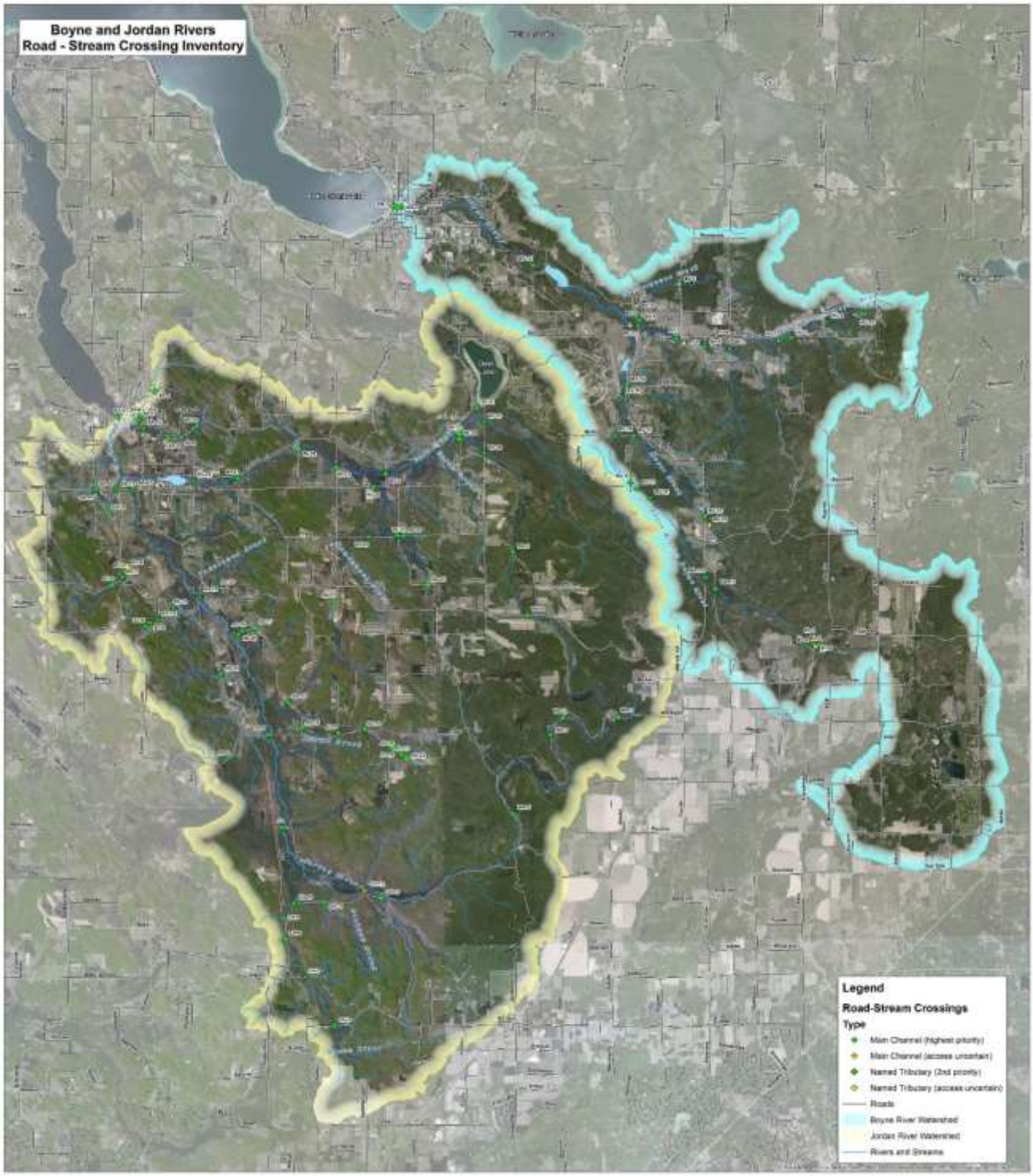
Boyne and Jordan Rivers Road Stream Crossing Inventory Project



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Tip of the Mitt Watershed Council

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Background:

In 2015, a road/stream crossing (RSX) inventory for the Jordan River and Boyne River Watersheds was conducted by the Tip of the Mitt Watershed Council (TOMWC). In total, 116 RSX sites were inventoried.

RSXs that are improperly designed or installed, structurally failing, or no longer accommodate current stream conditions affect stream health. They can affect stream hydrology, prevent fish and other aquatic organisms from reaching up-and downstream reaches, increase water temperatures, and are sources of nutrients, sediments, bacteria, heavy metals, and other nonpoint source pollutants. In Northern Michigan, sediments pose the greatest threat to rivers and streams. Sedimentation can adversely impact fish and aquatic organisms by degrading their habitat and reducing water quality.

Role of RSX Inventories in Watershed Management:

RSX inventories serve as a useful watershed management tool. They help to identify sediment pollution entering surface waters from poorly designed, maintained or aging infrastructure; fish passage barriers due to perched culverts or velocity barriers; and altered stream hydrology due to inadequately designed or installed crossings. Therefore, identifying failing or deficient RSXs is critical to resource management. Regular inventorying of RSXs allows road commissions and resource managers to note change in stream and structure conditions over time. Furthermore, by applying the Great Lakes Road/Stream Crossing protocol, RSXs can be ranked as minor, moderate, or severe as a means of prioritizing them for improvements or replacement.

The Lake Charlevoix Watershed is fortunate to have an active watershed advisory committee to oversee implementation of the Michigan Department of Environmental Quality and Environmental Protection Agency-approved *Lake Charlevoix Watershed Management Plan* (2012). As part of the plan, several recommendations are included with respect to RSXs:

- RSX. 1. Repeat road stream crossing inventory every 10 years to determine if priorities are the same, and to document newly installed BMPs or improvements.
- RSX. 2. Develop a project schedule and fundraising plan to restore the priority road/stream crossings.
- RSX. 3. Restore, repair, or replace priority road stream crossings as determined in RSX.1 with BMPs appropriate to site.
- RSX. 4. Work with road commissions to minimize impacts to resources. Conduct Better Backroads workshops to encourage better maintenance, design, and installation.
- RSX. 5. Maintain and update Lake Charlevoix Watershed road/stream crossing database as part of northernmichiganstreams.org.

The completion of the inventory fulfills RSX. 1. The upload of database, including the site photos, to www.northernmichiganstreams.org fulfills RSX. 5.

Methods:

TOMWC staff and interns conducted the field inventory by evaluating each RSX within the Boyne and Jordan Rivers Watersheds. The purpose of the inventory project was to comprehensively document conditions at all RSX within on the Boyne and Jordan Rivers and their tributaries including Bartholomew, Bennet, Birney, Brown, Collins, Deer, Eaton, Jones, Landslide, Lilac, Marvon, Moyer, Nemecheck, Schoolhouse, Stevens, Sutton, Warner, and Webster Creeks, as well as the Green River and many other unnamed tributaries.

TOMWC utilized the Great Lakes Road/Stream Crossing protocol and corresponding field form, which includes the fields:

At each road-stream crossing, the following general information was collected:

1) Site identification number*;
2) Stream name;
3) Names of survey crew;
4) Date or survey;
5) GPS information (if GPS was employed);
6) County name;
7) Township, range, section (optional);
8) Adjacent landowner information (if known); and
9) Additional comments about the site.

* The previous RSX inventories assigned different systems of site identification. In an effort to apply the same framework across the entire watershed, each site was renamed with the prefix "LTB", followed by a number between one and 264. Of these, only LTB 1 through LTB 121 are included in the database (see page 6 for more information).

Each crossing was documented in terms of crossing type, whether a culvert, bridge, ford, or dam. Culverts, the most common type, were further documented in context of these parameters:

1) Shape (e.g., round, ellipse, square);
2) Inlet type (e.g., projecting, mitered, wingwall);
3) Outlet type (e.g., cascade over riprap, freefall into pool);
4) Structure material (e.g., concrete, metal, plastic);
5) Structure interior whether smooth or corrugated;
6) Structure length, width, and height;
7) General condition of culvert;
8) Substrate material in the structure and depth of embeddedness;
9) Whether structure was plugged or crushed;
10) Water depth at inlet and outlet;
11) Flow velocity at inlet and outlet; and
12) perch height at outlet (if perched).

The stream at each site was documented with regards to:

1) Flow, whether at bankfull, over, or below;
2) scour pools downstream of structure;
3) Ponding upstream of structure; and
4) Channel and flow characteristics associated with a reference riffle, which included bankfull width, wetted width, average stream depth, average flow velocity, and dominant substrate.

The road was assessed in terms of:

1) type/ownership (e.g., county, private);
2) Surface type (e.g., paved, gravel);
3) Road surface condition;
4) Width of road at culvert;
5) Location of low point, whether at stream crossing or at other location;
6) Runoff path, whether along road or into ditch;
7) Embankment slope and fill depth at structure;
8) Length and slope of approaches from both directions; and
9) Ditch information regarding vegetation.

Any erosion at the site was documented using the following:

1) Location;
2) Dimensions: length, width, and depth;
3) Whether eroding material was reaching the stream;
4) The type of eroding material (e.g., sand, clay, gravel);
5) Severity of erosion; and
6) Whether corrective actions could be installed or not.

Additional information collected includes photographs of the site, a site sketch, whether it is considered a priority site, whether a future visit is recommended, and if any invasive species were observed at the site.

All data collected during the inventory was entered into the Great Lakes Road Stream Crossing Inventory Access database by TOMWC staff and interns. The database includes formulas built into each record as a means to rank each site with respect to the following:

<u>Erosion (tons/year):</u>

Erosion is determined in Access using both field measurements and a model.

- 0 to .4 ton of sediment
- .5 to 1 ton of sediment
- 1.1 to 2.5 tons of sediment
- Over 2.6 tons of sediment

<u>Fish Passage Determination:</u>

- 1=Not a barrier
- .9=Barrier at high flows
- .5=Some species and life stages cannot pass at most flows.
- 0=Most species and life stages cannot pass at most flows.

Extent of Erosion:

- Stabilized
- Minor
- Moderate
- Severe
- Very Severe

The database then employs another formula combining the abovementioned categories to give an overall severity calculation ranking:

Severity Calculation:

- Minor
- Moderate
- Severe

Results:

In general, many culverts are undersized. Ideally, the crossing structure, whether it is a bridge, culvert, or other type of structure should span the entire width of the stream channel, and if not, it should be as wide as possible. When the stream is constricted at a crossing, stream hydrology is affected. Stream velocity increases through the crossing and can result in preventing passage of aquatic organisms both up-and downstream, as well as upstream flooding, and downstream scouring of the stream bottom.

Many culverts are aging and they are losing their structural integrity. The majority of the culverts are made of corrugated metal. Although they are able to last for decades, many of them are showing signs of deterioration as evidenced by rust, holes, and many are now compressed or “squashed”, meaning their cross-sections are no longer round or elliptical.

Another common issue noted was the “perched” culvert. Perched culverts occur when the bottom of the culvert is elevated above the streambed. Typically, this applies to the downstream end of the culvert and is the result of either improper setting of the culvert or the stream has eroded away the streambed immediately below the culvert. Perched culverts pose nearly impossible obstacles to aquatic organism passage, particularly macroinvertebrates and smaller fish. Upstream and downstream passage is critical to fish and other organisms so they can access habitat resources, as well as other genetic populations of the same species. Lack of access to stream reaches beyond the RSX isolates populations and causes habitat fragmentation.

The inventory results revealed that the majority of RSX conditions are currently posing as barriers to aquatic organism passage (Table 1). In addition, many of them are also contributing significant sediment loads to the streams. In addition to the Boyne and Jordan Rivers, many of their respective tributaries were inventoried. Inventoried tributaries to the Jordan River include Bartholomew, Bennet, Birney, Brown, Collins, Deer, Eaton, Jones, Landslide, Lilac, Marvon, Nemecheck, and Stevens, Sutton, Warner, and Webster Creeks, as well as the Green River and many other unnamed tributaries. Inventoried

tributaries to the Boyne River include Moyer and Schoolhouse Creeks. Of the 116 RSX inventoried, 73 were within the Jordan River Watershed and 43 were within the Boyne River Watershed.

Results from the inventory were uploaded to northernmichiganstreams.org. The website serves as a repository of RSX inventory data for Northern Michigan and is accessible to the public. Each inventoried RSX has its own record and is shown on a clickable map. Each record includes data for each inventoried parameter, photos, fish passage and erosion calculations and severity rankings.

Table 1: Road Crossing Severity Ranking System

	Boyne River	Jordan River	Total
Fish Passage			
1	0	2	2
0.9	8	16	24
0.5	14	27	41
0	21	28	49
Total # RSX	43	73	116
Severity Ranking			
Minor	5	9	14
Moderate	13	34	47
Severe	25	30	55
Total # RSX	43	73	116
Tons of sediment/year	34	183	217

The Access database is an excellent tool for general sorting of “good” and “bad” RSX; however, it does not allow user to rank sites relative to one another. In other words, there is no mechanism to rank one site as more of a priority than another. Another shortcoming of the database is it does not take into account stormwater runoff inputs. Although erosion from road surfaces is factored into severity ranking, other nonpoint source pollutants are not accounted for. Therefore, TOMWC has identified seven priority RSX sites based on results from both the database, discussions with the road commissions and resource managers, and firsthand observation. The priority RSX are likely to change as RSX improvement projects are implemented, funding sources become available for specific types of stream projects, and stream and RSX conditions change.

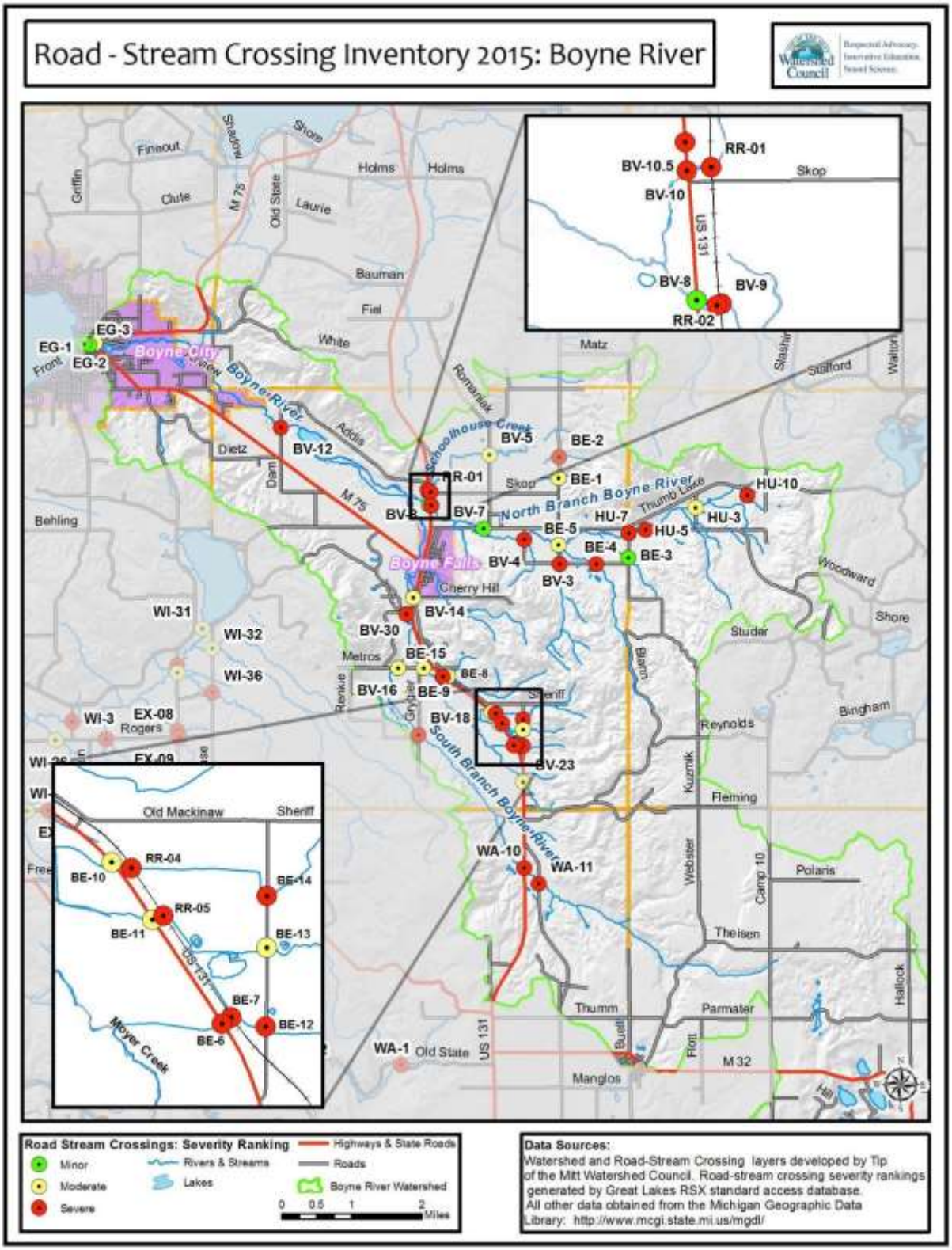

Figure 1: Boyne River Watershed Road/Stream Crossings Inventory Results

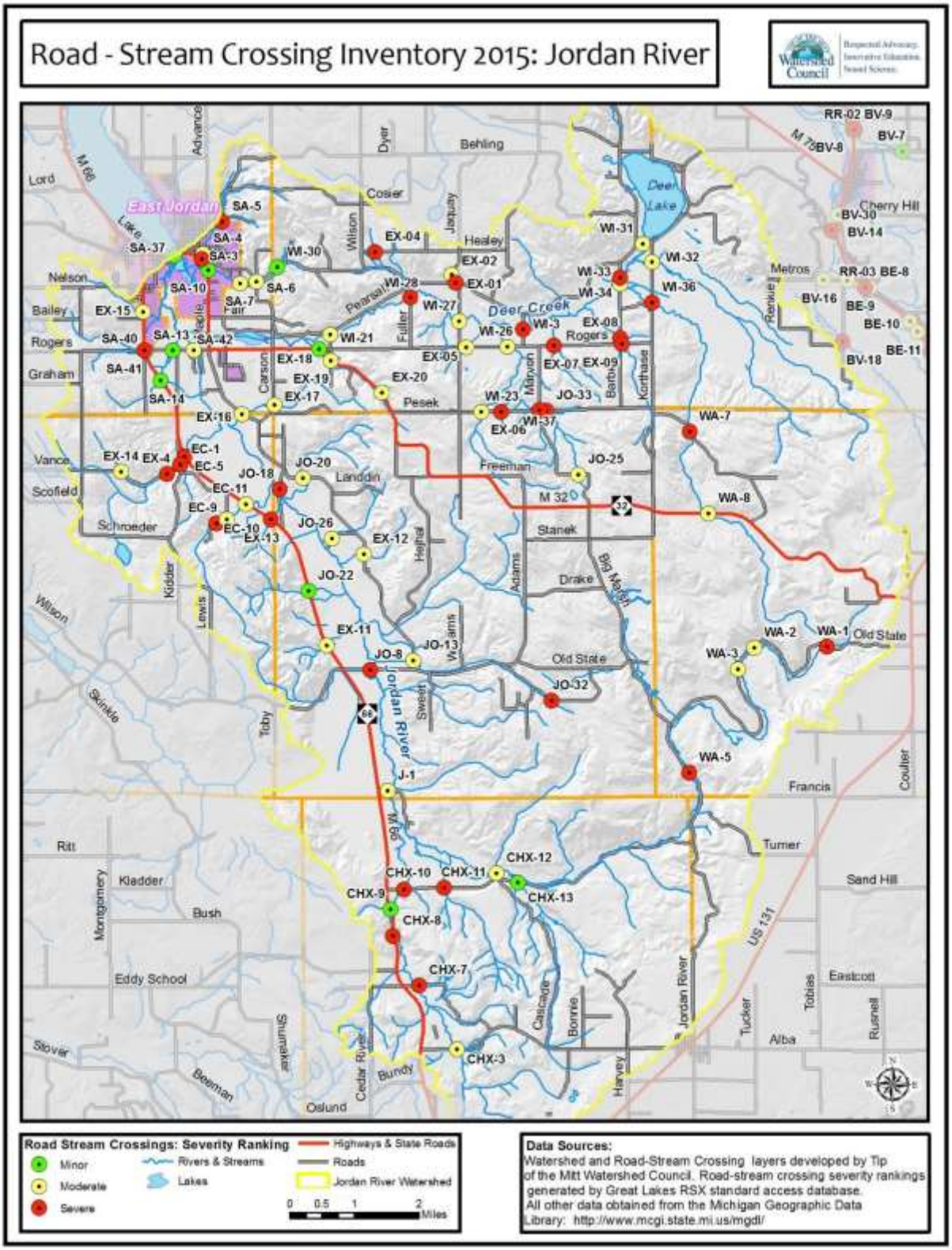

Figure 2: Jordan River Watershed Road/Stream Crossings Inventory Results

Priority sites for future improvements:

Jordan River at Old State Road (JO-8)

Known locally as Chestonia Bridge, two 16' wide culverts currently sit where Old State Road crosses the Jordan River. These culverts along with eroding streambanks and worn access trails are causing unnatural stream changes and speed up stream flow to the point where some fish and other aquatic species cannot get upstream. As a popular canoe and kayak launch, this site has a high recreational value as well. Both the health of the river and making this a safe, accessible site for recreationists are top priorities.

- Erosion (tons/year): 8
- Fish Passage Determination: 0
- Extent of Erosion: Very severe
- Severity Calculation: Severe
- Structure Water Velocity: 5.28 ft./sec (inlet); 8.37 ft./sec (outlet)

Proposed RSX Improvement:

- Engineering plans for the RSX are complete and include a full-span timber bridge along with recreational access.

Cost: $1,200,000 based on estimates prepared for Conservation Resource Alliance in their pursuit of fully funding the project.

Figure 3: Jordan River at Old State Road Creek (JO-8)

Figure 4: Jordan River at Old State Road (JO-8)

Boyne River at Dam Road (BV-12)

Current conditions include three, 8’ wide by 7’ high metal culverts. Located approximately ¼ mile upstream of the RSX are the U.S.A Power Plant Dam and its 80-acre impoundment. Both downstream and upstream of the crossing are very popular fishing areas. Friends of the Boyne River, Tip of the Mitt Watershed Council and other stakeholders have considered the Dam Road crossing to be a priority for restoration of the Boyne River. The proximity of the dam, however, detracts from potential fish passage funding programs because of the upstream barrier.

- Erosion (tons/year): 1.1
- Fish Passage Determination: 0
- Extent of Erosion: Moderate
- Severity Calculation: Severe
- Structure Water Velocity: 4.9 ft./sec (inlet); 5.8 ft./sec (outlet)

Proposed RSX Improvement:

- A full-span timber bridge would allow passage of all fish species, prevent downstream erosion and upstream flooding immediately around the crossing, and allow hydrologic processes to restore channel geomorphology.

Cost: $500,000 or more based on costs estimates for similar construction projects, such as the timber bridge constructed in 2012 in Emmet County across the Bear River.

Figure 5: Boyne River at Dam Road (BV-12)

Boyne River at Cherry Hill Road (BV-14)

Current conditions include two metal culverts that are both submerged. One culvert is approximately 3½' x 2½'. The other culvert could not be measured as it was submerged well below the water's surface. The area immediately above the culverts (embankment) is eroding, likely due to recreational access.

- Erosion (tons/year): .2
- Fish Passage Determination: .5
- Extent of Erosion: Moderate
- Severity Calculation: Moderate
- Structure Water Velocity: 1.64 ft./sec (inlet); 2.1 ft./sec (outlet)

Proposed RSX Improvement:

- The crossing once provided access to Boyne Mountain Resort, but it has since been abandoned. Given its condition and lack of usefulness, the RSX does not need to be replaced or upgraded. A pedestrian bridge could provide Boyne Mountain visitors a non-motorized connection to Boyne Falls., such as the timber bridge constructed in 2012 in Emmet County across the Bear River.

Figure 6: Boyne River at Cherry Hill Road (BV-14)

Collins Creek at Korthage Road, Charlevoix County (WI-32)

Current conditions include one undersized, metal culvert that is fully submerged at the inlet (and creating a whirlpool) and nearly fully submerged at the outlet. The culvert measures 6’ wide x 5’ high.

- Erosion (tons/year): .2
- Fish Passage Determination: .5
- Extent of Erosion: Minor
- Severity Calculation: Moderate
- Structure Water Velocity: 2.2 ft./sec (inlet); 2.5 ft./sec (outlet)

Proposed RSX Improvement:

- The recommended RSX improvement includes a larger, bottomless elliptical culvert that both spans the width of the stream channel and has a bottom elevation that is flush with the stream bottom. These corrections would allow for fish passage, decrease erosion, and restore the local hydrology of the stream

Cost: $180,000 based on cost estimates prepared for similar sites.

Figure 7: Collins Creek at Korthage Rd. (WI-32)

Brown Creek at Pesek Rd., Antrim County (WI-23)

One 18” metal culvert is perched (elevated) approximately 1.25’ above the stream. Although the RSX is located on a rural road in the upper reaches of Brown Creek, corrections to this crossing would yield downstream benefits.

- Erosion (tons/year): 2.4
- Fish Passage Determination: 0
- Extent of Erosion: Moderate
- Severity Calculation: Severe

The recommended RSX improvement includes a larger, bottomless elliptical culvert that both spans the width of the stream channel and has a bottom elevation that is flush with the stream bottom. These corrections would allow for fish passage, decrease erosion, and restore the local hydrology of the stream

Cost: $30,000 based on costs estimates prepared for similar sites.

Figure 8: Brown Creek at Pesek Rd (WI-23)

Jordan River at Jordan River Road, Antrim County (WA-5)

Current conditions include three undersized (6 ft. x 3.83 ft.) metal culverts.

- Erosion (tons/year): .3
- Fish Passage Determination: 0
- Extent of Erosion: Moderate
- Severity Calculation: Severe
- Structure Water Velocity: 3 ft./sec (inlet); 5.1 ft./sec (outlet)

Proposed RSX Improvement:

- Replace culverts with 24-foot span by 6-foot rise precast concrete box culvert.

Cost: $200,000 based on costs estimates prepared for similar sites.

Figure 9: Jordan River and Jordan River Road (WA-5)

Deer Creek at Fuller Road, Charlevoix County (WI-28)

Current conditions include three undersized (6’ x 3’ 10”) metal culverts.

- Erosion (tons/year): 14
- Fish Passage Determination: 0
- Extent of Erosion: Very Severe
- Severity Calculation: Severe
- Structure Water Velocity: 2.9 ft./sec (inlet); 3.1 ft./sec (outlet)

Proposed RSX Improvement:

- Replace culvert with full-span timber bridge. Pave approaches (100' each side of crossing).

Cost: $450,000 based on costs estimates prepared for similar sites and preliminary discussions with engineering firms.

Figure 10: Deer Creek at Fuller Road (WI-28)

Future efforts:

With the updated inventory now complete, stakeholders will continue to pursue funding to implement Specifically, TOMWC and other stakeholders will seek funds to support development of engineering plans, which will position the projects more favorably for the construction-focused grant programs.

TOMWC will continue to work with road commissions to encourage best management practices at RSX. For example, practicing better sediment management on bridge surfaces, re-vegetating eroding embankments and side-slopes, providing discrete and stable pedestrian and paddler access, and diversion of roadway runoff into infiltration basins before reaching the stream are all relatively inexpensive investments that will yield long-term protection of both the stream and alleviate stress on existing infrastructure.

Lastly, we will also repeat the inventory in 5-10 years, as it is recommended, because RSX conditions can change relatively quickly.