SRF No. 14708

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From:	SRF Consulting Group (SRF) Resource Environmental Solutions (RES)
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Subject:	Nine Mile Creek Watershed District - Protection of High-Quality Wetlands Scoping, Prioritization, and Feasibility Study

1. Introduction

SRF Consulting Group (SRF) and Resource Environmental Solutions (RES) were retained by Nine Mile Creek Watershed District (NMCWD) to study four, previously identified, high-quality wetlands within the watershed and identify potential projects that improve wetland functionality and/or preserve wetland quality. As noted, these are all high-quality wetlands in need of protection or enhancement and not restoration. The wetlands covered in this study are Whited Marsh (Minnetonka City ID #700), Minnetonka City ID #576A (also referred to as Rowland Road Wetland), Cranberry Bog Pond (Bloomington City ID #62-04), and Tierney's Woods Pond SW (Bloomington City ID #59-06). This Memorandum and supporting appendices communicate the approach, rationale, and prioritization process, as well as present conceptual design of potential projects, approximate costs, and benefits to the NMCWD.

2. Existing Data Review and Field Data Collection

2.1 Existing Data Review

The request for proposals included a report titled "Wetland Restoration and Protection Opportunity Identification" prepared by Barr Engineering (Barr) for the NMCWD (June 2021). These report findings were used to inform what further data would need to be requested or collected from field visits. The watershed-scale map provided in the RFP is included in Appendix A for reference of wetland locations within the watershed. GIS and as-built data was supplied by the cities of Minnetonka and Bloomington including shapefiles for public utilities, property boundaries and easement information. This information was supplemented with Hennepin County Tax Parcel information to identify nearby public properties, and LiDAR (elevation) data to identify steeper slopes and verify drainage boundaries. Minnesota Routine Assessment Methodology (MNRAM) outcomes for the four wetlands, XP-SWMM modeling data, and subcatchment information was provided by Barr. The NMCWD also provided a report detailing groundwater and surface water interaction for wetlands within the District.

2.2 Field Data Collection

Field data collection was conducted for all four wetlands at two spatial scales: subcatchment and wetland basin. For subcatchment assessment, drainage and sewershed boundaries, storm sewer inlets, outlets, and other features such as berms and forebays were confirmed to match provided information or noted on maps (see Appendix A, Wetland Basin and Subcatchment Maps). Additional field conditions assessed within the subcatchment and in the wetlands themselves included scour, erosion, sedimentation, debris, and signs of high water and normal water; these were also photographed and noted within the subcatchment and along the edges of the wetlands. Discussions were also had with several residents providing anecdotal evidence of pipe surcharging and large water level bounces in some of the wetlands. At the wetland basin scale and in the surrounding buffer areas, plant communities were assessed considering their character and quality, based on dominant species, native plant cover and diversity, invasive plant cover, and uncommon species.

Potential wetland protection and enhancement projects were envisioned and considered during our field assessment in order to determine which projects may be most impactful and best suited for their specific conditions.

3. Scoping Analysis of Potential Projects

3.1 Criteria Selection

3.1.1 Identification of Potential Criteria

It is recommended that prioritization of projects consider the wetland basin that would be affected as well as the anticipated merits of the actual project. Considering all data reviewed and collected to date, the SRF/RES team developed a list of over 40 potential criteria that included quantitative and qualitative attributes of each subcatchment, each wetland basin, and attributes of a particular potential project. Criteria also included the categories used by MNRAM for wetlands (completed by Barr Engineering (2021) for all wetlands in the Nine Mile Creek Watershed). The NMCWD Board of Managers was consulted regarding the relative level of importance of an extensive list of criteria. Using the Board's input and the SRF/RES team's experience with similar wetland and stormwater management projects, we developed the following methodology to differentiate between different high-quality wetlands and potential project benefits.

It was decided that a two-tiered approach would be necessary for prioritizing projects. Wetland basin scale criteria would be used to rank wetlands in terms of quality and relative threat. These two criteria could potentially point to a wetland in most need of protection regardless of what potential project opportunities may be. Then projects could also be considered in terms of costs and benefits to choose the best projects for each wetland. The following section discusses criteria used at the wetland basin scale.

3.1.2 Wetland Basin Considerations and Criteria

Considering which wetlands warrant NMCWD investments in protection and/or functional improvement requires consideration of two primary attributes: 1) each wetland's existing ecological quality and the associated functions it provides to help maintain a healthy watershed, and 2) the relative threat to the wetland in terms of stormwater inputs, invasive vegetation, and other stressors that may degrade the wetland's quality or its functionality.

While all four wetlands in this study have already been identified as high-quality, there are significant differences between them worthy of consideration. Likewise, the threat to each of these wetlands varies in terms of type, magnitude, and timing. In general, it is recommended that NMCWD investments be used first in the highest quality wetlands facing the greatest threat to their ecological integrity and function as opposed to protecting those that are not currently under as much threat. With this approach in mind, the following wetland basin criteria are recommended.

Ecological Quality & Function Criteria

- Wetland Size (acres)
- Maintenance of Characteristic Wildlife Habitat Structure (from MnRAM, representing the general value of a wetland for wildlife)
- Weighted Average Vegetative Diversity and Integrity Rating by Community Proportion (from MnRAM, representing the general quality of wetland vegetation)
- NMCWD Overall Classification Rating (based on Barr analysis)
- Highest Vegetative Diversity and Integrity Rating by Community (from MnRAM, representing the highest quality plant community within the wetland)
- Maintenance of Characteristic Amphibian Habitat (from MnRAM, representing the general value of a wetland specifically for amphibians)

Relative Threat Criteria

- Maintenance of Characteristic Hydrologic Regime (from MnRAM, representing typical water level fluctuations and groundwater interaction)
- Wetland Sensitivity to Stormwater and Urban Development (from MnRAM, considering the plant communities present)
- Additional Stormwater Treatment Needs (from MnRAM, representing the relative contribution of untreated stormwater inputs)
- Invasive Vegetation Presence/Pressure/Threat
- Existing Stormwater Threat to Wetland Integrity (considers "Additional Stormwater Treatment Needs" above)
- Future Stormwater Threat to Wetland Integrity (considers future development, climate change, etc.)
- Wetland Resilience to Stormwater Impacts (considers if the plant community is a floating mat, is it is supported by groundwater, etc.)

Utilizing this criteria, we could determine which basins were more threatened by stormwater, sediment, erosion, changes in land use or climate, or pressures from invasives species. We could also start differentiating between wetlands of slightly higher quality based on resilience and unique vegetation. By grouping and ranking basins by threat and quality criteria, we were able to focus on important project outcomes and determine which kinds of projects might best protect each wetland from their threats and preserve what makes them unique. Project based considerations to determine the benefits to the wetlands or watershed and come up with the best projects in terms of a cost benefit ratio are listed in the next section.

3.1.3 Project Considerations and Criteria

Project considerations taken into account included feasibility and site suitability, but also criteria of particular concern to the watershed district. These criteria below have been included in a simplified project matrix in Appendix B.

- Project partners
 - o Public vs private (preference for public)
 - Number of potential project partners (preference for lower number of participants to reduce project complexity)
- Permanent projects versus sustained management (preference for permanent projects)
- Cost
- Level of time investment by NMCWD staff
- Achievement of co-benefits
- Educational opportunities
- Citizen engagement

3.2 Description of Wetlands and Identified Potential Projects Identified

Considering all data reviewed and collected (including wetland quality, functions, and threats), the SRF/RES team identified potential projects that would protect and/or improve the four highquality wetlands as well as benefit downstream water resources. Our preliminary matrix of project criteria was refined to create Appendix B, "Project Benefit Matrix and Cost Estimates" based on the criteria we determined to be the most useful for differentiating between projects per NMCWD's preferences and goals. Appendix C provides our initial opinions of probable cost for potential projects, and Appendix D provides site photographs. The following sections summarize each of the four wetland basins and present potential projects identified for each.

Whited Marsh (City ID #700)

Whited Marsh (9.8 acres) is located directly southeast of the intersection of Whited Avenue and Excelsior Boulevard in Minnetonka, MN. This wetland is classified as a MnDNR Public Water (PWI ID: 27078300W). The vast majority of the wetland is under private ownership (multiple parcels although one landowner owns the majority), and there is a parcel owned by the City of Minnetonka

in the northwest portion of the basin and a tax-forfeit parcel owned by Hennepin County in the southeast portion of the basin. The surrounding landscape is forested with low-density single-family housing, and Whited Avenue skirts the west edge of the basin. In addition to overland runoff from the basin's adjacent, moderately-sloped uplands, the wetland receives runoff from two, small storm sewer systems in the southeast corner, and one on the north end of the basin that discharges runoff from the drainage areas to the northeast through a series of pumps and ponds. In times of high water level, the wetland outlets through a pipe on the west edge of the wetland. During normal water levels, water may be lost from the wetland via evapotranspiration and infiltration to shallow groundwater according to the study, "Evaluation of Groundwater and Surface Water Interaction within the Nine Mile Creek Watershed" conducted by Barr in 2019.

Whited Marsh is classified as a rich fen floating mat, an uncommon wetland type in the watershed. Low water levels at the time of assessment permitted access to the wetland floating mat by crossing what normally is an open water "lagg" around the perimeter of the basin. The wetland was observed to contain a high diversity of native plants, including uncommon species (e.g., large cranberry (*Vaccinium macrocarpon*), fen wiregrass sedge (*Carex lasiocarpa*), and cotton grass (*Eriophorum* sp.)). Invasive vegetation in the wetland includes a considerable amount of narrowleaf cattail (*Typha angustifolia*, not abundant in the basin's interior, Appendix D, Photos 1 and 2) and a relatively narrow (and in areas, dense) band of purple loosestrife (*Lythrum salicaria*) along the edge of the floating mat. Growth patterns suggest that the invasive cattail is spreading into the higher quality portions of the wetland. The City of Minnetonka has reportedly released purple loosestrife beetles into the wetland, but it was not confirmed if they remain present and/or are controlling this invasive plant. The upland buffer around the wetland consists mostly of degraded lowland and mesic forest; invasive common buckthorn (*Rhamnus cathartica*) and other weedy/invasive plants are abundant. The following potential projects were identified at Whited Marsh:

- Invasive species control in wetland Invasive vegetation management is warranted within the wetland and along the wetland buffer. While invasive vegetation is present in all four high-quality wetlands assessed as part of this project, Whited Marsh appeared to be under the greatest invasive pressure due to the spread of cattails into high quality native plant communities. Invasive vegetation control can be conducted in a variety of ways, using a professional ecological contractor, volunteers, and/or partnerships with the City of Minnetonka or surrounding landowners. There are various pros and cons to the different methods, including varying cost, time to complete, quality of work, safety considerations, etc.
- Upland buffer enhancement The upland buffer surrounding the wetland could be improved through invasive species removal (e.g., common buckthorn), installation of native seed/plants, and potentially expanding the buffer where feasible.
- Stormwater infrastructure improvements Concentrated stormwater discharges into the wetland at the north and southeast ends. At the north end, pretreatment could be installed at the upstream manholes to capture sediment, or a forebay could be installed at the outlet to prevent scour and capture sediment. At the southeast end, similar projects could be installed as well as pretreatment at the catch basins in low-lying residential yards.

- **Rain gardens** Rain gardens or other bioinfiltration practices could be installed at residences and Gatewood Elementary School (southeast of the wetland), where runoff drains to the storm sewer or directly to the wetland.
- Educational/experiential amenities Other potential projects include the installation of an educational viewing platform or boardwalk in the northwest portion of the wetland within the City-owned parcel. This would improve safe public access to this high-quality wetland, with minimal impact to the resource. A boardwalk would also facilitate collection of water samples, if that was of interest to Gatewood Elementary School or NMCWD.

Rowland Road Wetland (City ID #576A)

Rowland Road Wetland (2.6 acres) is located directly east of Interstate-494 (I-494) and the Minnesota River Bluffs LRT Regional Trail in Minnetonka, MN. This wetland is classified as a MnDNR Public Water (PWI ID: 27078900W). The wetland is located on two parcels owned by the adjacent townhome owner's association (to the east) and a business park (to the south). The wetland receives runoff from I-494 on the west (some direct-discharged into the wetland, and some that is first routed through an infiltration ditch), a private drainage outlet from the townhomes to the east, and the adjacent, forested, steep-to-moderately-sloped uplands. In times of high water level, the wetland outlets into a shallow wetland basin to the north. During normal water levels, water may be lost from the wetland via evapotranspiration and infiltration to shallow groundwater (Barr 2019).

Rowland Road Wetland is classified as a rich fen floating mat, an uncommon wetland type in the watershed. Water levels at the time of assessment inhibited access to the wetland floating mat due to a significant open water "lagg" around the perimeter of the basin (Appendix D, Photo 3). However, field assessment from the basin edge and reports by others indicate the wetland contains a moderately high diversity of native plants, including a considerable amount of the native poison sumac (*Toxicodendron vernix*). Invasive vegetation in the wetland includes narrowleaf cattail (somewhat sparsely distributed in the basin's interior) and a relatively narrow (and in areas, dense) band of purple loosestrife along the edge of the floating mat (Appendix D, Photo 3). The upland buffer around the wetland consists mostly of degraded mesic oak forest; invasive common buckthorn and other weedy/invasive plants are abundant (Appendix D, Photo 4). The following potential projects were identified at Rowland Road Wetland:

- Invasive species control in wetland Invasive vegetation management is warranted within the wetland and along the wetland buffer. This can be conducted in a variety of ways, using a professional ecological contractor, volunteers, and/or partnerships with the City of Minnetonka or surrounding landowners. There are various pros and cons to the different methods, including varying cost, time to complete, quality of work, safety considerations, etc.
- Upland buffer enhancement and slope stabilization The upland buffer surrounding the wetland could be improved through invasive species removal (e.g., common buckthorn), installation of native seed/plants, and potentially expanding the buffer where feasible. Removal of dense buckthorn will increase light levels reaching the forest floor, enabling growth of soil-stabilizing vegetation. This may be most effective on the steep slopes

southeast, south, and southwest of the wetland, where there is significant sheet erosion occurring adjacent to business park's parking lot. Slope stabilization would reduce sediment loading into the wetland and to protect the parking lot at the top of the slope.

- Stormwater infrastructure improvements Concentrated stormwater discharges into the wetland at the west end from catch basins and an infiltration ditch that collects runoff from I-494, and from a private storm sewer system from the townhomes to the east. Pretreatment could be installed on either system upstream of the outlet to capture sediment, or a forebay could be installed at the outlet to prevent scour and capture sediment. The I-494 drainage could also be routed through a bioinfiltration system similar to the other I-494 storm sewer.
- **Rain gardens** Rain gardens or other bioinfiltration practices could be installed at the townhomes east of the wetland where runoff drains directly to the wetland.
- Adjacent wetland functional enhancement The Rowland Road Wetland is adjacent to a wetland to the north and is hydraulically connected when water levels overtop the berm between the basins. Current modeling would need to be refined to determine the hydraulics of this system and whether it could be used for possible water quality improvement.

Cranberry Bog (City ID #62-04)

Cranberry Bog (4.6 acres) is located near Bush Lake, directly west of W Bush Lake Rd and West Bush Lake Park in Bloomington, MN. This wetland is classified as a MnDNR Public Water (PWI ID: 27101900W). The wetland is located on a city-owned parcel, and is surrounded by private, residential parcels. While all surrounding parcels are developed with single family homes, the contributing drainage area is mostly forested. The wetland receives runoff primarily through overland flow and a "burp pipe" that discharges stormwater into the wetland when the storm sewer is surcharging. In times of high water level, the wetland outlets into a water control structure (pipe) on the east edge of the basin. That structure was blocked and locked at the time of our assessment, and reportedly it remains closed except during times of high water levels when it is opened up. Though the "burp pipe" and outlet structure are currently not functioning as designed, they have minimal negative impact on the wetland water quality due to the small catchment area and the relative infrequency of their use. Re-designing and constructing the storm sewer system through this area will require coordination with the City of Bloomington public works department. During normal water levels, water may be lost from the wetland via evapotranspiration and infiltration to shallow groundwater (Barr 2019).

Cranberry Bog is classified as a poor fen floating mat, an even more uncommon wetland type in the watershed when compared with rich fens. Water levels at the time of assessment inhibited access to the wetland floating mat due to a significant open water "lagg" around the perimeter of the basin. However, field assessment from the basin edge and reports by others indicate the wetland contains a high diversity of native plants, including uncommon species (e.g., cranberry, rannoch rush (*Scheuchzeria palustris*), bog bean (*Menyanthes trifoliata*), and floating pennywort (*Hydrocotyle ranunculoides*), Appendix D, Photo 5). Invasive vegetation in the wetland includes a dense patch of narrowleaf cattail in the northern portion of the basin, sparse cover by reed canary grass (*Phalaris arundinacea*) throughout the basin and on its edges, and a relatively narrow (and in areas, dense) band of purple loosestrife along the edge of the floating mat. The upland buffer around the wetland consists mostly

of degraded lowland and mesic oak forest; invasive common buckthorn and other weedy/invasive plants are moderately abundant (Appendix D, Photo 6). The following potential projects were identified at Cranberry Bog:

- Invasive species control in wetland Invasive vegetation management is warranted within the wetland and along the wetland buffer. This can be conducted in a variety of ways, using a professional ecological contractor, volunteers, and/or partnerships with the City of Bloomington or surrounding landowners. There are various pros and cons to the different methods, including varying cost, time to complete, quality of work, safety considerations, etc.
- Upland buffer enhancement The upland buffer surrounding the wetland could be improved through invasive species removal (e.g., common buckthorn), installation of native seed/plants, and potentially expanding the buffer where feasible. This may be most effective on the steep slope west of the wetland, where it is likely sheet runoff and erosion is most significant. Removal of dense buckthorn will increase light levels reaching the forest floor, enabling growth of soil-stabilizing vegetation.
- Stormwater infrastructure improvements There are no storm sewer outfalls that discharge directly to Cranberry Bog; however, due to surcharging stormwater, a burp pipe was installed along the storm sewer pipe that runs adjacent to the southeast edge of Cranberry Bog. Flows through this pipe and out of the connected manhole structure have caused significant erosion in the local area. A potential project would repair this erosion and/or re-design the stormwater system to prevent surcharging and provide adequate drainage. This system is owned by the City of Bloomington and would require coordination with their Public Works Department.
- Educational/experiential amenities A boardwalk or viewing platform and other educational features could be installed at Cranberry Bog within the City-owned parcel. This could be done in partnership with the City of Bloomington (who also owns West Bush Lake Park, east of the wetland), and local landowners.

Tierney's Woods Pond SW (City ID #59-06)

Tierney's Woods Pond SW (0.2 acres) is located southeast of the I-494/US-169 interchange in Bloomington, MN. This small wetland is split between private parcels owned by the surrounding homeowners, with the wetland itself contained within a city-owned easement. The wetland receives runoff from two storm sewer systems which capture runoff from the surrounding area, Tierney's Woods Rd, and Tierney's Woods Curve; runoff from these collection areas discharges into the northwest and southwest portions of the wetland. According to the 2019 Barr study, this wetland primarily receives groundwater inflow. In times of high water level, the wetland outlets into the southwest storm sewer pipe (which acts as a stormwater inlet during periods of low flow). During normal water levels, water is lost from the wetland via evapotranspiration.

Tierney's Woods Pond SW is classified as a wet meadow floating mat, an uncommon wetland type in the watershed. During our field assessment, we observed that approximately half of the wetland consisted of a floating mat (however, standing water was absent). The remainder of the wetland consisted of sparsely vegetated mudflat and a sediment plume adjacent to the southwest storm sewer pipe (Appendix D, Photo 7). The floating mat portion of the wetland was dominated by lake sedge (*Carex lacustris*) and contained a surprisingly high diversity of native plants. Invasive vegetation was generally absent from the floating mat and most of the mudflat area, but patches of reed canary grass were present in the sediment plume and around the perimeter of the basin, and a few purple loosestrife plants were also present. The upland buffer around the wetland consists mostly of degraded lowland and mesic forest, including a steep slope on the west side of the basin (Appendix D, Photo 8). Invasive common buckthorn and other weedy/invasive plants are relatively abundant, especially on the east side of the wetland.

The following potential projects were identified at Tierney's Woods Pond SW:

- Invasive species control in wetland Invasive vegetation is quite limited in the wetland, but its management there (and in the more significantly invaded upland buffer) would benefit the site. This can be conducted in a variety of ways, using a professional ecological contractor, volunteers, and/or partnerships with the City of Bloomington or surrounding landowners (especially the landowner to the north, who reportedly is very interested in enhancing this wetland). There are various pros and cons to the different methods, including varying cost, time to complete, quality of work, safety considerations, etc.
- Upland buffer enhancement The upland buffer surrounding the wetland could be improved through invasive species removal (e.g., common buckthorn), installation of native seed/plants, and potentially expanding the buffer where feasible. This may be most effective on the steep slope west of the wetland, where it is likely sheet runoff and erosion is most significant. Removal of dense buckthorn will increase light levels reaching the forest floor, enabling growth of soil-stabilizing vegetation.
- Stormwater infrastructure improvements Stormwater discharges into the wetland at the northwest and southwest ends, and both have significant sediment deltas at the outlets. At the northwest pipe, there is a corrugated baffle in the existing catch basin structure (at street level) and the bottom of the metal outlet pipe is completed scoured out (on the edge of the wetland). This pipe could be repaired, and improved pretreatment could be installed at the upstream catch basin to capture sediment. Similar pretreatment could be installed at the upstream structures associated with the southwest outlet. Additionally, a forebay could be installed at either or both outlets to prevent scour and further sedimentation entering the main portion of the wetland basin. The storm sewer system is owned by the City of Bloomington and would require coordination with their public works department.

4. Prioritization Outcomes and Recommended Project(s)

After considering the many projects that would protect and/or improve the four assessed highquality wetlands, performing invasive vegetation management in the wetlands and in their upland buffers stand out as the best projects. Considering the ecological integrity and functional values of the four wetlands, as well as existing or imminent threats to these basins, Whited Marsh represents the largest high-quality wetland with the greatest threat: that threat in the form of invasive vegetation (primarily cattails) actively spreading into high-quality native plant communities in this wetland. Invasive vegetation management in the wetland would prevent the further spread of actively invading cattails and other invasive species. Invasive vegetation management in the surrounding upland buffer would improve habitat quality of the combined wetland-upland natural area and would likely reduce sheet erosion and associated sediments and nutrients from entering the wetland.

Invasive vegetation management would be highly visible work that provides educational opportunities regarding the presence of high-quality wetlands within the watershed, their species diversity, and the importance of their protection and maintenance. Additionally, the use of volunteers would promote long-term stewardship of wetlands within the watershed. The work could also be performed wholly or in part by professional ecological contractors or through coordination with partners, such as cities. Initial management (over the first few years) would result in a significant and noticeable decrease in (but not complete eradication of) invasive plant cover. This would allow the wetland's diverse native vegetation to flourish and, over time, fill in the gaps left by the removed invasive plants. Long-term maintenance of the wetland might best be achieved with volunteers after initial removal of invasive vegetation. Given the ongoing pressure of seed coming in from off site, it is unlikely that complete eradication of all invasive vegetation will be achieved; however, conservation and ecological gains will still be accomplished with a low level of perpetual maintenance. This project would show NMCWD's commitment to wetland protection and enhancement within the watershed and set the stage for future projects down the road.

Coupled with this invasive vegetation management, the City-owned parcel in the northwest portion of the site could be improved as a small nature-based park. A small/simple pull-off/parking area along Whited Ave. would provide a safe place for a school bus or a few cars. A natural-surface trail to a spur boardwalk over the edge of the wetland would enable visitors to better engage with this high-quality habitat in a low impact fashion. This would improve safe public access to this highquality wetland, with minimal impact to the resource. A boardwalk would also facilitate collection of water samples, if that was of interest to Gatewood Elementary School or NMCWD. Lower impact options such as an overlook without parking could also be considered. A feasibility analysis of access and amenities is recommended if such improvements here are pursued.

Secondary priority projects could include similar invasive vegetation control in and around other high quality wetlands. In addition, strategically-located rain gardens or other low-cost stormwater BMPs could be promoted through the NMWCD's cost-share program. These practices would provide runoff reduction, water quality improvements, and educational value to landowners and other nearby residents.

5. Feasibility Analysis and Refined Costs

Based on our study findings and discussion with the NMCWD Board, the following sections convey our recommended approach to proceed with the top priority project: to remove and control invasive vegetation in and around Whited Marsh (Appendix A, Whited Marsh Enhancement Map). These actions would help protect and enhance this unique, high-quality wetland. Section 5.1 lays out our base scope of work, focused on the physical removal and control of invasive vegetation. Sections 5.2 through 5.5 address: potential partnerships; opportunities for education, outreach, and volunteers; anticipated commitments by NMCWD, and a refined opinion of probable cost.

Partnerships, volunteers, and other resources that may become available for this project may justify alteration of the recommended approach presented below. Also, this work assumes permissions will be received from all landowners encompassing the wetland and its surrounding upland buffer.

5.1 Recommended Base Scope of Work

5.1.1 Remove and Control Invasive Vegetation in Whited Marsh

The primary invasive plant species of concern in Whited Marsh are invasive cattails (*Typha angustifolia*, *T.* x *glauca*), purple loosestrife (*Lythrum salicaria*), glossy buckthorn (*Frangula alnus*), and reed canary grass (*Phalaris arundinacea*). Other non-native, invasive, or otherwise inappropriate species encountered in the wetland should also be removed and controlled.

Our recommended approach to invasive vegetation management strives to minimize the use of herbicide; however, chemical applications are often the most cost-effective method for addressing this major ecological stressor. Therefore, selective use of appropriate (e.g., aquatic-approved) chemicals by professionals trained in precise application methods helps to minimize the amount of herbicide used and collateral damage to native vegetation. Because Whited Marsh is a MnDNR Public Water, a MnDNR permit(s) will need to be secured prior to vegetation removal and control. Preliminary discussions with MnDNR representatives indicate removal/control of cattails (not recognized by MnDNR as an invasive species) will require an Aquatic Plant Management permit. Purple loosestrife (considered by MnDNR to be invasive) could be controlled under an Invasive Aquatic Plant Management (IAPM) Permit. The MnDNR offers technical assistance and facilitates the IAPM permitting process for public waters (such as Whited Marsh). Coordination with a local MnDNR Aquatic Invasive Species Specialist would be an important step in project planning for and obtaining an IAPM permit for this project.

Due to the extensive cover of cattails in portions of Whited Marsh (and dense purple loosestrife along the edge of the floating mat and scattered throughout the wetland), it would be most cost-effective to use a tracked vehicle with boom-mounted wicking bars in these areas. This approach (using a vehicle with booms) would greatly reduce the amount of time required for treatment and limit collateral damage to native vegetation (wicking bars would be set to a specific height to treat taller (the invasive) vegetation, avoiding shorter native vegetation). However, the use of mechanized equipment will crush/disturb vegetation, which will require time to recover. While this is an unfortunate reality in many large-scale wetland treatment projects, we view these impacts as temporary and often necessary to make a project feasible. Portions of the wetland that are inaccessible to a track-mounted vehicle and less infested areas would be treated by hand-wicking and spot spraying. Woody invasive species in the wetland (primarily Glossy buckthorn) too large for foliar herbicide application (typically >1/2" diameter stems) would be cut near the base and stump-treated with aquatic-approved herbicide.

Initial invasive vegetation treatments will require multiple follow-up treatments over the following two to three years. This initial "short-term" management effort will then need to be followed by less intensive "long-term" monitoring and management to maintain control of these and potentially new invasive plant species.

5.1.2 Remove and Control Invasive Vegetation around Whited Marsh

The plant communities around Whited Marsh (including the City-owned parcel containing the upland area just northwest of the wetland) consist primarily of degraded lowland forest and woodlands. The primary invasive plant species of concern in the upland buffer around the wetland is the invasive shrub common buckthorn (*Rhamnus cathartica*). However, other non-native, invasive, or otherwise inappropriate species (e.g., glossy buckthorn, pale-yellow iris (*Iris pseudoacorus*), silver grasses (*Miscanthus* spp), garlic mustard (*Alliaria petiolata*)) should also be removed and controlled.

Woody invasive species around the wetland (primarily Common buckthorn) too large for foliar herbicide application (typically >1/2" diameter stems) would be cut near the base and stump-treated with herbicide. The remaining invasive vegetation would be treated primarily with spot spraying. As mentioned in Section 5.1.1, initial invasive vegetation treatments will require multiple follow-up treatments during the "short-term" management phase, followed by less intensive "long-term" monitoring and management.

Overseeding with native woodland species is an additional strategy appropriate for the restoration of areas around the wetland. Following initial invasive vegetation removals and treatments, broadcasting shade-tolerant native grass and wildflower seed will facilitate recovery of the ecosystem and help fill the void created by invasive vegetation removal, suppressing re-invasion. This overseeding will also reduce sheet erosion through the soil-anchoring properties of the plant roots, and provide habitat value through diversification of native vegetation. Some upland buffer areas would benefit from additional live native plantings (e.g., trees, shrubs, woodland wildflowers). Such plantings are included as optional tasks in our cost estimate (Section 5.5 below). Landowners, neighbors, and the wider community could be engaged as volunteers for the installation of these live plants, providing an opportunity for education and personal investment in enhancing these natural areas.

5.2 Partnership and Grant Opportunities

Based on our discussion with NMCWD staff, the Board of Managers, and other local resource managers the following partnership opportunities have been identified for this project.

• **City of Minnetonka**. The City of Minnetonka has identified Whited Marsh as an important ecological resource, supporting NMCWD's identification of this wetland as a priority for protection and enhancement in the watershed.

The City-owned parcel in the northwest portion of the wetland provides an important opportunity for public access to this wetland (off of Whited Avenue). This access could be enhanced be constructing a small parking area that could be used by the local community

and nearby students from Gatewood Elementary School. Enhancement of the upland portion of this parcel (see Section 5.1.2) would provide an attractive way to invite the community to sensitively access and engage with this unique, high-quality wetland. A simple, boardwalk-type structure extending into the northwest portion of the wetland would allow for closer observation and appreciation of this unique, high-quality wetland, and would facilitate water sampling, if desired. An observation platform at the wetland edge may be preferred as opposed to a boardwalk spur out into the wetland. Discussions with stakeholders and neighboring landowners as well as feasibility of this feature need to be determined. This location is fortuitous in that the City-owned portion of the wetland is moderately degraded (being infested with invasive cattails and other non-native species), but it has retained significant diversity of native wetland plants and has high restoration potential.

- U.S. Fish & Wildlife Service. The USFWS provides technical support and grant and/or cost-share funding for enhancement of wetlands through its "Partners for Fish and Wildlife" program (https://www.fws.gov/program/partners-fish-and-wildlife). Preliminary communications with Mike Malling (USFWS Wildlife Biologist) suggest that the enhancement of Whited Marsh would be a strong candidate for this program, which may provide cost-share (in the form of project materials, such as seed or herbicide) and/or funds for discrete enhancement tasks (e.g., buckthorn removal).
- Minnesota Department of Natural Resources (MnDNR). The MnDNR offers an Aquatic Invasive Species Control Grant Program to help local entities manage invasive aquatic plants (such as purple loosestrife, present in Whited Marsh). The application period for 2022 has closed, but it is anticipated that this program will be offered in 2023.
- **Great River Greening.** Great River Greening works with many Metro area conservation partners including municipalities, counties, non-governmental organizations, federal and state agencies, corporations, and private landowners to engage volunteers in restoring ecological health to critical natural areas, parks and open spaces, and other features. They may be able to help provide funding, technical support, as well as outreach and volunteer support, for not only restoration, but also a more sustainable and long-term management of the wetland.

5.3 Educational, Outreach and Volunteer Opportunities

Education and outreach are important considerations, as it is likely that some of the community surrounding the wetland do not fully understand or appreciate the unique, high-quality wetland they live near (or even may own a portion of). Education and outreach will often lay the groundwork for identifying and recruiting volunteers—some of whom could become long-term management stewards of this wetland, which would be valuable for protecting the investments recommended in this report.

- Educational/Outreach Flyer or Meeting for Residents. Education and outreach messaging should convey both appreciation for this ecological resource as well as protection strategies. Communicating the rarity of this type of wetland and the diversity of native plant and animal species and uncommon in the metropolitan region should lead to an increased appreciation and care for Whited Marsh. Explaining the wetland's sensitivity to nutrient enrichment, sediment, and other degradation threats would help underscore the importance of how people nearby manage their private property. Protection strategies would include do not clear vegetation to the wetland edge, manage runoff so it does not adversely affect the wetland, and remove and control invasive vegetation on your property. Understanding signs of a healthy wetland can also help neighbors to understand and know what plant and animal life to expect from a healthy habitat.
- Landowner Engagement. There are 14 landowners with property within the 30-foot wide generalized buffer and another five nearby properties that drain to Whited Marsh. Engaging with landowners to obtain access for vegetation management also presents an opportunity to educate landowners on the importance of protecting high quality wetlands (such as Whited Marsh) and maintaining a healthy wetland buffer, as well as other lawn and garden maintenance that can impact the wetland. This is also a good opportunity to highlight the Watershed District's Stewardship Grant Program and example projects that could help keep runoff to Whited Marsh clean and provide additional buffer space. Additionally, two of the 14 properties referenced above are held by a public entity. Along with access and restoration opportunities on the Minnetonka parcel, that and the Hennepin County parcel in the southeast portion of the wetland could be used as demonstration areas to showcase sustainable landscaping, native plantings, rain gardens, and buffer enhancements that neighbors could implement on their own properties.
- Volunteer Crew(s). Identifying, recruiting, training, and supervising a crew (or crews) of volunteers would go a long way to helping secure the long-term management of this wetland protection/enhancement project. Volunteer work always warrants attention to safety issues, but this would be even more important for work within the wetland itself given the nature of floating mat wetlands and the open water "lag," which present inherent (but not insurmountable) risk.
- **Gatewood Elementary School**. Having an elementary school close to the site provides a unique opportunity to engage children in the appreciation of this unique, high-quality wetland system. As stated above, while not ideally located (on the opposite side of the wetland), the City-owned parcel in the northwest portion of the wetland would provide a great opportunity for providing students with access to the wetland. Students could learn about a wide variety of topics, including watersheds, stormwater management, wetlands, native vegetation, invasive vegetation, and water sampling.

5.4 NMCWD Commitments

Execution of this wetland protection and enhancement project as described in the preceding sections will require commitments by the NMCWD. While unknowns remain regarding the exact nature of the project and the participation and contributions from partners and volunteers, the NMCWD has technical resources (i.e., its staff and consultants) and financial resources that can facilitate successful execution of this project.

As project initiator, the NMCWD should budget time and finances for in-house staff and potentially ecological consultants to further develop this project. Tasks that warrant refinement include:

- Solidification of partner commitments and working with landowners,
- Applying for and securing MnDNR permits, anticipated to include Aquatic Plant Management permit and Invasive Aquatic Plant Management (IAPM) permit,
- Securing potential grant funds,
- Developing bid documents, and
- Monitoring and oversight of retained ecological contractors and volunteers.

While there are significant unknowns that will influence the roles and responsibilities that may be taken on by the NMCWD, we would recommend that, in addition to the tasks/costs presented in Appendix E, the NMCWD consider the following potential future commitments:

- 40 hours/year staff time (for coordination of ongoing projects associated with Whited Marsh, including grant applications, coordination with contractors, volunteers, and partners, etc.)
- Long-term management of invasive vegetation (i.e., after Years 1-3, addressed in Appendix E): \$2,500-\$3,000/year (if relying on professional ecological contractor)

5.5 Refined Opinion of Probable Costs

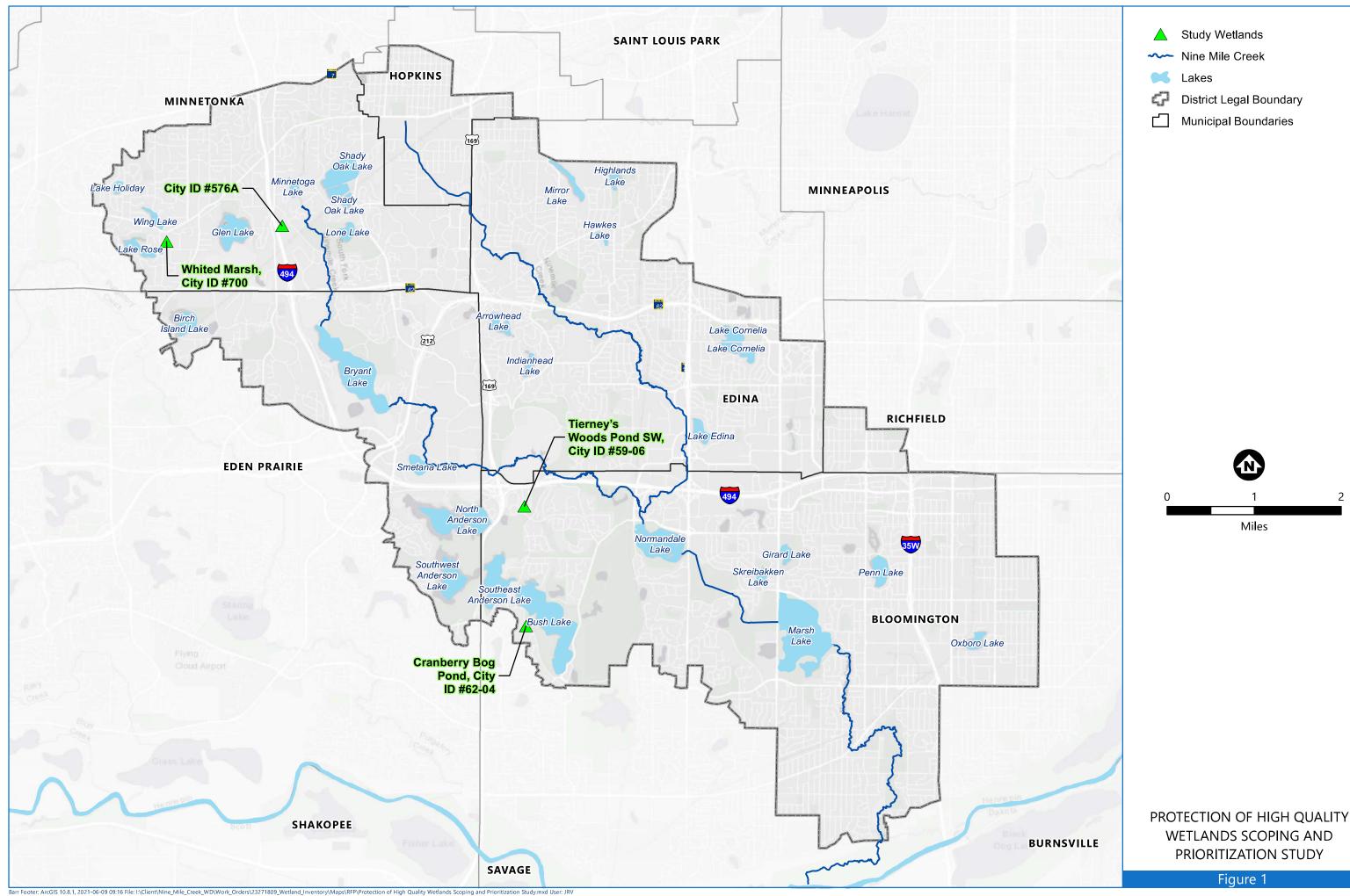
Based on our recommended approach to the protection and enhancement for Whited Marsh, a refined opinion of probable costs was developed for the project (Appendix E). The presented costs assume execution by professional ecological contractors. As with all opinions of probable costs, there are many additional assumptions (several noted in the spreadsheet) that may affect the ultimate cost of project execution.

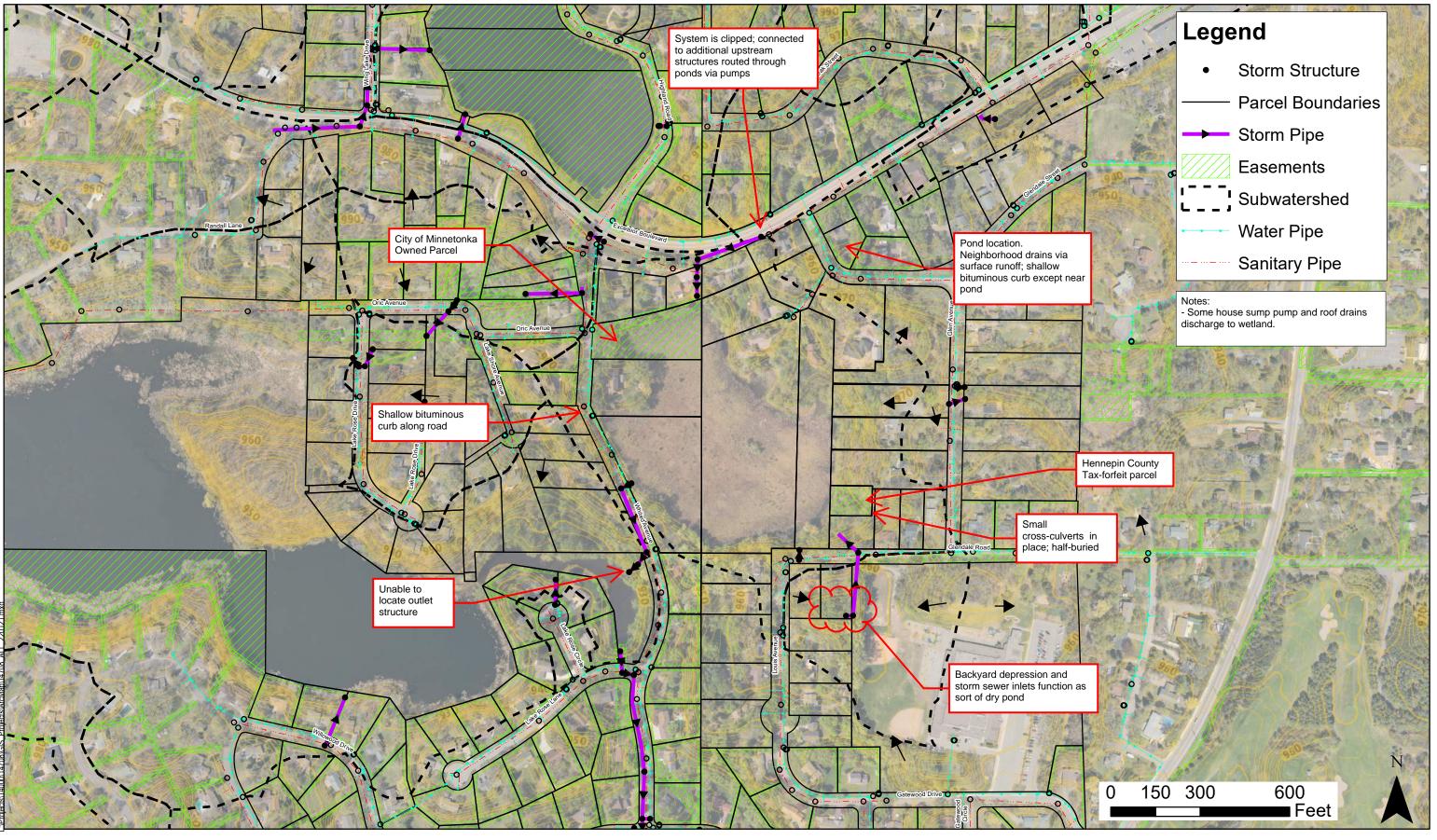
Appendices

- A) Watershed Overview Map, Wetland Basin and Subcatchment Maps, and Whited Marsh Enhancement Map
- B) Project Benefit Matrix and Initial Cost Estimates
- C) Initial Opinions of Probable Cost for Potential Projects
- D) Site Photographs
- E) Refined Opinion of Probable Cost for Whited Marsh

Appendix A

Watershed Overview Map, Wetland Basin and Subcatchment Maps, and Whited Marsh Enhancement Map

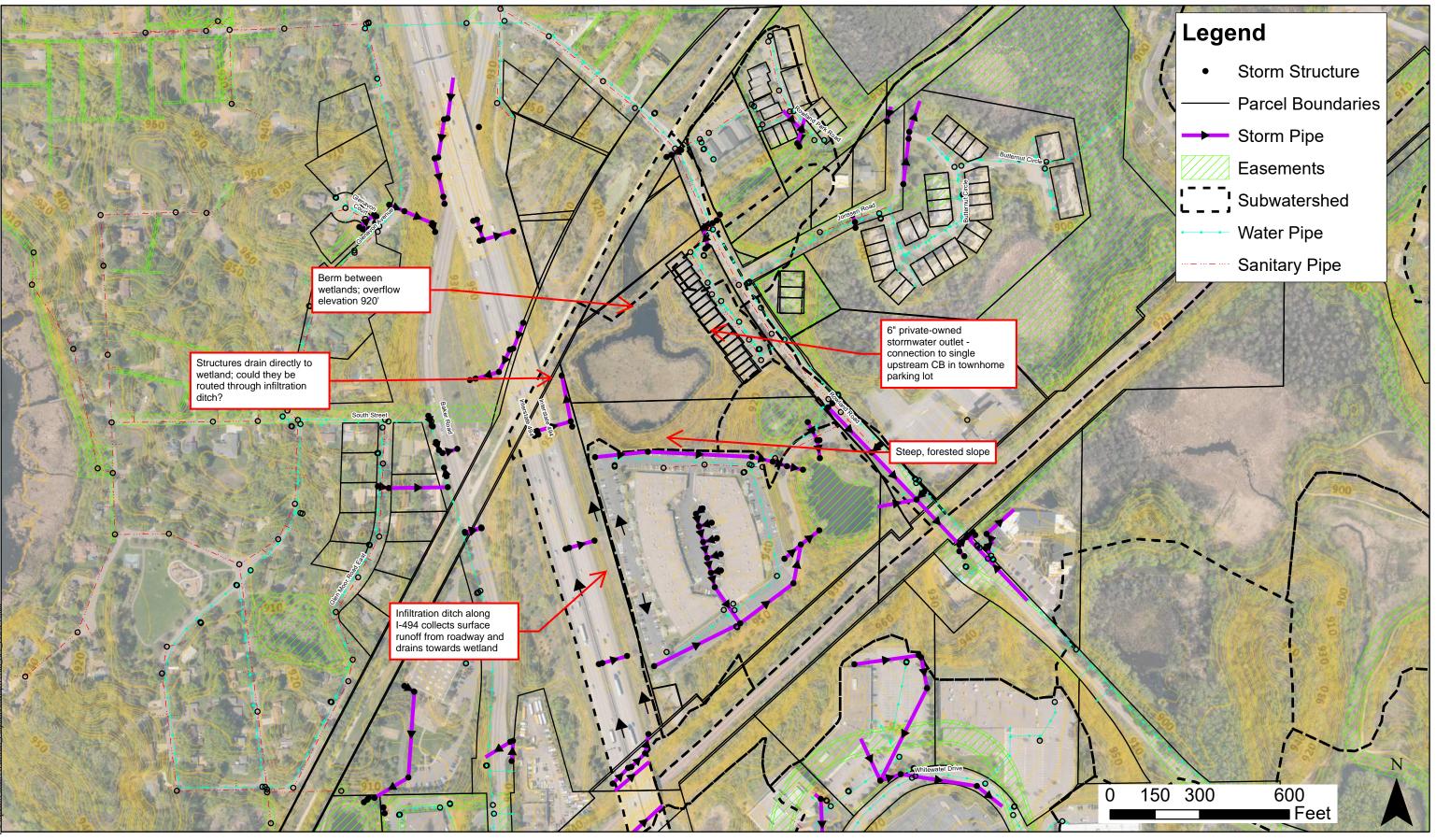






Whited Marsh (700) High Quality Wetland Prioritization Study Nine Mile Creek Watershed District

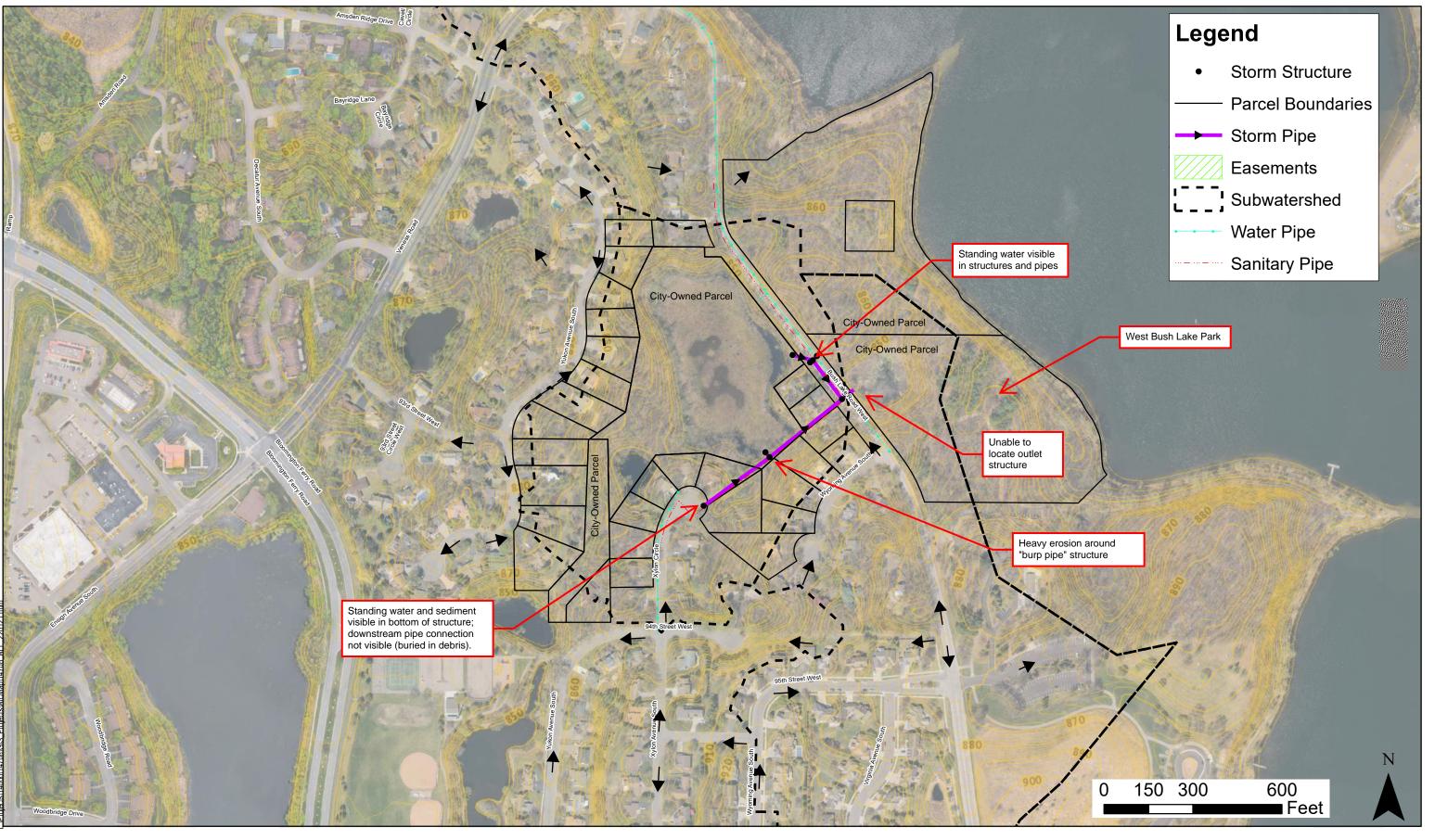
Figure A1





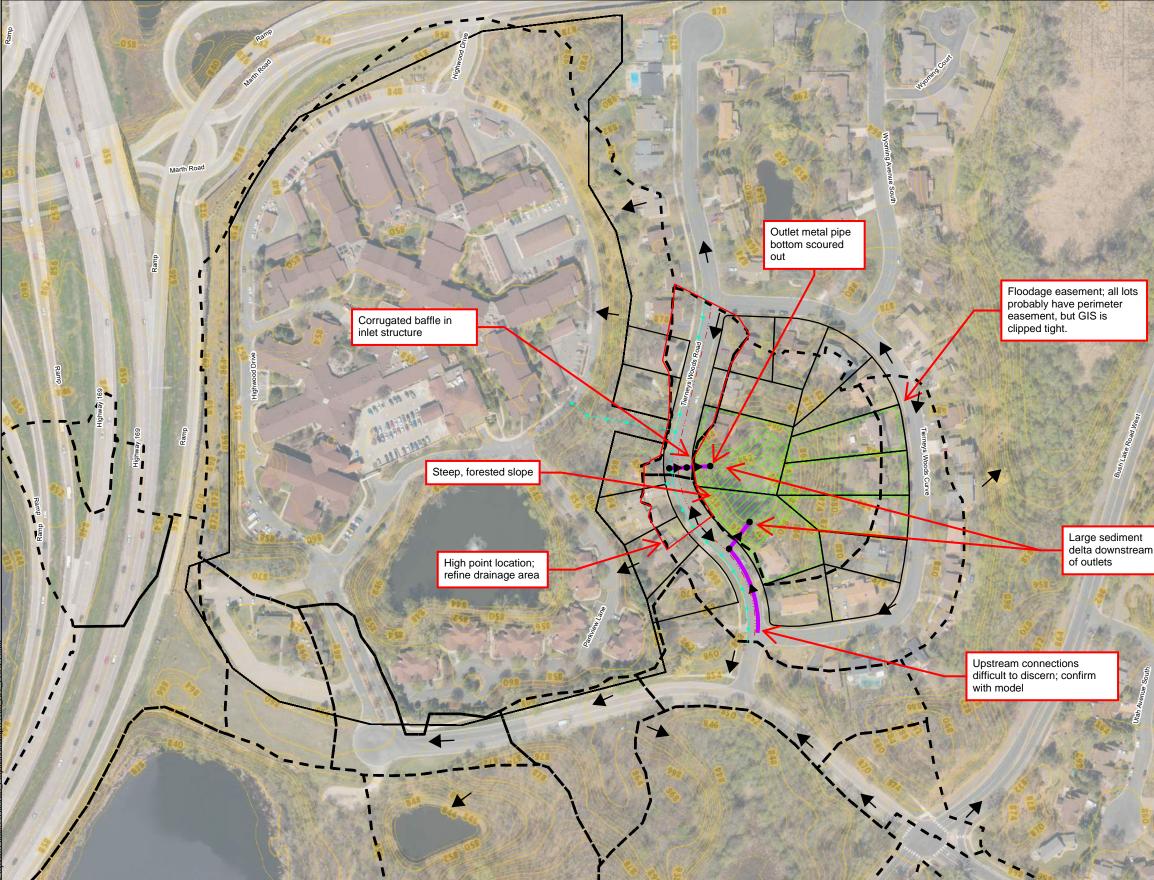
Rowland Road (576A) High Quality Wetland Prioritization Study Nine Mile Creek Watershed District

Figure A2





Cranberry Bog (62-04) High Quality Wetland Prioritization Study Nine Mile Creek Watershed District



Tierney's Woods Pond SW (59-06) High Quality Wetland Prioritization Study

Nine Mile Creek Watershed District

Legend

- Storm Structure •
 - Parcel Boundaries
- Storm Pipe
- Easements
- Subwatershed
- Water Pipe
 - Sanitary Pipe

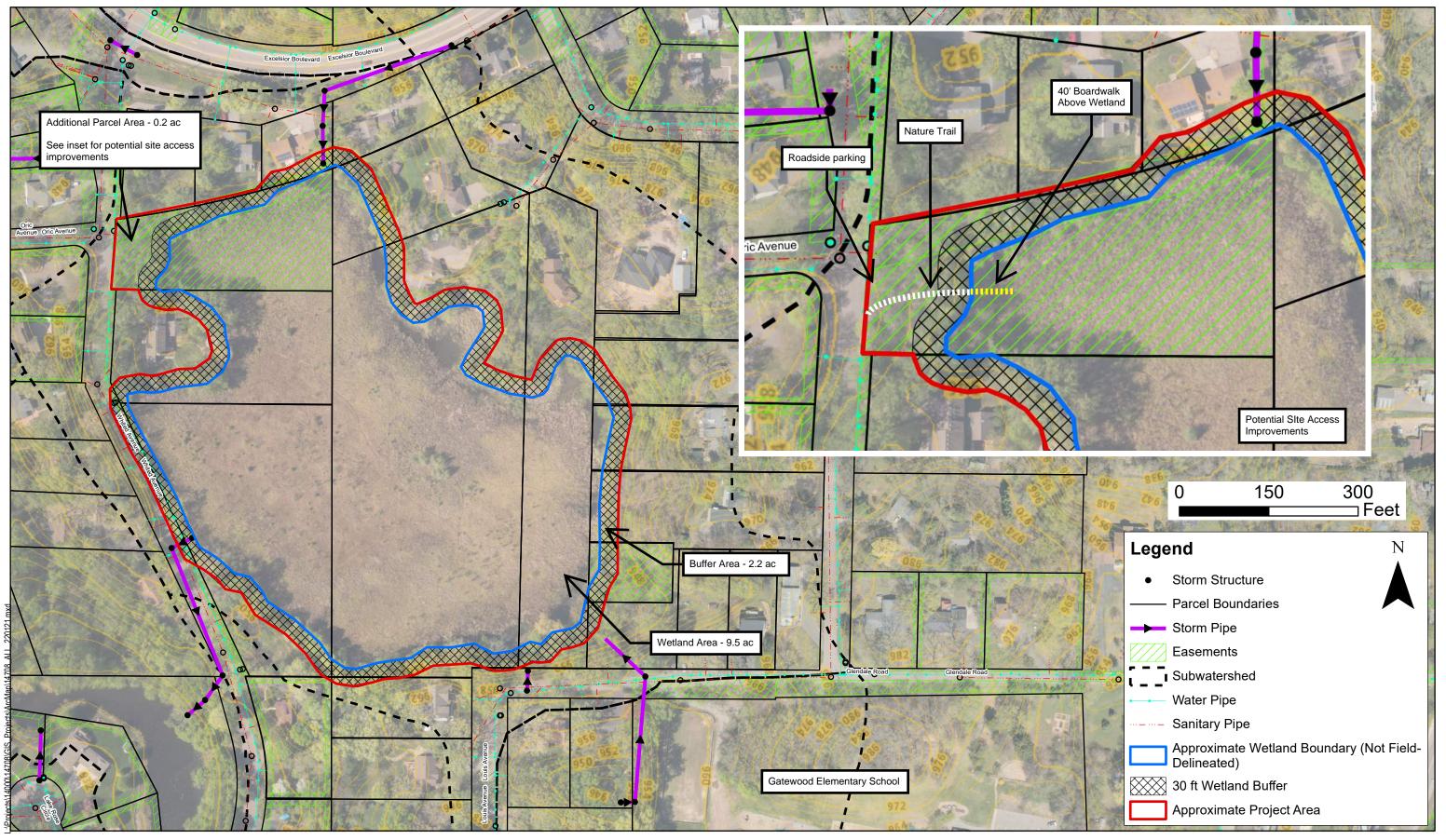
400

Feet

100 200

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Figure A4





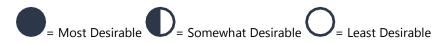
Whited Marsh (700) High Quality Wetland Prioritization Study Nine Mile Creek Watershed District

Figure A5

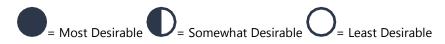
Appendix B

Project Benefit Matrix and Cost Estimates

Name/ Location Wetland ID (Bold is most threatened , <i>Italics</i> is <i>highest quality</i>)	Wetland Description	Protection Strategies	Description of Potential Wetland Protection Activities (BOLD scored best)	Potential Project partners and Number (preference for lower number to reduce project complexity)	Public vs. private (preference for public)	Permanent projects vs. sustained management (preference for permanent projects)	NMCWD staff involvement	Achievement of co-benefits	Ecological Benefits	Educational Opportunities and Community Engagement	Cost (lower is preferred)	TOTAL
Whited Marsh, Minnetonka	Graminoid Sphagnum Rich Fen Basin	 Invasive species control Stormwater management Rain gardens 	Coordinate invasive species control in wetland including pulling/treating cattails and possibly using beetles for purple loosestrife management.	Most land is private, but vast parcel owned by single willing landowner	Private (most of wetland is private land)	Some continued monitoring and management		Ecosystem, buffer, aesthetic	Stop degradation; begin vegetation improvement	Could include engagement with Gatewood Elementary and neighbors	\$48,200	5.5
27-117- 22-33- 013		Upland buffer improvements and protections	Coordinate upland buffer vegetation management (e.g., removal of buckthorn, installation of native plants, buffer expansion where feasible).	Most land is private, but vast parcel owned by single willing landowner	Private (most of wetland is private land)	Some continued monitoring and management		Ecosystem, buffer, aesthetic	Stop degradation; begin vegetation improvement	Could include engagement with Gatewood Elementary and neighbors	\$16,872	6
			Pretreatment at catch basins and manholes in road upstream of storm outlets or in low back yards.	1-2 Partners	Public	Maintenance on city/county		WQ	0	0	\$22,000- \$67,000	4-5
			Partner with surrounding landowners to install raingardens or other suitable stormwater pre- treatment options (rain gardens at roof drains, residential buffers).	Many	Private	Maintenance is responsibility of landowner, could require inspections	Grants	Eco, education, buffer, WQ, aesthetic		Engagement with neighbors	Variable, cost- share/grants	4
			Coordinate with City of Minnetonka to manage City- owned property. Potential for overlook or signage at this location.	2 Partners	Public	Maintenance is responsibility of city		Ecosystem, access, education, aesthetic		 Gatewood Elementary Signage 	Variable, cost- share/grants	5



Name/ Location Wetland ID (Bold is most threatened , <i>Italics</i>	Wetland Description	Protection Strategies	Description of Potential Wetland Protection Activities (BOLD scored best)	Potential Project partners and Number (preference for lower number to reduce project complexity)		Permanent projects vs. sustained management (preference for permanent projects)	NMCWD staff involvement	Achievement of co-benefits	Ecological Benefits	Educational Opportunities and Community Engagement	Cost (lower is preferred)	TOTAL
is <i>highest quality</i>) City ID #576A, Minnetonka 27-117- 22-34- 017	Graminoid Sphagnum Rich Fen Basin	 Invasive species control Stormwater management Rain gardens Upland buffer protections 	Coordinate invasive species control in wetland including pulling/treating cattails and possibly using beetles for purple loosestrife management.	Townhomes and commercial	Private	Some continued monitoring and removal		0			\$18,450	4
017		 Slope stabilization 	Coordinate upland buffer vegetation management (e.g., removal of buckthorn) and vegetated slope stabilization.	Townhomes and commercial	Private	Some continued monitoring and removal					\$21,756	4.5
			Increased upstream infiltration and outlet stabilization at MnDOT drainage outlet	MnDOT	Private				0	0	Variable, cost by owner/agency	3
			Rain gardens or other pretreatment at town home (office parks drains to separate BMPS)	Townhomes and commercial	Private	Maintenance is responsibility of landowner, could require inspections					Variable, cost- share/grants	3.5



Name/ Location Wetland ID (Bold is most threatened , <i>Italics</i>	Wetland Description	Protection Strategies	Description of Potential Wetland Protection Activities (BOLD scored best)	Potential Project partners and Number (preference for lower number to reduce project complexity)		Permanent projects vs. sustained management (preference for permanent projects)	NMCWD staff involvement	Achievement of co-benefits	Ecological Benefits	Educational Opportunities and Community Engagement	Cost (lower is preferred)	TOTAL
is <i>highest quality</i>) Cranberry Bog Pond, Bloomington	Graminoid Sphagnum Rich Fen Basin	 Invasive species control Stormwater management Upland buffer improvements 	Partner with City of Bloomington and surrounding landowners for invasive species control in wetland.	Residents and Bloomington, mostly city	Public	Some continued monitoring and removal					\$13,400	5
27-116- 21-19- 003		 and protections Boardwalk and educational opportunities 	Partner with City of Bloomington and surrounding landowners for upland buffer improvements and protections.	Residents and Bloomington, mostly city	Public	Some continued monitoring and removal					\$9,842	5
			Stormwater management including redesign/repair of "burp pipe" and surcharged outlet.	City of Bloomington	Public	Maintenance by city			0	0	Variable, cost by owner	4
			Boardwalk and educational opportunities.	Residents, regional park, Bloomington	Public	Maintenance by city	0		0		Variable, cost- share/grants	3.5
Tierney's Woods Pond SW, Bloomington 27-116-	Sedge meadow/ shallow marsh	 Invasive species control Stormwater pre- treatment 	Coordinate invasive species control in wetland.		Public- easements	Some continued monitoring and removal					\$1,400	6.5
21-18- 020			Coordinate upland buffer vegetation management (e.g., removal of buckthorn, installation of native plants, buffer expansion where feasible).		Public- easements	Some continued monitoring and removal					\$4,752	6.5
			Improve pretreatment and energy dissipation at north inlet and add pretreatment to south inlet/outlet to prevent sediment delta.		Public- easements	Maintenance by city			0	0	\$22,000- \$47,000	4 – 4.5

Appendix C

Initial Opinions of Probable Costs for Potential Projects

Initial Opinions of Probable Cost for Inv Veg Control (Wetlands & Buffers)

Site	Task (over 3 yrs)	Units	Qty	Unit Cost	Cost		Notes
Whited Marsh	cattail/PL control (wick-mechanical) - 2x	ac	3	\$ 3,000	\$	9,000	assumes use of Marsh Master/similar vehicle with wick boom
9.81 ac	cattail/PL control (wick-hand) - 3x	ac	3	\$ 12,000	\$	36,000	
	cattail/PL control (spot spray) - 3x	ac	1	\$ 1,200	\$	1,200	
	RCG control (spot spray) - 4x	ac	0.25	\$ 8,000	\$	2,000	
				Wetland Total	\$	48,200	
							assume avg. 30ft width around perimeter (2,912 ft) + Henn Co. parcel
v	Whited Buffer remove invasive trees/shrubs - 1x	ac	2.28	\$ 4,000	\$	9,120	(0.27ac)
	treat woody re-sprouts & seedlings -3x	ac	2.28	\$ 900	\$	2,052	
	spot herbicide - 5x	ac	2.28	\$ 1,500	\$	3,420	
	enhancement overseeding - 1x	ac	2.28	\$ 1,000	\$	2,280	
				Buffer Total	\$	16,872	
			[Site Total	\$	65,072	
Rowland Rd	cattail/PL control (wick-hand) - 3x	ас	1.5	\$ 12,000	\$	18,000	mat 1.82
2.57 ac	cattail/PL control (spot spray) - 3x	ac	0.3		\$	450	
				Wetland Total		18,450	
Ro	Rowland Buffer remove invasive trees/shrubs - 1x		2.94	\$ 4,000	\$	11,760	assume site (5.51 ac) minus wetland
	treat woody re-sprouts & seedlings -3x	ac	2.94	\$ 900	\$	2,646	
	spot herbicide - 5x	ac	2.94	\$ 1,500	\$	4,410	
	enhancement overseeding - 1x	ac	2.94	\$ 1,000	\$	2,940	
				Buffer Total	\$	21,756	
			[Site Total	\$	40,206	
Cranberry	cattail/PL control (wick-hand) - 3x	ас	1	\$ 12,000	\$	12,000	mat 3.8ac
4.55 ac	cattail/PL control (spot spray) - 3x	ac	1	\$ 1,400	\$	1,400	
	RCG control (spot spray) - 4x	ac	0.25	\$ 8,000	\$	2,000	
				Wetland Total	\$	13,400	
Cra	nberry Buffer remove invasive trees/shrubs - 1x	ас	1.33	\$ 4,000	\$	5,320	assume avg. 30ft width around perimeter (1,935 ft)
	treat woody re-sprouts & seedlings -3x	ac	1.33	\$ 900	\$	1,197	
	spot herbicide - 5x	ac	1.33	\$ 1,500	\$	1,995	
	enhancement overseeding - 1x	ac	1.33	\$ 1,000	\$	1,330	
				Buffer Total	\$	9,842	
			Γ	Site Total	\$	23,242	
			L				

Opinions of Probable Cost for Inv Veg Control (Wetlands & Buffers)

Site	Task (over 3 yrs)	Units	Qty	Un	it Cost	Cost		Notes
Tierney's Woods Pond SW	RCG control (spot spray) - 4x	ac	0.07	7\$	20,000	\$	1,400	
0.24 ac				W	etland Total/	\$	1,400	
Tierney's Buffe	r remove invasive trees/shrubs - 1x	ас	0.44	\$	5,000	\$	2,200	assume avg. 50ft width around perimeter (1,935 ft)
	treat woody re-sprouts & seedlings -3x	ac	0.44	\$	2,200	\$	968	
	spot herbicide - 5x	ac	0.44	\$	2,200	\$	968	
	enhancement overseeding - 1x	ac	0.44	\$	1,400	\$	616	
					Buffer Total	\$	4,752	
					Site Total	\$	6,152	
TOTAL COST - WETLANDS						\$	81,450	
TOTAL COST - BUFFERS						\$	53,222	
TOTAL COST - ALL INV VEG	CONTROL					\$	134,672	

Site	Task	Units	Qty	Unit	t Cost	Cost		Notes
Whited Marsh			-					
	Outlet Modifications and Forebay	ea		0	\$12,180		\$0	
	Pretreatment at Catch Basin or Manhole	ea		3	\$22,185		\$66,555	up to 3 pretreatment locations, includes retrofit for adding baffle
					Site Total	\$	66,555	
Rowland Road							<u> </u>	
								other projects are highly variable and would be a cost share or gran
	Outlet Modifications and Forebay	ea		0	\$12,180		\$0	program
	Pretreatment at Catch Basin or Manhole	ea		0	\$22,185		\$0	
					Site Total	\$	-	
								other projects are highly variable and would be a cost share or gran
Cranberry Bog								program
	Outlet Modifications and Forebay	ea		0	\$12,180		\$0	
	Pretreatment at Catch Basin or Manhole	ea		0	\$22,185		\$0	
					Site Total	\$	-	
Tierney's Woods Pond	SW							
								access will be difficult at this site. It is recommended that if
	Outlet Modifications and Forebay	ea		2	\$12,180		\$24,360	improvements are made for one inlet, they should be made for bot
	Pretreatment at Catch Basin or Manhole	ea		1	\$22,185		\$22,185	
					Site Total	\$	46,545	

Outlet modifications and forebay could include repair/replace pipe/apron, excavation, riprap, mobilization and contingency. Pretreatment includes replacement of structure to include sump and baffle and restoration of area.

Appendix D

Site Photographs

Appendix D. Site Photographs



Photo 1. Whited Marsh – Invasive, non-native cattails and purple loosestrife intermixed with diverse native vegetation.



Photo 2. Whited Marsh – Invasive, non-native cattails are dense in background and expanding into high-quality foreground vegetation.



Photo 3. Rowland Road Wetland – Open water "lagg" with floating wetland mat on right. Brown vegetation on edge of floating mat is mostly invasive purple loosestrife.



Photo 4. Rowland Road Wetland – Degraded oak forest with invasive Common buckthorn on slope, south of wetland.



Photo 5. Cranberry Bog – Open water "lagg" (with uncommon floating pennywort in right foreground) and diverse native vegetation on floating wetland mat.



Photo 6. Cranberry Bog – Degraded oak forest with invasive Common buckthorn, west of wetland.



Photo 7. Tierney's Woods Pond SW – Wetland basin with sedge meadow in far left and (bright green) reed canary grass-infested sediment delta on right.



Photo 8. Tierney's Woods Pond SW – Degraded forest on steep slope, west of wetland.

Appendix E

Refined Opinion of Probable Cost for Whited Marsh

Appendix E - NMCWD Protection of High-Quality Wetlands

Refined Opinions of Probable Costs for Inv Veg Control (Wetlands & Buffers) - Whited Marsh Site Only

Option 1 - WITH Mechanical Equipment

Site		Task (over 3 yrs)	Units	Qty	U	nit Cost	Cost		Notes
Whited Marsh		cattail/PL control (wick-mechanical) - 2x	ас		3 \$	3,000	\$	9,000	assumes use of I
9.5 ac	0.5 ac	cattail/PL control (wick-hand) - 3x	ас		3 \$	12,000	\$	36,000	
		cut & stump-treat >1/2" woody - 1x*	ас		3 \$	3,000	\$	9,000	low density of cu left/thin-spread
		cattail/PL control (spot spray) - 3x	ас		1 \$	1,200	\$	1,200	
		RCG control (spot spray) - 4x	ас	0.1	25 \$	8,000	\$	2,000	
				W	/etla	nd Total	\$	57,200	
N	Whited Buffer (30ft buffer, including City parcel buffer	remove invasive trees/shrubs - 1x	ас	2	.2 \$	4,000	\$	8,800	assume piled & l
	2.2 ac	treat woody re-sprouts & seedlings -3x	ас	2	.2 \$	900	\$	1,980	
		spot herbicide - 5x	ас	2	.2 \$	1,500	\$	3,300	
		enhancement overseeding - 1x	ас	2	.2 \$	1,000	\$	2,200	
				30ft	Buf	er Total	\$	16,280	
	Whited Buffer (additional City upland)	remove invasive trees/shrubs - 1x	ас	C	.2 \$	6,000	\$	1,200	assume piled & l
	0.2 ac	treat woody re-sprouts & seedlings -3x	ас	C	.2 \$	1,350	\$	270	
		spot herbicide - 5x	ас	C	.2 \$	2,250	\$	450	
		enhancement overseeding - 1x	ас	C	.2 \$	1,500	\$	300	
						er Total		2,220	

Base Project Total (WITH mech. equip.) \$ 75,700

* Item(s) added to OPC since initial costing.

of Marsh Master/similar vehicle with wick boom

f cutting required; most if not all brush ad

& burned on site, or left as habitat brush piles

& burned on site, or left as habitat brush piles

te	Task (over 3 yrs)	Units	Qty	Unit Cost	Cost		Notes
/hited Marsh	cattail/PL control (wick-hand) - 3x	ас	6	\$ 12,000	\$	72,000	
	cut & stump-treat >1/2" woody - 1x*	ac	3	\$ 3,000	\$	9,000	low density of cu
5 ac							left/thin-spread
	cattail/PL control (spot spray) - 3x	ас	1	\$ 1,200	\$	1,200	
	RCG control (spot spray) - 4x	ас	0.25	\$ 8,000	\$	2,000	
			Wet	land Total	\$	84,200	
Whited Buffer (30ft buffer, including City parcel buffer)	remove invasive trees/shrubs - 1x	ас	2.2	\$ 4,000	\$	8,800	assume piled & b
2.2 ac	treat woody re-sprouts & seedlings -3x	ас	2.2	\$ 900	\$	1,980	
	spot herbicide - 5x	ас	2.2	\$ 1,500	\$	3,300	
	enhancement overseeding - 1x	ac	2.2	\$ 1,000	\$	2,200	
			30ft Bu	Iffer Total	\$	16,280	
Whited Buffer (additional City upland)	remove invasive trees/shrubs - 1x	ас	0.2	\$ 6,000	\$	1,200	assume piled & b
0.2 ac	treat woody re-sprouts & seedlings -3x	ac	0.2	\$ 1,350	\$	270	
	spot herbicide - 5x	ac	0.2	\$ 2,250	\$	450	
	enhancement overseeding - 1x	ac	0.2	\$ 1,500	\$	300	
			City Bu	uffer Total	\$	2,220	
	Base Pro	oject Total (WITHOUT me	ch. equip.)	\$	102,700	
Optional Tasks (installation of live herbaceous & woody plants)		ас		\$ 2,500		5,500	500 plugs/ac
	install native plant plugs (City upland) - 1x*	ас		\$ 5,000		1,000	1,000 plugs/ac
	install native trees/shrubs (30ft buffer) - 1x*	ac		\$ 2,000		4,400	assume ~4-10 tre
	install native trees/shrubs (City upland) - 1x*	each	1	\$ 1,600	\$	1,600	assume 8 trees (1

* Item(s) added to OPC since initial costing.

cutting required; most if not all brush

burned on site, or left as habitat brush piles

burned on site, or left as habitat brush piles

assume ~4-10 trees/ac, or ~50 shrubs/ac, or combination assume 8 trees (10-gal pot) or ~40 shrubs, or combination

Optional Total \$ 12,500