Engineering Study
for the
Ellis Street Property Assessment Project
Augusta-Richmond County, Georgia

Prepared for:

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1. Executive Summary

The Augusta Engineering Department commissioned a property assessment to assess the conditions of the structures on the 1900 block of Ellis Street to determine if the drainage issues were contributing to potential structural issues. Representatives from Cranston, LLC visited the affected properties over the course of two days, January 5th, 2023, and January 11th, 2023. Cranston inspected the structures on the properties addressed 1910, 1912, 1914, 1916, 1924, 1926, 1932, 1936, 1938, and 1946 for a total of ten structures. Inspections included observations of the structures, both interior and exterior. Crawlspaces were also inspected if they were accessible.

This report describes the observed conditions of each structure and discusses the potential causes of the observed conditions. The assessments include overall construction and condition of the structures, including any structural defects observed. The report concludes by discussing potential causes of the observed structural defects. This report also includes recommendations to retrofit any of the structures, if needed.

Cranston also performed a supplemental drainage study utilizing preliminary engineering data from the Augusta Engineering Department's Concept Study of the Ellis Street project area and topographic/feature survey performed by Cranston survey staff on January 5th, 2023. This supplemental study was performed to evaluate site specific alternatives to improve the drainage system surrounding properties investigated during the structural assessment. Specific areas of focus included the existing concrete drainage ditch and drop inlet located at the rear of the 1910-1938 Ellis Street properties bordering John C. Calhoun Expressway and the existing drainage system on Ellis Street and Eve Street.

The existing drainage area is 5.95 acres of residential, paved, and vegetated areas which flow to two independent storm sewer systems. One system being a drop inlet and ditch, which outflows to a 60-inch diameter combined sewer main that flows to the north. This inlet is tributary to approximately 2.23 acres from the south and west. The other system is a storm sewer located on both Eve Street and Ellis Street and is tributary to approximately 3.72 acres. This system conveys flow to a 48 inch storm pipe located at the corner of Eve Street and Ellis Street that continues towards the 1800 block of Ellis Street to the east.

Following study of the existing Ellis Street drainage systems and hydrologic and hydraulic modeling, Cranston recommends improvements to the existing storm system on Eve Street and the westbound on ramp to John C Calhoun Expressway. The improvements would divert flow away from the ditch and drop inlet located at the rear of the Ellis Street homes. It is also recommended to update the existing storm system within the Ellis Street right of way to provide adequate positive drainage.

2. Structural Assessment

The properties inspected on Ellis Street consist of single-family dwellings built in the early 20th century with most of the homes constructed before 1921. Many of the structures had at least one if not two additions. The construction dates of these additions are unknown.

The structures primarily consist of clay masonry piers supporting light framed wood construction. The floor construction consists of rough sawn timber girders supporting dimensional lumber floor joists and the subfloor/finished floor. The spacing and layout of the floor framing varies among the homes, and the subfloor, where observable, consists of diagonal deck boards. The majority of the observed walls consist of light-framed wood bearing and shear walls, with some additional concrete masonry unit (CMU) walls. Most of the CMU walls were used in construction of additions to the main structure. The roof construction consists of dimensional lumber rafters with exterior deck boards as sheathing, finished with either shingles or sheet metal. Selective demolition to expose foundations was not included, thus foundations were not visible, although it is assumed the foundations consist of shallow, reinforced concrete.

On almost all structures, clay masonry veneer (brick) was infilled between piers to enclose the crawlspaces between the clay masonry piers. The curtain walls are either constructed with clay masonry or un-grouted CMU and are not supported by a strip footing. It is assumed these walls were added to enclose and protect the crawl spaces. Finally, it appears some of the structures had modern CMU piers and dimensional lumber framing installed previously, perhaps as previous repairs, to function as intermediate supports to the original framing.

From our observations, there were some common defects shared amongst the homes. While some homes presented more severe damage, each of the following conditions was observed to some degree in all homes. Most of the interior structural damages observed were in the form of wall cracking and unlevel/sagging floors. Cracking was observed on interior walls and ceilings in almost all the homes inspected. There were also many doors that would rub when opened or closed due to either the floor being unlevel or the door frame shifting. Many of the homes' floors were sagging or bowing, a few also had a significant vibration when walked across. The most common exterior defects observed were the failure of curtain walls between the masonry piers, and the cracking of front porch slabs/steps.

2.1. Discussion

One of the main drivers in structural defects such as those observed in the Ellis Street properties is a phenomenon called differential settlement. This occurs when different portions of the structure settle at different rates. This can result in the buildup of internal compressive and tensile stresses in locations where they may have not been anticipated. This can lead to cracking and warping of materials depending on the material's stiffness. Differential settlement can come from a myriad of causes. From nonhomogeneous or improperly compacted soils to load redistribution on a structure, differential settlement is a common occurrence and will almost always exist. Age of the structure plays a significant factor in both the amount of settlement that occurs and the visual evidence of this process. Differential settlement can play a key role in interior cracking, as elements of the structure settle at different rates they can try and separate from each other causing cracks to show in brittle materials such as drywall or paint.

Another cause to some of the observed structural degradation in the observed properties was the unsealed building envelope. In many observed cases, there was evidence of current and/or existing leaks in the roofs, and holes in both the walls and floors. Many of the building materials in these structures are not made to withstand the elements, so upon exposure to excess moisture and temperature, these materials degrade at an accelerated rate. There was also evidence of termite damage in some of the structures. These damages again largely affect the overall performance and rate of degradation of the structure.

As for the sagging/unlevel floors, this can be caused by a few different factors. The first, previously addressed cause could be differential settlement. As different supports settle at different rates, this can cause the floor system to deflect excessively. Due to the material having a much lower stiffness than concrete and drywall, cracks are not as apparent in the actual wood floor system, rather higher deflection will be noticed. The next potential cause could be improper design. Some of the floor system observed from crawlspaces appeared to have joist spans/spacing approaching/exceeding what could be argued as the limits for those sized members in conventional framing. We understand that the dimensional and rough-cut lumber used at the time of original construction had higher design properties than the modern lumber used today, however this could potentially be a cause for approaching and even exceeding those deflection limits.

Another potential cause for the unlevel floors is a phenomenon called creep. This is the time-dependent deformation of loaded members undergoing elastic deformation. According to the *National Design Specification for Wood Construction,* under long-term loading, the expected (average) deflection for seasoned lumber and unseasoned lumber would be one and a half (1.5) to two (2) times the initial deflection, respectively. Long term loading also causes a permanent deformation of approximately one half (1/2) of the creep deflection. Listed below are the specific properties and their respective observed structural defects.

Overall, the structures were in fair to poor condition relative to the age and type of construction. Portions of some structures were inhabitable and unsafe due to partial damage or partial demolition and repair.

<u>1910 Ellis Street, Augusta, GA: Constructed – 1911</u>

This structure was the most dilapidated of the structures inspected. The owner stated that there were renovations that had begun and stopped multiple times in the past few years. Most of the damages were internal and were caused from the lack of protection from the elements.

See Appendix A for representative photographs.

<u>1912 Ellis Street, Augusta, GA: Constructed – 1921</u>

This structure mainly contained structural defects mentioned in the “Background” section. However, there was a column/pier that was experiencing a tipping settlement at the front porch. This is where the foundation in essence rotates as one side of the in situ or compacted fill beneath the footing provides an uneven bearing capacity as the loads distribute through the footing.

See Appendix B for representative photographs.

<u>1914 Ellis Street, Augusta, GA: Constructed – 1944</u>

Most of the interior damages observed in this structure were the result of a busted hot water heater in the attic. The floors that were unlevel tended to slope towards the fireplace area. Few cracks were able to be observed due to the water damage.

See Appendix C for representative photographs**.**

1916 Ellis Street, Augusta, GA: Constructed – 1944

This property had the most accessible crawlspace of all properties assessed. Beneath this home, we observed a combination of older clay masonry piers/rough cut timber framing with newer CMU piers/dimensional lumber framing. The newer piers/framing were placed between the original joist supports to function as intermediate supports. From the crawlspace you could see light entering between the top of the CMU curtain wall and the floor in multiple locations.

See Appendix D for representative photographs.

1924 Ellis Street, Augusta, GA: Constructed – 1906

This structure contained no other structural defects other than the generic issues listed in the "Background" section.

See Appendix E for representative photographs.

1926 Ellis Street, Augusta, GA: Constructed – 1906

This structure contained no other structural defects other than the generic issues listed in the "Background" section.

See Appendix F for representative photographs.

1932 Ellis Street, Augusta, GA: Constructed – 1916

We were unable to access the interior of this home during our site visits. From the exterior no other structural defects other than the generic issues listed in the "Background" section were observed.

See Appendix G for representative photographs.

1936 Ellis Street, Augusta, GA: Constructed – 1906

We were unable to access the interior of this home during our site visits. From the exterior no other structural defects other than the generic issues listed in the "Background" section were observed other than a partial separation between two portions of the rear of the home.

See Appendix H for representative photographs.

1938 Ellis Street, Augusta, GA: Constructed – 1906

The resident of this home stated, "the floors were fixed in October of 2021, and they were starting to sag again." We were unable to verify what floor repairs had been done during our visit. This structure contained no other structural defects other than the generic issues listed in the "Background" section.

See Appendix I for representative photographs.

1946 Ellis Street, Augusta, GA: Constructed – 1969

There was evidence that there had been cracks painted over on the interior of this home. The exterior was solid brick which showed cracking in multiple locations, but overall, this residence was in good condition and contained no other structural defects other than the generic issues listed in the "Background" section. We were unable to verify if the construction was different than the other homes inspected.

See Appendix J for representative photographs.

2.2. Conclusion

Considering the age of these structures, many of the cracks observed appear to have been caused by differential settlement. As for the unlevel floors, this could easily be attributed to any of the three potential causes previously discussed. We believe that the substantial deflections in the floor systems are caused by a combination of inadequate design and differential settlement. We witnessed previous remediation attempts to correct the floor deflection issues under some of the structures. These structures had original clay masonry piers with rough cut lumber as framing, but we observed concrete masonry unit piers and modern dimensional lumber functioning as intermediate supports for some of the floor joist systems. The structure with the least amount of damage was 1946 Ellis Street. This home was constructed in 1969 and is the newest construction of the homes inspected. We conclude that the current structural problems with these properties have been ongoing for an extended period of time and are not directly related to the current conditions.

The common occurrence of the curtain wall failures around the perimeter of the homes were determined to be non-structural. Most, if not all of these walls were not attached to a strip footing at their base and were not adequately secured at the top. This caused many of the curtain walls to lean, crack, or even completely fall over.

Depending on the soil type, an influx of water could speed up the process and increase the severity of differential settlement. However, with the known age and observation of the damages, we do not attribute the entirety of the structural defects to the drainage issues. While this may have well accelerated and worsened some of the issues, they likely would have occurred absent of any draining issues. We recommend consulting with a geotechnical engineering firm to test and evaluate the surrounding soils in this area. This could provide insight on how the soils behave with additional water in the system and if this has any effect on the bearing capacity and soil consolidation/settlement rate.

We appreciate the opportunity to provide structural engineering services for you and stand prepared to discuss any aspect of the results of our analysis or recommendations as necessary. Please contact us at your convenience should you have any questions regarding any aspect of the project.

Sincerely,

CRANSTON, LLC

Robert C Still, Jr., P.E., S.E.

Marissa N Jordan, P.E.

Scott E Sherman, Jr., E.I.T

3. Supplemental Drainage Study

Localized flooding has been reported via complaints made by the residents of the 1900 block of Ellis Street. The City of Augusta Engineering Department requested a drainage study to confirm the observed conditions and develop improvement recommendations. The study area encompasses the 1900 block of Ellis Street and limited 300 block of Eve Street. The specific area of study is limited to the Ellis Street properties bordering the John C. Calhoun Expressway (street addresses 1910 to 1938) and Entrance Ramp from Eve Street to John C. Calhoun Expressway. A breakdown of the study area can be found on sheet C100 in Appendix K of the Plans provided.

On August 15th, 2022, Cranston visited the site to observe existing conditions. A follow up meeting to discuss said conditions and possible solutions was held with the Augusta Engineering Department. Conceptual evaluation and solutions were developed.

On November 10th, 2022, a concept drainage study report based upon limited field survey, GIS data provided by the City, and historical documentation was submitted to the Augusta Engineering Department. This report ultimately recommended improvement to the existing storm system at the intersection of Eve Street and the entrance ramp to John C. Calhoun Expressway.

On January 25th, 2023, Cranston visited the site to observe existing conditions during a rain event.

The purpose of this supplemental study is to evaluate site specific alternatives for improving drainage system conditions south and north of the residential properties noted within the study area. The existing concrete drainage ditch and drop inlet located at the rear of the 1910-1938 Ellis Street properties bordering John C. Calhoun Expressway were evaluated as part of the report delivered on November 11th, 2022. The storm sewer system along Ellis Street is the focus of this study.

A topographic and feature survey of the project area was performed by Cranston. An existing conditions model was created to evaluate the capacity of the existing system during peak flow events using the Rational Method. Inputs to this model include runoff coefficient, drainage area, time of concentration, rainfall intensity, and inlet characteristics. Using the feature survey, the existing drainage system network was mapped and modeled in Hydraflow Stormsewer. Weighted runoff coefficients of the basin were defined using soil data provided by the United States Department of Agriculture and surface definitions recommended in the Georgia Stormwater Management Manual, 2016 Edition. Time of concentration was calculated using the TR-55 method.

3.1. Existing Conditions

The existing drainage area is comprised of six Subbasins. Subbasin 1, which includes the backyards of the residential properties on the south side of Ellis Street and a majority of the John C. Calhoun Expressway westbound on ramp currently drains to a concrete ditch which conveys flow to a drop inlet that connects to a, what is assumed to be, 60 inch combined sewer main. This assumption is based on historical documentation provided by the Augusta Engineering Department. Subbasins 2 through 4 drain to an existing storm sewer system, which flows to the north and outfalls to a 48-inch storm pipe at the intersection of Eve Street and Ellis Street. This system continues east. Subbasins 5 and 6 drain to a dilapidated storm system with multiple negatively sloped pipes and undersized inlets located on Ellis Street. This system shares the same 48-inch storm pipe outfall as the system on Eve Street. See sheet C101 in Appendix K for existing subbasin delineation.

The Ellis Street system includes two existing hood back trap inlet structures located within the right of way (labeled EX-B1 and EX-B2 on Sheet C100 of Appendix K) and connect to a system of manholes that follow the centerline of Ellis Street flowing to the east through a 24-inch diameter pipe.

3.1.1. Input Data

Rainfall intensity data can be found in Table #1. Table #2 denotes the input data used to model the existing storm sewer system. Please note that the 25-year storm event is the design storm for the purposes of this study.

Table #1: Precipitation frequency estimates with 90% confidence intervals

Storm Event (year)	Rainfall Intensity (in/hr)
2	3.46
5	4.32
10	5.06
25	**6.12**
50	6.96
100	7.83

Note: Rainfall Intensities referenced from NOAA.

Table #2: Existing Drainage Conditions

Structure Name		EX-B1	EX-B2	EX-B3	EX-B4	EX-B5	EX-B6
Drainage Subbasin Characteristics	Drainage Area (ac)	2.52	0.14	0.50	0.10	0.46	2.23
	Weighted Runoff Coefficient	0.57	0.85	0.85	0.95	0.20	0.33
	Inlet Time (min) TC	8.7	5.0	5.0	5.0	5.0	17.5
	Subbasin	Subbasin 5	Subbasin 2	Subbasin 6	Subbasin 3	Subbasin 4	Subbasin 1
Inlet Characteristics	Inlet Type	Drop Curb	Curb Inlet	Drop Curb	Curb Inlet	Drop Curb	Drop Curb
	On Grade/ Sag	Sag	On Grade	Sag	On Grade	Sag	Sag
	Bypass Structure	Offset	-	-	EX B2	-	-
	Inlet Length (ft)	16	12	16	12	16	16
	Throat Height (in)	4	4	4	4	4	4
	Cross Slope, Sx (ft/ft)	0.0045	0.008	0.074	0.013	0.020	0.020
	Local Depression (in)	0	0	0	0	0	0
	Gutter Width (ft)	2	2	2	2	0	0
	Longitudinal Slope SL (ft/ft)	-	0.008	-	0.013	-	-
	Manning's n Value	0.013	0.013	0.013	0.013	0.013	0.013
Pipe Characteristics	Downstream Pipe	C6 - B2	C1 - B3	C6 - B1	C1 - B4	B5 - B4	-
	Downstream Pipe Slope (%)	3.81	2.00	6.05	7.46	3.98	-
	Manning's n Value	0.013	0.013	0.013	0.013	0.013	0.013

3.1.2. Results

The Ellis Street system does not provide sufficient capacity due to negatively sloped, undersized pipes, and insufficient inlet capacity. These conditions result in surcharging of the existing system within the Ellis Street right of way. As noted in the 11/10/22 report specific to the area south of the Ellis Street properties, the existing concrete ditch and drop inlet structure is insufficient for the existing flow conveyed from Subbasin 1. See sheet C100 in Appendix K for a plan view of existing conditions.

Results of the "Existing Conditions" model indicate flooding within the Ellis Street right of way. The Hydraflow report is located in Appendix L.

A separate model was created to evaluate the hydraulic capacity of the existing concrete ditch and drop inlet to the rear of the Ellis Street properties. Inlet control of the drop inlet was confirmed using flows calculated by the rational method and hydraulic capacity of the drop inlet using the standard orifice equation. This inlet control results in overtopping of the concrete ditch during a 25-year storm event.

3.2. Proposed Conditions

Through coordination with the Augusta Engineering Department, a site specific improvement was developed to upgrade the existing drainage system. The initial concept report recommended installation of catch basins and header curb along the John C. Calhoun westbound on ramp. A topographic survey of the area and additional hydraulic modeling was performed to provide a final concept plan. The results of this engineering work emphasized the need for rehabilitation of the storm system with the Ellis Street right of way.

Comprehensive improvements recommended in the concept report and those resulting from the supplemental study are noted below.

1. Construct a concrete header curb along the John C. Calhoun Expressway westbound on ramp to convey runoff to a new collection and conveyance system.
2. Construct a new storm drain system along the John C. Calhoun Expressway westbound on ramp, which will subsequently outfall to the existing storm system on Eve Street. This new system will include three catch basins which tie to the proposed header curb and a yard drain to provide positive drainage and conveyance at the north corner of Eve Street and the entrance ramp.
3. Construct two GDOT 1034d catch basins to replace the existing hood back traps on Ellis Street for increased inlet capacity.
4. Replace the undersized and negatively sloped pipes and four manholes along Ellis Street. This improvement will include a single manhole to tie to the new catch basins and a 36 inch pipe to provide conveyance to the 48 inch outfall to the east. A second manhole may be required to capture flows from a 6-inch drainage pipe of unknown origin that is possibly inactive.

3.2.1. Input Data

Please refer to "*Table #3: Proposed Drainage Conditions"* in Appendix L for input data used in the proposed conditions.

3.2.2. Results

The existing concrete ditch and drop inlet does not provide the inlet capacity necessary to collect from during the 25-year storm event. The recommended header curb will serve to convey flow to a new drainage system on Eve Street, thus reducing the contributing area to the existing drop inlet. This improvement results in a 21% reduction in peak flow during a 25-year storm event. Refer to the Existing and Proposed Hydraflow Express reports found in Appendix L for results.

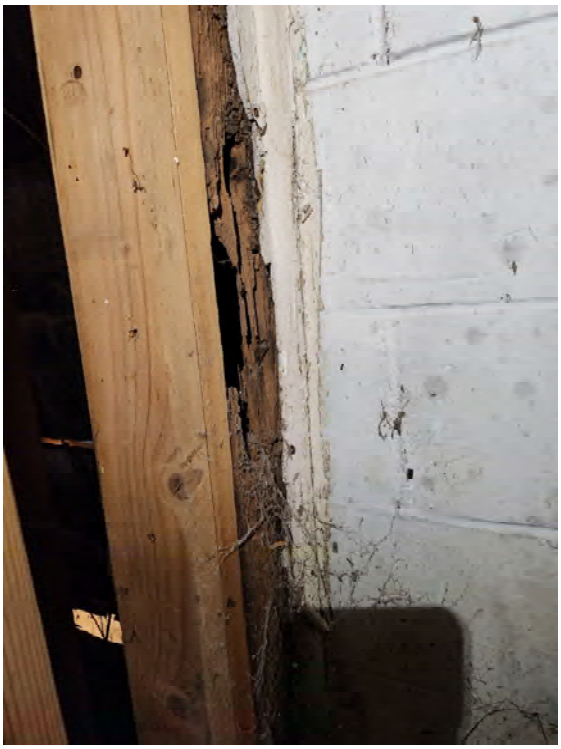
Additionally, the existing hood back trap inlets and 24-inch storm system on Ellis Street do not provide adequate capacity and result in localized flooding due to inlet control and surcharging of system. The recommended 36-inch longitudinal pipe and inlets with increased inlet capacity, provide positive drainage and mitigate flooding during a 25-year storm event by maintaining the Hydraulic Grade Line below existing grade.

Appendix A

1910 Ellis Street Photographs

Wood element decay, potential termite damage

Inadequate seal for protection from elements



Wood element decay, potential termite damage

Inadequate seal for protection from elements

Appendix B

1912 Ellis Street Photographs

Front porch slab cracking

Shifting porch pier/wall

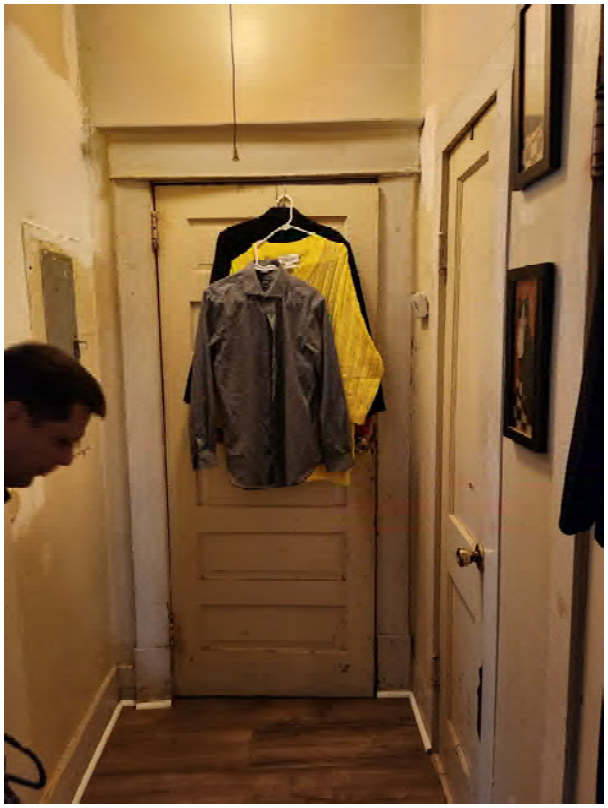
Tipping settlement and associated cracking

Tipping settlement of porch slab wall

Framing damage in response to tipping settlement

Interior ceiling crack

Interior ceiling crack



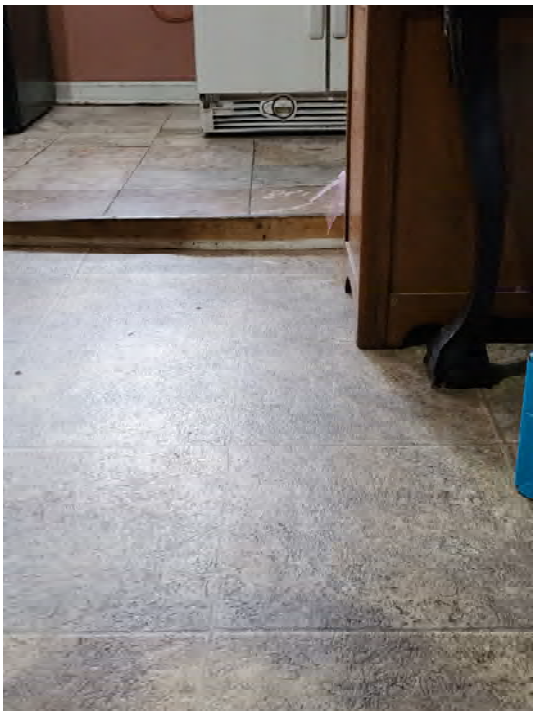
Shifted door/frame

Interior wall crack

Interior wall crack

Shifted interior column

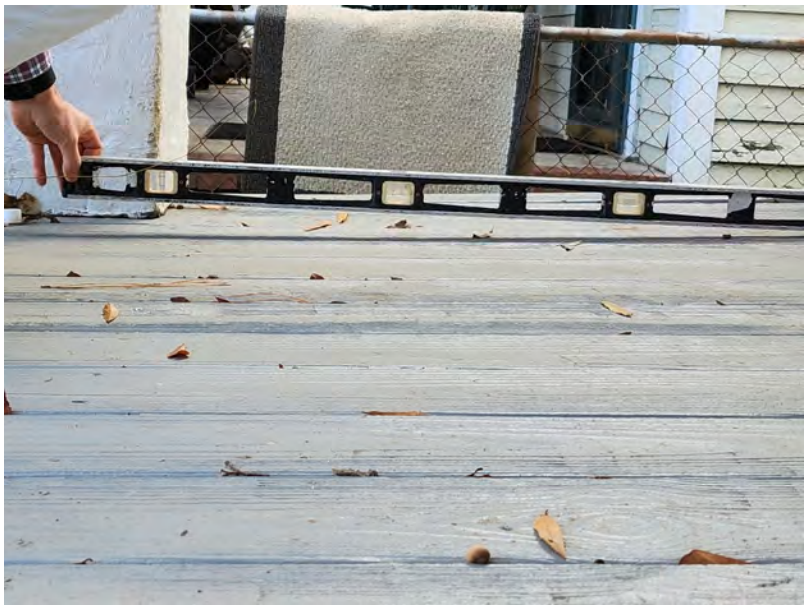
Unlevel/sagging floor



Settled/sagging floor

Appendix C

1914 Ellis Street Photographs



Unlevel/settled front porch

Front porch/column separation

Front porch/column separation

Front porch/column separation

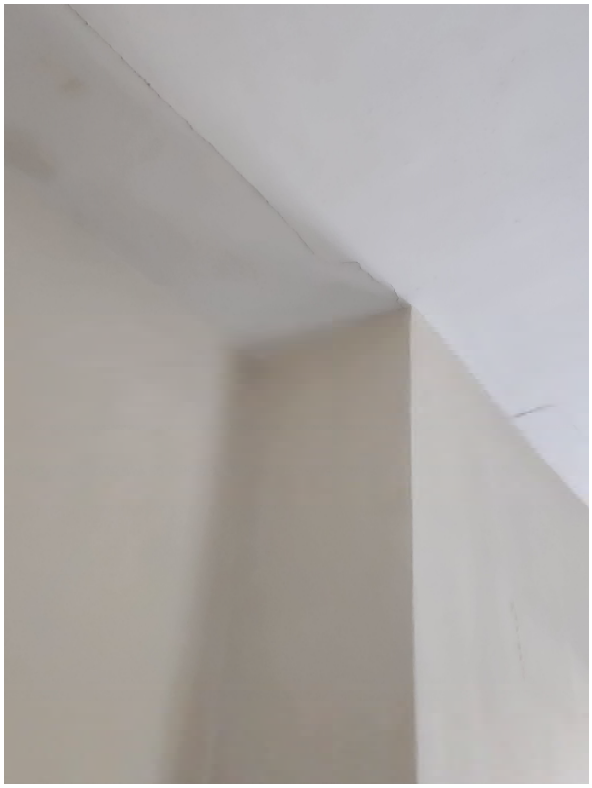
Water damage from busted hot water heater

Water damage from busted hot water heater

Water damage from busted hot water heater

Interior wall crack at door jamb

Unlevel/sagging floor



Interior ceiling crack

Unlevel/settled interior wall

Interior wall crack

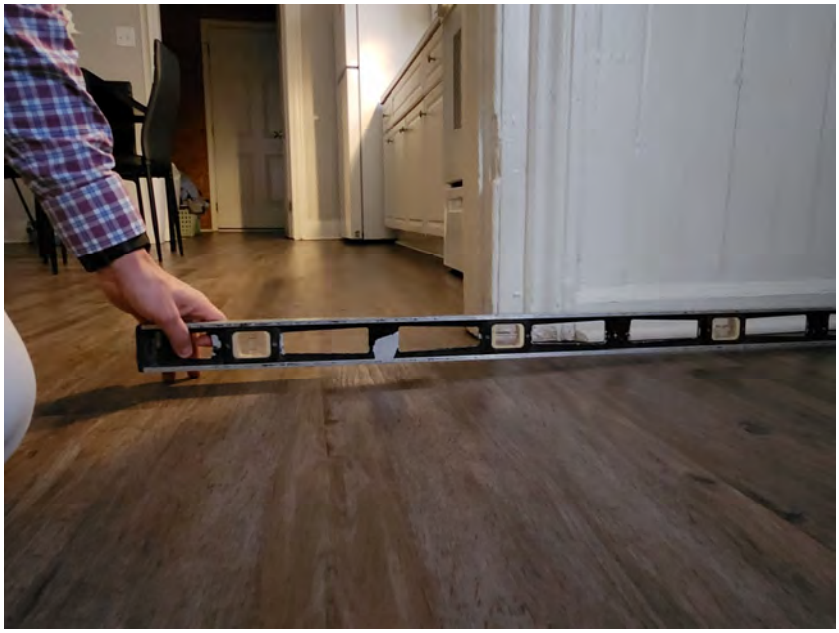
Interior wall crack

Appendix D

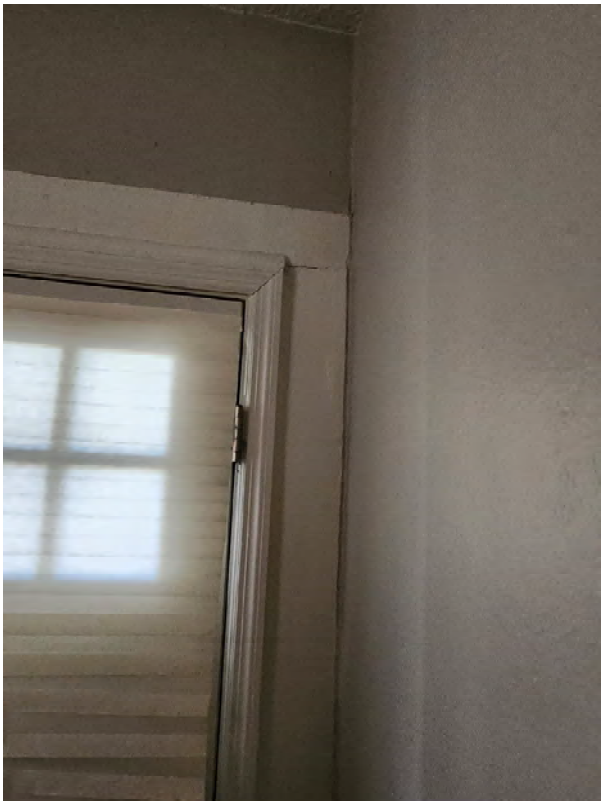
1916 Ellis Street Photographs

Interior wall crack at doorjamb

Interior wall crack at doorjamb



Unlevel/sagging floor



Interior wall crack at doorjamb

Shifted door/frame

Interior wall/ceiling crack

Unlevel/sagging floor

Unconnected infilled exterior curtain wall

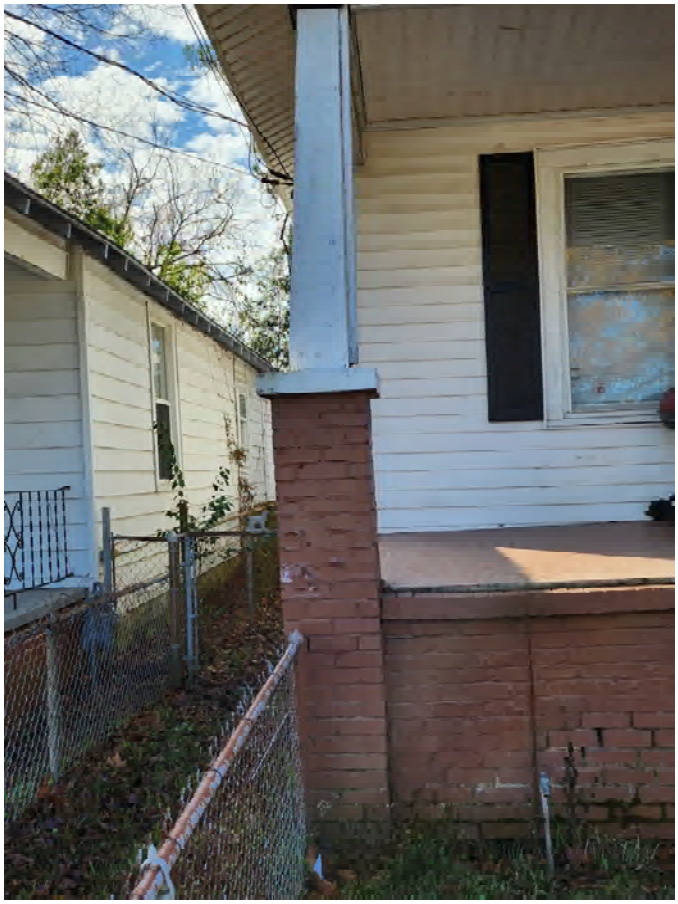
Unconnected infilled exterior curtain wall

Newer CMU piers and dimensional lumber framing/unconnected curtain wall

Appendix E

1924 Ellis Street Photographs

cracking brick curtain wall, unlevel front porch



Tipping settlement and associated column/pier effects

Unlevel front porch

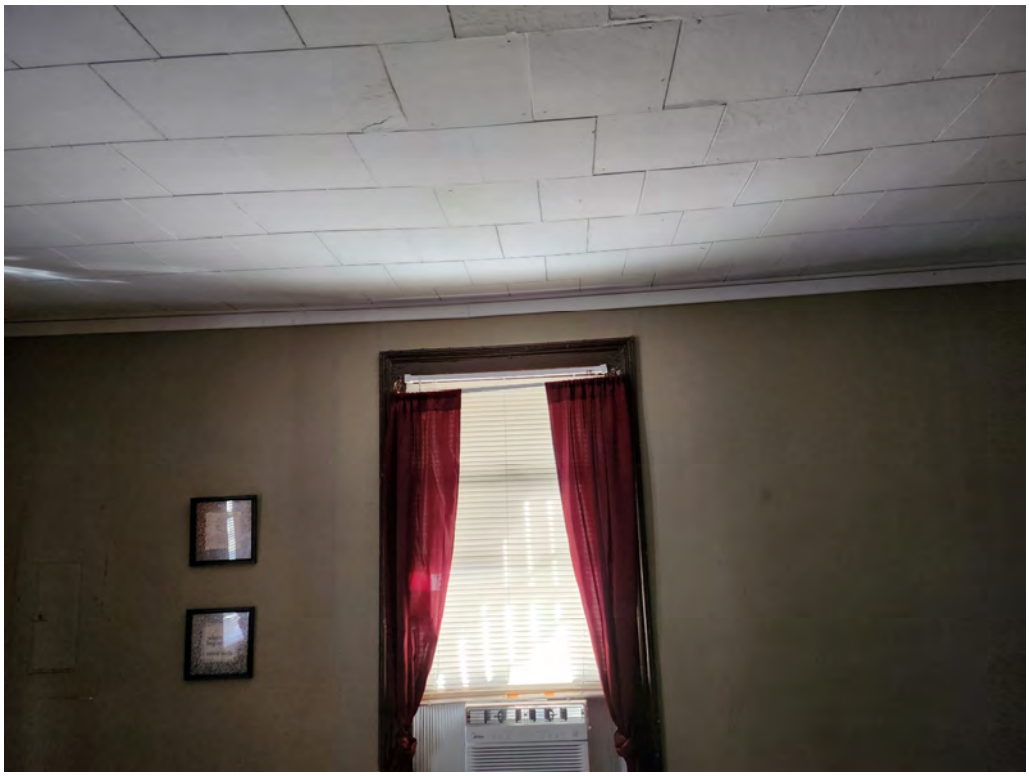
infilled exterior curtain wall/pier separation

Unconnected infilled exterior curtain wall

infilled exterior curtain wall/pier separation

infilled exterior curtain wall/pier separation

Newer CMU/dimensional lumber framing



Deflected/sagging wall

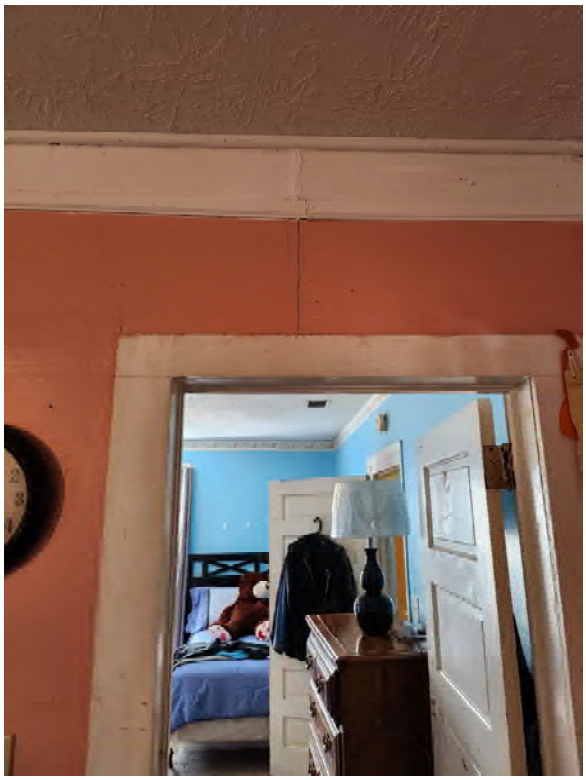
Interior wall crack

Unlevel/sagging floor

Interior floor/wall crack

Appendix F

1926 Ellis Street Photographs

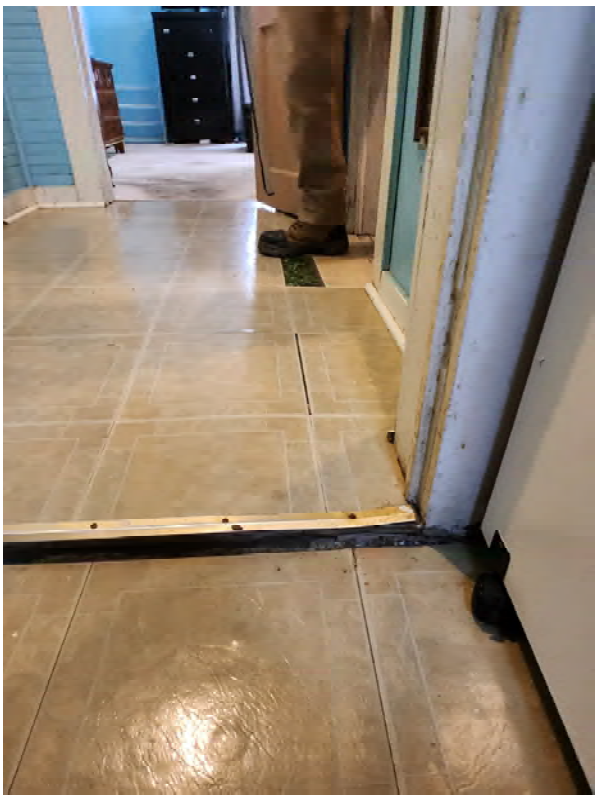


Interior wall crack at doorjamb

Interior wall crack at doorjamb

Shifted door/frame

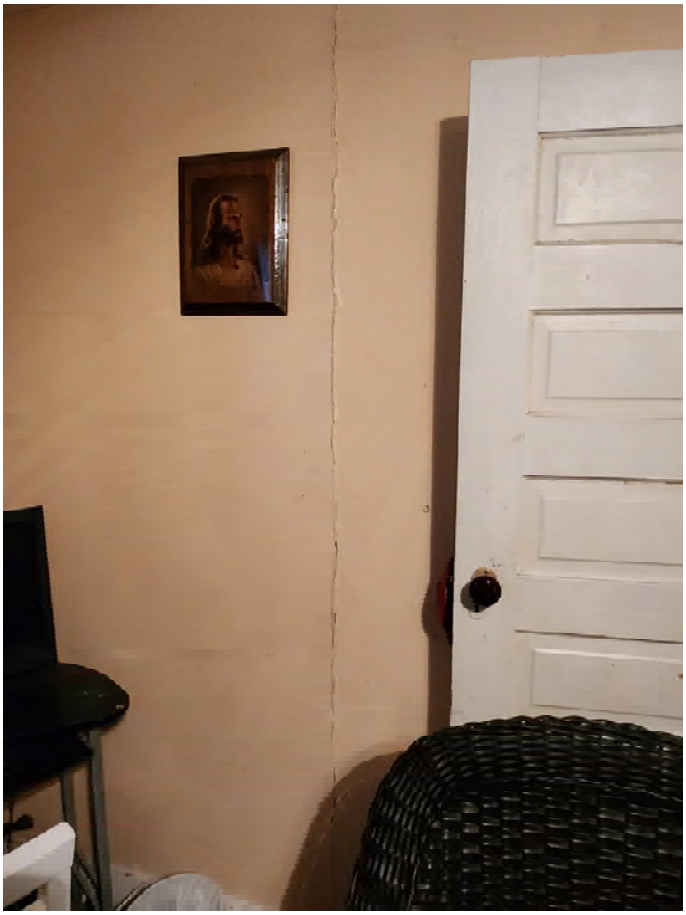
Interior wall crack at doorjamb



Unlevel/deflected floor

Interior wall crack at doorjamb

Unlevel/deflected floor



Repaired interior wall crack

Degraded clay masonry pier without curtain wall

Appendix G

1932 Ellis Street Photographs

Cracked porch wall/unlevel porch

Cracked exterior curtain wall

Newer CMU piers/dimensional lumber framing

Dilapidated exterior curtain wall

Appendix H

1936 Ellis Street Photographs

Separation between portions of the structure

Dilapidated masonry pier without curtain wall

Appendix I

1938 Ellis Street Photographs

Concrete front step cracking

Shifted door/frame

Cracking of finished floor

Unlevel/deflected floor

Unlevel/deflected floor

Interior wall crack at doorjamb

Curtain wall cracking

Curtain wall/pier separation

Dilapidated masonry pier/curtain wall separation

Curtain wall/pier separation

Shifted door/frame

Appendix J

1946 Ellis Street Photographs

Interior wall crack at doorjamb

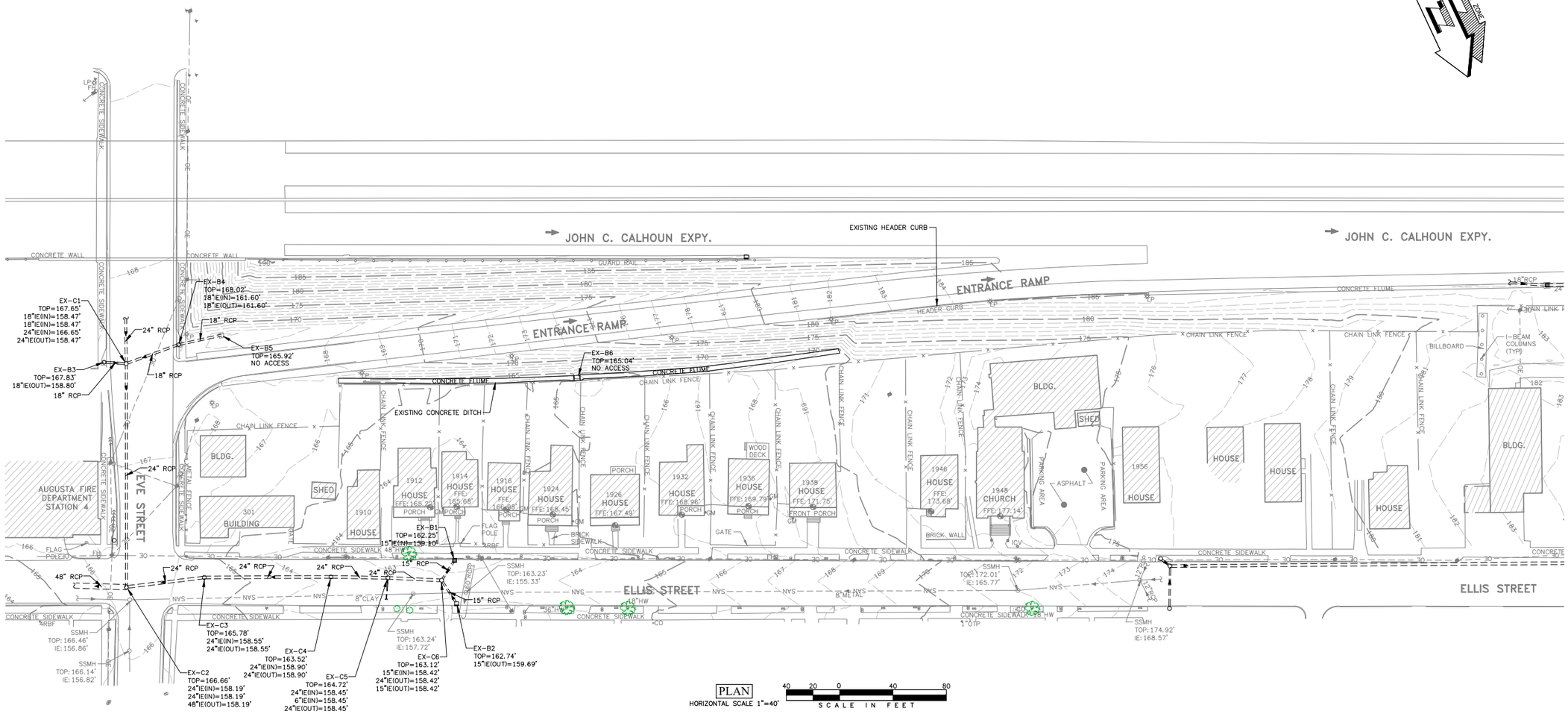
Interior ceiling crack

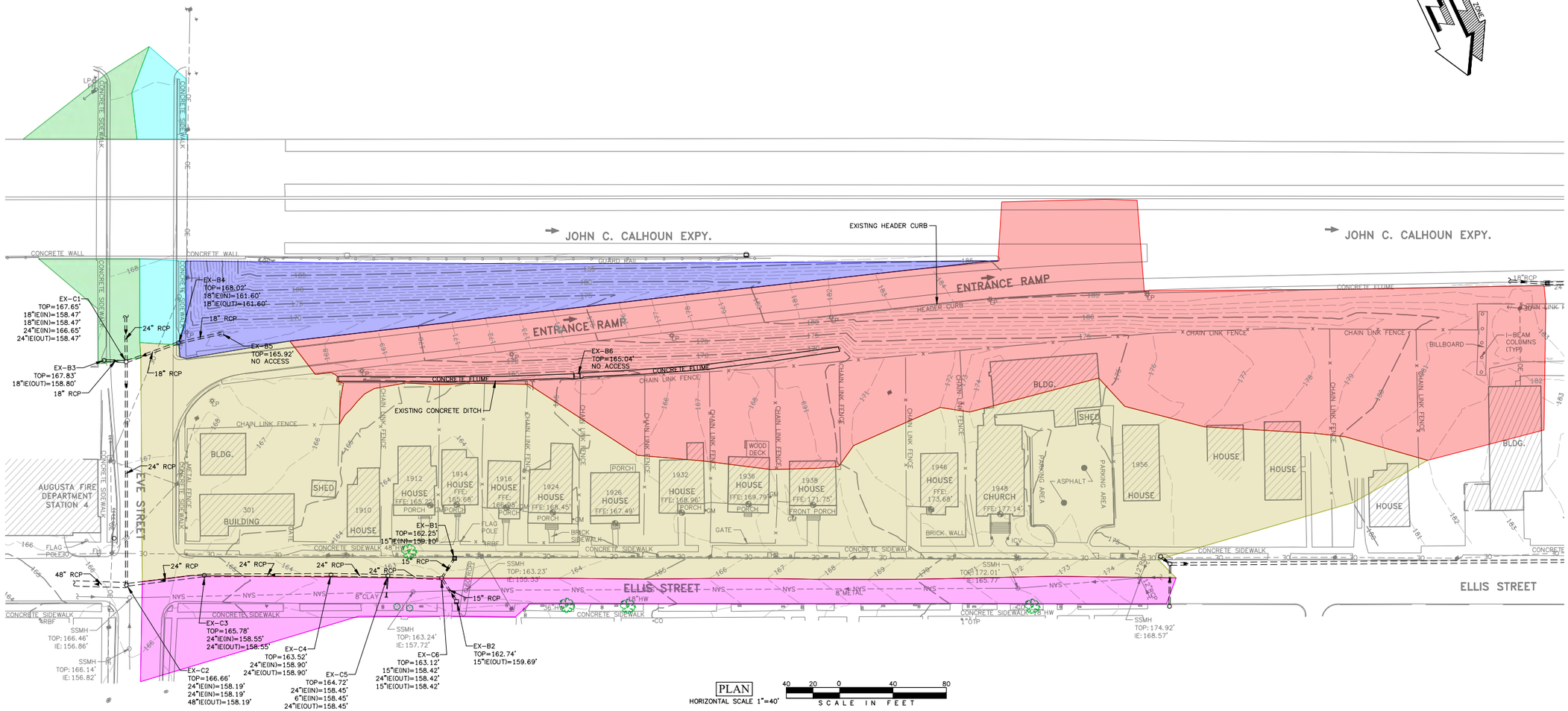
Shifted door/frame

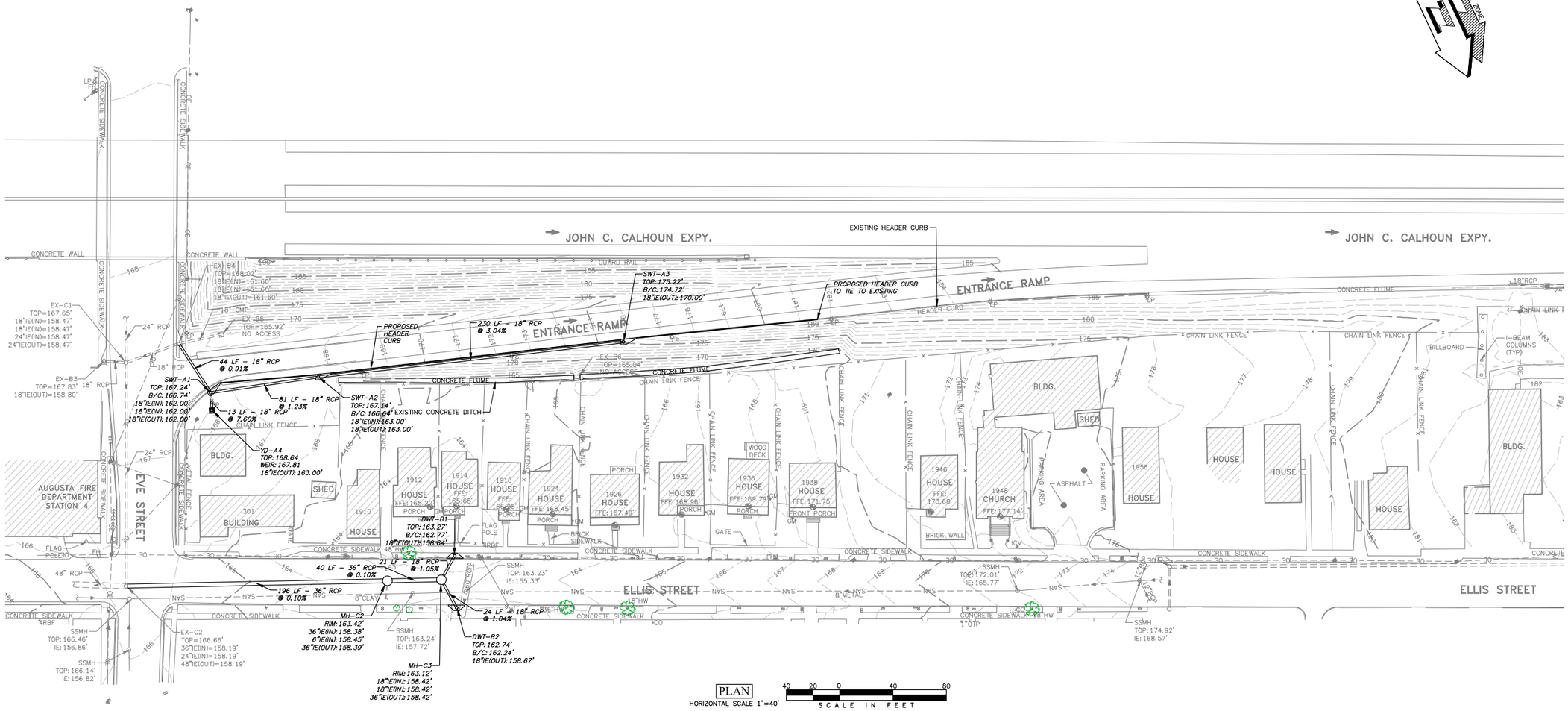
Interior wall crack at doorjamb

Appendix K

Concept Plans


JOHN C. CALHOUN EXPY.
EXISTING HEADER CURB
JOHN C. CALHOUN EXPY.
CONCRETE WALL
GUARD RAIL
ENTRANCE RAMP
ENTRANCE RAMP
HEADER CURB
CONCRETE FLUME
CONCRETE FLUME
CHAIN LINK FENCE
EXISTING CONCRETE DITCH
EX-C1
TOP=167.65'
18"IE(IN)=158.47'
18"IE(IN)=158.47'
24"IE(IN)=166.65'
24"IE(OUT)=158.47'
24" RCP
18" RCP
EX-B4
TOP=168.02'
18"IE(IN)=161.60'
18"IE(OUT)=161.60'
18" RCP
EX-B5
TOP=165.92'
NO ACCESS
EX-B6
TOP=165.04'
NO ACCESS
EX-B3
TOP=167.83'
18"IE(OUT)=158.80'
18" RCP
EX-B1
TOP=162.25'
15"IE(IN)=159.10'
15" RCP
EX-B2
TOP=162.74'
15"IE(OUT)=159.69'
EX-C2
TOP=166.66'
24"IE(IN)=158.19'
24"IE(IN)=158.19'
48"IE(OUT)=158.19'
EX-C3
TOP=165.78'
24"IE(IN)=158.55'
24"IE(OUT)=158.55'
EX-C4
TOP=163.52'
24"IE(IN)=158.90'
24"IE(OUT)=158.90'
EX-C5
TOP=164.72'
24"IE(IN)=158.45'
6"IE(IN)=158.45'
24"IE(OUT)=158.45'
EX-C6
TOP=163.12'
15"IE(IN)=158.42'
24"IE(OUT)=158.42'
15"IE(OUT)=158.42'
SSMH
TOP: 166.46'
IE: 156.86'
SSMH
TOP: 166.14'
IE: 156.82'
SSMH
TOP: 163.24'
IE: 157.72'
SSMH
TOP: 163.23'
IE: 155.33'
SSMH
TOP: 172.01'
IE: 165.77'
SSMH
TOP: 174.92'
IE: 168.57'
AUGUSTA FIRE DEPARTMENT STATION 4
BUILDING
301
SHED
1910 HOUSE
1912 HOUSE FFE: 165.92'
1914 HOUSE FFE: 165.68'
1916 HOUSE FFE: 165.68'
1924 HOUSE FFE: 168.45'
1926 HOUSE FFE: 167.49'
1932 HOUSE
1936 HOUSE FFE: 168.96'
1938 HOUSE FFE: 169.79'
1948 HOUSE FFE: 171.75'
1948 CHURCH FFE: 173.68'
1956 HOUSE FFE: 177.14'
HOUSE
HOUSE
HOUSE
HOUSE
BLDG.
BLDG.
SHED
PARKING AREA
ASPHALT
PARKING AREA
BILLBOARD
I-BEAM COLUMNS (TYP)
WOOD DECK
PORCH
FRONT PORCH
BRICK WALL
BRICK SIDEWALK
GATE
FLAG POLE
CONCRETE SIDEWALK
METAL FENCE
EVE STREET
ELLIS STREET
ELLIS STREET
CONCRETE SIDEWALK
CONCRETE WALL
CONCRETE SIDEWALK
CONCRETE SIDEWALK
CONCRETE SIDEWALK


JOHN C. CALHOUN EXPY.
JOHN C. CALHOUN EXPY.
EXISTING HEADER CURB
ENTRANCE RAMP
ENTRANCE RAMP
CONCRETE WALL
CONCRETE WALL
GUARD RAIL
HEADER CURB
CONCRETE FLUME
CONCRETE FLUME
EXISTING CONCRETE DITCH
CHAIN LINK FENCE
CONCRETE SIDEWALK
EX-C1
TOP=167.65'
18"IE(IN)=158.47'
18"IE(IN)=158.47'
24"IE(IN)=166.65'
24"IE(OUT)=158.47'
EX-B4
TOP=168.02'
18"IE(IN)=161.60'
18"IE(OUT)=161.60'
18" RCP
24" RCP
EX-B5
TOP=165.92'
NO ACCESS
EX-B6
TOP=165.04'
NO ACCESS
EX-B3
TOP=167.83'
18"IE(OUT)=158.80'
18" RCP
18" RCP
24" RCP
EX-B1
TOP=162.25'
15"IE(IN)=159.10'
15" RCP
24" RCP
24" RCP
24" RCP
24" RCP
48" RCP
EX-C3
TOP=165.78'
24"IE(IN)=158.55'
24"IE(OUT)=158.55'
EX-C4
TOP=163.52'
24"IE(IN)=158.90'
24"IE(OUT)=158.90'
EX-C5
TOP=164.72'
24"IE(IN)=158.45'
6"IE(IN)=158.45'
24"IE(OUT)=158.45'
EX-C6
TOP=163.12'
15"IE(IN)=158.42'
24"IE(OUT)=158.42'
15"IE(OUT)=158.42'
EX-B2
TOP=162.74'
15"IE(OUT)=159.69'
EX-C2
TOP=166.66'
24"IE(IN)=158.19'
24"IE(IN)=158.19'
48"IE(OUT)=158.19'
SSMH
TOP: 166.46'
IE: 156.86'
SSMH
TOP: 166.14'
IE: 156.82'
SSMH
TOP: 163.24'
IE: 157.72'
SSMH
TOP: 163.23'
IE: 155.33'
SSMH
TOP: 172.01'
IE: 165.77'
SSMH
TOP: 174.92'
IE: 168.57'
ELLIS STREET
ELLIS STREET
AUGUSTA FIRE DEPARTMENT STATION 4
BUILDING
301
SHED
BLDG.
HOUSE
1910
1912
1914
1916
1924
1926
1932
1936
1938
1946
1948
1956
CHURCH
WOOD DECK
PORCH
FRONT PORCH
FLAG POLE
GATE
BRICK SIDEWALK
BRICK WALL
PARKING AREA
ASPHALT
ICV
BILLBOARD
I-BEAM COLUMNS (TYP)
METAL FENCE
CONCRETE SIDEWALK
CONCRETE SIDEWALK
CONCRETE SIDEWALK



GENERAL NOTES:

1. SURVEY BY CRANSTON, LLC – PERFORMED 1/5/2023

CRANSTON

REV #	DATE	DESCRIPTION

ELLIS STREET DRAINAGE

PROPOSED CONDITIONS

DRAWN BY:	RA
CHECKED BY:	MKO
APPROVED BY:	WTD
DATE:	02/09/22023
SCALE:	1" = 40'
JOB No.	2022-0539
DRAWING No.	C200

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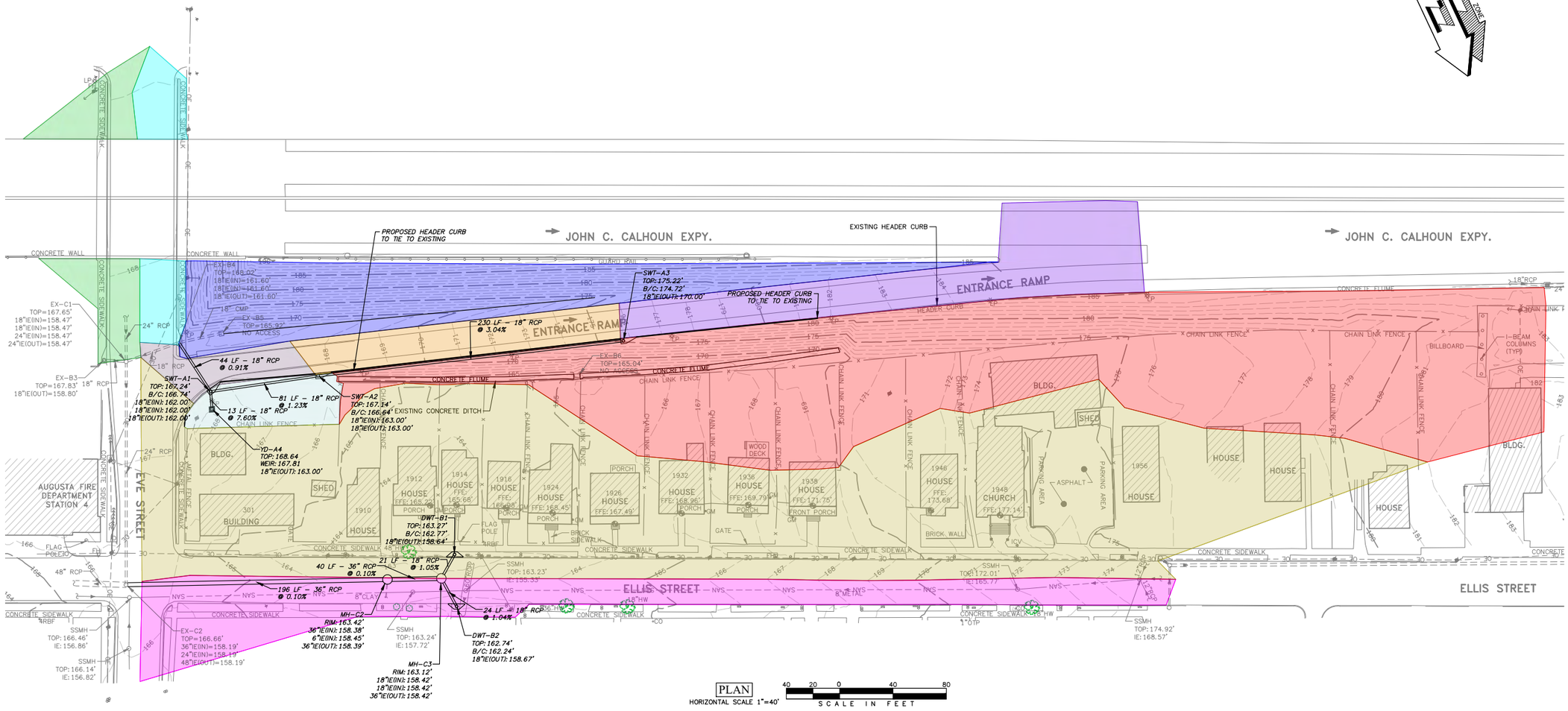

PLAN
HORIZONTAL SCALE 1"=40'

40 20 0 40 80
SCALE IN FEET

LEGEND

SUBBASIN 1
EX-B6
C=0.23
A=1.73 ACRES

SUBBASIN 2
EX-B3
C=0.85
A=0.14 ACRES

SUBBASIN 3
EX-B4
C=0.95
A=0.10 ACRES

SUBBASIN 4
EX-B5
C=0.20
A=0.46 ACRES

SUBBASIN 5
DWT-B1
C=0.60
A=2.36 ACRES

SUBBASIN 6
DWT-B2
C=0.85
A=0.50 ACRES

SUBBASIN 7
YD-A4
C=0.20
A=0.09 ACRES

SUBBASIN 8
SWT-A1
C=0.95
A=0.07 ACRES

SUBBASIN 9
SWT-A2
C=0.95
A=0.15 ACRES

SUBBASIN 10
SWT-A3
C=0.95
A=0.35 ACRES

CRANSTON

REV #	DATE	DESCRIPTION

ELLIS STREET DRAINAGE

PROPOSED BASINS

DRAWN BY:	RA
CHECKED BY:	MKO
APPROVED BY:	WTD
DATE:	02/09/22023
SCALE:	1" = 40'
JOB No.	2022-0539
DRAWING No.	C201

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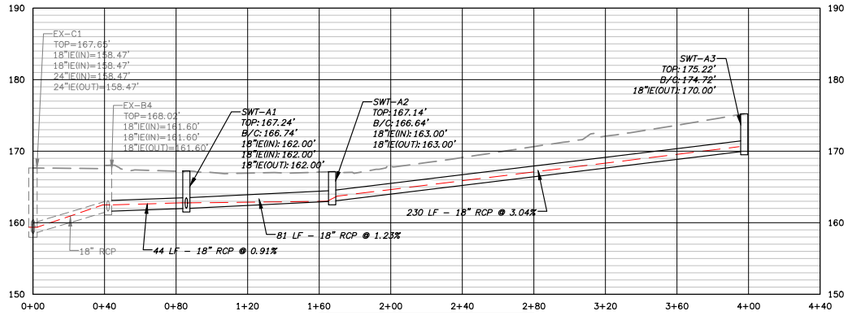
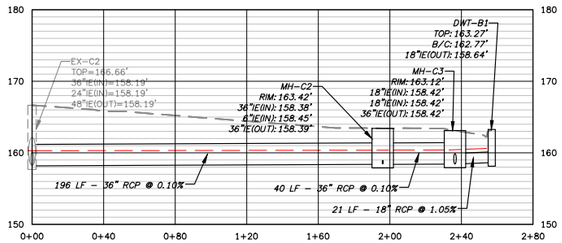


EVE STREET IMPROVEMENTS

HORIZONTAL SCALE: 1"=40'
VERTICAL SCALE: 1"=10'



ELLIS STREET IMPROVEMENTS

HORIZONTAL SCALE: 1"=40'
VERTICAL SCALE: 1"=10'

CRANSTON

REV #	DATE	DESCRIPTION

ELLIS STREET DRAINAGE

PROFILES

DRAWN BY:	RA
CHECKED BY:	MKO
APPROVED BY:	WTD
DATE:	02/09/22023
SCALE:	AS SHOWN
JOB No.	2022-0539
DRAWING No.	C300

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Appendix L

Existing and Proposed Drainage Modeling

Inlet Report

EX-B6 - Existing Conditions

Drop Curb Inlet

Location	= Sag
Curb Length (ft)	= 12.00
Throat Height (in)	= 4.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

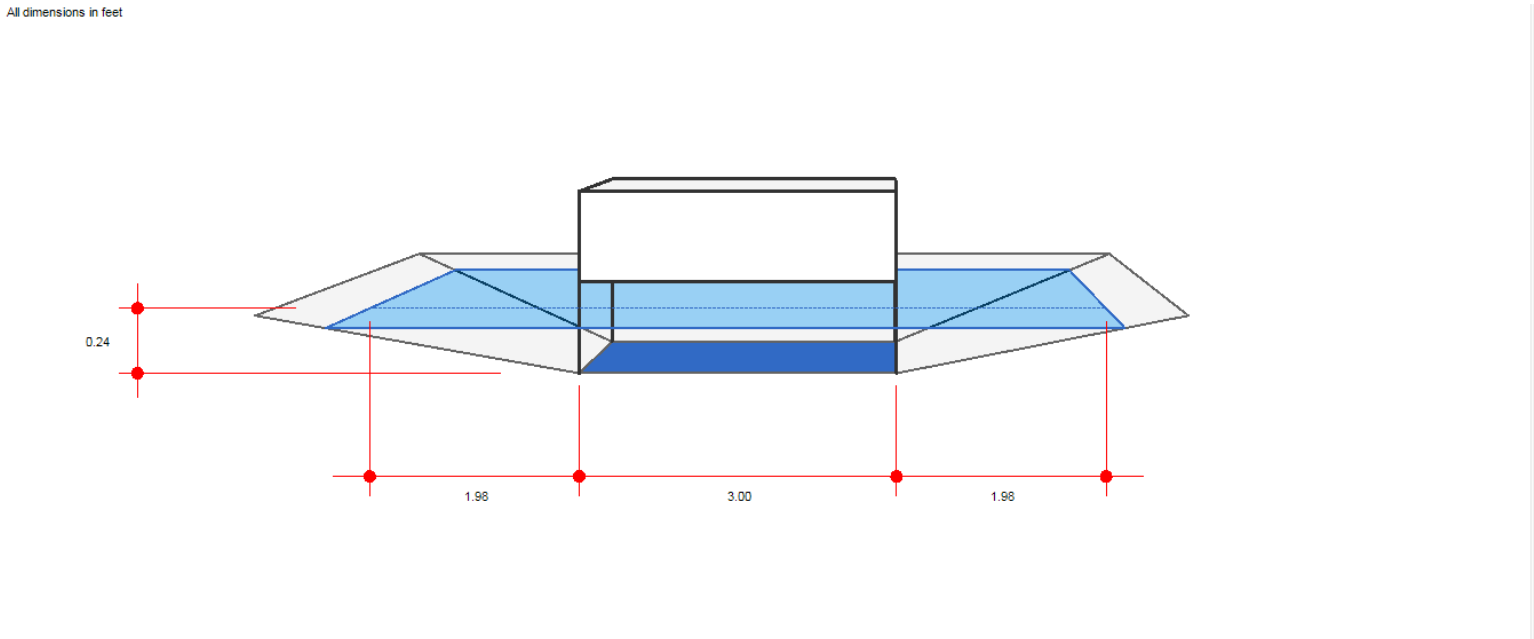
Slope, Sw (ft/ft)	= 0.120
Slope, Sx (ft/ft)	= 0.120
Local Depr (in)	= -0-
Gutter Width (ft)	= -0-
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

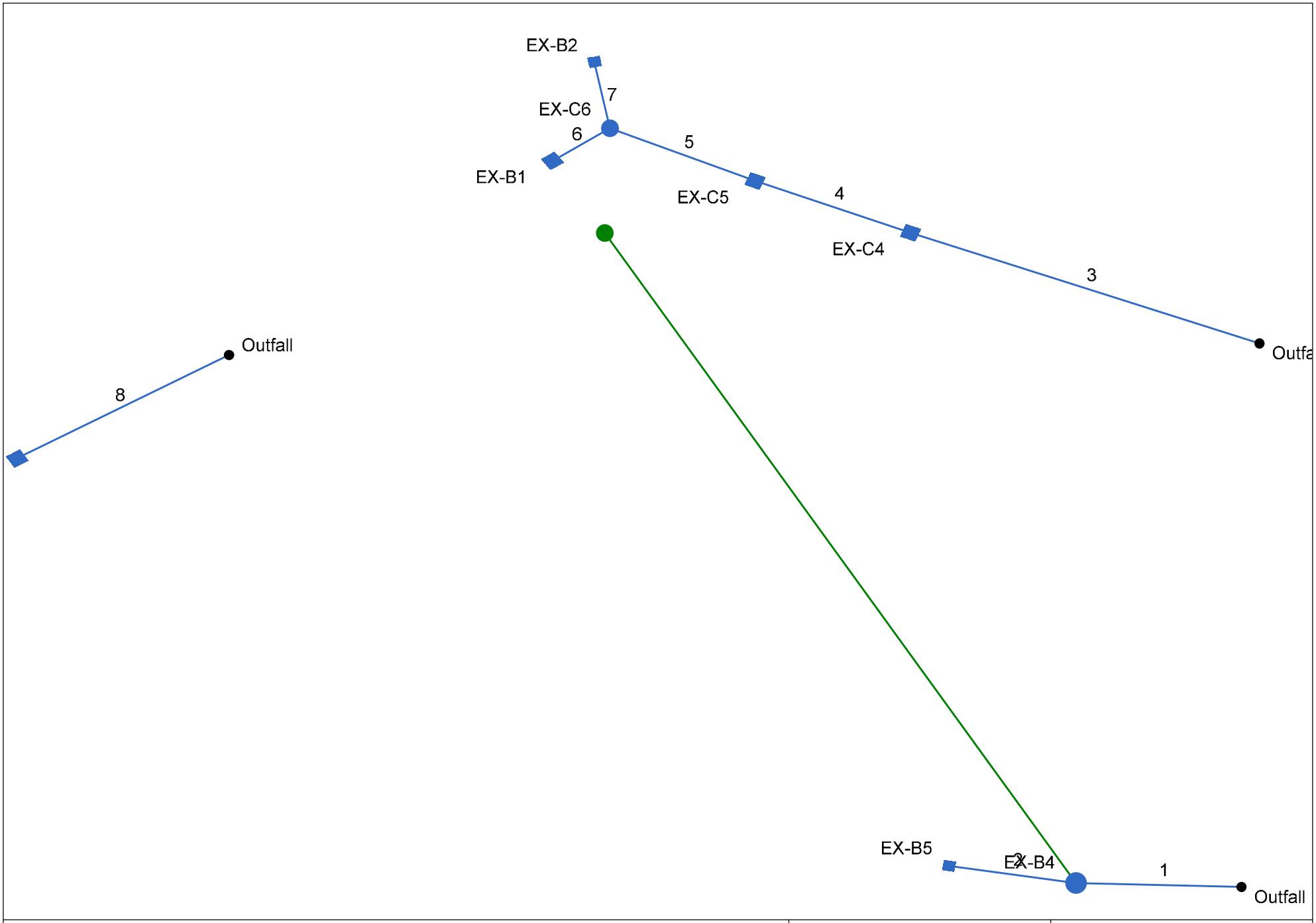
Compute by:	Known Q
Q (cfs)	= 4.17

Highlighted

Q Total (cfs)	= 4.17
Q Capt (cfs)	= 4.17
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 2.85
Efficiency (%)	= 100
Gutter Spread (ft)	= 1.98
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Existing Final-1-26-23.stm	Number of lines: 8	Date: 2/14/2023

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	41.982	-178.344	Curb	0.00	0.10	0.95	5.0	158.47	7.46	161.60	18	Cir	0.012	0.50	168.02	C1 - B4
2	1	32.651	7.989	DrCrb	0.00	0.46	0.20	5.0	161.60	3.98	162.90	18	Cir	0.012	1.00	165.92	B4 - B5
3	End	95.000	-158.573	MH	0.00	0.00	0.00	0.0	158.55	0.37	158.90	24	Cir	0.012	0.15	163.52	C3 - C4
4	3	42.670	1.039	MH	0.00	0.00	0.00	0.0	158.90	-1.05	158.45	24	Cir	0.013	0.15	166.72	C5 - C4
5	4	40.313	1.745	MH	0.00	0.00	0.00	0.0	158.45	-0.07	158.42	24	Cir	0.013	0.88	164.37	C6 - C5
6	5	17.830	-59.420	Grate	0.00	2.52	0.57	8.7	158.42	3.81	159.10	15	Cir	0.013	1.00	164.37	B1 - C6
7	5	21.000	54.947	Grate	0.00	0.50	0.85	5.0	158.42	6.05	159.69	15	Cir	0.013	1.00	162.78	B2 - C6
8	End	62.690	148.910	DrCrb	0.00	2.23	0.33	17.5	159.34	0.43	159.61	12	Cir	0.013	1.00	0.00	EX-B6

Project File: Existing Final-1-26-23.stm | Number of lines: 8 | Date: 2/14/2023

Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	EX-B4	Curb-Horiz	168.02	Cir	5.00	5.00	18	Cir	161.60	18	Cir	161.60
2	EX-B5	DropCurb	165.92	Rect	3.00	3.00	18	Cir	162.90			
3	EX-C4	Manhole	163.52	Rect	4.00	4.00	24	Cir	158.90	24	Cir	158.90
4	EX-C5	Manhole	166.72	Rect	4.00	4.00	24	Cir	158.45	24	Cir	158.45
5	EX-C6	Manhole	164.37	Cir	4.00	4.00	24	Cir	158.42	15 15	Cir Cir	158.42 158.42
6	EX-B1	Grate	164.37	Rect	4.00	4.00	15	Cir	159.10			
7	EX-B2	Grate	162.78	Rect	3.00	3.00	15	Cir	159.69			
8	EX-B6	DropCurb	0.00	Rect	4.00	4.00	12	Cir	159.61			

Project File: Existing Final-1-26-23.stm | Number of Structures: 8 | Run Date: 2/14/2023

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	C1 - B4	1.47	18	Cir	41.982	158.47	161.60	7.456	159.90	162.05	n/a	162.26 i	End	Curb-Horiz
2	B4 - B5	0.76	18	Cir	32.651	161.60	162.90	3.981	162.26	163.22	n/a	163.36 i	1	DropCurb
3	C3 - C4	13.32	24	Cir	95.000	158.55	158.90	0.368	162.75*	163.03*	0.04	163.07	End	Manhole
4	C5 - C4	13.39	24	Cir	42.670	158.90	158.45	-1.055	163.07*	163.22*	0.04	163.27	3	Manhole
5	C6 - C5	13.46	24	Cir	40.313	158.45	158.42	-0.074	163.27*	163.41*	0.25	163.66	4	Manhole
6	B1 - C6	10.40	15	Cir	17.830	158.42	159.10	3.814	163.66*	164.12*	1.12	165.24	5	Grate
7	B2 - C6	3.50	15	Cir	21.000	158.42	159.69	6.048	163.66*	163.72*	0.13	163.85	5	Grate
8	EX-B6	4.17	12	Cir	62.690	159.34	159.61	0.431	162.58*	163.44*	0.44	163.88	End	DropCurb

Project File: Existing Final-1-26-23.stm | Number of lines: 8 | Run Date: 2/14/2023

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; i - Inlet control.

MyReport

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	0.45	0.45	6	0.20	0.50	0.90	31.06	0.45	0.012	0.012	19.22	-178.344	1.43	0.45**	Outfall	0.10	707949.50	160.06	162.26 i	2.191
2	0.28	0.28	Sag	0.20	0.50	0.90	22.70	0.32	0.033	0.033	1.00	7.989	0.66	0.32**	1	0.46	707917.31	162.37	163.36 i	0.989
3	3.14	3.14	n/a	0.20	0.50	0.90	14.87	1.31	....	....	....	-158.573	2.00	2.00	Outfall	0.00	707907.59	163.03	163.31	0.281
4	3.14	3.14	n/a	0.20	0.50	0.90	0.00	1.32	....	....	....	1.039	2.00	2.00	3	0.00	707868.16	163.36	163.51	0.150
5	3.14	3.14	n/a	0.20	0.50	0.90	0.00	1.32	....	....	....	1.745	2.00	2.00	4	0.00	707831.39	163.55	163.69	0.143
6	1.23	1.23	Offsite	0.20	0.50	0.90	12.61	1.19	0.074	0.074	....	-59.420	1.25	1.25	5	2.52	707816.82	164.78	165.24	0.463
7	1.23	1.23	Sag	0.20	0.50	0.90	15.88	0.75	0.045	0.045	....	54.947	1.25	1.25	5	0.50	707827.44	163.79	163.85	0.062
8	0.79	0.79	Sag	0.20	0.50	0.90	2.34	0.86	0.020	0.020	16.00	148.910	1.00	1.00	Outfall	2.23	707681.13	163.02	163.88	0.859

Project File: Existing Final-1-26-23.stm | Number of lines: 8 | Date: 2/14/2023

NOTES: i Inlet control; ** Critical depth

MyReport

Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	Inlet Eff (%)
1.47	n/a	n/a	....	....	....	167.65	168.02	0.10	0.008	8.73	2.00	159.90	162.05 j	162.26 i	159.90	159.42	0.10	0.78	0.10	94
0.76	n/a	n/a	....	....	....	168.02	165.92	0.40	Sag	12.11	....	162.26	163.22 j	163.36 i	162.19	162.14	0.09	0.76	0.40	100
13.32	0.296	0.296	....	....	....	165.78	163.52	....	....	....	....	162.75	163.03	163.07	....	....	0.00	0.00	....	....
13.39	0.351	0.351	....	....	....	163.52	166.72	....	....	....	....	163.07	163.22	163.27	....	....	0.00	0.00	....	....
13.46	0.354	0.354	....	....	....	166.72	164.37	....	....	....	....	163.27	163.41	163.66	....	....	0.00	0.00	....	....
10.40	2.594	2.594	....	8.98	2.00	164.37	164.37	0.45	0.023	6.07	2.00	163.66	164.12	165.24	....	....	1.44	10.40	0.45	88
3.50	0.295	0.295	24.00	12.00	2.00	164.37	162.78	0.22	Sag	4.88	2.00	163.66	163.72	163.85	....	....	0.43	3.50	0.22	100
4.17	1.370	1.370	....	....	....	0.00	0.00	0.20	Sag	9.80	....	162.58	163.44	163.88	....	....	0.74	4.17	0.20	100

Project File: Existing Final-1-26-23.stm | Number of lines: 8 | Date: 2/14/2023

NOTES: i Inlet control; ** Critical depth

MyReport

Inlet ID	Inlet Loc	(ft)	Inlet Time (min)	i Sys (in/hr)	i Inlet (in/hr)	Invert Dn (ft)	Invert Up (ft)	Jump Loc (ft)	Jump Len (ft)	Vel Hd Jmp Dn (ft)	Vel Hd Jmp Up (ft)	J-Loss Coeff	Junct Type	Known Q (cfs)	Cost RCP	Cost CMP	Cost PVC	
EX-B4	On Grade		5.0	7.87	8.25	158.47	161.60	4.20	5.56	0.02	1.22	0.50	Curb	0.00	2,085	1,877	1,772	
EX-B5	Sag		5.0	8.25	8.25	161.60	162.90	6.53	1.63	0.11	0.39	1.00	Dp-Curb	0.00	1,344	1,210	1,142	
EX-C4	Sag		0.0	7.16	0.00	158.55	158.90	....	....	0.00	0.00	0.15	MH	0.00	4,656	4,190	3,958	
EX-C5	Sag		0.0	7.19	0.00	158.90	158.45	....	....	0.00	0.00	0.15	MH	0.00	2,246	2,021	1,909	
EX-C6	Sag		0.0	7.23	0.00	158.45	158.42	....	....	0.00	0.00	0.88	MH	0.00	2,228	2,005	1,894	
EX-B1	On Grade		8.7	7.24	7.24	158.42	159.10	....	....	0.00	0.00	1.00	Grate	0.00	733	659	623	
EX-B2	Sag		5.0	8.25	8.25	158.42	159.69	....	....	0.00	0.00	1.00	Grate	0.00	800	720	680	
EX-B6	Sag		17.5	5.66	5.66	159.34	159.61	....	....	0.00	0.00	1.00	Dp-Curb	0.00	1,850	1,665	1,573	

Project File: Existing Final-1-26-23.stm | Number of lines: 8 | Date: 2/14/2023

NOTES: Intensity = 103.30 / (Inlet time + 16.60) ^ 0.82 -- Return period = 25 Yrs. ; i Inlet control; ** Critical depth

MyReport

Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)	Tc (min)
C1 - B4	41.982	18	7.46	Cir	0.0	0.013	0.012	n/a	1267322.33	0.81	0.05	0.73	0.00	18	0.95	18	0.00	0.00	0.00	6.3
B4 - B5	32.651	18	3.98	Cir	....	....	0.012	n/a	1267327.80	1.27	0.00	0.76	0.00	18	0.20	18	0.00	0.00	0.00	5.0
C3 - C4	95.000	24	0.37	Cir	....	....	0.012	0.04	1267526.34	0.38	....	....	....	24	0.00	24	0.00	0.00	0.00	9.1
C5 - C4	42.670	24	-1.05	Cir	....	....	0.013	0.04	1267542.64	0.17	....	....	....	24	0.00	24	0.00	0.00	0.00	8.9
C6 - C5	40.313	24	-0.07	Cir	....	....	0.013	0.25	1267559.18	0.16	....	....	....	24	0.00	24	0.00	0.00	0.00	8.7
B1 - C6	17.830	15	3.81	Cir	0.0	0.013	0.013	1.12	1267548.90	0.04	1.21	9.24	0.05	15	0.57	15	0.00	0.00	0.00	8.7
B2 - C6	21.000	15	6.05	Cir	0.0	....	0.013	0.13	1267579.80	0.12	0.00	3.50	0.00	15	0.85	15	0.00	0.00	0.00	5.0
EX-B6	62.690	12	0.43	Cir	....	....	0.013	0.44	1267455.63	0.20	0.00	4.17	0.00	12	0.33	12	0.00	0.00	0.00	17.5

Project File: Existing Final-1-26-23.stm | Number of lines: 8 | Date: 2/14/2023

NOTES: i Inlet control; ** Critical depth

MyReport

Throat Ht (in)	Total Area (ac)	Total CxA	Total Runoff (cfs)	Vel Ave (ft/s)	Vel Dn (ft/s)	Vel Hd Dn (ft)	Vel Hd Up (ft)	Vel Up (ft/s)	Cover Dn (ft)	Cover Up (ft)	Storage (cft)
4.0	0.56	0.19	1.47	2.05	0.85	0.16	0.16	3.25	7.68	4.92	48.03
4.0	0.46	0.09	0.76	1.86	1.02	0.11	0.11	2.71	4.92	1.52	16.46
....	3.02	1.86	13.32	4.24	4.24	0.28	0.28	4.24	5.23	2.62	298.39
....	3.02	1.86	13.39	4.26	4.26	0.28	0.28	4.26	2.62	6.27	134.03
....	3.02	1.86	13.46	4.29	4.29	0.29	0.29	4.28	6.27	3.95	126.62
....	2.52	1.44	10.40	8.47	8.48	1.12	1.12	8.47	4.70	4.02	21.88
....	0.50	0.43	3.50	2.86	2.86	0.13	0.13	2.86	4.70	1.84	25.77
4.0	2.23	0.74	4.17	5.31	5.31	0.44	0.44	5.31	n/a	n/a	49.23

Project File: Existing Final-1-26-23.stm | Number of lines: 8 | Date: 2/14/2023

NOTES: i Inlet control; ** Critical depth

Table #3: Proposed Drainage Conditions

Structure Name		SWT-A1	SWT-A2	SWT-A3	YD-A4	DWT-B1	DWT-B2	EX-B3	EX-B4	EX-B5	EX-B6
Drainage Subbasin Characteristics	Drainage Area (ac)	0.07	0.15	0.35	0.09	2.36	0.50	0.14	0.10	0.46	1.73
	Weighted Runoff Coefficient	0.950	0.950	0.950	0.200	0.595	0.850	0.848	0.950	0.200	0.226
	Inlet Time (min)	5.00	5.00	5.00	5.00	13.60	5.00	5.00	5.00	5.00	5.00
	Sub-Basin	Sub-basin 8	Sub-basin 9	Sub-basin 10	Sub-basin 7	Sub-basin 5	Sub-basin 6	Sub-basin 2	Sub-basin 3	Sub-basin 4	Sub-basin 1
Inlet Characteristics	Inlet Type	Curb Inlet	Curb Inlet	Curb Inlet	Drop Curb	Curb Inlet	Curb Inlet	Curb Inlet	Curb Inlet	Curb Inlet	Drop Curb
	On Grade/ Sag	Grade	Grade	Grade	Sag	Sag	Sag	Grade	Grade	Sag	Sag
	Bypass Structure	DWT B1	SWT A1	SWT A2	-	-	Offset	-	SWT A1	-	-
	Inlet Length (ft)	12.0	12.0	12.0	16.0	12.0	12.0	12.0	12.0	16.0	16.0
	Throat Height (in)	5.5	5.5	5.5	4.0	5.5	5.5	5.5	5.5	4.0	4.0
	Cross Slope, Sx (ft/ft)	0.015	0.038	0.008	0.020	0.074	0.045	0.008	0.013	0.020	0.020
	Local Depression (in)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gutter Width (ft)	2.0	2.0	2.0	0.0	2.0	2.0	2.0	2.0	0.0	0.0
	Longitudinal Slope SL (ft/ft)	0.003	0.004	0.026	-	-	-	0.001	0.007	-	-
	Manning's n Value	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Pipe Characteristics	Downstream Pipe	B4 - A1	A1 - A2	A2 - A3	A1 - YD A4	C2 - B1	C2 - B2	C3 - B3	C3 - B4	B4 - B5	Ex B6
	Downstream Pipe Slope (%)	1.00	1.23	3.04	7.66	1.00	1.00	2.00	7.46	4.00	1.00
	Manning's n Value	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013

Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Feb 14 2023

EX-B6 -Proposed Conditions

Drop Curb Inlet

Location	= Sag
Curb Length (ft)	= 12.00
Throat Height (in)	= 4.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

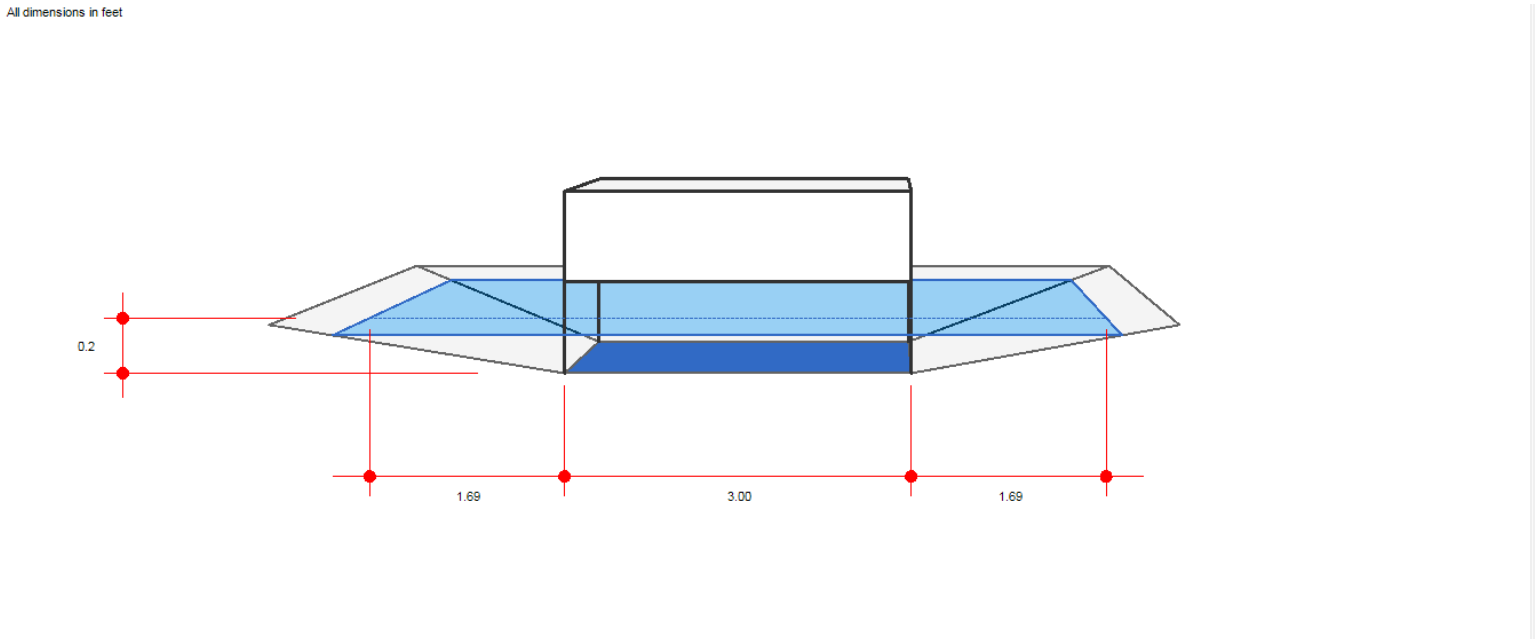
Slope, Sw (ft/ft)	= 0.120
Slope, Sx (ft/ft)	= 0.120
Local Depr (in)	= -0-
Gutter Width (ft)	= -0-
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

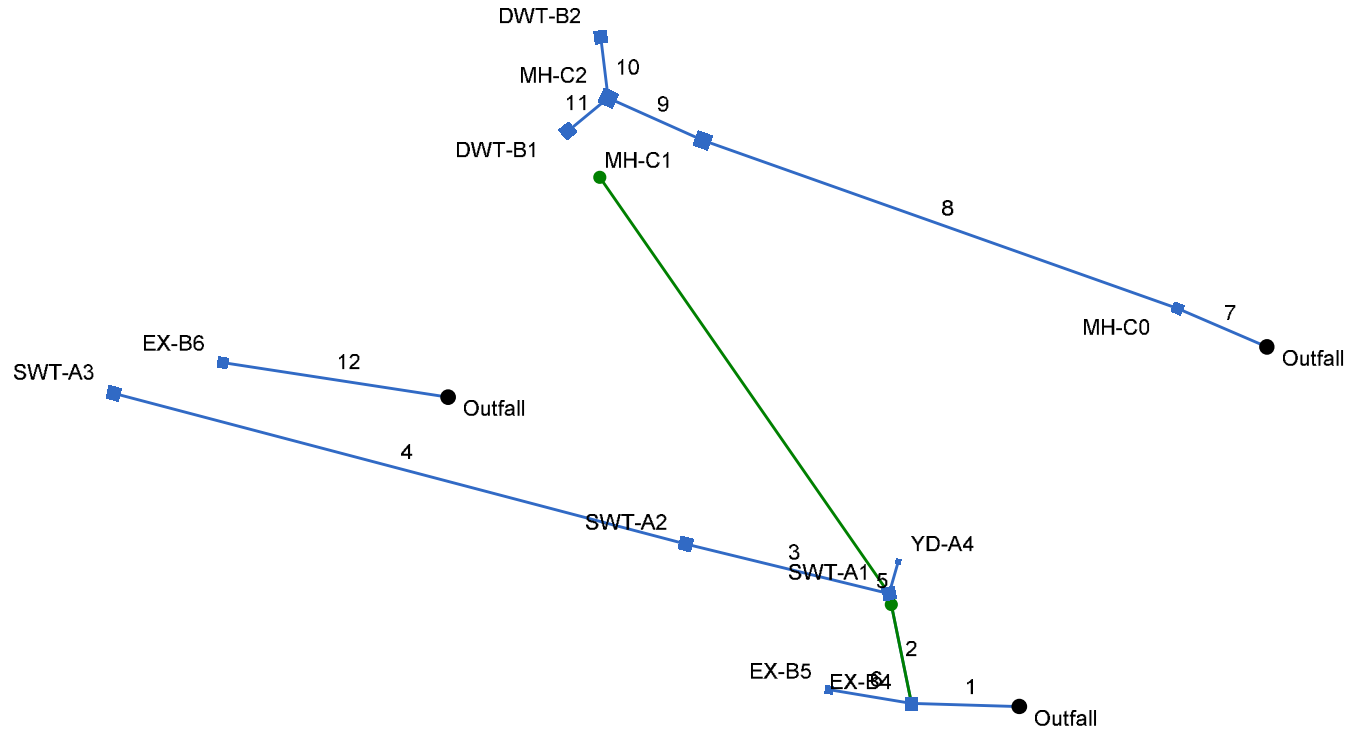
Compute by:	Known Q
Q (cfs)	= 3.28

Highlighted

Q Total (cfs)	= 3.28
Q Capt (cfs)	= 3.28
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 2.43
Efficiency (%)	= 100
Gutter Spread (ft)	= 1.69
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 2022-0539_Proposed Conditions_FINAL-1-31-23.stm	Number of lines: 12	Date: 2/14/2023

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	41.982	-178.344	Curb	0.00	0.10	0.95	5.0	158.47	7.46	161.60	18	Cir	0.013	1.93	168.02	C3 - B4
2	1	43.841	76.739	Curb	0.00	0.07	0.95	5.0	161.60	0.91	162.00	18	Cir	0.013	1.75	167.23	B4 - A1
3	2	81.310	-64.611	Curb	0.00	0.15	0.95	5.0	162.00	1.23	163.00	18	Cir	0.013	0.50	167.09	A1 - A2
4	3	230.327	1.039	Curb	0.00	0.35	0.95	5.0	163.00	3.04	170.00	18	Cir	0.013	1.00	179.03	A2 - A3
5	2	13.060	27.615	DrCrb	0.00	0.09	0.20	5.0	162.00	7.66	163.00	18	Cir	0.013	1.00	167.79	A1 - A4
6	1	32.651	7.989	DrCrb	0.00	0.46	0.20	5.0	161.60	3.98	162.90	18	Cir	0.013	1.00	165.92	B4 - B5
7	End	37.852	-156.701	MH	0.00	0.00	0.00	0.0	159.00	-2.14	158.19	48	Cir	0.013	0.15	166.66	Pipe - (28)
8	7	196.180	-3.685	MH	0.00	0.00	0.00	0.0	158.19	0.10	158.39	36	Cir	0.013	0.15	165.05	C0 - C1
9	8	40.313	4.596	MH	0.00	0.00	0.00	0.0	158.38	0.12	158.43	36	Cir	0.013	0.91	163.12	C1 - C2
10	9	23.941	58.665	Curb	0.00	0.50	0.85	5.0	158.43	1.00	158.67	18	Cir	0.013	1.00	164.00	C2 - B2
11	9	20.437	-63.673	Curb	0.00	2.36	0.60	13.6	158.43	0.98	158.63	18	Cir	0.013	1.00	164.21	C2 - B1
12	End	88.660	-171.240	DrCrb	0.00	1.73	0.23	5.0	160.04	5.01	164.48	12	Cir	0.013	1.00	0.00	EX B6

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Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	EX-B4	Curb-	168.02	Rect	5.00	5.00	18	Cir	161.60	18 18	Cir Cir	161.60 161.60
2	SWT-A1	Curb-	167.23	Rect	5.00	5.00	18	Cir	162.00	18 18	Cir Cir	162.00 162.00
3	SWT-A2	Curb-	167.09	Rect	5.00	5.00	18	Cir	163.00	18	Cir	163.00
4	SWT-A3	Curb-	179.03	Rect	5.00	5.00	18	Cir	170.00			
5	YD-A4	DropCurb	167.79	Rect	2.00	2.00	18	Cir	163.00			
6	EX-B5	DropCurb	165.92	Rect	3.00	3.00	18	Cir	162.90			
7	MH-C0	Manhole	166.66	Rect	4.00	4.00	48	Cir	158.19	36	Cir	158.19
8	MH-C1	Manhole	165.05	Rect	6.00	6.00	36	Cir	158.39	36	Cir	158.38
9	MH-C2	Manhole	163.12	Rect	6.00	6.00	36	Cir	158.43	18 18	Cir Cir	158.43 158.43
10	DWT-B2	Curb-	164.00	Rect	5.00	5.00	18	Cir	158.67			
11	DWT-B1	Curb-	164.21	Rect	5.00	5.00	18	Cir	158.63			
12	EX-B6	DropCurb	0.00	Rect	4.00	4.00	12	Cir	164.48			

MyReport

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	1.11	1.11	2	0.20	0.50	0.90	28.67	0.90	0.013	0.013	12.00	-178.344	0.90	0.90**	Outfall	0.10	707949.50	159.75	162.88	0.000
2	0.92	0.92	11	0.20	0.50	0.90	10.03	0.78	0.015	0.015	12.00	76.739	0.90	0.78**	1	0.07	707940.68	162.81	163.09	0.000
3	0.84	0.84	2	0.20	0.50	0.90	11.65	0.72	0.038	0.038	12.00	-64.611	0.78	0.72**	2	0.15	707861.71	163.06	164.00	0.000
4	0.70	0.70	3	0.20	0.50	0.90	18.31	0.63	0.008	0.008	12.00	1.039	0.72	0.63**	3	0.35	707639.05	163.96	170.87	0.000
5	0.08	0.08	Sag	0.20	0.50	0.90	29.06	0.14	0.020	0.020	16.00	27.615	0.78	0.14**	2	0.09	707944.28	162.83	163.19	0.000
6	0.28	0.28	Sag	0.20	0.50	0.90	20.95	0.32	0.020	0.020	16.00	7.989	0.90	0.32**	1	0.46	707917.31	162.61	163.34	0.000
7	2.35	6.81	n/a	0.20	0.50	0.90	0.00	0.96	....	....	....	-156.701	0.97	2.13	Outfall	0.00	708053.00	160.30	160.36	0.068
8	5.39	5.04	n/a	0.20	0.50	0.90	21.29	1.07	....	....	....	-3.685	2.14	2.01	7	0.00	707868.21	160.40	160.48	0.084
9	5.10	5.00	n/a	0.20	0.50	0.90	23.49	1.07	....	....	....	4.596	2.03	2.00	8	0.00	707831.44	160.49	160.51	0.019
10	1.77	1.77	Sag	0.20	0.50	0.90	10.51	0.71	0.045	0.045	12.00	58.665	1.50	1.50	9	0.50	707828.47	160.56	160.59	0.027
11	1.77	1.77	Sag	0.20	0.50	0.90	10.39	1.15	0.074	0.074	12.00	-63.673	1.50	1.50	9	2.36	707815.66	160.89	161.04	0.145
12	0.34	0.65	Sag	0.20	0.50	0.90	7.97	0.77	0.020	0.020	16.00	-171.240	0.45	0.77**	Outfall	1.73	707681.50	160.88	165.65	0.000

Project File: 2022-0539_Proposed Conditions_FINAL-1-31-23.stm | Number of lines: 12 | Date: 2/14/2023

NOTES: ** Critical depth

MyReport

Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	Inlet Eff (%)
5.45	0.000	0.000	....	....	....	160.27	168.02	0.11	0.007	8.52	2.00	159.37	162.50	162.50	....	....	0.10	0.78	0.11	75
4.13	0.000	0.000	....	....	....	168.02	167.23	0.20	0.003	13.58	2.00	162.50	162.78 j	162.78	162.46	162.41	0.07	0.55	0.20	69
3.58	0.000	0.000	....	....	....	167.23	167.09	0.20	0.039	5.34	2.00	162.78	163.72 j	163.72	162.82	162.76	0.14	1.18	0.20	52
2.74	0.000	0.000	....	....	....	167.09	179.03	0.12	0.026	14.44	2.00	163.72	170.63 j	170.63	164.33	164.20	0.33	2.74	0.12	27
0.15	0.000	0.000	....	....	....	167.23	167.79	0.02	Sag	1.06	....	162.78	163.14 j	163.14	162.77	162.68	0.02	0.15	0.02	100
0.76	0.000	0.000	....	....	....	168.02	165.92	0.06	Sag	3.14	....	162.50	163.22 j	163.22	162.49	162.18	0.09	0.76	0.06	100
10.78	0.179	0.339	....	....	....	163.66	166.66	....	....	....	....	159.97	160.32	160.33	....	....	0.00	0.00	....	....
11.37	0.043	0.040	....	....	....	166.66	165.05	....	....	....	....	160.33	160.40	160.41	....	....	0.00	0.00	....	....
11.49	0.047	0.046	....	....	....	165.05	163.12	....	....	....	....	160.41	160.43	160.50	....	....	0.00	0.00	....	....
3.51	0.111	0.111	....	....	....	163.12	164.00	0.21	Sag	4.70	2.00	160.50	160.53	160.59	....	....	0.43	3.51	0.21	100
8.86	0.712	0.712	....	....	....	163.12	164.21	0.41	Sag	5.58	2.00	160.50	160.65	161.04	....	....	1.42	8.86	0.41	100
3.28	0.000	0.000	....	....	....	0.00	0.00	0.17	Sag	8.35	....	160.49	165.25	165.25	....	....	0.40	3.28	0.17	100

Project File: 2022-0539_Proposed Conditions_FINAL-1-31-23.stm | Number of lines: 12 | Date: 2/14/2023

NOTES: ** Critical depth

MyReport

Inlet ID	Inlet Loc	(ft)	Inlet Time (min)	i Sys (in/hr)	i Inlet (in/hr)	Invert Dn (ft)	Invert Up (ft)	Jump Loc (ft)	Jump Len (ft)	Vel Hd Jmp Dn (ft)	Vel Hd Jmp Up (ft)	J-Loss Coeff	Junct Type	Known Q (cfs)	Cost RCP	Cost CMP	Cost PVC	
EX-B4	On Grade		5.0	7.31	8.25	158.47	161.60	....	....	0.00	0.00	1.93 z	Curb	0.00	1,652	1,486	1,404	
SWT-A1	On Grade		5.0	7.38	8.25	161.60	162.00	8.77	3.91	0.31	0.41	1.75 z	Curb	0.00	1,935	1,742	1,645	
SWT-A2	On Grade		5.0	7.54	8.25	162.00	163.00	8.13	3.61	0.28	0.43	0.50 z	Curb	0.00	3,360	3,024	2,856	
SWT-A3	On Grade		5.0	8.25	8.25	163.00	170.00	23.03	3.14	0.24	0.80	1.00 z	Curb	0.00	10,285	9,257	8,742	
YD-A4	Sag		5.0	8.25	8.25	162.00	163.00	6.53	1.36	0.01	0.28	1.00 z	Dp-Curb	0.00	640	576	544	
EX-B5	Sag		5.0	8.25	8.25	161.60	162.90	6.53	3.15	0.02	0.47	1.00 z	Dp-Curb	0.00	1,344	1,210	1,142	
MH-C0	Sag		0.0	5.86	0.00	159.00	158.19	....	....	0.00	0.00	0.15	MH	0.00	2,486	2,237	2,113	
MH-C1	Sag		0.0	6.17	0.00	158.19	158.39	....	....	0.00	0.00	0.15	MH	0.00	12,294	11,065	10,450	
MH-C2	Sag		0.0	6.24	0.00	158.38	158.43	....	....	0.00	0.00	0.91	MH	0.00	2,308	2,077	1,962	
DWT-B2	Sag		5.0	8.25	8.25	158.43	158.67	....	....	0.00	0.00	1.00	Curb	0.00	1,060	954	901	
DWT-B1	Sag		13.6	6.26	6.26	158.43	158.63	....	....	0.00	0.00	1.00	Curb	0.00	920	828	782	
EX-B6	Sag		5.0	8.25	8.25	160.04	164.48	....	....	0.00	0.00	1.00 z	Dp-Curb	0.00	2,578	2,320	2,191	

Project File: 2022-0539_Proposed Conditions_FINAL-1-31-23.stm | Number of lines: 12 | Date: 2/14/2023

NOTES: Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82 -- Return period = 25 Yrs. ; ** Critical depth

MyReport

Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)	Tc (min)
C3 - B4	41.982	18	7.46	Cir	0.0	0.013	0.013	n/a	1267322.33	0.22	0.20	0.59	0.00	18	0.95	18	0.00	0.00	0.00	8.4
B4 - A1	43.841	18	0.91	Cir	0.0	0.013	0.013	n/a	1267365.27	0.30	0.69	1.57	1.71	18	0.95	18	0.00	0.00	0.00	8.1
A1 - A2	81.310	18	1.23	Cir	0.0	0.013	0.013	n/a	1267384.64	0.64	1.51	1.67	2.01	18	0.95	18	0.00	0.00	0.00	7.5
A2 - A3	230.327	18	3.04	Cir	0.0	0.013	0.013	n/a	1267443.57	2.47	2.01	0.74	0.00	18	0.95	18	0.00	0.00	0.00	5.0
A1 - A4	13.060	18	7.66	Cir	....	....	0.013	n/a	1267377.82	2.59	0.00	0.15	0.00	18	0.20	18	0.00	0.00	0.00	5.0
B4 - B5	32.651	18	3.98	Cir	....	....	0.013	n/a	1267327.80	1.27	0.00	0.76	0.00	18	0.20	18	0.00	0.00	0.00	5.0
Pipe - (28)	37.852	48	-2.14	Cir	....	....	0.013	0.01	1267476.77	0.72	....	....	....	48	0.00	48	0.00	0.00	0.00	16.1
C0 - C1	196.180	36	0.10	Cir	....	....	0.013	0.01	1267542.62	2.03	....	....	....	36	0.00	36	0.00	0.00	0.00	14.1
C1 - C2	40.313	36	0.12	Cir	....	....	0.013	0.07	1267559.16	0.41	....	....	....	36	0.00	36	0.00	0.00	0.00	13.7
C2 - B2	23.941	18	1.00	Cir	0.0	....	0.013	0.06	1267582.91	0.20	0.00	3.51	0.00	18	0.85	18	0.00	0.00	0.00	5.0
C2 - B1	20.437	18	0.98	Cir	0.0	....	0.013	0.39	1267546.17	0.07	0.00	9.55	0.69	18	0.60	18	0.00	0.00	0.00	13.6
EX B6	88.660	12	5.01	Cir	....	....	0.013	n/a	1267455.63	0.35	0.00	3.28	0.00	12	0.23	12	0.00	0.00	0.00	5.0

Project File: 2022-0539_Proposed Conditions_FINAL-1-31-23.stm | Number of lines: 12 | Date: 2/14/2023

NOTES: ** Critical depth

MyReport

Throat Ht (in)	Total Area (ac)	Total CxA	Total Runoff (cfs)	Vel Ave (ft/s)	Vel Dn (ft/s)	Vel Hd Dn (ft)	Vel Hd Up (ft)	Vel Up (ft/s)	Cover Dn (ft)	Cover Up (ft)	Storage (cft)
5.5	1.22	0.75	5.45	4.93	4.93	0.38	0.38	4.93	0.30	4.92	46.46
5.5	0.66	0.56	4.13	4.10	3.73	0.31	0.31	4.46	4.92	3.73	44.53
5.5	0.50	0.48	3.58	4.06	3.87	0.28	0.28	4.26	3.73	2.59	71.81
5.5	0.35	0.33	2.74	3.59	3.26	0.24	0.24	3.91	2.59	7.53	177.60
4.0	0.09	0.02	0.15	0.96	0.16	0.05	0.05	1.76	3.73	3.29	6.19
4.0	0.46	0.09	0.76	1.70	0.69	0.11	0.11	2.71	4.92	1.52	22.28
....	2.86	1.84	10.78	3.08	4.58	0.33	0.04	1.58	0.66	4.47	171.45
....	2.86	1.84	11.37	2.18	2.11	0.07	0.08	2.26	5.47	3.66	1023.13
....	2.86	1.84	11.49	2.28	2.25	0.08	0.08	2.30	3.67	1.69	203.50
5.5	0.50	0.43	3.51	1.98	1.98	0.06	0.06	1.98	3.19	3.83	42.30
5.5	2.36	1.42	8.86	5.01	5.01	0.39	0.39	5.01	3.19	4.08	36.11
4.0	1.73	0.40	3.28	7.30	9.57	0.39	0.39	5.03	n/a	n/a	44.52

Project File: 2022-0539_Proposed Conditions_FINAL-1-31-23.stm | Number of lines: 12 | Date: 2/14/2023

NOTES: ** Critical depth

Appendix M

USDA Custom Soil Resource Report

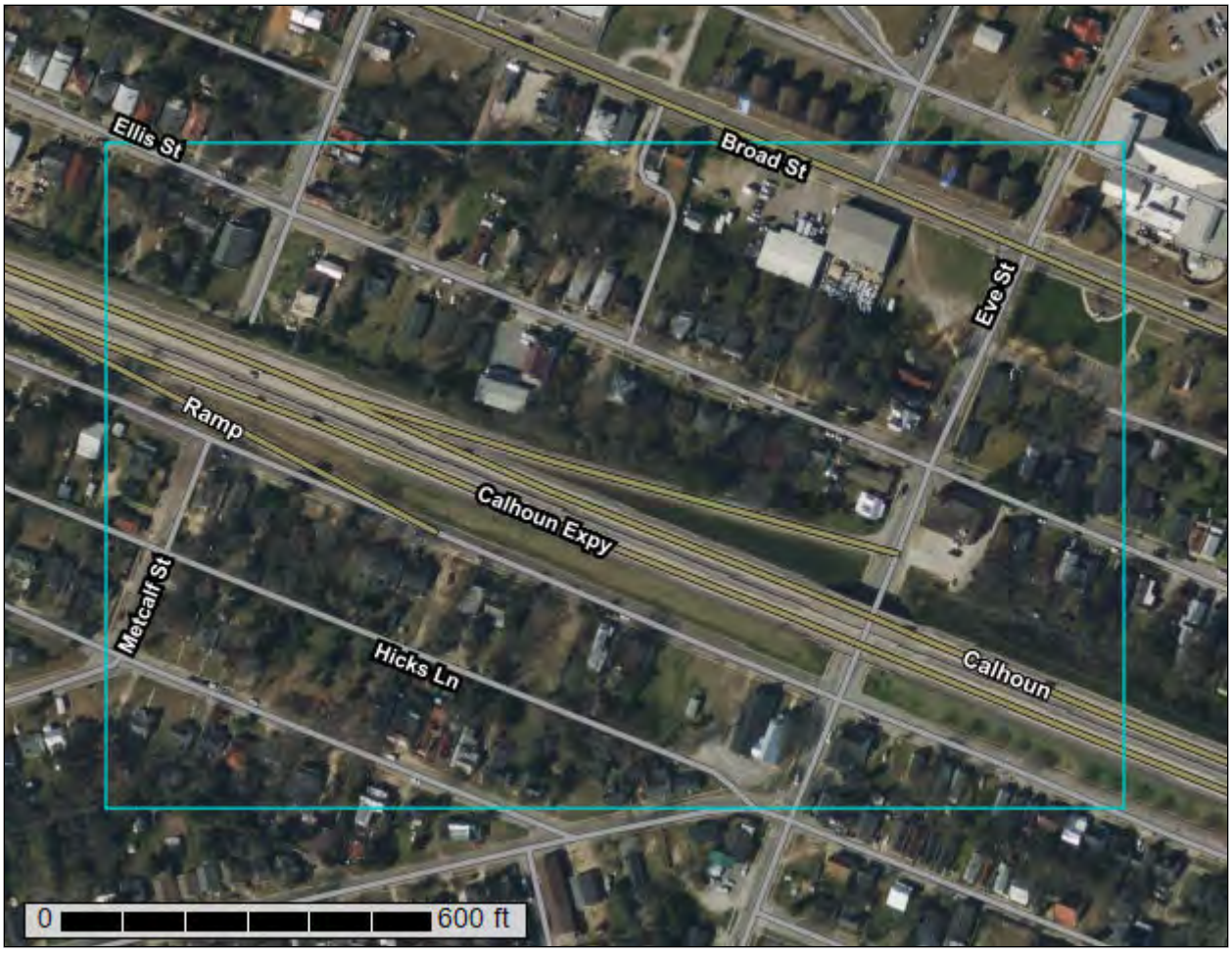
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Richmond County, Georgia



September 2, 2022

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Richmond County, Georgia
Survey Area Data: Version 15, Aug 30, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 11, 2020—Mar 12, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FuC	Fuquay-Urban land complex, 2 to 8 percent slopes	35.1	86.7%
GnA	Goldsboro-Urban land complex	2.3	5.8%
Ud	Urban land	3.1	7.6%
Totals for Area of Interest		**40.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the

development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Richmond County, Georgia

FuC—Fuquay-Urban land complex, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: bx1x
Elevation: 130 to 480 feet
Mean annual precipitation: 44 to 52 inches
Mean annual air temperature: 63 to 70 degrees F
Frost-free period: 230 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Fuquay and similar soils: 60 percent
Urban land: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fuquay

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Marine deposits

Typical profile

H1 - 0 to 30 inches: loamy sand
H2 - 30 to 35 inches: sandy loam
H3 - 35 to 65 inches: sandy clay loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Hydric soil rating: No

GnA—Goldsboro-Urban land complex

Map Unit Setting

National map unit symbol: bx22
Elevation: 40 to 450 feet
Mean annual precipitation: 44 to 52 inches
Mean annual air temperature: 63 to 70 degrees F
Frost-free period: 230 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Goldsboro and similar soils: 60 percent
Urban land: 35 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Goldsboro

Setting

Landform: Flats
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Marine deposits

Typical profile

H1 - 0 to 11 inches: sandy loam
H2 - 11 to 56 inches: sandy clay loam
H3 - 56 to 84 inches: sandy clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Rains

Percent of map unit: 5 percent
Landform: Depressions

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Ud—Urban land

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.