Town of Denton Stormwater Inventory

JULY 2022

Prepared by the

PIEDMONT TRIAD REGIONAL COUNCIL

Town of Denton
Stormwater Inventory

Prepared by the

Piedmont Triad Regional Council

Grace Messinger
Water Resources Planner

Malinda Ford
Senior Regional Planner

Melissa Jones
GIS Planner

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BACKGROUND & PURPOSE

The Town of Denton is located in southeastern Davidson County just east of High Rock Lake and the Yadkin River. The Town has experienced regular flooding during major storm events. It has been observed that over the past few years, there have been an increasing number of large storm events that have impacted the town resulting in road closures, flooded homes and downtown businesses, as well as sanitary sewer overflows. The Town sits within three HUC-12 watersheds that are part of the larger Yadkin-Pee Dee River Basin, these include Lick Creek (030401030601), Betty McGees Creek-Uwharrie River (030401030501) and Cabin Creek (030401030602). Lick Creek, a primary tributary in Denton, has been listed on the NC DEQ 303(d) list of impaired waters due to its inability to support aquatic life. The NC Division of Water Resources anticipates that these water quality impairments are caused by a combination of point and nonpoint sources, including urban stormwater runoff. NCDWR recommends the improvement and management of stormwater runoff in the watershed as outlined in the 2009 Lower Yadkin Pee-Dee River Basin Restoration Priorities report. Stormwater runoff can significantly impact aquatic organisms, because it disrupts the natural flow, temperature, and chemistry of the water and erodes streambanks and other habitat. There is a need to identify and map the exsiting infrastructure, identify its' integrity, maintenance and suggest retrofit options so as to better mitigate flooding and to improve water quality. The Town of Denton brings in tourists that visit the Denton Farm Park, a family owned historical park that accommodates campers which hosts various cultural events throughout the year. Additionally, with impending new development planned for at the end of Spring and Broad St, Denton needs to further address historical flooding and stormwater issues.

In an effort to address this problem, the Town of Denton partnered with the Piedmont Triad Regional Council (PTRC) to conduct a detailed inventory of the towns' stormwater drainage systems. The primary goals of this project were to establish an online database of all stormwater infrastructure for the Town, including all drains, pipes, and outfalls, evaluate any potential maintenance needs, and identify additional opportunities to reduce stormwater flows. This inventory will help Denton more easily manage and maintain existing stormwater infrastructure and better inform future stormwater management decisions, as well as to help identify potential sources of inflow and infiltration (I/I). The following report outlines the work completed and summarizes the project's findings.

PROCESS

FIELD WORK

In order to determine how stormwater is channeled throughout the Town of Denton, PTRC staff surveyed each inlet, junction box, culvert, manhole, outlet, and outfall over the course of several fieldwork days. A geodatabase was created in ESRI ArcGIS to house the stormwater infrastructure data. Each type of stormwater feature and its associated attributes (characteristics) was given a set of rules (attribute domains) for field data entry to enforce data integrity and ease data collection in the field. Attachments were enabled on the geodatabase to allow for photographs to be taken in the field and associated with each point.

The completed database structure was then uploaded to an online web map in ArcGIS Online so that it could be populated during field work. PTRC staff used the ArcGIS Collector application on Android tablets to collect stormwater infrastructure point data. For better locational accuracy, a Trimble R1 integrated GNSS Bluetooth device was used in combination with ArcGIS Collector. This device has a maximum precision of 1.64 feet.

Stormwater attribute data collected in the field consisted of stormwater inlet and outlet type, location (x-y coordinates), pipe material, diameter, direction, depth, condition rating, condition description, and a high-resolution hyperlinked photo of each stormwater feature. A laser distance tool and tape measurer aided in pipe diameter and depth measurements. At the end of each fieldwork day, data points from the Android tablets were synced back to the geodatabase. A total of 3,205 points were collected across 12 days of fieldwork.

ANALYSIS

Upon completion of the stormwater point data collection, PTRC reviewed the data in ArcMap. Necessary data edits were made to clean up data inconsistencies, fill in missing attribute data, snap collected points to aerial imagery, and add any points that were not visible in the field. A stormwater pipe layer was created using pipe diameter and flow direction information collected in the field. The stormwater pipe layer was symbolized with arrows to indicate flow directions so that stormwater flow can be traced from the point of origin to the surface or stream outfall.

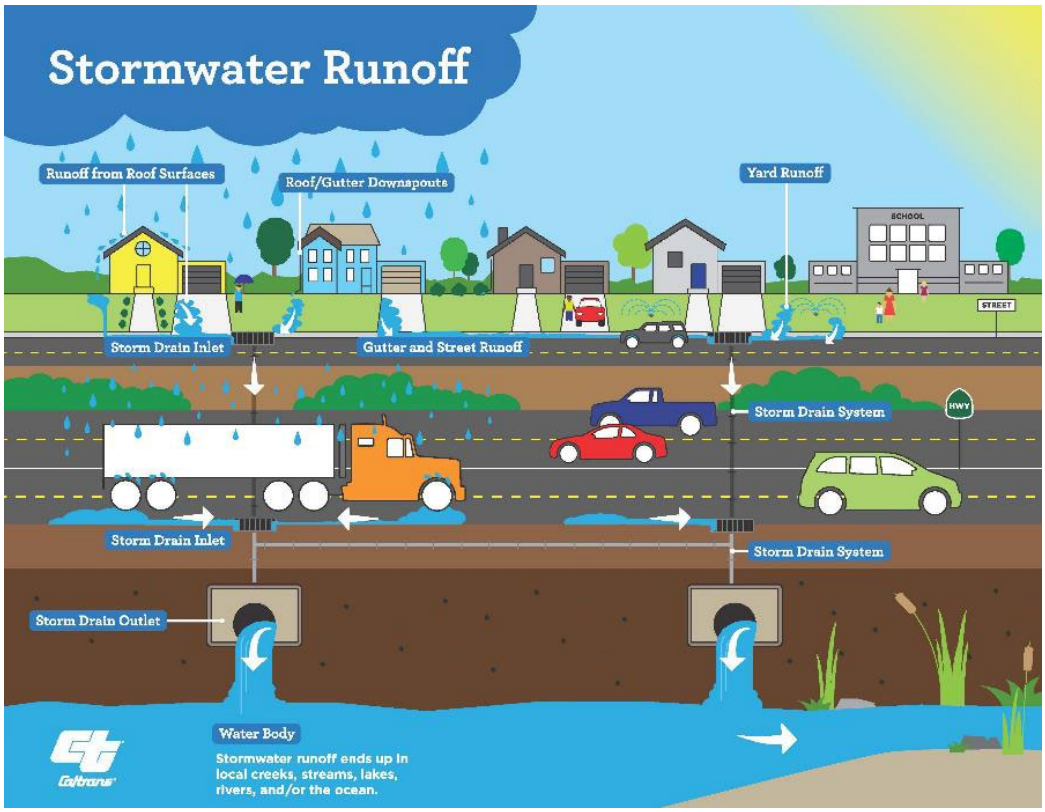
STORMWATER INVENTORY

SUMMARY

The completed stormwater inventory includes 1,067 stormwater pipes, 217 swales, 328 catch basins, and 76 outfalls. There is an equivlant of 9.1 miles of stormwater pipes and 5.3 miles of swales. A total of 45 issues were also noted to help the Town better manage and maintain existing stormwater systems, identify potential sources of I/I, and make informed future stormwater management decisions. The following sections go into more detail about what influences stormwater runoff, the data collected, and how the database can be accessed and used.

FACTORS INFLUENCING RUNOFF

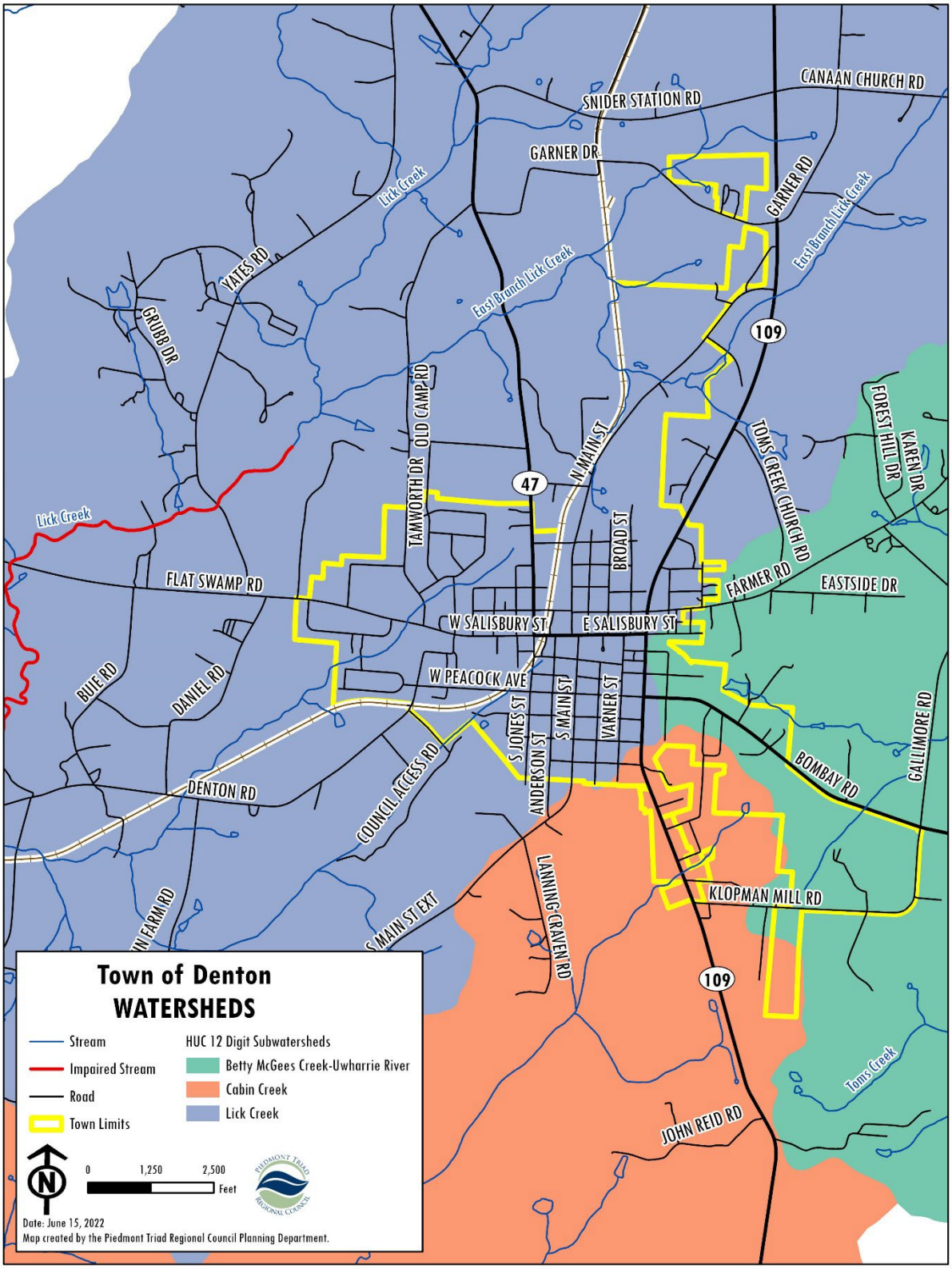
When it rains, some of the rainwater is absorbed into the ground, while part of it flows over the ground. All that water that rolls off of your roof, through your yard, and over the street is called stormwater runoff. The flow and volume of stormwater runoff is influenced by a number of environmental and human factors including the season, severity of storm, topography, soil conditions, and amount of vegetation or impervious surfaces (such as roads, driveways, parking lots, and roofs). To better understand the various factors influencing stormwater runoff in the Town of Denton, the PTRC reviewed available elevation, soil, and land cover data.



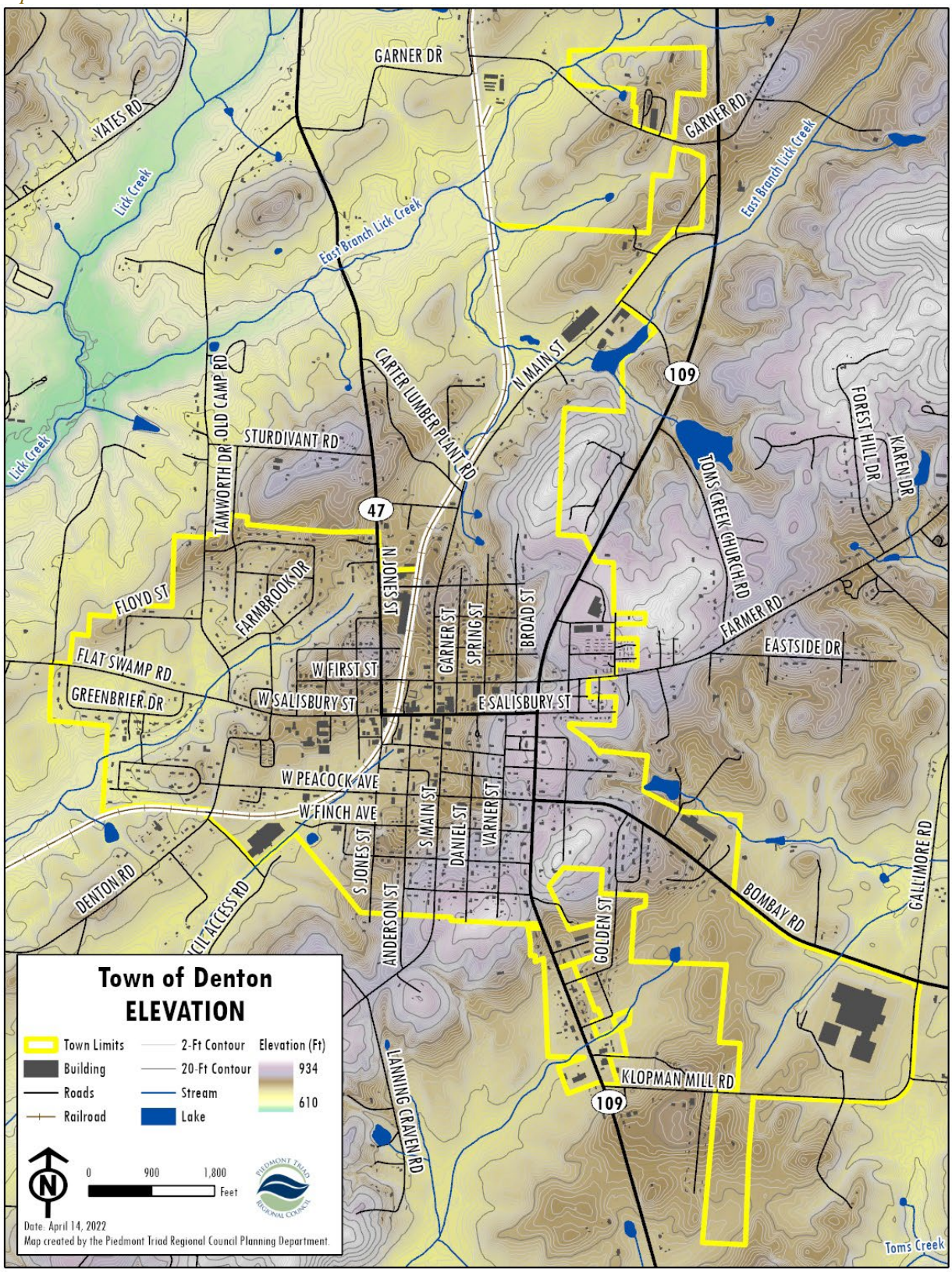
Elevation in Denton ranges from a peak of 846 feet to a low of 645 feet above sea level. Generally, all rainwater in Denton eventually drains west and into the Yadkin-Pee Dee River. NC-109 and the South Main Street Extension act as a ridge line running north to south through the Town. The highest peaks are on the east side of town, near the intersection of NC-109 and Bombay Road and the intersection of NC-109 and Tom's Creek Church Road. Stormwater west of NC-109 drains to Lick Creek and then to the Yadkin River. Stormwater east of NC-109 drains to Tom's Creek and then to the Uwharrie River, which feeds into the Pee-Dee River.

Topography not only influences flow directions, but also the speed at which water travels. In general, the steeper and longer a slope is, the faster water runs off of it, and the greater potential there is for erosion. Due to the natural topography of the foothills, there are several sections of Denton that have long and steep slopes. These areas likely contribute to higher stormwater velocities and erosion rates. However, other factors like soil composition and vegetative cover also play an important role in determining runoff and erosion potential. Map 1 and Map 2 show that the highest area of town is near NC Hwy 109 and as such there are three different watersheds that the stormwater flows to in Denton.

Map 1: Watersheds



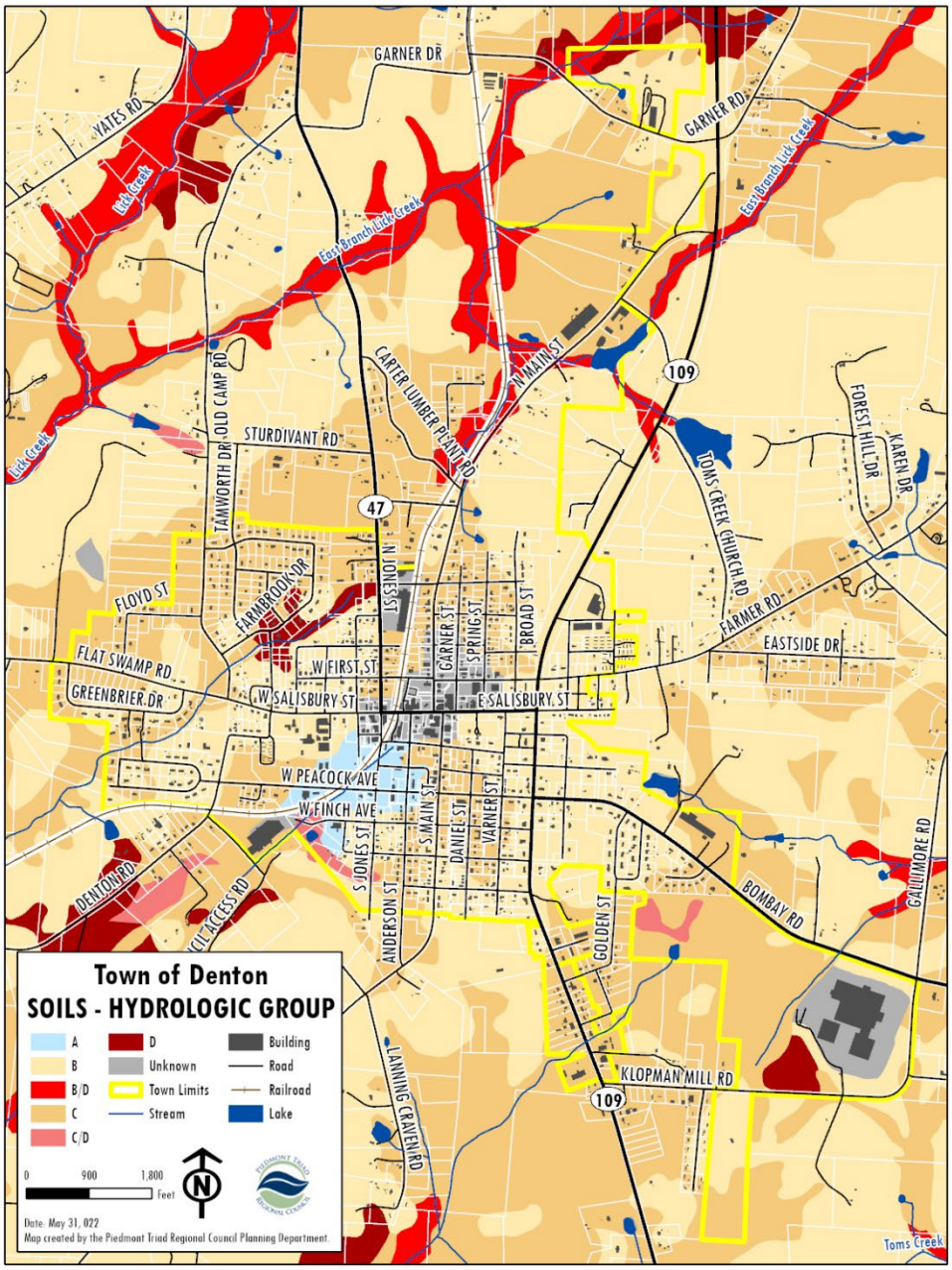
Map 2: Elevation



Source: NC DEM (10-foot Resolution)

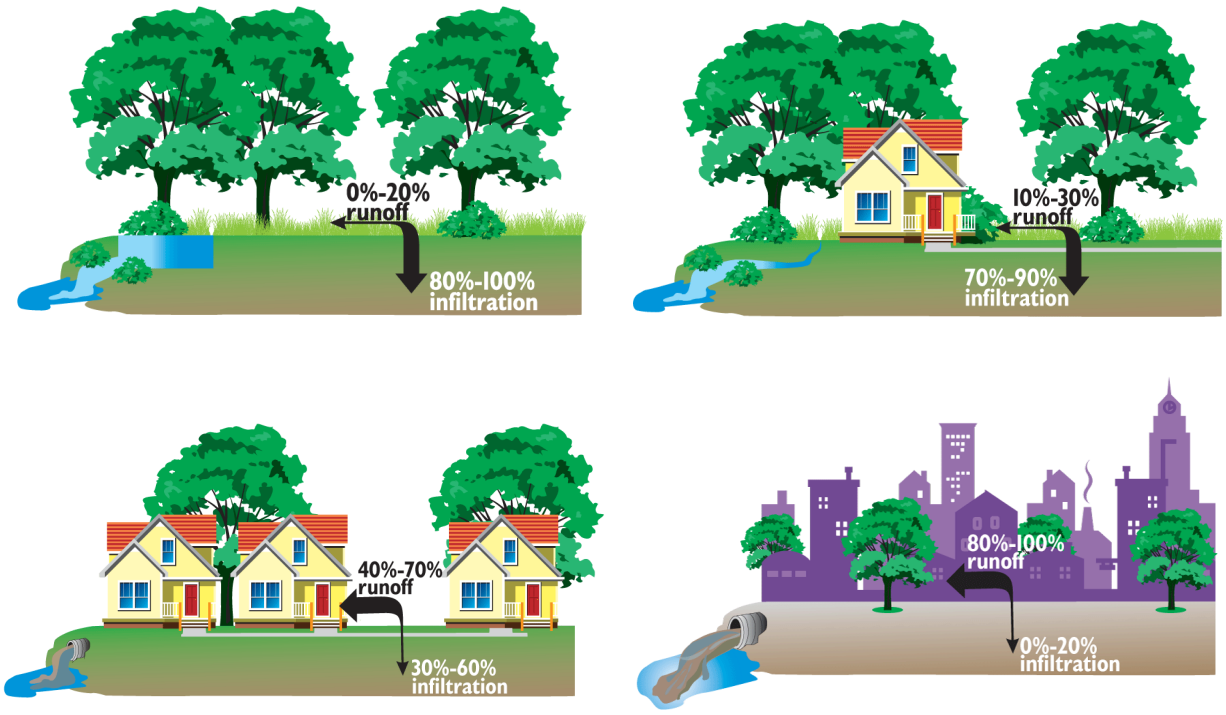
Soil composition affects how much water can be absorbed into the ground. Sandy soils have low runoff potential and high infiltration rates, while clay soils have high runoff potential and low infiltration rates. Soils are typically classified into four hydrologic soil groups (A, B, C, and D) based on their runoff potential, where A's generally have the smallest runoff potential and D's the greatest. A majority of the underlying soils in Denton are categorized as Type B or C, which includes silt loams and sandy clay loams. These soil types have moderate to low infiltration rates. Type B soils are well-suited for a wide-range of SCMs, while Type C soils typically do not drain as well.

Map 3: Hydrologic Soil Groups



Source: USDA SSURGO Soil Database

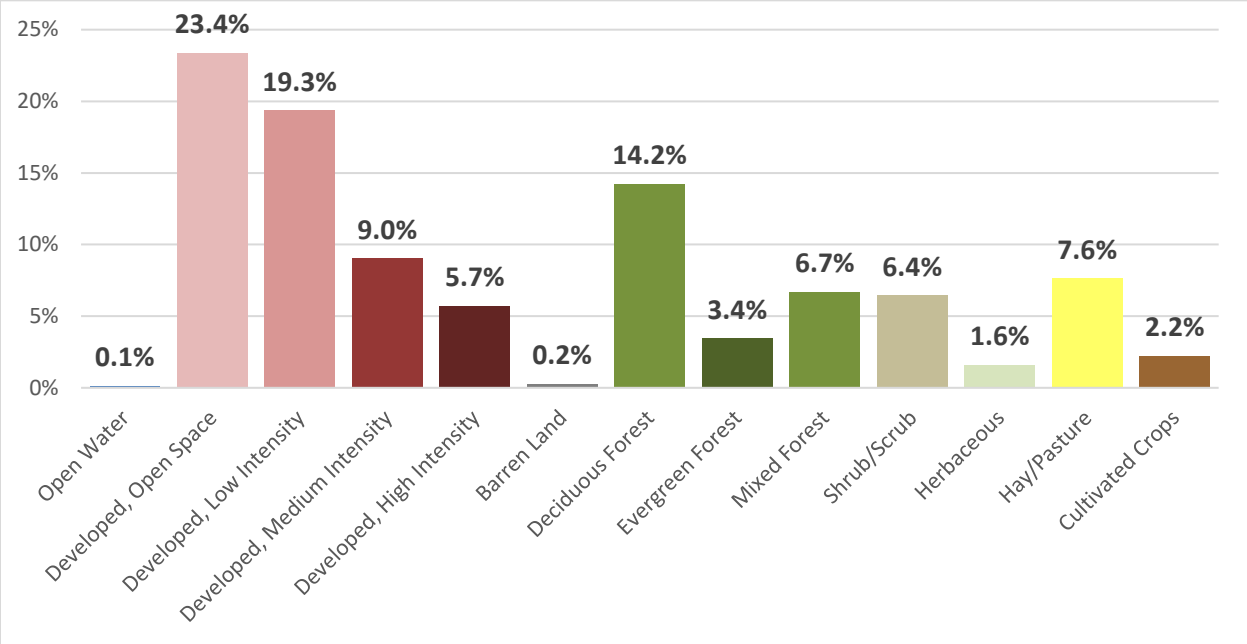
Another factor that influences stormwater runoff is the amount of impervious surfaces, such as roads, driveways, parking lots, and roofs, in an area. These hard surfaces prevent rainwater from percolating into the ground, which increases the amount of stormwater runoff and can lead to pooling or flooding.



There are roughly 262 acres of impervious surfaces in Denton, which make up approximately 19.2% of the total land area (NLCD Percent Developed Imperviousness, 2019). Impervious surfaces are most concentrated in the central part of Town, along major thoroughfares, such as NC-109, and in industrial centers. According to research by the Center for Watershed Protection, streams begin to be negatively impacted when impervious surfaces exceed just 10% of a watershed and streams in watersheds where impervious surfaces cover 25% of the watershed typically cannot support aquatic life. These ecological impacts can be offset by encouraging development in existing commercial and industrial centers and increasing the amount of greenspace and vegetation in open areas, which helps slow and filter stormwater runoff.

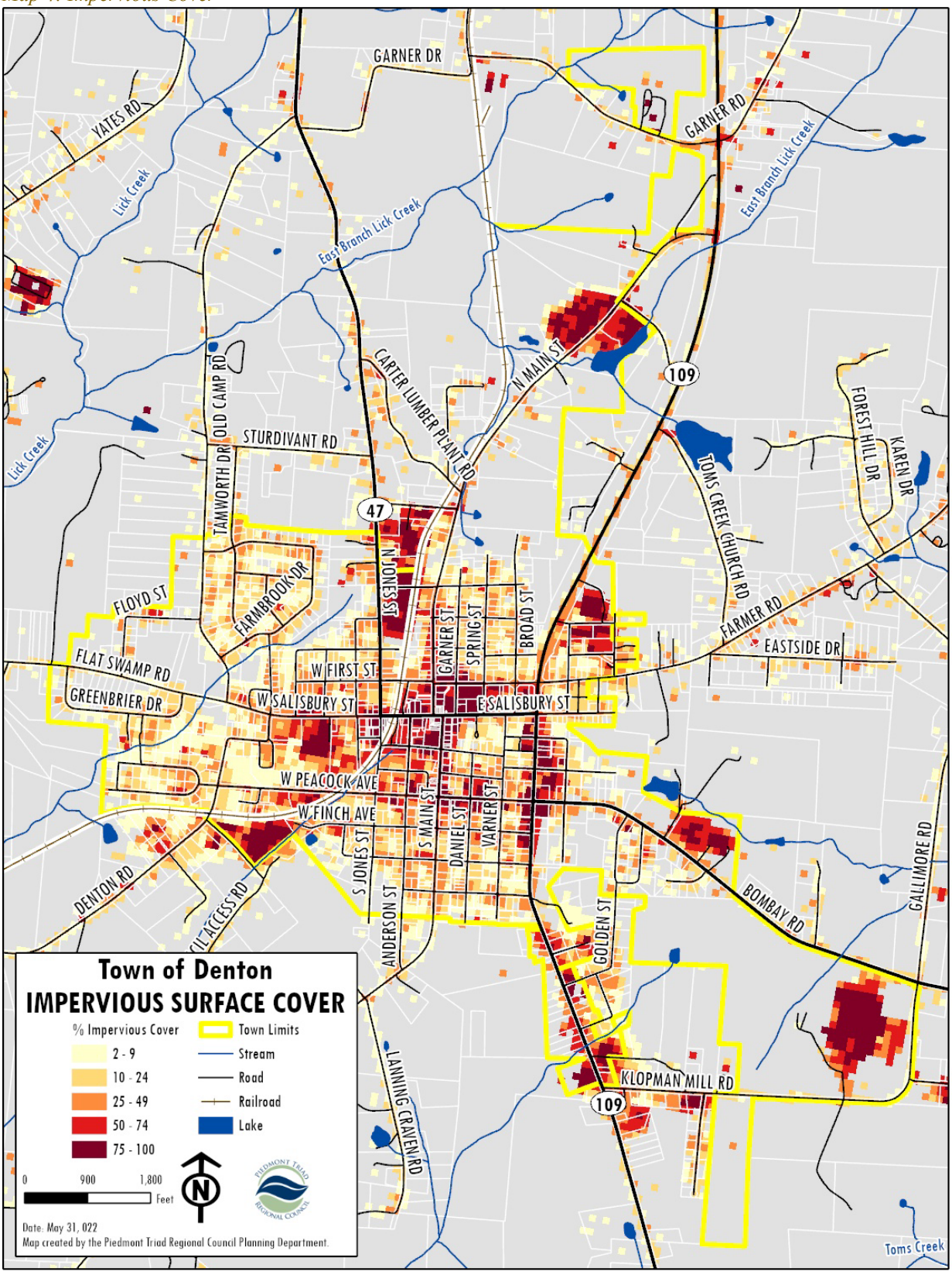
A more detailed breakdown of land cover shows that developed open space makes up the largest percentage of land cover in Denton (23.4%), followed by low intensity development (19.3%) and deciduous forests (14.2%). Map 5 describes how land cover is distributed across the Town (NLCD 2019 Land Cover).

Figure 1: Denton Land Cover



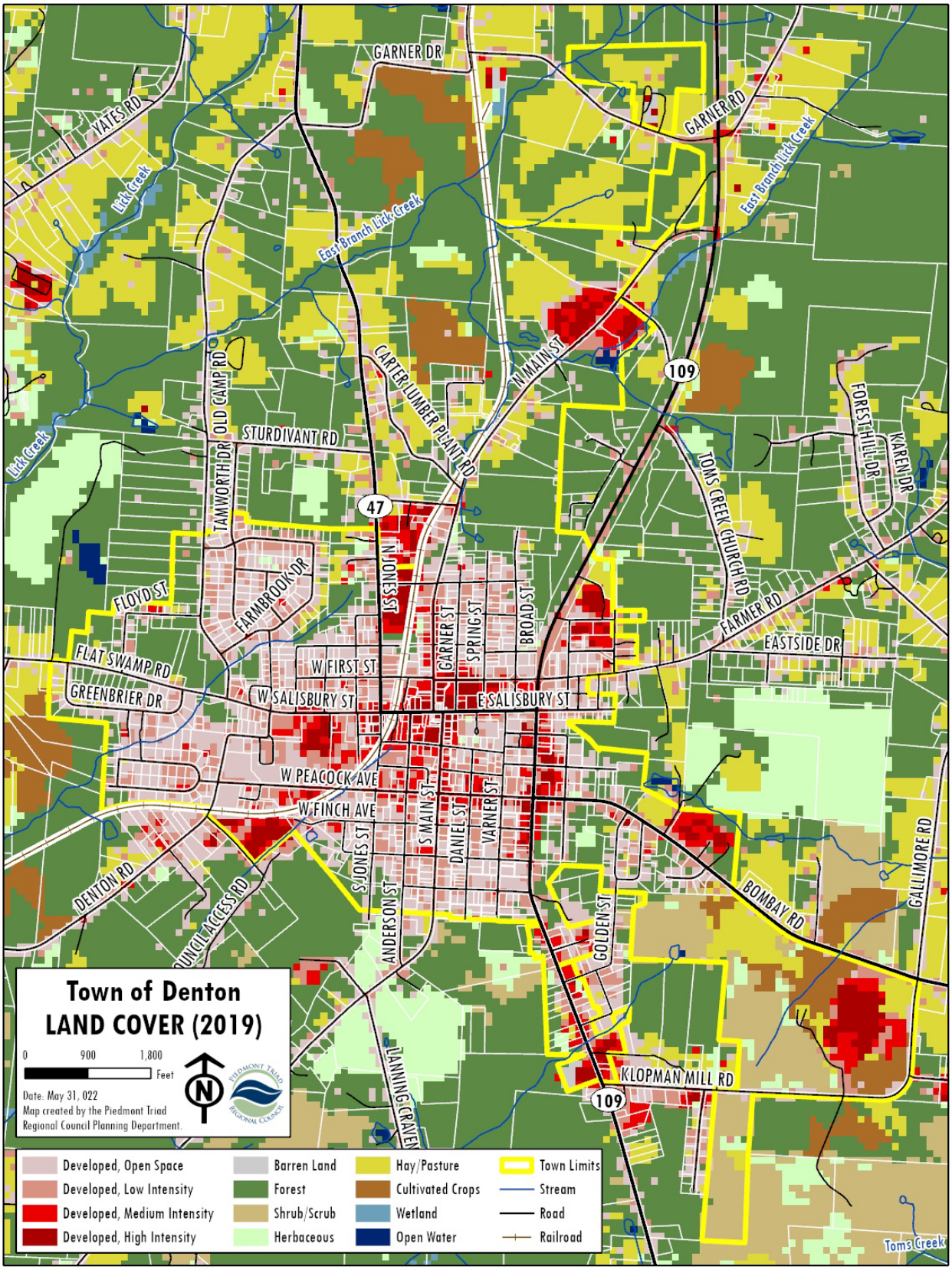
Source: NLCD 2016 Land Cover

Map 4: Impervious Cover



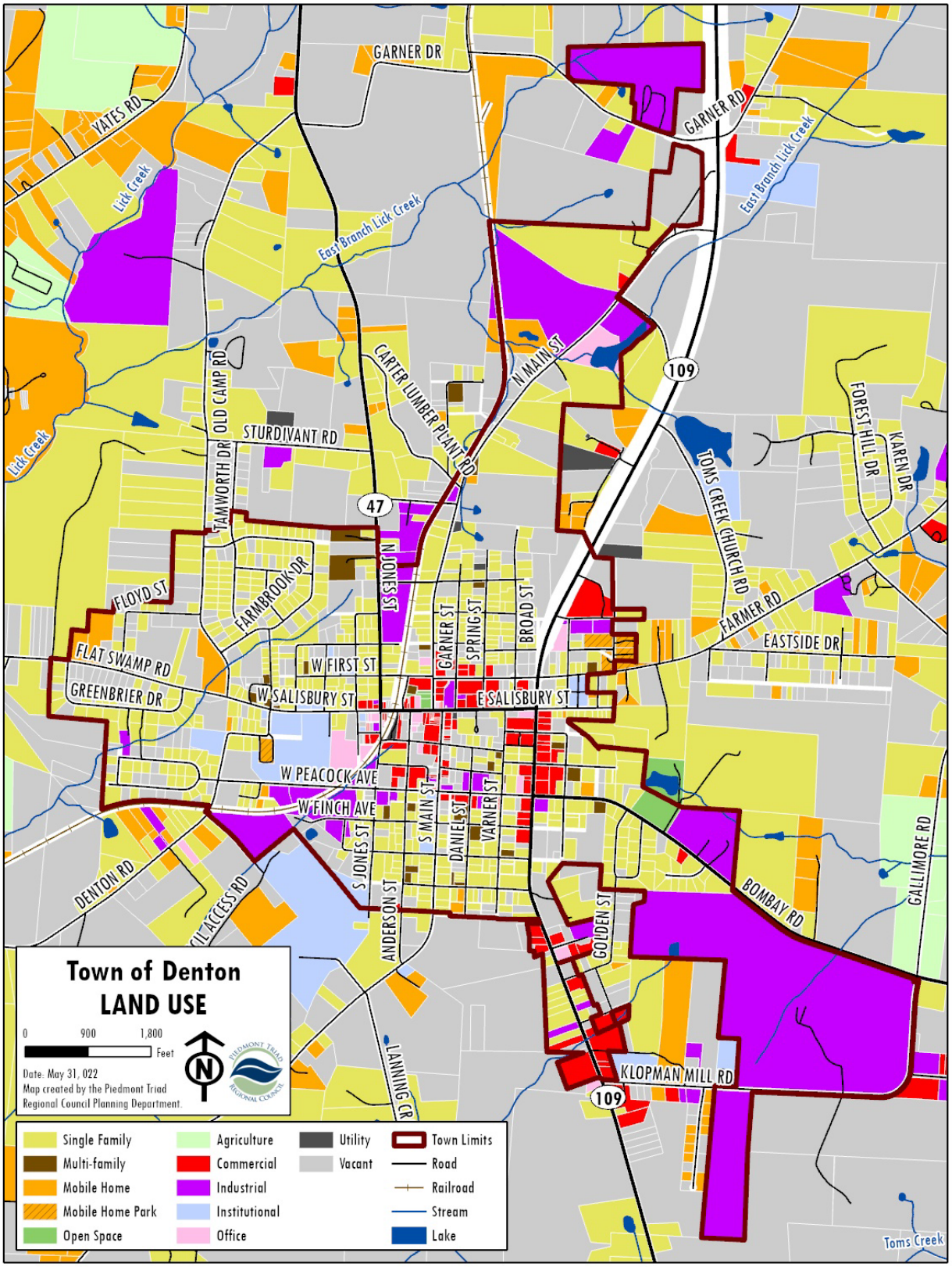
Source: NLCD 2019 Impervious Surface Cover

Map 5: Land Cover



Source: NLCD 2019 Land Cover

Map 6: Land Use

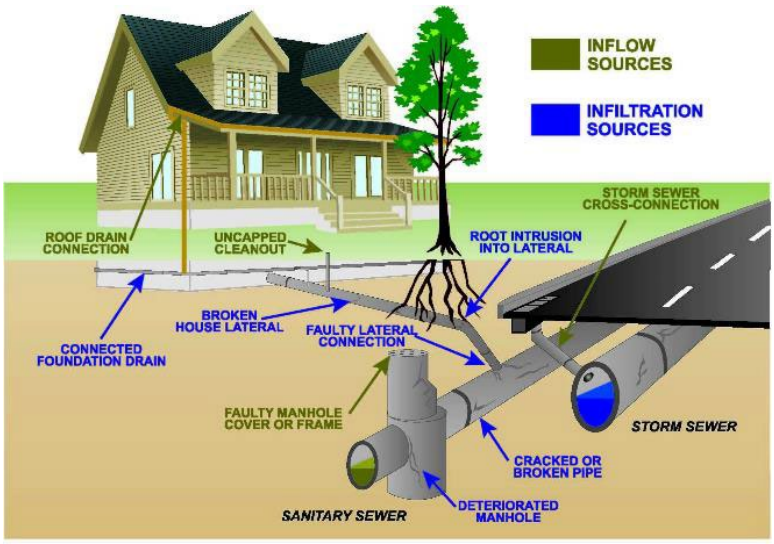


Source: Denton Land Development Plan (PTRC)

INFLOW AND INFILTRATION

Inflow and infiltration, or I/I, are terms used to describe the ways that groundwater and stormwater enter sanitary sewer systems. Stormwater (inflow) typically enters sewer systems via downspouts, foundation drains, storm drain cross-connections, or through holes in manhole covers, while groundwater (infiltration) can seep into sewer pipes through holes, cracks, joint failures, faulty connections, or other parts of a collection system that have deteriorated, cracked, sagged, or collapsed. Additional water from inflow and infiltration places an extra burden on collection systems and wastewater treatment facilities. Collection systems can be damaged when they are forced to transport larger volumes of flow than they have been designed to handle. I/I also increases operation and treatment costs and can sometimes lead to sanitary sewer overflows (SSOs) when wastewater flow volumes exceed the design capacity of the treatment plant.

The Town of Denton is working with engineering consultants from LaBella Associates to further indentify the areas most in need of improvement regarding I/I issues. It is anticipated that some water line and/or I/I issues will be addressd via the current American Rescue Plan Act funding, however not all the issues will be addressed.



FIELD IDENTIFICATION AND INVESTIGATION

MAINTENANCE NEEDS

Over the course of fieldwork, PTRC staff noted the visual condition of each stormwater feature to assist public works staff with infrastructure maintenance. Each feature was ranked as "Good", "Fair", or "Needs Improvement", based on their condition. Features were classified as "Fair" or "Needs Improvement" if they were not functioning as intended due to clogging or other structural impairments. Common issues included sediment, litter, and other debris buildup, as well as structural issues, such as cracks, sucken pipes, and erosion. Maintenance needs are fairly evenly distributed throughout the town, suggesting that there are no areas of particular concern, but seem to be more concentrated in areas where infrastructure is more dated. Map 7 through Map 12 illustrate sections of town noting visual condition of the stormwater features or identified areas that have issues or are in need of attention due to health and safety issues in more detail. Public Works staff should prioritize features ranked as "Issues" for maintenance and repair.

FURTHER INVESTIGATION

While a thorough effort was made to pinpoint all pipe connections and outfall locations, there were a number of areas where it was impossible to verify connections or outlets due to conflicting field data, inaccessibility, buried pipes, or overgrown vegetation. In some instances, pipe directions, materials, and sizes did not align with nearby stormwater points, suggesting that there may be additional underground connections that are not accessible from above ground. These data inconsistencies may require further investigation, beyond the scope of this project, to explain certain segments of the stormwater network and more accurately reflect stormwater connections and routes.

HAZARDS & SAFETY ISSUES

During the fieldwork observations, the PTRC staff noted area's that not only are in need of repair, maintenance or further investigation but areas were discovered that could pose a health and safety issue and whereby need more immediate attention. The observations are noted by Area of town under the *Health & Safety Issue* heading. Some of these issues could be fixed more quickly then others, but we did want to make sure it was brought to the attention of the Town the concerns as observed. A major safety concern is noted with corresponding photos at the former Burlington Industries property where there are three catch basins, two that do not have covers over them and, as such, they are large enough openings that a small adult or child could inadvertently fall into them.

Three catchbasins, two missing covers, at former Burlington Industries, along Bombay St.

Map 7: Area #1 – North Main Street

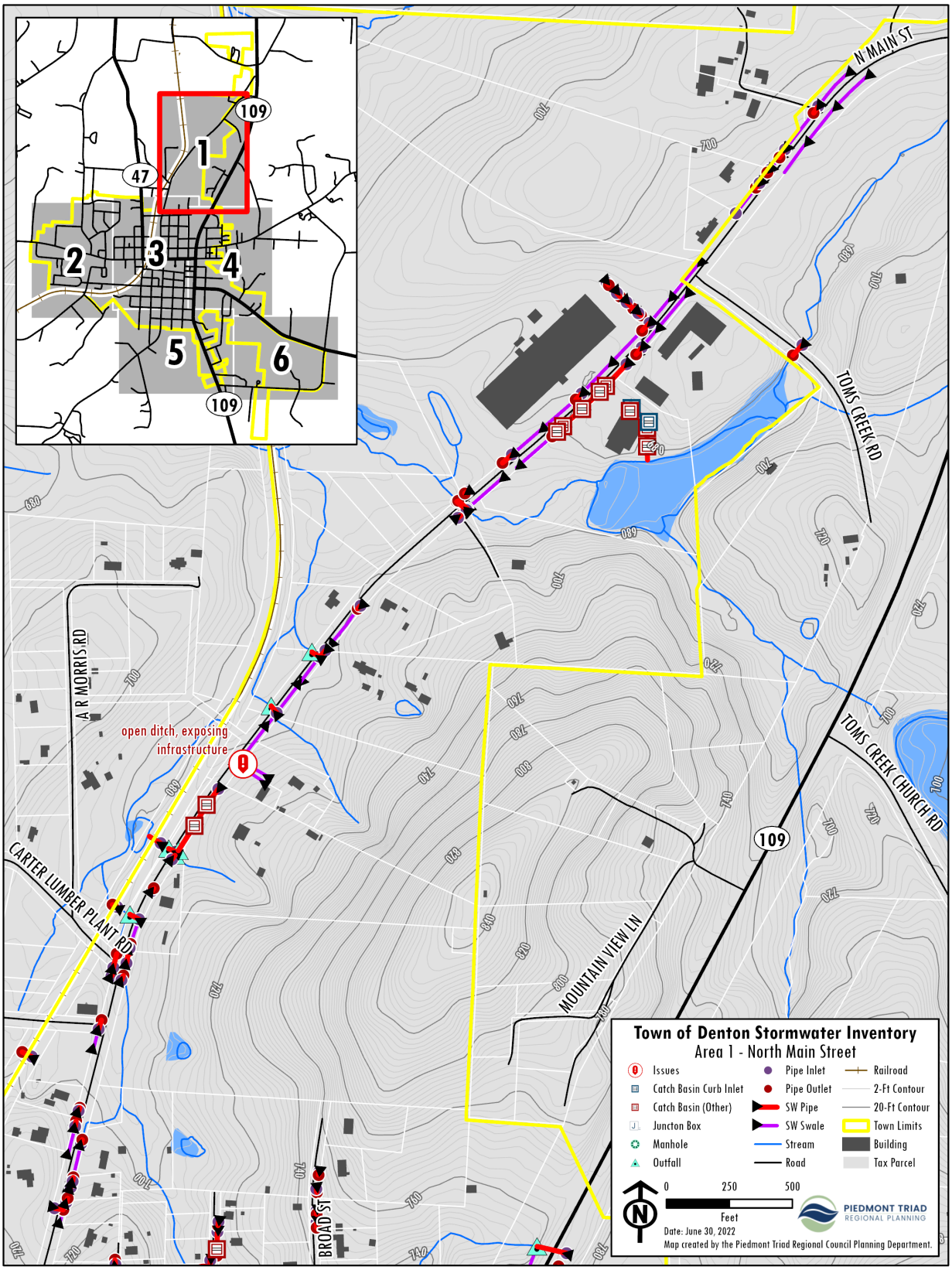


Table 1: Area #1 Issues Identified During Fieldwork

Stormwater Infrastructure Issues	
Location	**Description**
N. Main St, 1,193 feet north of Carter Davis Rd., on eastern side of N. Main St.,	Open ditch/channel; exposed soil, stagnet water; corrugated HDPE pipe under driveway; area prime for SCM, along driveway and along N. Main St.; ideal location for linear rain garden or planted channel/ditch; would need to check overhead utilities
End of Broad and Spring St.	Future location of new construction, Tower Mountain. Proposed 46 homes; 6 off N. Main St, drainage will flow towards N. Main St. Encourage enhanced stormwater control measures and/or use of green infrastructure in new building area
Health & Safety Issues	
Location	**Description**
Off N. Main St.	Open ditch, exposing infrastructure; along gravel drive, #794 N Main St.

Map 8: Area #2 – West Denton

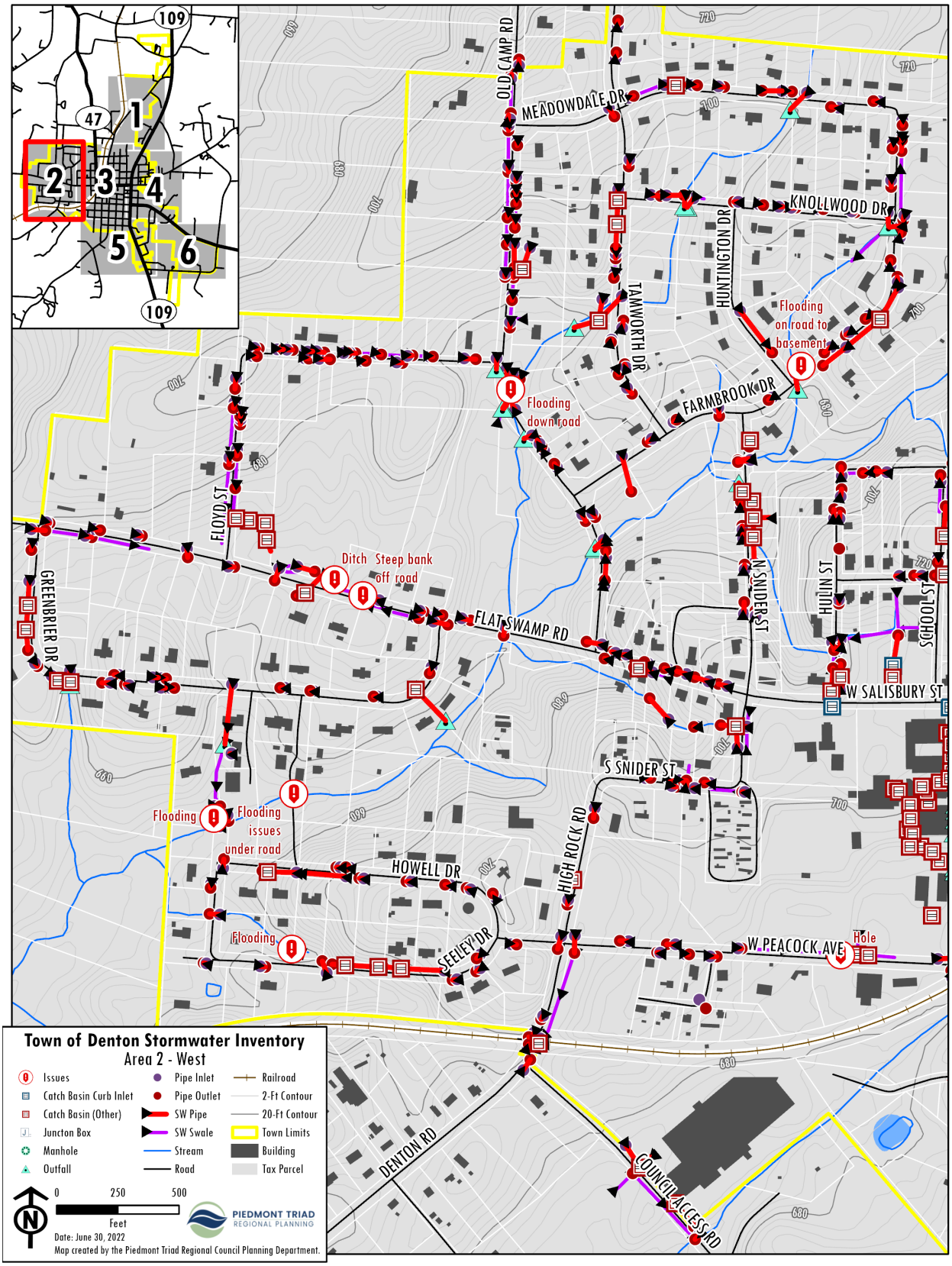
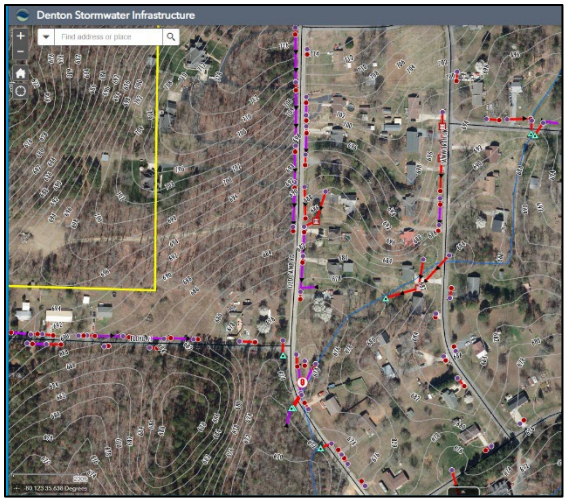


Table 2: Area #2 Issues Identified During Fieldwork

Stormwater Infrastructure Issues	
Location	**Description**
Clarks Acres: Corner of Farmbrook Rd & Huntington Dr	Homeowner noted flooding up to basement door; flooding on road. Based on mapping, tributary appears it turns in this section, right behind homeowners pool; there is an approximate 6-foot eleveation drop behind house to water course; recommend buffer, improve infiltration from house, reduce the large amount of impervious surface
Clarks Acres * Off Old Camp Road, south of Floyd St	Water comes down road, floods house, road is banked so water cannot get over road; multiple channelized/gulleys in front of house; 3 deep ditches with standing water in it;corrugated metal pipe blocked with debris & garbage Upstream (up Old Camp rd) pipes blocked or filled in with grass, sediment House sits in low spot where pipes collect runoff and goes under road
Greenbriar Dr.; rural homesite	Flooding issues, no buffer on either side, a few trees here and there Plant buffer along tributary (Lick Creek)
Drive way off Wynona Ln/south of Greenbriar Dr.	Newly installed culvert under lane, however it is noted: "still floods"; rural area where slope comes down to Lick Creek trib on both sides Suggestion: investigate wooded area; add, improve infiltration here, based on mapping, the elevation above indicates this area is downhill and water flows in that direction
Seeley Dr.	Homeowner indicated flooding when rain heavy; 22ft elevation drop; leading to Lick Creek trib (headwaters); driveway culvert
Corner bend in S. Snider St. & High Rock Rd.	Logging/grading at/near headwaters of Lick Creek trib
W. Peacock Ave	Noted visual issues; holes, pipe sections disconnected from each other Could be ideal location for linear rain garden along W. Peacock Ave ditch, approximately 746 feet from Denton Elementary School
Health & Safety Issues	
Location	**Description**
Swale, off Flat Swamp Road; 340 feet west of Greenbrier Rd; east of Floyd St.	Noted while in field: homeowner wants to fill in, deep embankment, feels safety issue if car goes off road Issue: acting as swale to convey water away from houses, off roadway. Investigate water flow in this area, based on topography. Suggest: alternative to "filling" it in; suggest step, pool, linear rain garden if no utility conflicts
Ditch, off Flat Swamp Road; approx. 459 feet west of Greenbrier Rd; east of Floyd St; off road approx. 32 feet	Appears as if swale as noted above drains to this ditch; without any infrastructure to further direct flow; does it drain into the wooded area in this block



Clark Acres at Old Camp Road: Road is pitched; three different inlet pipes lead to three open channelized areas, draining to Old Camp Road; Map image on right shows elevation change to the corner of Old Camp Road.

Flat Swamp Road

Map 9: Area #3 – Downtown Denton

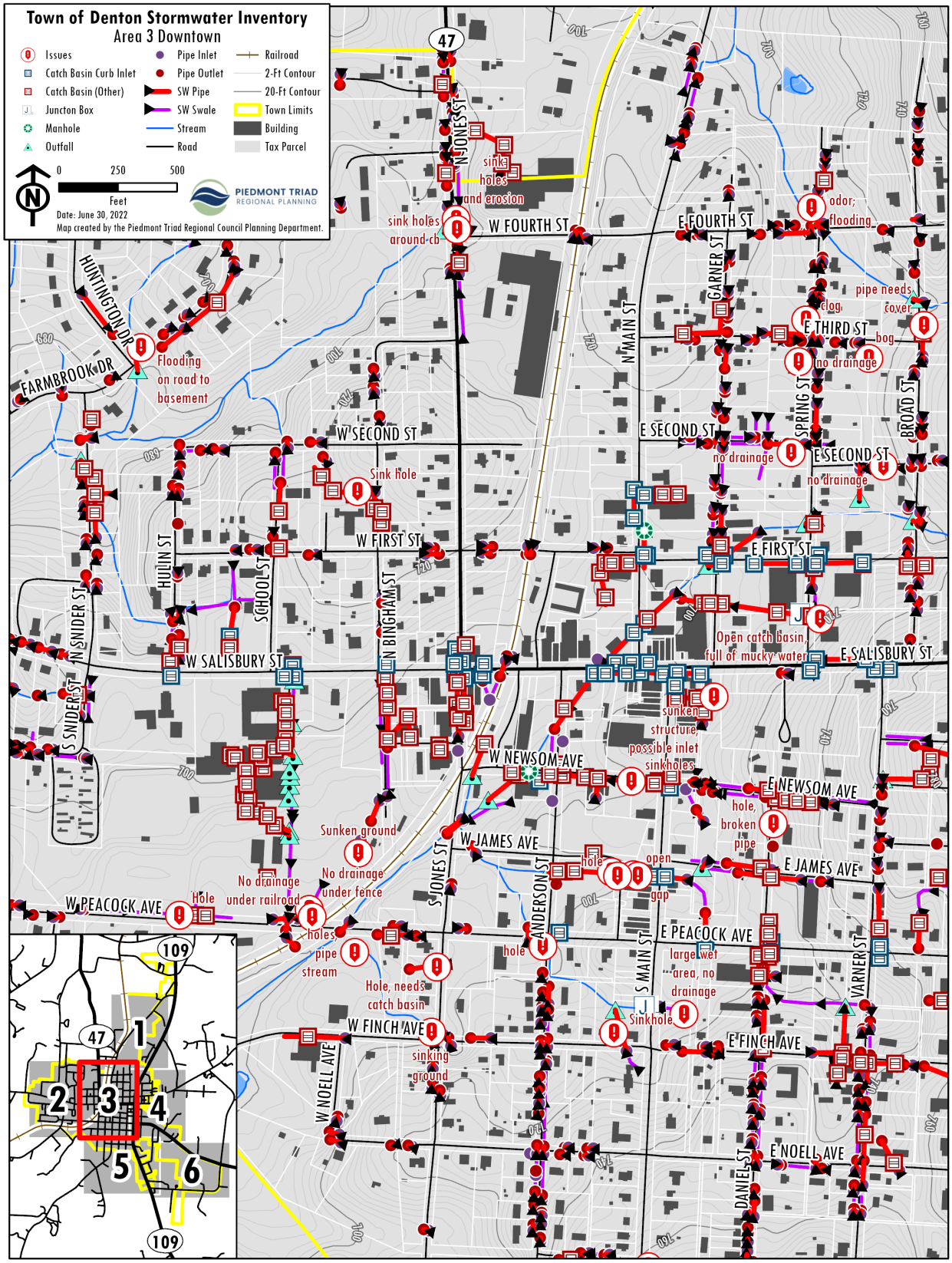


Table 3: Area #3 Issues Identified During Fieldwork

Stormwater Infrastructure Issues	
Location	Description
Corner of Spring St & E. Fourth St.	Noted flooding by homeowner; foul order from outfall
Convenience Store at Spring St. & E. Salisbury St.	Open catch basin with standing, murky water
***Behind Denton Elementary School; off W. Peacock Ave**	**Past observations of major flooding; pipes/system might be under-sized; no other retention/detention features in place; approximately a 26-ft elevation change; top of property at W. Salisbury; school property includes 17.54 acres with buildings, parking lots, concrete pads. Covered walkways, asphalt lots**
S. Jones St., South of W. Peacock Ave.	Hole, pipe outlet and inlet; needs Catch Basin Pipe inlet #794 - outlet #903; inlet #904 – outlet #820
W. Peacock & High Point Thomasville & Denton RR	No drainage under fence No drainage under/along RR tracks
***Along property of S. Bingham St.**	Ground sunken in field; slumping due to not having proper drainage; suggestion to improve infiltration
Parcel behind Firehouse; flowing towards S. Jones St.	Wetland, second stream behind fire station; large pipe
East of S. Main St., in E. Finch Ave block	Large wet area, no drainage happening; Closest pipe inlets need to be cleaned out that flows under S. Main St.; 157 feet north on S. Main St., gassy area off to right
Corner of S. Jones St., W. Finch Ave.	Outlet #806 and #882 drain to this area; noted that area is sinking; top of trib/drainage heading north-west
Access lane, south of W. Peacock; approx. 182 ft east of RR tracks	Trib/drainage heads to Outlet #1579; Inlet #1533; holes, pipe in stream- pipe appears not connected at joints
Corner Anderson St., W. Peacock Ave	Hole, inlet, catch basin; three pipes converge at this point; all concrete Outlet #847, Outlet #809, Inlet #805; takes trib flow from across street and redirects in pipes to under W. Peacock Ave; Need improved system
***Grassy area in block: E. Third St., (to north), Broad St. (to east); Spring St. (to west)**	**Approx.. 205 feet to the west of Broad St.; area of standing water is noted as a bog.**
Lot on corner of Spring St. (to east); Third St. (to south)	Issue with clog; stale/smelly, standing water Inlet #1034- Outlet #942 (goes across E. Third St.) Standing water Catch Basin #5183 - Outlet #991- standing water; needs improvement
Off Spring St.; approx. 90 feet south of E. Third Ave	Area doesn't drain, in between houses; water gets caught between 2 houses; can't flow down hill like it wants to Very small concrete culvert inlet #1214, outlet #1220
Corner of Spring, E. Fourth St.	Inlet #998 – Outlet #1019; outlet buried, inlet needs to be cleaned out Complaint of foul odor & flooding; approx. 66 feet north along west side of Spring St.
S. Main St., W. James Ave	Weird concrete pad/grate system; 86 feet to the west of CB #5254 Gap/opening near concrete lid- safety issue
Anderson St., W. James Ave; between outfall #1524 & inlet #1494	Recommendation improve buffer, add buffer behind storage building Stagnet water
South of E. Salisbury St, East of S. Main St.; eastern end of parking lot where Buttercup Café located	Sunken structure; in parking lot behind Buttercup Café & Lanier's Super Market; low spot in parking lot, paved over and filled in with gravel; Lanier's Super Market- parking area; CB #5291- needs improvement; parking lot ideal of GI/reconfigure parking & use of storage/staging area (vehicles parked over CB#5291)

E. Second St; between Board St. and Spring St. (127 feet west of Board St.)	Wet area, standing water, no drainage; down slope from inlet #1219 and outlet #1208; which are both almost or completely blocked with soil or debris; pipes need to be cleaned out; suggest add drainage/infiltration along street
Health & Safety Issues	
Location	**Description**
Behind Central Methodist Church, on Church property, west of N. Bingham St	Sinkhole
Corner S. Jones St. and W. Finch Ave	Sinking Ground
West of building on corner of S. Main St and W. Finch Ave.	Small sinkhole
In between gravel lot and paved lot, closer to corner of S. Main St. & W. Newsom Ave.	Small sinkholes near utility pole
Opposite sides of entrance for parking aera on corner of W. Fourth & N. Jones St.	Sinkholes and erosion
Along eastern side of Daniel St., approx. 106 feet down from E. Newsome Ave	Hole, broken pipe
Broad St. (approx. 67 feet north of E. Third St.)	Open pipe, needs cover
W. James to Anderson St.	Broken pieces of ashphalt laying in area; flow of water coming from S. Main St., heading west.
S. Bingham St., Bell Ave, parking lot behind Town Hall	Ground caving in above structure, filled in and hap hazardly covered with asphalt blocks; major safety issue

(Left) Safety issue - broken asphalt with unsecured grate placed on top
(Right) Exposed pipes and sinkholes, evidence of surface and overland flow

Map 10: Area #4 – East Denton

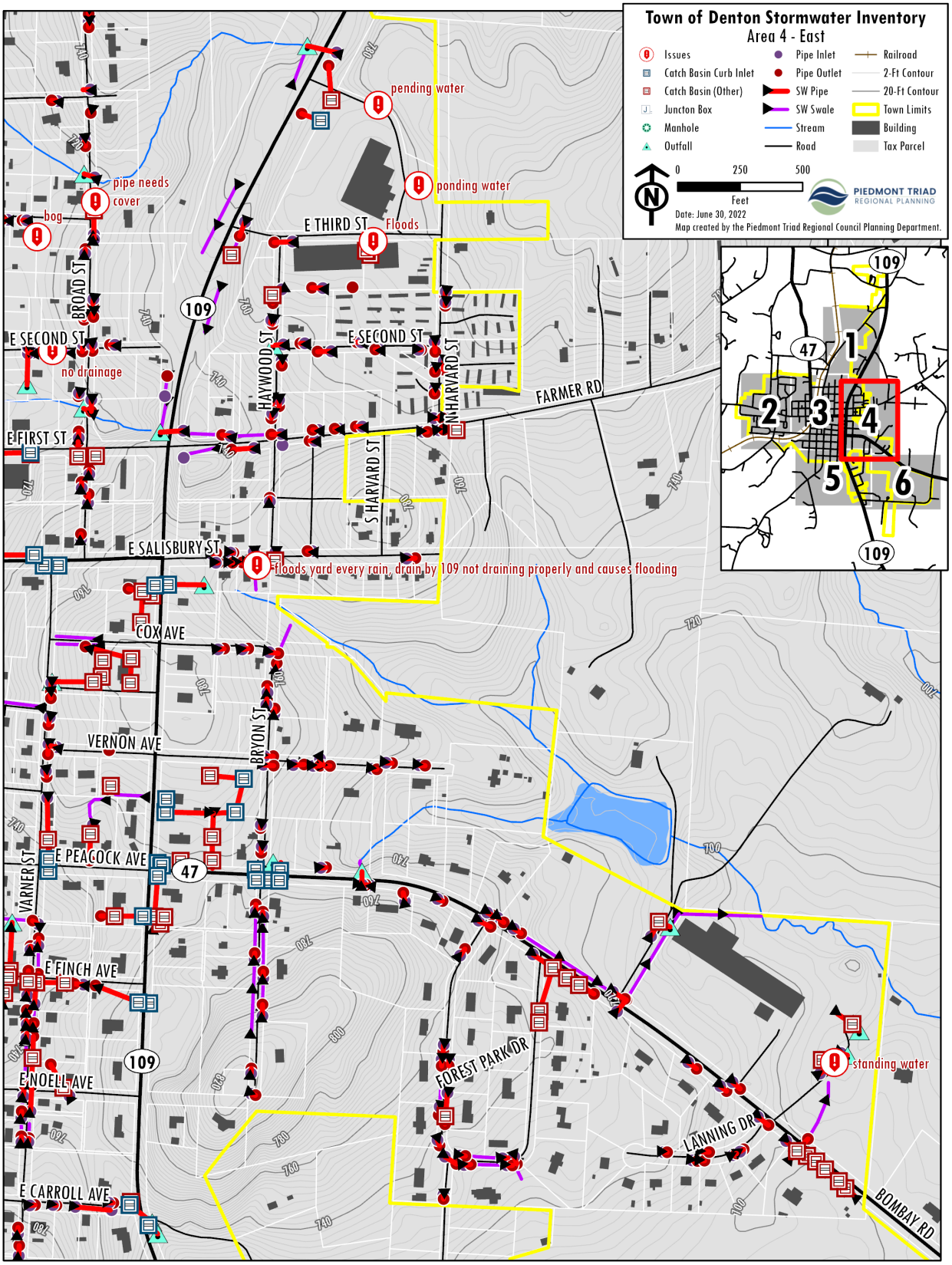


Table 4: Area #4 Issues Identified During Fieldwork

Stormwater Infrastructure Issues	
Location	**Description**
Across from Denton Cementary-E. Salisbury & Haywood St.	Home sits in bowl
Block/Property surrounded by E. Peacock Ave (to south), Varner St.(to west), Vernon Ave (to north); Glenn St./NC109 (to east);	(Backyard Buildings & Creations) noted from field visit, owner put in own pipe; inlet is concreted in with surrounding land/slope concreted like a funnel to the pipe #755; 151 foot swale leading to inlet pipe, swale goes around structures/grassy area
Off Bombay, Access lane across from Lanning Dr.; eastern edge of town (near wooded area)	Standing water; area driveway culverts (#630, #676, #767) and catch basin (#5133) are full of leaf litter and/or filled in; gravel; no where for water to flow, ponding in front of pipes
***E. Third St.(to north), Haywood St. (to west); N. Harvard St. (to east)**	**Noted as floods; commerical buildings with driveway/access between in lower spot; goes from 778 ft to 772 through access lane; area contains 2 catch basins; 1 inlet, 1 outlet- made of PVC**
Intersection of NC Hwy 109 & E. First St./Farmer St.	Difficult to capture inlets/outlets- need further investigation
***Behind Lowe's Food shopping center (NC Hwy109)**	**Ponding water, edge of gravel parking area behind Lowe's Food**
North of Lowe's Food entrance	Ponding water, across from north entrance of Lowe's Food
S. Bingham St.; edge of parking lot behind Town Hall	CB #5282; brick wall is bowing out, appears to be caving in
Health & Safety Issues	
Location	**Description**
Broad St. (approx. 67 feet north of E. Third St.)	Open pipe, needs cover

Map 11: Area #5 – South NC Hwy 109

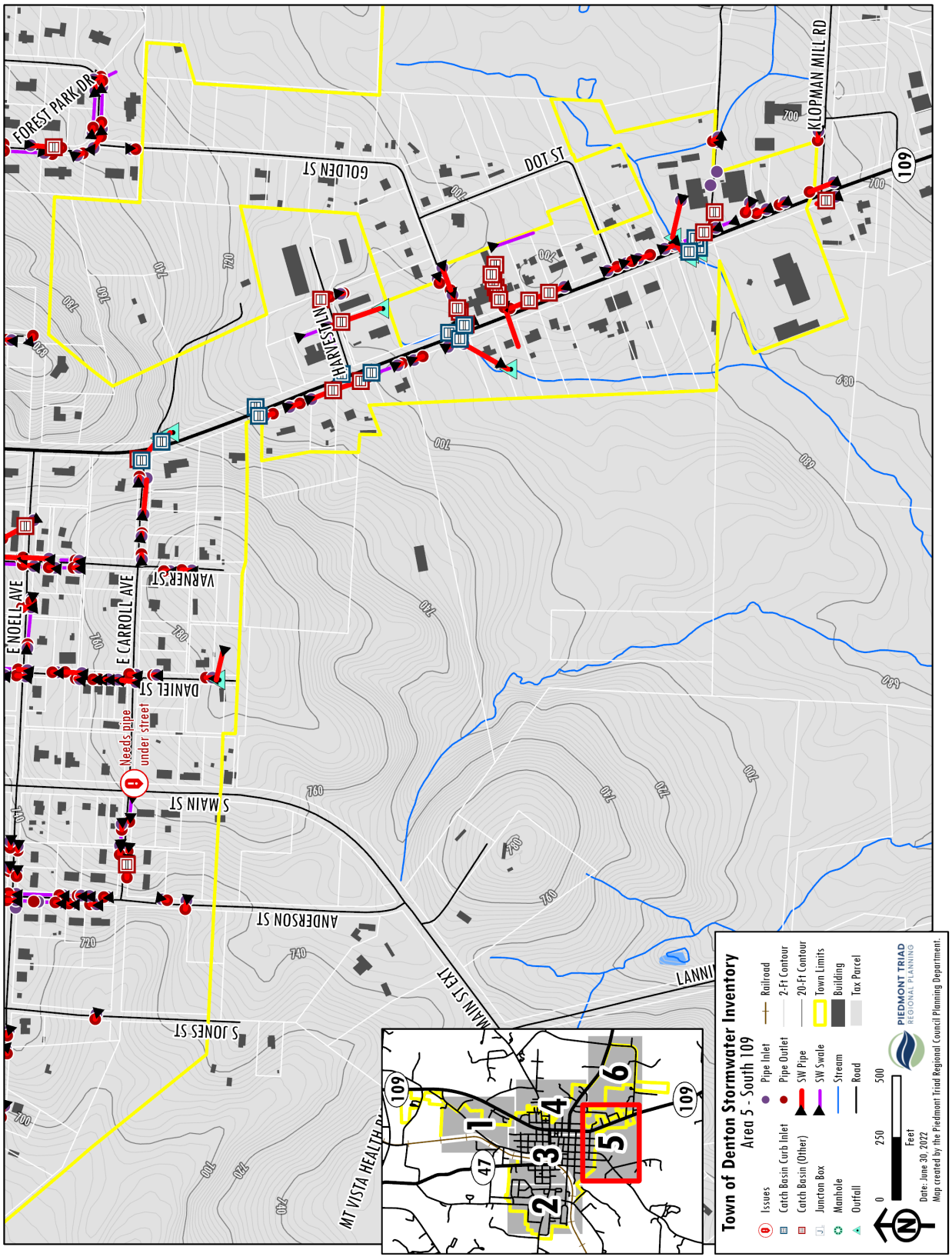


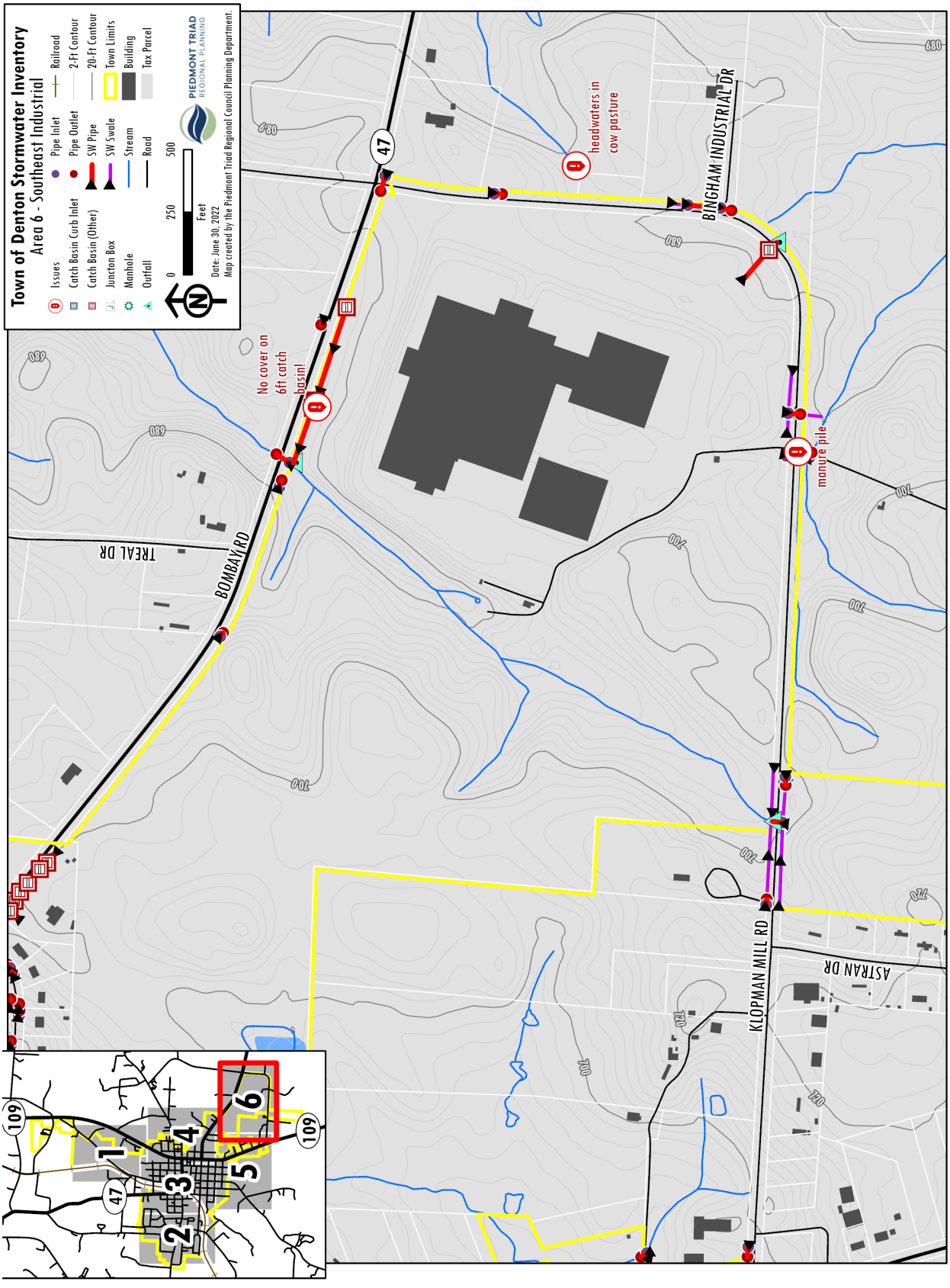
Table 5: Area #5 Issues Identified During Fieldwork

Stormwater Infrastructure Issues	
Location	Description
Corner of E. Carroll Ave., S. Main St.	Noted: No infrastructure identified, however suggestion is to investigate to putting one in (pipe); this corner appears to drain from high spot (elevation 776 ft) off Daniel St., towards northwest corner; is this location/suggestion for SCM (rain garden, linear rain garden/planted swale)
Health & Safety Issues	
Location	**Description**
Broad St. (approx. 67 feet north of E. Third St.)	Open pipe, needs cover

Table 6: Area #6 Issues Identified During Fieldwork

Stormwater Infrastructure Issues	
Location	**Description**
Klopman Mill Rd, along eastern edge of town, east of Burlington Industries; south of Bombay Rd. (approx. 410 ft south of Bombay)	Inlet #1326- filled with leaves, woody vegetation, needs cleaning out; Outlet #1298- clogged with woody debris, trash East side of Klopman Mill Rd- is not within town limits, however it is noted that a cow pasture is here at the headwaters of the trib
Health & Safety Issues	
Location	**Description**
Former Burlington Industries; off Bombay Rd, corner with Klopman Mill Rd	Deep catchbasins (5-feet deep concrete); 2 (#5241, #5235) do **NOT** have covers over them; 1 has cover over it but it appears moved (#5239)
Off Klopman Mill Rd	Manure pile; across from south entrance of Burlington Industries

Map 12: Area #6 – Southeast Industrial Area



DATABASE ACCESS & USE

Collected stormwater data was organized into a final Stormwater Master Geodatabase for the Town of Denton, enabling them to view and query infrastructure locations, attributes, and hyperlinked photos using ESRI ArcGIS or any similar GIS software. The file geodatabase has a Stormwater feature dataset containing five feature classes: CatchBasin, InletOutlet, Issues, Pipe, and Swale. Each of these feature classes (except for pipes) has a related table that contains photo attachments. The file geodatabase has another Reference feature dataset containing four feature classes for reference: Contours, Roads, Streams, and Town Limits.

In the mapping software, users can view additional information about each feature by clicking on each point or pipe, including invert depths, sizes, material, flow directions, and visual conditions. In total, the database includes 1,067 stormwater pipes, 217 swales, 328 catch basins, and 76 outfalls and 2,120 attached pictures. A total of 45 issues were also noted to help the Town better manage and maintain existing stormwater systems, identify potential sources of I/I, and make informed future stormwater management decisions. PTRC will work closely with Denton to ensure that the database is kept up-to-date to meet each town's specific needs.

Figure 2: File Geodatabase Structure

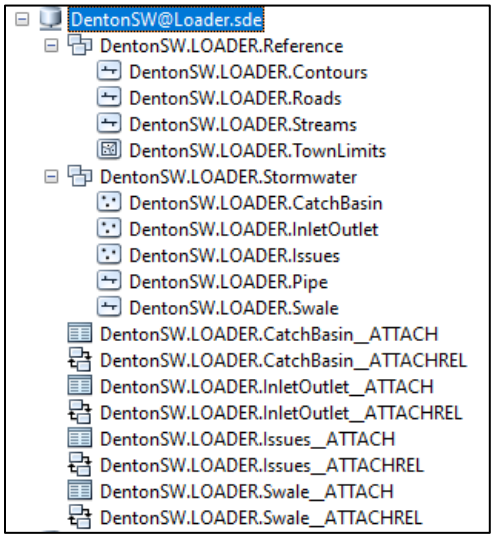


Table 7: Database Domains

BasinType		Cover Type	
CB-C	Catch Basin Curb Inlet	G	Grate
CB-O	Catch Basin (Other)	CS	Concrete Slab
JB	Juncton Box	MH	Manhole

MH	Manhole	O	Other
Box Material		**Pipe Type**	
B	Brick	SP	Stormwater Pipe
C	Concrete	DC	Driveway Culvert
O	Other	RC	Roadway Culvert
Point Type		**Pipe Material**	
PI	Pipe Inlet	C	Concrete
PO	Pipe Outlet	CM	Corrugated Metal
OF	Outfall	S	Steel
Condition		PVC	PVC
G	Good	T	Terracota
F	Fair	O	Other
NI	Needs Improvement	CH	Corrugated HDPE
Outfall Structure		**Outfall To**	
E	Endwall	D	Ditch
EW	Endwall with Wings	DP	Detention Pond
H	Headwall	PL	Pond/Lake
HW	Headwall with Wings	Str	Stream
FES	Flared End Section	Sur	Surface
O	Other	O	Other
Issue Type		**Flag**	
Issue	Issue	0	None
Note	Note	1	Check Old Data
Check	Check	2	Need Public Works Staff
Missing	Missing	3	Other

Table 8: Database Table Fields

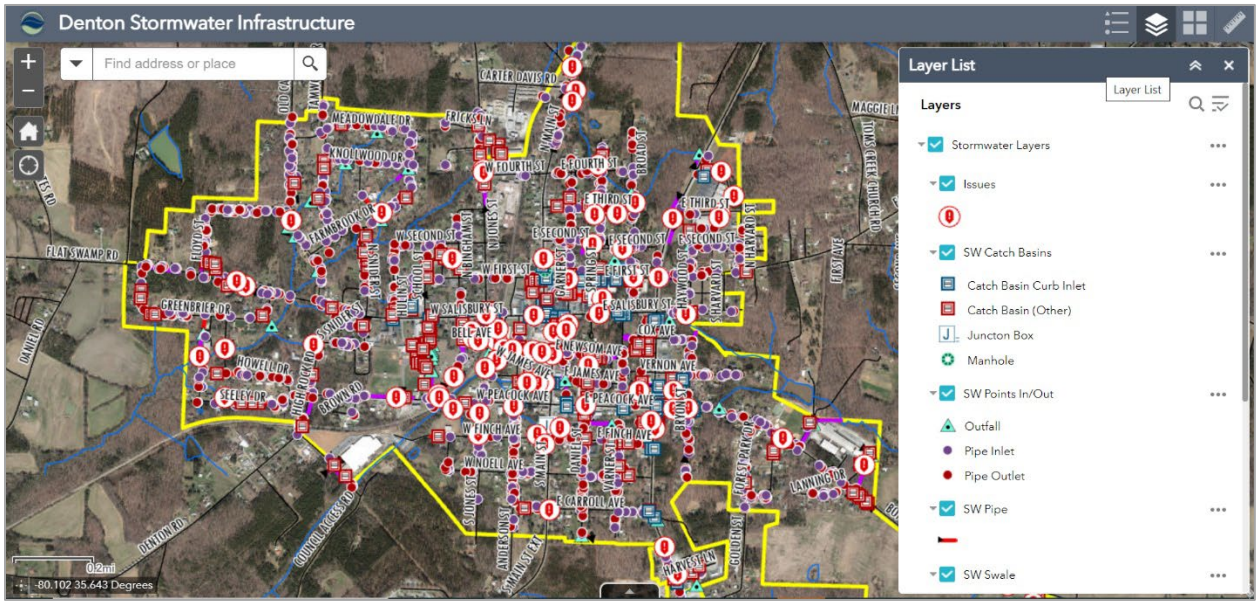
Catch Basin			
Column:	***Domain:***	**Column:**	***Domain:***
Unique_ID		Inv4_Depth	
Flag	*Flag*	Inv4_Material	*Pipe Material*
Type	*Basin Type*	Inv4_Diameter	*Diameter*
Cover	*Cover Type*	Inv4_Direction	*Direction*
Box_Material	*Box Material*	Flow_Presence	*YesNo*
Pipe_Connections		Visual_Pollution	*YesNo*
Outlet_Depth		Visual_Condition	*Condition*
Outlet_Material	*Pipe Material*	Owner	
Outlet_Diameter	*Diameter*	Elevation	
Outlet_Direction	*Direction*	Out_Elev	
Inv1_Depth		Inv1_Elev	
Inv1_Material	*Pipe Material*	Inv2_Elev	
Inv1_Diameter	*Diameter*	Inv3_Elev	
Inv1_Direction	*Direction*	Inv4_Elev	
Inv2_Depth		Outlet_ID	
Inv2_Material	*Pipe Material*	Inv1_ID	
Inv2_Diameter	*Diameter*	Inv2_ID	

Inv2_Direction	*Direction*
Inv3_Depth	
Inv3_Material	*Pipe Material*
Inv3_Diameter	*Diameter*
Inv3_Direction	*Direction*
Comments	
Inlet/Outlet	
Column:	***Domain:***
Unique_ID	
Flag	*Flag*
Type	*Point Type*
Diameter	*Diameter*
Material	*Pipe Material*
Direction	*Direction*
Outfall_To	*Outfall_To*
Structure	*Outfall_Structure*
Flow_Presence	*YesNo*
Visual_Pollution	*YesNo*
Visual_Condition	*Condition*
Comments	
Owner	*Owner*
Elevation	
Opp_ID	
created_user	
created_Date	
last_edited_user	
last_edited_date	
Issues	
Column:	***Domain:***
IssueType	*Issue Type*
Comments	
created_user	
created_Date	
last_edited_user	
last_edited_date	

Inv3_ID	
Inv4_ID	
created_user	
created_Date	
last_edited_user	
last_edited_date	
Pipe	
Column:	***Domain:***
Type	*Pipe Type*
Diameter	*Diameter*
Material	*Pipe Material*
Inlet_ID	
Outlet_ID	
Inlet_Elev	
Outlet_Elev	
Slope	
Roughness	
Comments	
LengthFeet	
created_user	
created_Date	
last_edited_user	
last_edited_date	
Swale	
Column:	***Domain:***
Height	
Width	
Inlet_ID	
Outlet_ID	
Inlet_Elev	
Outlet_Elev	
Slope	
Roughness	
Comments	
LengthFeet	
created_user	
created_Date	
last_edited_user	
last_edited_date	

To increase use and ease of access to the dataset, the final stormwater infrastructure network was exported as a map service and brought into a web map in ArcGIS Online for public viewing. This web map can be accessed from any device with internet access at the following address:

https://maps.ptrc.org/portal/apps/webappviewer/index.html?id=8b2bea51fcf7440aa9ebd296b03e48a1



STORMWATER MANAGEMENT OPPORTUNITIES

While upgrading and properly maintaining stormwater infrastructure plays an important role in managing stormwater runoff, there are a number of additional ways to reduce stormwater flows. Several communities throughout North Carolina have begun installing or requiring stormwater control measures (SCMs), also known as best management practices (BMPs), to help absorb and treat stormwater onsite.

> Stormwater Control Measure (SCM) is a permanent structural device that is designed, constructed, and maintained to remove pollutants from stormwater runoff by promoting settling or filtration or mimic the natural hydrologic cycle by promoting infiltration, evapo-transpiration, post-filtration discharge, reuse of stormwater, or a combination thereof (NC DEQ 2018a).

Bioretention Cell

Bioswale

Stormwater Pond

SCMs are engineered devices that use natural processes, such as soil and vegetation, to capture, filter, slow, and reuse rain water, but can range greatly in design and function. Some examples include raingardens, street trees, bioretention cells, vegetated swales, or stormwater ponds. This approach to stormwater management is sometimes also referred to as low impact development (LID). LID are principles that complement, and sometimes replace, traditional stormwater management systems, which historically emphasized moving stormwater off-site with curbs, pipes, ditches and ponds. Green Infrastructure (GI) is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. The ability of these practices to deliver multiple ecological, economic, and social benefits or services has made them an increasingly popular strategy in recent years.

There are also a number of creative actions that individuals can take at their own homes or businesses to conserve natural resources. Simple acts, such as disconnecting downspouts that are directly connected to the storm drain system, installing rain barrels, or planting small raingardens can dramatically reduce stormwater loads. Many houses and businesses in Denton have existing downspout connections that may be suitable for disconnection. Some communities have established creative programs to incentivize homeowners to reduce stormwater, including awards programs that recognize homeowners that implement green practices or financial assistance or rebate programs. Other communities have held events such as rain barrel workshops/giveaways and storm drain markings to remind residents that anything entering the storm drains flows directly into our streams. Homeowners can also help protect water quality and prevent localized flooding by picking up after their pets, bagging their leaves and grass clippings, and limiting fertilizers and pesticide use.

This project worked to collect and identify the stormwater infrastructure in place in Denton and to document glaring issues or areas that could use SCMs or GI improvements to help address excessive storm flows and flooding events, however this project did not get into producing models that would site various SCMs throughout the town. A future project could involve the use and development of a GIS model that would identify stormwater management projects. This can be completed through the use of the US EPA's *System for Urban Stormwater Treatment and Analysis IntegratioN (SUSTAIN) BMP Siting Tool,* where this model overlays environmental and land use data to identify suitable locations for SCM projects. Such projects could include bioretention, grassed swale, porous pavement, and constructed wetland/wet pond projects. Once created, these maps can be used to help prioritize future stormwater management projects. Property ownership and costs should also be considered when weighing various projects, as certain stormwater BMPs are much cheaper than others and typically easier to implement on publically-owned land unless there is significant local buy-in. Table #6 gives an overview of the various types of SCM BMPs that could be further identified in Denton and what their restrictions of use are.

Table 9: Stormwater BMP Suitability Model Criteria

BMP type	Drainage area (acre)	Drainage slope (%)	Impervious (%)	Hydrologic soil group	Water table depth (ft)	Road buffer (ft)	Stream buffer (ft)	Building buffer (ft)
Bioretention	< 2	< 5%	> 0%	A–D	> 2	< 100	> 100	--
Cistern	--	--	--	--	--	--	--	< 30
Constructed Wetland	> 25	< 15%	> 0%	A–D	> 4	--	> 100	--
Dry Pond	> 10	< 15%	> 0%	A–D	> 4	--	> 100	--
Grassed Swale	< 5	< 4%	> 0%	A–D	> 2	< 100	--	--
Green Roof	--	--	--	--	--	--	--	--
Infiltration Basin	< 10	< 15%	> 0%	A–B	> 4	--	> 100	--
Infiltration Trench	< 5	< 15%	> 0%	A–B	> 4	--	> 100	--
Porous Pavement	< 3	< 1%	> 0%	A–B	> 2	--	--	--
Rain Barrel	--	--	--	--	--	--	--	< 30
Sand Filter (non-surface)	< 2	< 10%	> 0%	A–D	> 2	--	> 100	--
Sand Filter (surface)	< 10	< 10%	> 0%	A–D	> 2	--	> 100	--
Vegetated Filterstrip	--	< 10%	> 0%	A–D	> 2	< 100	--	--
Wet Pond	> 25	< 15%	> 0%	A–D	> 4	--	> 100	--

When narrowing down or choosing SCMs, various factors have to be considered, these include site suitability (measure of construction feasibility, topography, soil type, slope, obstructions, easements or utility conflicts), access, landowner type and support, implementation costs, short- and long-term maintenance and benefits of installed practice verse end result.

PRIORITY PROJECT AREAS

While conducting fieldwork in Denton, PTRC staff noted several sites that could be particularly well suited for SCM improvements.

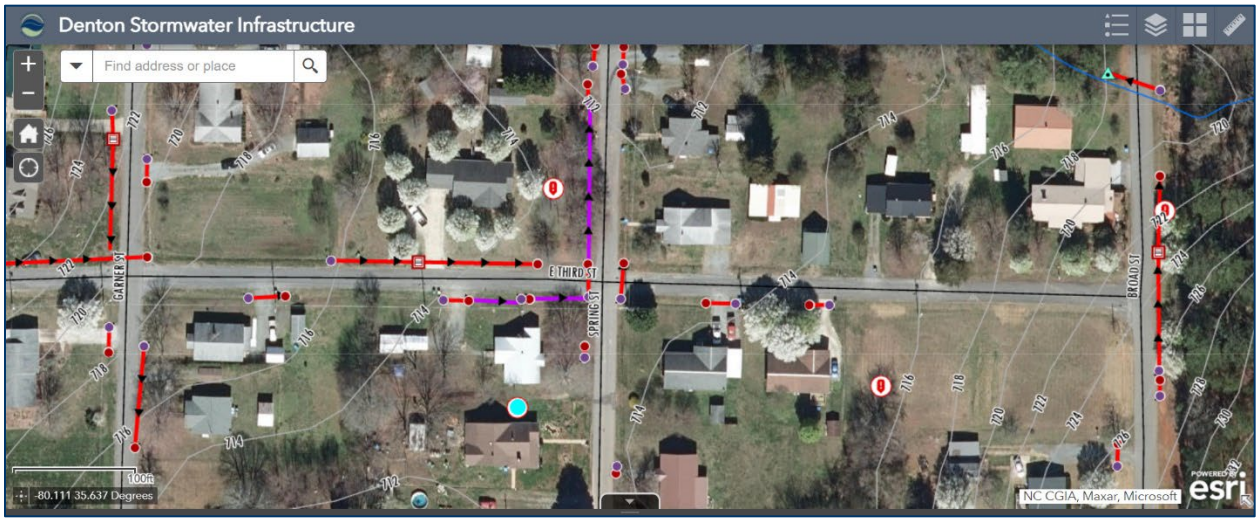
1. Clark Acres

As noted in Area #2-West Denton the area along Old Camp Road has issues with the stormwater that flows down the road, floods the house at this bend, it is the low spot collecting water upstream before it heads back under Old Camp Road. PTRC staff observed several channelized ditches and/or gulleys that converge in front of house. It was observed to have standing water in the one ditch and it was observed that the corrugated metal pipe is blocked with debris and garbage. This has been noted as an area as having historic flooding, stormwater issues. It is recommended that a professional engineering firm be engaged in order to further assess how the movement of stormwater flows in this area. A first step would be to conduct some pipe maintenance and clean-outs so that the existing infrastructure can function, however a larger evaluation should occur here.

Aerial View of Clark Acres (Old Camp Road)

2. East Third Street/Spring Street/Broad Street

As noted in Area #3, at the intersections of E. Third Street with both Spring St and Broad St, all downhill from NC Hwy 109 there were several areas of concern noted such as issues with standing water. This location could be an ideal candidate for rain garden(s), planting of native trees and/or installation of rain barrels to collect run-off from the area homes. There is evidence of water issues on paved areas/home lots off Spring St, with issues with standing water at E. Third, Spring and Broad St. as well as noted poor drainage. Further investigation for appropriately sized and sited SCMs would help to capture and treat stormwater runoff and prevent standing water/flooding issues. : standing water; broad, Third & spring street (block) (pic on left); (pic on right) issue with poor drainage, standing water in between houses: roadway floods- see wet signature on pavement between houses off Spring St.

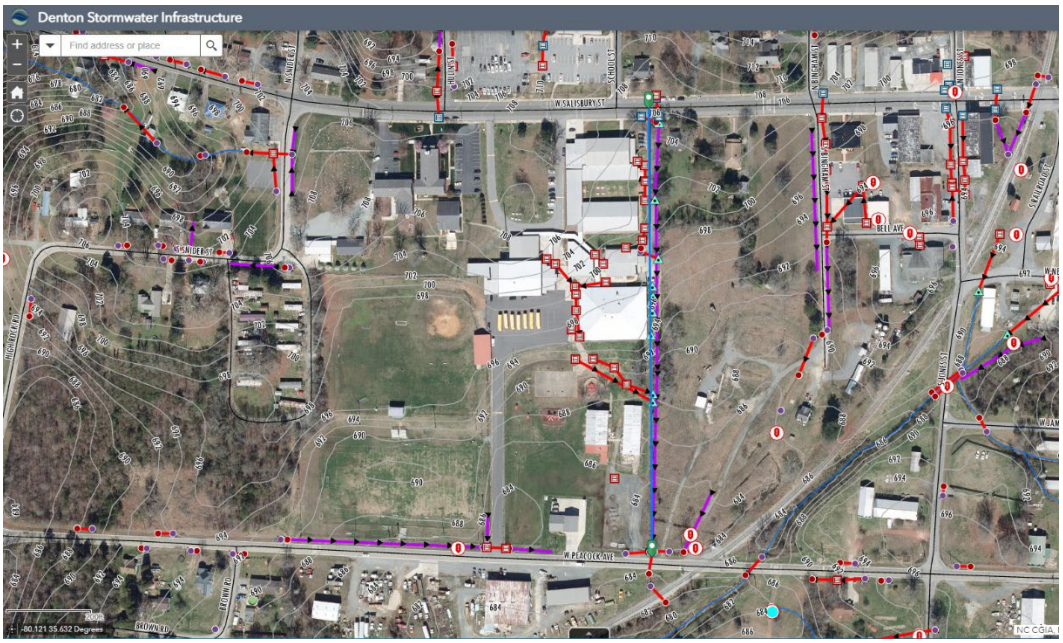


Aerial View of E Third/Spring/Broad Streets

Potential Raingarden(s) on E Third and Spring St

3. Denton Elementary School

Noted in Area #3, the Denton Elementary School property goes from W. Salisbury Street, main school entrance, and slopes to W. Peacock Ave, back of the school, there is a 1,055 foot long drainage ditch on the school's eastern boundary with ball fields to the west. There are seveal noted issues dealing with flooding or stormwater along W. Peacock Ave. The property encompasses 17.54 acres. Based on field observations and conversations with the Davidson County Schools maintenance staff that is responsible for the maintenance at the Denton Elementary School, there has been historic flooding issues that have severely impacted the school, buildings and grounds area. It is suggested that further identification of issues of concern be identified and corresponding SCMs or BMPs to best tackle stormwater and flooding be explored with the Davidson County Schools. These type of locations could be ideal opportunities for grant funding as they could incorporate academic opportunities and hands-on applications to address aging or unmet stormwater needs.



Aerial View of Denton Elementary School

School grounds contain lots of impervious surfaces, unvegetated drainage ditches, and unmanaged drainage areas

4. Lowes Foods

As identied in Area #4, at the Lowes Food of NC Hwy 109, there were identified issues with ponding water near and around the shopping center parking lot including areas behind the building as well as areas of concern at the nearby gravel parking area that is across from northern entrance to center. It is noted that pipe outlet #1126 needs repair or replacement. This area should be further inspected to identify areas that can be repaired as well as to identify areas most suitable to implement SCMs. A simple, yet effective practice would be to make sure that all exposed soil is covered in vegetation, it could simply be grasses, however native trees or shrubs would further enhance the infiltration process, reduce uncontrolled runoff and improve aesthetics of the center, both in the front and behind the building.

Aerial View of Lowes Foods

SCMs to reduce sediment, erosion; repair broken pipes

5. NC Hwy 109/ E Third Street

As identified during the field visits, noted in Map Area #4, is an area off NC Hwy 109 and E. Third St that has identified flooding as an issue. The commerical buildings have a driveway/access in between a low spot, the evaluation goes from 778 ft to 772 ft. There are two catch basins; one inlet, and one outlet- made of PVC. In working with the private business owners, this site could be considered an ideal location to install a linear rain gardens or several smaller rain gardens that would capture run off from E. Third St before heading down the entrance/access lane, as long as there are no utility conflicts. Additionally, this business could consider capturing the roof-runoff, as well as implementing impervious pavement/pavers in the access/entrance and parking areas in order to better capture and slow the runoff through the site. Additionally, this commercial landowner should work with the landowner of the Lowe's Food in order to properly vegetate the lot such that it could work to infiltrate stormwater as well as reduce excess erosion of the exposed soil.

Vegetated Swales or linear rain gardens are build such that underneath contains porous materials such as rock and/or organic matter to absorb water and native plants are established to help absorb water from the surface. Infiltration is slowed; pollutants absorbed before it reaches a pipe that goes to a sediment pond, river, storm system.

Aerial View of NC Hwy 109/E Third St

Example of a Potential Linear Rain Garden

6. Harrison Park

Based on initial conversations with the Town and based on historical flooding, PTRC field staff observed that the Harrison Park, located in Area #3 is at the bottom of drainage area along W. Salisbury St. across from the Denton Farmer's Market. Further investigation in this area should occur. There are opportunities to improve the infiltration of the area with a network of SCMs implementated along W. Salisbury St., N. Main St. and Anderson St. However there are challenges with work in this area as there are many conflicting utilities that would have to be dealt with or worked around. It is suggested that a stormwater engineer further survey and investigate options available that could tie into accomplishing many goals: flood and stormwater management, improved aesthetics, re-use or reduction of parking areas to incorporate green infrastructure. It would be prudent to encorporate a street corridor vision for use of space, determining a long-range vision for the area as well as to incorporate maintenance requirements.

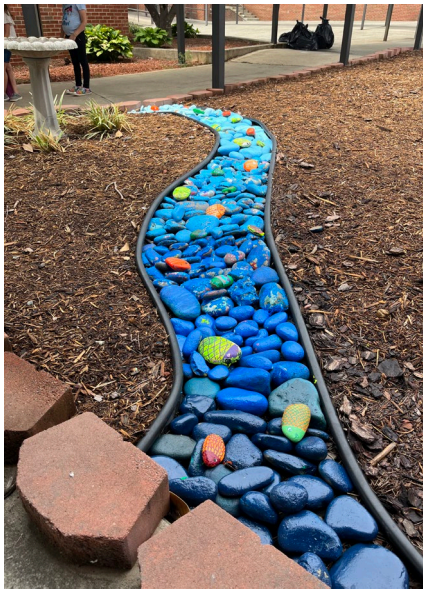
NEXT STEPS

Managing stormwater runoff can be a difficult task and often requires a multi-pronged approach that involves maintaining and upgrading existing pipes, updating development ordinances to address stormwater, and increasing public awareness about stormwater issues. By completing this project, the Town of Denton have taken a significant step forward addressing this growing problem and can now begin resolving drainage issues and continue to build upon its stormwater management program. Using the information generated over the course of this project, Public Works staffs can begin addressing identified maintenance needs as they are able. This will help reduce clogs and improve stormwater flow during major storms. Known problem areas may require some additional investigation to determine upstream sources of erosion, debris, or stormwater.

It is recommended that Denton then explore ways in which they can increase public awareness about stormwater issues, as there are many actions that local residents can take on their own properties to reduce stormwater runoff. Several organizations in Davison County are already doing this work and could partner with Denton to help meet stormwater education needs. These groups include the Yadkin Riverkeeper, Davidson Soil & Water Conservation District, and Cooperative Extension. These partners may also be able to assist the Towns in identifying site-specific SCM projects that could be implemented to further reduce stormwater runoff and pursue state and federal funding to support such efforts. A comprehensive list of potential partners and funding sources has been provided below for the Towns' convenience.

PARTNERS & TECHNICAL ASSISTANCE

Organization	Potential Role
Piedmont Triad Regional Council	• Locate and secure grant funding for follow-up studies and implementation • Planning assistance and expertise
PTRC: Stormwater SMART	• Support services through direct education • Assist with stormwater projects
Yadkin Riverkeeper	• Assist with water quality monitoring, outreach and education, and water quality projects in larger Yadkin River watershed
Davidson County Soil & Water Conservation District	• Provide recommendations to control erosion • Assist with drainage issues and runoff problems • Assist with stormwater outreach and education, particularly regarding agriculture
Piedmont Land Conservancy	• Work with willing property owners to conserve land and protect water quality
NC Wildlife Resources Commission	• Provide free trainings for local officials on Green Growth strategies that reduce runoff and protect wildlife
NCDEQ-DWR	• Provide funding for water quality planning & stormwater management projects



EDUCATIONAL & OUTREACH

PTRC supports a cooperative partnership between county and municipal governments, **Stormwater SMART**. The goal is to prevent stormwater pollution by connecting people to shared watersheds. Many communities participate in the Stormwater SMART programming as a way to address the education requirements set forth for the Municipal Separate Storm Sewer System (MS4) which is based on community size and population. Davidson County has been a Stormwater SMART member of since 2005, they serve a population of approximately 169,000 people. They pay into the program for direct education programming. This includes providing public outreach and education at fairs and festivals; coordinate, plan and facilitate environmental camp programs; facilitate lessons for elementary, middle and high school science and environmental classes; partner with schools and clubs on environmental projects that have a water component; partner with community members for trash clean-ups, rain garden education, storm drain markings and many other volunteer opportunities.

In 2020-2022 contract year, the Stormwater SMART programming supported Davidson County, along with partnering communities of Thomasville and Lexington through direct education. They were able to accomplish the following:

- 800 Nature Notebooks AND Seeds were delivered to the Lexington Main Library with distribution to the other Davidson Co Libraries
- 900 Nature Notebooks and Native Seed packets were distributed to various Davidson County Schools
- Educational programming was provided for N. Davidson Middle, South Davidson Middle and Welcome Elementary
- During the pandemic, there was participation from Davidson County in the iNaturalist BioThon and Seeds for Surveys.
- Summer Reading Programs at various Libraries in Davidson County
- Participation and support of the *Keep Davidson County Beautiful* event.
- In 2021, Stormwater SMART program sponsored the inaugural Davidson County Creek Week as organized by Keep Davidson County Beautiful.

Direct education services for the Town of Denton could be coordinated or schedule to occur at the Denton Library or be showcased at the Denton Elementary School. The Denton Elementary School offers many opportunities to further engage with the students around the topic of stormwater, flooding, watershed and water quality. Hands on porjects could be formulated and installed at the school which would encourage, enforce STEM education coupled with BMP that could help to further allivate on-going stormwater issues on the school campus.

FUNDING SOURCES

Funding can be one of the largest barriers to smaller municipalities when seeking to improve their stormwater management programs. Luckily, there are a number of state and federal grants that are

specifically designated for projects that reduce stormwater runoff and improve water quality. Some of the most common grants for water quality projects include:

§205(j) Water Quality Management Planning Grants

Through the Section 205(j) Grant program, the U.S. Environmental Protection Agency provides states with funding for water quality planning. These projects can involve identifying the nature, extent and cause of water quality problems or doing planning work to address those problems. Projects can include, but are not limited to the development of EPA 9-Element Watershed Restoration Plans for a 12-digit or smaller USGS HUC, mapping stormwater infrastructure, conducting engineering designs for stormwater best management practices, and GIS-based watershed assessments of pollutant sources. 205(j) grants are eligible to regional Councils of Government, who can partner with any public sector organization to implement projects. Match is preferred, but not required.

NC Land and Water Fund Grants *(formerly Clean Water Management Trust Fund (CWMTF))*

The NC Land and Water Fund (NCLWF) provides grant assistance to conservation non-profits, local governments and state agencies for the protection of surface waters in North Carolina. The NCLWF funds projects that (1) enhance or restore degraded waters, (2) protect unpolluted waters, and/or (3) contribute toward a network of riparian buffers and greenways for environmental, educational, and recreational benefits, (4) provide buffers around military bases to protect the military mission, (5) acquire land that represents the ecological diversity of North Carolina, and (6) acquire land that contributes to the development of a balanced State program of historic properties. Match varies depending on the project, but is recommended as it increases applicant competitiveness.

NC Water Resources Development Grant Program

The NC Water Resources Development Grant program provides cost-share grants and technical assistance to local governments throughout the state. This grant program primarily funds general and recreational navigation, stream restoration, water management (SCMs, drainage, flood control, hydrologic restoration, etc), and water-based recreation projects (greenways, paddle access, fishing docks/piers, etc), as well as related preliminary feasibility or engineering studies. Applications are accepted throughout the year for two grant cycles during the spring and fall and there is a 50% match requirement.

NC Department of Environmental Quality Division of Water Infrastructure: Local Assistance for Stormwater Infrastructure Investments (NCGA SL 2021-180 Sect 12.14)

With funding through the American Rescue Plan Act (ARPA) for State Fiscal Recovery Fund, NCDEQ through DWI will administer grants for stormwater projects from the newly-created Local Assistance for Stormwater Infrastructure fund. Funding will be awarded to cities (municipalities), counties, councils of government and nonprofit entities for projects that improve or create infrastructure for controlling stormwater quantity or quality. Two types of grants will be available through a competitive basis: 1) construction grants to develop or implement a new stormwater utility or stormwater control measures (SCM), rehabilitation of existing SCMs, retrofitting of existing stormwater conveyances to provide SCMs for quantity and quality control purposes or installation of innovative technologies or nature-based solutions; or 2) planning grant available for research, investigative studies, alternatives analyses, engineered concept or desgn plans preparation, or best solution to address quality or quantity issue.

Other Resources

A comprehensive list of financial resources, including grants, cost shares, and loans, has been compiled by NCDWR's Use Restoration Watershed Program in order to aid water quality project implementation. This list can be found at https://deq.nc.gov/about/divisions/water-resources/planning/basin-planning/use-restoration-watershed-programs/funding.

Depending on the level of need, the Town of Denton may also want to consider implementing a stormwater utility fee. Similar to water or sewer, stormwater utility fees help generate funds to support the construction, operation, and maintenance of stormwater systems. Rates are typically assessed based on the amount of impervious surface on a property. While not incredibly common in smaller towns, stormwater fees have been recognized as one of the best ways to generate local funds for stormwater maintenance and improvements. The University of Chapel Hill's Environmental Finance Center has a useful Stormwater Rates Dashboard that can be used to compare stormwater rates across the state. This dashboard can be accessed at: https://efc.sog.unc.edu/resource/north-carolina-stormwater-fee-dashboard/

The Environmental Protection Agency (EPA) has developed numerous innovative models, tools and technologies for communities to manage water runoff in urban and other environments. The resources incorporate green or a combination of green and gray infrastructure practices that help communities manage their water resources in a more suitable way, and for increasing resiliency for future changes. A next step in further identifying and placing the most appropriate green infrastructure practice in the correct location in the Town of Denton would be to work with an engineering firm that specializes in stormwater, green infrastructure and retrofit designs. Modeling tools, such as the Storm Water Mangement Model (SWMM), can design and size drainage system components for flood control, map floodplains of natural channel systems, design control strategies for minimizing combined sewer overflows, and control site runoff with green infrastructure.