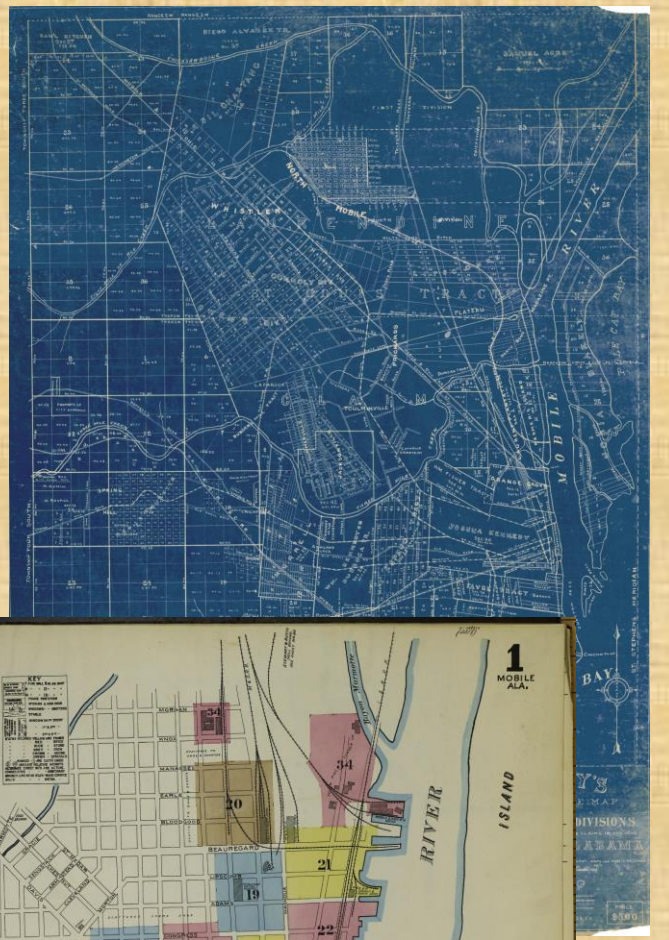


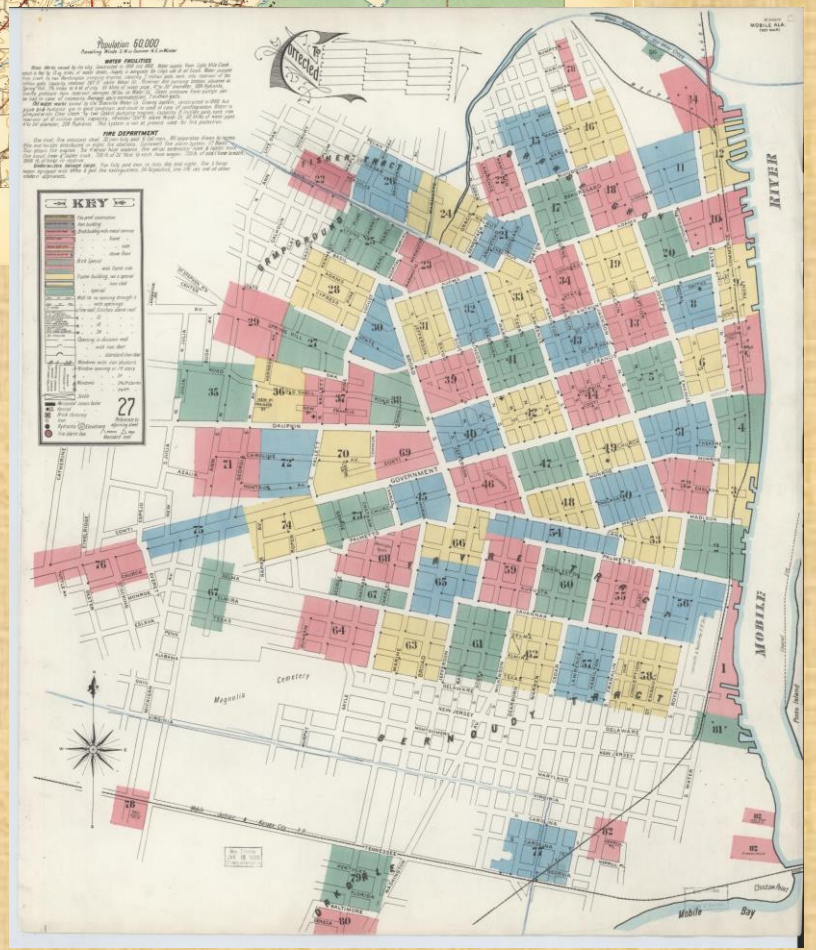


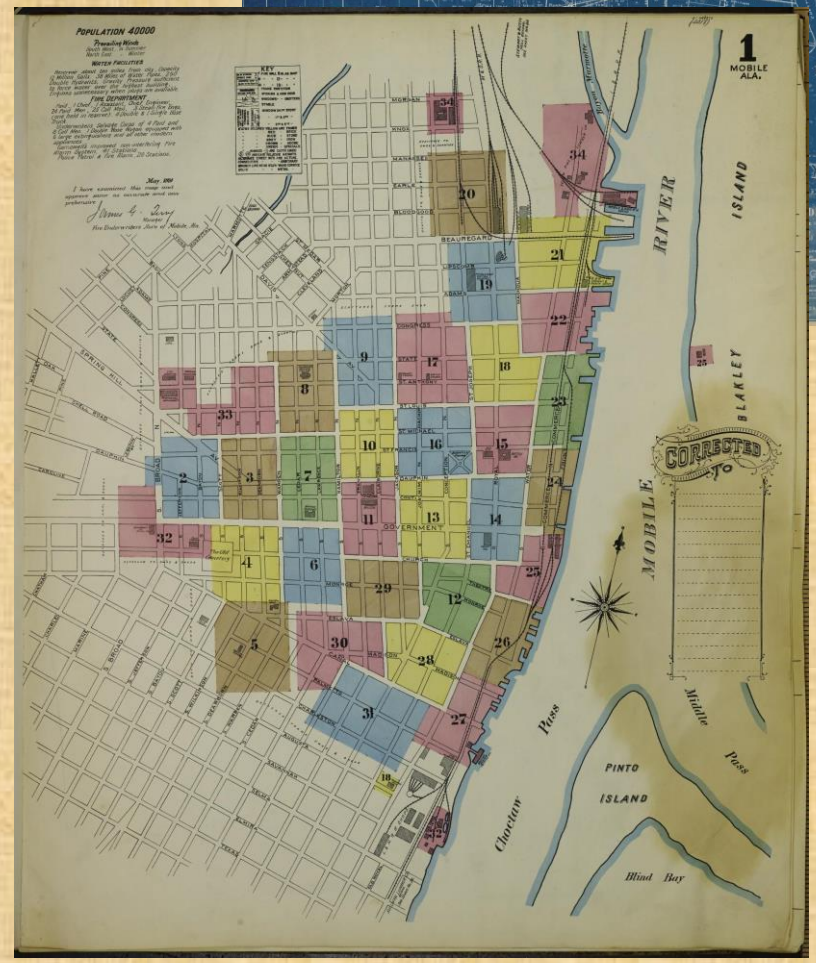


MOBILE
ALABAMA

Historic City Historic Maps

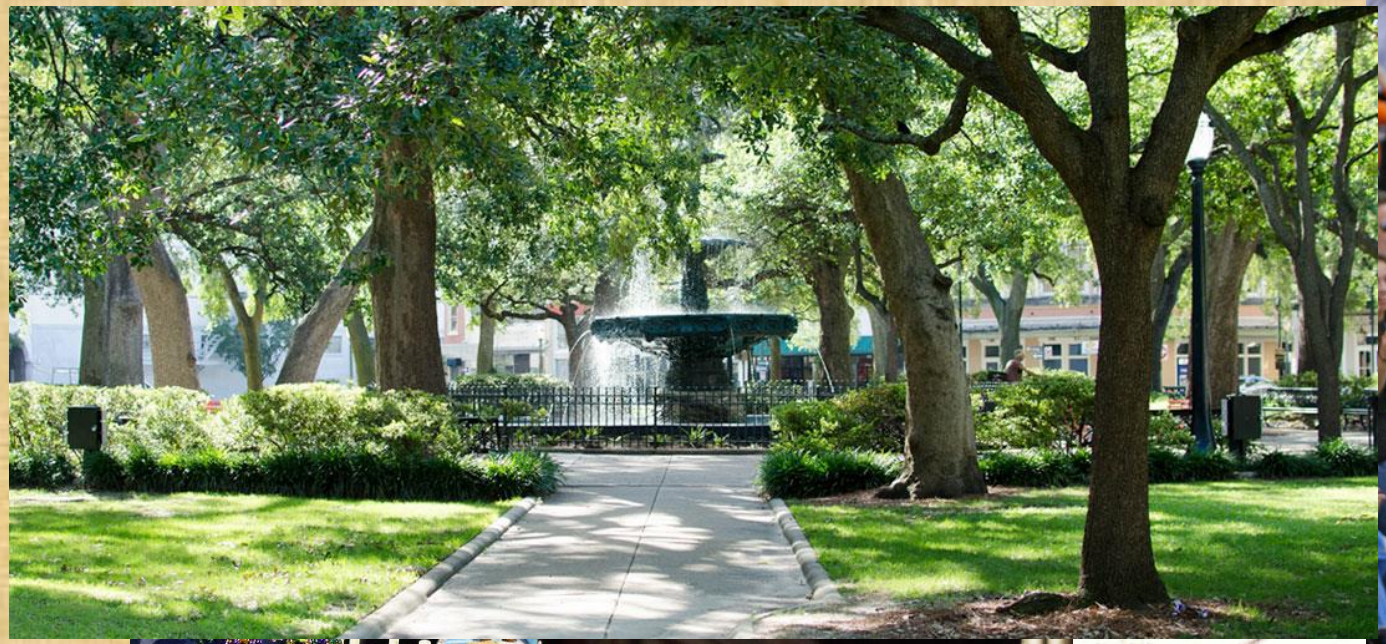






MOBILE
ALABAMA

Aging Infrastructure
Party *USED* to go down the drain!



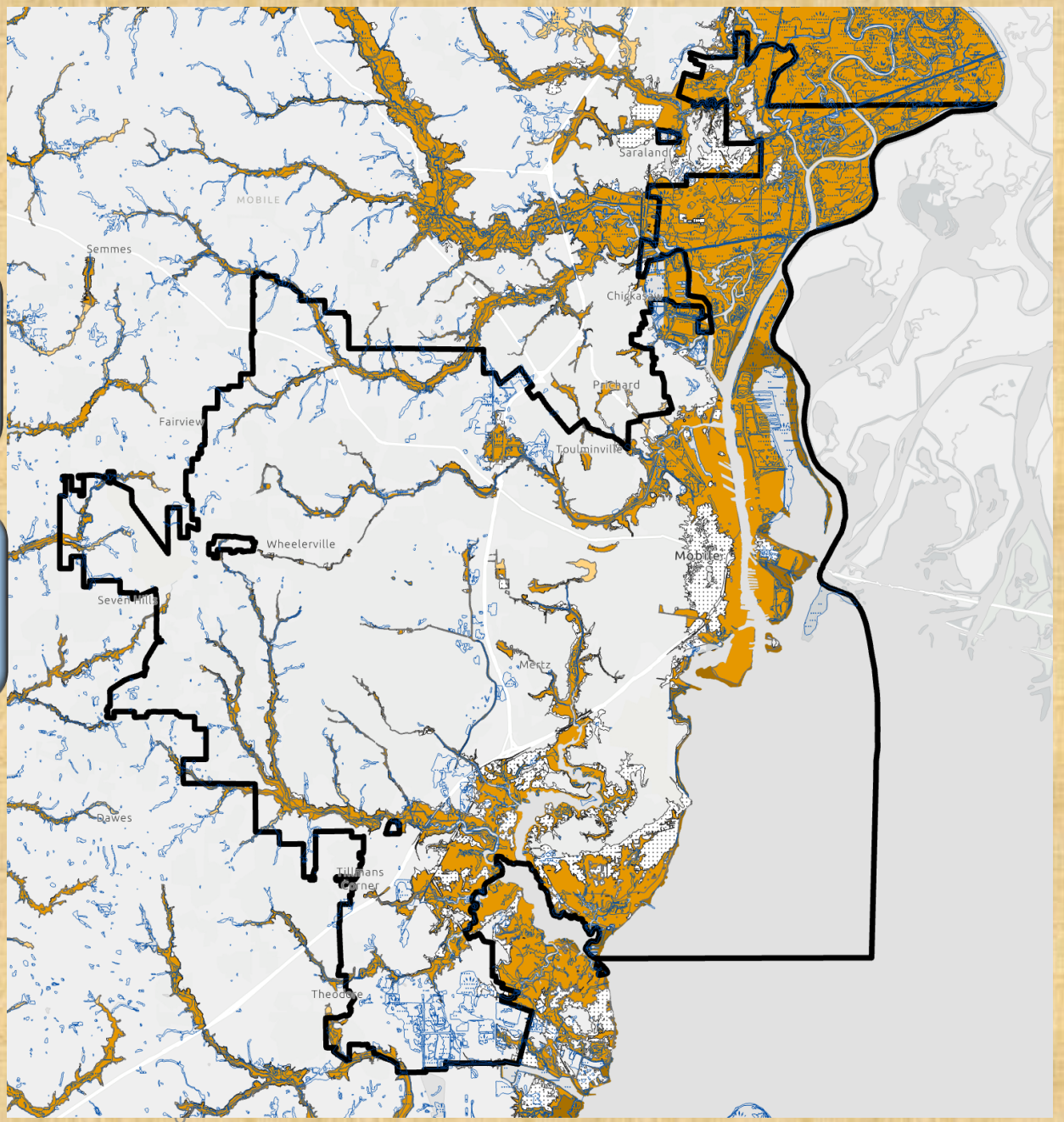
MOBILE
ALABAMA

AREA CITY-WIDE FLOOD PLAIN OR WETLANDS

Amount of Flood Plain

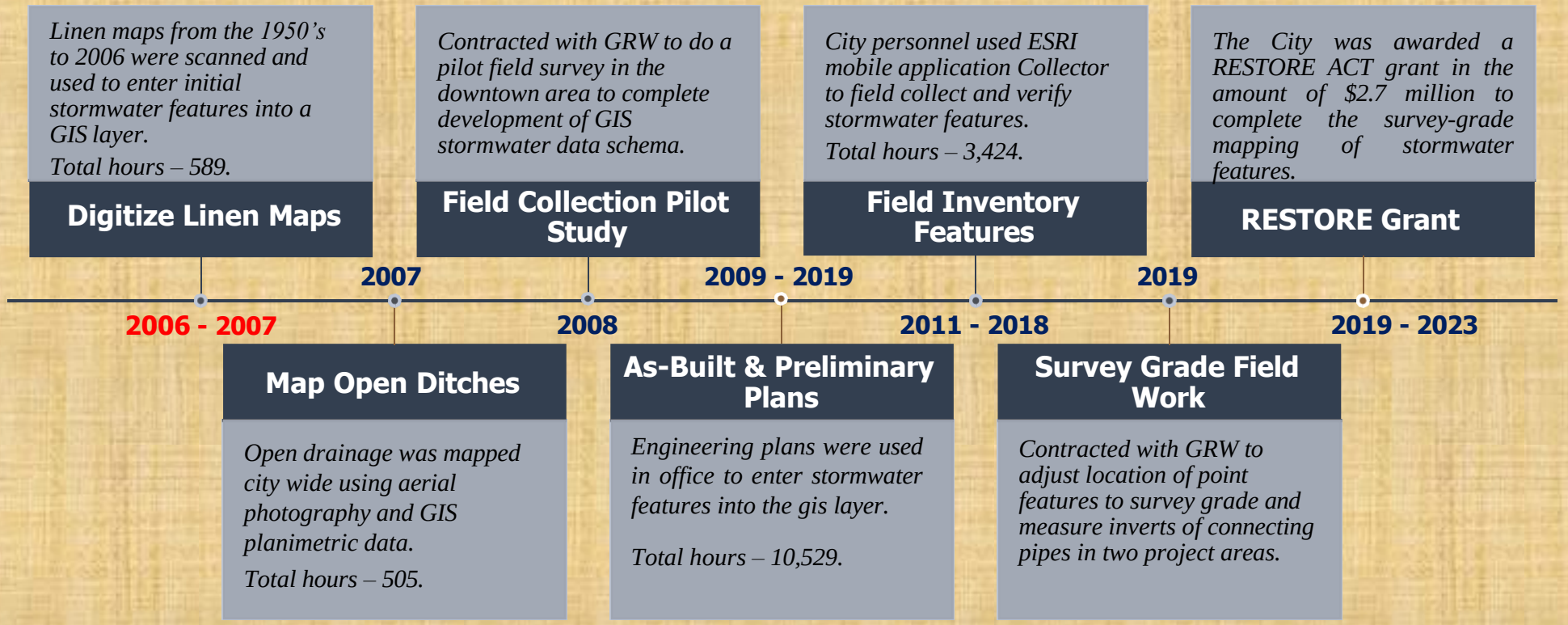
41,147 acres

36% of City in Flood Plain



MOBILE
ALABAMA

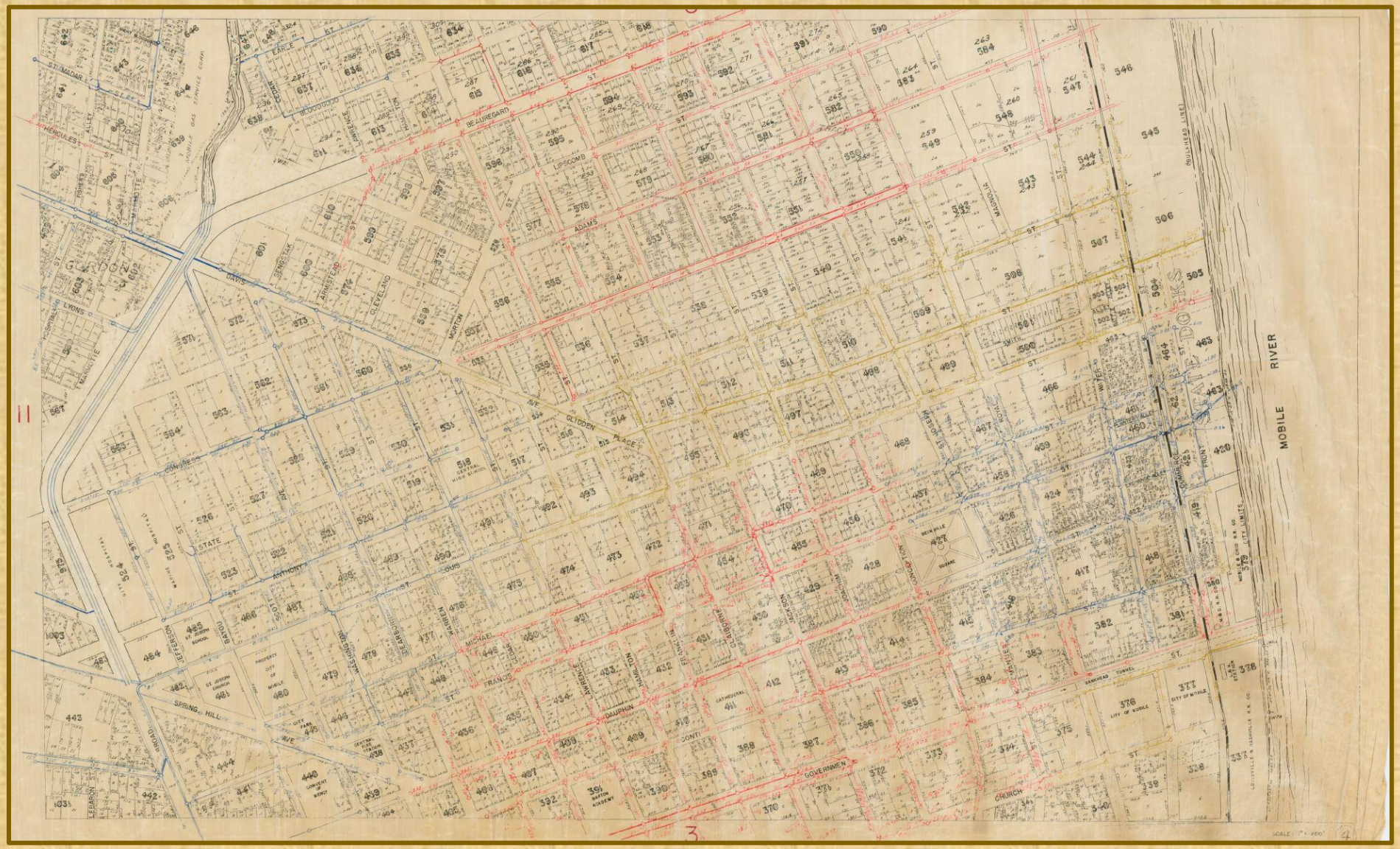
Stormwater Features Collection Timeline



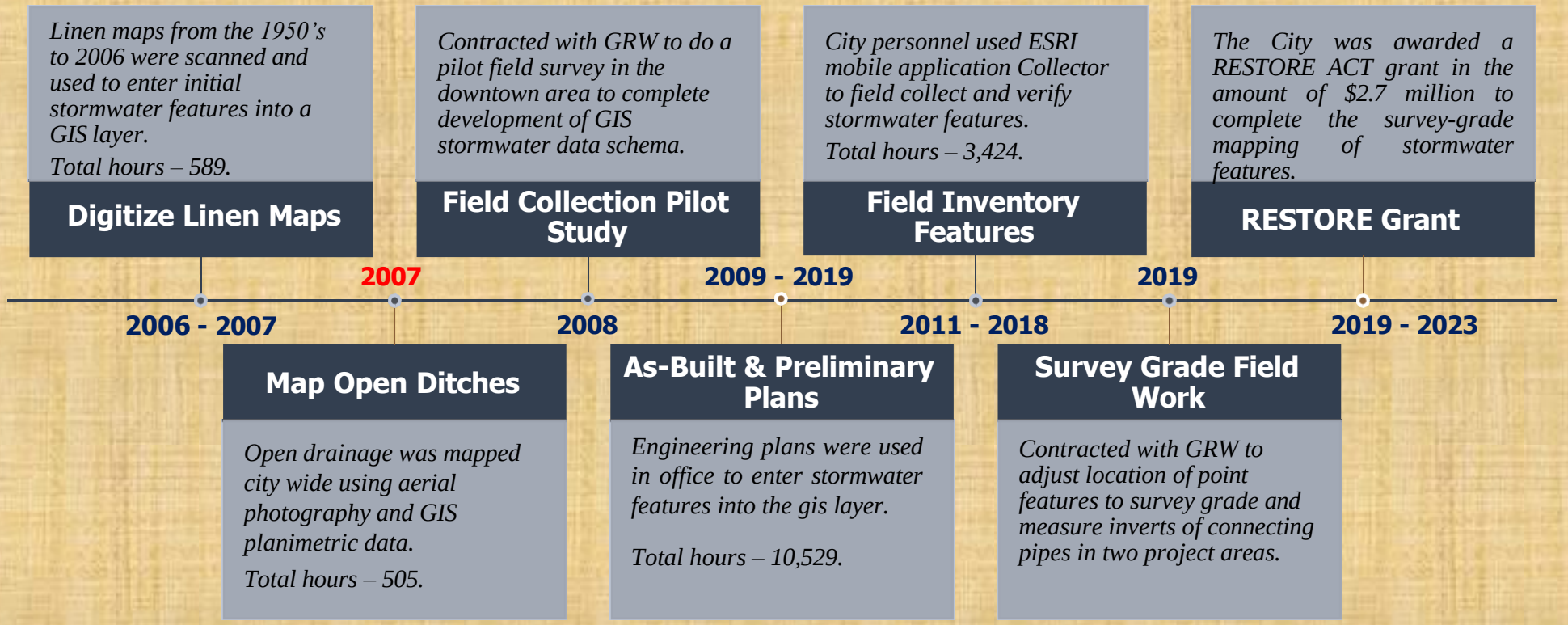
- Over 162,000 features have been mapped with detailed attributes over the last 13 years.
- City personnel have dedicated over 15,000 hours in the development of the GIS stormwater database.

A WORK OF ART

1950's Linen Map

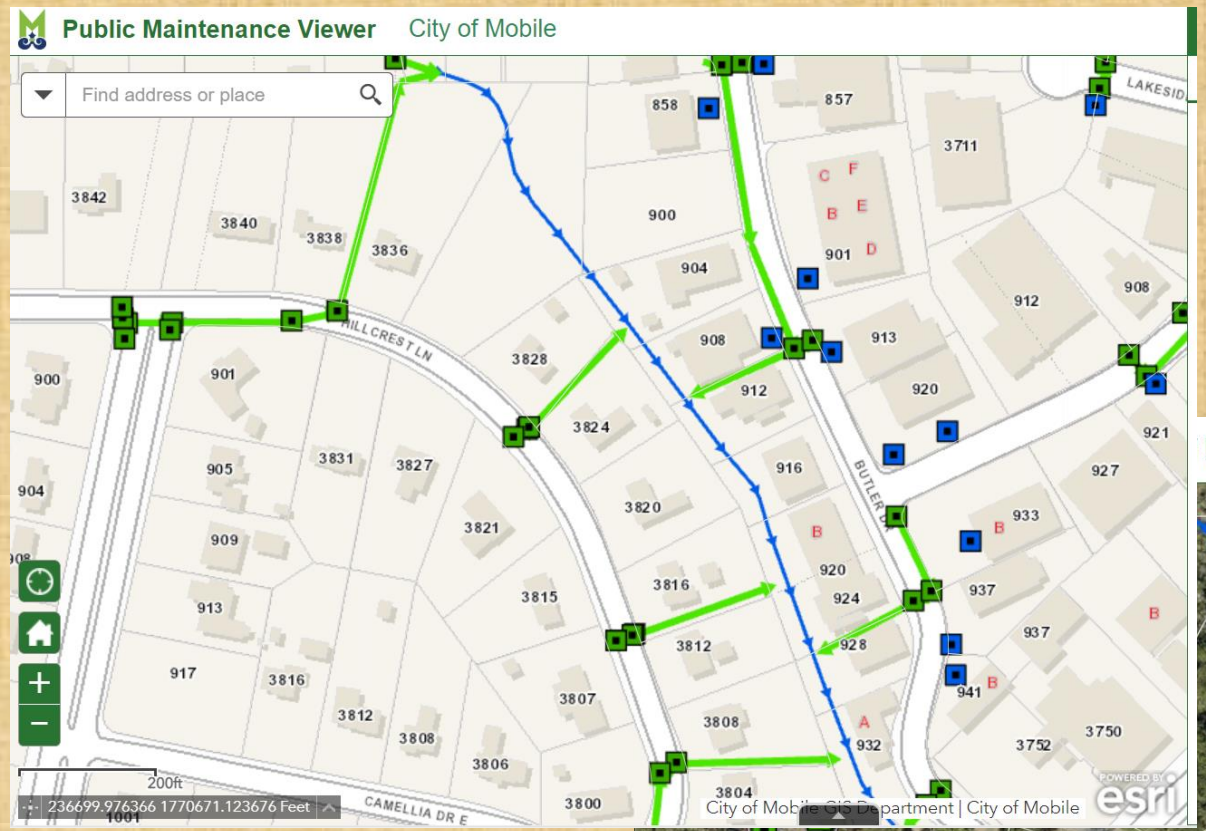


Stormwater Features Collection Timeline

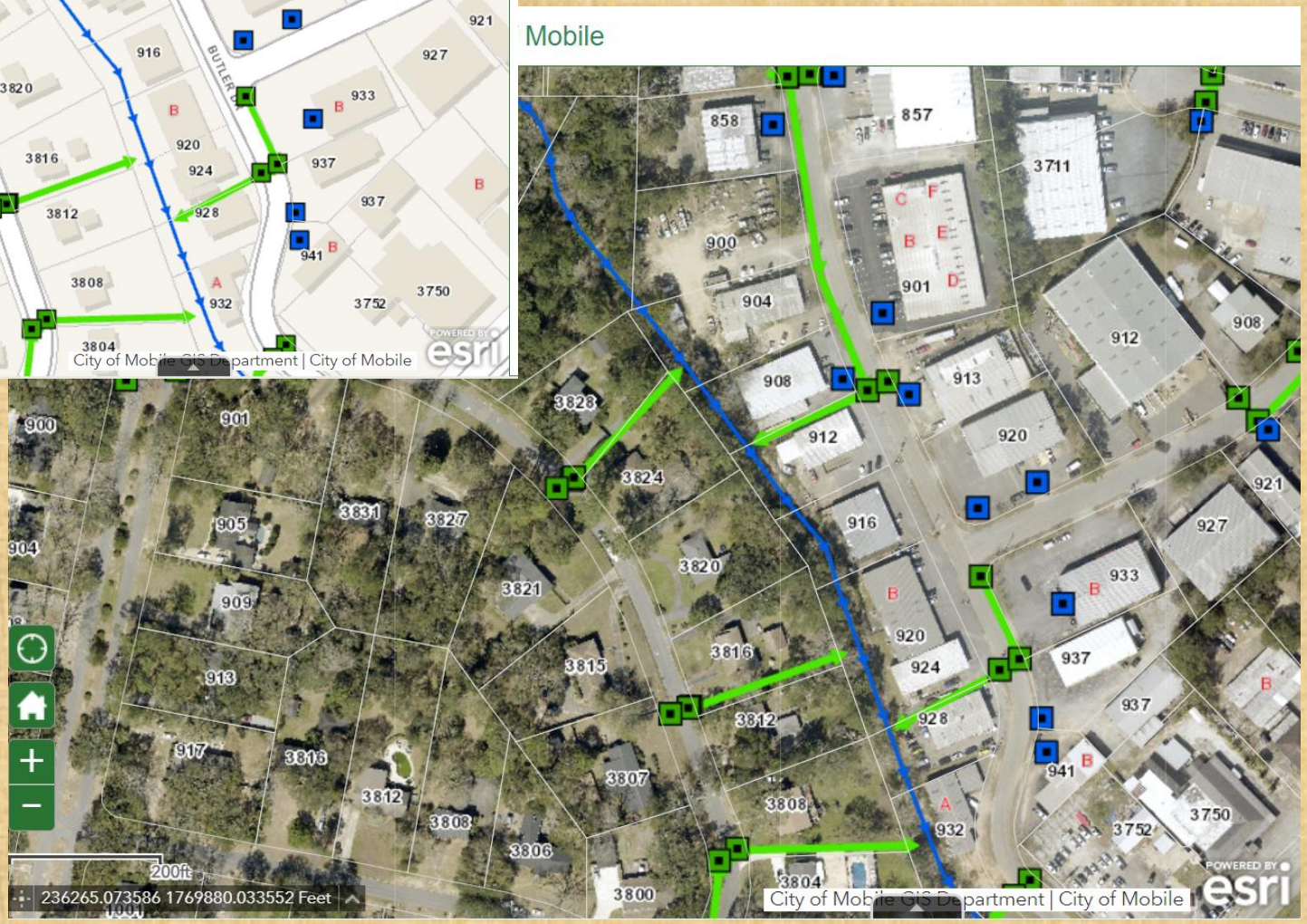


- Over 162,000 features have been mapped with detailed attributes over the last 13 years.
- City personnel have dedicated over 15,000 hours in the development of the GIS stormwater database.

MAP OPEN DITCHES

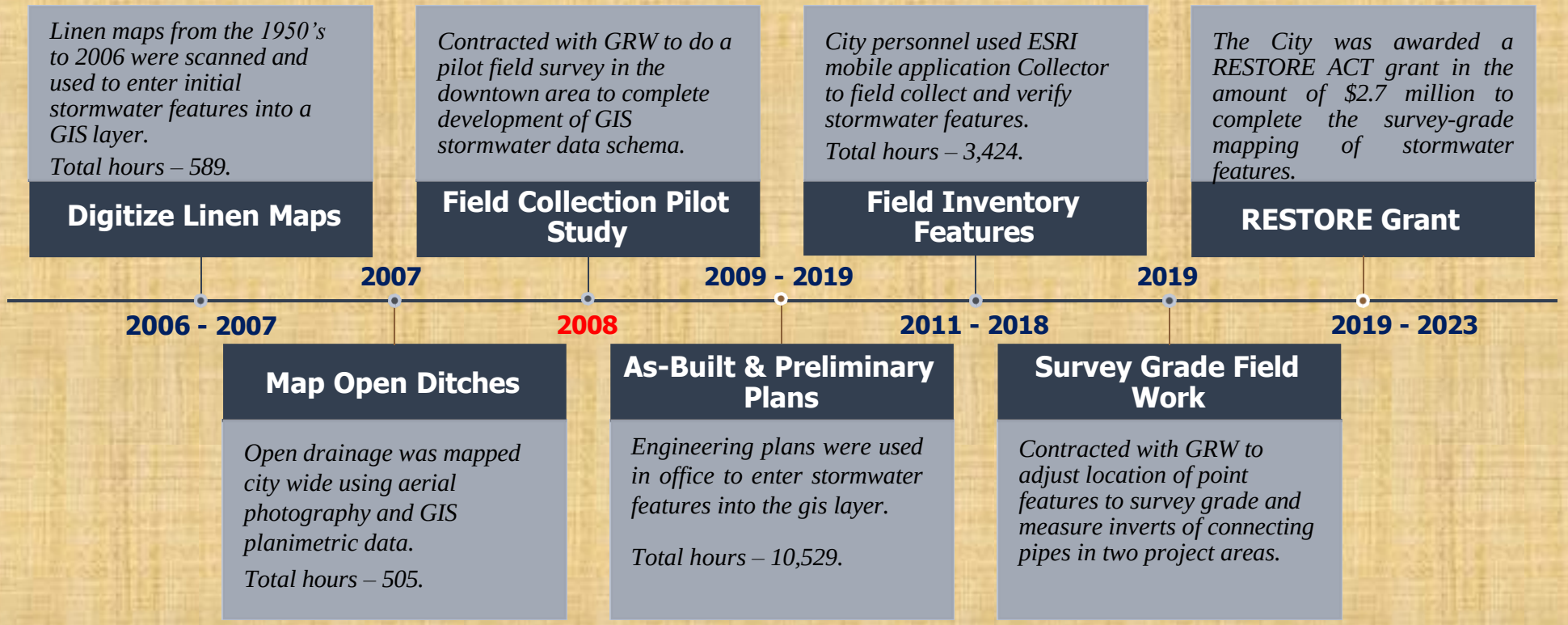


- 2002 LIDAR data supplemented the aerial data in the mapping.



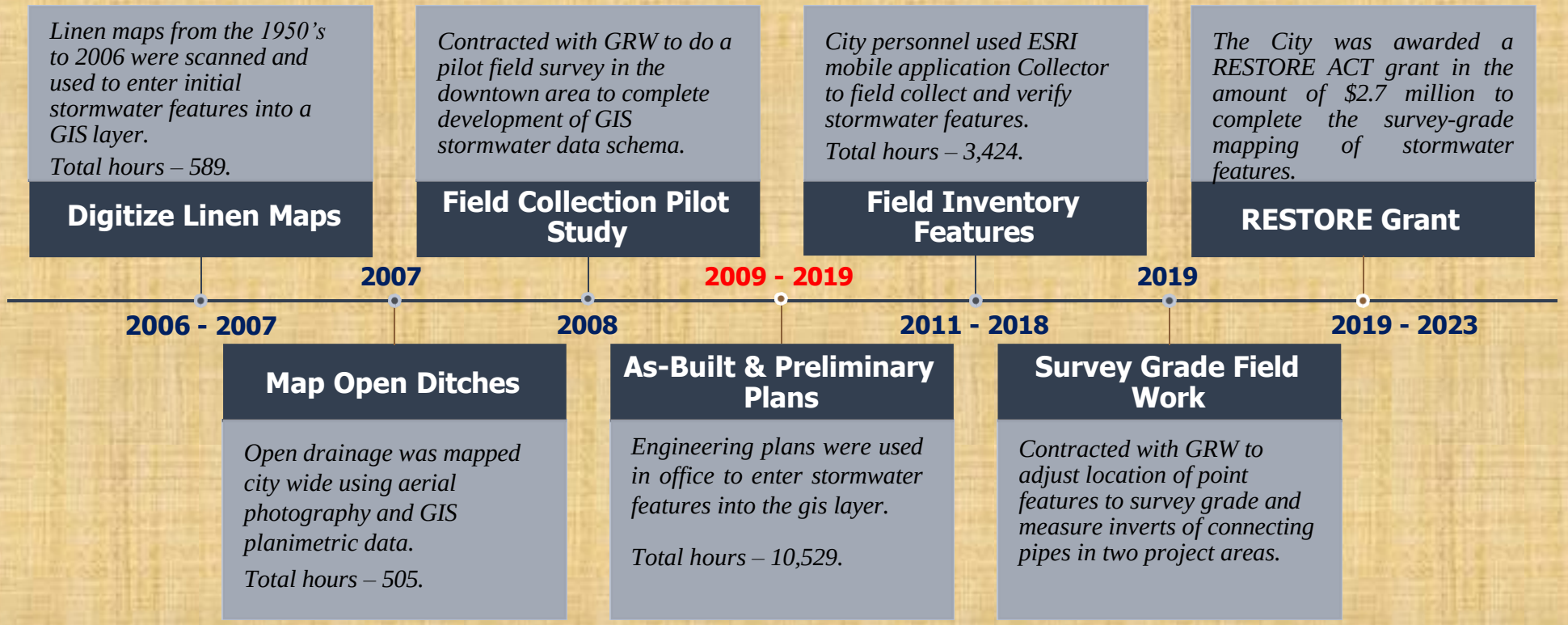
MOBILE
ALABAMA

Stormwater Features Collection Timeline



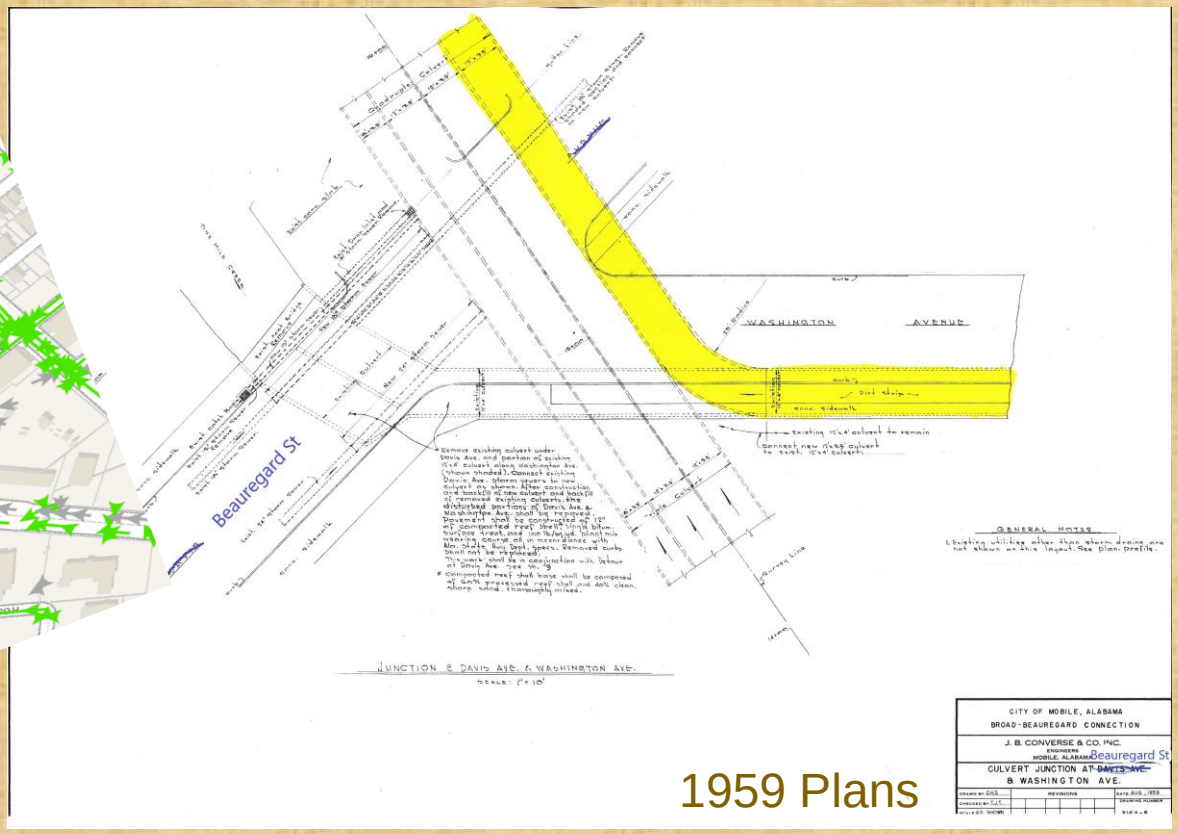
- Over 162,000 features have been mapped with detailed attributes over the last 13 years.
- City personnel have dedicated over 15,000 hours in the development of the GIS stormwater database.

Stormwater Features Collection Timeline



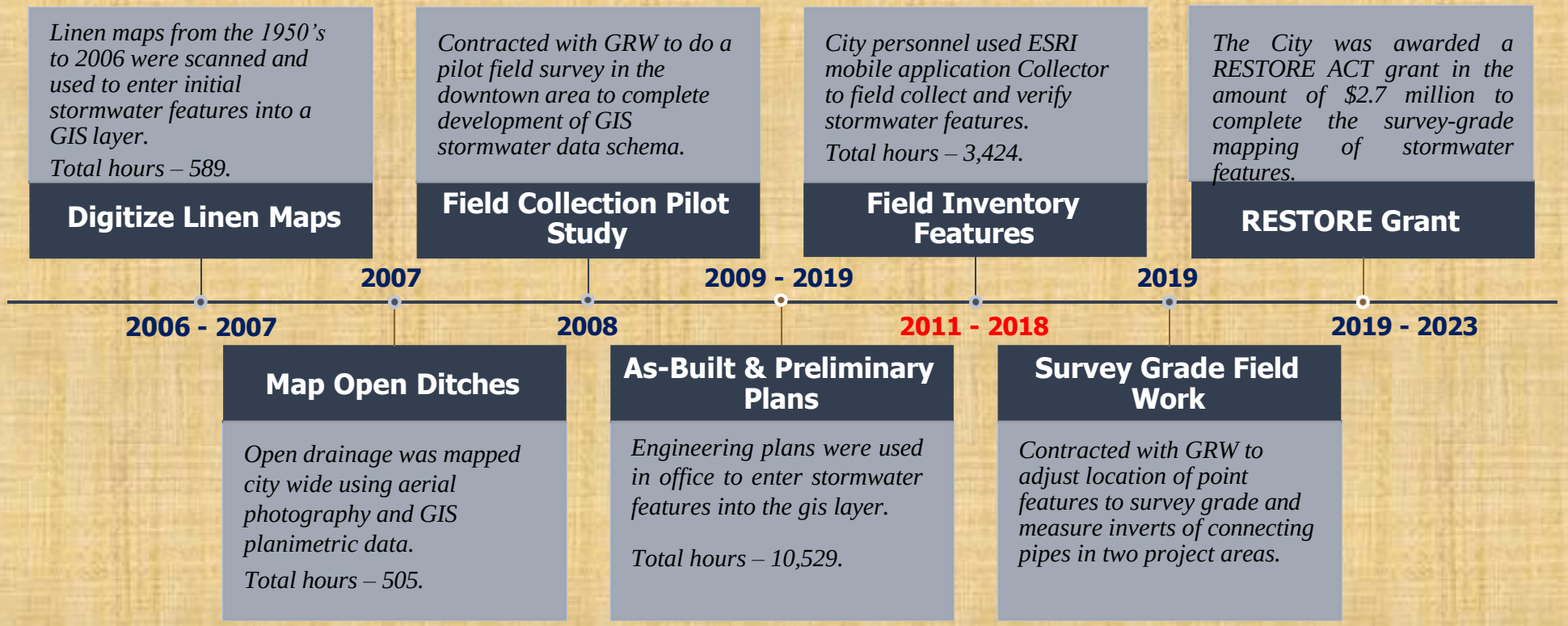
- Over 162,000 features have been mapped with detailed attributes over the last 13 years.
- City personnel have dedicated over 15,000 hours in the development of the GIS stormwater database.

AS-BUILT PLANS



1959 Plans

Stormwater Features Collection Timeline



- Over 162,000 features have been mapped with detailed attributes over the last 13 years.
- City personnel have dedicated over 15,000 hours in the development of the GIS stormwater database.

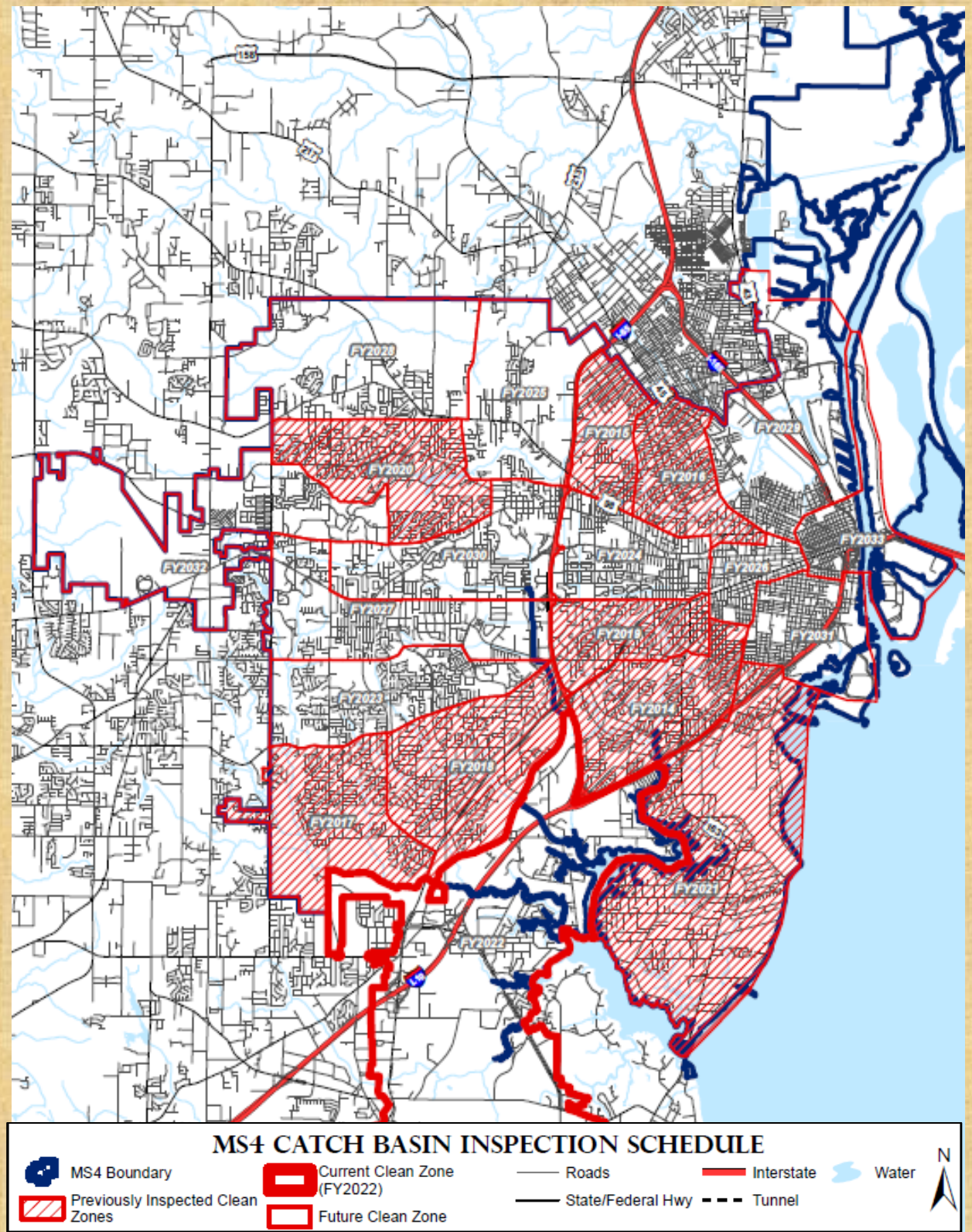
Catch Basin Inventory

- City maintains approximately 34,000 catch basins within our MS4 boundary
- If an Engineering Inspector, GIS Analyst or Public Works Operator identifies a new catch basin not in the inventory, the location is added into the geodatabase
- GIS Analysts must review and approve the location before it is permanently added into the system

MOBILE
ALABAMA

Catch Basin Inspection Areas

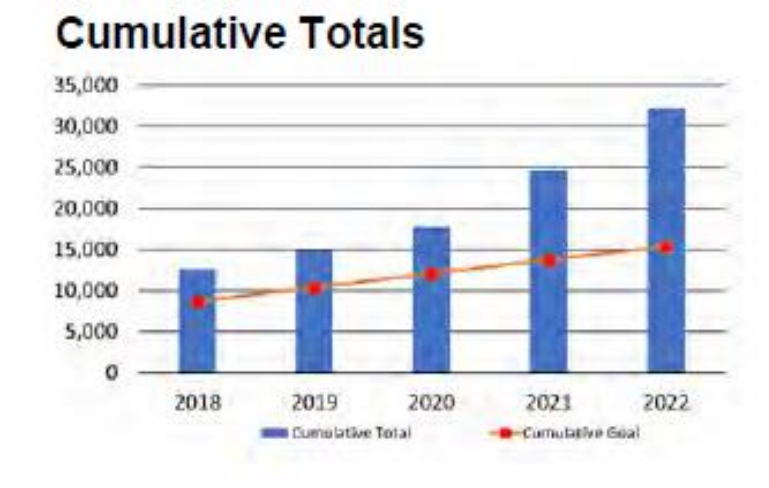
- 20-year/5% inspection schedule
- Approximately 179 sq. miles



MOBILE ALABAMA

Catch Basin Cleaning

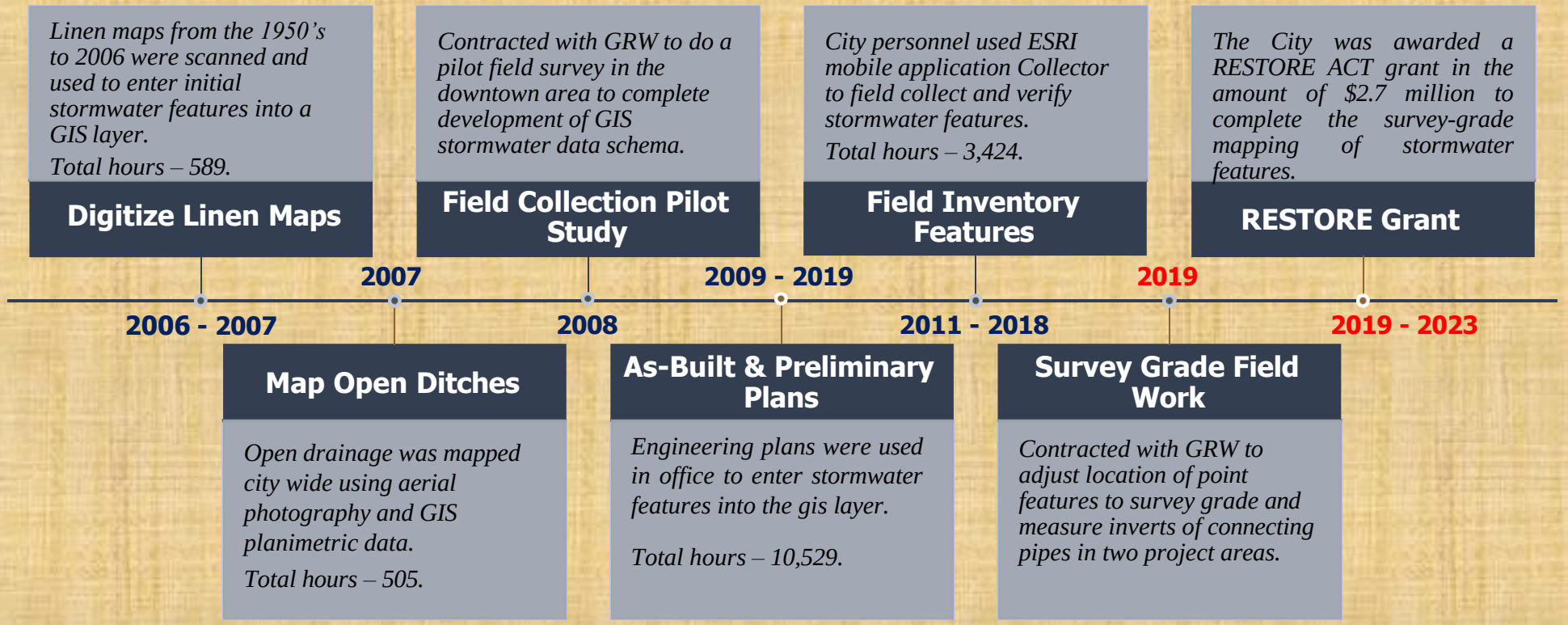
- Since FY18 the City has inspected and cleaned over 21,383 of a total 34,000 catch basins.
- The City has determined that its original FY15 inventory of 35,000 catch basins included 1000 private catch basins.



- FY22: 19,365 CY of material was removed from catch basins and pipes

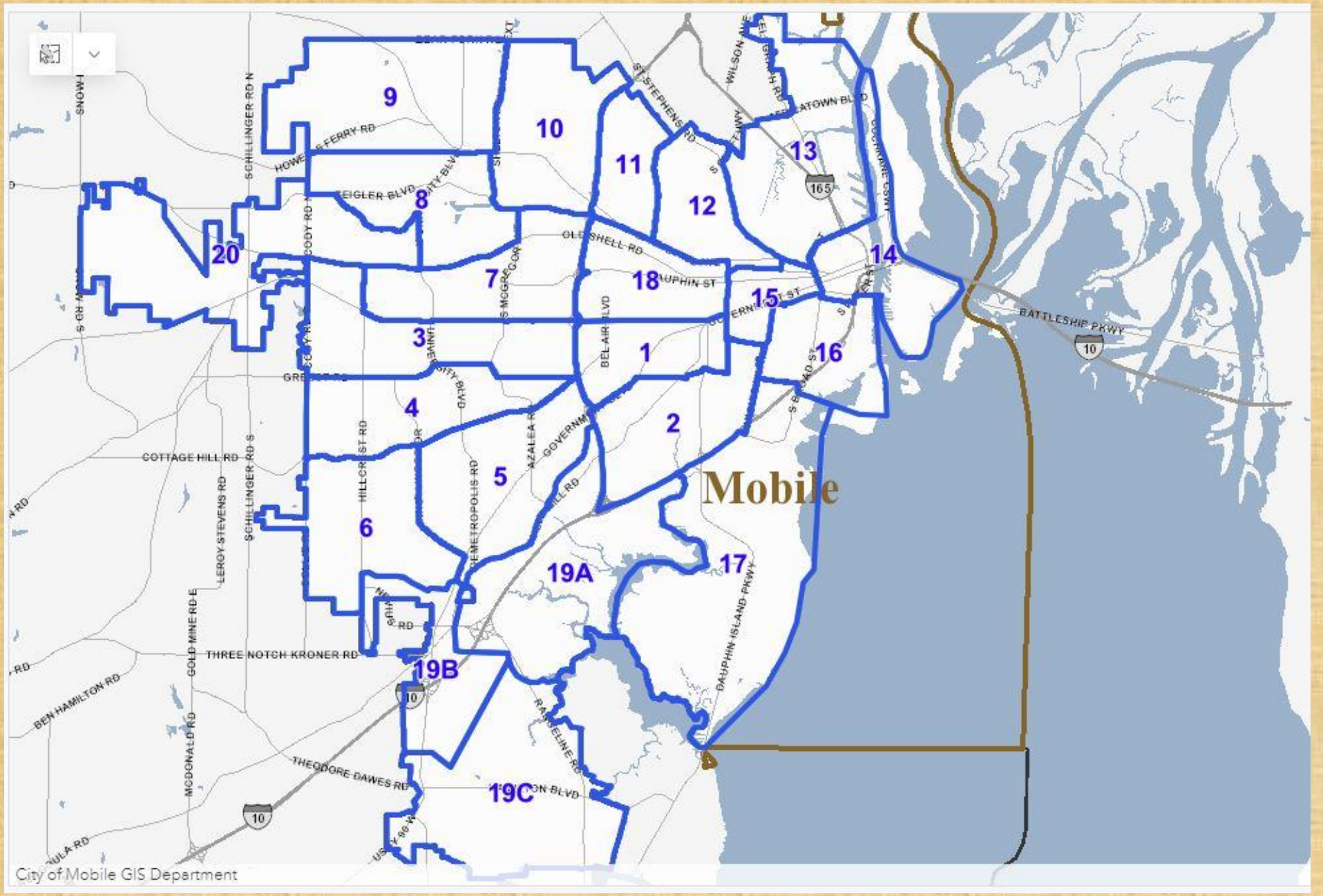
MOBILE
ALABAMA

Stormwater Features Collection Timeline

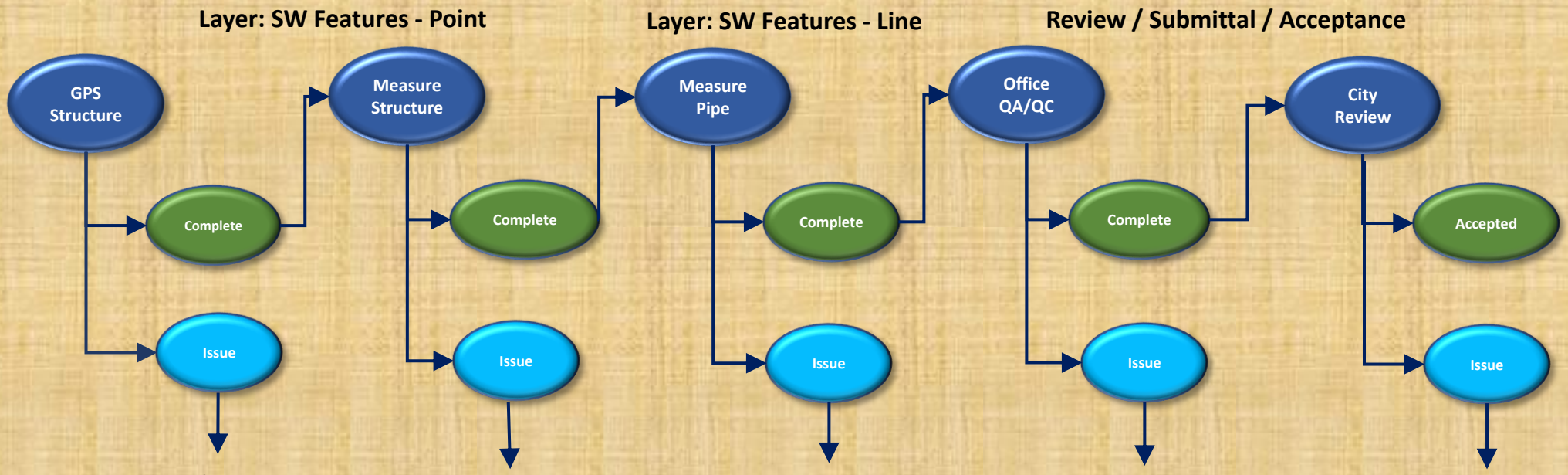


- Over 162,000 features have been mapped with detailed attributes over the last 13 years.
- City personnel have dedicated over 15,000 hours in the development of the GIS stormwater database.

SW MAPPING DATA COLLECTION DONE BY CATCH BASIN CLEAN ZONES



Workflow Stages for Storm Water Field Survey



- Not found
- Unable to Access

Log in field "GPS Status"

Contractor will use map service provided by City of Mobile for field survey and final data submittal.

- Clogged
- Collapsed
- Other
- Unable to Access

Log Status in field "Measure Status" and Issue in "Measurement Issue".

Structure condition will be forward to public works using an online map. Public works will update condition when complete. Contractor will return to measure structure when accessible.

- Clogged
- Collapsed
- Other
- Unable to Access

Log Status in field "Measure Status" and Issue in "Measurement Issue".

Pipe condition will be forward to public works using an online map. Public works will update condition when complete. Contractor will return to measure pipes when accessible.

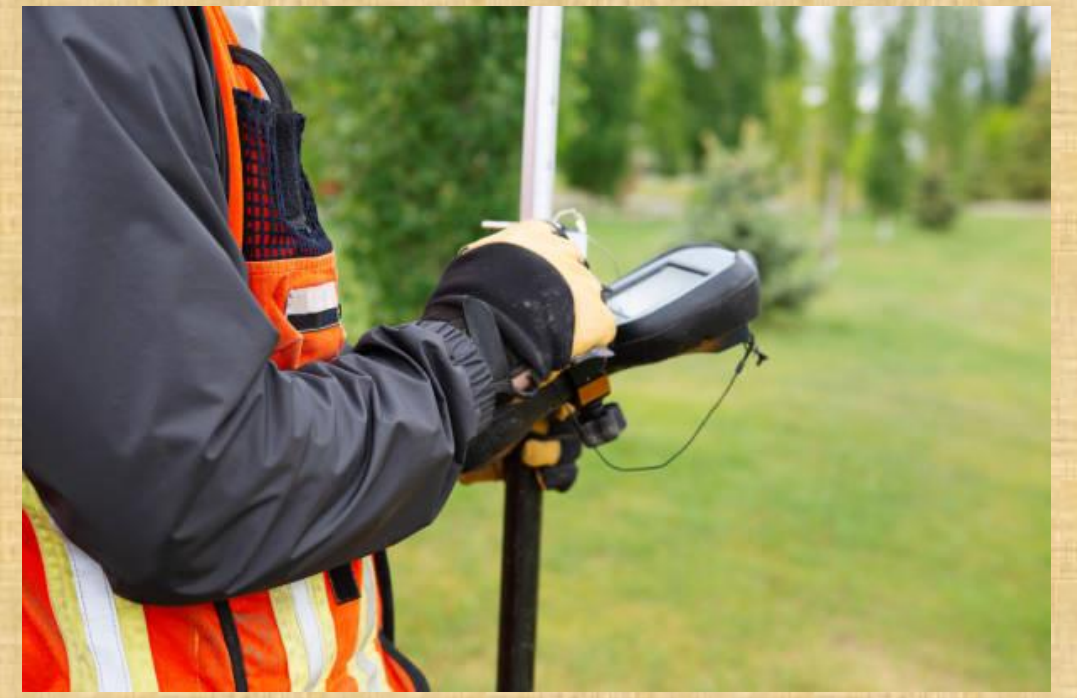
Contractor Process

Data will be submitted for review monthly. The city will respond within 30 days of submittal.

Return to contractor for correction. Contractor will return correction for review within 30 days.

MOBILE
ALABAMA

GPS LOCATING



MOBILE
ALABAMA

SW MAPPING - STANDARD GPS SURVEY LOCATIONS

Mobile Stormwater GPS Survey Locations

Curb Inlet With No Grate (C-TYPE) – Survey location is based on the entry point to the inlet. If the entry is round, survey the northern-most point on the round lid. If the entry point is square/rectangular, survey the center of the northern most edge of the entry point.

Double Curb Inlet With No Grate (Double C-TYPE) – Survey location is based on the northernmost entry point to the inlet. If the entry is round, survey the northern-most point on the round lid. If the entry point is square/rectangular, survey the center of the northern most edge of the entry point.

City of Mobile, Alabama The GRW Team

Mobile Stormwater GPS Survey Locations

Curb Inlet with Grate- Always survey the center of the rim on the longest edge in the road.

Double Curb Inlet with Grate – Survey the middle point between two grates along the long edge of the grates that is out in the road (NOTE: This rule applies whether or not there is a gap between the two grates)

SW MAPPING - STANDARD GPS SURVEY LOCATIONS

Mobile Stormwater GPS Survey Locations

S-TYPE Curb Inlet - Survey location is based on the entry point to the inlet. If the entry is round, survey the northern-most point on the round lid. If the entry point is square/rectangular, survey the center of the northern most edge of the entry point.

Double S-TYPE Curb Inlet - Survey location is based on the entry point to the inlet. If the entry is round, survey the northern-most point on the round lid. If the entry point is square/rectangular, survey the center of the northern most edge of the entry point.

City of Mobile, Alabama The GRW Team

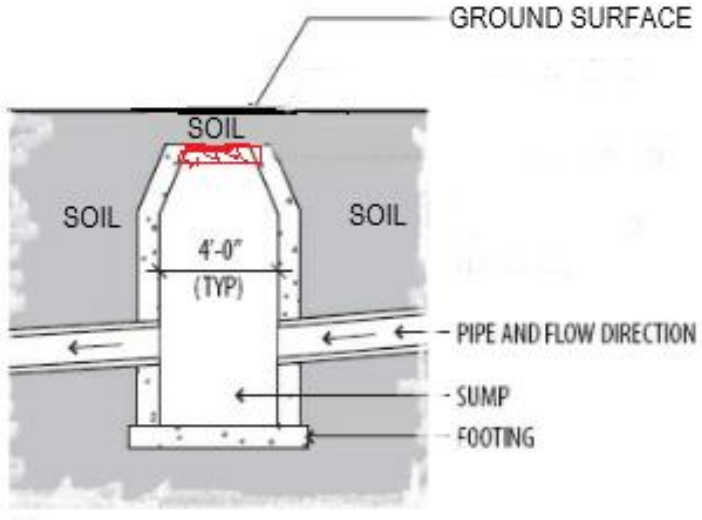
Mobile Stormwater GPS Survey Locations

Outfall Pipe End - Survey the bottom center of the pipe.

Slab Top Inlet (If the slab top inlet has a lid that can be opened, the survey will occur on the center of the northernmost edge of the opening. If there is no opening, the survey will occur on the center of the northernmost edge of the concrete)

SW MAPPING
DRAINAGE STRUCTURES – NOT ABLE TO ACCESS

Blind Structures

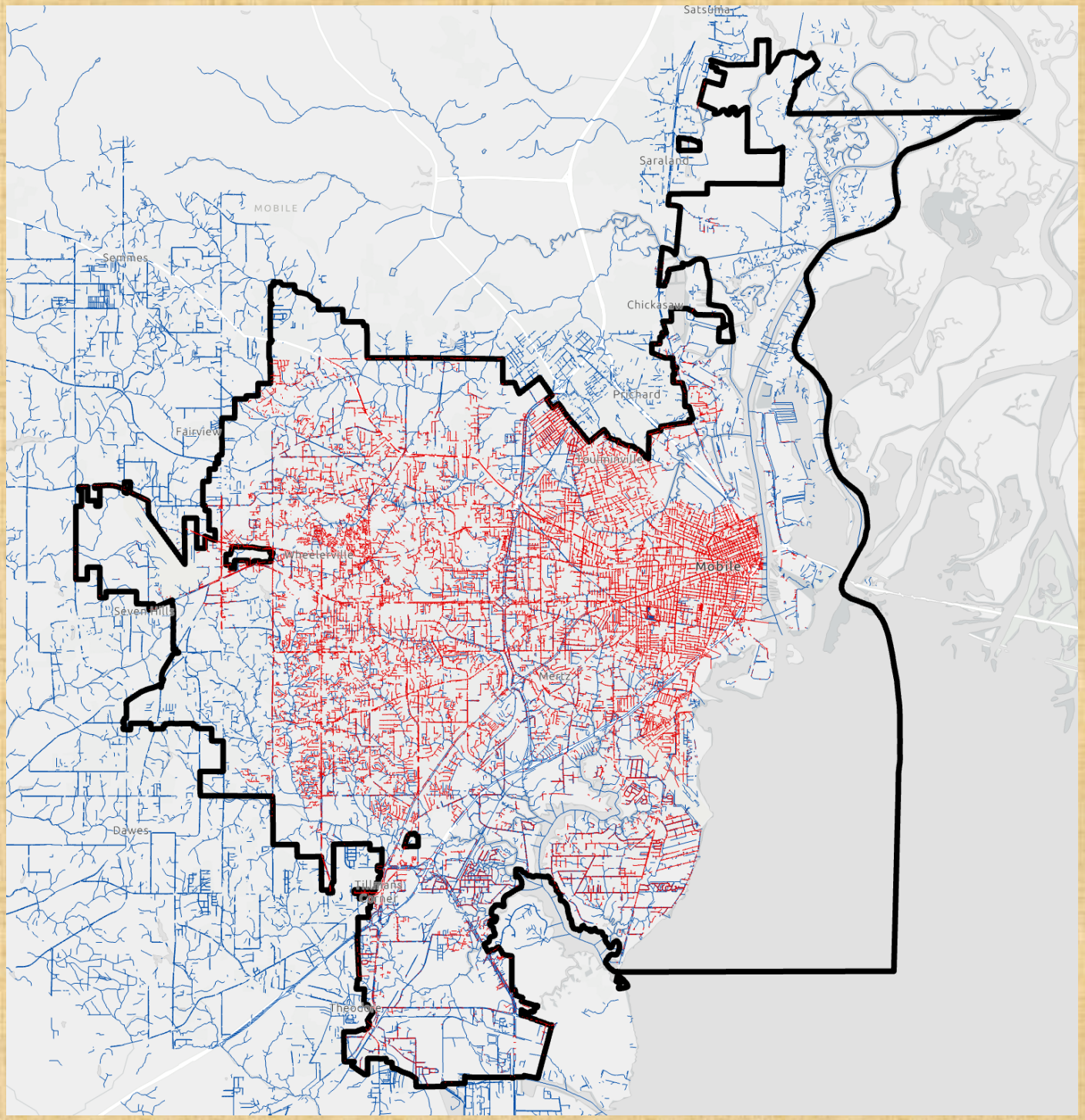


MOBILE
ALABAMA

RESULTS OF SW MAPPING PROJECT

Red are pipes

Blue are open channel



RESULTS OF SW MAPPING PROJECT

Blue – open ditch

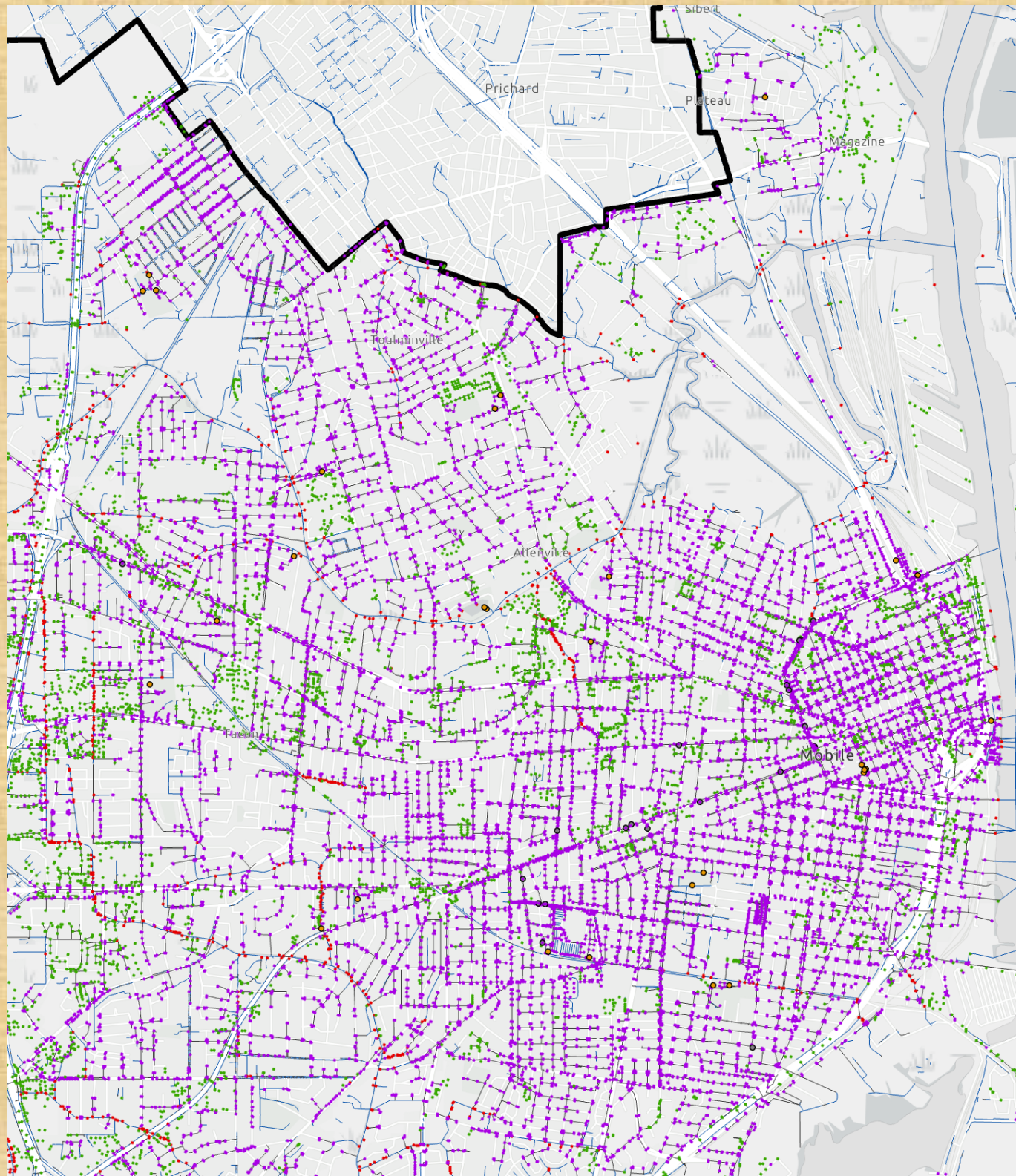
Dark gray – pipes

Red – outfalls

Purple – City SW points

Green – private, etc. SW points

Orange – structural controls



MOBILE
ALABAMA

SW MAPPING - DASHBOARD

Stormwater Survey

Clean Zone	Select a Billing Month	Select a Date Range by Surve...	Structure Condition	Point Features with Easement ...	swPoint Selector - FeatureID(E...	Outfall Selector - OutfallNum...
All	All	No date selected	No category selected	None	None	None

No Clean Zone Selected

Total # of Point Features
41,580

Total # of Inlets
34,100

Total # of Manholes
6,096

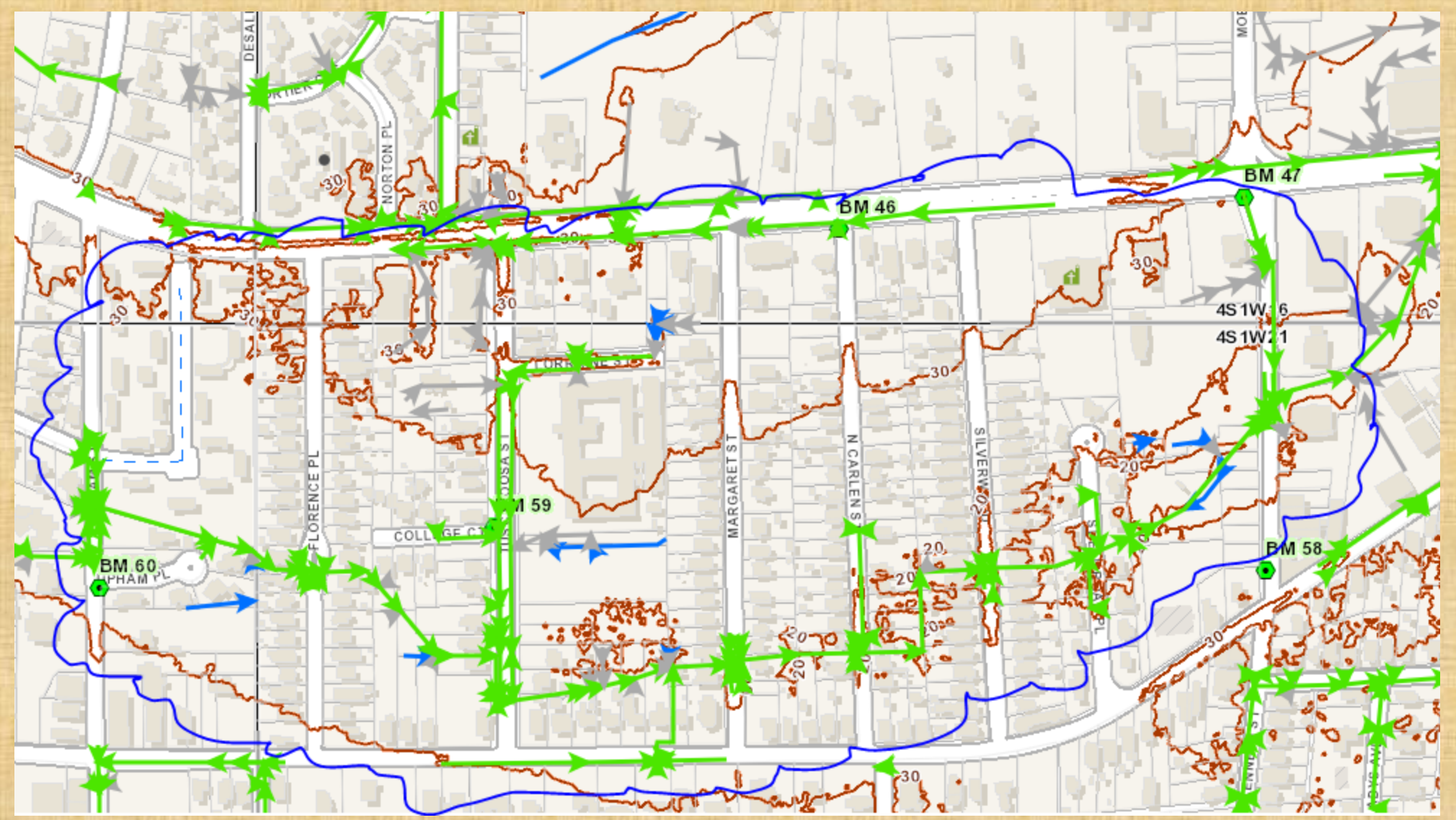
Total # of CleanOuts
1,383

Total # of Outfalls
3,659

	Point - Clogged	Point - Collapsed	Point - Needs Immediate Action	Point - Paved Over	Point - Heavy or Welded Lid	Point - Easement Issue	Outfall - Easement Issue
No Clean Zone Selected	995	21	219	461	2230	6	239

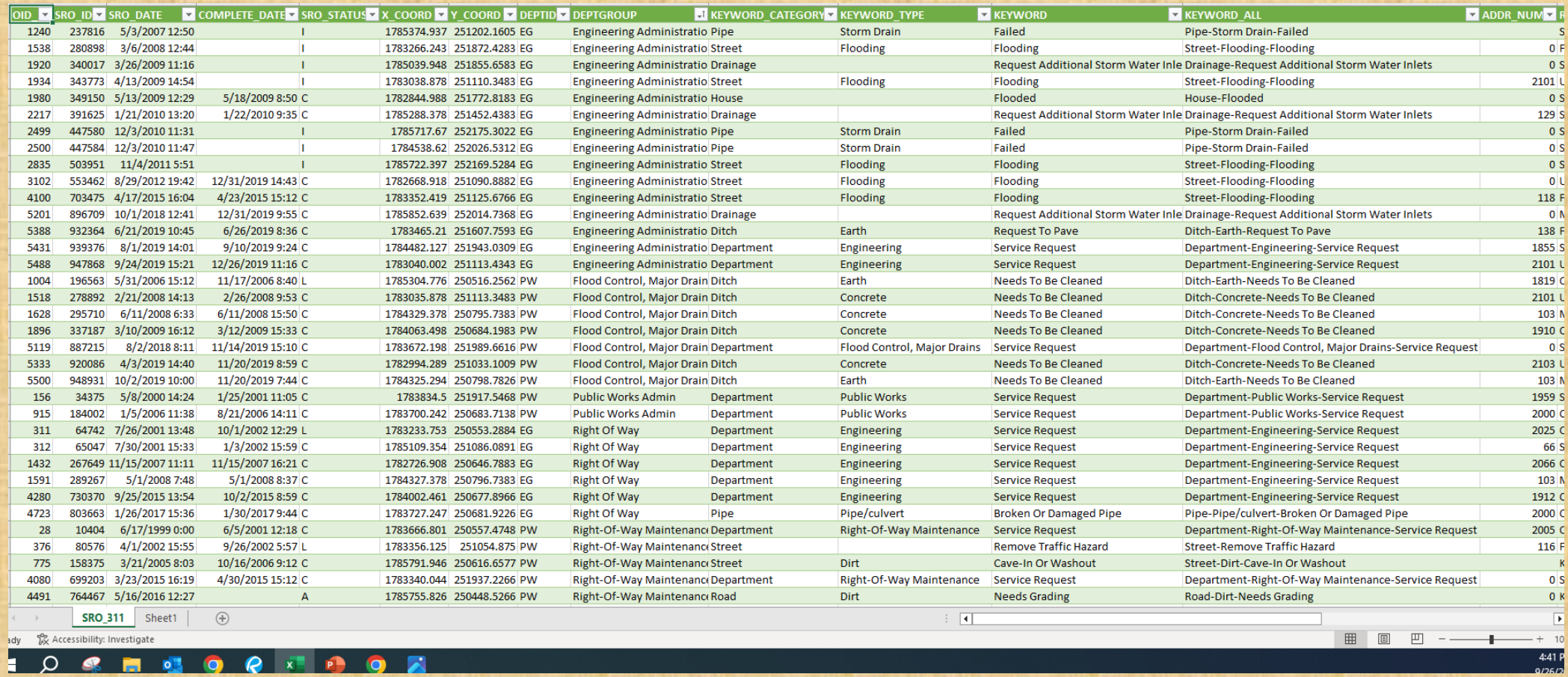
Issues Measuring - Points | Billing

NINE-BLOCK PILOT PROJECT



- Sub-watershed Capacity SWMM analysis
- Identify system-wide issues
- Can partial critical pipe segments be retrofitted or repaired?
- Do capacity issues overlay with 311 calls?

NINE-BLOCK PILOT PROJECT
311 CALL TO OVERLAY WITH CAPACITY ANALYSIS



OID	SRO_ID	SRO_DATE	COMPLETE_DATE	SRO_STATUS	X_COORD	Y_COORD	DEPTID	DEPTGROUP	KEYWORD_CATEGORY	KEYWORD_TYPE	KEYWORD	KEYWORD_ALL	ADDR_NUM	R
1240	237816	5/3/2007 12:50		I	1785374.937	251202.1605	EG	Engineering Administratio	Pipe	Storm Drain	Failed	Pipe-Storm Drain-Failed		S
1538	280898	3/6/2008 12:44		I	1783266.243	251872.4283	EG	Engineering Administratio	Street	Flooding	Flooding	Street-Flooding-Flooding	0	F
1920	340017	3/26/2009 11:16		I	1785039.948	251855.6583	EG	Engineering Administratio	Drainage		Request Additional Storm Water Inle	Drainage-Request Additional Storm Water Inlets	0	S
1934	343773	4/13/2009 14:54		I	1783038.878	251110.3483	EG	Engineering Administratio	Street	Flooding	Flooding	Street-Flooding-Flooding	2101	L
1980	349150	5/13/2009 12:29	5/18/2009 8:50	C	1782844.988	251772.8183	EG	Engineering Administratio	House		Flooded	House-Flooded	0	S
2217	391625	1/21/2010 13:20	1/22/2010 9:35	C	1785288.378	251452.4383	EG	Engineering Administratio	Drainage		Request Additional Storm Water Inle	Drainage-Request Additional Storm Water Inlets	129	S
2499	447580	12/3/2010 11:31		I	1785717.67	252175.3022	EG	Engineering Administratio	Pipe	Storm Drain	Failed	Pipe-Storm Drain-Failed	0	S
2500	447584	12/3/2010 11:47		I	1784538.62	252026.5312	EG	Engineering Administratio	Pipe	Storm Drain	Failed	Pipe-Storm Drain-Failed	0	S
2835	503951	11/4/2011 5:51		I	1785722.397	252169.5284	EG	Engineering Administratio	Street	Flooding	Flooding	Street-Flooding-Flooding	0	S
3102	553462	8/29/2012 19:42	12/31/2019 14:43	C	1782668.918	251090.8882	EG	Engineering Administratio	Street	Flooding	Flooding	Street-Flooding-Flooding	0	L
4100	703475	4/17/2015 16:04	4/23/2015 15:12	C	1783352.419	251125.6766	EG	Engineering Administratio	Street	Flooding	Flooding	Street-Flooding-Flooding	118	F
5201	896709	10/1/2018 12:41	12/31/2019 9:55	C	1785852.639	252014.7368	EG	Engineering Administratio	Drainage		Request Additional Storm Water Inle	Drainage-Request Additional Storm Water Inlets	0	M
5388	932364	6/21/2019 10:45	6/26/2019 8:36	C	1783465.21	251607.7593	EG	Engineering Administratio	Ditch	Earth	Request To Pave	Ditch-Earth-Request To Pave	138	F
5431	939376	8/1/2019 14:01	9/10/2019 9:24	C	1784482.127	251943.0309	EG	Engineering Administratio	Department	Engineering	Service Request	Department-Engineering-Service Request	1855	S
5488	947868	9/24/2019 15:21	12/26/2019 11:16	C	1783040.002	251113.4343	EG	Engineering Administratio	Department	Engineering	Service Request	Department-Engineering-Service Request	2101	L
1004	196563	5/31/2006 15:12	11/17/2006 8:40	L	1785304.776	250516.2562	PW	Flood Control, Major Drain	Ditch	Earth	Needs To Be Cleaned	Ditch-Earth-Needs To Be Cleaned	1819	C
1518	278892	2/21/2008 14:13	2/26/2008 9:53	C	1783035.878	251113.3483	PW	Flood Control, Major Drain	Ditch	Concrete	Needs To Be Cleaned	Ditch-Concrete-Needs To Be Cleaned	2101	L
1628	295710	6/11/2008 6:33	6/11/2008 15:50	C	1784329.378	250795.7383	PW	Flood Control, Major Drain	Ditch	Concrete	Needs To Be Cleaned	Ditch-Concrete-Needs To Be Cleaned	103	M
1896	337187	3/10/2009 16:12	3/12/2009 15:33	C	1784063.498	250684.1983	PW	Flood Control, Major Drain	Ditch	Concrete	Needs To Be Cleaned	Ditch-Concrete-Needs To Be Cleaned	1910	C
5119	887215	8/2/2018 8:11	11/14/2019 15:10	C	1783672.198	251989.6616	PW	Flood Control, Major Drain	Department	Flood Control, Major Drains	Service Request	Department-Flood Control, Major Drains-Service Request	0	S
5333	920086	4/3/2019 14:40	11/20/2019 8:59	C	1782994.289	251033.1009	PW	Flood Control, Major Drain	Ditch	Concrete	Needs To Be Cleaned	Ditch-Concrete-Needs To Be Cleaned	2103	L
5500	948931	10/2/2019 10:00	11/20/2019 7:44	C	1784325.294	250798.7826	PW	Flood Control, Major Drain	Ditch	Earth	Needs To Be Cleaned	Ditch-Earth-Needs To Be Cleaned	103	M
156	34375	5/8/2000 14:24	1/25/2001 11:05	C	1783834.5	251917.5468	PW	Public Works Admin	Department	Public Works	Service Request	Department-Public Works-Service Request	1959	S
915	184002	1/5/2006 11:38	8/21/2006 14:11	C	1783700.242	250683.7138	PW	Public Works Admin	Department	Public Works	Service Request	Department-Public Works-Service Request	2000	C
311	64742	7/26/2001 13:48	10/1/2002 12:29	L	1783233.753	250553.2884	EG	Right Of Way	Department	Engineering	Service Request	Department-Engineering-Service Request	2025	C
312	65047	7/30/2001 15:33	1/3/2002 15:59	C	1785109.354	251086.0891	EG	Right Of Way	Department	Engineering	Service Request	Department-Engineering-Service Request	66	S
1432	267649	11/15/2007 11:11	11/15/2007 16:21	C	1782726.908	250646.7883	EG	Right Of Way	Department	Engineering	Service Request	Department-Engineering-Service Request	2066	C
1591	289267	5/1/2008 7:48	5/1/2008 8:37	C	1784327.378	250796.7383	EG	Right Of Way	Department	Engineering	Service Request	Department-Engineering-Service Request	103	M
4280	730370	9/25/2015 13:54	10/2/2015 8:59	C	1784002.461	250677.8966	EG	Right Of Way	Department	Engineering	Service Request	Department-Engineering-Service Request	1912	C
4723	803663	1/26/2017 15:36	1/30/2017 9:44	C	1783727.247	250681.9226	EG	Right Of Way	Pipe	Pipe/culvert	Broken Or Damaged Pipe	Pipe-Pipe/culvert-Broken Or Damaged Pipe	2000	C
28	10404	6/17/1999 0:00	6/5/2001 12:18	C	1783666.801	250557.4748	PW	Right-Of-Way Maintenanc	Department	Right-Of-Way Maintenance	Service Request	Department-Right-Of-Way Maintenance-Service Request	2005	C
376	80576	4/1/2002 15:55	9/26/2002 5:57	L	1783356.125	251054.875	PW	Right-Of-Way Maintenanc	Street		Remove Traffic Hazard	Street-Remove Traffic Hazard	116	F
775	158375	3/21/2005 8:03	10/16/2006 9:12	C	1785791.946	250616.6577	PW	Right-Of-Way Maintenanc	Street	Dirt	Cave-In Or Washout	Street-Dirt-Cave-In Or Washout		K
4080	699203	3/23/2015 16:19	4/30/2015 15:12	C	1783340.044	251937.2266	PW	Right-Of-Way Maintenanc	Department	Right-Of-Way Maintenance	Service Request	Department-Right-Of-Way Maintenance-Service Request	0	S
4491	764467	5/16/2016 12:27		A	1785755.826	250448.5266	PW	Right-Of-Way Maintenanc	Road	Dirt	Needs Grading	Road-Dirt-Needs Grading	0	K

- Compare complaints to pipe segments with issues
- Do they align? If not, why?

PILOT - CONNECTIVITY MAP

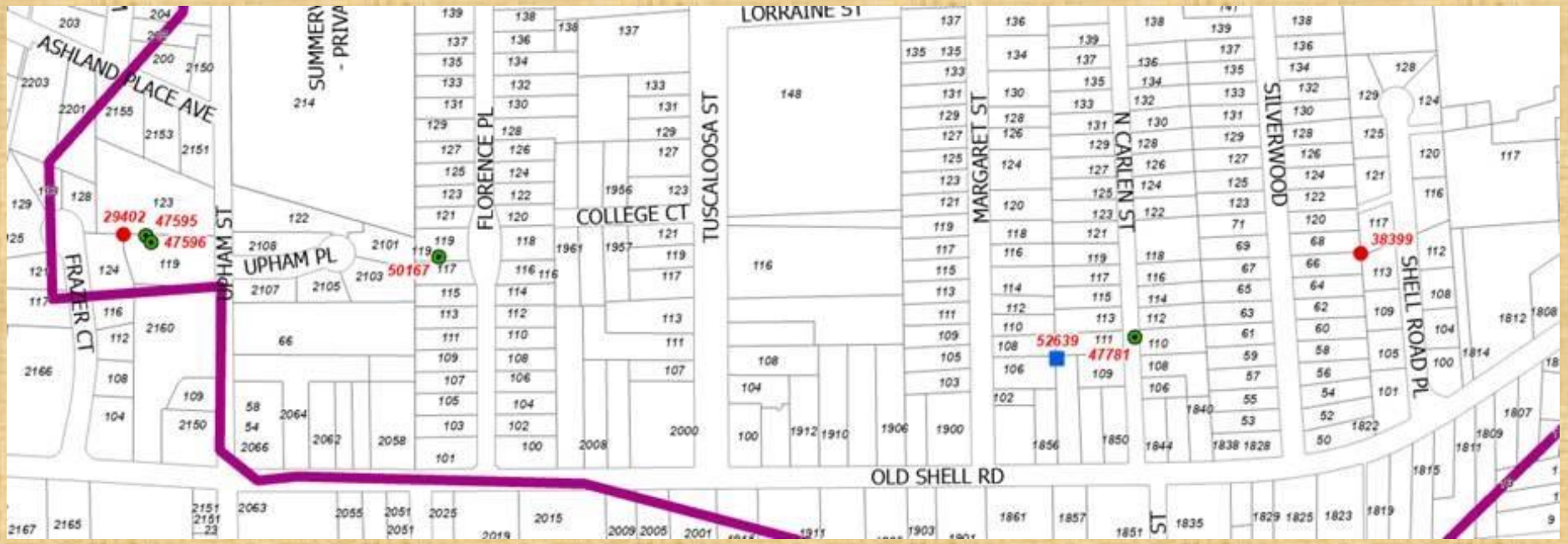
PILOT -DATA ANALYSIS

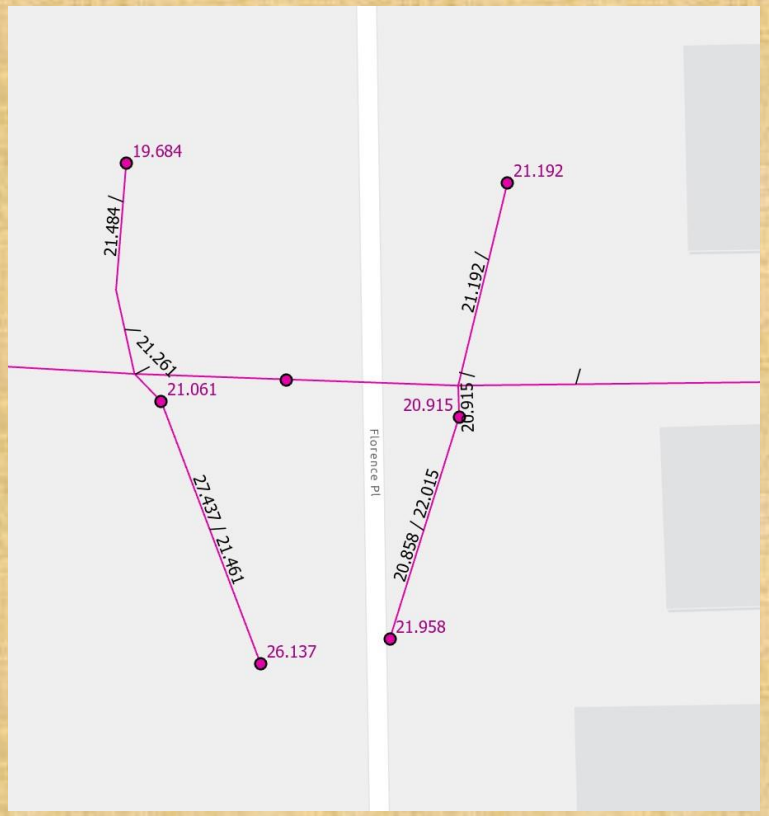
			Note: -all "circular" are Null -all "rectangular" are Null – should this be?		
Number of Barrels	swLine_Features_vwArdurra	BarrelNumber	Number of Barrels; (Column F – pipes spreadsheet) Assume "1" means 1 barrel. What does "0" mean? DEFAULT VALUE	No Data: 66.44% Populated: 33.56%	Assume 1
Pipe Invert Upstream	swLine_Features_vwArdurra	Survey_Upstreaminvert Survey_Upstream_Top_Depth; Survey_Upstream_Bottom_Depth	What are "Top Depths"? TOP OF PIPE (column AC – pipe spreadsheet)	No data: 62.19% Populated: 37.81%	1.use inlet invert elevations to create an assumed pipe slope or; 2. assume a pipe slope; in both 1 and 2 assume flow direction
Pipe Invert Downstream	swLine_Features_vwArdurra	Survey_Downstreaminvert; Survey_Downstream_Top_Depth; Survey_Downstream_Bottom_Depth	What are "Bottom Depths"? BOTTOM OF PIPE (Column AD-pipe spreadsheet)	No data: 73.5% Populated: 26.5%	1.use inlet invert elevations to create an assumed pipe slope or; 2. assume a pipe slope; in both 1 and 2 assume flow direction
Conveyance length	swLine_Features_vwArdurra	SHAPE_Length	Assume LF? YES (Column BM – pipes spreadsheet)	No data: 0% Populated: 100%	

			Note: -all "circular" are Null -all "rectangular" are Null – should this be?		
Number of Barrels	swLine_Features_vwArdurra	BarrelNumber	Number of Barrels; (Column F – pipes spreadsheet) Assume "1" means 1 barrel. What does "0" mean? DEFAULT VALUE	No Data: 66.44% Populated: 33.56%	Assume 1
Pipe Invert Upstream	swLine_Features_vwArdurra	Survey_Upstreaminvert Survey_Upstream_Top_Depth; Survey_Upstream_Bottom_Depth	What are "Top Depths"? TOP OF PIPE (column AC – pipe spreadsheet)	No data: 62.19% Populated: 37.81%	1.use inlet invert elevations to create an assumed pipe slope or; 2. assume a pipe slope; in both 1 and 2 assume flow direction
Pipe Invert Downstream	swLine_Features_vwArdurra	Survey_Downstreaminvert; Survey_Downstream_Top_Depth; Survey_Downstream_Bottom_Depth	What are "Bottom Depths"? BOTTOM OF PIPE (Column AD-pipe spreadsheet)	No data: 73.5% Populated: 26.5%	1.use inlet invert elevations to create an assumed pipe slope or; 2. assume a pipe slope; in both 1 and 2 assume flow direction
Conveyance length	swLine_Features_vwArdurra	SHAPE_Length	Assume LF? YES (Column BM – pipes spreadsheet)	No data: 0% Populated: 100%	

MOBILE
ALABAMA

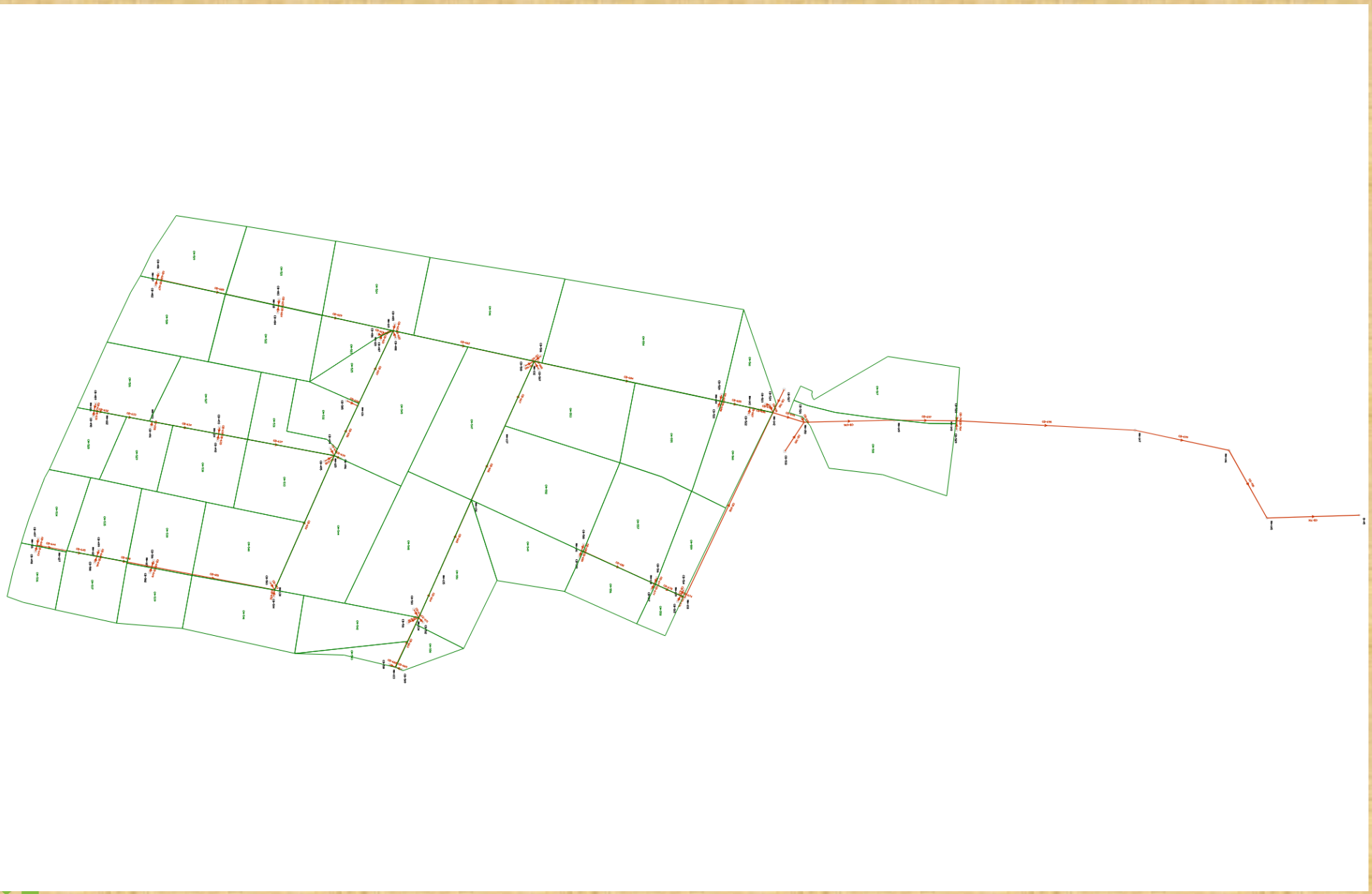
PILOT - DATA GAP EXAMPLES





MOBILE ALABAMA

PILOT - STORMCADD MAP



CONCLUSIONS FROM PILOT PROJECT

- Due to data gaps, no analysis was able to be performed.
- If data was to be used for modeling/identifying impervious areas – driveway polygons are needed…not only the lines from GIS and aerial mapping.
  - ➢ City GIS team digitized the driveway lines to create polygons.
- Positive byproduct was a deep dive into the data set for small sub-watershed – revealed what we already knew….

The data set is a work in progress.

Accomplishment of the Internal Team & Two (2) Projects:

- Gone from linen maps to current stage - all work done by City personnel except for the SW Mapping Project (RESTORE grant), only other outside work was by two (2) pilot projects in small 4-6 block-areas.

- Identifying where and how we can acquire more information to make this data even more beneficial.

We asked ourselves, why did we have issues encountered?

MOBILE ALABAMA

LESSONS LEARNED FROM PILOT PROJECT & SW MAPPING

Issues Unique to Older Areas

- Pilot project was in the oldest part of the City – Northeast (NE) side with heritage oak trees & blind structures.
- NE portion of City is what is not complete.
- NE area has the most flooding issues.
- Lack of Historic Data on what private pipes & how many and where pipes tied to the City system
- There may be multiple systems to tie to.
- In the very oldest area of town, we have a few stormwater antiquities…wooden culverts.
- Existing drainage built to standard of the day – over 300 years old

MOBILE
ALABAMA

LESSONS LEARNED FROM PILOT PROJECT & SW MAPPING

Unexpected CITY-WIDE Issue from SW Mapping Project:

- Property Owners did not allow access to their fenced back yard (in easements)

Other Issues CITY-WIDE

- Tidally influences – all major creeks/rivers outfall to tidally influenced waterways.
  - ➢ Tidal influence complicates data collection.
- Newer areas were built to modern standards – limited blind structures.
- Newer developments post-2010 used modern-day permitting standards.
  - ❖ Minimum vertical and horizontal distance from drainage infrastructure was required on permits in City ROW.

MOBILE ALABAMA

WHERE DO WE GO FROM HERE?

1. Have field confirmation design standards in City ROW are protecting City infrastructure.
2. We know data gaps – develop additional projects to bridge the gap.
3. Develop drainage project specifically geared to retrofit the concrete lids with no access.
4. Working on Pilot Project to use Ground Penetrating Radar (GPR) to get high-traffic and buried structure information.
5. Plan future public education efforts with City Communications department/citizens to allow access in their back yards.

MOBILE
ALABAMA

Presenter Contact Information

Rosemary Ginn, PE
Assistant City Engineer
City of Mobile
rosemary@cityofmobile.org
www.stormwatermobile.org

Martha Jackson
GIS Analyst III
City of Mobile
marti.byrnes@cityofmobile.org
https://open-government-cityofmobile.hub.arcgis.com

MOBILE
ALABAMA