A Framework for Northfield Minnesota to Combat Invasive Plants

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Executive summary:

Invasive plants are not native to the system they are living in and cause "economic or environmental harm, or harm to human health."[1] Since they are not native to the ecosystem they infest, invasive plants are often more resilient than native plants, and as a result, invasives are able to effectively choke out native plants. As invasive plant populations grow, it becomes more costly to treat them, and the treatments are often rendered less effective.[2] Therefore, it is imperative that the city of Northfield, MN acts sooner rather than later.

Currently invasive species management is largely not addressed by Northfield policies. This leaves a definitive weak point in Northfield policy. This proposal will discuss the current status of invasive plant management in Northfield, and will recommend how this management can be improved for Northfield's benefit. In doing so, it will also outline critical goals and objectives Northfield should include in their eventual invasive plant management policy. This proposal recommends Northfield pursue an ambitious invasive species management initiative that includes prevention, early detection, organized responses, and prioritization of protecting high quality natural lands (HQNLs) in the Northfield City jurisdiction. This proposal builds on a variety of invasive species management plans from other cities, as well as existing scholarship, to provide Northfield with a framework and proposal that combines many of the best practices from various other organizations, cities, states, etc, and adapts those practices and recommendations specifically to Northfield's needs.

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[1] "Executive Order 13751 | National Invasive Species Information Center." Accessed March 2, 2021. https://www.invasivespeciesinfo.gov/executive-order-13751.

[2] City of Austin, *City of Austin Invasive Species Management Plan*, 2010. http://www.austintexas.gov/watershed_protection/publications/document.cfm?id=196403 (March 2, 2021.)

Introduction:

Invasive species of all kinds are dangerous threats to native ecosystems worldwide. Negative impacts of invasives include, but are not limited to, "reduction of native biodiversity, interference with ecosystem functions like fire, nutrient flow, and flooding, reduction of the value of streams, lakes, and reservoirs...reduction of the recreational value of natural areas, parks, and other areas."[3] According to the Association of Fish and Wildlife Agencies, "at this point in time, the single greatest threat to wildlife of all kinds and sizes is the spread of exotic species, especially invasive plants."[4] Invasive plants specifically often have a combination of several characteristics that allows them to out-compete native plants. Many invasives are habitat generalists, meaning they do not need specific environments to thrive. They may reproduce easily, or produce abundant dispersed seeds. Since they have not evolved within the native ecosystems, invasive species are often not affected by native pests or diseases that affect native plants.[5]

While invasive species management is a key focus in Minnesota, Northfield has not pursued direct city-wide action against invasive species to the extent that they ought to. Treatment of noxious weeds is required at both a state and county level, but Northfield does not currently have the staff or resources to adequately address this issue. This proposal calls for Northfield to increase and improve their invasive plant management techniques, and to use a proactive, instead of a reactive, approach to invasive plant management. If Northfield were to do this, they would preserve local biodiversity, promote land stewardship and community action,

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[3]City of Austin, *City of Austin Invasive Species Management Plan*
[4]Michigan Department of Natural Resources Wildlife Division, *Meeting the Challenge of Invasive Plants: A Framework for Action*, Phyllis Higman, and Campbell, Suzan. https://www.michigan.gov/documents/dnr/Invasives_strategy_final_289799_7.pdf (Accessed March 2, 2021).
[5]Center for Invasive Species and Ecosystem Health, *EDDMapS Invasive Species Mapping Handbook,* K.A Rawlins, R.D Wallace, D.J Moorhead, C.T Bargeron, and S.J Swain. Tifton GA: University of Georgia, 2018. https://bugwoodcloud.org/CDN/eddmaps/tools/EDDmapS_Handbook022118.pdf (March 2, 2021)

and preserve land resources.[6] While invasives are already a national and state issue, Northfield has a special responsibility to manage invasives due to several high quality land areas within its borders. These areas provide valuable ecosystem services and biodiversity which is increasingly threatened. Northfield should aim to pursue land stewardship and protect their HQNLs, which may otherwise be infested or damaged before state or national initiatives could effectively protect them. In order to protect their HQNLs, Northfield should emphasize community education and involvement, prevention, early detection, and monitoring of invasive species, as well as adding additional positions to the Northfield City Government to allow these initiatives to be accomplished.

Impacts of invasive plants:

To the average citizen, it may be difficult to decipher why invasive plants are bad. They still provide green space to the community, and often still produce flowers that pollinators can benefit from. However, ecologically, the impact of invasive plants is substantial. Among other issues, invasive species may "displace more valuable resources for wildlife, not support critical components of the food chain...be unpalatable or toxic to wildlife, disrupt mutualistic relationships between fungi and their plant hosts, hinder forest regeneration, diminish biodiversity the amount and quality of recreational opportunities including hunting, hiking, bird watching, etc."[7] Invasives have been found to lower soil quality and nutrient pools, affect tree-cover and displace forest wildlife, and increase erosion and flooding.[8]

Invasive plants also affect more than the local ecology. They are also economically damaging. According to one 2005 study, "at a minimum, [invasives cost the US economy] $120

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[6]The Trustees of Reservations, *Invasive Plant Management: Guidelines for Managers*, Julie Richburg. 2008. https://pdfs.semanticscholar.org/ab14/860958caa8eea6b92260169497b875065150.pdf (March 2, 2021)
[7]Michigan Department of Natural Resources Wildlife Division, *Meeting the Challenge of Invasive Plants: A Framework for Action*.
[8]City of Austin, *City of Austin Invasive Species Management Plan*.

billion a year in environmental damages, control, and losses", and this number is only likely to continue to grow.[9] In 2010, "a roadside installation and maintenance study [of .64 miles] found potential savings of $3,820 to $69,750 over 20 years" when using strictly native seed plantings along the road.[10] However, many of these economical figures are controversial and often calculate the cost of treating invasives instead of just letting them run rampant in the community and focusing money elsewhere. As a result, some critics of invasive plant management claim that it is a waste of time and money to treat invasive species at all.[11] However, because Northfield is home to several HQNLs, it is imperative that these lands be protected in order to preserve endangered ecological biodiversity of the midwestern prairie. Additionally, while there are also state and national initiatives dedicated to invasive plant management, often these initiatives can be slow to act and will not be as effective as preserving Northfield's HQNLs as a city-wide approach will be.

Invasives also do not respect human borders-- if there are invasive initiatives in the counties and townships surrounding Northfield, but Northfield does not collaborate and take initiative against invasive plants, the surrounding invasive initiatives will also be much more limited in their success. As stated in a press release from the Canon Valley Noxious Weed Collaborative Group, "further coordination will be needed by all surrounding jurisdictions to reduce the explosive spread of old and new invasive species. Containment and mitigation of these species is possible with cooperative efforts...All jurisdictions and land managers

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[9] Center for Invasive Species and Ecosystem Health, *EDDMapS Invasive Species Mapping Handbook.*
[10] City of Austin, *City of Austin Invasive Species Management Plan*.
[11] Martin A.Schlaepfer,, Dov F. Sax, and Julian D. Olden. "The Potential Conservation Value of Non-Native Species." *Conservation Biology: The Journal of the Society for Conservation Biology* 25, no. 3 (June 2011): 428–37. https://doi.org/10.1111/j.1523-1739.2010.01646.x.

throughout MN have the authority and obligation to eliminate noxious weeds."[12] By not acting, Northfield is putting surrounding jurisdictions, as well as their own HQNLs, at risk.

Current status of invasive plants and invasive management programs/organizations:

As of a 2019 meeting, the Northfield City Council was urged to "amend the City ordinance" about noxious weeds and "create a prohibited plant list, to be posted on the city website."[13] While this was passed, the list by no means easy to find on the Northfield website. Since Northfield does not have any invasive specific management programs currently in place, this list is not enforced. Conversely, there has been a widely successful invasive plant management program undertaken in the surrounding townships of Northfield, Bridgewater, Greenvale and Waterford. In 2018, the Northfield and Bridgewater townships received a grant to "study and mitigate one specific invasive plant: Wild Parsnip.[14] Following the success of the Wild Parsnip initiative, Northfield and Bridgewater received an additional grant to join forces with Greenvale and Waterford. This body of township collaboration has adopted the name of "Cannon Valley Noxious Weed Collaborative Group."

Not only has this program been successful at managing and eradicating wild parsnip, they are also currently focusing on managing and reducing other invasive plants like thistle, leafy spurge, wild carrot, and palmer amaranth. Additionally, the Cannon Valley Noxious Weed Collaborative group is largely volunteer based, which shows invasive management in Northfield could be feasible without adding a large amount of new staff to the city. This also illustrates Northfield would not have to " go it alone" in the fight against invasive plants -- there is already an established group dedicated to invasive species management that is directly looking for

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[12]Cannon Valley Noxious Weed Collaborative Group, *Invasive Species Management,* John Holden. Northfield, MN. PDF (March 2, 2021)
[13]City of Northfield, *Meeting Agenda, Environmental Quality Commission*, Northfield, MN. 2019. https://www.ci.northfield.mn.us/ArchiveCenter/ViewFile/Item/1669
[14]Cannon Valley Noxious Weed Collaborative Group, *Invasive Species Management.*

additional collaboration with surrounding jurisdictions. The Cannon Valley Noxious Weed Collaborative Group also already has the recommended machinery and management options available to treat invasives, so it would be much easier for Northfield to join and contribute to an already successful and established group

Beyond local organizations, Minnesota has a wide variety of resources and programs currently available to combat invasive plants. One such program is the state-wide Invasive Species Program, established in 1991. This program is the primary monitoring and managing resource for combating Minnesota Invasives.[15] However, the primary area of concern for the Invasive Species Program revolves around aquatic invasives, many of which are not relevant for Northfield. Additionally, participation and funding from the Invasive Species Program would require Northfield to "prepare an annual report each year to submit to the state legislature," which could use up time and resources better managed elsewhere. The Minnesota Department of Agriculture, a department with additional Invasive Species initiatives, primarily works on training townships. This has less direct involvement with city-level government. However, if Northfield were to partner with the Cannon Valley Noxious Weed Collaborative Group, Northfield could benefit from the education the townships receive without having to directly become involved, and would also have to submit less paperwork to the state, allowing time and resources to be more effectively used.

Another state collaborative organization is the Minnesota Invasive Species Advisory Council (MISAC). MISAC is a "multi-organization partnership working to control invasive species under the guidelines of the Minnesota State Management Plan for Invasive Species." Some partners of MISAC include the Minnesota Department of Agriculture, the Minnesota

[15]Minnesota Department of Natural Resources. "Invasive Species Programs and Links." Accessed March 2, 2021. https://www.dnr.state.mn.us/invasives/links.html.

Department of Natural Resources, The Department of Natural Resources, the Minnesota Sea Grant, and various regional associations. If Northfield were to become a MISAC partner, they could receive benefits from these departments without having to apply directly to department-specific grant programs. Additionally, if Northfield were to join the Cannon Valley Noxious Weed Collaborative Group, the entire group could join as a MISAC partner and collectively receive the benefits.

On an even broader scale, there are also many broad regional and federal programs and organizations dedicated to work against invasive plants. One such organization is the Midwest Invasive Plant Network (MIPN), which is dedicated to reducing invasive plants across the Midwest.[16] MIPN is similar to MISCAC, but is concerned with the entire Midwest region, instead of just Minnesota. Becoming a MIPN member could be beneficial to Northfield because it could provide valuable information about which invasive species are growing in prevalence across the midwest, but have not yet affected Minnesota. Regardless if Northfield joins the MIPN, the organization has a valuable MIPN database that allows individuals to "select what type of plant they want to control, indicate the type of habitat it is in...and the database comes back with specific chemical, mechanical, and/or biological methods" to combat it.[17] This could be an incredibly useful tool for Northfield moving forward, as it would allow for the city to use already researched, approved, and respected methods for each invasive plant targeted.

Federally, there is the National Invasive Species Council, which ensures there are Federal programs dedicated to preventing and controlling invasive species. It also ensures these programs are "coordinated, effective, and efficient."[18] The USDA Forest Service Forest Health

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[16] City of Austin, *City of Austin Invasive Species Management Plan*.
[17] "Invasive Species Control - General Invasive Species Control Information | MN Board of Water, Soil Resources." Accessed March 2, 2021. http://bwsr.state.mn.us/invasive-species-control-general-invasive-species-control-information.
[18]"National Invasive Species Council," November 7, 2017. https://www.doi.gov/invasivespecies.

Protection program provides specialists "trained to provide assistance on forest health-related matters."[19] Finally, the National Institute of Invasive Species Science is a collaborative effort between government and non-governmental organizations and functions as a "hub for invasive species science collaboration, coordination, and integration across agencies and disciplines."[20] While there are nearly countless other organizations and initiatives, these stand to be the most beneficial to Northfield and allow the city much more resources and information than would be available if Northfield were to pursue this plan alone. However, state and federal programs may be difficult for a city the size of Northfield to join. By becoming involved in MISAC, and/or in the Cannon Valley Noxious Weed Collaborative Group, Northfield would be able to join smaller and more accessible initiatives, which could then make it easier to achieve state/federal support and join broader coalitions as time goes on.

Goals and Objectives:

The overall goal of this invasive species management proposal is to *create a plan for Northfield that allows the city to address invasive concerns proactively, instead of retroactively. The emphasis of this proposal is to protect high quality natural lands (HQNLs) within Northfield's borders, as well as to encourage greater communication and coordination with Northfield citizens and other involved parties and organizations.* There are 5 main objectives that will allow these goals to be realized. The objectives are as follows: 1) City positions, funding, community leadership and sustainable citizens , 2)education, outreach, and cooperation, 3) assessment and prioritization 4) prevention, early detection, and rapid response, and 5) control, management, and restoration. Each of the objectives, as well as potential steps the city could take, are outlined in-depth below. Under each objective, the recommended steps are listed from highest to lowest priority. This provides the city some guidance as to which steps should be pursued first, but ultimately the city should strive to achieve all recommendations provided. A diagram visually illustrating where these different steps are prioritized can be viewed in Appendix A.

Objective 1: City Positions, Funding, Community Leadership and Fostering Sustainable Citizens

- ❏ Create necessary positions on the Northfield city council in order to coordinate community efforts against invasive plants

[19]"Forest Health Protection." Accessed March 2, 2021. https://www.fs.fed.us/foresthealth/.
[20]City of Austin, *City of Austin Invasive Species Management Plan*.

- ❏ Push for a culture of sustainable citizenship for Northfield citizens to promote additional volunteer efforts
- ❏ Pursue and secure funding to manage invasive plants
- ❏ Add more invasive focused positions to Northfield government

Objective 2: Education, Outreach, and Cooperation

- ❏ Join the Minnesota Invasive Species Advisory Council (MISAC) and/or the Cannon Valley Cannon Valley Noxious Weed Collaborative Group
- ❏ Create a variety of educational products to distribute to the community
- ❏ Place information at high risk points
- ❏ Promote extra-governmental cooperation -- work with businesses and clubs to increase awareness and coordination
- ❏ Work with other states to determine future threats that could reach Northfield

Objective 3: Assessment and Prioritization

- ❏ Train staff and volunteers
- ❏ Survey Northfield and compile invasive information into a comprehensive database every spring and fall.
- ❏ Prioritize HQNLs and high-ranked invasives

Objective 4: Prevention, Early Detection, and Rapid Response

- ❏ Follow field-approved methods of invasive species prevention
- ❏ Utilize a reporting, verification, and alert system that allows for a rapid response
- ❏ Implement increased detection monitoring at high quality natural areas and their established buffers

Objective 5: Control, Management, and Restoration

- ❏ Follow standard operating procedures to combat invasive plants and prioritize action against invasive plants

My proposal:

Objective 1: Positions, Funding, Community Leadership and Fostering Sustainable Citizens

Invasive plants are not an issue that will take care of themselves. Thus, a few positions need to be added to the City Council/Northfield Environmental Quality Commission (EQC) in order to properly address invasive plants.[21] These positions could function as an Invasive Species

[21] The City of Northfield, *Urban Forest Asset Management Plan.* Katie Himanga. 2014

sub-committee within the Northfield government structure. The highest priority positions that should be added are as follows: 1 volunteer coordinator, 1 invasive plant coordinator/manager, 1 GIS Analyst (optional). With these positions only, Northfield would have to pursue a much more volunteer-based approach to invasive plant management. Luckily, this approach is not unheard of in the Northfield area -- in fact, most of the Cannon Valley Cannon Valley Noxious Weed Collaborative Group's work is completed by volunteers. The volunteer coordinator would be responsible for a variety of volunteer-driven initiatives around Northfield, and would not be limited to only invasive plant work. However, the invasive plant coordinator will be focused primarily on invasive plant management and cooperation with state and federal agencies. The invasive plant coordinator will also be responsible for applying for various state and federal grants that are designed to provide additional funding for invasive initiatives, as well as developing programs to train city staff and collaborate with other agencies.[22] As time goes on, however, additional positions could be added to help the city of Northfield apply for grants and additional funding for invasive plant management.

The GIS analyst would update and maintain the city's invasive species database to keep all data well organized and standardized. Currently, the Cannon Valley Cannon Valley Noxious Weed Collaborative Group works with the Minnesota DNR for their GIS needs. If Northfield pursued a similar partnership, working with an external/state GIS analyst would be fine, and an additional GIS analyst position would not have to be added to the Northfield government. Together, these positions will spearhead Northfield's invasive plant management plan. They will

[22]Department of Agriculture, *Noxious Weed and Invasive Plant Grant, 2020* https://www.mda.state.mn.us/sites/default/files/2019-10/noxiousweed2020rfp.pdf (March 2, 2021)

also be expected to voice their opinions and expertise in regard to city development policy and city zoning to avoid disrupting lands unnecessarily.[23]

Since Northfield is a small city, funding from external sources will have to be heavily pursued in order to sustain this initiative. One potential funding source is the Native Plant Conservation Initiative (NPCI). NPCI provides grants for "conservation, education, restoration, research, sustainability and creating data linkages for native plant conservation in North America."[24] The USDA Forest Service has an Urban and Community Forestry branch, which promotes restoration and improvement to urban forest systems. This program provides "technical, financial, research, and educational services to local government, nonprofit organizations, educational institutions, and tribal governments."[25] If Northfield were to join the Cannon Valley Cannon Valley Noxious Weed Collaborative Group, for example, many of these funding channels would be easier to access, even with a limited initial staff.

However, funding aside, one small sub-committee cannot prevent invasive plants from spreading. To increase resources for the invasive plant initiative, members of the invasive species sub-committee will have to recruit volunteers from Northfield City organizations, such as garden clubs, civic club members, fishermen, FFA, Carleton/St. Olaf colleges, the Greater Northfield Sustainability Collaborative, etc.[26] Outside of specific associations, the sub-committee could work together to promote a culture of sustainable citizenship for Northfield citizens. While it

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[23]City of Portland, *Citywide Invasive Plant Management and Natural Areas Restoration,* Nick Fish and Michael Jordan. Portland, Oregon. https://www.portlandoregon.gov/bes/article/560220 (March 2, 2021)
[24]"Invasive & Non-Native Species (U.S. National Park Service)." Accessed March 2, 2021. https://www.nps.gov/subjects/invasive/index.htm.
[25]"National Urban and Community Forestry Advisory Council | US Forest Service." Accessed March 2, 2021. https://www.fs.usda.gov/managing-land/urban-forests/ucf/nucfac.

[26]Center for Invasive Species and Ecosystem Health, *EDDMapS Invasive Species Mapping Handbook*

would be unlikely for Northfield to implement compulsory environmental volunteer work, there are many ways that sustainability citizenship could be fostered in Northfield.[27]

Huron Pines, a nonprofit organization based out of Michigan uses a homeowner-survey approach that could be adopted in Northfield. Each spring, they reach out to contacts at each property that was reported to have invasive species the prior year. The landowners then complete a survey about the treatment progress. By opting to be in this program, landowners are offered a 50% cost-share program, meaning they only have to pay half of the treatment cost. They do this through Michigan-based invasive grants, as well as the U.S Forest Service grants, grants from the EPA, and individual donors. They also are involved in the Northeast Michigan Cooperative Weed Management Area (NEMI CWMA).[28] Minnesota also has a CWMA organization that Northfield could join, the Minnesota Invasive Species Advisory Council (MISAC). While this is a more active approach that would require more extensive city resources, there are also more passive or volunteer-based approaches to invasive plant management that could be used in conjunction with active approaches.

One local environmental project, the Cannon River Watershed Partnership, holds a variety of community events including a water festival, cleanup days, storm drain stenciling, and fundraising. They also allow individuals to become members by donating or by volunteering three hours each year.[29] This provides benefits to interested citizens and allows them to put their money or time where their interest lies. Northfield could apply this strategy to invasive plant management. Most surveying for invasive plants is recommended to take place twice a year -

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[27] Ralph, Horne, John Fien, Beau B. Beza, and Anitra Nelson. *Sustainability Citizenship in Cities: Theory and Practice*. Routledge, 2016. https://books.google.com/books?hl=en&lr=&id=fD0SDAAAQBAJ&oi=fnd&pg=PP1&dq=sustainability+citizenship&ots=xAHReeRJZz&sig=qqFyP2y23waenzjs-agPDJ4Xsc0#v=onepage&q=sustainability%20citizenship&f=false

[28] "Invasive Species Program," January 28, 2016. https://huronpines.org/invasives/.

[29] "Get Involved – Cannon River Watershed Partnership." Accessed March 2, 2021. https://crwp.net/volunteer/.

once in spring and once in early fall. The spring survey allows invasives to be identified early enough to allow chemical control in addition to other methods.[30] The fall survey illustrates how effective the invasive management technique was. Northfield could have two "invasive plant days" which would encourage volunteers to do the surveying in one day. With management from the volunteer coordinator, the invasive plant coordinator, and the GIS analyst, all volunteers could be on the same page, which would also result in much more accurate and standardized reporting. This could also be marketed towards students that attend St. Olaf and Carleton. Many college students are busy throughout their term, but by only asking for one or two days of work, this could provide a much more enticing option for students looking to get involved in their community.

Objective 2: Education, Outreach, and Cooperation

As mentioned throughout this proposal, I strongly encourage Northfield to join external groups focused on invasive plant management. Specifically, I would recommend Northfield join the Cannon Valley Noxious Weed Collaborative Group and the Minnesota Invasive Species Advisory Council (either independently, or as a member of the Cannon Valley Noxious Weed Collaborative Group). MISAC was created in 2001 and is co-chaired by members of the MISAC Council. The council includes various representation from organizations like the Minnesota Department of Agriculture, the Minnesota Department of Natural Resources, the USDA Animal and Plant Health Inspection Service, the University of Minnesota, county agricultural inspectors, local nursery and landscape representatives, local, state, tribal, and federal agencies, environmental groups, etc. As mentioned earlier, MISAC would be incredibly useful for Northfield to join, as it provides substantially more information and resources than Northfield

[30] Roger, Sheley, Mark Manoukian, and Gerald Marks. "Preventing Noxious Weed Invasion," n.d., 4. https://library.ndsu.edu/ir/bitstream/handle/10365/3240/625she96.pdf?sequence=1

could likely come up with itself. MISAC also focuses solely on invasive plants, while many other invasive initiatives often also include invasive animals. By working with MISAC, Northfield would not have to start from scratch, and could instead rely on this larger organization to help get organized. Similarly, the Cannon Valley Noxious Weed Collaborative Group could also provide Northfield with a strong localized invasive plant network. However, since the Cannon Valley Noxious Weed Collaborative Group is only about three years old, it has less resources than MISAC and relies heavily on state-wide grants. By joining the Cannon Valley Noxious Weed Collaborative Group and MISAC, Northfield would be given more resources and funding to combat invasive species, and could also work to encourage the Cannon Valley Noxious Weed Collaborative Group to join MISAC as well.

The city of Northfield should also occasionally check DNR reports from surrounding states to see which invasive plants may be invading Minnesota in the future. One way this could be done is if Northfield partnered with the Minnesota DNR via the Northfield invasive coordinator. The DNR representative would be able to communicate across state borders and warn Northfield what invasives are in other states, and could also reach out and tell other cities, states, etc what Northfield is doing and what is working well. This DNR partnership would not be required if Northfield joined the Cannon Valley Noxious Weed Collaborative Group or MISAC, as these organizations already have this information. Thus, joining these organizations would also increase Northfield's invasive awareness and would reduce bureaucratic red tape communicating with state agencies.

Beyond organizations outside of Northfield, the city itself should create a variety of educational fliers and informational pamphlets to release to the community. These could be posted on the city website, as well as in businesses around Northfield. There should be a large

emphasis placed on community outreach in order to foster volunteer relationships as outlined in Objective 1. Additional information should be placed around HQNLs, and around areas that have high-priority infestations. Additionally, Northfield should work with local businesses and organizations to increase awareness and coordinate invasive efforts. The Northfield Garden Club, as well as the Northfield Rotary Club would likely be valuable partners in this effort. Similarly, nurseries and flower-shops around Northfield should also be given educational information to give to customers. Northfield could potentially offer a monetary incentive for businesses that promote education invasive plant outreach efforts.

Objective 3: Assessment and Prioritization

Training and assessment: Once staff are hired and volunteers are organized, all individuals involved should be trained on proper invasive plant identification and management techniques. This could be completed by an "invasive species" workshop and partnership with the Minnesota DNR. The EQC is already well versed in creating community workshops, as illustrated by their composting workshops.[31] If partnering with a state agency seems out of reach, Northfield could partner with the Carleton College Master Naturalists program instead.[32] The Master Naturalists program is a 40-hour course that teaches individuals about the ecosystems in the area. Using either the state or the local the resources outlined above, Northfield City Council and the EQC should plan on surveying Northfield land for invasive species every fall and spring. This could be accomplished by partnering with the Minnesota DNR, St. Olaf and/or Carleton College, Cannon Valley Cannon Valley Noxious Weed Collaborative Group, and other organizations and volunteers in the community.

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[31]"Sustainability | Northfield, MN - Official Website." Accessed March 2, 2021. https://www.ci.northfield.mn.us/1306/Sustainability

[32]Arboretum, Cowling. "Master Naturalists Volunteer Training - Carleton College." Accessed March 2, 2021. https://www.carleton.edu/arboretum/resources/programs/master-naturalists/.

Regardless of who Northfield partners with to train staff and volunteers, for data entry they should use the Early Detection and Distribution Mapping System (EDDMapS). Both the Minnesota DNR, as well as the Cannon Valley Noxious Weed Collaborative Group, use EDDMapS for their invasive plant reporting. EDDMapS is a program that allows individuals to enter invasive species to a larger database that is reviewed and analysed by the Minnesota DNR. Northfield could partner with the DNR or the Master Naturalist program, and have program biologists brief volunteers in EDDMapS etiquette. There is also an EDDMapS handbook that lays out the recommended procedures for working with the system.[33] Once individuals were instructed on EDDMapS, they would be well equipped to complete the fall or spring invasive plant survey. EddMapS also provides interactive maps that allow individuals to see how/if various species have been observed and treated down to a county level. Data can also be extracted (via the GIS analyst) to make maps small enough to measure only the townships or city.

Prioritization: Natureserve is a nonprofit organization made up of biodiversity scientists. They have an extensive invasive species ranking system (I-rank). They rank invasive species based on their "biological and ecological characteristics, ecological impact, current distribution/abundance, trend in distribution/abundance, and management difficulty.[34] Species are ranked high, medium, low, and insignificant.[35] However, some species that have a high ranking locally may not be of the utmost concern from Natureserve. Therefore, local knowledge and state knowledge must also be considered. This includes invasive species handouts from the State of Minnesota as well as regional invasive concerns. Additionally, Northfield should prioritize HQNLs above other areas. These areas include the Cowling Arboretum, the St. Olaf Natural

[33]Center for Invasive Species and Ecosystem Health, *EDDMapS Invasive Species Mapping Handbook*
[34]The Trustees of Reservations, *Invasive Plant Management: Guidelines for Managers.*
[35]"NatureServe Explorer 2.0." Accessed March 2, 2021. https://explorer.natureserve.org/

Lands, the Hauberg Woods, Sibley Swale Park, and other city parks and nature areas. These HQNLs will be much more closely monitored than other Northfield areas, and if there are not enough resources to survey the entirety of Northfield, resources should be reserved for these areas of interest first. Using I-ranking and HQNL prioritization, invasive plant management can be delegated to fighting the most dangerous invasive species and protecting high-quality areas first.[36]

Objective 4: Prevention, Early Detection, and Rapid Response

Prevention: The most effective way to combat invasive plants is to prevent them from becoming established in the first place.[37] The following are recommended preventative measures Northfield could pursue:[38]

- If mowing, spraying, etc is used to manage invasive plants, mowing, spraying and all equipment used at invasive sites must be cleaned thoroughly after uses
- Minimize soil disturbance
- New plantings on farms, landscapes, etc should be monitored for invasives that may have been present in soils or seeds

Many of these methods have been used and have been successful through the Cannon Valley Noxious Weed Collaborative Group, so it stands to reason that these basic preventative measures could be successful within Northfield city limits as well.

Early Detection and Rapid Response: EDDMapS allows invasive species to be accurately reported and verified across all 50 US States, and using EDDMapS would allow Northfields invasive plant management to be easily included in a larger database. As mentioned previously, the GIS analyst could then take EDDMapS information and create a Northeild specific map. This could allow a rapid-community response following the city survey. Once city resources allow,

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[36]Rebecca, Epanchin-Niell, "Economics of Invasive Species Policy and Management." *Biological Invasions* 19, no. 11 (November 1, 2017): 3333–54. https://doi.org/10.1007/s10530-017-1406-4.
[37]City of Austin, *City of Austin Invasive Species Management Plan*.
[38] *Ibid.*

areas with designated high and medium priority invasives, as well as the areas surrounding HQNLs should be surveyed more frequently (bi-monthly March-November) by sub-committee staff and/or trained volunteers. Once new invasive species are detected or reported, they should be removed using the best practices for that specific species. These best practices could be found using the MIPN website.[39]

Objective 5: Control, Management, and Restoration

Currently, Northfield does not perform pest management activities. In regard to one invasive insect, the Emerald Ash Borer, Northfields city website refers to state information and does not have any city-wide initiatives or approaches. This theme is recurring for invasive species management in general.[40] If Northfield were to adopt an invasive species management plan, Northfield should focus on pest control and management, in addition to prevention and early detection initiatives. If Northfield decides to create such an initiative, the city should use an Ecologically Based Integrated Pest Management system (EBIPM) to combat invasive species. The EBIPM approach relies on a holistic approach to weed control and has been shown to be over 70% more effective than singular methods.[41] EBIPM relies on working within lifecycles of pests and their environment to provide a more effective and customized approach, instead of "one size fits all".[42] EBIPM can be applied to "both agricultural and non-agricultural settings, such as the home, garden, and workplace."[43] Instead of relying solely on herbicides (which can often damage and kill native plants along with invasives), an EBIPM approach factors in more

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[39] "Invasive Species Control - General Invasive Species Control Information
[40]"Emerald Ash Borer | Northfield, MN - Official Website." Accessed March 2, 2021. https://www.ci.northfield.mn.us/498/Emerald-Ash-Borer.
[41] Roger, Sheley, and Brenda S. Smith. "Ecologically Based Invasive Plant Management: Step by Step." *Rangelands* 34, no. 6 (December 2012): 6–10. https://doi.org/10.2111/RANGELANDS-D-12-00061.1.
[42]City of Austin, *City of Austin Invasive Species Management Plan*.
[43]*Ibid.*

than weed control alone, and considers soil erosion and environmental concerns.[44] An EBIPM approach also provides "a rubric for managers to decide whether site availability, species availability, or species performance is in disrepair and which ecological principles should guide the repair of proper ecological functions."[45] Successful invasive species management requires a long-term approach that utilizes a variety of treatments and follow-ups.[46]

A successful EBIPM approach would require the invasive species coordinator to assess infestations in three steps: 1) Identify Causes of Invasion and Associated Processes Not Functioning, 2) Choose Appropriate Tools and Strategies, 3) Design and Execute a Plan for Adaptive Management. Step one requires land managers/coordinators to scout out each designated area and assess why the land is susceptible to invasives. Has the land been disturbed by floods, wildfires, windstorms, insects, human development, etc? Disturbances reduce native plant's ability to compete with invasives. In order to provide a more suitable environment for native plants, land managers should try and minimize future disturbances. For example, if native plants are low in density, they should be re-planted in order to make the native plants the dominant presence in the area. The illustration below provides potential variables that managers could examine in order to determine how to best support the area.[47]

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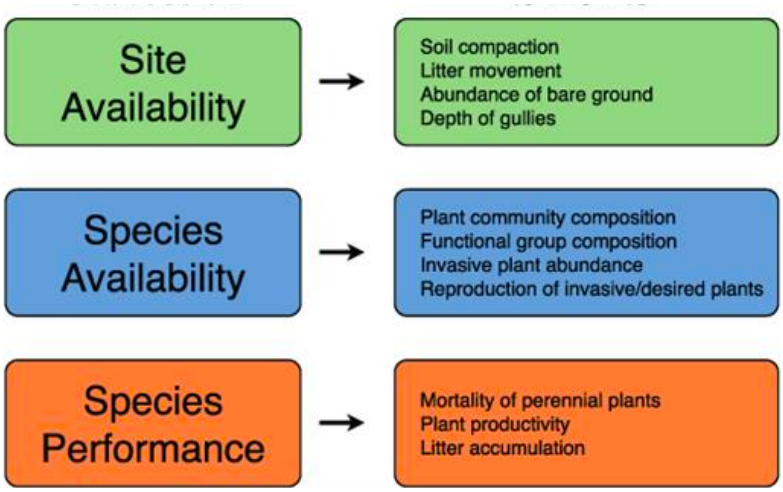
[44]Douglas Buhler, Matt Liebman, and John J. Obrycki. "Theoretical and Practical Challenges to an IPM Approach to Weed Management." *Weed Science* 48, no. 3 (June 2000): 274–80. https://doi.org/10.1614/0043-1745(2000)048[0274:TAPCTA]2.0.CO;2.

[45]A.Leffler, Joshua, and Roger L. Sheley. "Adaptive Management in EBIPM: A Key to Success in Invasive Plant Management." *Rangelands* 34, no. 6 (December 2012): 44–47. https://doi.org/10.2111/RANGELANDS-D-12-00053.1.

[46]Karin, Kettenring., and Carrie Reinhardt Adams. "Lessons Learned from Invasive Plant Control Experiments: A Systematic Review and Meta-Analysis." *Journal of Applied Ecology* 48, no. 4 (2011): 970–79. https://doi.org/10.1111/j.1365-2664.2011.01979.x.

[47] Leffler, A. Joshua, and Roger L. Sheley. "Adaptive Management in EBIPM: A Key to Success in Invasive Plant Management."



Step two calls for the city to decide on specific treatment and timing choices for each infestation. Northfield should consider toxicity, effectiveness, and economic cost to each infestation approach considered. When using herbicides, Northfield should use the least toxic and most effective option.[48] The Cannon Valley Noxious Weed Collaborative Group has reported that target spraying has been found to be more effective than mowing, and preserves natural habitat for many species. Additionally, they have found that broadcast spraying should not be used unless absolutely necessary because it is less accurate than spot spraying and can result in the destruction of valuable plants.[49] However, invasive plants react differently to different pesticides or management options, so again Northfield should consult the MIPN, the Cannon Valley Noxious Weed Collaborative Group, the Minnesota DNR, or other resources to assess the best management option for each infestation.

Finally, step 3 in an EBIPM approach requires the city to constantly be evaluating which methods worked and which did not in order to find out which methods work best for which plants. This approach "promotes the most efficient use of funds"[50] and will increase the cities

[48]City of Austin, *City of Austin Invasive Species Management Plan*.
[49]Cannon Valley Noxious Weed Collaborative Group, *Invasive Species Management,* John Holden. Northfield, MN. PDF (March 2, 2021)
[50] Sheley, Roger L., and Brenda S. Smith. "Ecologically Based Invasive Plant Management: Step by Step."

ability to combat invasives more efficiently over time. Data standardization and consistent data collection procedures will be a combined effort from the invasive plant coordinator and the GIS Analyst.

Once the spring survey is complete, Northfield will know which species are present, as well as the size and location of the species' infestations. Once this information is collected, the city should prioritize 1)HQNLs and areas surrounding them, 2) high priority invasives, 3) medium priority invasives. If there are enough resources remaining, low priority invasives should also be targeted.[51] The land manager will then assess each infestation area and determine if it requires a passive or active restoration approach. A passive approach only requires the invasive plants be killed or removed from the area, while an active approach may require native planting, competitive grass planting, etc. Need for active restoration would be determined by the density of infestation, adjacent land use, level of disturbance, size or area, soil texture, soil depth and erodibility, slope, and vegetation type.[52]

Northfield should create a proactive policy and management approach to handling invasive species, and this proposal highlights many of the best ways for the city to do this. By addressing invasive plants, Northfield will protect their own high quality natural lands, and will also support initiatives undertaken by surrounding organizations.

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[51] The Trustees of Reservations, *Invasive Plant Management: Guidelines for Managers*.
[52] Mostert, Elana, Mirijam Gaertner, Patricia M. Holmes, Patrick J. O'Farrell, and David M. Richardson. "A Multi-Criterion Approach for Prioritizing Areas in Urban Ecosystems for Active Restoration Following Invasive Plant Control." *Environmental Management* 62, no. 6 (December 1, 2018): 1150–67. https://doi.org/10.1007/s00267-018-1103-9.

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Appendix

Appendix A: Prioritization Visual