



Looking NE upstream from 57th Avenue NE

NORTH WASHINGTON STREET WATERSHED STORM WATER MANAGEMENT PLAN



**A Storm Water Runoff Evaluation
City of Bismarck, North Dakota**

March 2004



**Swenson, Hagen & Co.
909 Basin Avenue
P.O. Box 1135
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In Association With:



**Houston Engineering, Inc.
304 East Rosser Avenue, Suite 220
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March 31, 2004

Mel J. Bullinger, P.E.
Bismarck City Engineer
221 North Fifth Street
P.O. Box 5503
Bismarck, ND 58506-5503

**RE: NORTH WASHINGTON STREET WATERSHED
STORM WATER MANAGEMENT PLAN - HEI NO. 4242-006**

Dear Mel:

Enclosed are six copies of the final North Washington Street Watershed Management Plan. We have reviewed and incorporated the City's comments on the draft report into this final document. These included text revisions and additions as well as modifications to the figures, as applicable.

Probably the most notable question on the draft report was related to the size of the detention facilities and stream crossings. Since the passage of HB1148, which increased the detention storage trigger for the State Engineer's jurisdiction to 25 acre-feet, there are no crossings within the master plan that require permitting. This does not mean, however, that upon final design that verification is not required. In addition, while sizing the trunk line facilities to control larger flood events it is very important to recognize local storm water controls are still necessary. These local systems and storm sewers will reduce or prevent local flooding, however the risk for erosion damage at each outfall into the greenway remains an issue. The stability and capacity of the greenway channel is also a long term maintenance issue when considering future erosion risks and sedimentation.

An original copy of this report was also provided to Keith Demke and Lisa Ansley for their files. If you have specific questions regarding the final report, please give me a call.

Sincerely,



Michael H. Gunsch, P.E.
Project Manager

C: Keith Demke, Director of Public Utilities
Lisa Ansley, City Engineering
Jason Petryszyn, Swenson, Hagen & Co.

***North Washington Street Watershed
Storm Water Management Plan***

CERTIFICATION

As Registered Professional Engineers under the laws of the State of North Dakota, we hereby certify this storm water runoff evaluation for the North Washington Street Watershed located in Burleigh County, North Dakota was prepared by us or under our direct supervision.



A circular professional engineer seal for Michael H. Gunsch, Registered Professional Engineer, ND Registration Number 3052. The seal is stamped over a handwritten signature. Below the seal, the text reads: Michael H. Gunsch, P.E., Project Manager, Hydrologist, Houston Engineering, Inc., ND Registration Number 3052.

Michael H. Gunsch, P.E.
Project Manager, Hydrologist
Houston Engineering, Inc.
ND Registration Number 3052

Date: 3/31/2004



A circular professional engineer seal for Sherwin Wanner, Registered Professional Engineer, ND Registration Number 4230. The seal is stamped over a handwritten signature. Below the seal, the text reads: Sherwin Wanner, P.E., Project Engineer, Houston Engineering, Inc., ND Registration Number 4230.

Sherwin Wanner, P.E.
Project Engineer
Houston Engineering, Inc.
ND Registration Number 4230

Date: 3/31/2004

NORTH WASHINGTON STREET WATERSHED
A Storm Water Runoff Evaluation
City of Bismarck, North Dakota

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- Appendix A** - North Washington Street Watershed Site Photos
- Appendix B** - HB 1148 (Amendment to 25 acre-feet storage limit for construction permits)
- Appendix C** - State Engineer and NDDOT Stream Crossing Design Standards

NORTH WASHINGTON STREET WATERSHED

A Storm Water Runoff Evaluation

City of Bismarck, North Dakota

1.0 INTRODUCTION

In accordance with a January 2002 Engineering Services Agreement (ESA), the following storm water runoff evaluation and concept level watershed master plan report was completed for the North Washington Street Watershed. Swenson, Hagen & Co. in association with Houston Engineering, Inc. was requested by the City of Bismarck (City) to complete a watershed evaluation and develop a master plan for future primary trunk line storm water facilities to convey runoff from Hay Creek Watersheds HC3-8, HC3-9, and HC3-10, and part of HC3-11 to Hay Creek.

The North Washington Street Watershed is located north of Bismarck and discharges into Hay Creek in the middle of Section 15, Township 139 North, Range 80 West. The total drainage area is approximately 1,950 acres or 3.04 square miles. As part of the analysis the primary watersheds were further subdivided as illustrated on **Figure 1.0**. North Washington Street and Highway #83 cross through the watershed north to south, while 43rd Avenue is located along the southern border and 57th Avenue crosses through the watershed east to west. Some areas along Highway #83 contain light commercial development, while scattered rural residential developments are located to the northwest. The remaining lands are mostly undeveloped and used for pasture, hay land or in some cases small grains.

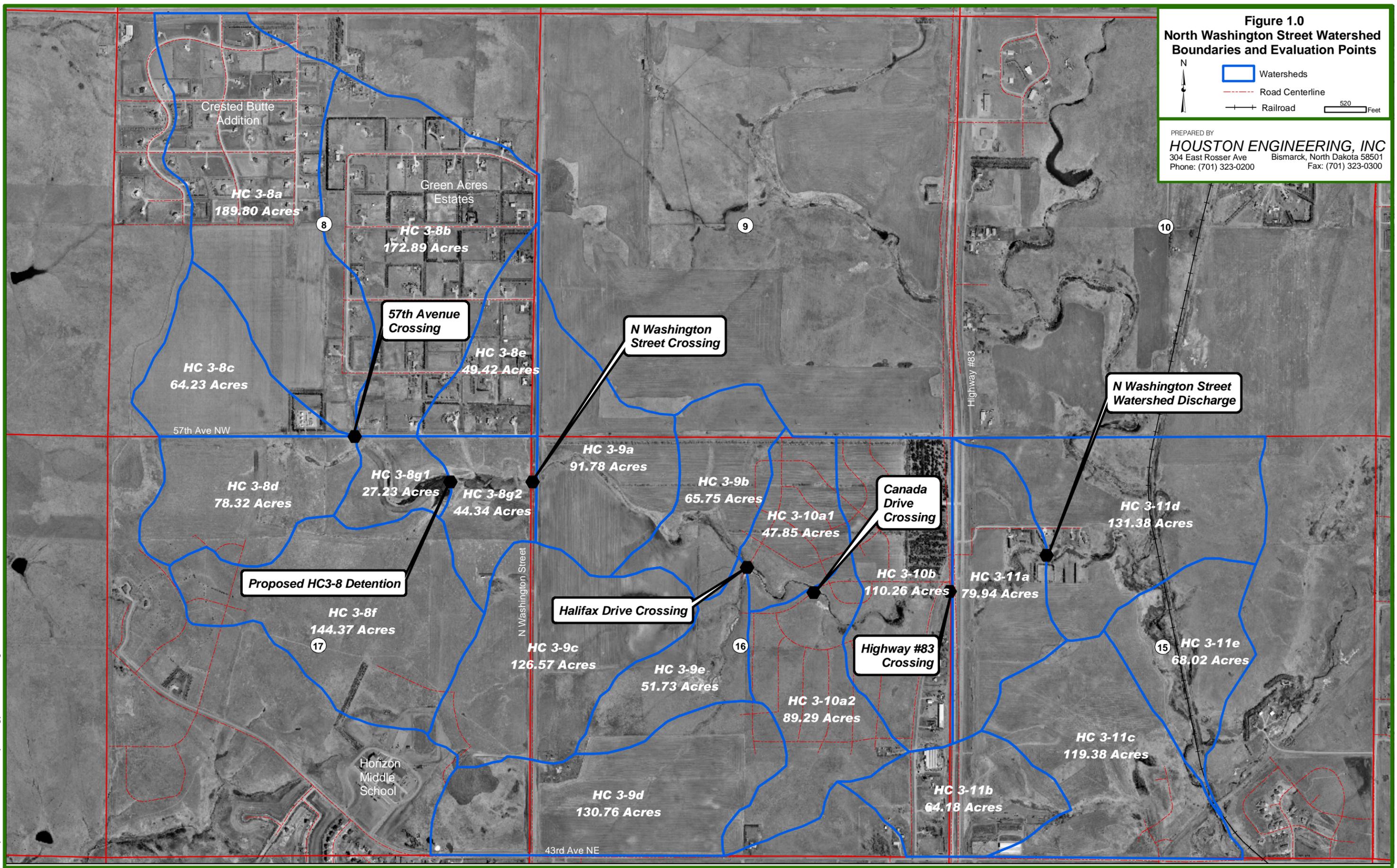
The principal master plan objective is to limit and/or prevent undesirable impacts due to increased runoff generated by future rural and/or urban development. The master plan hydrology will also provide useful information for planning future subdivisions and land uses. The scope of this report is generally defined by the following tasks:

- Prepare a land use map for projected future development (i.e., anticipated zoning) within the watershed.
- Identify the projected principal arterial streets and major trunk line storm water control facilities.
- Revise, update and refine the 1994 HEC-1 Hay Creek hydrology models to reflect and incorporate existing and proposed master plan conditions.
- Provide recommendations to improve the primary storm water conveyance features to minimize and/or prevent undesirable impacts due to increased runoff associated with future development.
- Provided recommendations related to the creation of preliminary Development Control Lines (DCL) (i.e., greenway) along the primary storm water conveyance route.

Figure 1.0
North Washington Street Watershed
Boundaries and Evaluation Points



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It is important to recognize that any rural and/or urban development, which significantly modifies existing storm water systems or land uses within any given watershed, will result in changes to downstream flows. Such changes can be beneficial, detrimental, or minor in nature; and while implementing storm water controls may prevent damages from occurring in one location, they may limit development in others. The proposed master plan's conceptual goal is to minimize the impacts from future development by limiting changes in peak flows downstream. Though increases in peak flows are expected to occur on the more frequent rainfall events the master plan recommendations are intended to control the larger peak flows (i.e., 50 and 100-year events) as close to existing conditions as possible. Since all the potential variables cannot be evaluated this may not be practical in all situations considering the level of analysis included in the scope of work.

Any master planning process requires assumptions as to the configuration of future conditions. In this evaluation the key elements include the type of development anticipated in each subwatershed, potential culvert sizes and future detention features to control runoff. All the storm water management features discussed in this concept level report are based on these assumptions, which can and will change as planning and development continues. Therefore, caution is advised, this is a broad perspective evaluation and not a replacement for specific site evaluations. As actual platting and development occur it is recommended the City update this master plan and the hydrologic models as necessary to evaluate projected changes based on actual planned development or constructed conditions.

2.0 METHODOLOGY AND ASSUMPTIONS

Hydrologic models and an analysis of existing and projected watershed conditions were completed using the HEC-1 Flood Hydrograph Package developed by the U.S. Army Corps of Engineers (Corps). The conveyance capacities and rating curves for the various roadway culverts within the watershed were developed using Culvert Master software available from Haested Methods. The roadway elevations and culvert invert data were determined or estimated either from design plans or using the 2-foot aerial topographic mapping. It was assumed for the purposes of analyzing conveyance capacity that all culverts were undamaged and free of obstructions. Some of these culverts and site conditions are shown in site photos contained in **Appendix A**.

Assumptions related to future zoning within the watershed were based on development pressures in and around the existing rural residential areas, the Horizon Middle School, located in Section 17, and areas along the Highway #83 corridor. The projected zoning for the various subwatersheds is discussed in the following sections. As a general assumption urban development is based on R5 or R10 zoning unless specifically noted otherwise. Due to the nature of the topography the density of development in some locations may be limited. This may justify allowing a slightly higher density with final development. If not, any development with a density greater than R10 is assumed to require a site local detention such that peak discharges are equal to or less than those generated under R5 zoning.

The HEC-1 hydrological models indicate the highest peak flows and water levels at the selected evaluation points occur during the simulated 6-hour rainfall events. While the other rainfall distributions were evaluated only the results from the 6-hour events are presented. In some cases a 500-year event is presented as a point of reference or for additional information. This larger event, however, was not specifically used to develop the master plan facilities, but may influence final design.

It is important to understand that detention facilities having the potential to store more than 25 acre-feet must be evaluated as to the need for a construction permit from the North Dakota State Engineer. The North Dakota State Legislature recently increased the regulatory trigger for such permits to 25 acre-feet, see HB1148, **Appendix B**. In addition all new roadways or modifications to existing roadway installations must comply with the State Engineer's and NDDOT's Stream Crossing Design Standards, see **Appendix C**. If the stream crossing is sized using the roadway standards and is not designed for the purpose of storm water runoff control a construction permit may not be required, even if storage exceeds 25 acre-feet. The final determination will be made by the State Engineer.

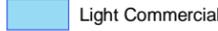
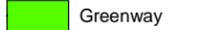
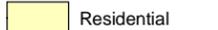
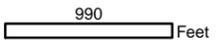
3.0 PROJECTED LAND USE

Future land uses were determined based on past and current development trends, recently completed developments and planned development or platting activities. During the past decade north Bismarck has been rapidly developing into both urban and rural residential areas. This trend is expected to continue at an increasing pace due to the recently completed Horizon Middle School and the expanding retail and commercial developments along Highway #83. Both these elements will increase the desirability and demand for additional housing within this area.

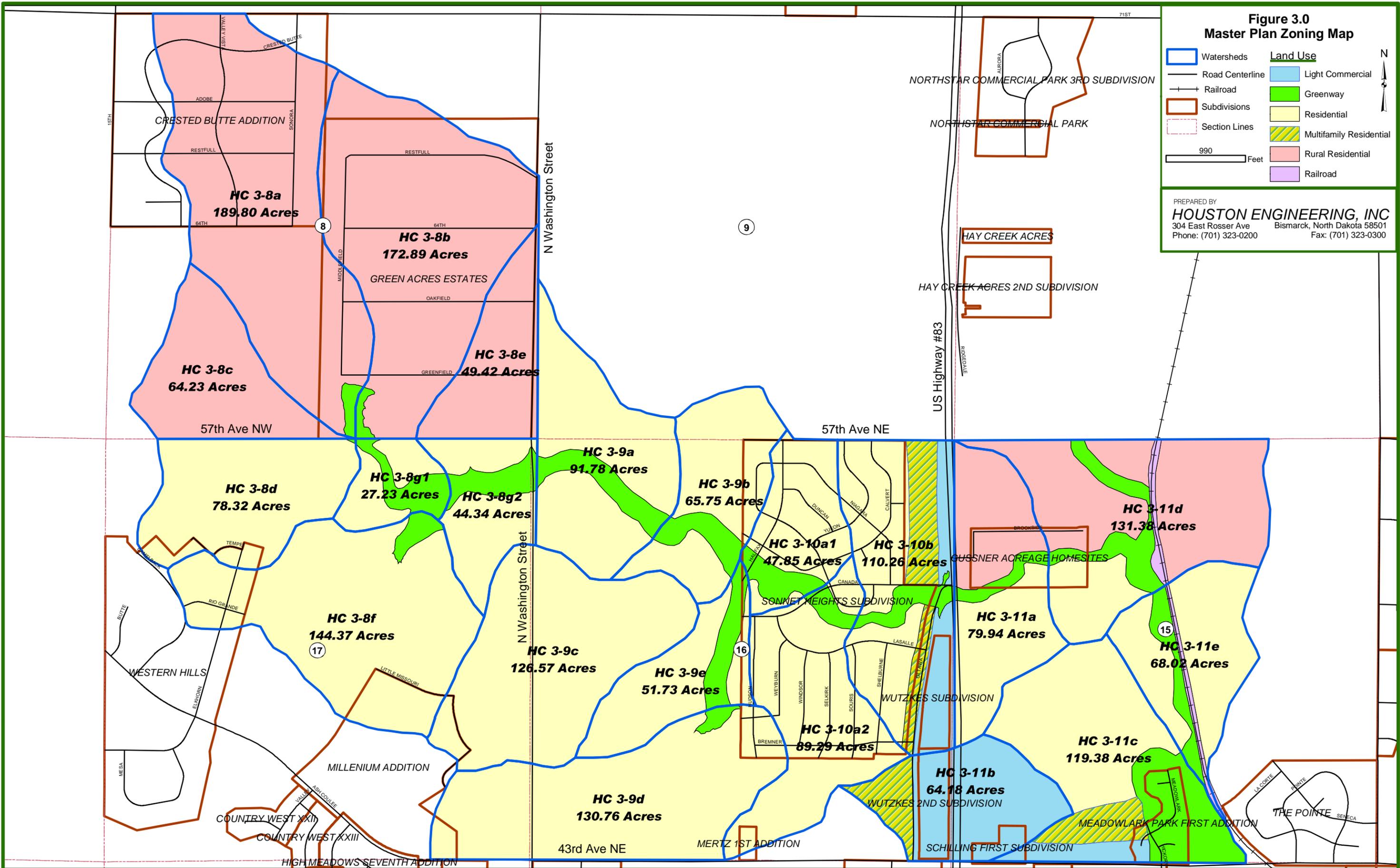
Figure 3.0 illustrates the existing watershed and subdivision boundaries along with the anticipated future zoning for the North Washington Watershed. The majority of land located south of 57th Avenue is expected to develop into single-family residential lots (R5). It is anticipated those lands located along Highway #83 will continue to develop as light commercial property. A small area of multiple-family development is anticipated between the commercial properties and the single-family development. The watershed to the north of 57th Avenue NW currently contains scattered rural residential lots, which is the projected near term future use in this area. Typical rural residential lots will average from approximately 1.5 to 2.0 acres in size.

Storm water runoff generated in this watershed is primarily conveyed through a natural coulee, which drains in an easterly direction to Hay Creek. The master plan concept is to retain this coulee as the primary trunk line storm water conveyance system within a greenway corridor. This requires the establishment of preliminary Development Control Lines (DCL) along this watercourse as well as expanded areas upstream from proposed detention sites created by selected roadway crossings. The general location and size of the proposed greenway is illustrated on **Figure 3.0**. This boundary is provided for illustrative purposes only and will require further refinement during final platting.

**Figure 3.0
Master Plan Zoning Map**

 Watersheds	Land Use	
 Road Centerline	 Light Commercial	
 Railroad	 Greenway	
 Subdivisions	 Residential	
 Section Lines	 Multifamily Residential	
 990 Feet	 Rural Residential	
	 Railroad	

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4.0 EVALUATION POINTS

The following sections discuss the projected changes in peak flows between existing and master plan conditions, the proposed DCL's along the channel and around the detention areas, and the proposed infrastructure requirements at the existing and/or proposed control points along the primary trunk line storm water conveyance system.

Section 4.1	57 th Avenue NW Crossing
Section 4.2	HC3-8 Detention Facility and North Washington Street
Section 4.3	Halifax Drive Crossing
Section 4.4	Canada Drive Crossing
Section 4.5	Highway #83 Crossing
Section 4.6	North Washington Street Watershed
Section 4.7	Hay Creek Subwatersheds
Section 4.8	Meadowlark Hills - Watershed HC3-11b
Section 4.9	Tributary Channel Detention Areas (Lateral Storm Water Systems)

Storm water detention for the purposes of this master plan report is based on using natural topographic features. The final configuration of storage can vary as long as the benefits provided are either increased or remain unchanged from the master plan. Under this concept plan no excavation is required to create the required detention storage areas. Therefore, the only costs for the primary trunk line facilities are related to the roadway and culvert installations. Due to the nature of these trunk line facilities only the roadway culverts needed to be sized. In the case of lateral storm sewer systems preliminary pipe sizing can be determined by using the projected 2-year or 5-year events from the selected subwatershed and the anticipated pipe gradient. The only caution is that the maximum allowable street conveyance and depth may require a larger storm sewer to meet the City's street design standards.

4.1 57th Avenue NW Crossing

The 57th Avenue NW roadway crossing serves as the first major control point for runoff from the North Washington Street Watershed. As shown on **Figure 4.1** this crossing controls flows generated by Watersheds HC3-8a, HC3-8b, and HC3-8c, together totaling approximately 427 acres. The current land use within these watersheds includes pasture and scattered areas of rural residential development. The existing stream crossing contains a single 36" RCP and has a top of roadway at around elevation 1888.

The upstream watershed is projected to develop entirely into rural residential lots. The current roadway is expected to continue as the primary arterial street serving this developing area. As a rural residential area, the projected storm sewer system conveyance system will consist primarily of open channel flows through ditches, natural watercourses and controlled by roadway culverts. Under the proposed master plan the 57th Avenue NW crossing will require one additional 36" RCP and the roadway will be raised one foot to an elevation of 1889. While it is desirable to provide more detention storage at this location an existing residence would be adversely impacted by further increases in storage.

Figure 4.1
57th Avenue NW Roadway Crossing

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57th Ave NW Roadway Crossing
 Existing Conditions
 Top of Road: 1888 msl
 1 - 36" RCP
 Invert: 1884 msl
 Master Plan Conditions
 Top of Road: 1889 msl
 2 - 36" RCP's
 Invert: 1884 msl

Developmental Control Line at 1890 msl

Existing Residence

Diversion



Table 4.1 lists the peak inflows, peak discharges, and water surface elevations under existing and master plan conditions. The increases in upstream water surface elevations are directly related to the proposed roadway grade raise.

Table 4.1							
57th Avenue NW Crossing, (Drainage Area = 427 acres)							
Peak Inflows, Peak Discharges and Water Surface Elevations							
(6-Hour Rainfall Events)							
Frequency	Existing Conditions 1-36" RCP Top of Roadway 1888 msl			Master Plan Conditions 2-36" RCP's Top of Roadway 1889 msl			Change in Water Surface Elevation (feet)
	Peak Inflow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)	Peak Inflow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)	
2	25	25	1886.56	43	40	1886.26	-0.30
10	127	127	1888.23	158	116	1888.65	0.42
25	202	202	1888.45	242	232	1889.17	0.72
50	275	275	1888.58	315	311	1889.30	0.72
100	348	348	1888.68	394	390	1889.43	0.75

The watershed upstream from 57th Avenue NW is modeled as uncontrolled resulting in frequent overtopping at this crossing. The roadways within the upstream rural residential development were not modeled, therefore the results area intentionally conservative as storage within these developments will tend to reduce peak flows. **Table 4.1** indicates peak inflows and discharges will increase for all runoff events under full development. Adding one 36" RCP and raising the roadway provides a limited reduction in overtopping.

If proposed development changes (i.e., urban zoning) or the public requires less frequent overtopping options are available to reduce this occurrence. First, Watershed HC3-8 (62.23 acres) has been diverted to this location via the north roadway ditch. Flows in this ditch are controlled by the approaches into the Williston Basin Interstate Pipeline Compressor Station. Restoring the natural drainage via a ditch block and placing a culvert in the natural low area to the west should be considered prior to additional platting upstream. This will reduce the risk and frequency for overtopping at this location. Secondly, the culverts could be enlarged, which would change the projected impacts downstream. Third, is to relocate the one upstream residence to the northeast and raise the roadway to create additional detention storage. Upstream storage in Watershed HC3-8a should also be considered. These issues should be evaluated when the roadway is improved from gravel to a paved surface.

Considering the scope of this master plan, site-specific storm water controls were not evaluated. However, most rural residential developments result in reduced peak flows by creating storage upstream from roadway and approach installations. Subsequently, additional storage has a high probability of occurring under full development. The City's storm water ordinance requires an analysis of the upstream watersheds as part of any storm water management plan or permit for new development in this watershed. This analysis will need to include roadways outside the scope of this study.

Based on the projected water surface elevations under master plan conditions it is recommended a DCL be established upstream at elevation 1890 upstream from this crossing to prevent development within the detention and identified flood hazard area. In addition, storm water easements should be mandated upstream from future roadway storage areas. On a related design note the projected master plan cross flow depth is 0.42 feet during the 100-year event. While this is not in compliance with an arterial street design standard it does meet the local or collector street maximum allowable cross flow depth of six inches. Approximately 7.5 ac-ft of detention storage is provided prior to overtopping.

4.2 HC3-8 Detention Area and North Washington Street

The final collection point for runoff generated by Watershed HC3-8 is located at North Washington Street. This stream crossing contains a 7 ft x 5 ft concrete box culvert with an overflow elevation of 1868. This crossing receives discharges from 57th Avenue NW and direct runoff from Watersheds HC3-8d, HC3-8e, HC3-8f, HC3-8g1 and HC3-8g2, for a local drainage area of 344 acres and a total drainage area to this crossing of 771 acres. The current land use between 57th Avenue NW and North Washington Street consists primarily of pasture and/or hay land. This watershed area is anticipated to develop entirely into single-family residential housing.

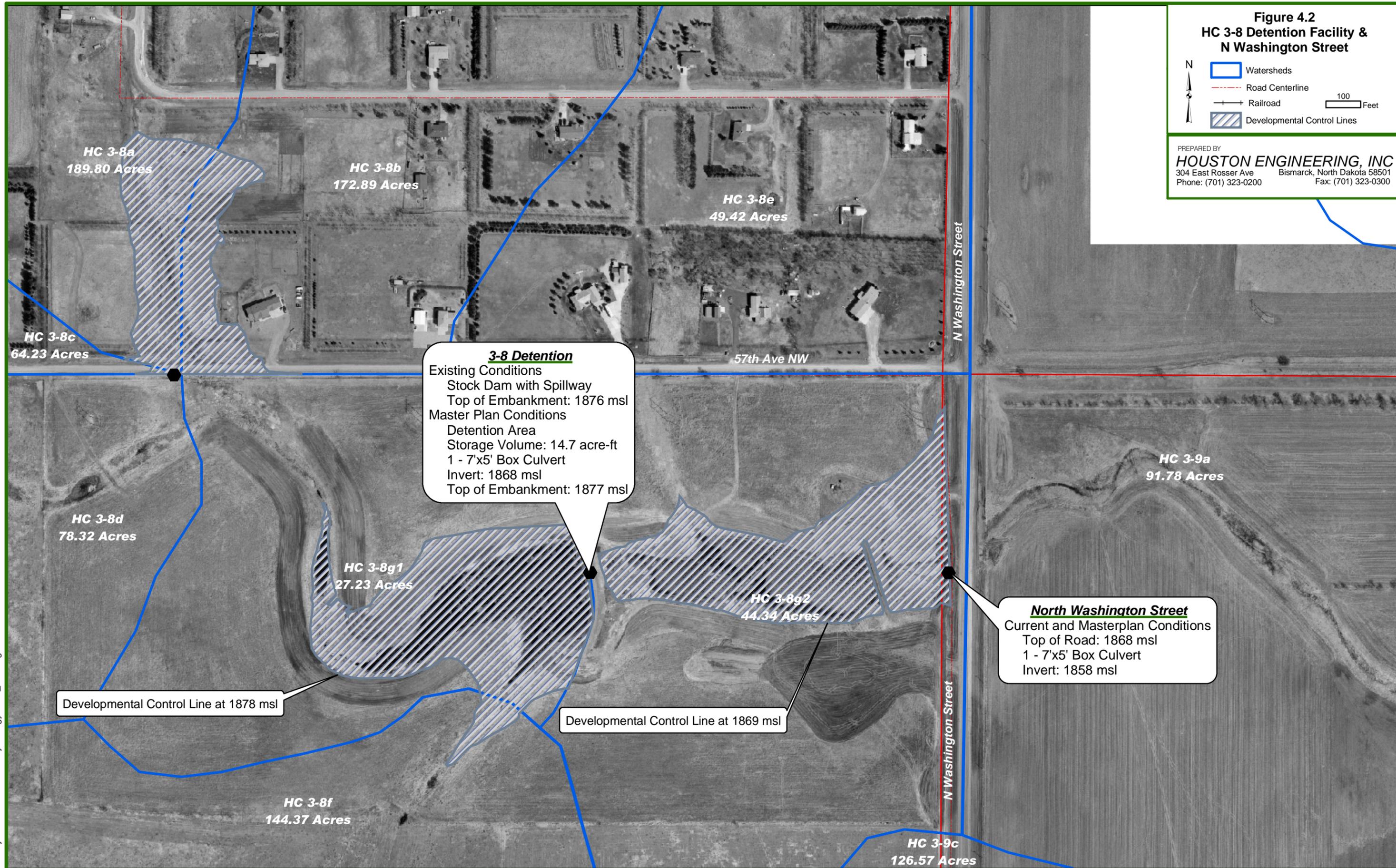
It was determined through the HEC-1 modeling process that North Washington Street would be adversely impacted by future development without additional upstream storage. While the culvert at this crossing appears to have been recently upgraded it cannot adequately convey the projected runoff under fully developed conditions. The potential adverse impacts include increased backwater elevations ranging from 1.0 to 1.5 feet and increases in peak flows ranging from over 200% on a 2-year event to around 24% on the 100-year event. These impacts were deemed unacceptable and the HC3-8 Detention Facility was evaluated and master planned to reduce these impacts. Additional upstream detention storage along tributary channels not part of the primary trunk line facilities, is also included in the master plan. Since these areas are considered lateral systems the modeling results at these locations are not presented in this report. The location and background information related to these facilities is discussed in **Section 4.8**.

Upstream from North Washington Street there are two existing impoundments or stock dams. The existing condition analysis assumed these sites were full and unable to provide additional event storage. The master plan recommends that the upstream impoundment, identified on **Figure 4.2** as the HC3-8 Detention Facility, be modified to allow its use as a storm water detention facility. The proposed modification will require the installation of a 7' x 5' concrete box culvert through the embankment with an inlet elevation at 1868. It is anticipated this embankment may be used as a future street crossing with an overflow elevation at approximately 1877. At this elevation approximately 20.8 ac-ft of storage would be provided. Storage on a 100-year event is approximately 14.7 ac-ft. **Table 4.2.1** shows a measurable reduction in peak discharges downstream to North Washington Street under all simulated rainfall events with this facility in place.

**Figure 4.2
HC 3-8 Detention Facility &
N Washington Street**



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3-8 Detention
Existing Conditions
Stock Dam with Spillway
Top of Embankment: 1876 msl
Master Plan Conditions
Detention Area
Storage Volume: 14.7 acre-ft
1 - 7'x5' Box Culvert
Invert: 1868 msl
Top of Embankment: 1877 msl

North Washington Street
Current and Masterplan Conditions
Top of Road: 1868 msl
1 - 7'x5' Box Culvert
Invert: 1858 msl

Developmental Control Line at 1878 msl

Developmental Control Line at 1869 msl

Table 4.2.1 HC3-8 Detention Facility (Master Plan), (Drainage Area = 676.8 acres) Peak Inflows, Peak Discharges and Water Surface Elevations Estimated Top of Embankment at 1877 (6-Hour Rainfall Events)			
Frequency	Peak Inflow (cfs)	Peak Discharges (cfs)	Maximum Water Surface Elevation (msl)
2	84	76	1870.4
10	218	193	1872.6
25	334	289	1874.1
50	450	351	1875.2
100	594	414	1876.4

It is our understanding the two upstream impoundments located in Watershed HC3-8g1 and HC3-8g2 may be governed by an agreement between the landowner and the USFWS. Therefore, mitigation and/or replacement measures for wetland and wildlife habitat may be required in order to create the desired detention. This information is provided only as a point interest as further investigation is outside the scope of services.

Based on the master plan conditions at the HC3-8 Detention Facility it is recommended a DCL be established upstream at or above elevation 1878 to prevent development within the identified flood hazard area. This is one foot above the top of the embankment and considers that during certain extreme flood events overtopping may still occur.

Table 4.2.2 provides the peak inflows, peak discharge and water surface elevations at North Washington Street under existing and master plan conditions.

Table 4.2.2 North Washington Street, (Drainage Area = 771 acres) Peak Inflows, Peak Discharges and Water Surface Elevations (6-Hour Rainfall Events) Top of Roadway: 1868 msl 7' X 5' Concrete Box Culvert							
Frequency	Existing Conditions			Master Plan Conditions			Water Surface Elevation Increase (feet)
	Peak Inflow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)	Peak Inflow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)	
2	44	43	1859.9	84	79	1860.9	1.0
10	191	173	1862.9	212	198	1863.4	0.5
25	321	272	1864.7	303	282	1864.8	0.1
50	445	343	1866.2	369	337	1866.0	-0.2
100	583	395	1867.5	436	378	1867.0	-0.5
500				755	723	1868.3	Overtops

Based on the projected master plan conditions at North Washington Street it is recommended a DCL be established upstream at or above elevation 1869 to prevent development within the identified flood hazard area. This is one foot above the top of the embankment and considers that during certain extreme flood events overtopping may still occur. Considering the projected reductions in peak inflow flows associated with upstream storage overtopping of this street will not occur during a 100-year 6-hour rainfall event. The estimated detention storage at elevation 1868 is estimated at around 20.0 ac-ft.

4.3 Proposed Halifax Drive Crossing

Discharges from North Washington Street are routed east toward a future downstream roadway crossing. This stream crossing is located at the west end of the undeveloped Sonnet Heights Subdivision and was platted as Halifax Drive. Inflows to this crossing also occur from Watersheds HC3-9a, HC3-9b, HC3-9c, HC3-9d, and HC3-9e, for a drainage area of 467 acres, or a total drainage area of 1,238 acres to this crossing, see **Figure 4.3**. Again, the land uses within these intermediate subwatersheds are pasture and/or hay land.

Those lands within the intermediate subwatersheds are projected to develop into primarily single-family residential lots. The available detention storage behind Halifax Drive at elevation 1830 is estimated at around 13.5 ac-ft. Under the master plan this crossing will contain a double 8 ft x 6 ft concrete box culvert and have an overflow elevation at 1830. **Table 4.3** provides the projected peak inflows, peak discharges and water surface elevations for the simulated rainfall events under master plan conditions.

Table 4.3 Halifax Drive Master Plan (Drainage Area = 1,238 acres) Peak Inflows, Peak Discharges, and Water Surface Elevation (6-Hour Rainfall Events) Top of Roadway: 1830 msl Double 8' X 6' Concrete Box Culvert			
Frequency	Peak Inflow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)
2	130	118	1825.1
10	362	318	1827.0
25	510	447	1828.1
50	638	541	1828.7
100	770	646	1829.5

Halifax Drive will not overtop during the 100-year rainfall event under master plan conditions. The freeboard depth on a 100-year is estimated at 0.50 feet. This is acceptable condition in accordance with the City's street design standards. Based on the projected master plan conditions at Halifax Drive it is recommended a DCL be established upstream at or above elevation 1832 to prevent development within the identified flood hazard area. This is two feet above the top of the embankment and considers that during certain extreme flood events overtopping may still occur, but can be adjusted during final platting.

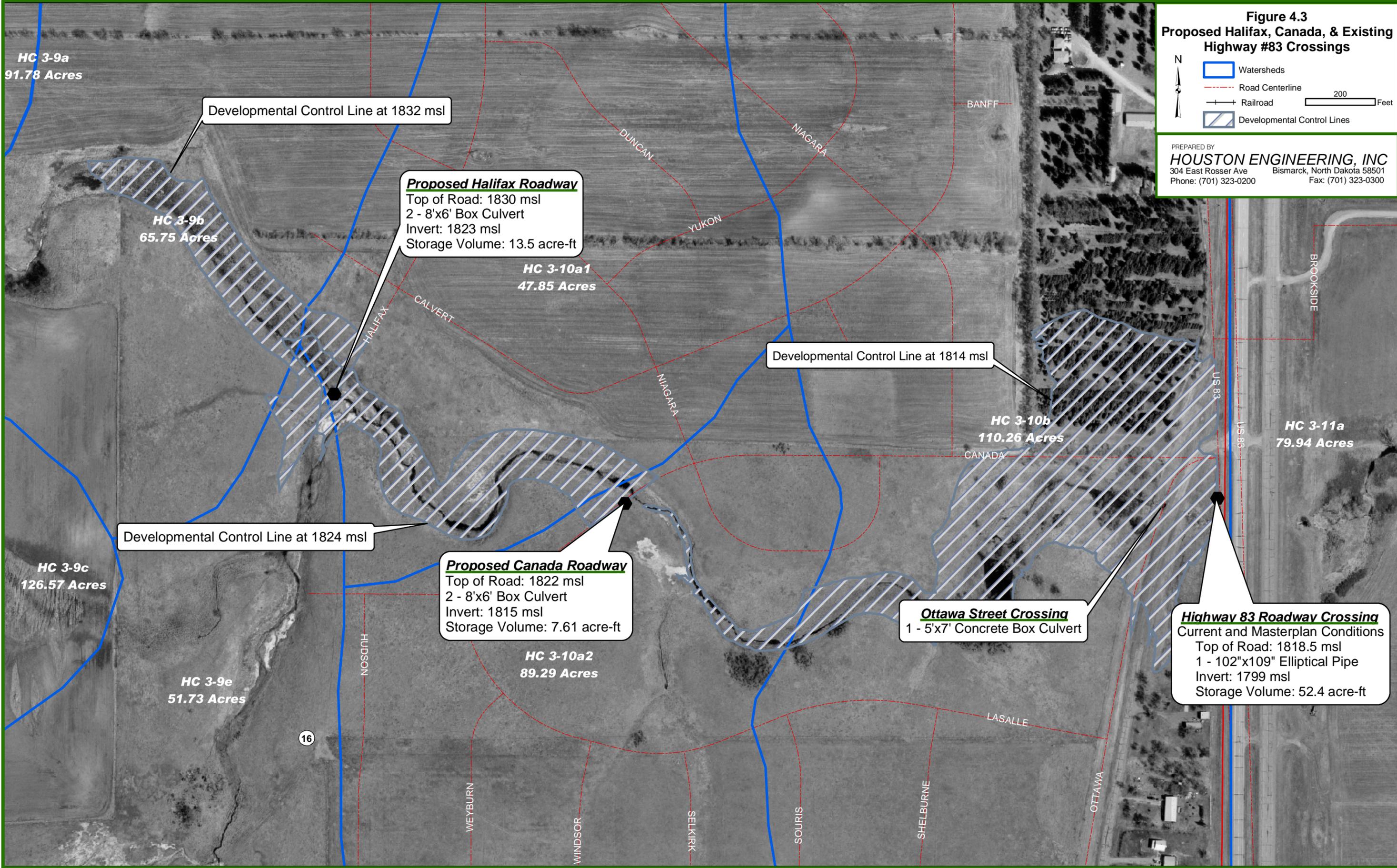


Figure 4.3
Proposed Halifax, Canada, & Existing Highway #83 Crossings

- Watersheds
- Road Centerline
- Railroad
- Developmental Control Lines

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HC 3-9a
91.78 Acres

Developmental Control Line at 1832 msl

HC 3-9b
65.75 Acres

Proposed Halifax Roadway
 Top of Road: 1830 msl
 2 - 8'x6' Box Culvert
 Invert: 1823 msl
 Storage Volume: 13.5 acre-ft

HC 3-10a1
47.85 Acres

Developmental Control Line at 1814 msl

HC 3-10b
110.26 Acres

Developmental Control Line at 1824 msl

Proposed Canada Roadway
 Top of Road: 1822 msl
 2 - 8'x6' Box Culvert
 Invert: 1815 msl
 Storage Volume: 7.61 acre-ft

HC 3-10a2
89.29 Acres

Ottawa Street Crossing
 1 - 5'x7' Concrete Box Culvert

Highway 83 Roadway Crossing
 Current and Masterplan Conditions
 Top of Road: 1818.5 msl
 1 - 102"x109" Elliptical Pipe
 Invert: 1799 msl
 Storage Volume: 52.4 acre-ft

HC 3-9c
126.57 Acres

HC 3-9e
51.73 Acres

16

N:\Hay Creek Watershed Hydrology\CAD_GIS\Fig 4.3.mxd

4.4 Proposed Canada Drive Crossing

Discharges from the Halifax Drive crossing, described in **Section 4.3**, are routed to a second platted roadway in the Sonnet Heights addition identified as Canada Drive. In addition to these flows this crossing must accommodate runoff from Watershed HC3-10a1, approximately 48 acres. Current land uses in this watershed are pasture and hay land.

Again the anticipated development is single-family residential lots. The estimated available detention storage behind this crossing is approximately 7.61 ac-ft at elevation 1822. The proposed configuration for the roadway crossing is a double 8 ft x 6 ft box culvert and a roadway elevation of 1822. **Table 4.4** shows the projected peak inflow, peak discharge, and water surface elevations under master plan conditions.

Frequency	Peak InFlow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)
2	119	118	1817.1
10	323	315	1819.0
25	455	423	1820.0
50	551	529	1820.6
100	656	628	1821.4

Canada Drive is not expected to overtop on the 100-year rainfall event and would have an estimated freeboard of 0.8 feet. As shown in **Figure 4.3**, it is recommended a Development Control Line be established at 1824 msl around the detention area created by the roadway. This is two foot above the top of the embankment and considers that during certain extreme flood events overtopping may still occur, but can be adjusted during final platting.

4.5 Highway #83 Crossing

The Highway #83 crossing is the final upstream crossing before the reaching the confluence with Hay Creek. This crossing contains a 102" x 109" elliptical culvert and has an estimated top of roadway elevation at 1818.5. The runoff to this point is generated by the watersheds described in **Section 4.1** through **Section 4.4** and Watershed HC3-10a2 and HC3-10b, which are currently used as pasture and/or hay land. Watershed HC3-10b currently contains some light commercial development along Highway #83. The projected land use is primarily single-family residential development with light commercial and multi-family development along Highway #83. No changes are proposed to this roadway crossing. Upstream from Highway #83 is Ottawa Lane, which presently contains a 5' x 7' concrete box culvert. This crossing is currently adequate, but will be inundated on a 100-year event, see **Figure 4.3**. Consideration should be given to replacing this structure when upstream development results in undesirable cross flows. It would appear traffic issues and its connection to Highway #83 also needs to be evaluated.

Table 4.5 lists the peak flows and water surface elevations under existing and master plan conditions. While additional erosion control features between Highway #83 and Hay Creek may be deemed necessary in the future as development continues, they are not evaluated in this master plan. These features could include additional detention, check dams, structural drops, base flow storm sewers and lined channels.

<p align="center">Table 4.5 Highway #83 Peak Inflows, Peak Discharges and Water Surface Elevations</p> <p align="center">Top of Roadway: 1818.5 msl 102" x 109" Elliptical CMP</p>							
Frequency	Existing Conditions			Master Plan Conditions			Water Surface Elevation Increase (feet)
	Peak Inflow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)	Peak Inflow (cfs)	Peak Discharge (cfs)	Water Surface Elevation (msl)	
2	79	76	1802.3	126	121	1803.2	0.9
10	267	249	1805.3	329	307	1806.2	0.9
25	401	362	1806.9	461	418	1807.7	0.8
50	518	458	1808.2	554	499	1808.8	0.6
100	643	551	1809.5	654	580	1809.9	0.4
500				975	704	1812.3	Freeboard @ 6.2 ft

Increases in peak inflows, peak discharges and water surface elevations occur for all the simulated rainfall events, however the changes on the 50 and 100-year rainfall events are relative ranging from 8.9% to 5.2%. Based on the results in **Figure 4.3** it is recommended a Development Control Line be established at 1814 msl around the detention area created by Highway #83. This elevation is 1.7 feet above the projected water surface elevation on a 500-year 6-hour rainfall event. Caution is advised, however, since this elevation is still 4.5 feet below the top of roadway. Unless the highway is lowered upstream structures should have finished floor elevations above the top of roadway or elevation 1818.5. While it may take a very extreme event to create such flooding the City should evaluate and weigh the risks of such an occurrence over the life of the proposed structures. Establishing a higher design standard in such situations is a determination to be made by the City.

4.6 North Washington Street Watershed

The goal of the master plan is to limit the potential impacts from future development on the existing downstream infrastructure. The location of the final evaluation or discharge point from the North Washington Street Watershed is shown on **Figure 1.0**. This location includes all discharges from the Highway #83 crossing as described in Section 4.5 and Watershed HC3-11a containing approximately 80 acres. Downstream from this location runoff combines with Hay Creek in Watershed HC3-11d. **Table 4.6** lists the total discharges from the North Washington watershed into Hay Creek. While significant increases in flow occur during the 2 and 10-year rainfall events the increased peak on the 100-year rainfall event is acceptable, though further reductions are preferable.

Table 4.6 North Washington Street Watershed Discharges to Hay Creek (6-Hour Rainfall Events)				
Frequency	Existing Conditions Peak Flow (cfs)	Master Plan Conditions Peak Flow (cfs)	Change in Flow (cfs)	Percent Increase (%)
2	77	123	46	59.7
10	253	311	58	22.9
25	368	422	54	14.7
50	465	505	40	8.6
100	558	587	29	5.1

It is likely the changes in low flow durations on the more frequent events will eventually result in high tractive forces increasing the potential for erosion on the primary conveyance channel in the greenway. Ultimately this will increase maintenance costs and may require the installation of erosion control features and/or channel stabilization measures. Adequate erosion protection at the culvert inlets and outfalls is an important component in reducing this risk. The installation of a base flow storm sewer is also recommended to prevent continued saturation of the channel prism under normal operational conditions. This system would be designed to accommodate from one to three percent of the 100-year peak flow. Since this system will not be required for some time it should be incorporated into the cost of the lateral storm sewer facilities. Therefore, the size and costs for this system were not determined.

4.7 Hay Creek Subwatersheds

There are a number of watersheds located east of Highway #83 in the North Washington Street Watershed study area, which have been modeled under existing and projected conditions. These include Watershed HC3-11b, HC3-11c, HC3-11d and HC3-11e. Due to the nature of their proximity to Hay Creek it was felt that regional detention or primary trunk line detention storage in these watersheds was not specifically required. This does not preclude, however, the need for on-site detention storage to prevent local adverse impacts downstream.

Watershed HC3-11d is projected to contain mostly rural residential development. As such this area is anticipated to contain the typical on-site storage behind local roadways and approaches. The installation of a regional detention facility in this reach of the proposed greenway is also impractical due to existing development located along the channel in the Gussner Acreage Homesites.

Watershed HC3-11e is located primarily within the Hay Creek floodplain; therefore, development opportunities are limited and regional detention storage is not required. It is recommended consideration be given to incorporating all or portions of this watershed into the downstream Hay Creek Greenway Project. This should be considered prior to the preliminary platting process, if practical, or incorporated into the storm water management plan for this area.

Watershed HC3-11c is anticipated to develop primarily as single-family residential with some commercial development or multi-family areas occurring along Highway #83. Due to the steep topography and non-concentrated runoff regional detention storage does not appear practical. Since this watershed is not located along the primary trunk line system it will need to be serviced by lateral storm sewer systems and on-site storage if necessary.

Though these last watersheds are incorporated into the master plan model the reporting of impacts on Hay Creek are not included in the scope of work for this assessment. The potential impacts from master plan development are to be completed separately.

4.8 Meadowlark Hills - Watershed HC3-11b

Watershed HC3-11b provides an interesting development scenario. That portion of the watershed located east of Highway #83 has undergone significant topographic changes associated with earthmoving and site grading. As part of this development a 36" RCP culvert under Highway #83 was extended east through the watershed as a storm sewer. This system discharges into a small tributary upstream from Hay Creek at the east end of the Meadowlark Hills Commercial First Addition. This storm sewer was installed as part of a planned 40+ acre commercial development. A previously completed storm water management plan, entitled *Meadowlark Hills Site Development, SW¹/₄ Section 15, T139N R80; Bismarck, North Dakota* was reviewed for this report. This plan is on file with the City and has been approved.

The Meadowlark storm sewer is a lateral facility and outside the scope of this evaluation, however, several items of interest can be noted. First, the approved management plan assumes the storage west of Highway #83 is maintained to prevent a flood hazards in the Meadowlark Hills development. Due to the nature of this commercial site surface flows over Highway #83 are unacceptable. Prior to approving building permits within this development the extent and capability of this upstream storage should be determined. This is necessary to verify the ability of this area to contain the flows in accordance with the assumptions outlined in the storm water management plan.

Second, the Meadowlark Hills storm water management plan identifies a proposed detention site located east of the proposed development, which is outside the plat boundary. As a general comment the use of non-platted storage areas is not desirable. Considering the nature of the proposed commercial development detention storage is necessary to prevent erosion damages due to concentrated discharges. While it is anticipated the lateral storm sewer and detention system will be constructed by a single developer/owner the assurance of the effectiveness of this storage site needs to be addressed. Based on a cursory review the site appears adequate to accommodate the projected runoff, however impacts between the storm sewer outfall and the storage site as well as the means to convey overflows to Hay Creek present significant concerns. These need to be addressed prior to the approval of any site plan for development within this area.

4.9 Tributary Channel Detention Areas

When evaluating the potential storm water control facilities within a given watershed many elements need to be considered. In reviewing the North Washington Street watershed a number of secondary storage sites were identified. Not all these sites were included in the master plan hydrology due to their size, location and anticipated impact on peak flows. These secondary storage facilities are identified on **Figure 4.9**. The following is a brief description for each site. Those locations where approximate detention storage and culvert information is provided are included in the master plan hydrology models.

- Watershed HC3-8e Detention in these areas consists of small culverts under 57th Avenue NW.
- **Watershed HC3-8f** Single detention site located above outfall to the greenway. This site contains approximately **10 acre-feet** of storage and is to be controlled using a 42" RCP. The estimated Development Control Line is elevation 1885 with an estimated top of roadway at 1884.
- Watershed HC3-9c Two minor detention areas located west of North Washington Street. These may be eliminated via storm sewer systems, though cross flows on this arterial street are a concern. A third site located upstream from the outfall to the greenway is recommended for further consideration.
- **Watershed HC3-9d** Single detention site above outfall to the greenway. This site contains approximately **6.4 acre-feet** of storage and is to be controlled using a 48" RCP. The estimated Development Control Line is elevation 1859 with an estimated top of roadway at 1858.
- Watershed HC3-10a2 Single detention area above outfall to the greenway. Considering this site is located within the undeveloped Sonnet Heights Addition this site will require re-platting.
- Watershed HC3-11b Single detention area west of Highway #83. This detention site is created by the 36" RCP culvert under the highway and downstream storm sewer system.

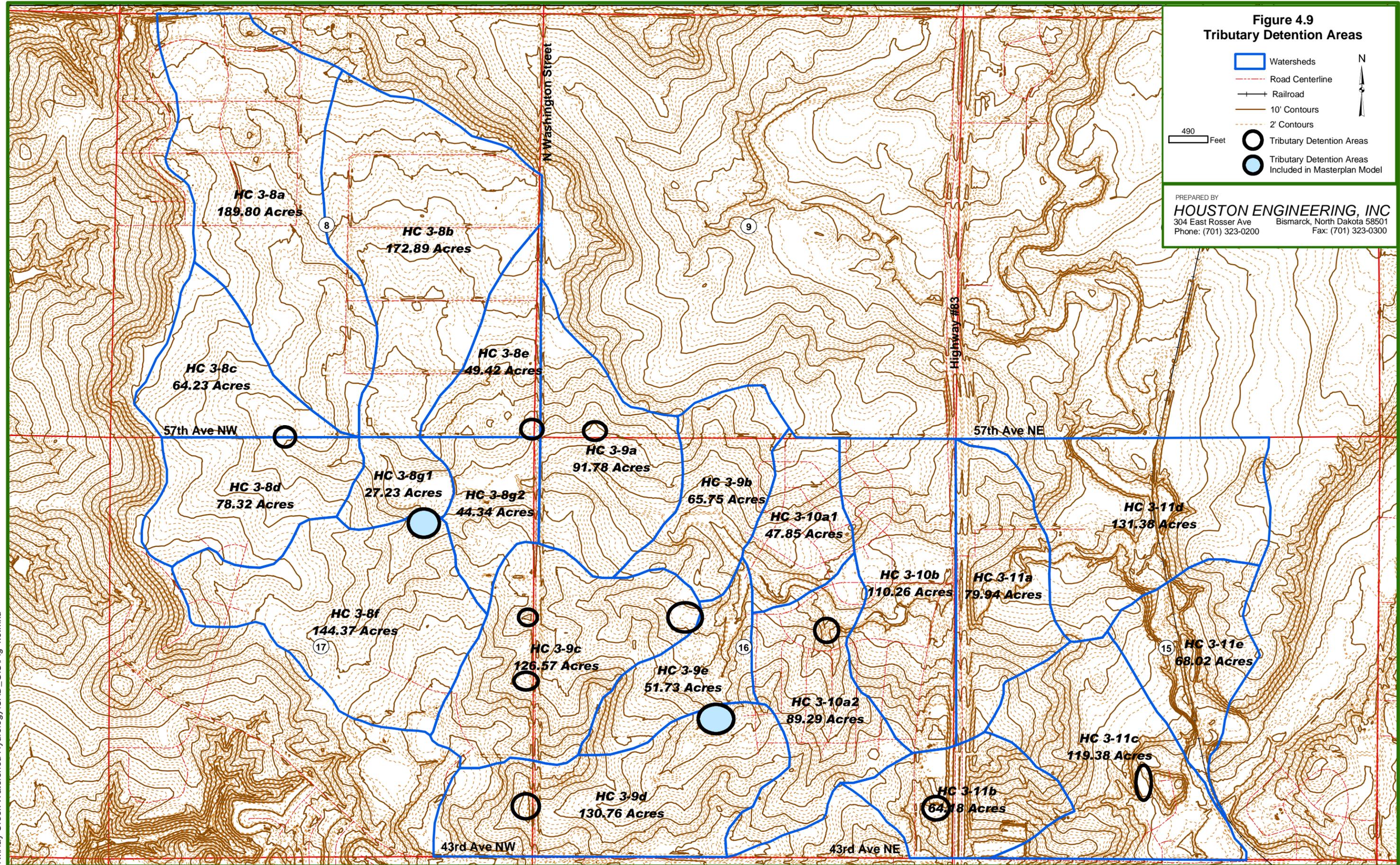
These secondary storage sites are located upstream from existing roadways or could be created on the tributary channels. Their purpose is to aid in controlling peak discharges from future development, primarily those flows generated on the more frequent events. It is recommended the City evaluate these sites on a case-by-case basis through the plat related storm water management plan procedures.

Figure 4.9
Tributary Detention Areas

-  Watersheds
-  Road Centerline
-  Railroad
-  10' Contours
-  2' Contours
-  Tributary Detention Areas
-  Tributary Detention Areas Included in Masterplan Model

490 Feet

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N:\Hay Creek Watershed Hydrology\CAD_GIS\Fig 4.9.mxd

Master planning this watershed in accordance with the scope of work does not preclude the need for site local storm water analysis and/or evaluation prior to development. Though this master plan will reduce the extent of additional study required in many locations. As a general rule, watersheds greater than 80 acres have the potential to generate peak flows that may require a major storm sewer system. In these situations detention storage can substantially reduce infrastructure costs and excessive street flows.

5.0 SUMMARY AND CONCLUSIONS

This conceptual master plan for the North Washington Street Watershed was developed to limit and/or prevent undesirable impacts due to increased runoff generated by future rural and/or urban development. This includes the evaluation of the impacts on existing infrastructure and recommendations related to facility improvements or new system installations. Based on the findings contained within this watershed assessment it is recommended the City continue to monitor development and update this master plan as necessary based on actual planned development. All new development should be required to comply with this master plan or provided sufficient justification to support any proposed modifications and their potential impact on the master plan objectives.

While controlling peak flows and discharges is a primary master planning objective another is to identify green space to enhance the appeal of local development. The proposed open channel and greenway/storage areas are known to increase adjacent property values. These areas also provide the ability to settle out sediments and are proven to remove storm water pollutants thus improving water quality discharges downstream. The design of sediment collection facilities is not considered at this planning level.

As a point of interest the North Washington Street Watershed is comparable in size and general configuration to the Jackman Coulee Watershed, which contains approximately 2,182 (3.41 square miles). The use of green space from Marian Park through the Highland Acres area and south to West Main Avenue in this fully developed watershed provides measurable enhancement values. Using proper planning methods many of the storm water management problems that occurred within the Jackman Coulee area can be avoided.

In summary any master planning process requires assumptions as to the configuration of future conditions. In this evaluation the key elements include the type of development anticipated in each subwatershed, potential culvert sizes and future detention features to control runoff. All the storm water management features discussed in this concept level report were based on these assumptions, which will change as planning and development continues. Therefore, caution is advised, this is a broad perspective evaluation and not a replacement for specific site evaluations.

It is important to recognize that any rural and/or urban development, which significantly modifies existing storm water systems or land uses within any given watershed, will result in changes to downstream flows. Such changes can be beneficial, detrimental, or minor in nature; and while implementing storm water controls may prevent damages from occurring in one location, they may limit development in others. The proposed master plan minimizes the future development impacts by limiting changes in peak flows. Though increases in peak flows will occur on the more frequent rainfall events the master plan maintains the larger peak flows on the 50 and 100-year events to manageable levels. Since all the potential variables were not evaluated additional studies will be necessary as development within this watershed continues.

Appendix A

North Washington Street Watershed Site Photos



This photo was taken looking northwest upstream from the 36" RCP culvert under 57th Avenue NW. The master plan improvements include the addition of another culvert (36" RCP) and raising the top of roadway from elevation 1888 to 1889. Raising the roadway may not be necessary if adequate upstream storage is created within the rural residential development.



This photo is taken looking west upstream from the North Washington Street box culvert. The upstream impoundment is the first of two between 57th Avenue NW and the North Washington Street Crossing. The master plan recommends the second upstream impoundment be modified for detention storage using a 5' x 7' concrete box culvert.



This photo is looking east at the box culvert under North Washington Street. This 5' x 7' box culvert appears to be a recent installation. Upstream storage is recommended to reduce the risk for overtopping resulting from projected urban/rural development.



This photo is taken looking east at the Highway #83 culvert. The crossing presently contains a 102" x 109" CMP elliptical culvert. This crossing is the last control point before the flows combine with Hay Creek. Based on the master plan hydrology models additional storage and control could be implemented upstream at this location. A determination on this issue should be considered as development continues.

**NORTH WASHINGTON STREET WATERSHED
ADDITIONAL SITE PHOTOS**

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Photo 1: Hay Creek Upstream from the 43rd Avenue NE Roadway Crossing



Photo 3: Culvert at the 57th Avenue NE Roadway Crossing



Photo 2: Upstream side of the concrete box culvert located under 43rd Avenue NE on Hay Creek



Photo 4: Downstream from the 43rd Avenue NE box culvert on Hay Creek

**NORTH WASHINGTON STREET WATERSHED
ADDITIONAL SITE PHOTOS**

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Photo 5: Downstream from the 43rd Avenue Roadway Crossing on Hay Creek.



Photo 7: Embankment outlet from stock dam location, west of North Washington Street in Watershed HC3-8.



Photo 6: Embankment Drop Structure on stock dam west of North Washington Street in Watershed HC3-8.



Photo 8: Highway #83 center line culvert.

Appendix B

HB1148 – Legislative Amendment to NDCC 61-16.1-38

**Fifty-eighth Legislative Assembly of North Dakota
In Regular Session Commencing Tuesday, January 7, 2003**

HOUSE BILL NO. 1148
(Natural Resources Committee)
(At the request of the State Water Commission)

AN ACT to create and enact a new section to chapter 61-16.1 of the North Dakota Century Code, relating to release of water resource board easements; and to amend and reenact sections 61-02-14.1, 61-16.1-38, and 61-16.1-53 of the North Dakota Century Code, relating to dam construction easements, dam construction permits, and dike and dam removal notices and hearings.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:

SECTION 1. AMENDMENT. Section 61-02-14.1 of the North Dakota Century Code is amended and reenacted as follows:

61-02-14.1. Release or assignment of easements - Procedure. The commission may, when it deems such action to be in the best interest of the state, for good and valuable consideration, release easements granted to the state for the construction, operation, and maintenance of dams, along with access thereto, if such dams have not been constructed within ten years of the granting of the easement or if such dams are no longer useful ~~and will not be reconstructed.~~ The commission may also assign such easements to a political subdivision if it determines the assignment would be in the best interests of the state. Any release ~~executed under the authority of this section or assignment~~ shall be in the name of the state of North Dakota by the governor and attested by the secretary of state.

SECTION 2. A new section to chapter 61-16.1 of the North Dakota Century Code is created and enacted as follows:

Release of easements - Procedure. When it deems such action to be in the best interests of the district or other political subdivision, a water resource board or governing body of another political subdivision may release easements assigned to it from the state for the construction, operation, and maintenance of dams, along with access to the dams, if the dams are no longer useful.

SECTION 3. AMENDMENT. Section 61-16.1-38 of the North Dakota Century Code is amended and reenacted as follows:

61-16.1-38. Permit to construct or modify dam, dike, or other device required - Penalty - Emergency. No dikes, dams, or other devices for water conservation, flood control regulation, watershed improvement, or storage of water which are capable of retaining, obstructing, or diverting more than ~~twelve and one-half fifty~~ 15448.52 61674.08 acre-feet [cubic meters] of water or ~~twenty-five~~ 30837.04 acre-feet [cubic meters] of water for a medium-hazard or high-hazard dam, may be constructed within any district except in accordance with the provisions of this chapter. An application for the construction of any dike, dam, or other device, along with complete plans and specifications, must be presented first to the state engineer. Except for low-hazard dams less than ten feet [3.05 meters] in height, the plans and specifications must be completed by a professional engineer registered in this state. After receipt, the state engineer shall consider the application in such detail as the state engineer deems necessary and proper. The state engineer shall refuse to allow the construction of any unsafe or improper dike, dam, or other device which would interfere with the orderly control of the water resources of the district, or may order such changes, conditions, or modifications as in the judgment of the state engineer may be necessary for safety or the protection of property. Within forty-five days after receipt of the application, except in unique or complex situations, the state engineer shall complete the state engineer's initial review of the application and forward the application, along with any changes, conditions, or modifications, to the water resource board of the district within which the contemplated

project is located. The board thereupon shall consider, within forty-five days, the application, and suggest any changes, conditions, or modifications to the state engineer. If the application meets with the board's approval, the board shall forward the approved application to the state engineer. The state engineer shall make the final decision on the application and forward that decision to the applicant and the local water resource board. The state engineer may issue temporary permits for dikes, dams, or other devices in cases of an emergency. Any person constructing a dam, dike, or other device, which is capable of retaining, obstructing, or diverting more than ~~twelve and one-half~~ fifty acre-feet [~~15418.52~~ 61674.08 cubic meters] of water or twenty-five acre-feet [30837.04 cubic meters] of water for a medium-hazard or high-hazard dam, without first securing a permit to do so, as required by this section, is liable for all damages proximately caused by the dam, dike, or other device, and is guilty of a class B misdemeanor.

SECTION 4. AMENDMENT. Section 61-16.1-53 of the North Dakota Century Code is amended and reenacted as follows:

61-16.1-53. Removal of a noncomplying dike or dam - Notice and hearing - Appeal - Injunction. Upon receipt of a complaint of unauthorized construction of a dike, dam, or other device for water conservation, flood control, regulation, watershed improvement, or storage of water, the water resource board shall promptly investigate and make a determination thereon. If the board determines that a dam or other device, capable of retaining, obstructing, or diverting more than ~~twelve and one-half~~ fifty acre-feet [~~15418.52~~ 61674.08 cubic meters] of water or twenty-five acre-feet [30837.04 cubic meters] of water for a medium-hazard or high-hazard dam, has been established or constructed by a landowner or tenant contrary to this title or any rules adopted by the board, the board shall notify the landowner by registered mail at the landowner's post-office address of record. A copy of the notice must also be sent to the tenant, if any. The notice must specify the nature and extent of the noncompliance and must state that if the dike, dam, or other device is not removed within the period the board determines, but not less than fifteen days, the board shall cause the removal of the dike, dam, or other device and assess the cost of the removal, or the portion the board determines, against the property of the landowner responsible. The notice must also state that the affected landowner, within fifteen days of the date the notice is mailed, may demand, in writing, a hearing upon the matter. Upon receipt of the demand, the board shall set a hearing date within fifteen days from the date the demand is received. In the event of an emergency, the board may immediately apply to the appropriate district court for an injunction prohibiting the landowner or tenant from constructing or maintaining the dike, dam, or other device, or ordering the landowner to remove the dike, dam, or other device. Assessments levied under this section must be collected in the same manner as other assessments authorized by this chapter. If, in the opinion of the board, more than one landowner or tenant has been responsible, the costs may be assessed on a pro rata basis in proportion to the responsibility of the landowners. A person aggrieved by action of the board under this section may appeal the decision of the board to the district court of the county in which the land is located in accordance with the procedure provided in section 28-34-01. A hearing as provided for in this section is not prerequisite to an appeal.

89-14-01-05. Allowable headwater. The allowable maximum headwater when passing the design discharge must be measured from the bottom of the channel. For arch pipes, the maximum allowable headwater must be based on the rise of the pipe, and the pipe size category must be the equivalent round pipe size. For multiple pipe installations, the pipe diameter used to calculate the allowable headwater must be the diameter of the largest pipe. Tailwater resulting from downstream conditions, either natural or manmade, must be accounted for in the determination of the crossing's capacity and the resulting headwater. Additional guidance is provided in the North Dakota department of transportation design manual.

Streambed Slope (feet/mile)	Pipe Size	Allowable Headwater
< 5	24" - 54"	pipe diameter + 2 feet
	≥ 60"	1.5 pipe diameters
5 to 10	24" - 36"	pipe diameter + 2 feet
	42" - 54"	1.5 pipe diameters
	≥ 60"	2 pipe diameters
> 10	≥ 24"	2 pipe diameters

History: Effective May 1, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1

89-14-01-06. Deviations. The board of county commissioners, board of township supervisors, their contractors, subcontractors, or agents, or any individual, firm, corporation, or limited liability company may deviate from the standards contained in this chapter if the deviation is approved in writing by the state engineer and the director of the department of transportation. A request to deviate from the standards must be made in writing and must set forth the reasons for the deviation. The state engineer and department of transportation may grant a deviation for good and sufficient cause after considering public safety, upstream and downstream impacts, and other relevant matters. The department of transportation may deviate from these standards if the director of the department determines it is appropriate to do so and the crossings are designed in accordance with scientific highway construction and engineering standards. The basis for the director's decision must be documented in writing. If a crossing results in less than one-half foot [15.24 centimeters] of headloss when passing the appropriate design discharge, the headwater limitations of section 89-14-01-05 do not apply.

Roads constructed as part of a surface coal mining operation for use solely as part of the mining operation are not subject to the requirements of this chapter. Roads constructed as a result of a surface coal mining operation for use by the public are bound by the requirements of this chapter, but deviations may be requested in accordance with this section.

History: Effective May 1, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1

Appendix C

North Dakota Administrative Code

Article 89-14

Stream Crossings

NORTH DAKOTA ADMINISTRATIVE CODE

ARTICLE 89-14

STREAM CROSSINGS

Chapter
89-14-01 Stream Crossing Design

**CHAPTER 89-14-01
STREAM CROSSING DESIGN**

Section
89-14-01-01 Standards
89-14-01-02 Definitions
89-14-01-03 Design Flood Frequency
89-14-01-04 Floodplain Consideration - Upstream Development
89-14-01-05 Allowable Headwater
89-14-01-06 Deviations

89-14-01-01. Standards. Except as provided in section 89-14-01-06, all highways constructed or reconstructed by the department of transportation, board of county commissioners, board of township supervisors, their contractors, subcontractors, or agents, or by any individual firm, corporation, or limited liability company must be designed to meet the standards contained in this chapter. The department, or any board of county commissioners, board of township supervisors, their contractors, subcontractors, or agents, or any individual, firm, corporation, or limited liability company that fails to comply with these standards is not entitled to the immunity provided in section 24-03-06, 24-03-08, or 24-06.26.1 of the North Dakota Century Code.

History: Effective May 1, 2001; amended effective July 27, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1

89-14-01-02. Definitions.

1. "Construct" means to construct a new highway on a new location or corridor.
2. "Reconstruct" means to regrade or widen an existing roadbed on the existing highway location. For purposes of this chapter, reconstruct also includes replacing, modifying, or installing a stream crossing.

History: Effective May 1, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1

89-14-01-03. Design flood frequency. The following table provides the recurrence interval of the event for which each type of crossing must be designed. This represents a minimum design standard. Nothing contained in this chapter is intended to restrict the road authority from providing greater capacity.

Type of Crossing	State Highway System						County	
	Urban System		Rural System				Rural System	
	Regional	Urban Roads	Principal Arterial		Minor Arterial	Major Collector	Major Collector	Off ⁴ System
Interstate			Other					
Bridges & Reinforced Concrete Boxes	25 year ²	25 year ²	50 year ²	50 year ²	50 year ²	25 year ²	25 year ^{2,3}	15 year ^{2,3}
Roadway Culverts	25 year ²	25 year ²	50 year ²	25 year ²	25 year ²	25 year ²	25 year ^{2,3}	15 year ^{2,3,5}
Storm Drains	10 year ¹	5 year ¹	10 year ²	10 year ²	10 year ²	10 year ²		
Underpass Storm Drains	25 year ¹	25 year ¹	50 year ²	25 year ²	25 year ²	25 year ²		

¹ Discharges shall be computed using the rational method or other recognized hydrologic methods.

² Discharges shall be computed using United States geological survey report 92-4020 or other recognized hydrologic methods.

³ If an overflow section is provided, the pipes and the overflow section, in combination, must pass the appropriate design event within the headwater limitations provided in this chapter.

⁴ Off system roads include all township roads.

⁵ For township roads, the recurrence interval is 10 years.

History: Effective May 1, 2001; amended effective July 27, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1

89-14-01-04. Floodplain consideration - Upstream development. All stream crossings must comply with applicable floodplain regulations and regulatory floodway requirements. If a stream crossing is being replaced and buildings or structures are located upstream from the crossing, the stream crossing must not be constructed or reconstructed in a manner that increases the likelihood of impacts to those upstream buildings or structures from that which existed with the stream crossing being replaced, even if the capacity of the crossing being replaced was greater than the capacity otherwise required by this chapter. Any stream crossing constructed as part of a newly constructed roadway shall be constructed to pass a one hundred-year event without the resulting increase in headwater impacting any existing buildings or structures. Structures, for the purposes of this section, include grain bins, silos, feedlots, and corrals. Structures do not include pasture fencing.

History: Effective May 1, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1

89-14-01-05. Allowable headwater. The allowable maximum headwater when passing the design discharge must be measured from the bottom of the channel. For arch pipes, the maximum allowable headwater must be based on the rise of the pipe, and the pipe size category must be the equivalent round pipe size. For multiple pipe installations, the pipe diameter used to calculate the allowable headwater must be the diameter of the largest pipe. Tailwater resulting from downstream conditions, either natural or manmade, must be accounted for in the determination of the crossing's capacity and the resulting headwater. Additional guidance is provided in the North Dakota department of transportation design manual.

Streambed Slope (feet/mile)	Pipe Size	Allowable Headwater
< 5	24" - 54"	pipe diameter + 2 feet
	≥ 60"	1.5 pipe diameters
5 to 10	24" - 36"	pipe diameter + 2 feet
	42" - 54"	1.5 pipe diameters
	≥ 60"	2 pipe diameters
> 10	≥ 24"	2 pipe diameters

History: Effective May 1, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1

89-14-01-06. Deviations. The board of county commissioners, board of township supervisors, their contractors, subcontractors, or agents, or any individual, firm, corporation, or limited liability company may deviate from the standards contained in this chapter if the deviation is approved in writing by the state engineer and the director of the department of transportation. A request to deviate from the standards must be made in writing and must set forth the reasons for the deviation. The state engineer and department of transportation may grant a deviation for good and sufficient cause after considering public safety, upstream and downstream impacts, and other relevant matters. The department of transportation may deviate from these standards if the director of the department determines it is appropriate to do so and the crossings are designed in accordance with scientific highway construction and engineering standards. The basis for the director's decision must be documented in writing. If a crossing results in less than one-half foot [15.24 centimeters] of headloss when passing the appropriate design discharge, the headwater limitations of section 89-14-01-05 do not apply.

Roads constructed as part of a surface coal mining operation for use solely as part of the mining operation are not subject to the requirements of this chapter. Roads constructed as a result of a surface coal mining operation for use by the public are bound by the requirements of this chapter, but deviations may be requested in accordance with this section.

History: Effective May 1, 2001.

General Authority: NDCC 24-02-01.1, 24-02-01.5, 28-32-02, 61-03-13

Law Implemented: NDCC 24-03-06, 24-03-08, 24-06-26.1