Guidance for Applicants and Grantees: Metrics Reporting and Monitoring

B.1.1 Purpose and Intended Uses

The purpose of this document is to provide guidance to Sustain Our Great Lakes (SOGL) applicants/grantees when reporting on project activities and metrics during full proposal development and subsequent metric tracking after grant award.

The specific project types this appendix addresses includes:

- Section B.2: Fish passage improvements
- Section B.3: Stream/channel restoration or naturalization
- Section B.4: Riparian restoration
- Section B.5: Brook trout habitat improvements
- Section B.6: Wetland reconnection
- Section B.7: Wetland hydrology improvements
- Section B.8: Wetland habitat/vegetation improvements
- Section B.9: Implementation of agricultural best management practices
- Section B.10: Installation of green infrastructure for stormwater retention
- Section B:11: Invasive Species Control

Please note that in some cases, grantees may need to follow guidance for multiple project types depending on the scope of project activities proposed.

B.1.2 General Guidance on Activity/Metrics Reporting

The National Fish and Wildlife Foundation (NFWF) requests that applicants/grantees report on proposed project activities using Easygrants or, when specified, by including information in the narrative of the full proposal and subsequent interim report narratives. NFWF uses this information to inform individual project funding recommendations, track grant/project progress throughout the life of a grant, and summarize outcomes across projects to assess program impact. To ensure reporting and tallying is done correctly, grantees should follow the guidance in this document to the extent feasible, including specifics about how to gather and report relevant data.

The potential for ***double-counting project activities***, and guidance on how applicants/grantees can help NFWF avoid it, is an issue mentioned in multiple sections below. Double-counting is primarily a concern when grantees are reporting on the total number of acres or miles restored by a project. For example, consider a 10-acre project that removed invasive plants and planted native vegetation on all 10 acres. While the total restoration footprint (i.e., the total number of acres restored) would be 10, grantees may instead report 20 acres as the total number restored (i.e., 10 acres for invasive removal and 10 acres for planting) if not given specific guidance about how to handle multiple activities that occur on the same acres. To address this potential confusion, in most cases, one metric has been identified for reporting the total geographic footprint on which all restoration activities have occurred.

However, it is important to note that outside of metrics that are specifically focused on understanding the total footprint of a given project (e.g., total acres or stream miles restored), grantees can report on restoration activities separately, even if they occur on the same acres or stream miles. For example, for a barrier removal project, grantees can report the number of

stream miles opened as well as the number of stream miles on which habitat improvements have occurred, even though such activities will likely occur in the same area.

B.2 Stream Fish Passage Improvement Projects

B.2.1 Relevant Project Types

Applicants/grantees should follow this guidance if their projects are intended to improve fish passage in streams or rivers. Project types may include dam removals, road-stream crossing replacements, and fish passage structure installations. If the project is also intended to restore stream geomorphology or improve instream habitat, see additional guidance under Section B.3. If the project is also intended to improve brook trout habitat, see additional guidance under Section B.5. If the project is also intended to decrease sediment loads, see additional guidance under Section B.9. If the project is focused on wetland reconnection, follow the guidance under Section B.6 instead.

B.2.2 Relevant Easygrants Metrics

To track progress toward this project type, NFWF has identifies two metrics that grantees will report on through the online reporting system Easygrants:

- Fish passage improvements – # fish passage barriers rectified
- Fish passage improvements – Miles of stream opened

B.2.3 Guidance for Applicants/Grantees Gathering of Relevant Data

During proposal development, the applicant/grantee should estimate the miles of habitat that will be opened from the proposed barrier removal. This should include the miles of upstream habitat until the next barrier upstream (or end of flowline) as well as the miles of downstream habitat until the next barrier downstream (or large water body, such as a lake). This estimate should include both the mainstem of the stream or river and smaller tributaries. To accurately estimate the number of stream miles opened, the grantee could use an online mapping tool (e.g., Fishwerks; https://greatlakesconnectivity.org/) or conduct a geographic information system (GIS) analysis. For standardization, applicants/grantees should use a 1:100,000 scale for flowlines. Since no barrier inventory is totally complete and error-free, the grantee should also coordinate with the appropriate state agency [e.g., Department of Natural Resources (DNR)] and/or other agency/organization [e.g., U.S. Fish and Wildlife Service (USFWS), U.S. Geological Service (USGS), Great Lakes Fishery Commission (GLFC)] for information on other known barriers. This is important to validate the upstream barriers are captured in the online mapping tool or GIS analysis. Following restoration, the grantee should confirm that the project adequately removed or mitigated the proposed barrier.

A few considerations:

- Using a flowline dataset at a resolution scale of 1:100,000 will likely miss smaller tributaries, especially those in the headwaters of streams and fringing wetlands. While this could result in an underestimate of stream miles opened, it is important to use a standard resolution in flowlines across projects. In some cases, it is possible that grantees may be interested in some stream reaches that are not captured at this resolution. If this is the case, grantees should use a different dataset that covers the area of interest.
- A number of distinct barrier inventories are available for the Great Lakes region (and most of them have been incorporated into Fishwerks). However, none of these datasets are totally complete and error-free. To address this, grantees should coordinate with the appropriate

state agency (e.g., DNR) and/or other agency/organization (e.g., USFWS, USGS, GLFC) for information on known barriers upstream, and confirm they are included in the barrier inventory.

- The GLFC keeps track of connectivity enhancement projects as a part of its sea lamprey control strategy. Thus, grantees should be strongly encouraged to notify GLFC of their project plans (contact Sea Lamprey Control Program staff- Kevin Mann: kevin_mann@fws.gov; Pete Hrodey: pete_hrodey@fws.gov).

B.2.3.1 Online Mapping Tool, Such as Fishwerks

A variety of tools are available online that inform aquatic connectivity (see Moody et al., 2017 for a review). For this specific application, Fishwerks (https://greatlakesconnectivity.org/) is recommended since it is user-friendly offers coverage across the entire Great Lakes Basin, and has been recently updated. However, other online mapping applications are relevant to the Great Lakes region, including USFWS's FishXing (https://www.fs.fed.us/biology/nsaec/fishxing/), the GLFC's Sea Lamprey Control Map (http://data.glfc.org/), and The Nature Conservancy's Northeast Region Aquatic Barrier Prioritization (http://maps.freshwaternetwork.org/northeast/). Each of these tools features a different underlying database; the Fishwerks database is the most complete of the set.

B.2.3.2 Overview and Application of Fishwerks

Fishwerks is a web-based decision support tool that integrates online mapping with optimization tools to assist users in selecting a portfolio of barrier removal projects that maximizes habitat gains for migratory fish in the Great Lakes Basin under a user-specified budget and geographic domain (https://greatlakesconnectivity.org/). Key data layers underlying the tool include (1) an inventory of potential barriers (dams, road crossings, and waterfalls), that are mapped onto (2) stream flowlines throughout the Great Lakes Basin (both United States and Canada), where every watershed is associated with (3) a list of migratory fish species likely to be found there. The barrier inventory in the U.S. portion includes road crossings from the U.S. Census Bureau's Topologically Integrated Geographic Encoding and Referencing (TIGER) database and dam locations from the U.S. Army Corps of Engineers' (USACE's) National Inventory of Dams. The stream flowlines are from the Great Lakes Aquatic Habitat Framework (GLAHF) database (1:100,000 scale for flowlines), which were slightly modified to remove stream miles with less than a 1 km^2 catchment basin. Users can query Fishwerks to determine the current barriers in a watershed, and quantify the amount of miles that would be opened if any one or more barriers were removed. Fishwerks was developed by the cross-sector team, including Peter McIntyre at the University of Wisconsin-Madison's Center for Limnology, Michael Ferris from the Wisconsin Institutes for Discovery, Matt Diebel from the Wisconsin DNR, and Patrick Doran from The Nature Conservancy.

Fishwerks also allows users to solve for optimal scenarios of barrier removals based on the total habitat access gained for a specified overall budget. These optimization models are important for analyzing trade-offs and cumulative habitat gain from multiple potential projects. Grantees are recommended to use Fishwerks prior to project initiation, as the optimization approach offers information on how a particular set of projects compares to alternatives. Registered users can ground-truth and update dam/culvert information for more accurate optimization scenarios. In addition to visualizing the distribution of any migratory species in the Great Lakes, Fishwerks also provides result graphics on a species-specific basis. Results are also provided in the form of channel length or area gained per dollar of removal costs.

The tool requires little technical skill due to its user interface, and all of its functionality is available for use at no cost.

B.2.3.3 GIS Analysis

Stream miles opened can also be determined by conducting a GIS analysis using geospatial data (e.g., stream flowline, barrier inventory). Potential recommended options include the National Hydrography Dataset Plus (NHD +; https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus), a dataset developed and maintained by the USGS and the U.S. Environmental Potential Agency (EPA), or the GLAHF Great Lakes Hydrography Dataset (https://www.glahf.org/watersheds/). For standardization, grantees should use a 1:100,000 scale for flowlines. For barrier locations, potential recommended options include the U.S. Census Bureau's TIGER database (http://www.census.gov/geo/maps-data/data/tiger-line.html), the USACE's National Inventory of Dams (http://nid.usace.army.mil/cm_apex/f?p=838:12), and the North Atlantic Aquatic Connectivity Collaborative (https://streamcontinuity.org/index.htm). In addition, Fishwerks is in the process of releasing shapefiles for their entire database, including the hydrography, barrier locations, and estimated passability values.

B.2.4 Guidance for Applicant/Grantee Reporting in Easygrants

Reporting fish passage improvements. Applicants/grantees should report the number of fish passage improvements in Easygrants using the following metric: "Fish passage improvements – # passage barriers rectified" (required). In the notes section of this metric, indicate the specific type of fish passage improvement (e.g., large dam removal, small dam removal, fish passage structure, road-stream crossing improvement/replacement). If there are different types of improvements, indicate the number of each type of improvement. This Easygrants metric should be used to report the *total* number of passage barriers rectified, including those done for wetland or stream connectivity and/or sediment reduction. For example, if a project is replacing one road-stream crossing that is intended to both improve connectivity and reduce sediment loadings, this road-stream crossing should only be reported once. This is essential to avoid double-counting (i.e., it will allow NFWF to confidently add up "fish passage improvements – # passage barriers rectified" to tabulate the total number of barriers rectified).

Reporting steam miles opened. Applicants/grantees should report the number of stream miles opened in Easygrants using the following metric: "Fish passage improvements – Miles of stream opened" (required). This value should be determined using the guidance outlined in Section B.2.4. In the notes section, indicate how the stream miles opened were estimated (e.g., specific tools and/or datasets used). If the project is also intended to restore stream geomorphology or improve instream habitat, the applicable stream miles may also be reported using the metric of "Instream restoration – Miles restored" (see Section B.3). If the project is also intended to improve brook trout habitat, the applicable stream miles may also be reported using the metric "Miles of suitable brook trout habitat created, enhanced, or connected in priority restoration areas" (see Section B.5).

B.2.5 Additional Resources

If using an online mapping tool, below are some potential options:

- Fishwerks tool and online tutorial (recommended): https://greatlakesconnectivity.org/
- USFWS's FishXing: https://www.fs.fed.us/biology/nsaec/fishxing/
- The Great Lakes Fisheries Commission's Sea Lamprey Control Map: http://data.glfc.org/
- The Nature Conservancy's Northeast Region Aquatic Barrier Prioritization: http://maps.freshwaternetwork.org/northeast/.

If conducting a GIS analyses, below are some potential data sources:

- ArcGIS: https://www.arcgis.com/features/index.html
  - Add-ons for evaluating aquatic connectivity in ArcGIS (Moody et al., 2017): Barrier Analysis Tool, CADSS, FIPEX, RivEX
- USGS's NHD + (1:100,000 flowline resolution): https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus
- GLAHF database (1:100,000 flowline resolution): https://www.glahf.org/watersheds/
- U.S. Census Bureau's TIGER: http://www.census.gov/geo/maps-data/data/tiger-line.html
- USACE's National Inventory of Dams: http://nid.usace.army.mil/cm_apex/f?p=838:12
- North Atlantic Aquatic Connectivity Collaborative: https://streamcontinuity.org/index.htm.

B.3 Stream/Channel Restoration or Naturalization Projects

B.3.1 Relevant Project Types

Applicants/grantees should follow this guidance if their projects are intended to restore stream geomorphology or improve instream habitat. Project types may include removing impoundments, naturalizing the stream channel configuration, managing existing sediment loads, or installing instream habitat structures (e.g., log jams, log drops, individual logs, boulders). If the project is also intended to improve fish access, see additional guidance under Section B.2. If the project is also intended to improve brook trout habitat, see additional guidance under Section B.5. If the project is focused on riparian restoration, follow the guidance under Section B.4 instead.

B.3.2 Relevant Easygrants Metrics

To track progress toward this project type, NFWF identifies one metric that will be reported by Grantees through Easygrants:

- Instream restoration – Miles restored.

B.3.3 Guidance for Grantee Gathering of Relevant Data

During proposal development, the applicant/grantee should estimate the linear miles of stream/channel habitat that are anticipated to be restored or naturalized. This will likely be based on the type and areal extent of restoration that is proposed. To accurately estimate the number of stream miles restored or naturalized, the applicant/grantee could use an online mapping tool (e.g., Google maps; https://www.google.com/maps) or conduct a GIS analysis. For standardization, grantees should use a 1:100,000 scale for flowlines (if applicable). Following restoration, the grantee should confirm that the restoration activities were conducted as planned (e.g., during the as-built survey) and the estimate should be adjusted as needed. A follow-up assessment may be needed to ensure installed structures or channel modifications have not been washed out.

One consideration when estimating stream miles restored or naturalized is:

- Using a flowline dataset at a resolution scale of 1:100,000 will likely miss smaller tributaries, especially those in the headwaters of streams and fringing wetlands. While this could result in an underestimate of miles restored, it is important to use a standard resolution in flowlines across projects. In some cases, it is possible that grantees may be interested in some stream reaches that are not captured at this resolution. If this is the case, grantees should use a different dataset that covers the area of interest (and specify the type used in Easygrants; see below).

B.3.3.1 Online Mapping Tool

There are a variety of mapping tools available to estimate the miles of stream/channel habitats that will be restored/naturalized, including Google maps (https://www.google.com/maps), Google Earth (https://www.google.com/earth/), or a Draft Logic's Distance Calculator Tool (https://www.daftlogic.com/projects-google-maps-distance-calculator.htm). Using the online mapping tool, grantees can identify the specific sections that are intended to be improved and use the distance calculator to determine the total linear miles that will be restored or naturalized. When using the linear measurement tool, additional points can be dropped to follow the meander of the river to ensure that the distance calculator does not underestimate the length of a meandering stream reach.

B.3.3.2 GIS Analysis

If applicants/grantees have in-house expertise, they can also determine stream miles restored or naturalized by conducting a GIS analysis using geospatial data (e.g., stream flowline, restoration footprint). For stream flowlines, potential sources include NHD + (https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus), a dataset developed and maintained by the USGS and EPA, or the GLAHF Great Lakes Hydrography Dataset (https://www.glahf.org/watersheds/). For standardization, grantees should use a 1:100,000 scale for flowlines (if applicable). Grantees should overlay the shapefiles of the restoration footprint with the stream miles, and determine the total linear miles that will be restored or naturalized. If habitat improvements are expected to extend beyond the restoration footprint (e.g., benefit downstream habitat), then those should be estimated as well.

B.3.4 Guidance for Applicant/Grantee Reporting in Easygrants

Applicants/grantees should report the number of stream miles restored or naturalized in Easygrants using the following metric: "Instream restoration – Miles restored." This should include all relevant activities, including removing impoundments, naturalizing stream channel configurations, managing existing sediment loads, or installing instream habitat structures. In the notes section of this metric, indicate the specific type of restoration activities and how the number of miles was estimated (e.g., tools and/or datasets). This Easygrants metric should be used to estimate the *total* footprint of all instream restoration activities. This is essential to avoid double-counting (i.e., it will allow NFWF to confidently add up "Instream restoration – Miles restored" to tabulate the total number of miles on which instream restoration activities have occurred). If the project is also intended to improve fish access, the applicable stream miles may also be reported using the metric of "Fish passage improvements – Miles of stream opened" (see Section B.2). If the project is also intended to improve brook trout habitat, the applicable stream miles may also be reported using the metric "Miles of suitable brook trout habitat created, enhanced, or connected in priority restoration areas" (see Section B.5).

B.3.5 Additional Resources

- Draft Logic's Distance Calculator Tool: https://www.daftlogic.com/projects-google-maps-distance-calculator.htm.

If conducting GIS analyses, below are some potential data sources:

- USGS's NHD + (1:100,000 flowline resolution): https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus
- GLAHF database (1:100,000 flowline resolution): https://www.glahf.org/watersheds/.

B.4 Stream Riparian Restoration Projects

B.4.1 Relevant Project Types

Applicants/grantees should follow this guidance if their projects are intended to restore riparian habitat along stream or river banks. Project types may include stabilizing stream banks, controlling invasive vegetation, and/or planting native riparian vegetation. If the project is also intended to improve brook trout habitat, also see guidance under Section B.5. If the project is also intended to reduce sediment inputs, also see guidance under Section B.9. If the project is focused on instream habitat restoration, follow the guidance under Section B.3 instead.

B.4.2 Relevant Easygrants Metrics

To track progress toward this project type, NFWF identifies one metric that applicants/grantees will report on through Easygrants:

- Riparian restoration – Miles restored.

B.4.3 Guidance for Grantee Gathering of Relevant Data

During proposal development, the applicant should estimate the linear miles of riparian habitat that are anticipated to be restored. This will likely be based on the type and areal extent of the restoration that is being proposed. To accurately estimate the number of miles restored, grantees could use an online mapping tool (e.g., Google maps; https://www.google.com/maps) or conduct a GIS analysis. For standardization, applicants/grantees should use a 1:100,000 scale for flowlines (if applicable). Following restoration, the grantee should confirm that the restoration activities were conducted as planned (e.g., during the as-built survey) and the estimate should be adjusted as needed.

One consideration when estimating riparian habitat restored is:

- Using a flowline dataset at a resolution scale of 1:100,000 will likely miss smaller tributaries, especially those in the headwaters of streams and fringing wetlands. While this could result in an underestimate of miles restored, it is important to use a standard resolution in flowlines across projects. In some cases, it is possible that grantees may be interested in some stream reaches that are not captured at this resolution. If this is the case, grantees should use a different dataset that covers the area of interest (and specify the type used in Easygrants; see below).

B.4.3.1 Online Mapping Tool

There are a variety of mapping tools available to estimate the miles of riparian habitat that will be restored, including Google maps (https://www.google.com/maps), Google Earth (https://www.google.com/earth/), or a Draft Logic's Distance Calculator Tool (https://www.daftlogic.com/projects-google-maps-distance-calculator.htm). Using the online mapping tool, applicants/grantees can identify the specific sections that are intended to be improved and use the distance calculator to determine the total linear miles that will be restored. When using the linear measurement tool, additional points can be dropped to follow the meander of the river to ensure that the distance calculator does not underestimate the length of a meandering stream reach.

B.4.3.2 GIS Analysis

Miles of riparian restoration can also be determined by conducting a GIS analysis using geospatial data (e.g., stream flowline, restoration footprint). For stream flowlines, potential

sources include NHD + (https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus), a dataset developed and maintained by the USGS and the EPA, or the GLAHF Great Lakes Hydrography Dataset (https://www.glahf.org/watersheds/). For standardization, applicants/grantees should use a 1:100,000 scale for flowlines (if applicable). Grantees should overlay the shapefiles of the restoration footprint with the stream miles, and determine the total linear miles that will be improved.

B.4.4 Guidance for Applicant/Grantee Reporting in Easygrants

Applicants/grantees should report the number of miles of riparian restoration in Easygrants using the following metric: "Riparian restoration – Miles restored" (required). This should include all relevant activities, including stabilizing stream banks, controlling invasive vegetation, and planting native vegetation. In the notes section of this metric, indicate the specific type of restoration activities and how the number of miles was estimated (e.g., tools and/or datasets). This Easygrants metric should be used to estimate the *total* footprint of all riparian restoration activities. This will be essential to avoid double-counting (i.e., it will allow NFWF to confidently add up "Riparian restoration – Miles restored" to tabulate the total number of miles on which riparian restoration activities have occurred). If the project is also intended to improve brook trout habitat, the applicable stream miles may also be reported using the metric "Miles of suitable brook trout habitat created, enhanced, or connected in priority restoration areas" (see Section B.5).

B.4.5 Additional Resources

- Draft Logic's Distance Calculator Tool: https://www.daftlogic.com/projects-google-maps-distance-calculator.htm.

If conducting GIS analyses, below are some potential data sources:

- USGS's NHD + (1:100,000 flowline resolution): https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus
- GLAHF database (1:100,000 flowline resolution): https://www.glahf.org/watersheds/.

B.5 Brook Trout Habitat Improvement Projects

For this project type, it is important to consider the two types of brook trout found in the Great Lakes region, namely stream resident and lake-dwelling populations. The latter, also called "coasters," require uninterrupted access from the tributary to the lake. The present range and abundance of coasters is very limited, so most restoration projects are likely to focus on stream-resident brook trout. Given this, there are likely to be differences in habitat accessibility needs based on the type of brook trout being targeted.

B.5.1 Relevant Project Types

Applicants/grantees should follow this guidance if their project is intended to improve brook trout habitat, including spawning, nursery, and refuge habitat. Project types may include eliminating fish passage barriers, modifying flows, removing artificial impoundments, creating pool habitats, naturalizing stream channels, managing existing sediment loads, installing instream habitat structures, stabilizing banks, and restoring riparian vegetation.

If applicants/grantees are eliminating a passage barrier, also see guidance in Section B.2. If applicants/grantees are improving instream conditions, also see guidance under Section B.3. If grantees are restoring riparian restoration, also see guidance under Section B.4.

B.5.2 Relevant Easygrants Metrics

To track progress toward this project type, NFWF identifies one metric that grantees will report on:

- Miles of suitable brook trout habitat created, enhanced, or connected in priority restoration areas.

Although this metric is not currently in Easygrants, NFWF will be requesting this information from applicants/grantees in the narrative of the full proposal.

B.5.3 Guidance for Applicant/Grantee Gathering of Relevant Data

During proposal development, the applicant should estimate the (1) baseline stream miles that are suitable and accessible for brook trout in the project area, and (2) additional stream miles that are expected to become suitable and accessible for brook trout following restoration. This post-restoration estimate will likely be based on the type and areal extent of restoration that is proposed. Following restoration, the grantee should confirm that restoration activities were conducted as planned (e.g., during the as-built survey) and the estimate should be adjusted as needed. All habitat "necessary" for brook trout should be included in this total, including habitat used for spawning, nursery, and/or refuge. However, this total should not include the stream segments that are not expected to be utilized by brook trout. The grantee should coordinate with the appropriate state agency (e.g., DNR) and/or other agency/organization (e.g., USFWS, USGS) to develop these estimates.

Habitat suitability for brook trout is based on stream characteristics, such as water temperature, gravel/cobble substrate, stream flow, etc. (Raleigh, 1982; Williams et al., 2006). Models of optimal brook trout habitat should consider combinations of optimal parameters present such as cold water (< 16°C for spawning, maximum summer temperature < 22°C), equal pool-riffle ratio, good water quality [dissolved oxygen (DO) > 8 mg/L], rocky substrate with < 20% fine sediment, 80–90% stable banks, riparian vegetation covering > 25% of stream area, adequate flow regime, and presence of woody debris and cold springs (based on Raleigh, 1982; Williams et al., 2006). It is possible that restoration would improve only some of these parameters. While it is not expected that grantees will collect quantitative information about the habitat, the grantee should coordinate with the appropriate state agency (e.g., DNR) and/or other agency/organization (e.g., USFWS, USGS) to develop estimates of changes in suitable habitat (as discussed above).

Depending on the type of restoration that is planned, the applicant/grantee may be able to estimate the number of miles improved using an online mapping tool (e.g., Google maps; https://www.google.com/maps) or conducting a GIS analysis. For standardization, grantees should use a 1:100,000 scale for flowlines (if applicable).

One consideration when estimating brook trout habitat created, restored, or enhanced is:

- Using a flowline dataset at a resolution scale of 1:100,000 will likely miss smaller tributaries, especially those in the headwaters of streams and fringing wetlands. While this could result in an underestimate of miles restored, it is important to use a standard resolution in flowlines across projects. In some cases, it is possible that grantees may be interested in some stream reaches that are not captured at this resolution. If this is the case, grantees should use a different dataset that covers the area of interest (and specify the type used in Easygrants; see below).

B.5.3.1 Online Mapping Tool

There are a variety of mapping tools available to estimate the miles of habitat that will be improved, including Google maps (https://www.google.com/maps), Google Earth (https://www.google.com/earth/), or a Draft Logic's Distance Calculator Tool (https://www.daftlogic.com/projects-google-maps-distance-calculator.htm). Using the online mapping tool, the grantees can identify the specific sections that are intended to be improved and use the distance calculator to determine the total linear miles that will be restored. When using the linear measurement tool, additional points can be dropped to follow the meander of the river to ensure that the distance calculator does not underestimate the length of a meandering stream reach.

If the project is improving fish passage, the grantee may also use Fishwerks to estimate stream miles opened (described in Section B.2).

B.5.3.2 GIS Analysis

The miles of habitat restored can also be calculated by conducting a GIS analysis using geospatial data (e.g., stream flowline, restoration footprint). For stream flowlines, potential sources include NHD + (https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus), a dataset developed and maintained by the USGS and the EPA, or the GLAHF Great Lakes Hydrography Dataset (https://www.glahf.org/watersheds/). For standardization, applicants/grantees should use a 1:100,000 scale for flowlines (if applicable). Grantees should overlay the shapefiles of the restoration footprint with the stream miles, and determine the total linear miles that will be improved.

B.5.4 Guidance for Applicant/Grantee Reporting in Easygrants

Applicants/grantees should report the miles of suitable brook trout habitat restored using the following metric: "Brook Trout – Habitat improvements – Miles of suitable brook trout habitat created, enhanced, or connected." Although this metric is not currently in Easygrants, NFWF will be requesting this information from grantees in the narrative of the full proposal. The applicant/grantee should report the baseline stream miles and post-restoration stream miles. The difference between pre- and post-restoration would be the miles of brook trout habitat created, restored, or enhanced. The applicant/grantee should also indicate the specific type of restoration activities implemented, the type of brook trout targeted (i.e., resident or lake), and how the number of miles was estimated (e.g., agency coordination). If the project is also intended to improve fish access, the applicable stream miles may also be reported using the metric of "Fish passage improvements – Miles of stream opened" (see Section B.2). If the project is also intended to restore stream geomorphology or improve instream habitat, the applicable stream miles may also be reported using the metric of "Instream restoration – Miles restored" (see Section B.3).

B.5.5 Additional Resources

If using an online mapping tool, below are some potential options:

- Google maps: https://www.google.com/maps
- Google Earth: https://www.google.com/earth/
- Draft Logic's Distance Calculator Tool: https://www.daftlogic.com/projects-google-maps-distance-calculator.htm
- Fishwerks tool and online tutorial: https://greatlakesconnectivity.org/.

If conducting GIS analyses, below are some potential data sources:

- USGS's NHD + (1:100,000 flowline resolution): https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus
- GLAHF database (1:100,000 flowline resolution): https://www.glahf.org/watersheds/.

B.6 Wetland Reconnection Projects

B.6.1 Relevant Project Types

This guidance applies to any wetland projects that are focused on eliminating fish passage barriers through the installation of fish passages, sediment removal, or the removal of hard structures. If applicants/grantees are also simultaneously improving wetland hydrology or habitat structure, they should also review Sections B.7 and B.8, respectively. If the project is focused on stream connectivity outside of wetlands, follow the guidance under Section B.2 instead.

B.6.2 Relevant Easygrants Metrics

To track progress toward this project type, NFWF identifies three metrics that grantees will report on through Easygrants:

- Fish passage improvements – # fish barriers rectified
- Acres of lake/pond/wetland habitat opened
- Wetland restoration – acres restored.

B.6.3 Guidance for Grantee Gathering of Relevant Data

During proposal development, the applicant should estimate the amount of wetland acres that will be newly accessible to fish in adjacent waterways after the fish barriers have been removed. Following restoration, the grantee should confirm that restoration activities were conducted as planned (e.g., during the as-built survey) and the estimate should be adjusted as needed.

Depending on the type of restoration that is planned, the applicant/grantee may be able to estimate the number of acres made newly accessible using an online mapping tool (e.g., Google maps; https://www.google.com/maps) or through conducting a GIS analysis. See below for more about each approach.

B.6.3.1 Online Mapping Tool

A variety of mapping tools are available to estimate the area of wetland habitat that will be opened, including Google maps (https://www.google.com/maps) or Google Earth (https://www.google.com/earth/). Using the online mapping tool, grantees can identify the specific areas that are likely to be newly accessible and use the area calculator to determine the total acres that will be restored.

B.6.3.2 GIS Analysis

Acres of habitat restored can also be determined by conducting a GIS analysis using geospatial data. If a fish passage barrier is removed, for example, one can assess the size of the wetland affected using data from the Great Lakes Coastal Wetlands Consortium (see https://greatlakesinform.org/data-catalog/item/71).

B.6.4 Guidance for Applicant/Grantee Reporting in Easygrants

Applicants/grantees should report the acres of wetland habitat newly accessible due to restoration in Easygrants using the following metrics:

- The "fish passage improvements – # fish passage barriers rectified," which should be used to report how many barriers were removed, or fish passages installed, as a part of the project. In the notes section of this metric, indicate the specific type of fish passage improvement (e.g., large dam removal, small dam removal, fish passage structure). If there are different types of improvements, indicate the number of each type of improvement. This Easygrants metric should be used to report the *total* number of passage barriers rectified, including those done for wetland or stream connectivity and/or sediment reduction. This is essential to avoid double-counting (i.e., it will allow NFWF to confidently add up "fish passage improvements – # passage barriers rectified" to tabulate the total number of barriers rectified).
- The "acres of lake/pond/wetland habitat opened" metric, which should be used to indicate the number of wetland acres made newly accessible to fish passage.
- The "wetland restoration – acres restored" metric, which should be used to describe the entire footprint of the project (i.e., the total number of acres on which grantee activities directly occurred); importantly, **acres on which multiple restoration activities occur should only be counted once**. For example, if the fish barrier removal opens up 10 acres of wetland habitat, and invasive removal is conducted on 5 of those acres, the grantee should report 10 acres for this specific metric (other metrics will be used to capture the acres on which specific activities occurred).

B.7 Wetland Hydrology Improvement Projects

B.7.1 Relevant Project Types

This guidance applies to any wetland projects that are focused on improving habitat quality through the use or removal of water control structures, which can help restore key natural hydrological dynamics. If grantees are also simultaneously improving wetland connectivity or habitat structure, they should also review Sections B.6 and B.8, respectively.

B.7.2 Relevant Easygrants Metrics

To track progress toward this project type, NFWF identifies four metrics that grantees should report on through Easygrants:

- Number of structures installed
- Acres with restored hydrology
- Acres of different wetland habitat types[1]
- Wetland restoration – acres restored.

B.7.3 Guidance for Applicant/Grantee Gathering of Relevant Data

B.7.3.1 Acres with Restored Hydrology

To estimates the overall acres with restored hydrology, the applicant/grantee should estimate the total amount of wetland acres that will be restored through the removal or installation of

1 Although this metric is not currently in Easygrants, NFWF will be requesting this information from applicants/grantees in the narrative of the full proposal.

water control structures. Following restoration, the grantee should confirm that restoration activities were conducted as planned (e.g., during the as-built survey) and the estimate should be adjusted as needed. Depending on the type of restoration that is planned, the grantee may be able to estimate the number of acres made newly accessible to fish using an online mapping tool (e.g., Google maps; https://www.google.com/maps) or through conducting a GIS analysis. See below for more about each approach.

Online Mapping Tool

A variety of mapping tools are available to estimate the area of wetland habitat that will be opened, including Google maps (https://www.google.com/maps) or Google Earth (https://www.google.com/earth/). Using the online mapping tool, grantees can identify the specific areas that are likely to be newly accessible and use the area calculator to determine the total acres that will be restored.

GIS Analysis

Acres of habitat restored can also be calculated by conducting a GIS analysis using geospatial data. If a fish passage barrier is removed, for example, one can assess the size of the wetland affected using data from the Great Lakes Coastal Wetlands Consortium (see https://greatlakesinform.org/data-catalog/item/71).

B.7.3.2 Acres of Wetland Habitat Type

The areas of seven general wetland habitat types will be estimated within the project impact area from aerial photography, and verified by ground-truthing and reconnaissance before and after project completion. The following wetlands should be classified and mapped, and their areas measured:

- Dry mudflat (shorebird guild)
- Wet mudflat/moist soil (shorebird guild)
- Shallow open water (shorebird guild)
- Emergent shallow marsh (waterfowl guild)
- Emergent and forested swamp (waterfowl guild)
- Aquatic bed and deep marsh (waterfowl guild)
- Open water and unconsolidated bottom (waterfowl guild).

These wetland habitat types align with wetland community types that the Upper Mississippi River and Great Lakes Region Joint Venture uses to set wetland habitat conservation objectives for migrating waterfowl (Soulliere et al., 2007) and shorebirds (Potter et al., 2007). These wetland habitat types also align with monitoring protocols of the Integrated Waterbird Monitoring and Management (IWMM) monitoring manual (NPS, 2015). The procedures described below were adapted from IWMM Standard Operating Procedures (SOPs) 2.3 and 2.5 (see http://iwmmprogram.org/documents/IWMM_Manual_V9.0_final_11_20_2017.pdf).

This approach does not include a “wet meadow” habitat category, primarily because it does not provide significant energetic value for most migratory waterfowl or shorebirds (even though it is a critical habitat for waders and passerines). However, wet meadow with < 30% vegetation would be included in the dry and wet mudflat categories described above.

Using aerial photographs and on-site reconnaissance, delineate and estimate the proportion of the project area in the following water-depth classes:

- Non-inundated dry substrate with < 30% vegetation cover (= dry mudflat)

- Non-inundated moist or saturated substrate with < 30% vegetation cover (= wet mudflat/moist soil)
- Inundated substrate with water depth < 25 cm and < 30% vegetation cover (= shallow open water)
- Inundated substrate with water depth > 25 cm regardless of vegetation cover (see following habitat types).

Using aerial photographs and on-site reconnaissance, delineate and estimate the proportion of the project area according to the following wetland habitat classes (see Cowardin et al., 1979 for criteria and definitions of wetland habitats):

- Predominantly (> 70%) non-persistent emergent wetland grasses and broad-leaved plants that are adapted to grow in saturated or inundated soils (= shallow marsh).
- Predominantly (> 70%) trees and shrubs that are adapted to grow in saturated or inundated soil (= emergent and forested swamp). This habitat type may contain an understory or isolated patches (< 0.0025 acre) of herbaceous persistent or non-persistent emergent plants.
- Predominantly (> 70%) persistent emergent wetland plants (e.g., cattail, reed, bulrush) and floating leaf or submergent plants that are adapted to grow only in saturated or inundated soils (= aquatic bed and deep marsh).
- Unvegetated (> 70%) areas of open water with only scattered patches (< 0.0025 acre) or < 30% cover of emergent or submergent vegetation, and > 25 cm water depth and rock, cobble, or unconsolidated bottom.
- Non-habitat includes any areas that fall outside of the water depth and wetland habitat types described above.

Percentages of wetland habitat cover are mutually exclusive so percent cover estimates summed over all water depth, wetland habitat, and non-habitat types equal 100%. Senesced (i.e., dead) vegetation should be included in the classification and area estimates of each wetland habitat type. The recommended minimum mappable unit is 0.025 acre.

Recommended for Consideration

As a measure of overall wetland project area quality, record the interspersion of vegetated area with areas of open water or bare ground according to IWMM SOP 2.2 (see Figure SOP 2.2; http://iwmmprogram.org/documents/IWMM_Manual_V9.0_final_11_20_2017.pdf):

- Large and well-connected patches of water or bare ground
- Small disconnected patches of water or bare ground
- Discernible area of both of the above interspersion classes.

Recommended for Consideration

As a measure of longer-term annual hydrology, estimate (based on knowledge of seasonal water levels and water-level manipulations) how long each of the water depth and wetland habitat types are inundated according to IWMM SOP 2.4:

- Surface water present > 90 days
- Surface water present 30–90 days
- Surface water present < 30 days
- Permanent inundation
- No information.

B.7.4 Guidance for Applicant/Grantee Reporting in Easygrants

Applicants/grantees should report on the following metrics in Easygrants:

- The "# structures installed," which should be used to report how water control structures were installed as part of the project.
- The "Acres with restored hydrology" metric, which should be used to indicate the number of wetland acres improved through the use or removal of the water control structures.
- The "Acres of wetland habitat types" metric, which should be used to report the number of acres of different habitat types before and after project completion (so that NFWF can understand the net change in the amount of different habitats – see Section B.7.3.2 above). Although this metric is not currently in Easygrants, NFWF will be requesting this information from grantees in the narrative of the full proposal.
- The "Wetland restoration – acres restored" metric, which should be used to describe the entire footprint of the project (i.e., the total number of acres on which grantee activities directly occurred); importantly, **acres on which multiple restoration activities occur should only be counted once**. For example, if the fish barrier removal opens up 10 acres of wetland habitat, and invasive removal is conducted on 5 of those acres, the grantee should report 10 acres for this specific metric (other metrics will be used to capture the acres on which specific activities occurred).

B.7.5 Additional Resources

- The IWMM Program provides publically available protocols for conducting vegetation surveys as described above (http://iwmmprogram.org/protocols-data-forms/), as well as online tutorials at no cost. IWMM staff can also be consulted on an as-needed basis for technical assistance.

B.8 Wetland Habitat/Vegetation Improvement Projects

B.8.1 Relevant Project Types

This guidance applies to any wetland projects that are improving wetland vegetation through direct vegetation removal or planting. If grantees are also simultaneously improving wetland connectivity and/or wetland hydrology, they should also review Sections B.6 and B.7, respectively.

B.8.2 Relevant Easygrants Metrics

To track progress toward this project type, NFWF identifies four metrics that grantees need to report on through Easygrants:

- Removal of invasives (acres restored)
- Native plant restoration (acres restored)
- % invasives in wetland habitat types[2]
- Wetland restoration – acres restored.

2 Although this metric is not currently in Easygrants, NFWF will be requesting this information from applicants/grantees in the narrative of the full proposal.

B.8.3 Guidance for Grantee Gathering of Relevant Data

B.8.3.1 Percent Invasives in Wetland Habitat Types

Percent cover of invasive plants will be estimated within each of the water depth and wetland habitat types identified in Section B.7.4.2. Invasive plants are typically non-native species with little or no food or cover value for migrating waterfowl and shorebirds. Invasives, particularly emergent, shrubby plants, often create homogeneous stands of dense vegetation that crowd out desirable wetland plants that provide food and cover for migrating shorebirds and waterfowl. Invasive plants can also have a dense growth form that restricts access by migrating marsh birds to food and cover. Invasive plant species in the Great Lakes region include, but are not limited to:

- Purple loosestrife
- Common reed
- Tartarian honeysuckle
- Multiflora rose
- Reed canary grass
- Narrow-leaved and hybrid cattail
- Glossy buckthorn
- Autumn olive
- Rose mallow
- Eurasian watermilfoil
- Flowering rush.

Applicants/grantees should record ocular estimates of percent cover of monotypic stands of invasive plants that occur in patches $\geq$ 0.025 acre within each of the water depth and wetland habitat types described in Section B.7.4.2.

B.8.4 Guidance for Applicant/Grantee Reporting in Easygrants

Applicants/grantees should report on the following metrics in Easygrants:

- The “Removal of invasives (acres restored)” metric, which should be used to report the number of wetland acres on which invasive species control was conducted.
- The “Retreatment of invasives (acres retreated)” metric, which should be used to report the number of acres receiving additional retreatment post initial treatment.
- The “Native plant restoration (acres restored)” metric, which should be used to report the number of wetland acres on which native plant seeding took place.
- The “% invasives in wetland habitat types” metric, which should be used to report the cover of invasives in each major wetland habitat type before and after project completion (so that NFWF can understand the net change in different habitats).
- The “Wetland restoration – acres restored” metric, which should be used to describe the entire footprint of the project (i.e., the total number of acres on which grantee activities directly occurred); importantly, **acres on which multiple restoration activities occur should only be counted once**. For example, if the fish barrier removal opens up 10 acres of wetland habitat, and invasive removal is conducted on 5 of those acres, the grantee should report 10 acres for this specific metric (other metrics will be used to capture the acres on which specific activities occurred).

B.8.5 Additional Resources

- The IWMM provides publically available protocols for conducting vegetation surveys (http://iwmmprogram.org/protocols-data-forms/) as well as online tutorials at no cost. IWMM staff can also be consulted on an as-needed basis for technical assistance related to wetland monitoring.

B.9 Implementation of Agricultural Best Management Practice Projects

B.9.1 Relevant Project Types

Applicants/grantees should follow this guidance if their projects are intended to reduce phosphorus and sediment inputs to surface waters. Project types may include the development of farm nutrient plans, enrollment in Farm Bill programs, installation of BMPs, and road-stream crossing improvements/replacements. If the project is also intended to benefit aquatic connectivity, see additional guidance under Section B.2 (for streams) or Section B.6 (for wetlands).

B.9.2 Relevant Easygrant Metrics

To track progress toward this project type, NFWF identifies four metrics that applicants/grantees will report on through Easygrants:

- Acres under improved management
- Fish passage improvements – # passage barriers rectified
- Pounds of phosphorus avoided (annually)
- Pounds of nitrogen avoided (annually)
- Pounds of sediment avoided (annually).

B.9.3 Guidance for Grantee Gathering of Relevant Data

While grantees may make direct measurements of phosphorus, nitrogen or sediment loads at their individual sites, it is likely that those data may be difficult and expensive to obtain. Therefore, guidance is provided regarding several models or tools that grantees can use to estimate “pounds of phosphorus avoided (annually)”, “pounds of nitrogen avoided (annually)” or “pounds of sediment avoided (annually).” Below are some models and tools that can be used to make the appropriate estimates. Some of the models, as described below, require users to run two separate model scenarios: a baseline model run to establish initial phosphorus and sediment loadings and a model run incorporating implemented BMPs to calculate the resulting pollutant load reduction. Although several viable tools or models are provided for grantees to use to estimate these metrics, this list is not exhaustive. To ensure accurate results, applicants/grantees should use the tools or models that they are comfortable executing and have the required expertise to run correctly. In some instances, the tool or model that grantees are most comfortable using may not be included in the list below.

B.9.3.1 Agricultural Policy/Environmental eXtender Model

Overview

The Agricultural Policy/Environmental eXtender (APEX) model is an open-source, physically based model that allows users to simulate the effect of agricultural practices on hydrology, soil erosion, and nutrient loss within small-medium watersheds and heterogeneous farms (https://epicapex.tamu.edu/apex/). The model requires weather (user defined or from model database), soil, land management, and site geographic data as inputs.

Application

Applicants/grantees can use the APEX model to estimate the reduction in phosphorus or sediment loadings to surface waters. APEX can model the cumulative impacts of numerous BMPs, including the implementation of grass waterways, strip cropping, terrace systems, buffer strips/vegetated filter strips, drainage systems, crop rotations, plant competition, plant burning, grazing patterns of multiple herds, varying fertilizers, liming, irrigation practices, manure management, stream restoration, wetland creation, and furrow diking. While there is no direct way to model the impacts of road-stream crossing improvements/replacement in APEX, grantees could potentially model the impacts using a proxy like stream restoration.

The APEX model is data intensive and capable of simulating real-world physical processes. Therefore, use of the APEX model requires expertise and special training. However, the developers (Texas A&M University) frequently host training workshops, have set up a modeling forum, and update the model periodically based on user feedback.

A few considerations if using the APEX model include:

- Applicants/grantees will need to run APEX separately to first establish the baseline conditions and then evaluate the impact of project implementation. To report progress toward the NFWF sediment and phosphorus metrics, grantees will need to calculate the difference between these two scenarios (annual reductions).
- The APEX model outputs annual phosphorus yield (sum of soluble phosphorus yield and mineral phosphorus yield) in kilograms per hectare (kg/ha) and annual sediment yield in tons per hectare (t/ha). Therefore, to report phosphorus and sediment reductions in Easygrants, grantees will need to first convert the output from kilograms or tons to pounds, and then multiply by the area of the subarea or watershed (hectares).
- The APEX model is appropriate at the small-medium watershed scale. It will be difficult to capture a change in model outputs if grantee projects are at a much smaller scale.
- Since grantees will be able to set their own model time period, they should either choose a time period that is representative of the climate conditions that occurred in the past year or a longer time period that represents the average conditions of their project location.

Additional Resources

- APEX tool download: https://epicapex.tamu.edu/model-executables/
- APEX model documentation and user guide: https://epicapex.tamu.edu/manuals-and-publications/
- APEX modeling forum: https://groups.google.com/forum/#!forum/agriliferesearchmodeling.

B.9.3.2 Long-Term Hydrologic Impact Assessment Low Impact Development Model

Overview

The Long-Term Hydrologic Impact Assessment/Low Impact Development (L-THIA/LID) model is a modeling tool that helps evaluate the benefits of LID or changes to land use management practices. Purdue University created the tool (https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.php) and it can be applied in the Great Lakes region on a small “lot”-sized scale up to a larger watershed-scale. For inputs, it requires daily precipitation, soil, and land use data for the modeled area; however, L-THIA/LID already has most of these inputs incorporated. Users can adjust the percent of impervious service for an area or select the LID practice incorporated in the area, and then run the model to estimate the reduction or change in non-point source total phosphorus and sediment loads.

Application

Applicants/grantees can use L-THIA/LID to estimate the reductions in phosphorus or sediment loadings to surface waters. It can model the benefits of LID practices in two ways. The first way is by allowing users to adjust the percent of imperviousness for particular land uses. The second way is at the "lot-level" and includes allowing users to choose from a set of BMPs, including bioretention basins, swales, connected gutters and curbs, rain barrels, cisterns, porous pavement, narrowing impervious surfaces, green space, conservation practices, and green roofs. The model can only estimate changes to phosphorus or sediment loads if there are changes to impervious surfaces or soil infiltration rates. Therefore, it cannot model some management practices such as changing fertilizer application processes or road-stream crossing improvements/replacements.

L-THIA/LID is user-friendly and requires a minimal time investment to run effectively. The model is designed to be run on a lot-level, but can also be run in an area as large as an eight-digit Hydrologic Unit Code (HUC). The user can either select a watershed or draw a boundary to define the area to model.

A few considerations if using L-THIA/LID:

- L-THIA/LID outputs average annual phosphorus loads and average annual sediment loads in pounds with and without the implementation of LID. Therefore, grantees will need to calculate the difference between loadings with and without LID implementation in order to report phosphorus and sediment reductions in Easygrants.
- L-THIA/LID calculates average annual runoff using 30 years of existing weather data. Accordingly, the tool represents average conditions for grantee project locations and is, therefore, unable to represent the climate conditions that occurred in the past year.

Additional Resource

- L-THIA/LID tool and tutorial: https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.php.

B.9.3.3 Spreadsheet Tool for Estimating Pollutant Load

Overview

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) is a Microsoft Excel-based tool that calculates nutrient and sediment loads from different land uses, and the load reductions that would result from the implementation of different BMPs (see http://it.tetratech-ffx.com/steplweb/). It is a tool available at no cost that was developed for the EPA Office of Water. The STEPL tool calculates annual phosphorus loading based on the runoff volume and phosphorus concentration. It calculates annual sediment load based on the Universal Soil Loss Equation and the sediment delivery ratio.

Application

Applicants/grantees can use STEPL to estimate the reductions in phosphorus or sediment loadings to surface waters. The spreadsheet tool can model the impacts of a large variety of BMPs for pastureland, cropland, forest, user-defined land use type, feedlots, and urban land uses. It also allows users to set parameters for increased sediment loads from gully formations and impaired streambanks. The BMPs that can be applied to the various land uses include, but are not limited to, porous pavements, reduced tillage systems, filter strips, grass swales, stream bank stabilization, and settling basins. While there is no direct way to model the impacts of road-

stream crossing improvements/replacements in STEPL, grantees could potentially model the impacts using a proxy like stream bank stabilization.

This tool is data-driven, simple, and easy-to-use. There is training and support available in person and online. STEPL is capable of evaluating the effects of implementing a broad range of BMPs. The user can provide local data to derive inputs or easily search for input data on the STEPL online data input server. Although STEPL is a simple tool, it requires some training. Users will need a basic understanding of Microsoft Excel, hydrology, erosion, and pollutant loading processes.

A few considerations if using the STEPL tool:

- STEPL outputs the total phosphorus load reduction by subwatershed in pounds/year and the total sediment load reduction by subwatershed in tons/year. Therefore, the annual phosphorus load reduction estimated with STEPL can be directly reported in Easygrants, while the sediment load reductions will need to be converted from tons/year to pounds/year.
- STEPL calculates average annual runoff using 30 years of existing weather data. Accordingly, the tool represents average conditions for grantee project locations and is, therefore, unable to represent the climate conditions that occurred in the past year.

Additional Resources

- STEPL model introduction: http://it.tetratech-ffx.com/steplweb/
- STEPL model download, example files, and user guide: http://it.tetratech-ffx.com/steplweb/models$docs.htm.

B.9.3.4 Soil and Water Assessment Tool

Overview

The Soil and Water Assessment Tool (SWAT) is used to predict the impact of changes to land use and land management practices on water, nutrients, or sediment over time. It is managed by Texas A&M University and the U.S. Department of Agriculture (USDA; see http://swat.tamu.edu/software/arcswat/). The model is physically based (i.e., local field data for physical parameters can be input into the model) and is operated at a daily time-step. It can be used on a river basin- or watershed-scale. The tool is not intended to model individual events (e.g., flooding, fires), but to model changes to sediment or water quality over a longer period of time. SWAT requires information about weather, soil properties, topography, vegetation, and land management practices occurring in the watershed. SWAT can model physical processes (e.g., sediment movement and nutrient cycling) using only those input types; therefore, users can still model changes to sediment and nutrient loads in watersheds in locations where they do not have local water quality or sediment monitoring data.

Application

Applicants/grantees can use SWAT to estimate the reductions in phosphorus or sediment loadings to surface waters. SWAT can model the impacts of a variety of different BMPs, including vegetated buffers and/or filter strips, cover crops, tillage practices, wetland restoration, manure management, street sweeping, stream bank stabilization, and enhanced nutrient management. While there is no direct way to model the impacts of road-stream crossing improvements or replacements in SWAT, grantees could potentially model the impacts using a proxy-like stream bank stabilization.

SWAT is a complex model that requires expertise and specialized training. The developers provide updates and new versions of the model, and host workshops and conferences to help educate users. This tool is available at no cost to users.

A few considerations if using SWAT:

- Applicants/grantees will need to run SWAT separately to first establish the baseline conditions and then evaluate the impact of project implementation. To report progress toward the NFWF sediment and phosphorus metrics, grantees will need to calculate the difference between these two scenarios (i.e., annual reductions).
- SWAT outputs sediment yield in metric tons/hectare/time step and total phosphorus yield (sum of organic phosphorus yield, soluble phosphorus yield, and mineral phosphorus yield) in kilograms/hectare/time step. Therefore, to report phosphorus and sediment reductions in Easygrants, grantees will need to annualize the phosphorus and sediment yields, convert values from kilograms or tons to pounds, and then multiply by the area of the subwatershed or watershed (hectares).
- The SWAT model is appropriate at the river basin or watershed scale. It will be difficult to capture a change in model outputs if grantee projects are at a much smaller scale.
- Since grantees will be able to set their own model time period, they should either choose a time period that is representative of the climate conditions that occurred in the past year or a longer time period that represents the average conditions of their project location.

Additional Resources

- SWAT tool: http://swat.tamu.edu/software/swat-executables/
- SWAT documentation and user guide: http://swat.tamu.edu/documentation/.

B.9.4 Guidance for Grantee Reporting in Easygrants

Reporting acres under improved management. Applicants/grantees should report acres under improved management in Easygrants using the following metric: “Acres under improved management.”

Reporting road-stream crossings replaced/improved. Applicants/grantees should report the number of road-stream crossing replaced or improved in Easygrants using the following metric: “Fish passage improvements – # passage barriers rectified.” In the notes section of this metric, applicants/grantees should indicate that the project was a road-stream crossing improvement/replacement project. This Easygrants metric should be used to report the *total* number of passage barriers rectified, including those done for aquatic connectivity and/or sediment reduction. For example, if a project is replacing one road-stream crossing that is intended to both improve connectivity and reduce sediment loadings, this road-stream crossing should only be reported once. This is essential to avoid double-counting (i.e., it will allow NFWF to confidently add up “Fish passage improvements – # passage barriers rectified” to tabulate the total number of barriers rectified as well as the subset that are road-stream crossings).

Reporting annual phosphorus reductions. Applicants/grantees should report phosphorus reductions in Easygrants using the following metric: “Pounds of phosphorus avoided (annually).” In the notes section of this metric, grantees should indicate the model or tool that was used to estimate this metric.

Reporting annual sediment reductions. Applicants/grantees should report sediment reductions in Easygrants using the following metric: “Pounds of sediment avoided.” Note that although this is not explicitly stated in Easygrants, grantees should report annual reductions. In

the notes section of this metric, grantees should indicate the model or tool that was used to estimate this metric.

B.10 Installation of Green Infrastructure for Stormwater Retention Projects

B.10.1 Relevant Project Types

G Applicants/grantees should follow this guidance if their green infrastructure projects are intended to increase urban stormwater storage capacity. Installations may include rain gardens, green roofs, pervious surfaces, and constructed wetlands. If the project is also intended to reduce phosphorus or sediment inputs, see guidance under Section B.9.

B.10.2 Relevant Easygrant Metrics

To track progress toward this project type, NFWF identifies two metrics that applicants/grantees will report on through Easygrants:

- Sq ft of green infrastructure, sq ft of bioretention installed, sq ft of green roof installed
- Volume of stormwater storage added (gallons).

B.10.3 Guidance for Grantee Gathering of Relevant Data

Applicants/grantees can use several models or tools to estimate “Volume stormwater storage added (gallons).” Some models and tools that are available to make the appropriate estimates are presented below. Although several viable tools are provided for grantees to use to estimate this metric, this list is not exhaustive. To ensure accurate results, grantees should use tools or models they are comfortable implementing and have the required skill set to execute correctly. In some instances, the tool or model that grantees are most comfortable using may not be included in the list below or the grantee may rely on estimates from engineering plans. For all green infrastructure-related grantee-reported metrics, grantees should report the tool or model they used to estimate stormwater retention in Easygrants. If a grantee relies on estimates obtained from engineering plans, the grantee should report that as well.

B.10.3.1 i-Tree

Overview

i-Tree is a suite of no cost, peer-reviewed software from the USDA Forest Service (see https://www.itreetools.org/). The i-Tree toolkit quantifies the environmental services that are provided by trees. There are 11 different i-Tree applications that range in difficulty of use and vary in required inputs (i.e., i-Tree Eco, i-Tree Landscape, i-Tree Hydro, i-Tree Design, i-Tree Canopy, i-Tree Species, i-Tree MyTree, i-Tree Streets, and i-Tree Vue, i-Tree Database, and i-Tree Storm).

Application

Applicants/grantees can use i-Tree to estimate the gallons of stormwater intercepted by tree planting projects. i-Tree Hydro is a simulation tool that analyzes how changes in the extent of tree canopy cover or changes in the surface cover affect urban stormwater retention, and is likely of most relevance to the Great Lakes Program. i-Tree Eco and i-Tree Streets could also help grantees report increased urban stormwater retention, but i-Tree Eco is relatively data-intensive and i-Tree Streets focuses on management strategies and costs. i-Tree Hydro requires inputs for elevation data, land cover data, and weather data. However, the user can access some of the required data through the tool itself because it includes access to topographic, stream gauge, and weather gauge data. Among other outputs, the program

provides an estimate of the reduction in annual stormwater runoff due to changes in land cover parameters.

The i-Tree suite is available at no cost, there is a large user base, and there are many online tutorials available. Although i-Tree Streets is relatively easy-to-use, it will require some training.

A few considerations if using i-Tree Hydro:

- Applicants/grantees will need to run a "Base Case" or a baseline scenario; and an "Alternative Case" or "with project" scenario. Reductions in stormwater runoff between the Base Case and Alternative Case are output in cubic meters/hour. Grantees will need to first annualize the reductions in stormwater runoff and then convert them from cubic meters to gallons before reporting progress toward the NFWF stormwater retention outcome.
- The i-Tree suite of software is intended to only quantify the environmental benefits that are provided by trees. Similarly, the i-Tree Hydro tool only captures the stormwater reduction that results from changes in tree and impervious cover.
- Since applicants/grantees will be able to set their own model time period, they should either choose a time period that is representative of the climate conditions that occurred in the past year, or a longer time period that represents the average conditions of their project location.

Additional Resources

- i-Tree tools: https://www.itreetools.org/applications.php
- i-Tree manuals: https://www.itreetools.org/resources/manuals.php
- i-Tree online tutorials: https://www.itreetools.org/resources/videos.php.

B.10.3.2 National Stormwater Calculator Tool

Overview

EPA's National Stormwater Calculator (SWC) is a tool that estimates the annual amount of rainwater runoff from a specific site. The tool makes estimates based on local soil conditions, land cover, and historical rainfall records. The SWC tool requires several inputs, including soil characteristics, slope, local weather data, and the amount of the drainage area that is impervious. However, the user can access some of the required data regarding these inputs through the tool itself, as it has the capability to link to national databases with information on topography and local weather data. It models pre- and post-construction stormwater runoff discharges (in inches) using the EPA Storm Water Management Model (SWMM).

Application

Applicants/grantees can use SWC to model the impacts of seven green infrastructure practices: rooftop disconnection, rainwater harvesting, rain gardens, green roofs, street planters, infiltration basins, and porous pavements on stormwater retention.

SWC is a user-friendly desktop application. Users can determine how specific green infrastructure changes can affect runoff. There are many online resources available to help users effectively utilize the tool, including a user manual, a descriptive video, and a fact sheet.

A few considerations if using SWC:

- Applicants/grantees will need to use the SWC tool to separately estimate the baseline scenario and the "with project" scenario. To report progress toward the NFWF stormwater

outcome, grantees will need to calculate the difference in average annual runoff between these two scenarios.

- To estimate the amount of runoff retained in an average year in gallons, grantees will need to convert inches of rainfall to a volume of water using the following calculation:

  Inches of runoff retained x square feet of modeled area/12.

  The inches of runoff retained is divided by 12 to express the data in feet rather than inches. After the multiplication, the amount of water captured by the green infrastructure is expressed in cubic feet. To covert this to gallons, grantees can then multiply this number by 7.48 (1 ft^3 of water is 7.48 gallons).

- Since applicants/grantees will be able to set their own model time period, they should either choose a time period that is representative of the climate conditions that occurred in the past year or a longer time period that represents the average conditions of their project location.

B.10.3.3 Additional Resource

- SWC tool and user guide: https://www.epa.gov/water-research/national-stormwater-calculator.

B.10.3.4 STEPL

Overview

STEPL is a Microsoft Excel-based tool that primarily calculates nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of different BMPs (see http://it.tetratech-ffx.com/steplweb/). However, STEPL can now also estimate flow volume reductions for urban LID and infiltration BMP practices. It is a tool available at no cost that was developed for the EPA Office of Water.

Application

Applicants/grantees can use STEPL to estimate increases in stormwater retention related to the following urban LID and infiltration practices: infiltration basins, devices, swales, trenches, cisterns, rain barrels, bioretention basins, dry wells, filter/buffer strips, vegetated and wet swales, porous pavement, oil/grit separators, and sand filters.

This tool is data-driven, simple, and easy-to-use. There is training and support available in person and online. STEPL is capable of evaluating the effects of implementing a broad range of urban LID and infiltration BMP practices. The user can provide local data to derive inputs or easily search for input data on the STEPL online data input server. Although STEPL is a simple tool, it requires some training. Users will need a basic understanding of Microsoft Excel, hydrology, and erosion.

A few considerations if using STEPL:

- STEPL outputs the flow volume reductions in gallons/year by urban land use type in each watershed. Therefore, to estimate increases in stormwater retention, grantees will need to sum the annual flow volume reductions over the different urban land use types before reporting in Easygrants.
- STEPL calculates average annual runoff using 30 years of existing weather data. Accordingly, the tool represents average conditions for grantee project locations and is, therefore, unable to represent the climate conditions that occurred in the past year.

Additional Resources

- STEPL model introduction: http://it.tetratech-ffx.com/steplweb/
- STEPL model download, example files, and user guide: http://it.tetratech-ffx.com/steplweb/models$docs.htm.

B.10.3.5 L-THIA/LID

Overview

The L-THIA/LID model is a modeling tool that helps evaluate the benefits of LID or changes to land use management practices. Purdue University created the tool (https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.php) and it can be applied in the Great Lakes region on a small "lot"-sized scale up to a larger watershed-scale. For inputs, it requires daily precipitation, soil, and land use data for the modeled area; however, L-THIA/LID already has most of these inputs incorporated. Users can adjust the percent of impervious service for an area or select the LID practice incorporated in the area and then run the model to estimate the reduction or change in average annual runoff volume.

Application

Applicants/grantees can use L-THIA/LID to estimate increases in stormwater retention due to the installation of green infrastructure projects. It can model the benefits of LID practices in two ways. The first way is by allowing users to adjust the percent of imperviousness for particular land uses. The second way is at the "lot-level" and includes allowing users to choose from a set of BMPs, including bioretention basins, swales, connected gutters and curbs, rain barrels, cisterns, porous pavement, narrowing impervious surfaces, green space, conservation practices, and green roofs.

L-THIA/LID is user-friendly and requires a minimal time investment to run effectively. The model is designed to be run on a lot-level, but can be run in an area as large as an eight-digit HUC. The user can either select a watershed or draw a boundary to define the area to model.

A few considerations if using L-THIA/LID:

- L-THIA/LID outputs average annual runoff volume in acre-feet with and without the implementation of LID. Therefore, grantees will need to calculate the difference between runoff volume with and without LID implementation, and convert the volume in acre-feet to gallons before reporting stormwater retention changes in Easygrants.
- L-THIA/LID calculates average annual runoff using 30 years of existing weather data. Accordingly, the tool represents average conditions for grantee project locations and is, therefore, unable to represent the climate conditions that occurred in the past year.

Additional Resource

- L-THIA/LID tool and tutorial: https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.php.

B.10.4 Guidance for Grantee Reporting in Easygrants

Reporting green infrastructure installation. Applicants/grantees should report green infrastructure installation in Easygrants using the following metrics: "Sq ft of bioretention installed," "Sq ft of green roof installed," and "Sq ft of green infrastructure." Grantees should use the Easygrants metric that represents the specific green infrastructure installation (Sq ft of bioretention installed or Sq ft of green roof installed). If there is no Easygrants metric that

represents the specific installation, grantees can use the Easygrants metric "Sq ft of green infrastructure." Grantees should not include installations that they report in Sq ft of bioretention installed or Sq ft of green roof installed in their estimate for Sq ft of green infrastructure.

Reporting stormwater retention. Applicants/grantees should report stormwater retention in Easygrants using the following metric: "Volume stormwater storage added (gallons)." In the notes section of this metric, grantees should indicate the model or tool that was used to estimate this metric. Note that although this is not explicitly stated in Easygrants, grantees should report the annual volume of stormwater retained.

B.11 Invasive Species Control

This guidance applies to any projects that are controlling invasive species needed to sustain or enhance the benefits of ***previous*** habitat restorations. This work includes the retreatment or management to control invasive species that have received initial treatment or to expand existing invasive control efforts through the management of invasive species on new/previously untreated acres adjacent or strategically connected to existing control efforts. If grantees are incorporating invasive species control to a new acres associated with a new project, they should also review Section B.8.

B.11.1 Relevant Easygrants Metrics

To track progress toward this project type, NFWF identifies two metrics that a need to report on through Easygrants:

- Acres restored (total area treated, re-treated or controlled for invasive species)
- Acres re-treated (acres receiving additional treatment post initial treatment)

B.11.1.1 Percent Invasives in Wetland Habitat Types

Percent cover of invasive plants will be estimated within each of the water depth and wetland habitat types identified in Section B.7.3.2. Invasive plants are typically non-native species with little or no food or cover value for migrating waterfowl and shorebirds. Invasives, particularly emergent, shrubby plants, often create homogeneous stands of dense vegetation that crowd out desirable wetland plants that provide food and cover for migrating shorebirds and waterfowl. Invasive plants can also have a dense growth form that restricts access by migrating marsh birds to food and cover. Invasive plant species in the Great Lakes region include, but are not limited to:

- Purple loosestrife
- Common reed
- Tartarian honeysuckle
- Multiflora rose
- Reed canary grass
- Narrow-leaved and hybrid cattail
- Glossy buckthorn
- Autumn olive
- Rose mallow
- Eurasian watermilfoil
- Flowering rush.

Applicants/grantees should record ocular estimates of percent cover of monotypic stands of invasive plants that occur in patches ≥ 0.025 acre within each of the water depth and wetland habitat types described in Section B.7.3.2 and/or riparian or upland acres.

Grantees receiving funding for invasive species work will be asked to share this invasive species cover and habitat type spacial data with NFWF at the time of grant agreement and at the time of grant closure to measure change in habitat quality and presence of invasive species.