City of Novi
Storm Water Master Plan Phase II

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I. EXECUTIVE SUMMARY

Purpose of Study

The City of Novi contracted with Orchard, Hiltz and McCliment, Inc. (OHM) to complete the second phase of their most recent update to their Storm Water Master Plan. This phase is aimed at addressing two recommendations provided in the 2005 Master Plan Update including:

- Determining necessary improvements to increase existing regional detention basin effectiveness in improving stream water quality and flood protection.

- Providing recommendations for improvement to the City’s soil erosion and sedimentation control (SESC) program.

This report is aimed at addressing the first component and is being developed for the City to use as a guide for its storm water management 5-year capital improvement program. The second component relating to SESC is addressed in a separate report.

Summary of Findings

A summary of our pertinent findings is listed below:

Regional Basin Jurisdiction, Policy, and Maintenance

1. Meadowbrook Glens Basin is listed as an outlot on the subdivision plat. Therefore, it is our understanding that the subdivision homeowner’s association has responsibility for operation and maintenance of this basin.

2. Easement documents and a maintenance agreement could not be located for the Jamestown Green Basin. It is our understanding that the homeowner’s association has the operation and maintenance responsibilities of this facility.

3. The Ingersol Basin functions as a regional basin and is owned/operated by the Michigan Department of Transportation.

4. The Twelve Oaks Basin functions as a regional basin but the ownership, including operation and maintenance, is the responsibility of the Twelve Oaks Mall.

5. The City’s current policy of requiring sedimentation basins for new or redeveloped sites located upstream of regional basins significantly aids in reduction of sediment into the City’s watercourses and therefore should be continued.
6. The 2005 Storm Water Master plan indicated an area of flooding caused by regional issues in the area along Ingersol Creek and the Meadowbrook Lake District, near the confluence of the Walled Lake Branch of the Middle Rouge and Bishop Creek.

7. General maintenance for the regional detention basins consists of mowing of embankments and around the perimeter of the “wet” pond storage areas, and removal of debris from the outlet control structures. Mowing of these areas costs approximately $6,000 per year. Removal of debris is dependent on the number of rain/runoff events each year. On average the City checks each structure before and after each rain event. This amounts to approximately $40,000 per year. As part of maintenance, the City periodically dredges around basin inlets and outlets. This amounts to approximately $5,000 per year.

Lack of Buffer Areas

8. The Taft, West Oaks, Meadowbrook Glens, Lexington Green, Thornton, Jamestown Green and Cedar Springs Basins are having their buffer areas mowed extremely close to the water’s edge either by City maintenance staff or nearby homeowners. Two basins, West Oaks and Cedar Springs, exhibit significant algae growth in their wet pond areas, which is primarily attributed to minimal buffers and excessive phosphorous contributions. These nutrients contributions are often the result of excessive fertilizer use and geese and pet droppings. It is assumed that Jamestown Green also exhibits algae growth since it is treated with chemicals.

Inlet/Outlet Repairs

9. Erosion is jeopardizing the integrity of inlet or outlet pipes to the Taft, West Oaks, Meadowbrook Glens, and Thornton Basins.

10. An inlet pipe to the Meadowbrook Glens Basin is crushed and clogged with debris.

11. The outlet structure grates on the 10-year and 100-year control structures for the West Oaks, Meadowbrook Glens, Civic Center, Ingersol, and Thornton Basins have significant potential to collect debris and cause premature embankment overtopping.

12. The concrete aprons located at the outlet of the control structures for the Civic Center and Cedar Springs basins are cracked and not properly dissipating velocities.
Sediment Erosion/Deposition

13. Visible sediment deposition is occurring in the "wet pond" areas of the Taft, C&O, West Oaks, Bishop, and Cedar Springs basins. Significant deposition has also occurred in the sediment basin located near the Grand River (Leavenworth) Basin.

14. Undercut banks were observed at the Taft, Bishop and C&O Basins. Undercut banks result from high velocity flow and can contribute to additional erosion and sediment deposition in areas with a flat stream gradient.

Lack of Attenuation

15. Of the four regional detention basins indicated to have little to no attenuation (reduction in peak discharge) for the 2 through 100-year recurrence interval events, three of these (Taft, Bishop, and C&O) are located upstream of Meadowbrook Lake and are either a tributary to or on the Walled Lake Branch of the Middle Rouge River. The Lexington Green Basin is the only regional detention facility with inadequate attenuation that is not located upstream of Meadowbrook Lake.

16. From our investigation and review of previous studies, it is apparent that full bank flows occur too frequently on the Walled Lake Branch of the Middle Rouge and are a significant cause to its current stream water quality degradation, stream bank erosion and incision problems.

17. It would be very difficult to retrofit the four basins that have inadequate attenuation to obtain additional attenuation at low frequency events (50, 100-year) since increasing attenuation would increase 100-year floodplain water surface elevations. Retrofitting basin outlets (by reducing the outlet capacity) in order to provide greater attenuation for large storm events will cause the 100-year water surface elevation to increase. However, it may be possible to retrofit the control structures for attenuation of smaller storms while preserving the 100-year water surface elevation.
Summary of Recommendations

As in the findings, our recommendations are divided into the same categories. A summary of our pertinent recommendations is as follows:

Regional Basin Jurisdiction, Policy, and Maintenance

1. Any findings and recommendations related to the Meadowbrook Glens, Jamestown Green, Ingersol and Twelve Oaks Basins should be brought to the proper owners for corrective action, if required.

2. The City’s policy of requiring sedimentation basins, at a minimum, for new or redeveloped sites should be continued. Based on the results of the 2005 Master Plan Update, new sites located upstream of the confluence of the Ingersol Creek, Bishop Creek, and the Walled Lake Branch of the Middle Rouge River should be required to detain runoff as per the City’s ordinance and not be allowed to discharge undetained storm water runoff.

3. The City, as well as private owners, should continue its basin maintenance practices (with some restrictions to mowing as mentioned in this report). The City should also dredge basin inlets and outlets approximately every three years as part of its maintenance practices.

Lack of Buffer Area

4. Leave a no-mow zone around all of the regional basins currently being mowed. It should be noted that this does not apply to the basin embankments or outlet control structures. This practice should begin immediately. No-mow signs could be placed along the perimeter to reinforce the no-mow zone.

Inlet/Outlet Repairs

5. Correct the erosion around the inlet pipes at the Taft, West Oaks and Thornton Basins by placing compacted fill around and under each inlet pipe identified with this problem. Restore with topsoil, seed and mulch.

6. The crushed inlet pipe at Meadowbrook Glens should be cleared of debris and repaired or replaced by the homeowner’s association.

7. Remove the concrete aprons and replace with non-woven geotextile fabric and rip-rap at the Civic Center and Cedar Springs Basins.

8. To help prevent debris buildup, replace control structure grates or retrofit grates by raising 4 to 6 inches above concrete on the West Oaks, Meadowbrook Glens, Thornton, and Civic Center Basin outlet control structures.
9. Sediment deposition in each of the regional basin wet pond areas is below the elevation of the outlet and is therefore not impacting the storage volume provided by the basins. Since the sediment is not impacting the storage volume, removal does not have to be immediate and instead should be done in conjunction with other projects.

10. Sediment deposition in the pre-treatment sedimentation basin at the Leavenworth (Grand River) Basin should be removed to design grades, the outlet control structure should be retrofitted, and the existing underdrains should be abandoned.

**Lack of Attenuation**

11. Investigate potential retrofitting of the Taft, Lexington Green, Bishop, and C&O Basins to restrict high frequency (bank full, 2-year) events.

12. Initiate a pilot program by installing temporary bulkheads at the Taft, Lexington Green, Bishop, and C&O Basins. Monitor flows to aid in evaluation of benefits. If significant benefits are found, permanent retrofits can be installed. This would need to be initiated by contacting the MDEQ to determine permitting, analysis, and other requirements.

13. During the pilot program, evaluate potential retrofits for increasing low frequency (50-year, 100-year) attenuation.

14. An additional funding mechanism is available to supplement existing funding. The MDEQ's S2 grant (State Revolving Fund (SRF) and Strategic Water Quality Initiatives Fund (SWQIF)) has a 10% match and can be used for project planning and design. If this grant is used, an SRF loan would be required to be used for construction funding. It is anticipated that additional S2 grant funding will become available in 2007.

15. Due to flooding in the Meadowbrook Lake District, all new development sites upstream of this location should be required to fully detain runoff to the City’s current ordinances.
Summary of Capital Improvement Costs

Preliminary estimates indicate that in order to complete the recommendations for basin improvements, it will cost approximately $1,050,000 over the next 5 years. Basins were prioritized as High, Medium, or Low. High priority basins should be addressed within the first 2 years, Medium priority basins should be addressed within the first 4 years, and Low priority basins should be addressed within the next 5 years. A summary of the costs by City owned/operated basin and corresponding priority are summarized below:

<table>
<thead>
<tr>
<th>Basin</th>
<th>Priority</th>
<th>Implementation</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taft Road</td>
<td>High</td>
<td>By Year 2</td>
<td>$173,000</td>
</tr>
<tr>
<td>Bishop</td>
<td>High</td>
<td>By Year 2</td>
<td>$127,000</td>
</tr>
<tr>
<td>C&amp;O</td>
<td>High</td>
<td>By Year 2</td>
<td>$162,000</td>
</tr>
<tr>
<td>Cedar Springs</td>
<td>High</td>
<td>By Year 2</td>
<td>$83,000</td>
</tr>
<tr>
<td>West Oaks</td>
<td>High</td>
<td>By Year 2</td>
<td>$84,000</td>
</tr>
<tr>
<td>Ingersol</td>
<td>Medium</td>
<td>By Year 4</td>
<td>$12,000 (cost share with MDOT)</td>
</tr>
<tr>
<td>Civic Center</td>
<td>Medium</td>
<td>By Year 4</td>
<td>$148,000</td>
</tr>
<tr>
<td>Lexington Green</td>
<td>Low</td>
<td>By Year 5</td>
<td>$28,000</td>
</tr>
<tr>
<td>Thornton</td>
<td>Low</td>
<td>By Year 5</td>
<td>$139,000</td>
</tr>
<tr>
<td>Leavenworth</td>
<td>Low</td>
<td>By Year 5</td>
<td>$90,000</td>
</tr>
</tbody>
</table>

Total for Years 1-2 $629,000  
Total for Years 3-4 $160,000  
Total for Year 5 $257,000

Total All Basins $1,046,000

The City should also reserve up to an additional $500,000 to evaluate stream banks and implement stream bank restoration projects for stream reaches that are exhibiting excessive erosion and are determined to be a high priority.
II. INTRODUCTION

Background

The City currently has 15 regional storm water detention basins. Most of these facilities were constructed in the 1980’s with the most recent basins, the Dunbarton Pines Regional Detention Basin and the Haggerty Regional Detention Basin, constructed between 2004 and 2006. The Dunbarton detention basin is the only "off-line" regional basin. The Haggerty regional basin is partially "off-line" with the remaining 13 basins being "on-line." Off-line basins are located upstream of a watercourse and discharge to the watercourse. On-line basins are generally located within a watercourse and in some cases may be considered wetlands. As water levels in a watercourse increase, overflow is allowed to be stored in the adjacent on-line basins. Several of these basins are in the extreme upstream end of their subwatershed and may therefore be thought of as off-line basins. These include West Oaks and Meadowbrook Glens. The location of each of the regional basins is shown on Figure 1.

It was discovered that 3 of the basins investigated as part of this study are not owned by the City. These are the Ingersol, Meadowbrook Glens, and Jamestown Green Basins. The City has an agreement with MDOT to share maintenance costs for the Ingersol Basin.

Specific detention basin problems were identified in the 2005 Master Plan Update through a needs assessment. The needs assessment consisted of discussions with City personnel and performing a field reconnaissance of the City’s storm water management system.

This report is aimed at addressing one of the specific problems noted in the 2005 Master Plan: determining if the regional basins are performing at an adequate level to provide water quality, flood protection, and stream bank protection.

Study Methodology

To determine the most effective way to increase existing regional detention basin effectiveness in stream water quality and flood protection, the following tasks were performed in order to define problems associated with each basin:

Information Review

This task involved reviewing information available from the City. Information reviewed includes the 1983, 1992 and 2005 Storm Water Master Plans, regional detention basin plans that were available at the City, GIS topographic information, and floodplain mapping. This information allowed us to make comparisons to the survey and visual observations to determine changes that have occurred at each detention facility. Also, the City provided easement documents for regional basins that were on file. Copies of these documents are included in Appendix A.
Topographic Survey
This task included performing a topographic survey of the four regional detention basins (Bishop, C&O, Cedar Springs, and Taft Basins) that are suspected of having minimal attenuation and sediment accumulation problems. When available, the topographic survey was compared to original construction plans to determine differences in storage volume. The collected survey is summarized in a map for each of the surveyed basins, which can be found in Appendix B. It should be noted that survey of the Lexington Green Basin was not performed since it was obvious that the storage area has not changed since basin construction.

Field Reconnaissance
Because the Dunbarton and Haggerty Basins are newly constructed, our focus was on the remaining 13 regional detention basins. A field reconnaissance of each of these 13 regional detention basins was performed. Figure 1 shows the locations of the investigated basins. The purpose of the reconnaissance was to visually identify problems associated with each of the 13 regional facilities. Field notes for the visited sites can be found in Appendix C. Our visual observations from the field reconnaissance were used as the basis for the prioritization of improvements for the Capital Improvements Program.
Figure 1: Regional Detention Basin Location Map

Legend

- Detention Basin Location

1. Taft *
2. West Oaks
3. Ingersol**
4. Haggerty
5. Bishop *
6. Meadowbrook Glens**
7. C&O *
8. Civic Center
9. Lexington Green *
10. Thornton
11. Jamestown Green**, ***
12. Cedar Springs *
13. Leavenworth (Grand River)
14. Dunbarton
15. Twelve Oaks**

Streams

Municipal Boundary
Open Water
Natural Wetlands
Roads

* Previous studies indicate basin provides limited attenuation
** Basin not owned or operated by City
*** Basin not regional but was included in this study
III. FINDINGS AND RECOMMENDED IMPROVEMENTS

A field reconnaissance of the basins was performed on August 8 and 17, 2006. In addition, several follow-up visits were made in order to collect additional information. Figure 1 shows the locations of the investigated basins. The field reconnaissance allowed us to determine specific items that, if addressed, will increase water quality, minimize erosion sources, and correct maintenance issues at each facility. Types of problems that were noted include sediment deposition, erosion, lack of adequate buffers, problems associated with basin inlets/outlet, and algae growth.

This section contains a summary of the recommendations for improvements, prioritization of the basin improvements, followed by a detailed discussion of findings and associated recommendations organized by basin.

Summary of Recommendations

Recommendations were grouped in to 5 general categories: lack of buffer, inlet/outlet repairs, sediment erosion/deposition, and lack of attenuation. The fifth category, Regional Basin Jurisdiction, Policy, and Maintenance, is not discussed in detail here since the items under that category do not impact the costs outlined in the Capital Improvement Program.

Lack of Buffer

Leave a no-mow zone around all of the regional basins currently being mowed. It should be noted that this does not apply to the basin embankments. Allowing a vegetative grow zone around the basins helps both water quality and helps to stabilize banks. Vegetation filters pollutants from entering the basin from direct runoff. The roots of the vegetation also help to hold soil in place and prevent erosion. Implementing a no-mow zone should begin immediately. An example “no-mow” sign, which can be modified to be specific to Novi, is included in Appendix D.

In the case of the Taft, West Oaks, C&O, and Cedar Springs Basins, it is recommended that the existing non-native vegetation be eradicated and restored with native species. This restoration work should be completed at the time of the other corrections needed at each of these basins.

Inlet/Outlet Repairs

Correct the erosion around the inlet pipes at the Taft, West Oaks and Thornton Basins by placing compacted fill around and under each inlet pipe identified with this problem. Restore with topsoil, seed and mulch.

The crushed inlet pipe at Meadowbrook Glens should be replaced.
The concrete aprons should be removed and replaced with non-woven geotextile fabric and rip-rap at the Civic Center and Cedar Springs Basins. Replacing the concrete aprons with rip-rap will help reduce exit velocities and therefore help to prevent downstream erosion.

To help prevent debris buildup on regional basin control structures, replace control structure grates or retrofit grates, by elevating the grates with a galvanized C-channel or spacer under each bolt, 4 to 6 inches above concrete on the West Oaks, Meadowbrook Glens, Thornton, and Civic Center Basin outlet control structures.

**Sediment Erosion/Deposition**

Sediment has accumulated in many of the in-line basins, which originally had at least a portion of their storage area excavated to create a "wet pond" area. Since the excavated areas were below the low level outlet, sediment deposition generally does not impact the available storage volume and therefore will not impact attenuation of flow. However, after the excavated area fills with sediment, larger storm events may "flush" or resuspend the sediment and cause an unnatural, excessive amount of sediment to move into downstream areas. Excessive sediment movement is a partial contributor to stream bank erosion.

In lieu of excavating large wet pond areas to collect sediment as was done previously, more innovative techniques involve allowing unnatural sediment to be controlled at its source. Source control is being investigated as a separate task, and the report is included as a separate section of this report.

Since not all sediment can be controlled at the source, future installation of strategically placed in-line sediment traps are recommended. Many trout stream restoration groups have been utilizing this technique for over 15 years with excellent success. In those cases, the traps are for removal of sediment from the logging era that has covered the natural substrate for 50 to 100 years. The MDNR has completed numerous studies showing the success of this practice.

Sediment deposition that has occurred in the “wet pond” area of the West Oaks, Bishop, Jamestown Green and Cedar Springs Basins should be left in place and investigated for removal with other capital improvement projects associated with each individual basin. It appears that the sediment deposition is below the elevation of the outlet and is therefore not impacting the storage volume provided by the basins. Since the sediment is not impacting the storage volume, removal does not have to be immediate and instead should be completed in conjunction with CIP projects for each basin.

**Lack of Attenuation**

Another source of sediment in the City's watercourses is from bank erosion. Unnatural bank erosion is occurring because of excessive bank full flows. For example, prior to development a bank full event may have occurred once or twice per year. During these
flows, bank vegetation is disturbed but would "heal" itself since the event occurred infrequently. After development, in areas with inadequate controls for these events, bank full flows may occur much more frequently. Therefore, the vegetation doesn't have a chance to "heal" and bank erosion, channel incision, and channel widening occur, sending unnatural sediment into the watercourse.

To correct this problem, we recommend first getting full bank flows under control. Requiring new developments to provide multi-stage outlet structures on site detention basins should therefore continue.

In order to reduce the frequency of bank full events in the City's watercourses, we recommend initiating a pilot study in one to all four of the regional basins which currently exhibit minimal attenuation (i.e. Taft, Bishop, C&O, and Lexington Green Basins). It should be noted that all four of these basins were some of the first regional basins constructed in the City. As technology improved, the design of many of the basins was improved to adequately detain a wide range of flows. The first step in the pilot program would be to meet with the MDEQ to determine analysis and permit requirements, flow monitoring requirements, and evaluation frequency.

At this same time the City should discuss potential in-line sediment trap locations, retrofit of wet-pond areas, and other basin retrofit opportunities such as stream restoration and plantings within the wet pond areas.

Once these issues are agreed upon with the MDEQ, we recommend that the City apply for the appropriate MDEQ permits and prepare construction documents for either permanent or temporary bank full flow outlet control structure retrofits for the four basins with inadequate attenuation upstream of Meadowbrook Lake on the Middle Rouge. Determination of temporary versus permanent retrofits will be based on MDEQ requirements and the availability of City staff to assist with retrofitting. Pre- and post-retrofit flow monitoring should also be considered for part of the pilot program. Monitoring would provide model verification, help determine pilot project benefits, and provide data for future storm water management projects within the City.

Therefore, we recommend investigation of a potential retrofitting of the Taft, Lexington Green, Bishop, and C&O Basins to restrict high frequency (bank full, 2-year) events.

This would include initiation of a pilot program by installing temporary bulkheads at the Taft, Lexington Green, Bishop, and C&O Basins; and monitoring flows to aid in evaluation of benefits. Each retrofit would need to be individually evaluated based on its hydraulics. We envision the retrofit to include bulk heading with plates the various structure overflow openings to achieve the desired results. If significant benefits are found, permanent retrofits can be installed. This would need to be initiated by contacting the MDEQ to determine permitting, analysis, and other requirements.
Prioritization

In order to aid in the prioritization of improvements, a matrix to score improvements by regional basin was developed. The matrix includes key aspects that affect basin attenuation and water quality within, and downstream of, each of the basins. The items included in the matrix include attenuation percent, depth of sediment within the storage area, structural problems associated with the inlet and outlet control structures, algae growth in storage area, drain condition (erosion, incision), and quality of vegetation. A numerical rating was applied to each characteristic to provide an overall numerical rating for each basin. Based on the numerical rating, a low, medium, or high priority was assigned to each basin. This method served as the guide for categorizing and establishing recommendation priorities.

Table I outlines the basin characteristics that impact attenuation (storage) and water quality and the rankings for each of these basins. Basins with a high priority generally negatively impact downstream water quality and provide minimal benefits with regards to peak flow reduction. Medium priority basins have some benefits but could provide additional flow and/or water quality benefits with minor revisions to maintenance practices. Low priority basins have minor issues and generally provide significant peak flow reduction (attenuation).
### TABLE I  
CHARACTERISTIC RANKING WORKSHEET  
Regional Detention Basin Evaluation

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>RANK</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEGREE OF ATTENUATION</td>
<td>1</td>
<td>76% or above</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>56% - 75%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>36% - 55%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>16% - 35%</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0% - 15%</td>
</tr>
<tr>
<td>100-YR INFLOW</td>
<td>1</td>
<td>100 cfs or less</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>100 – 200 cfs</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>200 – 400 cfs</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>400 - 600 cfs</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>600 cfs or above</td>
</tr>
<tr>
<td>SEDIMENT DEPOSITION</td>
<td>1</td>
<td>Not a wet pond or not applicable.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Minor degree of sediment, can be removed by hand.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Accumulation may be resuspending and moving into</td>
</tr>
<tr>
<td></td>
<td></td>
<td>downstream areas.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Accumulation is resuspending and may be impacting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>available storage volume.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Accumulation is impacting available storage volume.</td>
</tr>
<tr>
<td>CONDITION OF INLETS</td>
<td>1</td>
<td>No problems.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Minor erosion that can be corrected by surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>restoration.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Erosion beginning to impact integrity of end section.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Erosion impacting integrity of end section,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>restoration will require end section removal and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>replacement.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Erosion impacting end section and pipe sections,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>restoration will require end section and pipe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>removal and replacement.</td>
</tr>
<tr>
<td>CONTROL STRUCTURE</td>
<td>1</td>
<td>No signs of potential debris accumulation.</td>
</tr>
<tr>
<td>DEBRIS ACCUMULATION POTENTIAL</td>
<td>3</td>
<td>Grate design may not allow debris passage, no signs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of debris accumulation.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Grate design does not allow debris passage, signs of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>debris accumulation, and requires retrofit.</td>
</tr>
<tr>
<td>ALGAE GROWTH</td>
<td>1</td>
<td>No signs of growth.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Minor signs of algae in some areas.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Significant algae growth.</td>
</tr>
<tr>
<td>UPSTREAM/DOWNSTREAM</td>
<td>1</td>
<td>No signs of bank erosion.</td>
</tr>
<tr>
<td>DRAIN CONDITION</td>
<td>3</td>
<td>Minor signs of bank erosion.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Significant bank erosion and incision/widening of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>watercourse.</td>
</tr>
<tr>
<td>VEGETATION</td>
<td>1</td>
<td>Well established buffer.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Buffer being mowed around some areas of basin/stream.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Entire buffer being mowed.</td>
</tr>
</tbody>
</table>
## TABLE II
### CITY OF NOVI
#### Storm Water Study Phase II
##### Site Ranking Summary

<table>
<thead>
<tr>
<th>Site</th>
<th>Degree of Attenuation</th>
<th>Sediment Deposition in Pond</th>
<th>100-year Peak Flow</th>
<th>Condition of Inlet(s)</th>
<th>Condition of Control Structure</th>
<th>Debris*</th>
<th>Algae Growth</th>
<th>Upstream Drain Condition</th>
<th>Downstream Drain Condition</th>
<th>Vegetation</th>
<th>Rating</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taft (0%)</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>West Oaks (25%)</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>29</td>
<td>High</td>
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<tr>
<td>Ingersol (35%)</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>17</td>
<td>Med</td>
</tr>
<tr>
<td>Bishop (2%)</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>26</td>
<td>High</td>
</tr>
<tr>
<td>Meadowbrook Glens (84%)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>17</td>
<td>Med</td>
</tr>
<tr>
<td>C&amp;O (4%)</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Civic Center (37%)</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Lexington Green (11%)</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>Low</td>
</tr>
<tr>
<td>Thornton (78%)</td>
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<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>12</td>
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<tr>
<td>Jamestown Green (87%)</td>
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<td>1</td>
<td>3</td>
<td>5</td>
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<tr>
<td>Cedar Springs (15%)</td>
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<td>2</td>
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<td>5</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>34</td>
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<tr>
<td>Leavenworth (75%)</td>
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<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>Low</td>
</tr>
</tbody>
</table>

* Control Structure Debris Accumulation Potential

Note: 10 to 16 = Low Priority
17 to 25 = Medium Priority
26 and above = High Priority
Taft Basin

Background

The Taft Basin is an online regional detention basin located just north of Grand River Avenue, between Taft and Novi Roads. The basin is located on the Walled Lake Branch of the Rouge River (upper to middle portion of the branch) and is regulated by the state’s dam safety regulations. Runoff from approximately 358 acres drains to this basin.

The 1983 Storm Water Management Master Plan indicated that the Taft Basin was constructed to help alleviate flooding further downstream at Novi Road. The recent 2005 update to the Master Plan indicated that the Taft Basin provides little or no peak attenuation.

Design plans of this detention basin were not available for review. However, this basin was designed as a wet (open water) basin. From our discussion with the adjacent property owner, the open area of the basin was excavated approximately 10 years ago.

Findings

- There was significant sediment accumulation observed within the detention basin. It appeared that there was some sediment accumulation within the basin at a higher elevation than the outlet. This sediment accumulation reduces the storage volume intended in the design of the basin.
- Survey data was collected for this site. The depth of sediment was measured in several locations. On average the sediment was 2.2 feet deep. The adjacent property owner indicated that the basin had a 10 to 15 foot deep open water area.
- Erosion was present around a 24-inch concrete inlet pipe to the basin.
- Erosion was observed along the basin’s banks (undercut banks).
• The surrounding grassed area was being mowed to the basin’s edge and no buffer exists.
• One side slide gate was missing on the outlet structure. The majority of the flow was traveling through this open space instead of the front face of the structure, as designed.
• A sanitary manhole is located in close proximity to the basin. The manhole cover was not bolted closed.
• There was an animal burrow visible to the left (looking downstream) of the outlet structure.

Recommendations

• The eroded areas around the 24-inch concrete inlet pipe should be filled with compact fill, riprap, etc. and restored with seed and mulch to prevent destruction of the pipe and further erosion.
• The missing side slide gate on the outlet structure should be replaced. This will help direct flow through the center of the outlet structure as originally designed and will help reduce the undercut banks observed.
• Mowing practices should be revised so that at least a 20-foot vegetative buffer is surrounding the basin. In industrial areas, such as this location, it is not necessary to mow to the basin’s edge. Higher vegetation creates a better buffer and helps improve water quality. Vegetation such as native plants (as opposed to grass) has deeper roots and can filter pollutants more effectively. Deeper root systems can also better hold soil in place and help prevent bank erosion. In addition, native vegetation does not need to be fertilized and could therefore lead to a reduction in algae growth.
- Riprap should be placed in the channel at the outlet pipe in order to slow existing flows and prevent erosion.
- The sanitary manhole in the immediate area of the basin should be bolted closed to prevent inflow into the sanitary sewer system.
- An inline sediment trap should be installed at the upper end of the open area of the basin in lieu of dredging the entire area. Along with construction of the trap, the low flow channel should be stabilized so that the majority of bank full flows are contained within the channel. This work should be done in conjunction with a future control structure retrofit project.
- Trees should be planted on the south side of the open area of the basin to provide shade and additional habitat.
- It is recommended to create a meandering open channel through the center of the basin from the basin inlet to the outlet. This channel will replace the channel that has established itself along the bank of the basin and will help prevent further bank erosion. Once water levels in the channel rise, water will overflow and be stored in the basin.
West Oaks Basin

Background

The West Oaks Basin is an online regional detention basin located north of I-96 and just west of Novi Road. The basin is located in the upper reaches of the Bishop Creek Drainage District. Runoff from approximately 169 acres drains to this basin. The basin is located in a predominately commercial retail area.

Findings

- The basin has five (5) inlet pipes, three of which are in poor condition. The earth around the 48-inch concrete inlet pipe from the north has eroded and the grate on this pipe has evidence of debris buildup. Two 24-inch concrete inlet pipes have separated.
- Several inches of sediment deposition were observed along the banks of the basin.
- There was a sheen observed at one of the inlet pipes, which was suspected to have originated from runoff from a surrounding parking lot.
- There was significant algae growth in the basin, which can negatively impact aquatic life.
- The basin perimeter is being mowed and no buffer exists.
• There were no observed problems with the outlet structure, although the grate on the structure may potentially collect debris. Clogging due to debris can lead to premature embankment overtopping.

Recommendations

• The two inlet pipes that have separated should be repaired or replaced.
• Storm water filters should be inserted upstream of the basin in order to reduce sediment and oil from entering the basin from the adjacent parking lot.
• The eroded areas around the 48-inch inlet pipe should be filled.
• The grate at the outlet structure should be raised to prevent clogging due to debris.
• Leave sediment in-place. Monitor sediment depth on a yearly basis. Remove sediment when it reaches the low level outlet.
• Mowing practices should be revised to leave a buffer around the basin perimeter.
• Re-vegetation with native plantings is recommended around the basin perimeter.

West Oaks Basin – Needed inlet repairs
**Ingersol Basin**

**Background**

The Ingersol Basin is an online regional detention basin located just north of I-96 and just west of M-5. The basin was constructed to store flows in the upper reaches of Ingersol Creek. Runoff from approximately 601 acres drains to this basin. This basin is owned by the Michigan Department of Transportation. The City has an agreement with MDOT to share the associated maintenance costs.

The 1983 Storm Water Management Master Plan indicated that, while there were no flooding problems identified on the Ingersol Creek, flows discharging from the creek to the Meadowbrook Lake were contributing to flooding problems. To help alleviate downstream flooding, this regional detention basin was constructed.

The recent 2005 update to the Master Plan indicated that further downstream of the detention basin (near the confluence of the Ingersol Creek, Bishop Creek, and Walled Lake Branch of the Rouge River), flooding was still occurring and stream bank erosion is evident.

**Findings**

- One 30-inch inlet pipe was located. It appeared that runoff from a nearby parking lot was conveyed through this pipe. It is unknown if there are additional inlet pipes. Vegetation at the pipe was heavy.
- Heavy wetland vegetation growth was observed at the outlet pipe.
- The wetland system appeared to be very stable.

*Ingersol Basin – Overview of basin with two outlet structures*
Recommendations

- The vegetation at the inlet pipe should be cleared to allow flow to enter the basin more efficiently.
- Vegetation at the outlet pipe to the downstream drain should be cleared to allow flow to exit the basin efficiently.
**Haggerty Basin**

**Background**

The Haggerty Basin is an online regional detention basin located just west of Haggerty Road and just south of I-96/I-275. The basin was constructed to detain flows within Ingersol Creek (also known as Townline Drain in this section). The detention basin is located in the middle portion of the watershed. Runoff from approximately 447 acres drains to this basin.

The 1983 Storm Water Management Master Plan indicated that while there was no reported flooding on Ingersol Creek, flow from this creek is a partial contributing source of downstream flooding problems.

In 2004, a permit was obtained from the Michigan Department of Environmental Quality to construct the Haggerty Basin. It appeared that the construction of the basin differs slightly from what is depicted on the design plans.

This basin was recently constructed and appears to be functioning as planned. Therefore we have no recommendations relating to it at this time.

*Haggerty Basin – Looking east at the sedimentation basin with areas of sparse vegetation visible*
**Bishop Basin**

**Background**

The Bishop Basin is an online regional detention basin located just north of Grand River Avenue and just east of Meadowbrook Road (although plans on file at the City indicate that the basin is located south of Grand River). The basin was constructed by excavating a large area and constructing a berm and control structure. The basin is a "wet" basin, however the depth of the permanent pool is unknown. The basin was constructed to detain flows within Bishop Creek. Runoff from approximately 719 acres drains to this basin.

The 1983 Storm Water Management Master Plan indicated that the Bishop Basin was chosen as a first priority (1983 construction) regional detention basin because of a nearby storm sewer project and because the basin could be easily constructed since the property was either owned by the City or could be secured inexpensively. The basin was constructed in order to provide a major reduction of flows into the Meadowbrook Lake area.

The recent 2005 update to the Master Plan indicated that the Bishop Basin provides little or no peak attenuation. Sedimentation in the basin was also noted as a problem and sediment accumulation may be inhibiting the low flow discharge control by blocking the outlet. The update also noted that the natural wetland further upstream in the Bishop District (immediately south of 11 Mile Rd) is filled with sediment.

**Findings**

- There was significant sediment build-up observed within the basin.
- The west banks of the basin were undercut and show signs of erosion.
- Debris and sediment deposits were observed on the outlet grate, which has been raised above the top of the concrete structure by installing angle iron. This appeared to have helped minimize debris accumulation on the top of the grate, and provides evidence of high water surface elevations within the basin.

*Bishop Basin – Looking west at undercut banks/erosion*
• The downstream channel exhibited algae growth and turbidity, both of which negatively impact aquatic life. The banks of the channel show no signs of erosion and were fully vegetated.
• Significant large woody vegetation exists around the perimeter of the basin. Woody debris provides stabilization for banks and also provides habitat for wildlife.
• The DPW reported a failed pipe between the outlet structure and the road.

Recommendations

• Leave sediment within the wet pond area in place since it is not impacting the active storage volume of the basin. Investigate sediment removal in conjunction with other retrofit projects.
• Sediment near the outlet of the basin should be dredged as part of the City’s regular maintenance.
• Along with future retrofit projects, install stump island type structures to the open water area to add habitat value. Habitat structures, such as coarse woody debris, can provide habitat for fish, birds, and amphibians in shallow water and wetlands.
• Allow woody perimeter vegetation to remain. Root systems help hold soil in place and prevent erosion. Woody vegetation also provides habitat and shade.
• Correct the failed pipe between the outlet structure and the road.
**Meadowbrook Glens Basin (private)**

**Background**

The Meadowbrook Glens Basin is an online regional detention basin located between Novi and Meadowbrook Roads, and between Ten Mile Road and Grand River Avenue. The basin was constructed to detain flows tributary to Bishop Creek and is located in the upper reaches of the drainage district. The basin was constructed prior to the 1983 Storm Water Management Master Plan (the plans received by the City indicate that the detention basin was approved for construction in 1974). It is our recollection that this basin was constructed as part of the surrounding residential development. Runoff from approximately 81 acres drains to this basin.

Plans for this detention basin were obtained from the City. No obvious differences between field observations and the plans were noted.

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**Findings**

- The detention basin is not easily accessible for maintenance.
- The detention basin was heavily vegetated with wetland vegetation at the lower elevations. At the time of our site visit, there was no standing water visible in the detention basin.
• Approximately 100 feet of the detention basin’s wetland vegetation is being mowed by an adjacent resident along the west side.
• One inlet pipe (10-inch or 12-inch CMP) was located within the heavy vegetation at the edge of the detention basin. This pipe was crushed from the top and had a build-up of muck on the bottom, limiting the capacity of the pipe. It appears that runoff from the surrounding residential area is conveyed through this pipe.
• There was no evidence of erosion in the downstream channel.
• Sediment accumulation did not appear to be a problem within the detention basin.
• The outlet consisted of a 12-inch diameter hole cast in the end of the concrete control structure with two overflow weirs. The outlet pipe was plugged.
• The lowest level (10-year) overflow weir was covered with debris and algae.
• There was an inlet pipe observed immediately upstream of the outlet from an adjacent development.

Recommendations

• Replace the crushed inlet pipe in order to eliminate flow restriction caused by the crushed top of the existing pipe. The pipe should be replaced from the next upstream manhole to the pipe outlet (the nearest upstream manhole was located approximately 20 feet from the outlet).
• Debris and sediment in the outlet pipe should be removed in order to prevent excessive high water elevations within the basin.
• For maintenance purposes, access to the outlet should provided by removing the vegetation in the immediate surrounding area or providing an access road.
• The grates of the outlet structure should be raised to minimize accumulation of debris.
C & O Basin

Background

The C&O Basin is an online regional detention basin located just north of 10 Mile Road between Novi and Meadowbrook Roads. The basin was constructed to detain flows in the Walled Lake Branch of the Rouge River. The basin is located in the middle portion of the branch. Runoff from approximately 591 acres drains to this basin. This basin is regulated under the State’s dam safety regulations. Plans for this detention basin indicate that it was constructed in 1985.

The 1983 Storm Water Management Master Plan indicated that flooding occurred on the Walled Lake Branch of the Rouge River at its crossing on Novi Road at the CSX Railroad tracks. The recent 2005 update to the Master Plan indicated that there was sediment accumulation in the regional detention basin. The update also identified the C&O Basin as providing little or no flood peak attenuation. The update stated that the City’s maintenance staff report that the 1-year storm outlet is completely filled in with sediment.

Findings

- Review of the plans for this basin showed a lower bar screen on the outlet structure that was not observed in the field. The screen may have been removed to prevent blockages from debris and sediment.
- The plans also indicated that the detention area should extend to the west of the stream. This was not observed. The basin may not have been constructed as planned or sediment accumulation has filled in this area. This sediment accumulation reduces the storage volume intended in the design of the basin.
- The banks of the stream exhibited undercut banks and signs of erosion. This was especially seen just south of 10 Mile Road where exposed roots were observed. Heavy erosion was observed along the toe of the railroad embankment slope.
- Survey data was collected for this site. Review of the data supported the observation noted above that sediment has accumulated in the excavated area of the basin.
- DPW reported a failed pipe between the outlet structure and the road.

C&O Basin – Stream bank erosion
Recommendations

- Investigate temporary basin retrofit to reduce high frequency flows downstream of the basin.
- Restore basin so that the open channel flows through the center of the basin from the basin inlet to the outlet. Once water levels in the channel rise, water will overflow and be stored in the basin.
- Provide a more significant vegetated buffer upstream of the embankment.
- Stabilize the streambanks in the area of the basin order to prevent further erosion.
- The City should send a letter to CSX Transportation, Inc. noting the erosion problem adjacent to the tracks.
- Perform an additional erosion inventory in this reach of the Walled Lake Branch of the Middle Rouge River to obtain background assessment data.
- Correct the failed pipe located between the outlet structure and the road.
Civic Center Basin

Background

The Civic Center Basin is an online regional detention basin located south of 10 Mile Road and east of Taft Road (south of the Novi City Hall). The basin was constructed to detain flows in the middle portion of Miller Creek. Runoff from approximately 489 acres drains to this basin.

The 1983 Storm Water Management Master Plan indicates that the Civic Center Basin was chosen as a first priority (1983 construction) regional detention basin because the property was either owned by the City or could be secured inexpensively. The hydrologic modeling indicated that constructing the basin would reduce flooding in the Brookland Farms area. The recent 2005 update to the Master Plan reported that the 10-year storm outlet for the Civic Center Basin was plugged.

In addition to the Master Plan, the design plans for this basin were also reviewed. There were no obvious differences noted between the field observations and the plans.

Civic Center Basin – Looking upstream at basin
Findings

- It appeared that the grates at the outlet structure have potential to collect debris. This can lead to premature embankment overtopping.
- There was stream bank erosion observed downstream of the basin. The concrete apron that was present at the downstream side of the basin outlet pipe does not adequately dissipate velocities.
- A minor amount of erosion was present behind the wingwalls of the downstream basin outlet pipe.
- No sediment buildup was observed in the basin.
- The DPW reported that access to this basin was a problem.

Recommendations

- A retrofit should be designed for the grate at the outlet structure in order to prevent debris blockages.
- The concrete apron at the downstream outlet pipe should be replaced with riprap in order to lower the flow velocity.
- Fill should be placed behind the areas that have eroded around the wingwalls of the outlet pipe.
- Improve access to basin for maintenance purposes. We envision designing an access that would be approximately 10 feet wide and adequate to support City vehicles. The access could be constructed of gravel or turf pavers and would have to be designed for the individual basin.
**Lexington Green Basin**

**Background**

The Lexington Green Basin is an online regional detention basin located south of 9 Mile Road and just west of Taft Road. The basin was constructed to detain flows in the middle/lower portion of Thornton Creek. Runoff from approximately 255 acres drains to this basin.

The 1983 Storm Water Management Master Plan indicated that the Lexington Green Basin was one of four regional detention basins planned for the Thornton Creek Drainage District. The recent 2005 update to the Master Plan indicated that the Lexington Green Basin may have little or no attenuation of storm water flows.

Design plans were obtained for this basin. The plans indicated that the basin was constructed in 1990. There were no obvious differences in the plans and the field observations.

**Findings**

- The basin was very heavily vegetated.
- There were dead ash trees observed in the forested area adjacent to the basin (to the north).
- The grassed area near the outlet structure was mowed up to the stream banks.

**Recommendations**

- Mowing practices should be revised to allow vegetation growth along the creek. Buffers help to protect water quality.
- It was estimated that the dead ash trees that were observed will fall in 2 years. These trees can simply be left in place.
- Review previous hydrologic/hydraulic calculations to determine whether attenuation is actually achieved. To date, flooding has not been reported downstream.
**Thornton Basin**

**Background**

The Thornton Basin is an online regional detention basin located between Beck and Taft Roads and 9 Mile and 10 Mile Roads. The basin was constructed to detain flows discharging to Thornton Creek. Approximately 475 acres drain to this basin. The outlet of the basin is a dam, which is regulated by the State’s dam safety regulations.

The 1983 Storm Water Management Master Plan indicates that there was flooding in the Brookland Farms and Dunbarton Pines Subdivisions, located in this watershed, downstream of the proposed location of this basin. Two detention basins along the Thornton Creek (including the Thornton Basin) and two detention basins along the Miller Creek were planned to alleviate this flooding.

Design plans for this detention basin were not available.
Findings

- It appeared that the grates at the outlet structure have potential to collect debris since flow carrying debris can reach the grates, which have not been raised.
- The lawn on the east side of the basin is being mowed up to the basin’s edge.
- There was a small degree of erosion observed around a storm manhole near the outlet.
- A small degree of erosion was evident at the 30-inch CMP outlet pipe.
- It is our understanding that the lowest level pipe is currently buried.
- The DPW indicated that access to this basin should be improved.

Recommendations

- Mowing practices should be revised to allow for at least a 20-foot buffer surrounding the basin perimeter (other than the berm).
- Retrofit basin outlet structure to minimize debris accumulation by raising the grate.
- Improve access to the basin for maintenance purposes. We envision designing an access that would be approximately 10 feet wide and adequate to support City vehicles. The access could be constructed of gravel or turf pavers and would have to be designed for the individual basin.

Thornton Basin – Outlet of the basin, with erosion around the manhole
Jamestown Green Basin (private)

Background

The Jamestown Green Basin is an online regional detention basin located in the Jamestown Green Subdivision, between Taft and Novi Roads and 10 Mile and 11 Mile Roads. The detention basin was constructed to detain flows in the upper reach of Chapman Creek. Runoff from approximately 63 acres drains to this basin. This basin is under the ownership of the subdivision homeowner’s association. It should also be noted that the Jamestown Green Basin is not a regional basin as previously thought, but was included in this study.

Findings

- There was a mucky buildup observed on the bottom of the basin.
- Displayed permits indicated that the pond had recently been treated by the homeowner’s association with copper sulfate and chelated copper, most likely to control algae growth.
- Water in the pond was stagnant and appeared to be flowing out of both the inlet and outlet of the pond (likely due to the blocked outlet).
- There was a vegetative buffer present on the northern side of the pond; however, the grassed area on the southern side of the pond was mowed to the edge.
• It appeared that a dam was created at the outlet of the pond by placing pieces of wood to block the outlet. Sediment and debris buildup was observed behind the dam.
• The DPW reported that access to this basin should be improved.

Recommendations

• Mowing practices should be revised so that at least a 20-foot vegetative buffer is surrounding the basin. Higher vegetation creates a better buffer and helps improve water quality.
• Leave sediment in-place. Monitor sediment depth on a yearly basis. Remove sediment when it reaches the low level outlet.
• Provide flyers to residents on impact of fertilizer on algae growth in basin and mowing practices.
• Remove debris that has built-up at the outlet.
• Improve access to the basin for maintenance purposes. We envision designing an access that would be approximately 10 feet wide and adequate to support City vehicles. The access could be constructed of gravel or turf pavers and would have to be designed for the individual basin.
Cedar Springs Basin

Background

The Cedar Springs Basin is an online regional detention basin located between Taft and Novi Roads, and between 10 Mile and 11 Mile Roads within the Cedarspring Estates Subdivision. The basin was constructed to detain flows in the Munro Creek and is located in the middle portion of this creek. Runoff from approximately 272 acres drains to this basin.

The 1983 Storm Water Management Master Plan indicated that the Cedar Springs Basin was chosen as a first priority regional detention basin (1983 construction) because of a nearby storm sewer project and because the basin could be easily constructed since the property was either owned by the City or could be secured inexpensively.

The basin area between the outlet structure and the road was excavated to create an open water area. The remaining storage area, upstream of Christina Lane, was left in its natural state. It should be noted that a retrofit project was performed at this site around 1992. The plans could not be located by the City. However, we recall the intent of the project being to increase attenuation. We believe the retrofit consisted of replacing the culverts under the road. This allowed flow to "back-up" into the floodplain, thereby increasing attenuation.

Findings

- Plans for the Cedar Springs Basin indicated that there are 3 inlet pipes to the detention basin. However, 4 pipes were noted during the field visit. These 4 pipes had vegetation growing within them, indicating that there is not a constant flow coming through these pipes.
- It was observed that the grassed area surrounding the basin was being mowed to the edges of the basin, providing little or no buffer around the basin.
- There was excessive algae growth visible within the basin. Algae growth can have a negative impact on aquatic life.
- There was some sediment visible along the edges of the basin. However, algae growth within the basin made it difficult to observe the depth of sediment further in the basin.
- The grate on the outlet structure has been raised. This was probably done in order to prevent blockages from debris.
- Erosion was evident behind the headwall of the outlet pipe. Vegetation was also overgrown in this area.
- The concrete pad at the exit of the outlet pipe was cracked.
• There was an unknown odor originating from the creek on the downstream side of the detention basin. This odor may have originated from dying vegetation or stagnant water due to the lack of rain at the time.
• Streambank erosion was observed in the creek downstream of the detention basin.
• Survey data was collected for this site. Review of the data indicates that the current basin configuration is comparable to the original design.

Recommendations

• It is recommended that the cracked apron at the outlet pipe be removed and replaced with riprap along the stream banks and bottom. This will help dissipate the velocity of flow entering the channel and help prevent further stream bank erosion.
• Re-vegetation is recommended around the basin perimeter.
• Refrain from mowing at least a 20-foot wide buffer around the basin perimeter. The City may want to consider erecting “no mow” signs along the perimeter of the basin.
• An inline sediment trap should be installed at the upper end of the open area.
Leavenworth (Grand River) Basin

Background

The Leavenworth Basin is an online regional detention basin located just north of 11 Mile Road and just east of Taft Road. The basin was constructed to detain flows in the middle reaches of Leavenworth Creek. Runoff from approximately 398 acres drains to this basin. This basin is regulated under the State’s dam safety regulations.

The 1983 Storm Water Management Master Plan indicated that the Leavenworth Basin was chosen as a first priority regional detention basin because the downstream area is currently experiencing flooding (at Lanny’s and 11 Mile Roads).

The design plans for this basin were obtained from the City and reviewed. No obvious differences between the plans and field observations were noted. The basin was constructed in 1995. This was one of the last online regional basins constructed in the City because of the MDEQ's change in position on creating storage within natural creeks and wetlands. As a compromise with the MDEQ, two "pre-treatment" basins were constructed to treat point storm water runoff prior to entering into the basin area. Also, wetlands were mitigated for the project's wetland disturbance. It should be noted that this was probably the first application of "pre-treatment" basins in the State of Michigan.

Findings

- The pre-treatment basin had significant sediment accumulation and flow was minimal at the time of the field visit.
- The first flush basin exhibited standing water at the time of our field visit (during dry conditions). This is due to the underdrains being blocked and/or sediment inhibiting infiltration into the underdrains.
- There were no sedimentation problems visible in the creek and associated floodplain upstream of the basin.
- It appeared that the grates at the outlet structure have potential to collect debris. This may lead to premature embankment overtopping.
- White pines were observed in the wetland mitigation area in an area that may be too wet to sustain the growth of these trees.
- The ash trees in the mitigation area are dying due to the emerald ash borer.
- The DPW reported that access to this basin should be improved.
Recommendations

- Sediment deposition in the pre-treatment sedimentation basin at the Leavenworth (Grand River) Basin should be removed to design grades, the outlet control structure should be retrofitted to current first flush and bankfull standards, and the existing underdrains should be abandoned because of the extensive maintenance required. Any modifications may need to be permitted by MDEQ.
- White pines in the wetland mitigation area should be relocated to a higher elevation.
- Improve access to basin for maintenance purposes. We envision designing an access that would be approximately 10 feet wide and adequate to support City vehicles. The access could be constructed of gravel or turf pavers and would have to be designed for the individual basin.
IV. CIP COSTS

Preliminary cost estimates were developed for each basin based on the recommended improvements. A total of approximately $1,050,000 in improvements should be completed over the next 5 years. Improvements to basins with the highest priority should be completed within the first 2 years, medium priority should be made within the first 4 years, and low priority basin improvements should be completed within 5 years. Cost estimates for each individual basin are included in the following pages.

The City should also set aside an additional $500,000 to further evaluate stream banks and implement stream bank restoration projects for stream reaches that are exhibiting excessive erosion and are determined to be a high priority.
## CITY OF NOVI

**Storm Water Study Phase II**

**Regional Detention Basin Capital Improvement Program**

<table>
<thead>
<tr>
<th>Basin</th>
<th>Priority</th>
<th>Implementation Years</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taft Road</td>
<td>High</td>
<td>By Year 2</td>
<td>$173,000</td>
</tr>
<tr>
<td>Bishop</td>
<td>High</td>
<td>By Year 2</td>
<td>$127,000</td>
</tr>
<tr>
<td>C&amp;O</td>
<td>High</td>
<td>By Year 2</td>
<td>$162,000</td>
</tr>
<tr>
<td>Cedar Springs</td>
<td>High</td>
<td>By Year 2</td>
<td>$83,000</td>
</tr>
<tr>
<td>West Oaks</td>
<td>High</td>
<td>By Year 2</td>
<td>$84,000</td>
</tr>
<tr>
<td>Ingersol</td>
<td>Medium</td>
<td>By Year 4</td>
<td>$12,000 (cost share with MDOT)</td>
</tr>
<tr>
<td>Civic Center</td>
<td>Medium</td>
<td>By Year 4</td>
<td>$148,000</td>
</tr>
<tr>
<td>Lexington Green</td>
<td>Low</td>
<td>By Year 5</td>
<td>$28,000</td>
</tr>
<tr>
<td>Thornton</td>
<td>Low</td>
<td>By Year 5</td>
<td>$139,000</td>
</tr>
<tr>
<td>Leavenworth</td>
<td>Low</td>
<td>By Year 5</td>
<td>$90,000</td>
</tr>
</tbody>
</table>

Total for Years 1-2 $629,000
Total for Years 3-4 $160,000
Total for Year 5 $257,000
Total Basins $1,046,000

Note: We recommend a budget of an additional $100,000 per year for monitoring of basin retrofit performance and miscellaneous stream bank stabilization projects.
## CITY OF NOVI

**Storm Water Study Phase II**

**Regional Private Basin Improvements**

<table>
<thead>
<tr>
<th>Basin</th>
<th>Priority</th>
<th>Implementation Years</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadowbrook Glens</td>
<td>Medium</td>
<td>By Year 4</td>
<td>$98,000</td>
</tr>
<tr>
<td>Jamestown Green</td>
<td>Medium</td>
<td>By Year 4</td>
<td>$67,000</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total for Years 1-2</td>
<td></td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Total for Years 3-4</td>
<td></td>
<td></td>
<td>$165,000</td>
</tr>
<tr>
<td>Total for Year 5</td>
<td></td>
<td></td>
<td>$0</td>
</tr>
</tbody>
</table>

<p>| Total Private Basins |          |                     | $165,000       |</p>
<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Native buffer plantings and installation of &quot;no mow zone&quot; signs</td>
<td>3 AC</td>
<td>$5,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>2</td>
<td>Plant trees along south side of open area of basin</td>
<td></td>
<td></td>
<td>$3,000</td>
</tr>
<tr>
<td>3</td>
<td>Seed and mulch eroded areas around 24&quot; concrete inlet pipe</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>4</td>
<td>Install an in-line sediment trap at the upper end of open area of basin</td>
<td></td>
<td></td>
<td>$20,000</td>
</tr>
<tr>
<td>5</td>
<td>Bolt and close sanitary manhole adjacent to basin</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>6</td>
<td>Replace missing side slide gate on outlet structure</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>7</td>
<td>Control structure outlet protection</td>
<td></td>
<td></td>
<td>$5,000</td>
</tr>
<tr>
<td>8</td>
<td>Restore channel through basin area</td>
<td></td>
<td></td>
<td>$25,000</td>
</tr>
<tr>
<td>9</td>
<td>Retrofit control structure to restrict high frequency (bank full, 2-year) events</td>
<td></td>
<td></td>
<td>$20,000</td>
</tr>
<tr>
<td>10</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td></td>
<td>$9,000</td>
</tr>
<tr>
<td>11</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td></td>
<td>$25,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal** = $123,000

Contingency (25%) = $31,000

CA/CE (15%) = $19,000

**Total Cost for Taft Rd Basin** = $173,000

**Notes:** Taft Road is an online regional detention basin just north of Grand River Ave, between Taft & Novi Roads. It is located on Walled Lake Branch of Rouge River. Runoff from approx 358 ac drains to basin.

Taft Road currently provides little to no peak attenuation.
### Bishop Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Native buffer plantings along undercut west bank</td>
<td>LS</td>
<td>$1,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>2</td>
<td>Install stump island and habitat improvement structures to open water area</td>
<td>10 EA</td>
<td>$1,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>3</td>
<td>Retrofit control structure to restrict high frequency (bank full, 2-year) events</td>
<td></td>
<td></td>
<td>$20,000</td>
</tr>
<tr>
<td>4</td>
<td>Replace failing pipe between road &amp; control structure</td>
<td></td>
<td></td>
<td>$30,000</td>
</tr>
<tr>
<td>5</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td></td>
<td>$8,000</td>
</tr>
<tr>
<td>6</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal =** $90,000

Contingency (25%) $23,000

CA/CE (15%) $14,000

Total Cost for Bishop Basin = $127,000

**Notes:** Bishop Basin is an online regional detention basin located just north of Grand River Avenue and just east of Meadowbrook Rd. It should be noted that plans on file at the City of Novi show that the basin is south of Grand River Avenue.

The basin was constructed to detain flows within Bishop Creek.

Runoff from approximately 719 acres drains to the basin.

Bishop Basin currently provides little to no peak attenuation.
# C&O Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Native buffer plantings and installation of &quot;no mow zone&quot; signs</td>
<td>2 AC</td>
<td>$5,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>2</td>
<td>Restore channel through basin area</td>
<td></td>
<td></td>
<td>$25,000</td>
</tr>
<tr>
<td>3</td>
<td>Retrofit control structure to restrict high frequency (bank full, 2-year) events</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td>4</td>
<td>Replace failing pipe between road &amp; control structure</td>
<td></td>
<td></td>
<td>$50,000</td>
</tr>
<tr>
<td>5</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td>6</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

Subtotal = $115,000

Contingency (25%) $29,000

CA/CE (15%) $18,000

Total Cost for C&O Basin = $162,000

**Notes:**

The C&O Basin is an online regional detention basin located just north of 10 Mile Rd between Novi and Meadowbrook Roads.

The basin was constructed to detain flows in the Walled Lake Branch of the Rouge River. The basin is located in the middle portion of the branch.

Runoff from approximately 591 acres drains to this basin.

C&O Basin currently provides little to no peak attenuation.
<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flyers to residents on importance of vegetative buffer</td>
<td></td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Retrofit control structure to restrict high frequency (bank full, 2-year) events</td>
<td></td>
<td>$8,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td>$10,000</td>
<td></td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal =** $20,000

Contingency (25%) $5,000

CA/CE (15%) $3,000

**Total Cost for Lexington Green Basin =** $28,000

**Notes:** Lexington Green is an online regional detention basin located south of 9 Mile Road and just west of Taft Road.

The basin was constructed to detain flows in the middle/lower portion of Thornton Creek.

Runoff from approximately 255 acres drains to this basin.

Lexington Green currently provides little to no peak attenuation.
# CITY OF NOVI
## Storm Water Study Phase II
### Capital Improvements

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Native buffer plantings and installation of &quot;no mow zone&quot; signs</td>
<td>2 AC</td>
<td>$5,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>2</td>
<td>Flyers to residents on impact of fertilizer on algae growth in basin</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>3</td>
<td>Remove vegetation at 4 inlet pipes and outlet pipe.</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>4</td>
<td>Seed &amp; mulch around eroded area behind headwall of outlet pipe</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>5</td>
<td>Replace cracked concrete apron at outlet with riprap along streambanks and bottom.</td>
<td></td>
<td></td>
<td>$3,000</td>
</tr>
<tr>
<td>6</td>
<td>Retrofit control structure to restrict high frequency (bank full, 2-year) events</td>
<td></td>
<td>$8,000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Install a sediment trap</td>
<td></td>
<td>$20,000</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td>$5,000</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td>$10,000</td>
<td></td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal =** $59,000

- Contingency (25%) $15,000
- CA/CE (15%) $9,000

**Total Cost for Cedar Springs Basin =** $83,000

**Notes:** Cedar Springs is an online regional detention basin located between Taft & Novi Roads and between 10 & 11 Mile Roads within the Cedar Spring Estates Subdivision.

The basin was constructed to detain flows in the Munro creek and is located in the middle portion of this creek.

Runoff from approximately 272 acres drains to this basin.

Cedar Springs currently provides little to no peak attenuation.
## West Oaks Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Native buffer plantings and installation of &quot;no mow zone&quot; signs</td>
<td>3 AC</td>
<td>$5,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>2</td>
<td>Install stump island, habitat improvement structures to open water area, and minor sediment removal</td>
<td>10 EA</td>
<td>$1,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>3</td>
<td>Fill the eroded areas surrounding 48&quot; concrete inlet pipe from north</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>4</td>
<td>Repair two (2) 24&quot; concrete inlet pipes that have split.</td>
<td>2 EA</td>
<td>$1,500</td>
<td>$3,000</td>
</tr>
<tr>
<td>5</td>
<td>Raise outlet grate 4-6&quot; above concrete to prevent collection of debris</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>6</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td></td>
<td>$5,000</td>
</tr>
<tr>
<td>7</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal =** $60,000

**Contingency (25%)**  
Total Cost = $60,000 + $15,000 + $9,000 = $84,000

### Notes:

West Oaks is an online regional detention basin located north of I-96 and west of Novi Rd.

The basin is located in the upper reaches of the Bishop Creek Drainage District.

Runoff from approximately 169 acres drains to the basin.

The basin is located in a predominantly commercial retail area.
### Ingersol Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clear heavy vegetation away from 30&quot; inlet pipe.</td>
<td></td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>2</td>
<td>Clear vegetation away from outlet structure.</td>
<td></td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>3</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>4</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal =** $8,000

Contingency (25%) $2,000

CA/CE (15%) $2,000

**Total Cost for Ingersol Basin =** $12,000

**Notes:**

Ingersol is an online regional detention basin located just north of I-96 and just west of M-5.

The basin was constructed to store flows in the upper reaches of Ingersol Creek.

Runoff from approximately 601 acres drains to this basin.
# CITY OF NOVI

## Storm Water Study Phase II

### Capital Improvements

#### Meadowbrook Glens Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flyers to residents on importance of vegetative buffer</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>2</td>
<td>Repair/replace crushed inlet pipe (approx. 20' of pipe)</td>
<td></td>
<td>$3,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Clear away debris and sediment from outlet pipe.</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>4</td>
<td>Improve accessibility to outlet by installing an access drive</td>
<td></td>
<td>$54,000</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Raise outlet grate 4-6&quot; above concrete to prevent collection of debris.</td>
<td></td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td>$6,000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td>$3,000</td>
<td></td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal =** $69,000

Contingency (25%) = $18,000

CA/CE (15%) = $11,000

**Total Cost for Meadowbrook Glens Basin =** $98,000

---

**Notes:** Meadowbrook Glens is an online regional detention basin located between Novi and Meadowbrook Roads, and between Ten Mile Road and Grand River Avenue.

The basin was constructed to detain flows tributary to Bishop Creek and is located in the upper reaches of the drainage district.

Runoff from approximately 81 acres drains to this basin.
## Civic Center Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raise outlet grate 4-6&quot; above concrete to prevent collection of debris.</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>2</td>
<td>Replace cracked concrete apron with rip rap</td>
<td></td>
<td></td>
<td>$3,000</td>
</tr>
<tr>
<td>3</td>
<td>Place fill behind wingwalls of outlet pipe to fill eroded areas</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>4</td>
<td>Improve accessibility to outlet by installing access drive</td>
<td></td>
<td></td>
<td>$87,000</td>
</tr>
<tr>
<td>5</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td>6</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td></td>
<td>$3,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

Subtotal = $105,000

Contingency (25%) $27,000

CA/CE (15%) $16,000

Total Cost for Civic Center Basin = $148,000

**Notes:** Civic Center is an online regional detention basin located south of Ten Mile Road and east of Taft Road (south of Novi City Hall).

The basin was constructed to detain flows in the middle portion of Miller Creek.

Runoff from approximately 489 acres drains to this basin.
### Thornton Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Native buffer plantings and installation of &quot;no mow zone&quot; signs</td>
<td>2 AC</td>
<td>$5,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>2</td>
<td>Raise outlet grate 4-6&quot; above concrete to prevent collection of debris</td>
<td>4-6 AC</td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Native plantings near outlet</td>
<td>4-6 AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Improve accessibility to outlet by installing an access drive</td>
<td></td>
<td></td>
<td>$74,000</td>
</tr>
<tr>
<td>5</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td></td>
<td>$9,000</td>
</tr>
<tr>
<td>6</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td></td>
<td>$5,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

**Subtotal =** $99,000  
Contingency (25%) $25,000  
CA/CE (15%) $15,000  

**Total Cost for Thornton Basin =** $139,000

**Notes:** Thornton Basin is an online regional detention basin located between Beck and Taft Roads and 9 & 10 Mile Roads.  
The basin was constructed to detain flows discharging to Thornton Creek.  
Runoff from approximately 475 acres drains to this basin.
### Jamestown Green Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Native buffer plantings and installation of &quot;no mow zone&quot; signs</td>
<td>1 AC</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>2</td>
<td>Flyers to residents on impact of fertilizer on algae growth in basin</td>
<td></td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>3</td>
<td>Remove dam &amp; debris at outlet pipe</td>
<td></td>
<td></td>
<td>$2,000</td>
</tr>
<tr>
<td>4</td>
<td>Improve accessibility to outlet by installing an access drive</td>
<td></td>
<td></td>
<td>$30,000</td>
</tr>
<tr>
<td>5</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td></td>
<td>$4,000</td>
</tr>
<tr>
<td>6</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

Subtotal = $47,000

Contingency (25%) = $12,000

CA/CE (15%) = $8,000

Total Cost for Jamestown Green Basin = $67,000

**Notes:** Jamestown Green is an online (DPW says it's not regional) detention basin located in the Jamestown Green Subdivision, between Taft and Novi Roads and 10 Mile and 11 Mile Roads.

The basin was constructed to detain flows in the upper reach of Chapman Creek.

Runoff from approximately 63 acres drains to this basin.
## Leavenworth (Grand River) Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Improvements</th>
<th>Quantity / Unit</th>
<th>Cost/Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove sediment and underdrains in first flush treatment basins</td>
<td>LS</td>
<td>$20,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Retrofit sediment basin control structure</td>
<td></td>
<td>$3,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Relocate white pines to higher elevation</td>
<td></td>
<td>$5,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Improve accessibility to outlet by installing an access drive</td>
<td></td>
<td>$24,000</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Misc. (Mobilization, Demobilization, Restoration, etc)</td>
<td></td>
<td>$6,000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Permitting &amp; Engineering*</td>
<td></td>
<td>$6,000</td>
<td></td>
</tr>
</tbody>
</table>

* = Costs could be reduced for combining multiple projects.

Subtotal = $64,000

Contingency (25%) | $16,000

CA/CE (15%) | $10,000

Total Cost for Leavenworth Basin = $90,000

**Notes:** Leavenworth is an online regional detention basin located just north of 11 Mile Road and just east of Taft Road.

The basin was constructed to detain flows in the middle reaches of Leavenworth Creek.

Runoff from approximately 398 acres drains to this basin.