Glenview Park District
2018 Pine and Spruce Evaluations

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Introduction
On July 16, 2018, Certified Arborists from Graf Tree Care, Inc. began a comprehensive evaluation of all the Pine and Spruce trees on the properties of Glenview Park District (GPD). This evaluation resulted in the assessment of 1,385 Pine and Spruce Trees on 26 properties. GPD has been experiencing a higher than normal rate of decline in their Pine and Spruce trees in recent years and has partnered with Graf Tree Care to create a management plan to address the situation and to help prioritize actions to be taken. Signs of foliar fungal pathogens, and the poor aesthetics that come as a result of the decline, were found at varying levels among much of the Pine and Spruce population, particularly in Austrian Pine, Scotch Pine, Blue Spruce, and White Spruce trees. A minor pest infestation was also observed at much lower levels on Austrian Pine and Scotch Pine trees, as well as a fungal canker in Blue Spruce. These pathogens and pests will be described in detail below.

Diplodia Tip Blight
Many Pine species can be infected by Diplodia Tip Blight (DTB), but in our region and in GPD in particular, Austrian and Scotch Pine are the most susceptible. DTB is more likely to occur when trees are stressed and near infected susceptible species. DTB can be particularly problematic in landscape plantings where trees have planted outside of their natural environmental requirements and tolerances. The disease first appears as browning of needles at the tips of shoots (see photo). Needles are often shorter than normal, and sometimes resin droplets exude from infected needles. Small black fruiting bodies of the fungus can be seen with the unaided eye at the base of needles, just under the fascicle or sheath tissue. Fruiting bodies also form on scales of two-year-old seed cones and on bark of infected shoots. Often the damage appears in the lower part of the tree, but shoots throughout the tree may show damage with time. Repeated infection of branch tips results in deformed tree growth and loss of vitality. The fungus can also cause cankers, with excessive and obvious sap exudate. Branches that become girdled will die. Sapwood may become discolored with a dark brown stain.

The fungus overwinters in infected cones, shoots, and needles. Spores are released in the spring during rainy periods, therefore the disease is usually more severe in wet springs. New shoots are susceptible to infection from two weeks after bud break until about mid-June. The fungus penetrates the needles and quickly causes necrosis. Second-year seed cones are infected in late May or early June and serve as a reservoir of future spores. Research on Austrian and Scotch Pines in Illinois and Kentucky indicates that the pathogen resides on and within symptomless shoots from both diseased and apparently healthy pines. These symptomless infections may become active during periods of tree stress and result in branch dieback.

Management of DTB includes the following actions. The fungus affects needles directly, but can also infect wounded tissue, therefore care should be taken to avoid wounding trees and pruning or shearing should not take place during wet weather when spores are being released. Do not plant susceptible trees near mature infected Pines. On infected trees, remove any dead or cankered wood and cones, if possible, however removal of cones may not be practical on large trees. Mulch and water as needed to reduce stress. Fungicide spray requires three timely applications: 1) when buds begin to elongate/swell 2) just before the new needles begin to emerge from the fascicle sheath, and 3) 10 to 14 days later. Lastly, consider avoiding the use of the most susceptible Pines in landscape plantings.

Rhizosphaera Needle Cast
Rhizosphaera Needle Cast (RNC) most commonly occurs on Blue Spruce, but some other Spruce and Pine species can be infected. Norway Spruce is resistant to the pathogen. Initial symptoms occur in late summer as yellowing of first-year needles. These rapidly turn brown or purple-brown, but do not fall from the tree until the following summer or autumn, 12-18 months after the initial infection. The fungus produces pycnidia in the needles, which appear as black pinhead-sized bodies that occur in rows down the needles. These will extend above the surface of the needle when moist and can be seen with a good hand lens. If not visible on dry needles, they will develop in 24-48 hours when infected needles are kept in a bag with a moist paper towel. The discoloration and defoliation generally occur on lower branches first and gradually move up the tree, but can also appear scattered throughout the tree. Severely infected trees will have healthy looking needles only at the tips of branches.
The fungus overwinters in fruiting structures on infected needles. Spores are released from spring until autumn. They readily infect young needles but can also infect older growth on trees under stressful growing conditions. Infection will occur more rapidly under warm, wet conditions.

Management of RNC includes the following actions: Cultural practices that will help reduce this disease include the use of healthy planting material and the continual inspection of trees for signs of the disease. Premature needle drop is a symptom that warrants follow-up inspection. Good air circulation will help to prevent infection, therefore maintaining adequate spacing between trees and keeping surrounding vegetation mown and pruned is necessary. Chemical controls are effective if the disease is not too severe. Fungicide spray requires three timely applications: 1) when buds begin to elongate/swell 2) when the needles are half elongated, and 3) when the needles are fully elongated. Because this fungus requires 12 to 18 months for symptom expression, at least two years of fungicide spray are often required. Lastly, consider avoiding the use of the most susceptible Spruces in landscape plantings.

**Zimmerman Pine Moth**
Zimmerman Pine Moth (ZPM) attacks most Pine species, but Austrian and Scotch Pines are particularly susceptible. The female ZPM lays her eggs in midsummer near the edges of previous wounds. The larvae overwinter and begin feeding the following spring. They first feed on the bark and then bore into the cambium. The tunneling girdles the branches and causes dieback. After several years of damage, the trunk may weaken and break off. Signs of infestation include large masses of frass and resin in the branch whorl area on the trunk. These masses are often off-white or yellowish (see photo). To control ZPM, apply an insecticide to the trunk and branches in early spring during larval activity and again in midsummer during egg-laying. Remove dead trees promptly, as they can serve as hosts and a center of infestation.

**Cytospora Canker**
Cytospora Canker is most common in Blue Spruce, but other conifers have been observed as hosts. Lower branches usually show symptoms first, with a progression of symptomatic branches moving up the tree. Needles turn purplish brown on entire branches rather than just branch tips. Whitish resin (see photo) can be found on older infected branches and this resin becomes more noticeable as needles drop. A canker is present and can be found by exposing the discolored inner bark, which will be brown. Small, black, pinhead-sized fungal fruiting bodies form within the cankered bark and cankered branches die. It is common to see infected Spruces lose lower branches over a period of years until the tree is unsightly.

The fungus overwinters as fruiting bodies and mycelia in cankered bark. Spores are released during the growing season and infect branches of the same or nearby trees at wound sites. Spores of the fungus are moved by wind, rain, or vectors of the fungus, including insects, birds, and humans. The fungus grows in the inner bark, girdling and killing branches. This disease commonly affects stressed Spruce and drought-stressed trees are particularly susceptible. The fungus usually attacks trees that are at least 15 years old.

Spruce trees should be managed for optimum vitality to help avoid stress and therefore Cytospora infection. If Cytospora has been a problem in an area, consider planting species other than Blue Spruce which are highly susceptible to this disease. It is best to avoid wounding trees, but when cankers appear they must be removed. Remove diseased branches, preferably in late winter or in dry weather and disinfect pruners between cuts. Never prune trees in wet weather. There are currently no effective chemical control measures for Cytospora Canker.

**Secondary Pathogens**
Some secondary pathogens that affect Pine and Spruce trees should also be mentioned. Dothriostroma Needle Blight, which is a fungus similar to DTB usually affects poor condition Pines that already have DTB and/or ZPM. Oftentimes if DTB clears up, so does Dothriostroma, so it is not commonly recognized as a strong pathogen. Pine Wilt Nematode is a devastating pathogen, and usually a death sentence for Austrian and Scotch Pine, but it is quite rare. Spruce trees can also develop SNEED, Sudden NEEDle Drop, which is similar to RNC, though less common. In Spruce trees, Spider Mites are common, but rarely get to a point where they cause significant damage to the tree. As mentioned, these are all more secondary diseases, which affect stressed and weakened trees that are already affected by the major pests/pathogens DTB, ZPM, or RNC. Our evaluations targeted the more problematic major pests/pathogens.
Overview
By far and large, both DTB and RNC are widespread in GPD parks and it is actually more unusual to find a Blue Spruce or Austrian Pine that does not exhibit some degree of foliar fungus. ZPM and Cytospora Canker are present in some of the parks, but at a minor and non-concerning level. Fortunately, DTB and RNC can be managed through chemical fungicide sprays, however with the large number of Spruce and Pine in the GPD system, it would be impractical and cost prohibitive to treat every tree for foliar fungi. The goal of our evaluations and this management plan was to identify higher quality Spruce and Pine trees that were in highly visible or higher traffic areas and therefore had higher location values. We also identified trees that were planted in a way as to have functionality in the landscape. These identified trees, which provide higher value for GPD and its patrons and neighbors, were designated as those which would benefit most from fungicide treatments to protect from foliar fungal pathogens. This selective process also attempted to keep in mind budget constraints and our goal was to keep treatment costs as reasonable as possible. The next section will highlight our observations at each GPD property, while also discussing our reasoning for recommending treatment, monitoring, or removal. In the sections that follow, we will explain the evaluation statistics, annual costs, and options for a longer term management program.

It is important to mention the fact that signs and symptoms of foliar fungal pathogens such as RNC and DTB can vary greatly from year to year depending on weather conditions. Oftentimes, springs with higher than average rainfall will result in higher levels of DTB being observed in Pine trees. In a similar fashion, summers with higher than average rainfall will result in higher levels of RNC in Spruce trees. Since treatments for these pathogens need to occur early in the spring, before we have any indication on how badly the pathogens will affect trees later in the year, there will always be a degree of uncertainty when developing a treatment set. A mid-summer evaluation of Pine and Spruce trees should be part of an ongoing, and likely evolving, management plan.

Glenview Park District 2018 Pine and Spruce Evaluations Park Narratives
Central Tot Lot
There are no Pine or Spruce trees at Central Tot Lot.

Cole
Many Austrian Pine trees have been lost in recent years at Cole due to DTB. In an effort to preserve the remaining good to fair condition Austrian Pines with higher location values, we have recommended to treat 5 Austrian Pines at Cole to control the foliar fungus. Three of these are on the east side of the park along the tennis club parking lot and two are on the north side of the park along the path. Two young Blue Spruce, one on the north side and one on the east side, have moderate signs of RNC and foliar fungus treatment is recommended to control this pathogen and preserve these trees. Since these trees are small, treatment cost should be relatively low and worth the expense in order to protect GPD’s investment in purchasing and planting these young trees. One Blue Spruce near the playground is in fair condition and has a higher location value therefore fungicide treatment is recommended. Three Blue Spruce near the playground and one Serbian Spruce on the southwest corner of the tennis court have significant dieback and removal is recommended. Removal is also recommended for 3 low location value Austrian Pines near the southwest corner of the tennis club building and 1 poor condition Austrian Pine on the east side of the tennis club parking lot. In general, the White and Scotch Pine trees at Cole are in good condition.

CPW
All of the White Pine trees at CPW are in good to fair condition. There are 2 Blue Spruce trees (see right) near the high-traffic corner of Zenith Dr and Milwaukee Ave, one of which has significant dieback and should be removed. The other has minor signs of RNC and fungicidal treatment is recommended. At the corner of Zenith Dr and the CPW entrance driveway, there are 2 Austrian Pines which have healthy canopies (see photo on cover page), however they are being girdled by cables (see left) installed to stake the trees when they were planted years ago. If these girdling cables can be successfully removed, we highly recommend fungicide treatment to protect these good-condition and high location value trees from DTB.
In the parking lot islands, most of the Spruce trees have limited growing space and one tree was recommended for removal due to severely limited growing space. Two of the parking lot Spruce have been recommended for fungicide treatment due to minor RNC. Lastly, one small Spruce along the driveway is recommended for removal due to severe dieback.

**Countrywide Lane**
Of the 4 Pine/ Spruce trees at Countrywide Lane, only the Austrian Pine on the west side of the playground is recommended for fungicide treatment to control DTB due to its higher location value. One of the Norway Spruce trees has been struck by lightning and should be monitored.

**Cunliff**
The Norway Spruce and White Pine trees at Cunliff are generally in good to fair condition. No trees at Cunliff were recommended for treatment and only one Blue Spruce should be removed due to limited growspace and dieback.

**Crowley**
At Crowley, a White Pine at the southwest corner of the tennis courts has severe dieback and should be removed. Six good to fair condition Austrian Pines with higher location values have been recommended for fungicidal treatment to control DTB. Three of these are southwest of the park building near the central ball field, two are near the southeast ball field (see right), and one is near the park entrance/ sign bed and playground. The two Austrian Pines that are near the southeast ball field also are showing signs of ZPM and treatment to control this pest is also recommended for these trees.

**Diederich**
Six young Blue Spruce along the east side of Diederich have minor to moderate signs of RNC and foliar fungus treatment is recommended to control this pathogen and preserve these trees.

**Flick**
There is a significant population of Pine and Spruce trees at Flick Park. Overall, the White Pines, Scotch Pines, and Norway Spruces at Flick are in good to fair condition and none have been recommended for treatment or removal.

There is very little evidence of ZPM at Flick and no Pines were recommended for treatment to control ZPM. Fungicide treatment to control DTB has been recommended for a number of the good to fair condition Austrian Pines (see left) that line the entrance drive due to their high visibility and location value. Treatment is also recommended for a limited number of Austrian Pines in more heavily used areas of the park. Unfortunately, most of the Blue Spruce trees (see right) that stand in the western section of the Arboretum have significant dieback along with limited growing space, and removal has been recommended for most of these based on the higher traffic along the Arboretum path. Early signs of Cytospora Canker were also observed on a small number of the Blue Spruce at Flick. A limited number of trees throughout the park were recommended for removal due to overcrowding and severely limited growing space and a small number of poor condition Pines and Spruces were also recommended for removal. The Austrian Pines along the west side of the park are in fair condition with minor signs of DTB but were not recommended for treatment due to overcrowding along this border. These trees should be monitored and possibly be treated in the future if deemed appropriate. Treatment was recommended for 5 Blue Spruce on the east side of the pool due to their value of serving as a screen for the adjacent residential neighbors. The line of Blue Spruce, Norway Spruce, and White Pine serving as a screen in the northwest corner of the park should be monitored and action taken if deemed necessary and preservation of the screen is desired.


**Gallery**

On the south side of Gallery Park along the driveways leading to Park Center, 11 Austrian Pines (see left) and 3 young Blue Spruce trees (see right) have been recommended for treatment to control foliar fungus. These trees are showing minor to moderate signs of DTB and RNC, respectively, and have high location values and visibility along the busy driveways. Two of the Austrian Pines in this part of the park have been recommended for removal due to overcrowding and decline. In the central part of the park south of the fountain, there are four good condition Blue Spruce with minor signs of RNC and these are recommended for fungicide treatment due to their high location value. On the north side of the park, north of the tennis courts, 10 Austrian Pines and 4 White Spruce form a natural screen between the courts and West Lake Ave. Due to their functionality and higher location value, these 14 trees are recommended for treatment to control foliar fungi. Also, two of these Austrian Pines have minor signs of ZPM and treatment to control this pest should be considered. There are a significant number of Pine and Spruce trees along the east side of the park that are in good to fair condition, however treatment is not recommended due to their lower location values. Two of the Austrian Pines along this border are dead and should be scheduled for low priority removals. We recommend that the remainder of these trees be monitored and removed and replaced as necessary.

**Glenview Ice Center**

At Glenview Ice Center, the 2 Austrian Pines that are on the island between the entrance and exit driveways have minor to moderate needle tip dieback are recommended for fungicide treatment to control DTB due to their good condition and their high location value and visibility along Landwehr Rd. The Blue Spruce along the west side of the building is in poor condition and should be removed (see right). The Swiss Stone Pines on the property are in fair to poor condition, however removal or treatment is not warranted at this time.

**Glenview Park Golf Club**

There is a significant number of Pine and Spruce trees in the GPGC population. An effort was made to focus on preserving younger trees, high quality trees, or trees with higher location values and/or importance and functionality on the course of play. In all, a total of 73 Pine and Spruce trees were recommended for foliar fungus treatment and 54 are recommended for removal. The photos below illustrate some of the Pine and Spruce which we recommended for treatment.
Hawthorn Glen
The 4 Spruce or Pine trees at Hawthorn Glen are all in fair condition and have low location value and limited growing space. No treatments or removals are warranted at this time.

Indian Knoll
There are no Pine or Spruce trees at Indian Knoll.

Indian Trail
Seven Blue Spruce trees at Indian Knoll have been recommended for removal due to significant dieback. These removals are not high priority as these trees are not posing any risks, particularly those on the west side of the park. The white sap runs associated with Cytospora canker is widespread on the Blue Spruce trees at Indian Knoll and for this reason, fungicide treatment to control RNC is not recommended at this time. Through sanitation pruning of diseased branches during dry weather, proper soil drainage, and fertilization to improve vigor, Cytospora canker can be managed and GPD may opt to use fungicide to combat RNC once the canker is deemed under control.

Jackman
Jackman is a busy and well used park and almost all of its trees could be considered as high location value. Jackman has lost quite a few Austrian Pine trees in recent years, however 5 of the 7 remaining Austrian Pines (see left) are in good to fair condition and fungicide treatment to control DTB is recommended. The other 2 Austrian Pines are in poor condition and should be removed. Lastly, the 2 Blue Spruces at Jackman are showing signs of RNC and treatment is recommended. The White Pine and Norway Spruce trees at Jackman are in good to fair condition.

Jennings
At Jennings, a hedgerow of Austrian Pines stands along the railroad tracks fence line. Most of these trees have limited growing space and minor signs of DTB and/or ZPM. Treatment of this number of trees would be cost prohibitive due to the number of trees and logistically difficult due to the significant overcrowding and is therefore not recommended at this time, however three of these Pines are recommended for removal due to severely limited growing space. On the north side of the park, there are 5 Austrian Pine trees which form a screen for a residential neighbor. Two of these have significant dieback due to DTB and removal is recommended. The remaining 3 have minor signs of DTB and fungicidal treatment is recommended. Lastly, 2 higher location value Austrian Pines (see right) along the path on the east side of the basketball court are recommended for fungicide treatment to control DTB.
Johns

There are two good condition Austrian Pine trees (see left) at the southwest corner of the sand volleyball courts at Johns which have minor needle tip dieback. These trees are in good condition and have higher location value therefore foliar fungus treatment is recommended. In the northwest part of the park, two Austrian Pines have been recommended for removal due to severe dieback. Also, one Norway Spruce in this area, as well as two Austrian Pines on the east side of the sand volleyball courts, have girdling cables from stakes installed long ago and an attempt to remove these cables should be considered, otherwise tree removal may be necessary.

Ladendorf

Most of the Norway Spruce trees at Ladendorf are in good to fair condition and require no maintenance at this time. There are, however, three Norway Spruces with severe dieback that have already been marked for removal by GPD. The sole limited growspace Blue Spruce at Ladendorf has moderate signs of RNC and Cytospora canker and should be monitored and removed as deemed necessary.

Manor

Ten of the Norway Spruce trees at Manor have significant dieback and removal has been recommended. Three of these ten have already been marked for removal by GPD. The remaining Norway Spruce and White Pine trees are in good to fair condition.

Park & Facility Services East

At Park & Facility Services East, 3 young Spruce trees near the administration building are recommended for treatment to control RNC. On the west side of the park, a Norway Spruce tree with significant dieback should be removed. The remaining Pine and Spruce trees are in generally good to fair condition.

Prairie Club

Our recommendations for Pine/Spruce treatment at Prairie Club focused on the better condition trees with higher location values and visibility particularly those near the entrance driveway, those around the parking lot (see below left), and those screening the maintenance building from the golf course and from West Lake Ave. The trees recommended for treatment for foliar fungi included Austrian Pines, White Spruces, and Scotch Pines. A very small number of Austrian and Scotch Pines which exhibited yellow oozing associated with ZPM were also recommended for treatment for the pest. Four poor condition trees, 3 Austrian Pine and 1 Blue Spruce, were recommended for removal due to significant dieback. Two Austrian Pines (see below center) are north of the parking lot, the other is at the entrance driveway, and the memorial Blue Spruce (see below right) with extensive Cytospora canker is north of the practice green. There are a variety of good to fair condition conifers with lower location values on both the west and east sides of the course. It would be impractical to treat only some of these trees and cost prohibitive to treat all of them, therefore we recommend these be monitored regularly and removed and replaced if necessary.
Roosevelt
With the relatively large number of Pine and Spruce trees at Roosevelt, our recommendations were focused on protecting the better condition and higher location value trees and removing the underperforming, low-location value trees. That being said, Roosevelt is a busy, well-used park with many amenities and a significant number of trees would be considered as high location value. Two poor condition Spruces in the northwest part of the park, and 10 poor condition Pines and Spruces (see left) in the southern part of the park have been recommended for removal due to decline and/or limited growspace. The younger Austrian Pine in the southwest corner of the park has yellow sap oozing associated with ZPM and treatment for the pest is recommended. A good condition and higher location value Scotch Pine at the northwest corner of the pool has signs of DTB and ZPM and treatment for both is recommended. The 16 trees recommended for foliar fungus treatment at Roosevelt are a combination of Austrian Pine (see right), Scotch Pine, and White Spruce which have higher location value and are in good to fair condition.

Rugen
At Rugen, two recently planted Blue Spruce trees are showing moderate signs of RNC and treatment is recommended to control the foliar fungus. Also, three Austrian Pine trees shading a bench along the path in the southwest part of the park have higher location values and treatment to control DTB should be considered. One of these Pines has moderate signs of ZPM and treatment to control this pest is also encouraged.

Sleepy Hollow
The 5 White Pines and 1 Norway Spruce at Sleepy Hollow are generally in good condition. The Scotch Pine near the parking lot and the park building has signs of both DTB and ZPM and treatment for both has been recommended due to the higher location value of this tree.

Swenson
At Swenson, a natural screen of Pines, Spruces, and Douglas Firs has been planted around the skating rink. The Norway Spruce trees are generally in good condition. All of the Blue Spruce trees (see right) have signs of RNC and 11 of these have been recommended for treatment to control the foliar fungus in order to preserve the screen. Removal of 8 of the Blue Spruce trees around the rink has been recommended so as to relieve overcrowding and improve air flow. Fungicide treatment to control DTB has been recommended for 2 Austrian Pines and 1 Scotch Pine that also make up part of the natural screen. Lastly, the 3 high location value Austrian Pines (see left) near the park entrance on the north side of the rink should be treated for DTB and the northernmost of these trees should also be treated for ZPM due to the yellow sap oozing associated with this pest. The remaining Pine and Spruce trees have lower location values and/or limited growspace and treatment is not warranted at this time.

Tall Trees
Generally, the White Pine and Norway Spruce trees at Tall Trees are in good to fair condition. One White Spruce near the north side of the park should be removed due to severe dieback. One Austrian Pine, also on the north side, is recommended for foliar fungus treatment due to its higher location value next to the adjacent residential property.
Wagner Farm
There are no Pine or Spruce trees at Wagner Farm.

West Fork (renamed Thomas J. Richardson)
Along most of the south side of West Fork, there is a dense natural screen (see right) made up of a variety of conifers separating the well-used park path from the adjacent, upscale neighborhood. Most of the Blue Spruce, Austrian Pine, White Spruce, and Serbian Spruce among this hedgerow of trees have signs of foliar fungus. A small number of Spruce trees were recommended for removal to reduce overcrowding and improve air circulation. Most of the remaining conifers that are susceptible to foliar fungus were recommended for treatment due to the high value of this natural screen to the residential neighbors. In a dense Pine/Spruce stand such as this, not treating any of the trees could result in extensive tree mortality. Given the proximity of these trees to one another, it would be most efficient to treat the largest number that budgets allow. In addition to the hedgerow trees discussed above, 15 additional Spruce and Pine (see left) trees in high value or visibility locations throughout the rest of the park were also recommended for fungicide treatment.

Willow
On the west side of the tennis courts at Willow, there are 7 Austrian Pine trees which have minor to moderate signs of DTB. One of these also have minor sap oozing associated with ZPM. Due to their high location value and acceptable condition, these trees are recommended for fungicide treatment and the one with yellow oozing is also recommended for treatment to control ZPM. The mature Blue Spruce (see left) in the center of the traffic turn-around circle is recommended for removal due to advanced needle dieback, significant canker, and poor aesthetics. One of the Norway Spruce (see right) trees on the north side of the playground has been struck by lightning and has a severe trunk wound with significant dieback on that side of the tree and removal is recommended. The remaining Norway Spruce trees are in good to fair condition. Four of the Blue Spruce at Willow have been recommended for removal due to severely limited growing space and advanced dieback. The remaining Blue Spruces may require eventual removal due to overcrowding and limited growing space, particularly along the northern border.

Statistics by Recommendations, Species, and DBH Classifications
Of the 1,385, Spruce and Pine evaluated for this project, we have recommended chemical treatment for 325 trees, removal of 168 trees, and monitoring of 883 trees. Of the 325 trees in this treatment set, 15 were recommended for treatment of both DTB and ZPM, therefore the cost estimates that follow reflect the foliar fungicide treatment for 324 trees and ZPM treatment for 16 trees. We also identified 8 stumps, as well as 4 trees with girdling cables that, if possible, should be removed before treatment is considered. Since the most recent inventory update, 52 Pine and Spruce have been removed. Below are tables with itemized species breakdowns for each category:
Recommendation Statistics – Tree Counts by Species

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**Recommendation Statistics - Tree Counts by DBH Classifications**
The tables below show tree counts for each treatment recommendation, as well as recommended removals, by DBH classifications. We will use these counts to develop management options that will be presented in later sections.

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**Breakdown of Annual Costs**

**Removals**
During this 2018 Pine and Spruce evaluation in GPD, we have recommended removal of 168 trees primarily due to significant decline associated with foliar fungal pathogens. A small number of trees were also recommended for removal due to overcrowding and severely limited growspace. It should be mentioned that we have not identified any of these declining trees as posing a risk, therefore the removals are not a high priority and can be budgeted over a longer time period, though those in areas of higher visibility may be prioritized over those in low traffic or remote areas. The vast majority of these recommended removals are under 18” DBH and many are under 35’ tall, therefore in-house removal of a significant number of these trees could be an option. In the case that GPD may want to contract out these removals, we have included a chart below with a broad estimate of removal costs based on DBH. Lastly, replacement cost estimates for these removed trees will be discussed in the management options section below.
Total Estimated Removal Cost

<table>
<thead>
<tr>
<th>Size</th>
<th>Count</th>
<th>Estimated Cost per Tree</th>
<th>Estimated Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBH 6&quot; or less</td>
<td>24</td>
<td>$150</td>
<td>$3,600</td>
</tr>
<tr>
<td>DBH 7-12&quot;</td>
<td>68</td>
<td>$175</td>
<td>$11,900</td>
</tr>
<tr>
<td>DBH 13-18&quot;</td>
<td>55</td>
<td>$200</td>
<td>$11,000</td>
</tr>
<tr>
<td>DBH 19-24&quot;</td>
<td>18</td>
<td>$225</td>
<td>$4,050</td>
</tr>
<tr>
<td>DBH 24-30&quot;</td>
<td>3</td>
<td>$250</td>
<td>$750</td>
</tr>
</tbody>
</table>

$31,300

Treatments
The charts below illustrate broad annual cost estimates for the treatment recommendations discussed in the narratives section above. Of the 324 total trees in this treatment set, 15 Pines were recommended for treatment of both DTB and ZPM, therefore the annual cost estimates that follow reflect the foliar fungicide treatment for 324 trees and ZPM treatment for 16 trees. Keep in mind that these broad estimates are based on annual costs per tree with a bulk discount that a local contractor would likely grant to an entity such as GPD. Actual prices could vary among various contractor bids. Full tables of trees to be treated are located in the appendices of this report.

Pricing Schedule
The below table represents the pricing structure we utilized for creating these estimates. These are annual cost estimates per tree, meaning they include three rounds on fungicide treatment and two rounds on insecticide treatment. As noted above, these prices will vary, but we believe these are competitive realistic rates based on our experience with Plant Health Care.

<table>
<thead>
<tr>
<th>DBH</th>
<th>ZPM: $/Tree</th>
<th>Fungicide: $/Tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6&quot;</td>
<td>$60.00</td>
<td>$85.00</td>
</tr>
<tr>
<td>7-12&quot;</td>
<td>$75.00</td>
<td>$100.00</td>
</tr>
<tr>
<td>13-18&quot;</td>
<td>$90.00</td>
<td>$115.00</td>
</tr>
<tr>
<td>19-24&quot;</td>
<td>$105.00</td>
<td>$130.00</td>
</tr>
<tr>
<td>25-30&quot;</td>
<td>$120.00</td>
<td>$150.00</td>
</tr>
</tbody>
</table>

Treatment Methodology Details

Diplodia Tip Blight and Rhizosphaera Needle Cast

Common Contact Fungicide Used: Chlorothanil
Average cost per tree annually: $115 (varies by DBH, see table above)

Treatment for the foliar fungal pathogens Diplodia Tip Blight (DTB) and Rhizosphaera Needle Cast (RNC) takes place as three separate, fungicide sprays in spring, each timed around 2 weeks apart. A drawback of foliar fungicide sprays is that the chemical is sprayed into the air and some level of spray drift is nearly unavoidable. Research of Chlorothanil has linked the chemical to a level of toxicity in both humans and animals, therefore care should be taken during application. Appropriate wind speed restrictions should be spelled out in the bid specifications, as well as marking of the area sprayed with pesticide flags when applicable.

For Pine trees affected with DTB, timely fungicide sprays occur 1) when the sheaths begin to fall off the new candles and the new needles are very soft, 2) a second spray within a 7 to 14 day window, and 3) the third and final round should be completed before the needles are fully elongated and begin to harden.

For Spruce trees affected with RNC, timely fungicide sprays will occur 1) when buds begin to elongate/swell, 2) when the needles are half elongated, and 3) before the needles are fully elongated.

The timing for these applications is generally at the same time for both diseases, so they can generally be sprayed at the same time.
Zimmerman Pine Moth

Common Contact Insecticide Used: Permethrin
Average cost per tree annually: $ 90 (varies slightly by DBH, see table above)

Insecticide treatment for Pine trees infested with Zimmerman Pine Moth (ZPM) occurs as two timely insecticide sprays. A drawback of contact insecticide applied as a spray is that some level of spray drift is nearly unavoidable. Research of Permethrin shows very little to no toxicity in humans and animals. Once again, appropriate wind speed restrictions should be spelled out in the bid specifications, as well as marking of the area sprayed with pesticide flags when applicable.

In April, Zimmerman Pine Moth will appear as small larvae between and under the bark. At this time, they begin to emerge from the bark, and then bore into the trunk where they feed and pupate. At this time, the first round of spray should be applied which will prohibit a significant number of the larva from completing their life cycle. In August, as remaining ZPM emerges as adult beetles, they breed and lay eggs in a very short period of time and this is when the 2nd timely insecticide spray needs to be applied in order to control the number of adult beetles and to prevent hatched eggs from completing their life cycle.

Cytospora Canker
Since Cytospora Canker affects stressed trees, it is best managed through maintaining and improving vigor of susceptible trees and therefore reducing the risk of canker infection. Canker infection can be managed through sanitation pruning of affected branch material, preferably during the late winter. If pruning is necessary during the active growing season, it should occur during dry weather and pruning tools should be disinfected between cuts. There are no chemical treatments to control Cytospora Canker.

Management Plan Options
Using the broad annual cost estimates outlined above, we will now discuss management options that will break down costs of recommended removals and replacements, as well as 4 separate treatment set options. Tree removal/ replacement costs were based on the flat rates $185 per tree for removal and $250 per replacement tree, though these numbers could vary depending on a number of factors. The management plan options are based on a six year time frame, from 2019-2024, keeping in mind the likelihood that this plan will be dynamic and will evolve over its six year time frame. It is probable that trees will be added or removed from the treatment set or added to the list of recommended removals over the course of this plan as trees are re-evaluated. It should also be mentioned that the Pine and Spruce trees at both golf courses were included in these estimates, therefore costs would certainly be reduced if treatment does not occur on these properties. Please also note that the failure rates discussed below only apply to trees that were recommended for treatment during this evaluation. The remaining Pine and Spruce population will continue to be monitored and additional trees will be added to recommended removal lists if they decline.

Option 1: No Chemical Treatments
The Park District will not treat any of the Pine/Spruce and will spread the recommended removal list over a 6 year time frame (2019-2024). The estimates for this option include costs for a 1 for 1 replacement for each removed tree. We have also included a 40% failure rate on trees which could have been treated, but were not, and succumbed to insects or foliar fungus. This adds an additional 136 trees to the removal and replacement lists over the coming years.

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated cost to remove and replace 136 trees which succumb to diseases/pests</td>
<td>$59,160</td>
</tr>
<tr>
<td>Estimated cost to remove and replace all recommended trees</td>
<td>$73,080</td>
</tr>
<tr>
<td><strong>Total Cost (6 Years)</strong></td>
<td><strong>$132,240</strong></td>
</tr>
<tr>
<td><strong>Annual Cost</strong></td>
<td><strong>$22,040</strong></td>
</tr>
</tbody>
</table>

With no treatments and all of the 168 trees recommended for removal being removed and replaced, as well as additional 136 trees which are likely to die because of the fungal and insect issues, the annual cost would be $22,040 and the total cost over six years would be $132,240. Keep in mind this cost will likely increase by a reasonable percentage since other Pine and Spruce trees will decline and require removal and more than 40% of the recommended trees left untreated could die as well. The reality could be much worse than these numbers reflect.

Pros: Reduced cost, chance to diversify new tree plantings
Cons: Loss of large amounts of screening and tree canopy
Option 2: Annual Treatment of All Recommended Pine/Spruce
Removal and Replacement of 168 Recommended Pine/Spruce
Six Year Plan

The Park District will annually treat all of the Pine and Spruce recommended for treatment as a result of this assessment and the Park District will remove and replace all trees recommended for removal over a six year period which will provide the highest level of pathogen and pest control. The annual treatment costs are based on the pricing schedule illustrated above. A line item was added below to reflect the possibility of failed treatments affecting an estimated 15% of the treatment set. Annual estimated fungicide and insecticide treatment costs for all recommended trees is $34,355.

| Estimated treatment cost for 340 trees for 1st two years | $68,710 |
| Estimated removal and replacement cost of 50 failed treatment trees (if needed) | $21,750 |
| Estimated cost to treat remaining 290 for 4 years | $117,210 |
| Estimated cost to remove and replace all recommended trees | $73,080 |
| **Total Cost (6 Years)** | **$280,750** |
| **Annual Cost** | **$46,791** |

Pros: Retains the most trees and tree benefits, slows rate of removal
Cons: Cost is very high, diversity issues with pine and spruce remain

Option 3: Annual Treatment of All Recommended Pine/Spruce 12” DBH and under
Removal and Replacement of 168 Recommended Pine/Spruce
Six Year Plan

The Park District will annually treat all of the Pine and Spruce recommended for treatment as a result of this assessment which have a DBH of 12” or less and the Park District will remove and replace all trees recommended for removal over a six year period which will provide a high level of pathogen and pest control for the younger Pine and Spruce population. The annual treatment costs are based on the pricing schedule illustrated above. A line item was added below to reflect the possibility of failed treatments affecting 15% of the treatment set. It is also estimated that 40% of the untreated trees could also die during this period, and require removal and replacement. Annual estimated fungicide and insecticide treatment costs for all recommended trees 12” DBH and under is $20,645.

| Estimated treatment cost for 222 trees for 1st two years | $41,290 |
| Estimated removal and replacement cost of 33 failed treatment trees (if needed) | $14,410 |
| Estimated cost to treat remaining 189 trees for 4 years | $82,580 |
| Estimated cost to remove and replace all recommended trees | $73,080 |
| Cost to remove and replace 40% of untreated large trees (50 trees) | $21,750 |
| **Total Cost (6 Years)** | **$233,110** |
| **Annual Cost** | **$38,852** |

Pros: Treating trees with the greatest chance of long term survival, slightly lower cost
Cons: Still represents significant loss of mature tree canopy
Option 4: Biennial Treatment of All Recommended Pine/Spruce

Removal and Replacement of 168 Recommended Pine/Spruce

Six Year Plan – 3 Treatments Cycles for Each Recommended Tree

The Park District will alternately treat 50% of the Pine and Spruce recommended for treatment as a result of this assessment every year, resulting in all trees being treated every other year. With a mid-summer re-evaluation of the Pine and Spruce population an important part of this management plan, we believe that a biennial treatment option is a viable one. These trees can then be re-assessed annually without the investment in annual treatment. Also, the Park District will remove and replace all trees recommended for removal over a six year period. The annual treatment costs are based on the pricing schedule illustrated above. A line item was added below to reflect the possibility of failed treatments affecting 25% of the treatment set. Keep in mind that annual vs biennial treatment options may not necessarily increase the failure rate by 10%, however it will likely decrease treatment effectiveness and result in less attractive trees. Biennial estimated fungicide and insecticide treatment costs for all recommended trees is $17,180 per year.

<table>
<thead>
<tr>
<th>Estimated cost to treat all 340 trees over a 2 year time period</th>
<th>$34,360</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated removal and replacement cost of 85 failed treatment trees (if needed)</td>
<td>$36,975</td>
</tr>
<tr>
<td>Estimated cost to treat remaining 255 trees for 4 years</td>
<td>$51,000</td>
</tr>
<tr>
<td>Estimated cost to remove and replace all recommended trees</td>
<td>$73,080</td>
</tr>
<tr>
<td><strong>Total Cost (6 Years)</strong></td>
<td><strong>$195,415</strong></td>
</tr>
<tr>
<td><strong>Annual Cost</strong></td>
<td><strong>$32,569</strong></td>
</tr>
</tbody>
</table>

Pros: Less environmental impact through an effort to control pests and pathogens, lower overall cost

Cons: Financial risk must be assumed, Treatments could fail particularly on larger trees, Less control over pests and pathogens due to less frequent treatments.

Option 5: Biennial Treatment of All Recommended Pine/Spruce 12” DBH and under

Removal and Replacement of 168 Recommended Pine/Spruce

Six Year Plan – 3 Treatments Cycles for Each Recommended Tree

The Park District will alternately treat 50% of the Pine and Spruce having a DBH of 12” or less and recommended for treatment as a result of this assessment every year, resulting in all trees 12” DBH or less being treated every other year. With a mid-summer re-evaluation of the Pine and Spruce population an important part of this management plan, we believe that a biennial treatment option is a viable one. These trees can then be re-assessed annually without the investment in annual treatment. Also, the Park District will remove and replace all trees recommended for removal over a six year period. The annual treatment costs are based on the pricing schedule illustrated above. A line item was added below to reflect the possibility of failed treatments affecting 25% of the treatment set. Keep in mind that annual vs biennial treatment options may not necessarily increase the failure rate by 10%, however it will likely decrease treatment effectiveness and result in less attractive trees. Biennial estimated fungicide and insecticide treatment costs for all recommended trees 12” DBH and less is $10,325 per year.

<table>
<thead>
<tr>
<th>Estimated cost to treat 222 trees 12” and under over a 2 year time period</th>
<th>$20,650</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated removal and replacement cost of 55 failed treatment trees (if needed)</td>
<td>$23,925</td>
</tr>
<tr>
<td>Estimated cost to treat remaining 167 trees for 4 years</td>
<td>$33,400</td>
</tr>
<tr>
<td>Estimated cost to remove and replace all recommended trees</td>
<td>$73,080</td>
</tr>
<tr>
<td>Cost to remove and replace 40% of untreated large trees (50 trees)</td>
<td>$21,750</td>
</tr>
<tr>
<td><strong>Total Cost (6 Years)</strong></td>
<td><strong>$172,805</strong></td>
</tr>
<tr>
<td><strong>Annual Cost</strong></td>
<td><strong>$28,800</strong></td>
</tr>
</tbody>
</table>

Pros: Less environmental impact through an effort to control pests and pathogens in younger trees with a significant amount of useful life remaining, Lowest cost treatment option

Cons: Financial risk must be assumed, Treatments could fail, Less control over pests and pathogens due to less frequent treatments.
Treatment Options Summary:

<table>
<thead>
<tr>
<th>Option</th>
<th>Annual Cost</th>
<th>Total Cost</th>
<th>Risk</th>
<th>Failure: Treated</th>
<th>Failure: Untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: No Treatments</td>
<td>$22,040.00</td>
<td>$132,240.00</td>
<td>Low</td>
<td>NA</td>
<td>40%</td>
</tr>
<tr>
<td>Option 2: Treat Recommended All Trees</td>
<td>$46,791.00</td>
<td>$280,750.00</td>
<td>High</td>
<td>15%</td>
<td>NA</td>
</tr>
<tr>
<td>Option 3: Trees 12'' and Below</td>
<td>$38,852.00</td>
<td>$233,110.00</td>
<td>Med</td>
<td>15%</td>
<td>40%</td>
</tr>
<tr>
<td>Option 4: All Rec Trees / Biennial</td>
<td>$32,569.00</td>
<td>$195,415.00</td>
<td>Med</td>
<td>25%</td>
<td>NA</td>
</tr>
<tr>
<td>Option 5: Rec Trees 12' and below / Biennial</td>
<td>$28,800.00</td>
<td>$172,805.00</td>
<td>Med</td>
<td>25%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Recommended Option:
We would strongly recommend either Option 3 or Option 5. These allow for treatment of the younger, healthier trees which will serve the district for the longest time period. We should also mention here that though treatments can likely stop for a time, there is always the possibility of reinfection from surrounding Pine and Spruce trees. Though all options are viable for the park district, depending on what it’s needs are, these represent the lowest risk and highest reward.

Summary
Foliar fungal pathogens have been a widespread problem in our region in recent years and Spruce and Pine decline can be observed in many local municipalities and park district tree populations, so GPD is not alone in its battle. As mentioned earlier in the report, the severity of foliar fungal problems among Pine and Spruce can vary greatly depending on weather conditions. We have created the options of this 6 year management plan with the current circumstances in mind, however future weather conditions and impending climate change could significantly alter the presence and severity of DTB and RNC in future years. There may be years when spring treatment is not deemed necessary after a mid-summer re-evaluation and there also could be years when a biennial treatment plan is not enough to keep the pathogens under control. Therefore, we reiterate that this 6 year management plan will be dynamic and will likely evolve with the environmental conditions and circumstances that our region will experience in coming years. Annual evaluations should also include monitoring for less common secondary pests and pathogens.

Conclusion
We encourage GPD to consider some sort of a treatment program to ensure preservation of some of its better condition and higher location value Spruce and Pine trees. If GPD opts to not implement a treatment program, it is recommended that the Pine and Spruce population be monitored on a regular interval and poor condition trees be removed as they decline and become a center of infection, as well as aesthetically displeasing. Going forward, we encourage GPD to choose conifer species which are more resistant to foliar fungi, for example Douglas-fir, Norway Spruce, Concolor Fir, Limber Pine, White Pine, Juniper, or Arborvitae. Matching a tree species environmental requirements and tolerances to its planting site will help the tree to establish more quickly and be more vigorous which will decrease tree stress over the long term, and therefore reduce susceptibility to fungal pathogens. We also encourage planting trees with adequate growing space for their mature size so that air circulation between trees in not impeded and that moist conditions, which are ideal for fungi, are not prevalent. As always, we have been pleased to assist GPD in this Spruce and Pine tree evaluation and we look forward to assisting GPD in the future with its Arboricultural, GIS, and Natural Resources needs.