

Technical Memorandum

Regional Stormwater Improvements West of North Washington Street City of Bismarck, ND

To: Brad Wright, PE
City of Bismarck Engineering Department

From: Apex Engineering Group, Inc.
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Re: Regional Stormwater Improvements West of Washington Street
Bismarck, ND
Project No. 12.105.0055

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This technical memorandum constitutes our understanding of items discussed and decisions reached. In the event there are questions, additions, or corrections, please contact the author.

Introduction

This technical memorandum addresses Apex Engineering Group's update of the North Washington Street Watershed InfoSWMM model. As development plans west of North Washington Street are progressing, the developers have requested information about the size and location of properties that will be required for regional stormwater facilities. Apex Engineering Group was tasked with updating the model west of Washington Street and determining the required regional stormwater facilities west of Washington Street and south of 57th Avenue.

The Mica, Flint, and Normandy crossings were designed using the TP-40 rainfall data and older hydrologic soil group ratings, producing less runoff than the updated datasets. The City of Bismarck's memo dated June 13, 2014 requires stormwater infrastructure to be analyzed and designed using newly



published rainfall data and updated hydrologic soil group ratings. The regional stormwater facilities upstream of North Washington Street will be designed to these new standards. The flow rate at Washington Street will also be limited to the previously modeled parameters including the master planned facilities, TP 40 rainfall and the older hydrologic soil group ratings.

Hydrologic Model Input

The North Washington Street Watershed InfoSWMM model was updated to reflect changes in hydrologic soil group ratings, development and land use changes, and rainfall data. Additional subcatchments were delineated to correspond with preliminary plats and the preliminary Heritage Ridge Stormwater Management Plan (SWMP) provided by the City of Bismarck. Land use was only updated for subcatchments that are upstream of the 7’x5’ box culvert under North Washington Street. On June 13, 2014 the City of Bismarck issued a memo requiring the use of the NRCS’s updated hydrologic soil group ratings for soils in Burleigh County. The soils data was updated over the entire watershed, where the rating changed from predominantly “B” soils to predominantly “C” soils. These three factors (hydrologic soil group, subcatchment areas, and land use) were used to calculate new curve numbers for the entire watershed. In general, the changes in hydrologic soil group and land use cause an increased amount of runoff over the entire modeled watershed.

The curve numbers (CN) that were calculated for Heritage Ridge were compared to the curve number values in the preliminary Heritage Ridge SWMP. The CN values in the SWMP were reviewed and found to be slightly more conservative overall than the calculated values. For this reason the CN values in the SWMP were used to update the InfoSWMM model.

Values for time of concentration were updated for subcatchments upstream of the 7’x5’ box culvert under North Washington Street. The values for the Heritage Ridge Subdivision were reviewed and found to be adequate. The times of concentration in the InfoSWMM model were updated with the values from the Heritage Ridge SWMP, with the exception that a minimum value of 10 minutes was applied to align it with the rest of the model. For subcatchments not included in Heritage Ridge, the time of concentration was calculated using the longest flow path and taking sheet flow into account where appropriate.

Another input parameter that affects the runoff in the InfoSWMM model is rainfall. The June 13, 2014 memo also required the use of NOAA’s recently published Atlas 14 rainfall data. In general, the updated rainfall data shows an increase over the TP-40 dataset rainfall depths for the storm events that are required to be analyzed for regional stormwater facilities. These increases can be seen in Table 1.

Table 1: Rainfall Data

Storm Event	TP-40 Data	Atlas 14 Data
2-Year, 6-Hour	1.6”	1.63”
10-Year, 6-Hour	2.5”	2.49”
25-Year, 6-Hour	3.0”	3.18”
100-Year, 6-Hour	3.8”	4.45”

For comparison purposes, a model simulation using the old TP-40 rainfall data and the old hydrologic soil group ratings was updated with new subcatchments and land use. Curve numbers were calculated for subcatchments upstream of the 7’x5’ box culvert under North Washington Street using the new land



use values. The times of concentration used in the updated model are the same as those used with the old dataset. This version of the model would be considered an updated version of the original InfoSWMM model.

Hydraulic Model Input

Hydraulic components of the model were updated in subcatchments upstream of the 7'x5' box culvert under North Washington Street. The Heritage Ridge SWMP was reviewed by Apex Engineering and the subcatchments, detention ponds and pipe sizes and grades were included in the InfoSWMM model. One exception that was not included in the InfoSWMM model is that the preliminary Heritage Ridge SWMP proposed a detention pond offsite, north of their property on a developed lot in Crested Butte Subdivision. This lot is an unlikely location for a regional pond, therefore the storage from this pond was combined with another proposed pond in subcatchment HR-3 on the east edge of the site, to control the runoff. The Burleigh County Highway Department provided as-built drawings for the grade raise that was completed on 57th Avenue in 2014 and the grade raise under construction in 2015. This included road elevations and inverts for culverts through 57th Avenue.

The 2007 North Washington Watershed Masterplan model included three regional ponds upstream of North Washington Street and downstream of 57th Avenue. The locations of these three ponds are the two existing stock dams just west of the 7'x5' culvert through North Washington Street and another pond to the south that discharges west of the two stock dams. Based on a concept development layout provided by the developer's representative, the two original stock ponds (Ponds 1 and 2) were updated with new structures and increased in size using the City of Bismarck 2013 LiDAR contours to develop storage curves. Storage was kept within the coulee and off of private property utilizing the concept drawing. The South Pond 3 storage was also estimated from the preliminary development plan.

Model Results

After several iterations of different modeling scenarios, it was determined that the increased runoff caused by the updated rainfall and soil data has created a need for more storage in this area of the watershed. On the 100-year, 6-hour event, the soil and rainfall data changes produce an additional 77 acre-feet of runoff upstream of the 7'x5' box culvert under North Washington Street. This volume increase needs to be managed to limit the peak flow through the existing Washington Street crossing to the flow rate produced by the older data set results.

The basic criteria of maintaining the flow rate through Washington Street from the previous design model was evaluated; however the original master planned facilities provided very little detention west of Washington Street. The pond outfall structures provided a small reduction in peak discharge due to sizes and lack of available storage. The changes in rainfall and hydrologic soil group ratings can be mitigated by additional storage and smaller outlet structures than originally master planned for in this area.

The required ponds are shown in Figure 2. Ponds 1 and 2 were developed at the existing stock dam embankment locations. The embankment and spillway locations/elevations can be adjusted as development plans progress; however, the hydraulics of these ponds are sensitive to the downstream water surface elevations. Therefore, setting the final pond locations/storage/elevations should be an iterative process with the developer in order to ensure that the goals of the regional storage are maintained. Pond 3 was located upstream of the future Lasalle Drive, with no roadway elevation provided by the developer's representative. It appears that portions of Pond 3 could be excavated to



maximize the available storage. Embankment elevations should be checked against road elevations as they become available from the developer. The storage results for the model can be found in Table 2.

Table 2: Pond Data

Pond	Invert ^[1] (NGVD 29)	Depth (ft)	WSE Elevation (NGVD 29)	Volume Used (ac-ft)	Freeboard Elevation (NGVD 29)	Surface Area at Freeboard Elevation (Acres)
Pond 1 – East Pond	1858.6	9.7	1868.3	20.5	1869.3	4.7
Pond 2 – West Pond	1864.6	12.1	1876.7	17.3	1877.7	5.5
Pond 3 – South Pond	1887.6	6.6	1894.2	17.0	1895.2	3.6

[1] Pond invert elevations are based on 1-foot contours in the vertical datum NAVD 1988. NGVD is 1.36-feet lower than NAVD 1988.

The volumes and surface areas described in Table 2 are the result of preliminary design using a multi-stage weir structure and single pipes through each embankment. One foot of freeboard is available in each pond based on the preliminary volumes used to develop the model.

Preliminary Opinion of Costs

A preliminary opinion of costs (OPC) has been prepared in order to give the City an indication of the anticipated costs associated with constructing these regional stormwater facilities. The preliminary OPC including engineering/legal/administrative is \$1,603,000. The OPC does not include land costs.

Conclusion

The updated rainfall and soils data have caused an increase in the amount of runoff that needs to be managed. Regional stormwater improvements west of North Washington Street should be designed to limit the flows at Washington Street to the previously modeled parameters. To do this, it is recommended that the City construct three regional detention ponds west of Washington Street and south of 57th Avenue as they are laid out in Figure 2. Ponds 1 and 2 are based on existing contours, but could be changed based on the Developer’s grading plan. Pond 3 is based on estimated contours from the preliminary development plan. As grading plans and development layouts are further defined, the model should be updated to ensure that the goals of the regional storage are maintained. Before the City purchases any property, the property owner should certify that all wetland easements and other encumbrances have been released.





