

## Summary

The North Saskatchewan Watershed Alliance (NSWA) is responsible for making watershed management recommendations to the Government of Alberta. The North Saskatchewan River (NSR) watershed is comprised of 12 sub-watersheds, one of which drains toward the Vermilion River (VR). Although the VR watershed covers a relatively large (14%) portion of the total NSR watershed, information regarding the aquatic ecosystem is not readily available. On behalf of the NSWA, CPP Environmental (CPPENV) completed an aquatic ecosystem assessment of the VR including aquatic habitat, vegetation, macroinvertebrates, and fish.

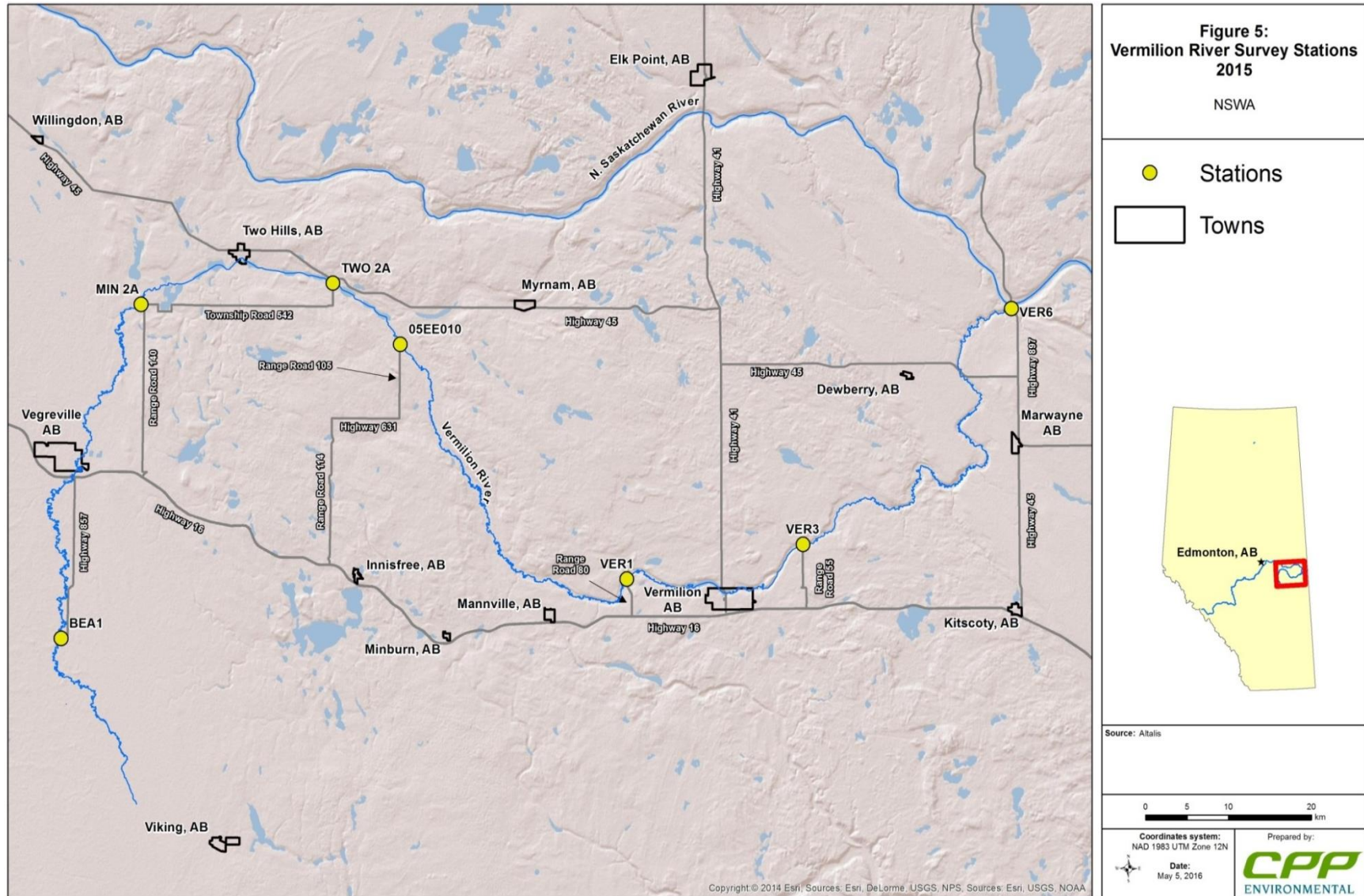
The VR is located in the east central part of Alberta in the Parkland Natural Region. The predominant land use is agriculture. The watershed has a population of approximately 57,000 people whom are concentrated in Vegreville, Vermilion, and Two Hills. Drainage works have occurred throughout the watershed, particularly in the upper reaches of the watershed (i.e., the Holden Drainage District) and in a 40+ km stretch of the VR near Two Hills. Two dams hold back the VR flow: the Morecambe Dam near Two Hills, and the Town of Vermilion dam which creates a reservoir next to the town. The river is fed by localized runoff from areas strongly associated with the riparian areas, precipitation, as well as the regional groundwater system. By late summer, most of the river reaches can cease to flow. At this time, the river's hydraulic behavior is similar to that of a shallow open water wetland or small lake. Indeed, the Vermilion Lakes complex, near Two Hills, is part of the river channel.

Seven sampling stations were surveyed from August to September in 2015, which corresponds to the locations visited in 2014 for water quality sampling. In late summer of 2015, flow was either non-existent or detected in trace amounts at all stations, except for the downstream-most station VER6. At each station, 5 transects were established, spaced 50m apart, representing a 200m reach. Habitat metrics measured at each transect included stream shading, aquatic plant cover, bank undercutting, habitat diversity, and bank stability. In addition to this, water quality sampling was completed to represent the chemical environment. These metrics were scored and converted into a Habitat Quality Index (USEPA 1997). Based on this index, station VER6 stood out with the best score, largely driven by high habitat diversity and better water quality. VER1 and 05EE010, representing the middle reaches in between Two Hills and the Town of Vermilion, had the second-highest habitat quality scores for different reasons. These three stations (VER6, VER1 and 05EE010) had the highest habitat scores and the highest aquatic plant species richness. The three stations representing the upper reaches of the VR (moving upstream from 05EE010: TWO2A, MIN2A, BEA1) had some of the lowest habitat quality due to a low diversity of habitat types (TWO2A), poor water quality (all 3), and little aquatic plant coverage (BEA1). VER3, downstream of the Town of Vermilion, had the lowest habitat quality due to low oxygen levels (below short-term guidelines for the protection of aquatic life) and an overabundance of aquatic vegetation. Water substantially improves in quality after passing through the Vermilion River lakes complex, which acts as an important sink of nutrients and drives results in aquatic ecosystem health.

To capture a representative sample of the fauna of the VR, macroinvertebrate and fish sampling was completed in each 200m reach. Macroinvertebrates were sampled by “jabbing” and “sweeping”

submerged macrophytes, vegetated banks and snags 20 times in proportion to the abundance of these habitat types as per the USEPA multi-habitat approach for slow moving streams. Based on the Family Biotic Index (FBI) calculated from macroinvertebrate data, all reaches in the VR were classified as “substantial organic pollution”. Differences in macroinvertebrate captures among stations reflect habitat quality and predation. Fish were sampled through a combination of backpack electrofishing and minnow trapping. The percentage of the fish catch classified as omnivores, which is a highly tolerant functional group, followed patterns in habitat quality, with a high percentage of omnivores at stations with low habitat scores. VER6 was the only reach that contained fish that were intolerant of poor environmental conditions.

In summary, the VR is characteristic of a small, slow-moving mud-bottom prairie river in Alberta. Except for the lowest reach, the river ceases to flow in mid to late summer, which dictates many ecosystem processes. As demonstrated by the poor macroinvertebrate FBI score, the Vermilion River generally is an unhealthy system, which is consistent with the widespread degradation of riparian areas and wetlands. Aquatic ecosystem health is much improved near the mouth of the VR (VER6) due to the presence of physical habitat diversity, improved hydraulic connectivity with the regional fish species pool (i.e., the North Saskatchewan River), and improved water quality linked to the presence of instream flows that can flush the system. Other places that show significant improvement are reaches downstream from the VR Lakes complex, which acts as a nutrient sink. Upstream of the VR lakes, the aquatic ecosystem is in a very poor state in late summer. Recommendations are provided in the report to conserve such a regionally important environmental resource.



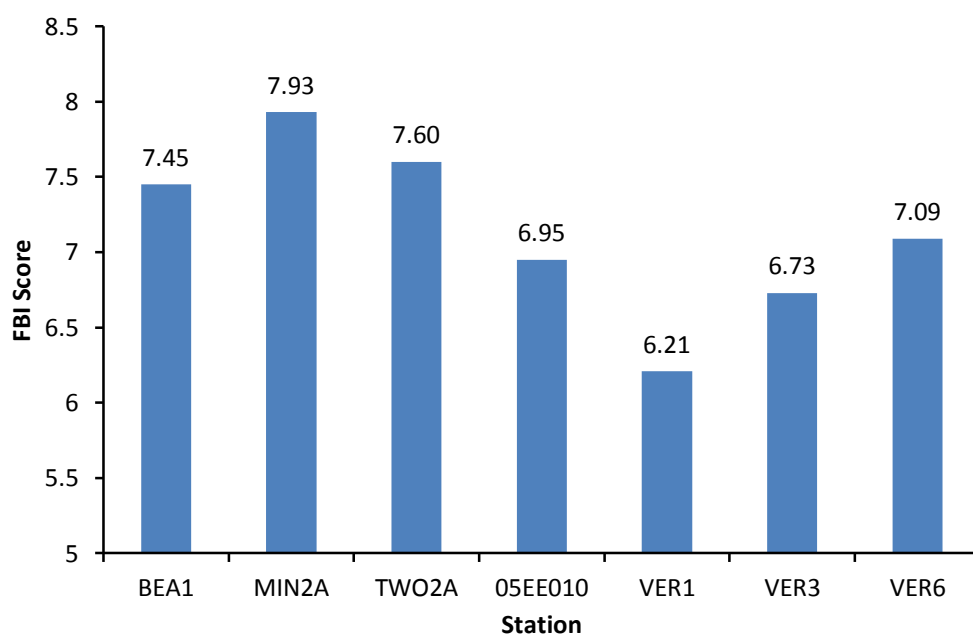
**Above:** locations of water quality sampling stations within the Vermilion River Watershed (Figure 5 in report).

## Family Biotic Index

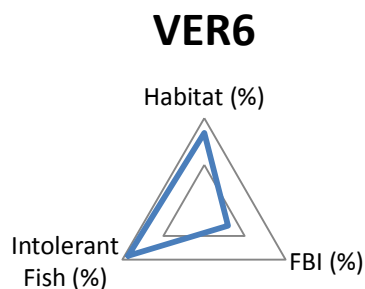
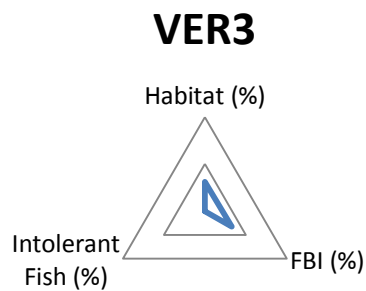
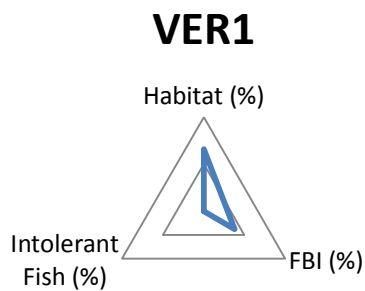
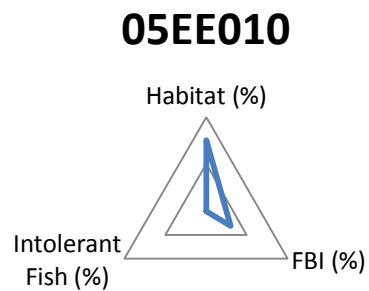
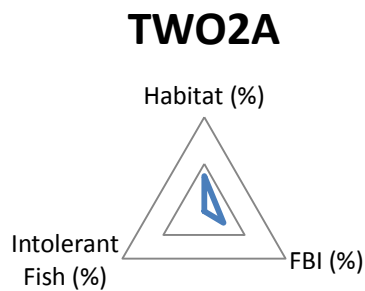
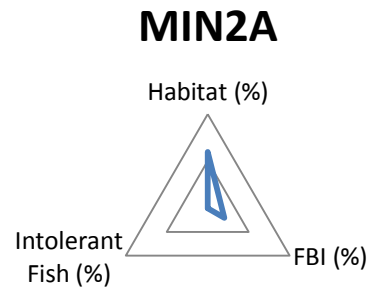
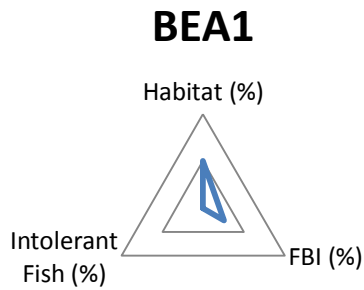
Family Biotic Index (FBI) values indicate organic pollution at all stations (Table 15). The FBI was consistently above 6 (i.e. 'poor') for all stations, with the highest FBI value at stations above the Vermilion Lakes (TW02A, MIN2A, and BEA1; Figure 24).

**Below:** FBI results at each station and the associated water quality score (Hilsenhoff 1988) (Table 15 in report).

Station	Biotic Index	Water Quality	Extent of Organic Pollution
BEA1	7.45	Very poor	Severe pollution likely
MIN2A	7.93	Very Poor	Very Substantial Pollution
TWO2A	7.60	Very poor	Substantial Pollution Likely
05EE010	6.95	Poor	Very Substantial Pollution
VER1	6.21	Fairly Poor	Substantial Pollution Likely
VER3	6.73	Poor	Very Substantial Pollution
VER6	7.09	Poor	Very Substantial Pollution



**Above:** Station Family Biotic Index (FBI) scores indicating degree of organic pollution (Figure 24 in report).



**Above:** Integrated aquatic ecosystem health assessment at VR stations. The middle of the triangle represents 0% and the tips are 100%. The larger the area of the blue triangle, the greater is the overall health of the site (Figure 28 in report). **Note: The FBI scores were inversed and expressed as a percentage so that high values represent improved conditions.**