Recovery Potential Screening (RPS) Scenarios: An Example Involving Nutrients Management

Recovery Potential Screening (RPS) was designed to accommodate a variety of different ways to compare watersheds and produce results that help users make decisions and follow specific strategies. Watershed comparison can easily become an "apples and oranges" task when a narrower subset of watershed types are of interest but there is much variety in conditions, land uses and ecological characteristics across all watersheds. Identifying **scenarios** is a technique to help focus an RPS project on a smaller set of the most relevant watersheds.

Applying the RPS tool involves identifying a specific screening purpose, relating this purpose to the targeted watershed setting (if known), selecting and weighting indicators that are relevant to that setting and purpose and calculating index scores. **The screening purpose, watershed setting and user-selected indicators together define an RPS scenario.**

Developing and then analyzing a scenario is usually iterative, first screening all watersheds (e.g., statewide) to determine the range of conditions, then narrowing further screening runs to focus on a subset of watersheds of highest interest (i.e., watersheds that the screening purpose is intended to target). The first, statewide screening run has two purposes: document the range of conditions statewide as background context, and provide information sufficient to reveal the subset of watersheds most relevant to the specific screening purpose. The subsequent screening runs, usually confined to the high-interest watersheds subset, may include different variations in indicator selections and weights that can provide alternative comparisons of the subset watersheds. One or many separate screening runs may be appropriate to characterize a scenario.

Using Scenarios in Recovery Potential Screening

- Define the purpose for your screening comparison and the types of watersheds most relevant to it
- Select initial traits (landscape settings, typical pollutants and sources, etc) that will help identify watersheds that best fit the screening purpose and therefore the scenario
- Screen all watersheds using indicators related to these traits
- If desired, refine the screening indicators (change weights, add or delete indicators) and re-run the screening on the subset of high interest watersheds
- Screening results then provide comparative scores about the scenario's watersheds that can be contrasted with one another, as well as with the statewide conditions in all watersheds, to inform potential priorities and actions.

For example, a user may screen all watersheds statewide with the intent to compare pollutant runoff differences among urban watersheds, but logically a smaller subset of the watersheds would be considered urban. The first screening run contains indicators sufficient to enable identification of the urban runoff scenario watersheds of interest and provide general statewide context about urban conditions. Subsequent screening runs would compare the subset watersheds with different

combinations of indicators related to factors such as urban extent, slope, imperviousness, riparian natural cover, magnitude of pollutant sources and so on.

The following provides an example of scenario development using watershed prioritizing for management of nutrient pollution as the general screening purpose. It describes 10 possible scenarios that address common nutrient challenges and settings across the country and includes for each scenario a list of indicators that could be used in the screening. The list of scenarios below are meant to serve as a starting place for initial nutrient focused Recovery Potential Screenings that can then be built upon and customized for more detailed and localized efforts:

- Scenario 1 - Generalized statewide nutrient management
- Scenario 2 –Watersheds with wastewater and stormwater runoff nutrient issues
- Scenario 3 – Rural row-crop dominated watersheds
- Scenario 4 – Rural non-row crop dominated watersheds
- Scenario 5 – Nonpoint source only watersheds
- Scenario 6 – Point source dominated watersheds
- Scenario 7 – Nitrogen dominated challenges
- Scenario 8 – Phosphorus dominated challenges
- Scenario 9 – Lake/reservoir dominated systems
- Scenario 10 – Wetland dominated systems

Each of these scenarios can be used to prioritize planning for restoration or protection, depending on the state's goals and objectives for nutrient management. For example, scenario 2 can be used by a state that is most interested in prioritizing the best prospects from a subset of watersheds dominated by urban nutrient sources. Scenarios can also simply be used to classify portions of the state so that comparisons are fair. A state that has both urban and agricultural landscapes may wish to prioritize them separately or together, as a watershed will often contain both. Scenarios result in a group of watersheds with similar characteristics, which can be refined to answer questions such as: which watersheds have the highest levels of nutrient related stress, ecological capacity and potential social support and, given the results of those comparisons, how might we change or adapt our restoration efforts? In addition to the scenarios provided below, scenarios can be developed based on project specific input to optimize application of a specific set of nutrient control practices. An example could include predominately row-crop agricultural watersheds with high levels of synthetic nitrogen fertilizer application rates which could be focused on for fertilizer use efficiency practices and education on recommended rates.

Indicators for the scenarios are chosen for their simplicity and ease of understanding in addition to being nutrient-relevant. The Ecological indicators capture the capacity for nutrient assimilation and processing, are measures of resistance and resilience to nutrients, and assume greater ecological scores imply greater recoverability. Stressor indicators reflect the magnitude of impact and assume large impacts will require greater effort to restore. Social indicators capture social capital, readiness of information and organization, or willingness to invest in recovery, among other concepts. Interpretation of the screening results can be dependent on state priorities. If a state wishes to address "low hanging fruit", those watersheds which have good ecological indicator values, lower levels of stressors and higher social readiness to implement can be

ranked more highly. Alternatively, if the state is looking to focus on more highly impacted areas, they may wish to prioritize watersheds that exceed a moderate to high stressor threshold, but still have strong ecological and social index scores. Note that the suggested indicators for each scenario merely provide a starting point from which a set of indicators more specific to the individual project can be developed.

Scenario 1 – Generalized statewide nutrient management

This is the most simplistic option short of considering loading magnitude alone (Note that loading alone is not recommended because it would not incorporate consideration of multiple factors besides loading that heavily influence restoration success). This approach sets priorities among watersheds based on a variety of metrics that span the common nutrient sources and settings, with the intent to help begin to differentiate them as to the level of effort or difficulty to achieve meaningful loading reductions. This very basic scenario measures but does not separate out different nutrient loading sources, landscape settings and other features that might be separately addressed in more narrowly defined scenarios (e.g., see below). All watersheds of a given scale (e.g., HUC8 or HUC12) statewide are compared in this simple scenario. If desired, the user can also first set a watershed estimated loading threshold above which a watershed is a candidate for priority attention; this step would narrow the number of watersheds screened to a smaller subset initially based on load, but further differentiated by recovery potential based on the other selected indicators.

Scenario 1 Indicators

Ecological:

- Natural cover in watershed and riparian zones
- % of watershed draining headwaters
- Aquatic animal species diversity

Stressor

- Cultivated crops
- Developed and impervious area
- Erodibility of soils
- % of nutrient-listed waters
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Percent of watershed instate
- Watershed group counts
- Miles of high quality waters

This scenario can be further refined to approach nutrient issues and a state's watersheds in two stages, using HUC8 units as the more general, first stage followed by screening of HUC12s as the second, more localized stage. As described above, all watersheds statewide are screened at the first (targeting) stage with special attention to those that exceed a threshold of loading magnitude and yet have some promising restorability traits. The targeting stage reveals priority large watersheds across the state. In the second (implementing) stage, individual priority watersheds from stage 1 are screened at the finer scale with a richer selection of indicators, and the results interpreted to help determine where within the priority HUC8 to expend efforts on priority HUC12s. The implementing stage can vary considerably in specificity (for options, see the next several scenarios). In addition, one major difference from stage 1 is that in this refined option the HUC12s within the same HUC8 can be compared with one another, versus comparison with one another along a statewide evaluation gradient.

This scenario, regardless of scale (HUC8 or HUC12), relies on scoring watersheds based on broad measures of land use across the range of land use types. Ecological indicators include natural cover, the percent of land draining small streams and the number of aquatic species, reflecting the general resilience of natural lands, processing potential of small streams and value of diversity in indicating quality. Stressor indicators focus on measures of agriculture and urban land uses known to generate nutrients, erodibility of soils (a significant NPS

nutrient source), point sources, numbers of nutrient listings and modeled watershed nutrient loads are meant to capture general nutrient loading across the widest spectrum of land uses and potential point and non-point sources. Social indicators in this generic scenario focus on existing recovery activity (TMDLs), watershed groups indicating community engagement, the presence of highly valued water resources and the number of jurisdictions (single or multiple states) to reduce political complexity.

Scenario 2 – Watersheds with wastewater and stormwater runoff nutrient issues

Scenario 2 addresses those watersheds that are dominated by developed land uses (low to high densities). Key sources of nutrients in developed watersheds are diffuse stormwater and point source discharges. These watersheds are typically served by storm sewer networks and can be regulated MS4s. Stormwater in urban areas is a function of the impervious area. Runoff is routed quickly over impervious areas into storm sewers, which can be treated by BMPs or discharged to downstream waters. This runoff collects pollutants including nutrients, sediment, bacteria and others common in developed areas (e.g., lawn fertilizer and chemicals) and due to the volume of runoff being conveyed, pollutant loading is typically high. These watersheds also include population centers and typically have wastewater treatment facilities which may discharge to surface waters and also other point source discharges such as industrial process water. Urban storm sewers can sometimes be combined with sanitary sewers to result in a combined sewer area which can be subject to overflows of untreated wastewater discharges.

Scenario 2 Indicators

Ecological:

- Natural cover in watershed
- Low imperviousness in riparian areas
- Biotic integrity

Stressor

- Developed and impervious areas in watershed
- % change in urban area
- Erodibility of soils
- % of nutrient-listed waters
- Point sources
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Protected or regulated areas
- Percent of watershed instate
- Watershed group counts
- Miles of high quality waters

Ecological indicators include natural cover, riparian area with low levels of imperviousness, and the presence of macroinvertebrates that are expected for good water quality. Stressors include developed and impervious areas, rate of development represented by increases in urban areas over time, point sources and high watershed nutrient yields. Social indicators focus on protected and regulated areas such as MS4s, active watershed groups and miles of streams designated as high quality water.

Scenario 3 – Rural row-crop dominated watersheds

Scenario 3 addresses those watersheds that are dominated by row crop agriculture. These watersheds can be served by drainage and irrigation and are typically subject to intense tillage practices and fertilizer application. Drain tile is often used to control the shallow groundwater level and also serves to collect and route surface runoff to nearby waters, drainage ditches can also be present. Key sources of nutrients in these watersheds include runoff and erosion from fields and in nearby streams. These watersheds may include point sources and other significant non-point sources such as septic systems and feedlots.

Ecological indicators include natural cover, wetlands in the riparian zone, the percent of land draining small streams and the number of aquatic species, reflecting the general resilience of the watershed, processing potential of small streams and value of diversity in indicating watershed quality. Stressors include cultivated crops and drained agricultural areas, agricultural water use, soil erodibility and watershed nutrient yields. Key sources of nitrogen including atmospheric deposition and fertilizer application are also key stressor indicators. Lower levels of these stressors will result in identifying watersheds with higher restoration potential. Social indicators focus on percent of watershed that are protected lands or potentially restorable as wetlands, watershed groups and miles of streams designated as high quality water.

Scenario 3 Indicators

Ecological:

- Natural cover in watershed and riparian zones
- % of watershed draining headwaters
- % wetlands in riparian zone
- Aquatic animal species diversity and biotic integrity

Stressor

- Cultivated crops in watershed and riparian area
- % of watershed drained
- Agricultural water use
- Erodibility of soils
- Nitrogen deposition and fertilizer use
- % of nutrient-listed waters
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Protected lands
- Potentially restorable wetlands
- Percent of watershed instate
- Watershed group counts
- Agricultural BMP activity
- Miles of high quality waters

Scenario 4 – Rural non-row crop dominated watersheds

Scenario 4 can be used to identify and prioritize watersheds that are dominated by rural, non-row crop land uses. These watersheds are predominately pasture and hay and often include animal agriculture activities. Pathways for pollutants can include watershed and stream channel erosion, feedlot runoff and manure management activities. This scenario is almost identical to Scenario 3 but ranks watersheds with high levels of non-row crop agriculture land uses (pasture, hay, rangeland). Synthetic nitrogen fertilizer application and percent of watershed that is tile drained are not used in this scenario as stressor indicators.

Ecological and social indicators are identical to Scenario 3. Stressor indicators include percent of watershed in pasture or hay, animal agricultural activities, soil erodibility, atmospheric deposition of nitrogen and watershed nutrient loads.

Scenario 4 Indicators

Ecological:

- Natural cover in watershed and riparian zones
- % of watershed draining headwaters
- % wetlands in riparian zone
- Aquatic animal species diversity and biotic integrity

Stressor

- Pasture/hay in watershed and riparian area
- Number of animal units
- Erodibility of soils
- Nitrogen deposition
- % of nutrient-listed waters
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Protected lands
- Potentially restorable wetlands
- Percent of watershed instate
- Watershed group counts
- Agricultural BMP activity
- Miles of high quality waters

Scenario 5 – Nonpoint source only watersheds

A nonpoint source only scenario can be used to address those watersheds without any regulated point sources and can be used to inform statewide section 319 strategies. These watersheds may include agricultural and other rural land uses such as smaller cities and towns and significant areas of public or protected lands. Sources and pathways of pollutants discussed in Scenario 3 and 4 are applicable. Scenario 5 is a combination of Scenario 3 and 4 and includes identical ecological and social indicators. The number of septic systems in the watershed is added to the stressor indicators. The agricultural BMP activity social indicator could also be expanded to represent eligibility for nonpoint source control funding. For example, if large portions of a watershed (e.g., HUC8) have been selected for targeted funding, that watershed could receive a higher social indicator rank.

Scenario 5 Indicators

Ecological:

- Natural cover in watershed and riparian zones
- % of watershed draining headwaters
- % wetlands in riparian zone
- Aquatic animal species diversity and biotic integrity

Stressor

- Cultivated crops and pasture/hay
- % of watershed drained
- Number of animal units
- Agricultural water use
- Erodibility of soils
- Nitrogen deposition and fertilizer use
- Septic systems
- % of nutrient-listed waters
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Protected lands
- Potentially restorable wetlands
- Percent of watershed instate
- Watershed group counts
- Agricultural BMP activity
- Miles of high quality waters

Scenario 6 – Point source dominated watersheds

A point-source-dominated scenario can be used for those watersheds that have disproportionate loading due to regulated point sources such as wastewater treatment facilities or mining. With appropriate data on permits that address nutrients, the point source component can be the theme for a specific RPS scenario and allows for more specific choices as to the social context indicators selected. This scenario is very similar to Scenario 2 (Urban Wastewater and Runoff), however it does not address watershed runoff to the same extent as Scenario 2. Ecological indicators focus on the assimilative capacity of the watershed represented by wetlands in the riparian zone and the presence of macroinvertebrates that indicate good water quality. Stressor indicators focus on urban areas as a proxy for population, percent of change in urban areas indicating increases in wastewater loads, point sources and watershed nutrient yields. Social indicators are identical to Scenario 2 and focus on protected and regulated areas such as MS4s, active watershed groups and miles of streams designated as high quality water.

Scenario 6 Indicators

Ecological:

- % wetlands in riparian zone
- biotic integrity

Stressor

- Developed areas
- % change in urban area
- % of nutrient-listed waters
- Point sources
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Protected or regulated areas
- Percent of watershed instate
- Watershed group counts
- Miles of high quality waters

Scenario 7 – Nitrogen dominated challenges

Nitrogen sources and pathways are primarily driven by nitrogen fertilizer application and drained agricultural fields. In drained agricultural areas, nitrogen fertilizer application at the surface is lost to tile drains and ditches through shallow groundwater flow which discharges into downstream surface waters. Manure and wastewater (septic systems and point sources) also contribute to nitrogen loading.

Ecological indicators include natural cover in the watershed, wetlands in the riparian zone and aquatic species diversity and biotic integrity. Stressor indicators include cultivated crops (primarily row crops), drained landscapes, animal units, septic systems, atmospheric deposition and fertilizer application, point sources and nitrogen yields. Nutrient impairment listings will most often be linked to drinking water concerns and thus are included as a stressor indicator. Social indicators focus on TMDL activity, percent of watershed that are protected lands or potentially restorable as wetlands, percent of watershed that is designated a drinking water source protection area, watershed groups, level of agricultural BMP activity and miles of streams designated as high quality water.

Scenario 7 Indicators

Ecological:

- Natural cover in watershed
- % wetlands in riparian zone
- Aquatic animal species diversity and biotic integrity

Stressor

- Cultivated crops
- % of watershed drained
- Number of animal units
- Septic systems
- Nitrogen deposition and fertilizer use
- % of nutrient-listed waters
- Point sources
- SPARROW nitrogen yields

Social

- Watershed TMDLs
- Percent of watershed instate
- Protected areas
- Designated for drinking water
- Watershed group counts
- Agricultural BMP activity
- Miles of high quality waters

Scenario 8 – Phosphorus dominated challenges

Scenario 8 ranks watersheds that could be focused on for phosphorus reductions. Phosphorus sources and pathways are primarily driven by sediment transport and point sources. Particulate phosphorus is attached to sediment particles, therefore stormwater runoff in the watershed (developed, rural or urban) and near-channel sources of sediment, including stream bank erosion, are typically important sources of phosphorus. Wastewater is also high in phosphorus when limited treatment is provided.

Ecological indicators include natural cover in the watershed and riparian areas, imperviousness in riparian areas, the percent of land draining small streams and aquatic species diversity and biotic integrity. Stressor indicators include cultivated crops, urbanized areas, animal units, septic systems, soil erodibility, point sources, percent of waters listed for nutrients (e.g., eutrophication, algae) and phosphorus yields. Social indicators focus on TMDL activity, percent of watershed that are protected or regulated, potentially restorable wetlands, watershed groups, level of agricultural BMP activity and miles of streams designated as high quality water.

Scenario 8 Indicators

Ecological:

- Natural cover in watershed and riparian area
- Imperviousness in riparian areas
- % of watershed draining headwaters
- Aquatic animal species diversity and biotic integrity

Stressor

- Cultivated crops
- Developed area
- Number of animal units
- Septic systems
- Erodibility of soils
- % of nutrient-listed waters
- Point sources
- SPARROW phosphorus yields

Social

- Watershed TMDLs
- Protected or regulated areas
- Potentially restorable wetlands
- Percent of watershed instate
- Watershed group counts
- Agricultural BMP activity
- Miles of high quality waters

Scenario 9 – Lake or reservoir dominated watershed

Lakes and reservoirs are susceptible to phosphorus loading in particular, although when used for drinking water sources nitrogen is also important. Lakes and reservoirs will often act as sinks for phosphorus as particulates settle in the water column. Algae production in these water bodies due to excessive nutrients can result in diminished recreational opportunities and degraded fish communities. High levels of nitrate in drinking water supplies is also a health threat and often leads to high treatment costs.

This scenario is a combination of Scenario 7 and 8 (Nitrogen and Phosphorus Dominated Challenges). The watersheds being screened will be pre-selected to include only those watersheds that are dominated by lakes or reservoirs.

Scenario 9 Indicators

Ecological:

- Natural cover in watershed and riparian area
- Imperviousness in riparian areas
- % wetlands in riparian zone
- % of watershed draining headwaters
- Aquatic animal species diversity and biotic integrity

Stressor

- Cultivated crops
- Developed area
- % of watershed drained
- Number of animal units
- Septic systems
- Erodibility of soils
- Nitrogen deposition and fertilizer use
- % of nutrient-listed waters
- Point sources
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Protected or regulated areas
- Potentially restorable wetlands
- Percent of watershed instate
- Watershed group counts
- Agricultural BMP activity
- Miles of high quality waters

Scenario 10 – Wetland dominated watershed

This scenario ranks watersheds that are dominated by wetlands. Wetlands can be both sinks and sources of nutrients, depending on various watershed and climatic factors, and therefore the presence of existing wetlands can be either an ecological indicator (sink) or a stressor indicator (source). This scenario is based on wetlands being nutrient sinks.

Watersheds dominated by wetlands can be ranked according to ecological indicators that consider the watershed's resilience including natural cover in the watershed and riparian areas, low level of change (or loss) of wetlands, the percent of land draining small streams and the number of aquatic species. Stressor indicators can include agricultural and developed land uses, presence of septic systems which can lead to nutrient loading especially in areas with a high water table often found in wetland dominated landscapes, animal agriculture activities, point sources, nutrient loading and known nutrient impairments (listings). Atmospheric deposition of nitrogen is also an important stressor indicator since deposition occurs directly into the waterbody. Social indicators focus on TMDL activity, protected lands (including drinking water sources), watershed groups and miles of streams designated as high quality water.

Scenario 10 Indicators

Ecological:

- Natural cover in watershed and riparian zones
- % of watershed that is wetland
- Change in wetland coverage
- % of watershed draining headwaters
- Aquatic animal species diversity

Stressor

- Agricultural land uses
- Developed area
- Number of animal units
- Septic systems
- Nitrogen deposition
- % of nutrient-listed waters
- Point sources
- SPARROW nutrient yields

Social

- Watershed TMDLs
- Protected lands
- Percent of watershed instate
- Watershed group counts
- Miles of high quality waters