Newport News Waterworks

**Diascund Reservoir**

**Hydrilla Management Work Plan**

**November 2017 Update**

**Background**

In March of 2013, Newport News Waterworks stocked 1,000 sterile grass carp (SGC), obtained from Smith Minnow Farm in Victoria Virginia, in Diascund Reservoir in an attempt to control the growth of hydrilla in the lake. The stocking rate was based on recommendations from the Virginia Department of Game and Inland Fisheries (VGIF) for a “slight” hydrilla infestation where less than 30% of the lake is affected. Stocking was performed in accordance with the VGIF permit conditions for this activity. As specified, the SGC were 8 to 10 inches in length when stocked. Details of the historical reservoir assessments and the 2012 Work Plan are provided for reference as an Appendix to this update.

As grass carp are known to be attracted to moving water, a protective plastic fence was installed around the inlet works of the Diascund Pump Station to prevent the fish from escaping the reservoir. A severe rain event in June 2013 necessitated the opening of the pump station outlet works to relieve pressure on the Diascund Dam. The rush of water through the outlet gates dislodged portions of the protective fencing and other bottom debris. The outlet gates were damaged by the debris which prevented them from closing properly. As a result operators were not able to stop the flow of water through the diversion channel. The lake level dropped several feet, and it is assumed that some percentage of the SGC escaped the reservoir through the damaged outlet. The lake level remained several feet below normal throughout the summer and fall of 2013. It is unknown whether the low lake level had an effect on the survival of the grass carp, but it is likely the shallow water conditions may have increased losses due to predation.

In the spring of 2015 an additional 1,300 SGC were stocked in Diascund Reservoir. Shortly thereafter the lake level was again dropped several feet so that needed repairs to the dam, spillway and pump station could be completed. The lake level remained down throughout the summer and fall of 2015, and it is possible that the SGC population and viability were again effected. Repairs to the dam and pump station were completed in late 2015 and the lake was back to normal pool level by early 2016.

Figure 1 below confirms the water level fluctuations associated with these events. It should be noted that as a water supply reservoir, some reservoir fluctuation is expected seasonally.
Update

Because the lake levels had been down for extended periods during the growing seasons of 2013 and 2015, Waterworks was unable to make an accurate assessment of the hydrilla densities following introduction of the SGC. It was not until the summer of 2016 when the reservoir returned to near full pool conditions that an accurate assessment could be completed.

When finished in late summer 2016, the assessment showed a general decrease in the spread of hydrilla in the reservoir from the 2011 assessment. That original 2011 assessment reported dense hydrilla growth found in most areas of the reservoir. By 2016, dense growth was found in only 6% of the reservoir. Another 17% of the reservoir had light to moderate hydrilla growth. However, monitoring crews were unable to determine if the decrease in hydrilla growth was due to the consumption by SGC, the extended drawdowns of 2013 and 2015, or a combination of both factors. A copy of the 2016 assessment is provided below in Figure 2.
Diascund Reservoir remained at near normal level during 2016 and 2017. There have been no other extended drawdowns since 2015. In late summer of 2017, staff conducted another assessment of the hydrilla growth in the reservoir to try to get better idea of what impact the grass carp were having and to document plant density trends. That assessment found that the hydrilla growth in the reservoir had increased by approximately 33% since the 2016 survey. Dense growth remained at about 6% but there was a steep increase in the moderate growth category from 13% of the lake surface to 21%.

Figure 3 below illustrates the results of the 2017 reservoir survey.
**Figure 3 - 2017 Diascund Hydrilla Assessment**

*Figure showing hydrilla coverage in different areas of the reservoir.*

**Recommendations and Action Plan**

Because there has been a measurable increase in the extent and density of hydrilla in Diascund Reservoir over the past year, we believe that the previous SGC have been unsuccessful due to a number of possible factors, including low stocking rates. We have consulted the Department of Game and Inland Fisheries regional fish biologist about these results, and he recommended that Waterworks move ahead with the stocking of 2,000 SGC in the reservoir in the spring of 2018, and continue to reassess plant growth and densities each year.

Waterworks is currently applying for permits and soliciting bids from qualified supplies for restocking in the spring of 2018. Stocking will occur with support from local residents and VGIF staff to ensure that the SGC are distributed in areas with heavy plant density. A group of residents and interested parties will be notified by email when the details regarding this activity have been finalized. The group members are based on a contact list maintained by our communications team.
Appendix

Newport News Waterworks

**Diascund Reservoir**

*Hydrilla Management Work Plan*

1.0 Introduction and Background

Reservoir Management

Lakes or reservoirs that are created by damming stream valleys may initially be highly productive as nutrients in the previous stream’s floodplain are released into the water column. Over a period of decades, the initial productivity tends to change until the impoundment takes on conditions governed more by the entire watershed, with depth and hydraulic detention time as critical elements of the reservoir’s response to watershed inputs.

Impoundments may never completely escape the legacy of their creation. In coastal plain settings, they are commonly shallow and the pre-existing nutrient and organic-rich bottom sediments may provide nutrients for abundant aquatic plant growth throughout the life of the lake. Human activity can accelerate the process of lake aging or, in the case of introduced species or pollutants, force an unnatural response. Unnatural responses include the elimination of aquatic species as a result of acid deposition, algal blooms resulting from excessive nutrient enrichment, and the development of a dense monoculture of a non-native aquatic plant. However, it would be unrealistic to assume that managing cultural impacts on lakes and in watersheds can convert all impoundments into infertile basins of ultra-clear and stable water.

Most impacts on reservoirs or lakes can be related to characteristics of the watershed, although acid rain, mercury deposition and drought (or floods) have demonstrated that not everything important to reservoirs occurs within the watershed. An impoundment is a system of interactions between hundreds of biological species, chemical compounds, hydrological processes and human actions, all in constant change. A change to any part of the web ripples throughout the rest of the ecosystem. Lake/reservoir management involves
the application of ecological principles and data to establish and maintain conditions that are consistent with the primary or designated uses.

Hydrilla

*Hydrilla verticillata*, also known as waterweed, is an invasive, submerged freshwater plant that is native to Europe, Africa and Asia. It is thought to have been introduced to the United States by the Florida aquarium trade in the 1960’s. Since that time it has spread throughout much of the southeast and Mid-Atlantic portions of the country. Hydrilla grows rapidly, can reproduce itself by several means and can tolerate a wide range of water conditions. As it grows it forms dense mats that can crowd out native aquatic plants and impede boat traffic. Once established, hydrilla can be very difficult to control.
In areas of North America where hydrilla has become established, it has major detrimental impacts on water use. Hydrilla adversely impacts aquatic ecosystems by forming dense canopies that often shade out native vegetation. Extensive mono-specific stands of hydrilla can provide poor habitat for fish and other wildlife, although hydrilla is eaten by waterfowl and is considered an important aquatic food source by some biologists. While dense vegetation may contain large numbers of fish, density levels obtained by plant species such as hydrilla may support few or no harvestable-sized sport fishes (Washington State Department of Ecology). Dense mats alter water quality by raising pH, decreasing oxygen under the mats, and increasing temperature. Stagnant water created by hydrilla mats provides good breeding grounds for mosquitoes. Hydrilla most typically interferes with recreational activities such as swimming, boating, fishing and water skiing. Hydrilla also has the potential to impact power generation and irrigation by clogging dam trash racks and intake pipes.

In areas where hydrilla, *Eurasian watermilfoil*, and Brazilian elodea coexist, hydrilla out-competes these two noxious species. Hydrilla has the potential to cause greater adverse impacts to aquatic ecosystems than either Eurasian watermilfoil or Brazilian elodea. In states where hydrilla has become established, millions of dollars are spent each year for management activities. Hydrilla has infested over 65,000 acres of Florida's lakes, rivers, streams, drainage and irrigation canals. Florida managers regard hydrilla as their most serious aquatic pest. There are two biotypes of hydrilla. Only the dioecious biotype is found in Florida, although monoecious hydrilla has been reported as far south as Macon, Georgia. Approximately 2.5 million dollars per year is spent on hydrilla control in South Carolina. State officials estimate that there are 50,000 hydrilla infested acres statewide and the infestation areas are still expanding. Management costs are expected to increase with expanding acreage. Approximately half a million dollars is spent each year for hydrilla control activities in North Carolina. Most of the hydrilla in North Carolina is monoecious, although the two biotypes do exist in Lake Gaston at the Virginia-north Carolina border.

The monoecious biotype of hydrilla became established in the Potomac River in 1981 and covered 3,600 acres by 1985. For many years, the Potomac River lacked any submersed aquatic vegetation, and the invasion of hydrilla has been viewed as mixed blessing. Hydrilla does provide an important food source for waterfowl but has proved a detriment for navigation, water supply intakes, and recreational activities.
2.0 Diascund Reservoir

Diascund Reservoir is located in the Virginia coastal plain in eastern New Kent County. It was constructed and filled in the early 1960’s and has the second largest storage volume (3,900 Mgal) in the Newport News system. It has a drainage area of 44 square miles which is sufficient to sustain the reservoir and transfers without filling from external sources. At full-pool elevation, the surface area of the reservoir is 2.0 square miles (1110 acres) with a mean depth of 9.3 feet. The maximum depth of the reservoir is 24 feet.

Three major tributaries drain into Diascund Reservoir: Diascund Creek, Beaverdam Creek, and Wahrani Swamp. Pumpage and transfers from the reservoir vary considerably during the year and between years depending on water demand and climate conditions. Historical data indicate the mean hydraulic retention time of Diascund Reservoir is approximately 130 days (USGS WRI Report 92-4043).

Water is transferred to Harwoods Mill and/or Lee Hall Reservoirs by Waterworks’ pumping station and intake facilities located on the eastern section of the earthen dam. The City owns all of the shoreline and lands beneath the reservoir. Buffer land width varies around the reservoir but generally ends at elevation +30 ft mean sea level, except in areas where additional tracts were purchased during construction. Adjacent landowners are permitted to store boats and canoes and are allowed access to the reservoir across City-owned land.

Rules and regulations for recreational use of the reservoir are established by City Ordinance. Public access for boating and fishing is provided adjacent to the earthen dam by a boat launch and parking facilities operated by Virginia Department of Game and Inland Fisheries and James City County.

Monitoring Areas of Hydrilla Growth

In recent years hydrilla has become established in Diascund Reservoir. It has certainly been present in the reservoir in small amounts for many years, however large, dense patches were first noted by land-owners and Waterworks staff in 2007. At that time the dense growth patches were mainly in the upper reaches of the Diascund and Beaverdam Creek arms of the reservoir. It has quickly spread and as of late summer 2011 dense hydrilla growth could be found in most many areas of the reservoir.

The sequence of map-view illustrations below confirm the increasing hydrilla infestation (red shading) issue at Diascund Reservoir.
Fall 2006
3.0 Impacts of Hydrilla Infestations

Recreational
Over the last few years the number of complaints about the hydrilla growth in Diascund have increased significantly. Adjacent landowners complain that they cannot access the reservoir for recreational purposes during the warmer months of the year and some believe that their property values may be affected. Boaters who put in at the DGIF ramp complain that the hydrilla mats make navigation in the reservoir difficult and cause large portions of the reservoir inaccessible for fishing, especially shallower water. Hydrilla plants caught in their props need to be frequently removed and can cause overheating of the batteries. Also, boats and boat trailers need to be thoroughly cleaned of hydrilla when exiting the reservoir to prevent spreading the plants to other surface waters.

Ecological
Hydrilla growth can adversely affect aquatic resources in several ways. The dense growth mats can completely block sunlight from reaching other native plants reducing aquatic plant species diversity sometimes creating a hydrilla monoculture in shallow waters. Additionally, the thick hydrilla mats can make hunting difficult for predatory fish which can affect their size and numbers. Stagnant water in and around the hydrilla mats are also prime breeding habitat for mosquitoes.

Water Quality
There are numerous water quality impacts associated with moderate or severe infestations of this non-native aquatic weed. In limited or small infestations the water quality benefits may exceed the undesirable impacts.

Water clarity is generally improved with increasing concentration of aquatic plants. This is due to baffling and settling of suspended sediments, and the reduction of dissolved nutrients that are available to phytoplankton. As algae populations decline, clarity improves and the infestation increases. Reduction of light penetration is both an ecological and water quality impact as it impacts the types and variety of aquatic species present, which in-turn, impact oxygen levels, temperature gradients and water movement.

In some studies dense aquatic weeds reduced flow and mixing in surface waters by 97%. Water flow and circulation can affect nutrient dynamics, the transport and final deposition of sediments, dissolved organic carbon and a host of other parameters. An over-abundance of aquatic plants may also have a major long-term indirect impact on impoundments by
filling of basins through the precipitation of calcium carbonate, entrapment of inflowing sediments, and accumulation of organic plant remains.

Although aquatic plants can increase the oxygen content of water through photosynthesis, plants can also decrease oxygen concentration directly and indirectly. The major mechanism by which aquatic plants contribute to reduction of oxygen is through decomposition. Even in unstratified impoundments, oxygen concentration may be reduced and fish killed after the death of large quantities of aquatic plants. Large plant mats also reduce wave action and can prevent physical re-aeration of the aquatic environment. Sharp pH gradients have also been reported vertically within aquatic weed beds.

Aquatic plants can also indirectly affect cycling of phosphorus. When large quantities of organic matter are deposited to the bottom, decomposition often produces anoxic conditions. During these anoxic periods phosphorus is released from the bottom sediments.
4.0 Outlook for Management

Without implementation of control measures hydrilla can be expected to spread throughout most of Diascund Reservoir. The limiting factor for hydrilla growth in lakes and reservoirs is the depth of light penetration. It will grow in water up to 30 feet deep depending on the water clarity but its more typically found in depths of 20 feet or less. Studies have shown that hydrilla will not usually survive in water deeper than three times the average Secchi depth of the lake. In Diascund Reservoir the average Secchi depth is 4.6 feet (RWSS database) consequently, hydrilla would not be expected to grow in areas deeper than approximately 14 feet in this reservoir.

**DCR Secchi Depths**

<table>
<thead>
<tr>
<th>Sample site</th>
<th>Secchi min.</th>
<th>Secchi max.</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCR01</td>
<td>1.9</td>
<td>9</td>
<td>4.7</td>
</tr>
<tr>
<td>DCR02</td>
<td>1</td>
<td>9</td>
<td>4.5</td>
</tr>
</tbody>
</table>

However the 1988 depth contours for Diascund show that only approximately 25% of the reservoir is deeper than 14 feet. Therefore, if the hydrilla were left to grow unabated it is possible that up to 75% (836 acres) of the reservoir could be affected.

**DCR - Pool Stage, Depth, Surface Area**

<table>
<thead>
<tr>
<th>Stage – feet (NGVD)</th>
<th>Depth - Feet</th>
<th>Surface Area - Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 (full pool)</td>
<td>0</td>
<td>1110</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>998</td>
</tr>
<tr>
<td>22</td>
<td>4</td>
<td>854</td>
</tr>
<tr>
<td>20</td>
<td>6</td>
<td>711</td>
</tr>
<tr>
<td>18</td>
<td>8</td>
<td>585</td>
</tr>
<tr>
<td>16</td>
<td>10</td>
<td>489</td>
</tr>
<tr>
<td>14</td>
<td>12</td>
<td>403</td>
</tr>
<tr>
<td>12</td>
<td>14</td>
<td>274</td>
</tr>
</tbody>
</table>
Options for Control

Once hydrilla has become established to the extent that it has in Diascund Reservoir, it is nearly impossible to remove it completely or permanently. The goal at Diascund should therefore be to limit and reduce the amount of hydrilla in the reservoir, not total eradication. This approach to management protects both the recreational and drinking water resources provided by the impoundment. The presence of hydrilla in limited amounts can create habitat for juvenile fish, provide limited wave protection in shallow areas and near shorelines, and reduce nutrient concentrations during the growing season.

There are numerous methods available for controlling hydrilla growth. While some may be more effective, practical or cost efficient than others each has some potential for use at Diascund Reservoir.

The most commonly used techniques are listed in the table below which was adapted from “A Practical Guide to Lake Management in Massachusetts” (Wagner, 2004).

<table>
<thead>
<tr>
<th>Control Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical harvesting –</td>
<td>1. Large amounts of hydrilla are removed quickly</td>
<td>1. Expensive regular harvesting schedule necessary</td>
</tr>
<tr>
<td>Hydrilla plants are cut by</td>
<td></td>
<td>2. Nonselective</td>
</tr>
<tr>
<td>a mechanical harvester,</td>
<td></td>
<td>3. Need to dispose of harvested material</td>
</tr>
<tr>
<td>placed on a barge and</td>
<td></td>
<td>4. May not be practical in shallow waters</td>
</tr>
<tr>
<td>removed from the reservoir.</td>
<td></td>
<td>5. Plant fragments can cause spreading</td>
</tr>
<tr>
<td>Similar to lawn mowing only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>part of the plant is cut.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Dredging – Entire plants are | 1. Long term control in dredged areas                                      | 1. Very expensive                                                             |
| removed along with bottom    | 2. Increased reservoir depth/storage                                         | 2. Nonselective                                                              |
| sediments.                   | 3. Water quality buffering capacity of bottom sediments is restored.        | 3. Need to dispose of dredged material                                        |
|                              |                                                                             | 4. Increased turbidity                                                       |</p>
<table>
<thead>
<tr>
<th>Control Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Chemical application – Contact or systemic herbicides are applied to impacted areas | 1. Can selectively target problem species  
2. Can be applied with in-house equipment and personnel  
3. No potential for spreading by plant fragments  
4. Cost effective  
5. Can be applied lake-wide | 1. Public perception of applying herbicides to drinking water reservoir  
2. Increased oxygen demand from dying vegetation  
3. Seeds not affected by contact herbicides  
4. Need to reapply on a regular basis |
| Physical barriers – Mats are laid on the lake floor to block plant growth | 1. Long term control in matted areas  
2. Can help control turbidity in high traffic areas | 1. Maintenance may be required  
2. Nonselective  
3. Not feasible for lake-wide use  
4. Can be difficult to install |
| Grass carp (sterile) - herbivorous fish feed on hydrilla plants | 1. Ease of application  
2. Long term control with one treatment  
3. Sterile fish prevent over population  
4. Cost effective  
5. Can be applied lake-wide | 1. Proper stocking rates can be difficult to predict  
2. Nonselective  
3. Sterile fish will need to be restocked |
| Drawdown – water level is lowered over winter months to expose soil to freezing temperatures that kill plant roots and seeds. | 1. Can be done in-house  
2. Cost effective  
3. Wide spread control | 1. Can cause issues with adjacent landowners and boaters  
2. Winter temps. may not be cold enough to kill vegetation  
3. Nonselective  
4. Water supply may be affected |

A review of these various control methods and several case-studies indicates that sterile grass carp can be one of the most effective and cost efficient ways to control hydrilla growth. Negative impacts to stocked waters are few with the main disadvantage being over-grazing of desirable aquatic vegetation and in some cases, increased turbidity. In 2010 Chesterfield County began a sterile grass carp stocking program in their Swift Creek Reservoir to aid in hydrilla control. At that time hydrilla was present in varying densities in nearly 70% of the reservoir. The [most recent report](#) from August 2011 showed that 93% of
Swift Creek was hydrilla free. In the remaining areas of the reservoir hydrilla was sparse or nearly absent.

A similar program was started in Claytor Lake in Pulaski County last May. In a joint effort between Pulaski County, Friends of Claytor Lake, Virginia Tech and the Department of Game and Inland Fisheries 6000 sterile grass carp were introduced to the lake. Fish sampled this past March were shown to have grown significantly from their stocked size:

“The average size of the sterile grass carp stocked on May 26, 2011 was 15 inches, with fish ranging in size from 13 to 18 inches. In March 2012, a total of 27 grass carp were collected from Claytor Lake and measured. They ranged from 21 to 28 inches, an increase of 6 to 13 inches from the 15 inch average length at stocking. The weights of March 2012 grass carp ranged from 3 to 11 pounds, an increase of 2 to 9 pounds from their 1 pound average at stocking. Significant growth of the grass carp indicates high hydrilla consumption rates by the stocked grass carp.”

There is typically a one year lag-time between the introduction of sterile grass carp and a significant decrease in the amount of hydrilla present. The growth rate of the fish in Claytor Lake indicates that there should be a noticeable reduction in the in hydrilla this upcoming growing season.
5.0 Proposed Work Plan for Diascund Reservoir

As the introduction of sterile grass carp has had positive results in settings and plant conditions similar to that of Diascund Reservoir it is recommended that this method of control be attempted there as well. The Beaverdam Creek arm of the reservoir was initially thought to be a candidate for pilot testing by isolating it from the rest of the lake by screening the culverts that pass under Rt. 620 (Homestead Rd.). Unfortunately the culverts were submerged 10'x10' box culverts and would require significant fabrication and maintenance for isolation fish containment screens. This would have provided Waterworks with a pilot study area of approximately 165 acres for treating with the sterile grass carp.
In order to reduce the costs of screening and to avoid significant maintenance, clogging and even potential flooding issues, a full-scale “pilot” program is currently proposed for the entire reservoir. The approach will be to introduce very conservative stocking rates and closely monitor the hydrilla density. This way, future fish stocking rates can be adjusted to achieve the desired reduction and control of this aquatic plant. The concept is to reduce the abundance of the aquatic infestation to between 10 and 15% of the reservoir. This will protect each of the beneficial uses of the reservoir.

Proper stocking rates for sterile grass carp varies depending on the density of the hydrilla infestation and length of growing season (latitude). Getting the stocking levels correct can be difficult. If a lake is over-stocked the grass carp can potentially eliminate all aquatic vegetation temporarily. This can cause starvation of the grass carp and be harmful to the other fish populations and dramatically reduce water clarity. If a lake is under-stocked hydrilla control may be difficult to detect and monitor and perhaps target goals will not be achieved. Climate conditions and water level also impact the growth rate and density of the plant.

The Virginia Department of Game and Inland Fisheries (DGIF) recommends the following stocking rates:

<table>
<thead>
<tr>
<th>Infestation level</th>
<th>Hydrilla coverage</th>
<th>Fish per acre of infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight</td>
<td>&lt;30%</td>
<td>2</td>
</tr>
<tr>
<td>Moderate</td>
<td>30-60%</td>
<td>5</td>
</tr>
<tr>
<td>Heavy</td>
<td>&gt;60%</td>
<td>10</td>
</tr>
</tbody>
</table>

*15 fish per acre is the maximum permitted by VDGIF

According to VDGIF fisheries biologist Scott Herman the Beaverdam Creek arm of Diascund Reservoir would be classified as a moderate hydrilla infestation of about 40% coverage. Similar conditions exist for the other shallow reaches of the reservoir. The average condition for the entire reservoir is likely somewhere in between slight and moderate. Mr. Herman’s recommendation for just the Beaverdam creek location was to introduce sterile grass carp at a stocking rate of 3-4 fish, 10-12 inches in size per infested acre. The larger fish are necessary to reduce predation. This level of stocking should provide enough fish to reduce
and control the hydrilla growth without removing too much aquatic vegetation. The area should then be monitored annually to determine effectiveness. If the desired results are not achieved by the second or third year after stocking then additional fish can be added, normally at half of the original stocking rate.

The proposed pilot area for Diascund Reservoir is 1110 acres of total water area. At an overall slight-to-moderate level of hydrilla infestation level estimated at 25%, approximately 277 acres of the reservoir area is targeted for treatment. The stocking rate for the pilot test is adjusted down to the slight infestation level to allow for monitoring and assessment and assure that desirable aquatic plants remain viable. At a rate of 2 sterile grass carp per infested acre the recommended stocking level would equal 554 fish. VDGIF maintains a list of approved sterile grass carp suppliers for the southeastern U.S. Cost estimates from these suppliers vary depending on the number of fish purchased but the average cost for 10-12 inch fish delivered to the reservoir is approximately $10 per fish. Total cost for 554 sterile grass carp delivered would be $5,540. These figures are only estimates however, and a more precise infestation level and number of fish would be determined in coordination with DGIF prior to moving forward with the pilot.

Restocking of the grass carp will be necessary over time as the fish are sterile and do not reproduce. The fish can live up to 10 years but are most effective at controlling aquatic plants in the first 3-4 years after stocking. Typically maintenance restocking occurs about every 5 years, but this would be determined by monitoring the carp population, the hydrilla growth and water quality results in the reservoir. VDGIF can provide assistance with these monitoring programs. Potential other sources for monitoring and assessment include Christopher Newport University. Water quality monitoring during the pilot program will be provided by Waterworks without modifying the current monthly reservoir monitoring program.

### Proposed Timeline for Pilot Project

<table>
<thead>
<tr>
<th>Spring 2013</th>
<th>Apply for permit from VDGIF to stock sterile grass carp in Diascund Reservoir.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2013</td>
<td>Begin controlled lowering of reservoir level to maintain pool at least 6-inches below full pool during pilot testing period.</td>
</tr>
<tr>
<td>Time Period</td>
<td>Action</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>Early Summer 2013</td>
<td>Conduct a survey of the pilot area to determine extent of hydrilla infestation; percent coverage and densities.</td>
</tr>
<tr>
<td>Summer 2013</td>
<td>Contact New Kent County, James City County and local stakeholders to explain the pilot program.</td>
</tr>
<tr>
<td>Winter 2013</td>
<td>Finalize fish orders and delivery schedule.</td>
</tr>
<tr>
<td>Spring 2014</td>
<td>Stock pilot area with fish.</td>
</tr>
<tr>
<td>Summer 2014 – Summer 2016</td>
<td>Resurvey hydrilla growth 4 times per year. Surveying and monitoring will be coordinated with VDGIF and potentially with CNU. Prepare report with results of monitoring and recommendations for management potential in full pool area.</td>
</tr>
</tbody>
</table>

Note:

It may be possible to expedite this schedule (and permitting) to allow stocking and additional monitoring to begin in the spring of 2013.