Stormwater Infrastructure Assessment

Prepared for:

City of Mountain Park

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ACRONYMS/DEFINITIONS

RCP	Reinforced Concrete Pipe
HDPE	High Density Polyethylene Pipe
CMP	Corrugated Metal Pipe

1. PURPOSE OF ASSESSMENT

The purpose of this report is to provide the City of Mountain Park (City) with an inventory and condition assessment of the stormwater infrastructure within the City Limits. It should be noted that the data below reflects infrastructure that was determined to be the City's responsibility by Integrated Science and Engineering. Deed research was not done in determining infrastructure ownership. A tax parcel map was used during the inventory process and only areas inside the right-of-way were inventoried.

2. LIMITS OF ASSESSMENT

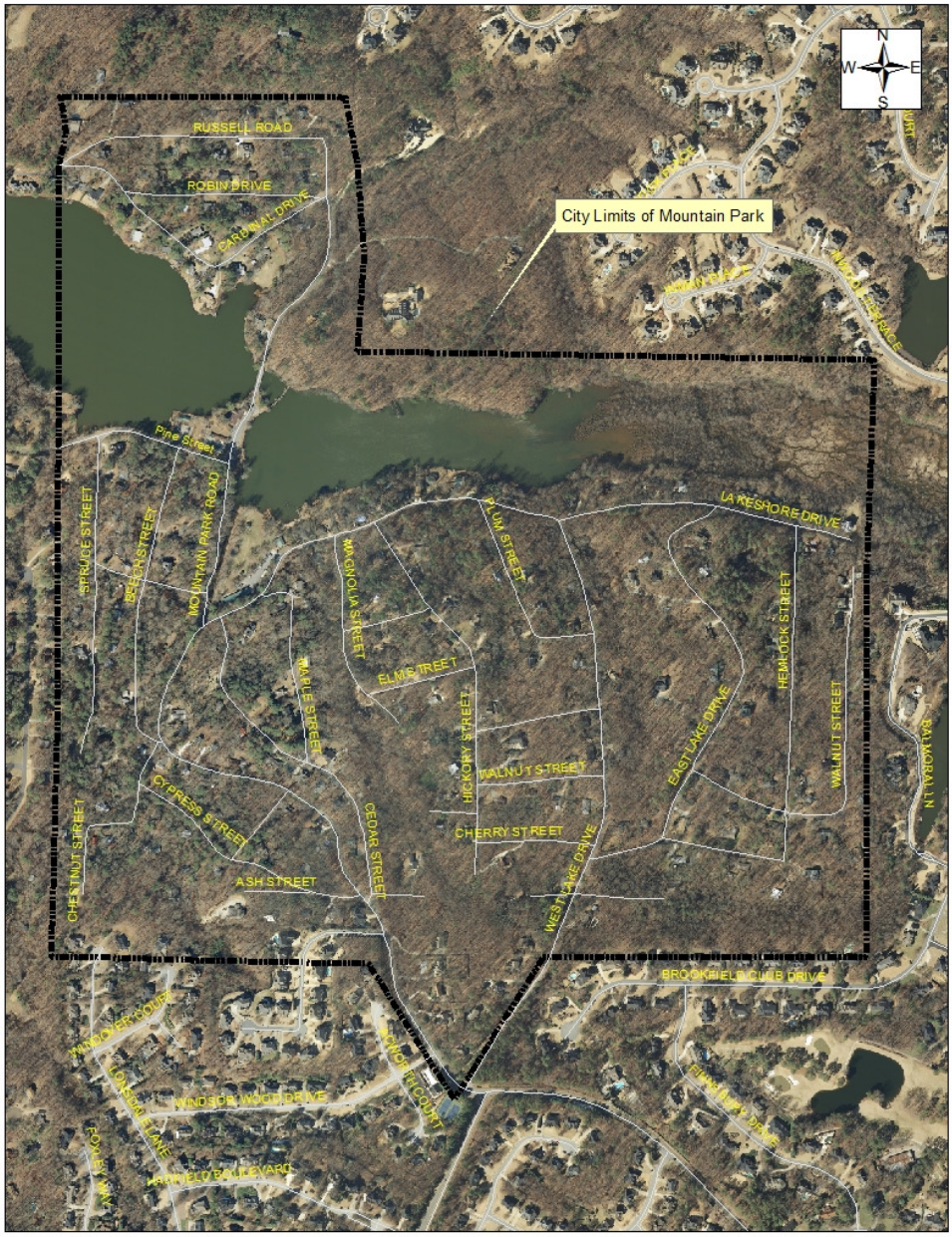

Figure 1 – Assessment Area Location Map

3. ASSESSMENT METHODS

The scope of the inventory was primarily limited to the drainage pipes and inlets / outlets of the drainage systems within the assessment area illustrated in Figure 1. The condition assessment was performed utilizing visual assessment of the infrastructure either directly (i.e. what could be seen by the field technician) or via digital photography of the infrastructure. The inventory was divided into storm drainage structures and storm drainage pipes. Each structure and pipe was evaluated for the attributes on the following pages. Please note that the pictures on the following pages are for illustrative purposes only and may not be representative of assessment area observed field conditions.

3.1. STORM DRAINAGE STRUCTURES

The following drainage structure attributes were collected for each physical structure inventoried within the assessment area.

- Structure Type
- Collection Status
- Structural Material
- Structural Damage
- Sediment Levels within the Structure
- Debris within the Structure
- Presence of Water within the Structure
- Scour In or Around the Structure

Structure Type

"Structure Type" denoted a physical description of the structure defining 10 distinct structures. The following pictures illustrate various types of drainage structures.

Catch Basin

End of Pipe

Headwall

Junction Box

Safety End Section

Collection Status

The "Collection Status" attribute describes whether the structure collects or discharges stormwater runoff. Stormwater is typically collected by catch basins, grated inlets, hooded grate inlets, pedestal inlets, etc. Headwalls, flared end sections and end of pipe structures can either collect stormwater runoff (when water flows into the pipe) or discharge stormwater runoff (when water flows out of the pipe). Junction boxes do not collect or discharge stormwater runoff but rather are used to change pipe directions, accommodate a change in pipe diameter or accommodate a change in pipe depth.

Structure Material

The "Structure Material" attribute describes what material is used to construct the drainage structure. A majority of the structures identified as part of this effort were constructed of either concrete or brick. Please note that this attribute defines the material of the structure and not necessarily the feature on top. For example, the "Structure Material" should describe the material of the "manhole" structure under the drop inlet grate or hooded grate inlet and not the metal grate itself. In the case of headwalls and flared end sections, the field describes the structure itself.

Brick Headwall

Brick Manhole

Concrete Manhole

Concrete Headwall

Structural Damage

The "Structural Damage" attribute describes the level of damage to the structure and the structure's ability to function properly or as designed. The following pictures illustrate examples of various types of structural damage.

Separated Pipe

Damaged Manhole Base

Crushed Catch Basin Top

Partially Collapsed Brick Headwall

Sediment Levels within the Structure

The "Structure Sediment" attribute describes the amount of sediment observed in the structure, stated as a percentage of the total structure capacity. Allowable entries to this attribute field include the following:

- 1% – 25% of the Structure
- 26% – 75% of the Structure
- 76% – 99% of the Structure
- Buried
- None

The following images illustrate various examples of sediment levels that can be found within drainage structures.

Brick Manhole with Approx 76% Blockage

Brick Manhole with Buried Pipes (>100%)

Headwall with Approx 26% Blockage

Concrete Manhole with no Sediment

Debris within the Structure

The "Structure Debris" attribute describes the amount of debris (leaf matter, wooded matter, trash or other material) observed in the structure that may limit the structure's ability to function properly. Allowable entries to this attribute field include the following:

- Minor
- Moderate
- Significant
- Buried
- None

The following images illustrate examples of debris that can be found within drainage structures.

Minor

Moderate

Significant

Buried

Presence of Water within the Structure

The "Water" attribute describes if water was observed within the structure at the time of the inventory. It should be noted that this attribute is particularly important for drainage systems that utilize corrugated metal pipe due to rust and corrosion potentials.

Standing Water in a Manhole

Flowing Water from a Headwall

Scour In or Around the Structure

Scour in or around a structure was noted due to the fact that long-term scour can ultimately result in failure of the structure to operate as designed and / or lead to structural collapse. The following images illustrate examples of scour that can be found around drainage structures.

Pipe Failure Due to Scouring

Scouring of Road Shoulder

3.2. STORM DRAINAGE PIPES

The following drainage structure attributes were collected for each physical structure inventoried within the assessment area.

- Pipe Type
- Pipe Material
- Sediment Upstream
- Sediment Downstream
- Corrosion Upstream
- Corrosion Downstream
- Pipe Damage

Pipe Type
The "Pipe Type" attribute is utilized to identify the various types of pipes including circular pipes, box culverts, and elliptical pipes. The following images provide examples of the various storm drain pipe types.

Circular Pipe

Elliptical Pipe

Pipe Material

The "Pipe Material" attribute is utilized to identify the various types of materials from which the pipes are constructed. The majority of the pipes within the assessment area were either Corrugated Metal Pipe (CMP) or Reinforced Concrete Pipe (RCP). The following images provide examples of each of these pipe materials.

Corrugated Metal Pipe

Reinforced Concrete Pipe

Sediment Upstream / Downstream

The "Sediment" attribute is utilized to identify the level of sediment in the pipes. The following images provide examples of the levels of sediment that can be found within storm drainage pipes.

Sediment Blocking Approx 30% of Pipe

Sediment Blocking Approx 1% of Pipe

Sediment Blocking Approx 75% of Pipe

Sediment Blocking Approx 0% of Pipe

Corrosion Upstream / Downstream

The "Corrosion" attribute is utilized to identify the level of corrosion in the pipes. Please note that this field typically only applies to Corrugated Metal Pipes. The following images provide examples of varying levels of corrosion that can be found within storm drainage pipes.

No Corrosion

Minor Corrosion

Moderate Corrosion

Severe Corrosion

Pipe Damage

The "Pipe Damage" attribute is utilized to identify any unique damage to the pipe. The following images provide examples of pipe damage.

Pipe Invert Missing

Pipe Damaged

Pipe Joint Separation

Pipe Deformed

4. STORMWATER INFRASTRUCTURE INVENTORY

The following stormwater drainage infrastructure was identified during the assessment:

Structure Summary

Structure Type	Total	Driveway Structure	Non-Driveway Structure
Catch Basin	1	0	1
End of Pipe	370	256	114
Headwall	11	6	5
Junction Box	2	0	2
Safety End Section	4	4	0
Total	**388**	**266**	**122**

Pipe Material Summary (Driveway Pipe)

Pipe Material	Length	% of Total
Reinforced Concrete Pipe (RCP)	336 ft	10.77%
Corrugated Metal Pipe (CMP)	2,315 ft	74.20%
High-Density Polyethylene (HDPE)	125 ft	4.00%
Polyvinyl Chloride (PVC)	32 ft	1.03%
Other	292 ft	9.36%
Unknown Material	20 ft	0.64%
Total	**3,120 ft**	**100.00%**

Pipe Material Summary (Non-Driveway Pipe)

Pipe Material	Length	% of Total
Reinforced Concrete Pipe (RCP)	1,487 ft	57.19%
Corrugated Metal Pipe (CMP)	746 ft	28.69%
High-Density Polyethylene (HDPE)	43 ft	1.65%
Other	281 ft	10.81%
Unknown Material	43 ft	1.66%
Total	**2,600 ft**	**100.00%**

Pipe Type Summary (Driveway Pipe)

Pipe Type	Length	% of Total
Circular Pipe	3,095 ft	99.00%
Elliptical Pipe	25 ft	1.00%
Total	**3,120 ft**	**100.00%**

Pipe Type Summary (Non-Driveway Pipe)

Pipe Type	Length	% of Total
Circular Pipe	2,472 ft	95.00%
Elliptical Pipe	128 ft	5.00%
Total	**2,600 ft**	**100.00%**

Pipe Size Summary (Driveway Pipe)

Pipe Diameter	Length	% of Total
10-inch Pipe	105 ft	3.37%
12-inch Pipe	463 ft	14.84%
15-inch Pipe	1,652 ft	52.95%
18-inch Pipe	492 ft	15.77%
24-inch Pipe	102 ft	3.27%
18-inch x 30-inch Elliptical Pipe	26 ft	0.83%
Unknown Size	280 ft	8.97%
Total	**3,120 ft**	**100.00%**

Pipe Size Summary (Non-Driveway Pipe)

Pipe Diameter	Length	% of Total
12-inch Pipe	43 ft	1.65%
15-inch Pipe	745 ft	28.65%
18-inch Pipe	502 ft	19.31%
24-inch Pipe	389 ft	14.96%
30-inch Pipe	44 ft	1.69%
36-inch Pipe	197 ft	7.58%
42-inch Pipe	282 ft	10.85%
48-inch Pipe	35 ft	1.35%
36-inch x 54-inch Elliptical Pipe	128 ft	4.92%
Unknown Size	235 ft	9.04%
Total	**2,600 ft**	**100.00%**

5. STORMWATER INFRASTRUCTURE ASSESSMENT

5.1. STORM DRAINAGE STRUCTURES

As discussed earlier, drainage structures (catch basins, grated inlets, headwalls, junction boxes, etc.) were assessed for structural damage, sedimentation, debris, scour and the presence of flowing or standing water. The following tables outline the results of our investigation.

Structural Damage

Damage	Driveway Structures	Non-Driveway Structures
Minor	30	4
Moderate	9	4
Severe	1	4
Safety Hazard	0	1
Total	**40**	**13**

Sedimentation

Sedimentation	Driveway Structures	Non-Driveway Structures
1% to 25% of Pipe Diameter / Structure Capacity	71	39
26% to 75% of Pipe Diameter / Structure Capacity	30	7
76% to 99% of Pipe Diameter / Structure Capacity	60	27
Buried	8	4
Total	**169**	**77**

Debris

Debris	Driveway Structures	Non-Driveway Structures
Minor	33	21
Moderate	23	13
Significant	29	10
Buried	9	2
Total	**94**	**46**

Scour

Scour	Driveway Structures	Non-Driveway Structures
Minor	2	4
Moderate	1	8
Severe	1	7
Total	**4**	**19**

Presence of Water

Water	Driveway Structures	Non-Driveway Structures
Standing Water in the Structure	0	1
Flowing Water in the Structure	0	16
Submerged / Inundated	0	1
Total	**0**	**18**

5.2. STORM DRAINAGE PIPES

As discussed earlier, drainage pipes were assessed primarily for corrosion and sedimentation. The following tables outline the results of our investigation.

Corrosion

Corrosion	Driveway Pipes	Non-Driveway Pipes
Minor Corrosion		
Noted on Upstream Invert	48	3
Noted on Downstream Invert	46	5
Noted On Both Inverts	43	3
Moderate Corrosion		
Noted on Upstream Invert	23	3
Noted on Downstream Invert	17	3
Noted On Both Inverts	14	3
Severe Corrosion		
Noted on Upstream Invert	1	4
Noted on Downstream Invert	0	6
Noted On Both Inverts	0	4

It should be noted that based on our investigation approximately 156 feet of non-driveway pipe was noted as having severe corrosion on both the upstream and downstream inverts of the pipe. Additionally, 96 feet of non-driveway pipe was noted as having moderate corrosion on both the upstream and downstream inverts of the pipe.

Sedimentation

Sedimentation	Driveway Pipes	Non-Driveway Pipes
1% to 25% of the Pipe Diameter		
Noted on Upstream Invert	33	18
Noted on Downstream Invert	20	18
Noted On Both Inverts	10	8
26% to 75% of the Pipe Diameter		
Noted on Upstream Invert	9	2
Noted on Downstream Invert	17	7
Noted On Both Inverts	3	1
76% to 99% of the Pipe Diameter		
Noted on Upstream Invert	13	12
Noted on Downstream Invert	45	15
Noted On Both Inverts	9	7
Buried		
Noted on Upstream Invert	1	3
Noted on Downstream Invert	6	1
Noted On Both Inverts	0	1

6. AREAS OF CONCERN

6.1. MAJOR DRAINAGE SYSTEMS

A major drainage system for the purposes of this report is identified as having a pipe diameter of at least 36-inches or greater and lie beneath a roadway surface. The primary concern with this systems is the fact that failure of the systems will potentially cause flooding upstream of the roadway and the roadway may become impassable due to a collapse of the roadway. ISE has identified at least 6 systems which could be classified as a major drainage system. Figure 2 below illustrates the locations of the systems described here.

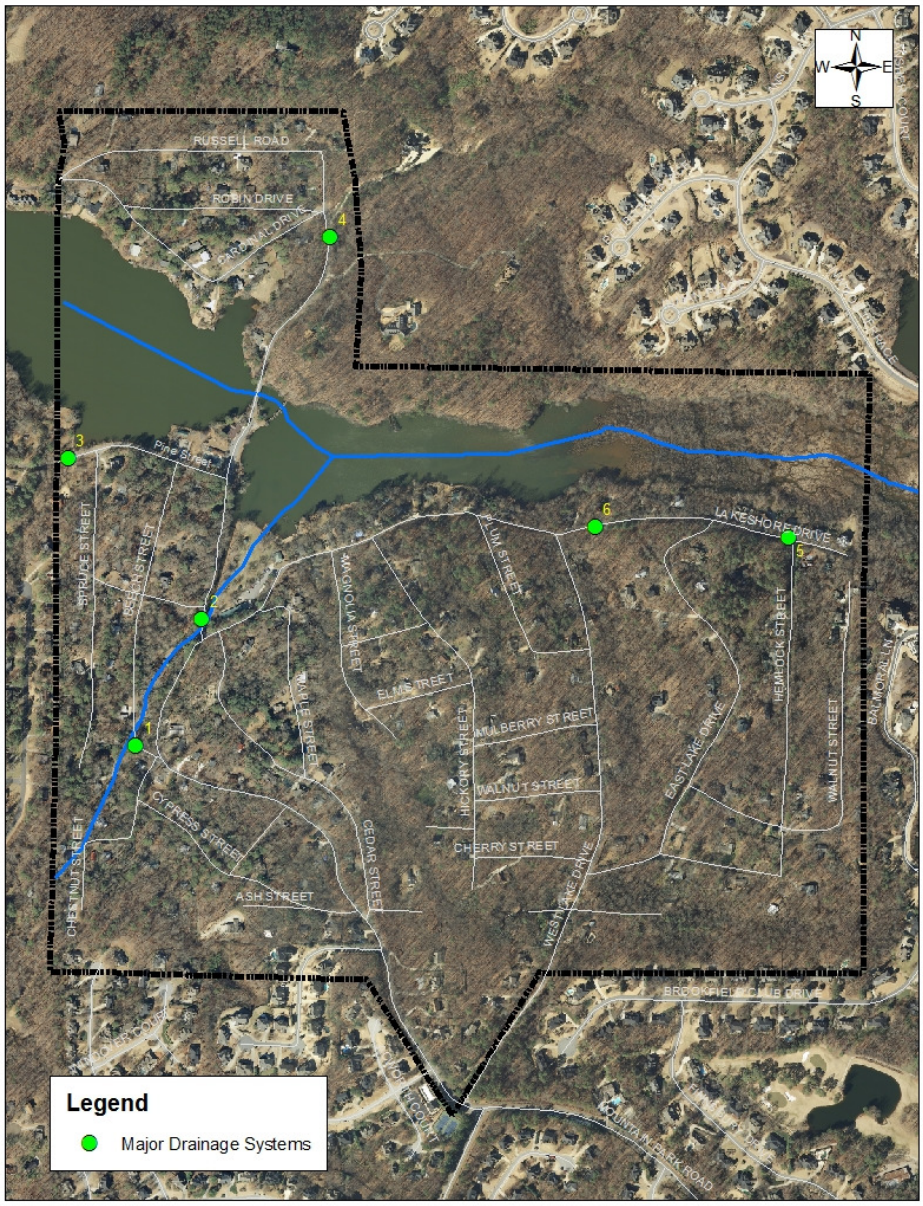

Figure 2 – Major Systems Location Map

Major Drainage System #1
This drainage system consists of a double 36-inch high by 54-inch CMP elliptical pipe system conveying stormwater runoff under Beech Street approximately 120 feet west of the intersection of Beech Street with Mountain Park Road. The condition assessment of the corrosion of the pipe inverts was noted as severe.

Major Drainage System #2
This drainage system consists of a triple 42-inch CMP pipe system conveying stormwater runoff under Mountain Park Road approximately 80 feet north of the intersection of Mountain Park Road with Lakeshore Drive. The condition assessment of the corrosion of the pipe inverts was noted as none.

Major Drainage System #3
This drainage system consists of a single 36-inch high by 54-inch CMP elliptical pipe system conveying stormwater runoff under Pine Street approximately 150 feet west of the intersection of Pine Street with Spruce Street. The condition assessment of the corrosion of the pipe inverts was noted as moderate.

Major Drainage System #4
This drainage system consists of a double 36-inch CMP/RCP pipe system conveying stormwater runoff under Russell Road approximately 140 feet south of the intersection of Russell Road with Cardinal Drive. The condition assessment of the corrosion of the pipe invert on the upstream end of pipe 51 was severe. A condition assessment of pipe 52 could not be determined due to a significant amount of sediment and debris blocking the inlet. Both pipes were RCP on the downstream end. Moderate scouring was also present on the downstream end.

Major Drainage System #5
This drainage system consists of a single 42-inch RCP pipe system conveying stormwater runoff under Lakeshore Drive approximately 350 feet east of the intersection of Lakeshore Drive with East Lake Drive. The condition assessment of the pipe indicated minor sedimentation and moderate debris present.

Major Drainage System #6
This drainage system consists of a single 48-inch CMP pipe system conveying stormwater runoff under Lakeshore Drive approximately 190 feet east of the intersection of Lakeshore Drive with West Lake Drive. The condition assessment of the corrosion of the pipe invert indicated severe corrosion on the downstream end along with severe scouring at the outlet. The field inspector noted that the "entire bottom was missing" in the field notes. It should be noted that the upstream end of this pipe is RCP. It could not be determined at what point the RCP changed to CMP.

6.2. SIGNIFICANT NEAR TERM REPAIRS

As noted earlier, ISE has identified several drainage systems that have exceeded their anticipated service life and will likely result in failure of the pipes in the near future (less than 10 years). These systems include:

- Major Drainage System #1 on Beech Street
- Major Drainage System #4 on Russell Road
- Major Drainage System #6 on Lakeshore Drive

6.3. OTHER CONCERNS

6.3.1. Safety Hazards

Safety Hazard #1
A junction box was discovered with no top on Spruce Street approximately 800 feet south of the intersection of Spruce Street and Poplar Street.

Safety Hazard #2
A portion of the downstream end of an 18" RCP pipe system located on Mulberry Street has fallen off. The pipe system is located approximately 190 feet east of the intersection of Mulberry Street and Hickory Street.

6.3.2. Rehabilitation Concerns

Finally, as part of our analysis of the data, we have evaluated the pipe alignments and aerial photography to determine if any structures are potentially in the influence zone of the pipe systems. For the purposes of this discussion, the influence zone was identified as an area of land within 25-feet (measured horizontally along the ground) of the pipe alignment. Our primary concerns are that if the pipe collapses then the foundation of the structure could be affected or that open trench rehabilitation of the pipe in the future could impact the structure. As a result of our analysis, we have estimated that approximately 2 structures lie within this influence zone. The structures have been identified on the following maps.

BEECH STREET
MOUNTAIN PARK ROAD
CHESTNUT STREET
N
W
E
S
194
192
193
197
195
196
Legend
STORM STRUCTURES
STRUCTURE TYPE
CATCH BASIN
END OF PIPE
HEADWALL
JUNCTION BOX
PIPE DIRECTION
SAFETY END SECTION
STORM PIPES
DITCHES

N
W
E
S
294
293
292
295
296
152
LAKESHORE DRIVE
HEMLOCK STREET
Legend
STORM STRUCTURES
STRUCTURE TYPE
CATCH BASIN
END OF PIPE
HEADWALL
JUNCTION BOX
PIPE DIRECTION
SAFETY END SECTION
STORM PIPES
DITCHES