# Management Decision Guidance

Results from the Flow Ecology analysis (Module 7) indicate that the flow metrics that most consistently were associated with biological responses were spring and summer high flows (Q10), summer low flows (Q90), and the flashiness index. Future and current spring high flow and summer low flow were calculated for all watersheds in the study area. Flashiness was calculated for all watersheds for the current time period only. For future conditions summer high flow was only calculated for the three pilot watersheds of the Knife, Baptism and Poplar consequently it is not included in this guidance diagram. Protecting the healthiest systems is likely to be more effective strategy than attempting to restore systems that are already degraded.

## How to use

Locate a watershed of concern in the “Management Decision Guidance” ArcGIS Map Package. Determine from the GIS data the modeled conditions for Flashiness, Spring High Flow, and Summer Low Flow. Using the grids below identify the color category and check the column on the right. Add the columns together to get an overall score. This then relates to the management recommendations table. Ecological flow criteria have been established for “sustainability boundaries” for flow alteration. More details on these criteria can be found in the Flow Ecology Module 7.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Modeled Conditions | | | |
| Current | Flashiness | Low | Medium | High |
|  |  |  |  |

R\_\_\_\_ Y\_\_\_\_\_ B\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
|  | Modeled Conditions | | |
| Change in High | Spring  High | Medium | High |
|  |  |  |

+

R\_\_\_\_ Y\_\_\_\_\_ B\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Current Modeled Conditions | | | |
| Change in Low | Summer Low | Low | Medium | High |
|  |  |  |  |

+

R\_\_\_\_ Y\_\_\_\_\_ B\_\_\_\_

Total R\_\_\_\_\*3, Y\_\_\_\_\_\*2, B\_\_\_\_

## Management recommendations score:

* 3 **Preservation**: Continue existing appropriate management actions along with protection
* 4-6 **Adaptive Management**: Implement intensive management action below
* 7-9 **Reevaluate**: Consider reassessment of management objectives for future conditions

|  |
| --- |
| **Preservation:** |
| Identify and protect reaches serving as refugia, understand the sources and mechanisms of their baseflow and insure connectivity of these reaches within the system and to Lake Superior. |
| Ensure that wetlands identified as significant are protected. |
| Identify and protect the wetlands, vernal pools, floodplain soils, and other hydro-geologic features that store and transport subsurface flow contributions to base flow. |
| Establish ecological buffers zones around natural features. |

|  |
| --- |
| **Adaptation Management:** |
| Protect base flows. To improve stream resilience, managers need to protect base flows, particularly at low flows, especially against significant extraction at times when low flows are of concern. This might be accomplished through guidance regarding protective thresholds for total forest harvest or amount of impervious surface in a watershed, or protection criteria limiting withdrawals at minimum flows. |
| Manage and maintain riparian zones to keep forest cover/shade. Buffers of mature riparian vegetation along the banks of small streams and tributaries can provide shade and other conditions to moderate the warming effects of climate change, at least within the range of a few degrees. Monitor for potential impacts of increased forest cover on low flows and temperature. |
| Better understand the role of riparian tree species (i.e., conifers), which may have an effect on water balance at low flows due to higher evapotranspiration. Boreal conifers (balsam fir, white spruce, black spruce, white cedar) are expected to persist longer on cool-moist sites and may have the most benefit in the riparian zones where they can provide shade and coarse wood inputs into streams. |
| Restore or construct riparian buffers where necessary to provide adequate shade along existing cold and cool water streams, and/or manage heavy runoff of non-point source pollution and sediments with potentially more frequent and intense precipitation events. Utilize LiDAR information to assess where riparian reforestation efforts are needed on high quality trout streams. |
| Establish ecological buffers zones around natural features. |
| Encourage stewardship groups to protect and rehabilitate aquatic habitat, riparian zones and wetlands. |
| Maintain and restore riparian and instream connectivity, including removing barriers where possible. |
| Build adaptive capacity by managing for healthy, high quality forests. Healthy, high quality forests minimize the risk of large-scale abrupt changes and help avoid simultaneous major disturbances to streams at the scale of a connected stream network. In addition to managing forests for future climate, management should include control of plant invaders, earthworms, insect pests, and deer populations to reduce the impact of these stressors. |
| Utilize the geophysical diversity inherent in the landscape. There is significant variation in soils and topographic features in this region that can accommodate a variety of tree species. |
| Manage for bur oak, red oak, northern pin oak and jack pine on drier upland sites on thin, coarse textured soils (the areas highest at risk for drought stress and forest loss). This will require planting, browse protection, and release for successful establishment. |
| Increase temperate tree species tolerant of warmer-wetter or hotter-drier conditions: white pine, red oak, bur oak, white pine, basswood, yellow birch, sugar maple. Models and empirical data show that aspen and birch will decline regardless of management in a warming climate. Oak species have adaptive traits for water-use efficiency and also may have lower evapotranspiration rates than fast growing species such as aspen. Without climate tolerant species, there is a greater risk of state change to more open savanna structure which could likely have adverse impacts on ecological flows in Minnesota’s Lake Superior tributaries. Recent work indicates that bur oak, red oak, and white pine sources from northern and central seed zones can establish on a variety of sites in northeastern Minnesota. |
| Collaborate in establishing forest cover thresholds. Fisheries managers should collaborate with foresters and land use planners to establish thresholds for minimum forest cover using historical or “range of natural variation” benchmarks to improve the chances of maintaining flow regimes within the range of natural variation to which stream systems have adapted. The desirable threshold for conifer cover ranges from 40-50%. |
| Manage for mixed stands where conifers make up an average of 15-25% of basal area. Conifer and hardwood proportion may have a significant effect on flow, especially summer flows, in a changing climate. |
| Implement the “slow the flow” strategy into forestry management activities to help reduce runoff rates and decrease sedimentation into Lake Superior. |
| Seek opportunities to coordinate watershed planning, infrastructure planning, mitigation/adaptation and disaster response with proactive stream and watershed restoration and management. Use information about high and low flow metrics to design more resilient road crossings, bridges, culverts, especially where connectivity is needed to ensure organisms have access to key habitats. |
| Expand stream gauging efforts. We recommend that where possible, stream gauges be maintained in operation over time to establish a historical record, winter flow data be collected, and further gauges be deployed within strategically defined subcatchments to quantify flow throughout the basin. |
| Collect groundwater data. There is a critical need for groundwater data including the completion of groundwater maps for the region. |
| Develop and maintain comprehensive biodiversity survey to more thoroughly characterize baseline conditions, against which future change can be effectively detected, managed and mitigated. This includes more repeat sampling of biological communities over time and across a range of seasons and conditions. |
| Develop and digitize historical biological data, where possible. |

|  |
| --- |
| **Reevaluate Management objectives:** |
| 9.       For highly vulnerable streams: examine and adjust, where appropriate, management to reflect fluctuations in aquatic carrying capacities and shifting fish breeding and migration patterns association with climate change. The main challenge to ecosystem response to climate change comes from warming temperatures and impacts from low flows, not high flows. Ultimately, the most resilient streams are likely to be the most thermally-resilient, not the most geomorphically-stable. |