

Appendix 3.1.5. Summary of IHA Parameters and their Ecosystem Influences

(Source: The Nature Conservancy with Smythe Scientific Software and Totten Software Design, April, 2005. Indicators of Hydrologic Alteration Version 7 User's Manual.)

IHA PARAMETER GROUP	HYDROLOGIC PARAMETERS	ECOSYSTEM INFLUENCES
1. Magnitude of monthly water conditions	Mean or median value for each calendar month <i>Subtotal 12 parameters</i>	<ul style="list-style-type: none"> ➤ Habitat availability for aquatic organisms ➤ Soil moisture availability for plants ➤ Availability of water for terrestrial animals ➤ Availability of food/cover for furbearing mammals ➤ Reliability of water supplies for terrestrial animals ➤ Access by predators to nesting sites ➤ Influences water temperature, oxygen levels, photosynthesis in water column
2. Magnitude and duration of annual extreme water conditions	Annual minima, 1-day mean Annual minima, 3-day means Annual minima, 7-day means Annual minima, 30-day means Annual minima, 90-day means Annual maxima, 1-day mean Annual maxima, 3-day means Annual maxima, 7-day means Annual maxima, 30-day means Annual maxima, 90-day means Number of zero-flow days Base flow: 7-day minimum flow/mean flow for year <hr/> <i>Subtotal 12 parameters</i>	<ul style="list-style-type: none"> ➤ Balance of competitive, ruderal, and stress-tolerant organisms ➤ Creation of sites for plant colonization ➤ Structuring of aquatic ecosystems by abiotic vs. biotic factor ➤ Structuring of river channel morphology and physical habitat conditions ➤ Soil moisture stress in plants ➤ Dehydration in animals ➤ Anaerobic stress in plants ➤ Volume of nutrient exchanges between rivers and floodplains ➤ Duration of stressful conditions such as low oxygen and concentrated chemicals in aquatic environments ➤ Distribution of plant communities in lakes, ponds, floodplains ➤ Duration of high flows for waste disposal, aeration of spawning beds in channel sediments
3. Timing of annual extreme water conditions	Julian date of each annual 1-day maximum Julian date of each annual 1-day minimum	<ul style="list-style-type: none"> ➤ Compatibility with life cycles of organisms ➤ Predictability/avoidability of stress for organisms ➤ Access to special habitats

	<i>Subtotal 2 parameters</i>	<ul style="list-style-type: none"> ➤ during reproduction or to avoid predation ➤ Spawning cues for migratory fish ➤ Evolution of life history strategies, behavioral mechanisms
4. Frequency and duration of high and low pulses	<p>Number of low pulses within each water year Mean or median duration of low pulses (days) Number of high pulses within each water year Mean or median duration of high pulses (days)</p> <hr/> <i>Subtotal 4 parameters</i>	<ul style="list-style-type: none"> ➤ Frequency and magnitude of soil moisture stress for plants ➤ Frequency and duration of anaerobic stress for plants ➤ Availability of floodplain habitats for aquatic organisms ➤ Nutrient and organic matter exchanges between river and floodplain ➤ Soil mineral availability ➤ Access for waterbirds to feeding, resting, reproduction sites ➤ Influences bedload transport, channel sediment textures, and duration of substrate disturbance (high pulses)
5. Rate and frequency of water condition changes	<p>Rise rates: Mean or median of all positive differences between consecutive daily values Fall rates: Mean or median of all negative differences between consecutive daily values Number of hydrologic reversals</p> <hr/> <i>Subtotal 3 parameters</i>	<ul style="list-style-type: none"> ➤ Drought stress on plants (falling levels) ➤ Entrapment of organisms on islands, floodplains (rising levels) ➤ Desiccation stress on low-mobility streamedge (varial zone) organisms

Summary of Environmental Flow Component (EFC) Parameters and their Ecosystem Influences

EFC TYPE	HYDROLOGIC PARAMETERS	ECOSYTEM INFLUENCES
1. Monthly low flows	<p>Mean or median values of low flows during each calendar month</p> <hr/> <i>Subtotal 12 parameters</i>	<ul style="list-style-type: none"> · Provide adequate habitat for aquatic organisms · Maintain suitable water temperatures, dissolved oxygen, and water chemistry · Maintain water table levels in floodplain, soil moisture for plants · Provide drinking water for terrestrial animals · Keep fish and amphibian eggs suspended · Enable fish to move to feeding

		and spawning areas · Support hyporheic organisms (living in saturated sediments)
2. Extreme low flows	Frequency of extreme low flows during each water year or season Mean or median values of extreme low flow event: · Duration (days) · Peak flow (minimum flow during event) · Timing (Julian date of peak flow) <hr/> <i>Subtotal 4 parameters</i>	· Enable recruitment of certain floodplain plant species · Purge invasive, introduced species from aquatic and riparian communities · Concentrate prey into limited areas to benefit predators
3. High flow pulses	Frequency of high flow pulses during each water year or season Mean or median values of high flow pulse event: · Duration (days) · Peak flow (maximum flow during event) · Timing (Julian date of peak flow) · Rise and fall rates <hr/> <i>Subtotal 6 parameters</i>	· Shape physical character of river channel, including pools, riffles · Determine size of streambed substrates (sand, gravel, cobble) · Prevent riparian vegetation from encroaching into channel · Restore normal water quality conditions after prolonged low flows, flushing away waste products and pollutants · Aerate eggs in spawning gravels, prevent siltation · Maintain suitable salinity conditions in estuaries
4. Small floods	Frequency of small floods during each water year or season Mean or median values of small flood event: · Duration (days) · Peak flow (maximum flow during event) · Timing (Julian date of peak flow) · Rise and fall rates <hr/> <i>Subtotal 6 parameters</i>	Applies to small and large floods: · Provide migration and spawning cues for fish · Trigger new phase in life cycle (i.e. insects) · Enable fish to spawn in floodplain, provide nursery area for juvenile fish · Provide new feeding opportunities for fish, waterfowl · Recharge floodplain water table · Maintain diversity in floodplain forest types through prolonged inundation (i.e. different plant species have different tolerances)

		<ul style="list-style-type: none"> · Control distribution and abundance of plants on floodplain · Deposit nutrients on floodplain
5. Large floods	<p>Frequency of large floods during each water year or season</p> <p>Mean or median values of large flood event:</p> <ul style="list-style-type: none"> · Duration (days) · Peak flow (maximum flow during event) · Timing (Julian date of peak flow) · Rise and fall rates <hr/> <p><i>Subtotal 6 parameters</i></p>	<p>Applies to small and large floods:</p> <ul style="list-style-type: none"> · Maintain balance of species in aquatic and riparian communities · Create sites for recruitment of colonizing plants · Shape physical habitats of floodplain · Deposit gravel and cobbles in spawning areas · Flush organic materials (food) and woody debris (habitat structures) into channel · Purge invasive, introduced species from aquatic and riparian communities · Disburse seeds and fruits of riparian plants · Drive lateral movement of river channel, forming new habitats (secondary channels, oxbow lakes) · Provide plant seedlings with prolonged access to soil moisture