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Tab 3. Post-Development Hydrologic Analysis:

A.-B. The developed site stormwater conveyance system will consist of a combination of overland flow and flow through an enclosed system of inlets and below-grade storm sewer piping. The site will be divided into two localized drainage basins with a majority of the flows being directed to detention/retention ponds within the respective basins. A small portion of the outer fringe along the south boundary of the property will flow off-site, un-detained. The off-site runoff that enters the property from the east and north has been included in the drainage areas and accounts for approximately 13.0 acres of the 58.3 acres that drain across the site. The rational method was utilized to determine the runoff rates and size the stormwater conveyance systems and detention. A summary of the drainage basins and conveyance systems for the 10-year storm event is provided in the tables below. The drainage areas and inlet numbers correspond to sheet C0.2 – Drainage Plan-Proposed Areas in Appendix C. Additional calculations for time of concentration are included in Appendix C.

Table III-1. Proposed Hydrologic Data Summary – West Drainage Basin

Drainage Area	Inlet No.	Area (Acres)	Runoff Coefficient (10-Yr)	Time of Concentration (10-Yr)	Rainfall Intensity (10-Yr)	10-Yr Runoff, Cfs
1	7	1.82	0.50	24.8	4.13	3.8
2	6	2.54	0.50	19.7	4.60	5.8
3	8	4.49	0.50	13.7	5.37	12.1
4	5	1.52	0.60	11.0	5.89	5.4
5	4	1.22	0.60	9.5	6.31	4.6
6	3	1.52	0.60	8.9	6.31	5.8
7	2	0.77	0.60	9.0	6.31	2.9
8	1	1.04	0.90	5.0	7.41	6.9
9	16	0.55	0.60	10.2	6.09	2.0
10	15	0.65	0.60	5.0	7.41	2.9
11	14	0.22	0.60	5.0	7.41	1.0
12	13	0.51	0.90	5.0	7.41	3.4
13	12	1.25	0.90	5.0	7.41	8.3
14	17	0.28	0.90	5.0	7.41	1.9
15	11	2.49	0.90	5.0	7.41	16.6
16	10	1.15	0.90	5.0	7.41	7.7
17	9	1.33	0.90	5.0	7.41	8.9
18	NA	5.18	0.50	15.7	5.08	13.2

Table III-2. Proposed Hydrologic Data Summary – East Drainage Basin

Drainage Area	Inlet No.	Area (Acres)	Runoff Coefficient (10-Yr)	Time of Concentration (10-Yr)	Rainfall Intensity (10-Yr)	10-Yr Runoff, Cfs
20	6	2.60	0.60	14.0	5.53	8.6
21	5	3.44	0.60	18.0	4.83	10.0
22	3	1.32	0.90	5.0	7.41	8.7
23	4	0.31	0.90	5.0	7.41	2.0
24	2	1.03	0.90	5.0	7.41	6.8
25	NA	2.13	0.50	14.2	5.37	5.7
26	NA	10.65	0.50	18.4	4.83	25.7

Table III-3. Proposed Hydrologic Data Summary – Un-Detained Runoff

Drainage Area	Inlet No.	Area (Acres)	Runoff Coefficient (10-Yr)	Time of Concentration (10-Yr)	Rainfall Intensity (10-Yr)	10-Yr Runoff, Cfs
19	7	7.75	0.26	63.0	2.37	4.8
27	6	1.25	0.30	5.0	7.41	2.8
28	8	0.30	0.24	5.0	7.41	0.5

The runoff from the overflow of Cruiser Lake to the north of the site currently flows through an 8.5' diameter metal culvert across 29th St. N and daylights into the north-south tributary to the East Fork of Chisholm Creek. The current plan includes the enclosure of the open channel tributary. The planned structure for the enclosure is an 8'x8' reinforced concrete box that will start on the north side of 29th St. N and daylight near the existing connection with the East Fork of Chisholm Creek. The RCB will attach to the 8.5' dia. metal pipe to the south of the railroad property. In comparing the open areas, the 8.5' dia. metal pipe has an open area of 56.75 square feet while the 8'x8' RCB has an open area of 64 sq. ft. which increases the open area slightly. An energy dissipater will need to be included in the final design due to the high velocities. The calculated flows, velocities and headwater depths are summarized below. Full calculations are included in Appendix F.

Table III-4. Hydrologic Data Summary – Cruiser Lake Watershed

Storm Event (yr)	Total Runoff (cfs)	Discharge, structure (cfs)	Velocity, Outlet (fps)	Top of Embankment Elev (ft)	Flow over embankment (cfs)	Headwater Elev. (ft)
2	401	401	14.73	1326.00	0.00	1317.35
5	790	790	17.84	1326.00	0.00	1323.11
10	1014	937	18.33	1326.00	76	1326.21
25	1318	953	18.98	1326.00	365	1326.53
100	1924	974	19.74	1326.00	950	1327.08
Ovrtp	928	928	18.9	1326.00	0	1326.00

As seen in table III-4, the embankment is overtopped during a storm slightly less than the 10-year frequency. The excess flows should follow the graded swales along the railroad to the west. Should the excess flow onto the subject property, it will flow within the street and/or overland to the detention ponds and discharge into the East Fork of Chisholm Creek. Should the overflow exceed the detention pond capacity, the flow will overtop the embankments and enter the East Fork of Chisholm Creek as the top elevations are 1322 for the east pond and 1318 for the west pond. Current finished floor elevations of the buildings are 1325.00 for the Field Maintenance Shop, 1325.00 for the Readiness Center and 1324.00 for the City building. All three elevations are at least 3' above the top of embankment for the creek.

C. N/A

D. The proposed contours for the detention pond facilities are shown on sheet C0.2 – Drainage Plan-Proposed Areas in Appendix C.

E.-F. There are two detention facilities planned for this development with one serving the west half of the site (approx.) and the other serving the east. The detention facilities will be sized to convey an equal to or lesser amount of discharge for all applicable storm events (2, 5, 10, 25 and 100 year events) into the East Fork of Chisholm Creek. The current proposed detention facilities are as follows:

<u>West Detention Pond:</u>

The west detention pond is a proposed detention/retention open pond with a detention outfall structure constructed along the south face of the pond. The detention structure is connected to the East Fork of Chisholm Creek with a 36" diameter reinforced concrete pipe daylighting in the north creek embankment (a riprap blanket would be constructed around the outfall to minimize erosion and provide energy dissipation). The proposed detention outfall structure for the west detention pond is a combination of a 4' diameter standpipe and 15" orifice system. The orifice will control the discharge of

smaller flow events while the standpipe combines with the orifice to control the larger flows. The circular orifice shall be cast into the side of the standpipe. Additionally, the orifice is set at an elevation such that there is some ponding created within the detention area to promote groundwater recharge and environmentally friendly design.

The 36" outfall pipe daylighting to the creek was sized to release flow under a submerged condition since the floodwater elevations within the creek generated from a larger storm event will exceed the flowline and top of pipe elevations. From the FEMA FIRM Map (see Appendix F) it was determined that the 100-year flood elevation within the creek is approximately 1314.00'. The planned outfall elevation of the 36" pipe is 1305.39'. A typical section of the detention outfall structure is shown on the next page.

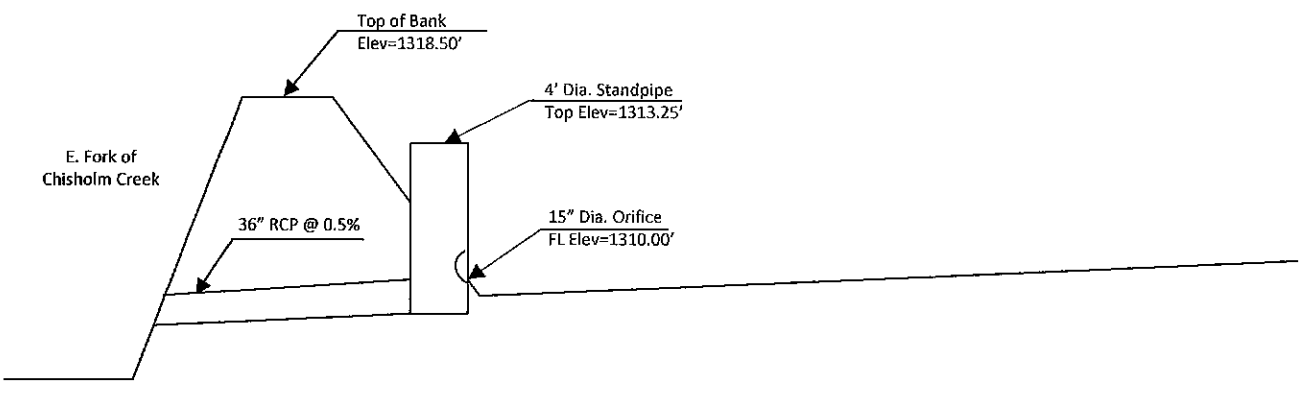
The rate of discharge allowed through the structure was determined by subtracting the un-detained flow (flows directly into the creek) from the flow generated by the undeveloped area for each applicable storm event.

A summary of the west detention outfall structure is presented below and the supporting calculations are included in Appendix D.

Allowable Discharge (Q_{rel}):
Q_2 = 14.3 cfs-4.0 cfs = 10.3 cfs
Q_5 = 20.9 cfs-5.7 cfs = 15.2 cfs
Q_{10} = 32.7 cfs-8.6 cfs = 24.1 cfs
Q_{25} = 41.6 cfs-10.8 cfs = 30.8 cfs
Q_{100} = 73.8 cfs-18.9 cfs = 54.9 cfs

Calculated Discharge through Detention Outfall Structure:
Q_2 = 9.6 cfs
Q_5 = 12.3 cfs
Q_{10} = 14.9 cfs
Q_{25} = 29.0 cfs
Q_{100} = 49.6 cfs

Discharge Allowed Through 36" RCP during 100-Year Storm Event (tailwater condition)
Q = 50.71 cfs (which is greater than Q_{100} discharged from the detention structure)



Typical Section – West Detention Outfall Structure

East Detention Pond:

The east detention pond is very similar to the west detention pond. It is also a proposed detention/retention open pond with a detention outfall structure constructed along the south face of the pond. The detention structure is connected to the East Fork of Chisholm Creek with a 30" diameter reinforced concrete pipe daylighting in the north creek embankment (a riprap blanket would be constructed around the outfall to minimize erosion and provide energy dissipation). The proposed detention outfall structure for the west detention pond is a combination of a 36" diameter standpipe and 11" orifice system. The orifice will control the discharge of smaller flow events while the standpipe combines with the orifice to control the larger flows. The circular orifice shall be cast into the side of the standpipe. Additionally, the orifice is set at an elevation such that there is some ponding created within the detention area to promote groundwater recharge and environmentally friendly design.

The 30" outfall pipe daylighting to the creek was sized to release flow under a submerged condition since the floodwater elevations within the creek generated from a larger storm event will exceed the flowline and top of pipe elevations. From the FEMA FIRM Map (see Appendix G) it was determined that the 100-year flood elevation within the creek is approximately 1318.20'. The planned outfall elevation of the 30" pipe is 1312.75'. A typical section of the proposed outfall structure is shown on the next page.

The rate of discharge allowed through the structure was determined by subtracting the un-detained flow (flows directly into the creek) from the flow generated by the undeveloped area for each applicable storm event.

A summary of the east detention outfall structure is presented below and the supporting calculations are included in Appendix E.

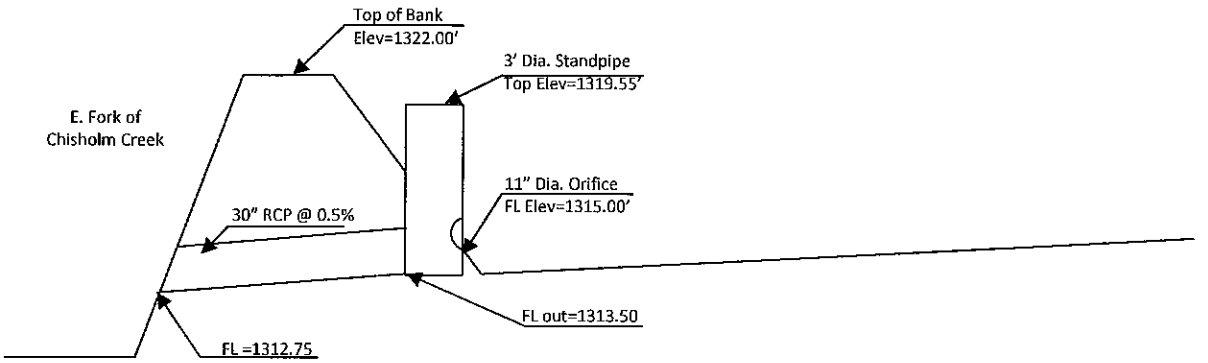
Allowable Discharge (Q_{rel}):
Q_2 = 7.1 cfs-1.3 cfs = 5.8 cfs
Q_5 = 10.4 cfs-1.6 cfs = 8.8 cfs
Q_{10} = 14.9 cfs-1.8 cfs = 13.1 cfs
Q_{25} = 18.6 cfs-2.3 cfs = 16.3 cfs
Q_{100} = 33.9 cfs-3.2 cfs = 30.7 cfs

Calculated Discharge through Detention Outfall Structure:

Q_2 = 5.6 cfs
Q_5 = 6.4 cfs
Q_{10} = 6.6 cfs
Q_{25} = 15.3 cfs
Q_{100} = 30.2 cfs

Discharge Allowed Through 36" RCP during 100-Year Storm Event (tailwater condition)

Q = 36.7 cfs (which is greater than Q_{100} discharged from the detention structure. The detention structure should control the rate)



Typical Section – East Detention Outfall Structure

G. With the proposed stormwater detention/retention facilities, there should be no negative impact on the East Fork of Chisholm Creek. All release rates are calculated to be equal to or less than the pre-development condition.

H. The proposed enclosed pipe invert elevations can be found in the Hydraflow analysis for the west and east storm sewers included in Appendix D and E respectively.

I. The design water surface elevations for the detention ponds are as follows:

West Detention Pond
2-Year Storm Event = 1312.70'
5-Year Storm Event = 1313.19'
10-Year Storm Event = 1313.42'
25-Year Storm Event = 1313.82'
100-Year Storm Event = 1314.25'

East Detention Pond
2-Year Storm Event = 1318.18'
5-Year Storm Event = 1319.06'
10-Year Storm Event = 1319.28'

25-Year Storm Event = 1319.93'
100-Year Storm Event = 1320.48'

J. Typical Details are included in Section E.-F of this report.

K. Proposed Limits of Clearing and grading can be seen on sheet C0.2 - Drainage Plan– Proposed Areas in Appendix C.

L. The existing roads and impervious area can be seen on sheet C0.1 – Drainage Plan-Existing Areas in Appendix B.

M. The existing utilities and proposed utilities can be seen on sheets C2.0 – Utility Plan-Readiness Center and C2.0 – Utility Plan-FMS in Appendix H.

N. The proposed conveyance systems can be seen on sheet C0. 2 – Drainage Plan-Proposed Areas in Appendix C.

O. The proposed 8'x8' RCB enclosure of the north-south tributary to E. Fork of Chisholm Creek can be seen on sheet C0.2-Drainage Plan-Proposed Areas in Appendix C.

P. Noted Above

Q. Emergency overflow from both detention ponds will flow over the bank and into the East Fork of Chisholm Creek.

R. The top of the west Detention Facility embankment is 1318.00. The top water surface elevation from the 100-year storm event is 1314.25' or 3.75' below the top of bank. The top of the east Detention Facility embankment is 1322.00. The top water surface elevation from the 100-year storm event is 1320.48' or 1.52' below the top of bank.

Tab 4. Floodplain Submittal

The Heartland Preparedness Center site does not lie within a floodplain as it is currently protected by levees. See the FEMA FIRM maps in Appendix F.

Tab 5. Federal, State and Local Permits

All applicable permitting will be submitted through the appropriate governmental agencies prior to construction.