

## 5. Improve Ecological Health

### 5.1 Healthy and biodiverse habitat - Water system services help to protect, restore and create well-functioning ecosystems that contribute to ecological resilience.

| Objectives   | Rating Scale   | Guiding questions   | Suggested data collection sources  | Facilitator guiding questions and notes   |
|--|--|---|--|---|
| <b>Urban landscape design</b><br>Water system services help to protect, restore and create well-functioning ecosystems that contribute to ecological resilience. | 1. The urban habitats supported by water system services and/or assets (including streamside habitat) are <b>not or virtually not connected</b> at all and <b>biodiversity is very low</b> even considering the type of urban development. The quality of the vegetation offers <b>little</b> in regards to <b>functioning ecological systems</b> .            | <b>Urban landscape design</b><br>To what extent do water system services and assets help to support biodiversity and functioning terrestrial ecosystems?<br><br>Are patches of vegetation connected or isolated?<br><br>What is the state and condition of vegetation and habitats? How has it changed over time? | Policy for the protection of biodiversity in urban areas<br><br>GIS layers of vegetation – areas and average distances between patches<br><br>Normalised Difference Vegetation Index (NDVI) to assess the extent and quality of vegetation using satellite remote sensing data. Access to website which maps NDVI 'on demand':<br><a href="http://ivfl-info.boku.ac.at/index.php/eo-data-processing/dataprocess-global">http://ivfl-info.boku.ac.at/index.php/eo-data-processing/dataprocess-global</a><br><br>Change Matters<br><a href="http://changematters.esri.com/compare">http://changematters.esri.com/compare</a> to compare Normalised Difference Vegetation Index (NDVI) across different years to show increase/decrease in extent and quality of vegetation.<br><br>Biological surveys, biodiversity trends, local research reported in scientific papers, biodiversity reports | <b>Hierarchy</b> <ul style="list-style-type: none"> <li>• Low biodiversity and habitat connection</li> <li>• Low biodiversity, habitats begin to be connected</li> <li>• Fair biodiversity and functioning ecological systems, reasonably connected habitats</li> <li>• High biodiversity and functioning ecological systems, well connected habitats</li> <li>• Very high biodiversity and functioning ecological systems, very well connected habitats</li> </ul>   |
|  | 2. The urban habitats supported by water system services and/or assets (including streamside habitats) are <b>patchy and some areas connected</b> , and <b>biodiversity is low</b> considering the development context. The quality of the vegetation provides <b>some functioning ecological systems</b> given the type of urban development.                 |   |  | <b>Examples</b> <ul style="list-style-type: none"> <li>• A city such as Melbourne has invested in establishing open space corridors along most urban waterways and revegetation with native species.</li> <li>• Fish ladders have been installed on in-stream barriers to allow for continuity of fish passage.</li> <li>• Many natural wetlands have been protected in open space reserves and are managed for biodiversity.</li> </ul>  |
|  | 3. The urban habitats supported by water system services and/or assets (including streamside habitats) are <b>reasonably connected</b> along waterway or infrastructure networks. The biodiversity and quality of the vegetation provides <b>fair functioning ecological systems</b> given the type of urban development.                                      |   |  | <b>Definitions</b><br><br>Type of urban development: inner, middle, outer and peri-urban<br>Patchy: areas of habitat are fragmented with limited connection<br>Infrastructure networks: can include pipe easements, waterways and drainage systems  |
|  | 4. The urban habitats supported by water system services and/or assets (including streamside habitats) are <b>well connected</b> along waterway or infrastructure networks and patches exist across the catchments. The biodiversity and quality of the vegetation provides <b>high functioning ecological systems</b> given the type of urban development.    |   |  | <b>Common Q and A's / Notes</b><br><br>What is meant by 'functioning ecosystem'?<br>This is habitat and ecosystem that are reasonably self-maintaining or sustainable with normal management. They would be generally free from major fluctuations in species numbers, for example, they are not devastated by outbreaks of pest plants or animals or algal blooms. However, the biota may include significant non indigenous plants and animals.<br><br>A 'high functioning ecosystem' would be close to 'natural' with mostly intact biota, limited species loss or displacement by non-indigenous species in an 'outer' or peri-urban' development context.<br>Inner urban areas with high functioning ecosystems may exist where they are connected to extensive natural areas such as oceans, bays, national parks or where there has been extensive investment in protecting or improving habitat quality and connectivity. |
|  | 5. The urban habitats supported by water system services and/or assets (including streamside habitats) are <b>very well connected</b> along waterway or infrastructure networks and extend across the catchments. The biodiversity and quality of the vegetation provides <b>very high functioning ecological systems</b> given the type of urban development. |   |  | A well-designed urban environment can still promote biodiversity<br><br><b>Must mention</b><br><br>This indicator includes both terrestrial habitats (including riparian areas) along with instream habitats<br><br>Terrestrial habitats can be designed and manmade – as long as they functioning and biodiverse (i.e. not mown grass)   |

### 5.2 Surface water quality and flows - To improve and protect the quality of surface waters and marine environments.

| Objectives  | Rating Scale   | Guiding questions  | Suggested data collection sources  | Facilitator guiding questions and notes   |
|---|--|--|--|---|
| <p><b>Policy and strategy</b><br/>To improve and protect the quality of surface waters and marine environments.</p> | <p>1. The quality and flow characteristics of surface and marine waters in the area is <b>detrimental to functioning ecosystems and leads to deterioration over time. Little action</b> is undertaken to prevent or treat point source pollution (such as, domestic and industrial wastewater prior to discharge to the environment) or urban runoff.</p> <p>2. The quality and flow characteristics of surface and marine waters in the area <b>falls short in supporting functioning ecosystems</b>. In some parts of the area it may be better than others, but on the whole it is still deteriorating. Early <b>action in some areas</b> is undertaken to prevent or treat <b>wastewater</b> prior to discharge to the environment. Little, if any, action is undertaken to address urban runoff quality prior to discharge.</p> <p>3. The quality and flow characteristics of surface and marine waters in the area <b>supports reasonably healthy ecosystems</b>. Though perhaps not everywhere, mostly the waters are of this quality, and it is <b>not</b> deteriorating. Action addresses almost all point source pollution (such as, appropriate treatment of domestic and industrial wastewater prior to discharge). <b>Some action</b> is undertaken to <b>address urban runoff quality</b> prior to discharge.</p> <p>4. The quality and flow characteristics of surface and marine waters in the area <b>supports healthy ecosystems</b> – this quality is fairly consistently observed throughout the area. <b>Action</b> addresses <b>all point source</b> pollution (such as, appropriate treatment of domestic and industrial wastewater prior to discharge) and <b>urban runoff</b> is <b>treated</b> using green infrastructure (such as, wetlands and rain gardens) in <b>some areas</b>. <b>Some harvesting</b> of urban runoff may occur in some areas.</p> <p>5. The quality and flow characteristics of surface and marine waters in the area <b>supports very healthy ecosystems</b> – this quality is consistently observed throughout the area. <b>Action</b> addresses <b>all point source</b> pollution (such as appropriate treatment of domestic and industrial wastewater prior to discharge) and <b>urban runoff</b> is <b>treated</b> using green infrastructure (such as, wetlands and rain gardens) across <b>many areas</b>. <b>Extensive harvesting</b> of urban runoff reduces flow related impacts on aquatic ecosystems. Actions improve and restore the quality of water that flows through the city.</p> | <p><b>Policy and strategy</b><br/>What proportion of domestic and industrial wastewater is treated prior to discharge to receiving waters?</p> <p>Do flow regimes or water quality significantly constrain instream biodiversity?</p> <p>What are the 3 key pollutants of concern to local water bodies?</p> <p>'Healthy' freshwater or marine ecosystems are defined as biodiverse and functioning. Ecosystems may be substantially altered from the pre-urban 'natural' state, but a 'functioning ecosystem', will have basic ecosystem elements in place. Increasing ecosystem health will be characterised by increasing biodiversity and resilience to system shocks.</p> | <p>Policy for protection of surface water quality</p> <p>Data monitoring and exceedance of acceptable water quality thresholds</p> <p>Number and types of WSUD assets (including stormwater harvesting)</p> <p>% of urban runoff treated by WSUD/harvesting schemes</p> <p>Data monitoring of instream biodiversity/ecosystem health</p> | <p><b>Hierarchy</b></p> <ul style="list-style-type: none"> <li>• Surface water quality is detrimental to functioning ecosystems</li> <li>• Some areas have better surface water quality than others, but is deteriorating as a whole</li> <li>• Surface water quality is maintained to support reasonably healthy ecosystems. All point source pollution is addressed.</li> <li>• Actions are taken to improve surface water quality for both point source pollution and urban runoff</li> <li>• Surface water quality supports very healthy ecosystems, actions address both point source pollution and urban runoff</li> </ul> <p><b>Examples</b></p> <p>In Melbourne, hundreds of stormwater treatment wetlands have been constructed to protect water quality and to provide additional habitat along waterways and environmental performance standards for water quality are embedded in planning provisions related to urban development. Point sources of pollution are effectively regulated by the Environment Protection Agency. Measures to manage the flow impacts of urban runoff are being developed but are not yet ready for adoption.</p> <p><b>Definitions</b></p> <p>See previous indicator for definition of 'functioning or healthy ecosystems'.</p> <p><b>Common Q and A's / Notes</b></p> <p>What is meant by 'flow characteristics' and why is this important?<br/>Natural waterways are highly sensitive to changes in flow regime. Reduced flows can result from water harvesting. Increased frequency of high flow are typical in urban catchments. Marine ecosystems or saltwater wetlands can be affected by increased freshwater inflows from urban runoff or sewage treatment plants.</p> <p>If water coming in is degraded, should still do what we can to not contribute to further degradation</p> <p><b>Must mention</b></p> |

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### 5.3 Groundwater quality and replenishment - To improve and protect the quality of groundwater dependent ecosystems.

| Objectives  | Rating Scale   | Guiding questions   | Suggested data collection sources  | Facilitator guiding questions and notes  |
|---|--|---|--|--|
| <p><b>Policy and strategy</b><br/>To improve and protect the quality of groundwater-connected environments.</p> | <p>1. The quality and/or replenishment of groundwater in the area is <b>detrimental to valued ecosystem services</b> (e.g. groundwater dependant ecosystems). <b>No action</b> is undertaken to address domestic and industrial wastewater, and urban runoff, impacting on groundwater.</p> <p>2. The quality and/or replenishment of groundwater in the area <b>falls short in supporting valued ecosystem services</b> (e.g. groundwater dependant ecosystems). In some areas it may be better managed than others, but on the whole it falls short. <b>Little action</b> is undertaken to address domestic and industrial wastewater, or urban runoff, impacting on groundwater.</p> <p>3. The quality and replenishment of groundwater in the area supports <b>reasonably healthy ecosystems and valued ecosystem services</b> (e.g. groundwater dependant ecosystems). Though perhaps not everywhere, mostly the groundwaters are of good quality and not being depleted. <b>Some action</b> is undertaken to address domestic and industrial wastewater, or urban runoff, impacting on groundwater.</p> <p>4. The quality and replenishment of groundwater in the area supports <b>healthy ecosystems and valued ecosystem services</b> (e.g. groundwater dependant ecosystems). Mostly the groundwaters are of good quality and not being depleted – this is fairly consistently observed throughout the area, with hardly any negative exceptions. <b>Significant action</b> is undertaken to address domestic and industrial wastewater, and urban runoff, impacting on groundwater.</p> <p>5. The quality and replenishment of groundwater in the area supports <b>very healthy ecosystems and valued ecosystem services</b> (e.g. groundwater dependant ecosystems). Mostly the groundwaters are of good quality and not being depleted – this is consistently observed throughout the area. <b>Extensive action</b> is undertaken to address domestic and industrial wastewater, and urban runoff, impacting on groundwater.</p> | <p><b>Policy and strategy</b><br/>What are the existing groundwater dependant ecosystems etc.?</p> <p>Does monitoring data indicate a decline in quality or seasonal depth of the groundwater?</p> <p><b>Note:</b> in absence of data, assess 1-3 on how the groundwater dependent ecosystems are performing</p> <p><b>Note:</b> this is different to groundwater supply for potable use – this indicator is about environmental health</p> | <p>Groundwater reporting by relevant government authority</p> <p>Policy for the protection of groundwater</p> <p>Data monitoring and exceedance of acceptable water quality or depth thresholds</p> <p>Number of use of licenced and private bores</p> <p>Active replenishment of groundwater – Aquifer Storage and Recovery schemes</p> | <p><b>Hierarchy</b></p> <ul style="list-style-type: none"> <li>• Groundwater quality and replenishment is detrimental to ecosystems</li> <li>• Groundwater quality and replenishment falls short in supporting ecosystems, little action is undertaken to improve</li> <li>• Groundwater quality and replenishment supports reasonably healthy ecosystem, some action undertaken to improve</li> <li>• Groundwater quality and replenishment supports healthy ecosystems, significant action is undertaken to improve and support</li> <li>• Groundwater quality and replenishment supports very healthy ecosystems, extensive action is undertaken to improve and support</li> </ul> <p><b>Examples</b></p> <p><b>Definitions</b></p> <p>Groundwater issues: salinity, rising water tables, shrinking water tables, contamination</p> <p>Groundwater dependent ecosystems: include waterways and wetlands that have a connection to groundwater that is essential to their functioning and health. These may be isolated or part of extensive landforms such as the Swan Coastal Plain around Perth in Western Australia.</p> <p>'Healthy' groundwater ecosystems are defined as biodiverse and functioning.</p> <p><b>Common Q and A's / Notes</b></p> <p>How do we know if there are groundwater dependent ecosystems?<br/>Groundwater systems and their surface water interactions are often poorly understood because of limited study. If there is little local knowledge amongst workshop participants it may be that a provisional' score is agreed subject to some further investigation after the workshop.</p> <p>How do we score this where there are few if any groundwater dependent ecosystems?<br/>Score as a '3' but mark up or down depending on how potential contamination issues are being addressed.</p> <p>Focus is on urban extractions and replenishment, e.g. residential gardens, irrigation of sports fields etc.<br/>Replenishment via infiltration practices (adequately pre-treated to ensure not contaminating with nutrients, metals and other pollutants) and Aquifer Storage and Recovery schemes.</p> <p><b>Must mention</b></p> |



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### 5.4 Protect existing areas of high ecological value - To protect existing areas of high ecological value from the impacts of catchment urbanisation and other ecological activities.

| Objectives   | Rating Scale  | Guiding questions  | Suggested data collection sources   | Facilitator guiding questions and notes   |
|--|---|--|---|---|
| <p><b>Policy and strategy</b><br/>To protect existing areas of high ecological value from the impacts of catchment urbanisation.</p> | <p>1. <b>Little</b>, or no, <b>recognition</b> of existing or remnant areas with significant ecological value. <b>No mechanisms</b> exist to <b>ensure</b> the <b>protection</b> of native flora and fauna from urban development and urban water systems.</p> <p>2. <b>Some recognition</b> of the significance of existing or remnant areas with significant ecological value. <b>Policy</b> may be <b>present</b> but <b>not enforced</b>. <b>Limited mapping</b> and records of native flora and fauna are available. The planning and constructions of urban <b>development</b> and urban water systems are <b>only restricted by internationally recognised sites</b> of significance.</p> <p>3. Existing or remnant areas with significant ecological value are protected through policy or informal understandings, agreements and cultural practices. <b>Extensive mapping</b> and records of endangered and protected species are available. Some urban <b>development</b> are <b>excluded</b> in some areas through <b>designated conservation zones</b> (including national and state parks, etc.) and urban water systems that impact on major sites of significance are restricted.</p> <p>4. Existing or remnant areas with significant ecological value are protected through policy and legislation or informal understandings, agreements and cultural practices. <b>Extensive mapping</b> and records of endangered and protected species are available. Urban <b>development</b> is <b>excluded</b> in some areas through <b>designated conservation zones</b> and urban water systems that impact on major sites of significance are restricted. Appropriate development activities are undertaken in other areas given the landscape type and <b>permits</b> are required for <b>vegetation removal</b>. <b>Vegetation offsets</b> are stipulated where vegetation is permitted to be removed.</p> <p>5. Existing or remnant areas with significant ecological value are protected through policy, legislation and informal understandings, agreements and cultural practices. <b>Extensive mapping</b> and records of endangered and protected species are available. Urban <b>development</b> is <b>excluded</b> in some areas through <b>designated conservation zones</b> and urban water systems that impact on major sites of significance are restricted. Appropriate development activities are undertaken in other areas given the <b>landscape type</b> and <b>permits</b> are required for <b>vegetation removal</b>. <b>Vegetation offsets</b> are stipulated where vegetation is permitted to be removed. The <b>community recognises</b> the importance of water systems designed to <b>support ecological significant landscapes</b> and they <b>actively contribute</b> towards <b>protecting</b> and <b>enhancing landscape</b> conservation values in the public and private realm.</p> | <p><b>Policy and strategy</b><br/>What are the existing areas designated as protected land/conservation areas (e.g. national or state forest)?</p> <p>Do areas of international significance exist (e.g. Ramsar listed sites)?</p> <p>Have rare and threatened species been identified and where?</p> <p>What are the measures in place to protect areas of significant ecological value from the impacts of urban development and water systems?</p> <p>What community driven initiatives are in place and how active is the community in protecting and enhancing areas of significant ecological value?</p> | <p>Regulation and legislation</p> <p>Mapping and surveys of rare and threatened species</p> <p>Percentage of protected area from GIS zoning or relevant maps</p> <p>Policy, planning reports and strategic plans to identify solutions in place to protect areas of significance from urban development</p> | <p><b>Hierarchy</b></p> <ul style="list-style-type: none"> <li>No protection of environment</li> <li>Some protection of environment through formal or informal mechanisms</li> <li>Protection of environment through formal or formal mechanisms</li> <li>Protection of environment through both formal and informal mechanisms</li> <li>Protection of environment through both formal and informal mechanisms, along with community behaviours</li> </ul>  |
|  |   |  |   | <p><b>Examples</b></p>  |
|  |   |  |   | <p><b>Definitions</b></p> <p>Designated conservation zones: National and state parks, nature reserves</p>   |
|  |   |  |   | <p><b>Common Q and A's / Notes</b></p> <p>What if there are few if any remnant areas of significant ecological value in or around the city?<br/>Rarity of such areas should make them an even higher priority to protect and effective protection measures should be more straightforward compared to cities which may be growing to cope with population pressures and impacting on remnant natural areas. The score should not be influenced by the extent of remnant areas but by the degree and effectiveness of protection measures.</p> <p>What are possible types of water system impacts and how can they be restricted?<br/>Impacts can be water harvesting impacting on natural flows, infrastructure disrupting or destroying natural areas, sewage or stormwater runoff discharges into natural environments. Impacts can be managed by prohibiting infrastructure that will disrupt natural areas, requiring treatment or diversion of polluting discharges, or provision of environmental flows to offset harvesting impacts.</p> |
|  |   |  |   | <p><b>Must mention</b></p>  |