PROJECT TOOL SUMMARY
For Project #758: Identifying and Valuing Restoration Opportunities and Resource Improvements at Watershed and Subwatershed Scales

Great Lakes Basinwide Assessment Tool

This tool was developed to identify watersheds that represent examples of the watershed types and landscapes within the Great Lakes, and where both hydrologic and landscape data are available to thoroughly evaluate, compare, and validate hydrologic and GIS landscape assessment models and tools. The project team developed a consistent and systematic method to screen Great Lakes watersheds using the following initial selection criteria: Imperviousness, Dam Storage Capacity, Canals/Ditches, Minor Road Intersections, Major Road Intersections, and Potential Restorable Wetlands (hydric soils without wetlands).

Watershed Assessment Tools

The project team reviewed several tools that assess landscape and instream alterations and selected the following tools to apply in the four demonstration watersheds. Not all tools reviewed here were applied to the pilot watershed. This list includes several tools developed by the project team.

- **Stream Power Tool** (AES, Habitat Solutions) - The stream power tool calculates a surrogate for total stream power using a flow accumulation approach that integrates the hydrologic response of changing land cover and of landscape elements (e.g. soils, slope, and drainage network) on stream hydrology. Variation in stream power can be compared over differing time periods. 'What if' scenarios can also be tested to assess potential hydrologic responses to changes in land cover. This tool can also be used to identify areas of maximum hydrologic restoration potential.

- **Wetlands Water Retention/Storage Tool** (AES, Habitat Solutions) - This tool is designed to identify and quantify potential hydrologic restoration opportunities associated with wetland restoration sites within watersheds and/or subwatersheds. This tool estimates the volume of water retained or stored by wetlands by integrating existing wetland, hydric soil, and non-urban land use coverages. Historical and/or what-if analyses can be performed to assess the potential hydrologic impact (or benefit) of wetland losses and/or restoration.

- **Water Use/Pathway Assessments** (Habitat Solutions) - Pathway assessments are designed to identify and assess the connections and pathways that water takes as it moves across, or through a watershed. These analyses are based on surface and groundwater datasets that include water supply, water storage, and water discharge within, and between, watersheds and subwatersheds. When combined with other tools, these assessments can be used to identify potential hydrologic restoration opportunities by restoring natural connections and modifying anthropogenic water use and discharge patterns at watershed and subwatershed scales.

- **Flow Duration Curve Regression Models** (University of Michigan, Michigan DNR, EPA Star Grant collaborators in IL, MI, and WI) - Specific flow-exceedance frequencies along flow duration curves (e.g. Q05, Q10, Q25, Q50, Q75, Q90, and Q95) can be estimated with multiple linear regression models that use catchment characteristics (e.g., geology, land cover, drainage area, average annual precipitation) as predictive variables. When generated using regression models, flow exceedance frequencies can be predicted for any stream reach within a particular region provided that appropriate catchment characteristics can be obtained. These models predict several points along the flow duration curve and can be used to characterize flow patterns when appropriate streamflow data are not available. This tool can be used to summarize current flow conditions, establish reference conditions, or forecast potential flows under different land cover scenarios.

- **Assessment of Dams** - The team used the best available information on the location of dams to estimate the potential impact of dams on streamflows in each of the four demonstration watersheds. The team calculated the number of dams and dam density for subcatchments within each of the four demonstration watersheds.

- **Assessment of Channel Modification** - To estimate the degree channel modification within each watershed, the team identified stream reaches that were either coded as 'channelized' within the National Hydrologic Dataset (NHD) or appeared unnaturally straight on the digital raster graphic files (DRGs). The percent of total stream length that had been artificially straightened was calculated for several subcatchments within each of the four demonstration watersheds.

Hydrologic Assessment Tools

The project team also reviewed and applied several tools that calculate changes to hydrologic statistics. These tools require daily stream flow as input, obtained either from stream gages or simulated using a watershed hydrologic model.

- **Indicators of Hydrologic Alteration** (The Nature Conservancy) - The Indicators of Hydrologic Alteration (IHA) software summarizes long periods of daily hydrologic data into a manageable series of ecologically relevant hydrologic metrics. The software permits single period analysis, which is useful for assessing long-term trends, and two-period analysis, which is used to compare flow regimes for two discrete periods, ideally before and after a discrete change in land or water management.

- **Richards-Baker Flashiness Index** (Baker et al. 2004) - The R-B Index is used to quantify the frequency and rapidity of short-term changes in stream flow. Flashiness is an important characteristic of a stream's hydrologic regime. A variety of land and water management changes may lead to increased or decreased flashiness. This flashiness index is based on mean daily flows. The index is calculated by dividing the path length of flow oscillations for a time interval (i.e., the sum of the absolute values of day-to-day changes in mean daily flow) by total discharge during that time interval. This index has low inter-annual variability relative to most flow regime indicators and thus greater power to detect trends.

- **Baseflow Separation Algorithms and Baseflow Index Models** (USGS & Environment Canada) - Estimates of the baseflow component of streamflow were calculated for all stream gages within the US portion of the Great Lakes basin by Neff et al (2005). The baseflow index (BFI) values can be used to identify potential changes to the groundwater component of streamflow over time. Piggott and others (2002) also developed regression models to approximate the BFI by using the proportions of surficial geology classes within the areas that are upstream of the gages. These models were developed using flows measured at gages in the Great Lakes basin (US and Canada) and corresponding catchment characteristics of these gages. These models were not applied to ungaged sites within the scope of this project.