Recovery Potential Metrics Summary Form

Indicator Name: RESTORATION COST

Type: Social Context

Rationale/Relevance to Recovery Potential: The expense of restoration due to the numbers of impaired waters and the complexity of most restoration and remediation techniques is a well known, major factor influencing likelihood of success. Extreme expense may halt progress on a single restoration effort, either directly due to the unwanted financial burden or due to inability to compete with other, less expensive restoration sites as priorities are set. Prioritization often depends as much on economic issues as ecological concerns.

How Measured: Detailed estimates of full restoration cost are not likely to be available, nor necessary for a rough comparison. Expert judgment based on impairment type and number, system type and size may be used to assign high-medium-low expense categories to waters of interest.

Data Source: Not likely to be available in mapped form, although system size, impairment type and numbers from mapped 303(d) data may be used as surrogates for factors commonly affecting cost (See: http://www.epa.gov/waters/tmdl/). Some regional costs for stream restoration projects are compiled in the National River Restoration Science Synthesis database (See: http://restoringrivers.org/newsite/nbii.html).

Indicator Status (check one or more)

_______ Developmental concept.
___x__ Plausible relationship to recovery.
_______ Single documentation in literature or practice.
___x__ Multiple documentation in literature or practice.
_______ Quantification.

Examples from Supporting Literature (abbrev. citations and points made):

- (Hillman, M. and G Brierley. 2005) Striving to help rivers adjust naturally provides the most cost-effective and strategic avenue for management programmes.
- (Russell et al., 1997) The socio-political factors that contribute to restoration decisions were not taken into account. Such factors as engineering capability, cost, land ownership, and legal mandates admittedly play a major role in determining if, when, where, and how a restoration project comes into being. Though beyond the scope of this project, these factors could, to some degree, be considered within a GIS environment (66).
- (Walsh et al., 2005) A critical factor in restoration and conservation of urban streams and their catchments is the human population (Booth 2005), suggesting that effective management of these streams will require a broader perspective than traditional stream ecology, one that includes social, economic, and political dimensions (707).
- (Palik et al., 2000) Restoration also requires prioritization of efforts. Prioritization depends as much on economic issues as ecological concerns (Wyant et al. 1995). An organization may prioritize restoration efforts based on current and historical abundance of an ecosystem, giving highest priority, for example, to restoring historically abundant ecosystems that are currently rare. The effort (cost) to restore a particular site is another factor in prioritization; effort depends on degree of similarity to a reference condition. Highly disturbed sites require greater effort to restore than minimally disturbed sites (following the idea of thresholds of irreversibility; Aronson et al. 1993). Effective

prioritization of restoration efforts requires information that integrates conservation status of ecosystems with effort to restore individual examples of these ecosystems (190).

- (Palik et al., 2000) However, a manager must weigh the benefits against financial costs, which can be considerable even for small land areas (Atkinson 1988). Prioritizing restoration, based on costs and benefits, is an essential consideration, particularly in large landscapes that include multiple types of ecosystems and various levels of disturbances among individual sites (200).
- (Palik et al., 2000) We also incorporate the cost of restoration into the prioritization, assuming that the level of disturbance is proportional to the effort required to restore a site to a reference condition. Given equal conservation status, highly disturbed sites receive lower priority for restoration than less-disturbed sites because restoration costs may be prohibitive for the former. However, even highly disturbed sites may be high priorities for restoration if the site represents an ecosystem that has lost substantial area in the landscape (200).
- (Filipe et al., 2004) The decision must, however, weigh both the need to ensure the species protection and the social and economic costs of rehabilitating a highly degraded river (196).
- (Russell et al., 1997) Areas with medium or high wetness indices that also had bare/herbaceous, scrub, or agricultural cover classes were regarded as potential sites for riparian wetland restoration. The urban class was regarded as ineligible for restoration, because of the probable high costs associated with altering this land use (64).
- (Palik et al., 2000) RPI integrates information on ecosystem conservation status (historical vs. current rarity), with effort to restore a selected polygon to a reference condition. Our assumption for the latter is that cost to restore a disturbed site to the reference condition increases as degree of dissimilarity to the reference ecosystem increases (194).
- (Lake et al., 2007) Unfortunately, the spatial and temporal scales of most restoration activities appear to be set more by logistic, economic and social constraints than by a specific understanding of the scales relevant to specific processes occurring in ecosystems (Lake, 2001). Consequently, much restoration appears to occur at relatively small scales, resulting in fragmented patches of restored habitat embedded in a landscape in which external and large-scale processes (often degradation) continue to dominate over the internal dynamics of restored areas (Beschta et al., 1995; Bohn & Kershner, 2002; Bond & Lake, 2003b) (607).
- (Palmer et al., 2005) All restoration projects need not be preceded by complex and expensive design. For example, areas with no riparian vegetation may simply need to be replanted and streams in farming communities may only need livestock to be fenced out to initiate ecological recovery (211).
- (Palmer et al., 2005) How far the restoration project will move a system towards the guiding image will depend on many factors, some of which are non-ecological (e.g. existing infrastructure limitations, stakeholder needs and values, available funding). Additionally, constraints often exist at the catchment scale, including constant factors such as flow barriers (press disturbances) and spasmodic events (pulse disturbances) such as sediment inputs (Bond & Lake 2003). A clear understanding of scale and severity of constraints is needed in order to prioritize restoration activities and arrive at a co-ordinated scheme of activity for the entire catchment (Bohn & Kershner 2002; Roni *et al*. 2002). In some cases, the large-scale constraints are so severe that one must question whether restoration of single reaches is an appropriate use of valuable resources. However, with sufficient watershed planning, the cumulative effects of multiple projects may yield great ecological benefits. Individual projects that are part of a large restoration scheme should be evaluated within the larger context, particularly to determine the effects on other regional projects (211).
- (Ekness and Randhir 2007) The riparian width that has maximum habitat gains may not always be possible in most watersheds. An effective approach is to protect riparian areas with maximum possible riparian width, to protect all four vertebrate groups. Another

approach is to follow a variable width policy that allows variability in riparian protection depending on local factors like land availability, habitat needs, and other community needs. Zoning regulations (Wenger and Fowler, 2000; Grant, 2001) can be used to reduce land disturbance to riparian areas. A variable buffer zone can be identified and protected using regulations. The variable width of the riparian buffer can be determined based on tradeoffs in location-specific benefits and costs of land protection. The recommended minimum width of riparian buffers is 7.6 m. A popular recommendation is to have three zones in a riparian buffer, namely undisturbed forest, managed forest, and the runoff control area (Welsch, 1991), that have a combined width of 30 m. In Massachusetts, a width of 7.6 m is required in urban areas 61 m in rural areas (River Protection Act). Buffer width policies could be developed based on the marginal gains identified in this study. An ideal is to have a variable width (Spackman and Hughes, 1995; Wenger and Fowler, 2000; Corlett, 2001) policy that uses optimal riparian width depending on local attributes. Subsidies and incentives that are spatially targeted can be used to encourage voluntary installation of riparian buffers (1478-1479).