# Recovery Potential Metrics
# Summary Form

**Indicator Name:** RIPARIAN PERCENT IMPERVIOUS COVER

**Type:** Stressor Exposure

**Rationale/Relevance to Recovery Potential:** Impervious cover is an indicator of the impacts of urbanization and development on water resources. Literature reveals greater impacts of corridor urbanization and imperviousness than the same activities across the watershed. Impervious cover results in multiple stressors to a watershed, such as increased pollutant loads from stormwater runoff, altered stream flow, decreased bank stability, and increased water temperatures. The significance of this metric in reducing recovery potential is based on the multiple secondary impacts to the corridor and water body as well as the nearly irreversible nature of imperviousness. (See also Watershed Percent Impervious.)

**How Measured:** Multiply the area classified as “urban” (i.e. low, medium, and high density residential; commercial; industrial; etc) within a defined corridor width (e.g. 90 meters per side) by the appropriate impervious cover coefficient for each land use type. The percent impervious cover indicator is calculated by averaging the impervious surface areas across the total land area of the corridor. A national dataset on impervious cover extracted from the NLCD is available.

**Data Source:** The 2001 National Land Cover Data contains information on impervious surfaces as well as urban land cover (See: http://www.epa.gov/mrlc/nlcd-2001.html). States might have local datasets with higher resolution. In addition, high resolution satellite imagery can be used to extract impervious cover. Corridors can be generated from hydrographic data (See: http://www.horizon-systems.com/nhdplus/) or high res NHD using a set buffer width for delineation.

**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.

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

- (ourso and frenzel 2002) Eighteen of the 86 variables examined, including riparian and instream habitat, macroinvertebrate communities, and water/sediment chemistry, were significantly correlated with percent impervious area. A sliding regression analysis of variables significantly correlated with percent impervious area revealed 8 variables exhibiting threshold responses that correspond to a mean of 4.4 – 5.8% impervious area, much lower than mean values reported in other, similar investigations. The percentage of impervious area at which degradation of water quality begins is varied, ranging from 4–5% (May et al., 1997) to 10–12% (Klein, 1979; Booth & Jackson, 1997; Wang et al., 2000). Effective impervious area relates to the ‘connectedness’ of impervious area to a watercourse and intuitively has a greater effect on water quality than does impervious area separated from the watercourse. In other words, buffer areas and open space near water bodies are important in controlling runoff from impervious areas. In addition to buffer areas, the reduction of impervious area also must be considered. Although the thresholds reported here appear low compared with values reported elsewhere (Schueler, 1994), the differences in this study may be related to the more advanced technology used to quantify PIA.

- (Dodds and Oakes 2008) Riparian land use may be particularly influential and, in some cases, a better predictor of in-stream water quality than land cover in the entire catchment (Johnson and others 1997; Osborne and Wiley 1988). Intact riparian zones provide water quality benefits and help preserve the biological integrity of watersheds (Gregory and others 1991) (368).
- (Dodds and Oakes 2008) Across all studied watersheds, riparian land cover was a significant predictor of among-site variation in water chemistry concentrations at the watershed and first-order streams scales, particularly for nutrients (Table 1) (371).
- (Ekness and Randhir 2007) Land use practices within a riparian zone are known to impact species richness and the diversity of amphibians, reptiles, birds and small mammals (Barclay, 1980; Mensing et al., 1998). Disturbance of the natural riparian riverine system may result in long-term modification to and reduction in natural biodiversity (Harding et al., 1998). Some of those impacts include changes in wildlife behavior, migration patterns, dispersal patterns, and distribution of species within a watershed (1470).
- (Brabec et al. 2002) The distance between impervious cover and the stream channel appears to be one of the most important factors regarding placement, particularly for areas in which runoff is not piped directly to the stream. Impervious cover further away from the stream resulted in less channel enlargement in watersheds near Philadelphia (Hammer 1972) (510).
- (Brabec 2009) While the effectiveness of riparian forests is limited, riparian buffers are key mitigants of temperature increases (Galli 1990), and the loss of large woody debris and leaf litter that enters the aquatic food chain (Booth and Jackson 1997). When streamside vegetation is cleared, less wood enters the channel (Bisson et al. 1987; Richards and Host 1994) which functions to protect the streambed and banks from erosion (Booth et al. 1996; Booth and Jackson 1997). There are several factors that can act to reduce the effectiveness of buffers (Booth 1991): (1) the effects of existing land use in the watershed; (2) stream crossings by roads and utilities; (3) human intrusion; (4) buffer alteration over time by individual property owners; and (5) channelized flow, or flow through buried culverts or pipes, through the buffer into the stream carrying pollutants and sediments, along with flow increases from impervious surfaces (429).
- (Brabec 2009) Significant changes in instream nutrient concentrations were identified if landcover changes occurred within 150 m of the stream channel, while insignificant changes in nutrient concentrations resulted if the land-use change occurred at more than 150 m from the channels (Tufford et al. 1998). This finding suggests that basin land-use planning aimed at reducing nonpoint sources of nutrient loading should be especially concerned with near-channel land uses. In particular, nutrient levels were found to be alleviated only temporarily by forested buffer strips (Omernik et al. 1981). One study found "stream buffers (100 m) were more important than whole catchment data for predicting sediment-related habitat variables (Richards et al. 1996) and riparian forest within about 1 km of a station was the most important in predicting maximum stream temperature and trout distribution in southern Ontario (Barton et al. 1985). One hundred ft buffers are generally accepted in planning practice since benefits of wood recruitment, aquatic food supply and shading appear to decline much beyond 100 ft (Murphy et al. 1986; Budd et al. 1987; Booth 1991) (429-430)
- (Brabec 2009) In an assessment of Ontario area streams, land uses in an area of 10–100 km2 above the site of interest were more important to biotic integrity than the land uses within the entire basin (Steedman 1988). These findings correlate well with the buffer findings discussed previously, since imperviousness further from the stream has less impact on the hydrologic system simply by not destroying the buffer (430-431).
- (Allan 2004) When land use at the reach and riparian scales is reported to have a strong influence over stream condition, direct local pathways are usually apparent. ….Near-stream connected imperviousness had a stronger influence on fish assemblages than did comparable amounts of impervious surface located farther from the stream, apparently

owing to increased severity and frequency of high-flow events and lowered baseflow (Wang et al. 2001) (271).