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The Recovery Potential Screening Tool-Screening for Land-Based Sources of Pollution that Stress Coral Reefs

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Purpose

The purpose of this document is to advise coral reef practitioners and local governments on using the Recovery Potential Screening (RPS) Tool to evaluate and compare watersheds for sediment and nutrient runoff into coral reef ecosystems. This document is not a comprehensive overview of the tool, but rather an introduction to the tool's specific features that may be relevant for coral reef protection. This document includes the following sections:

- Background
- Introduction to RPS Tools
- Setting up an RPS Tool
- Interpreting the Results of an RPS Tool
- Applying an RPS Tool to Prioritize Watersheds for Actions to Reduce Sediment and Nutrient Runoff to Coral Reef Ecosystems
- Indicators Relevant for Sediment and Nutrient Runoff to Downstream Coral Reefs

Resources with in-depth instructions have been created by EPA and its partners and are provided in the "Additional RPS Tool Resources" section at the end of this document. Support for RPS Tools is provided by EPA's Healthy Watersheds Program (HWP-Team@epa.gov).

Background

Coral reefs are precious marine ecosystems. An estimated 25% of all marine life is dependent on coral reefs at some point in their lifecycle. Coral reefs also benefit coastal communities by stimulating tourism and providing shoreline protection. A study completed by the U.S. Geological Survey (USGS) entitled *Rigorously Valuing the Role of U.S. Coral Reefs in Coastal Hazard Risk Reduction* estimated the value of shoreline protection provided by coral reefs to coastal communities to be close to two billion U.S. dollars annually (Storlazzi *et al*. 2019). Unfortunately, coral reefs are at risk because they are susceptible to many different threats, including local, land-based pollution. EPA and its partners work to address many land-based pollution sources that impact coral reefs, including excess sediments and nutrients, which can negatively interfere with the respiration, feeding, growth, recruitment, and reproduction of corals (Figure 1). Improved management of land-based sources of pollution can improve the health of coral reefs. This was further illustrated in a National Academies of Science (NAS) study, *A Decision Framework for Interventions to Increase the Resilience and Persistence of Coral Reefs.* This study demonstrated that the management of land-based pollution sources and sustainable fishing practices are essential to increasing the resilience of coral reefs to elevated ocean temperatures, which leads to coral bleaching and higher disease prevalence (NAS, 2019).

Figure 1. *A photo highlighting an effect of land-based sources of pollution on corals. Excess sedimentation leads to smothering of the coral colony.*

The RPS Tool provides a systematic approach for comparing watersheds and can be used by coral reef practitioners and local governments to prioritize watersheds for management actions to reduce nutrients and sediments in watershed runoff. As described below, customized RPS Tools have been created and are available, for all US states and territories, including Hawaii, Florida, Puerto Rico, US Virgin Islands (USVI), Guam, American Samoa, and the Commonwealth of the Northern Marianas Islands (CNMI). Access to state and territory tools can be found at https://www.epa.gov/rps/downloadable-rps-tools-comparing-watersheds#Statewide.

Introduction to RPS Tools

The term "RPS Tool" used throughout the document refers to any number of custom-coded Excel spreadsheets designed to support watershed comparison and prioritization. Each RPS Tool is configured for a given state or territory and stores pre-calculated watershed characteristics/considerations (described as indicators) for that area. RPS Tools can also be readily updated with user-supplied indicator data. Interactive menus allow users to set up a screening by choosing relevant watersheds and indicators. Recovery potential scores and ranks are automatically calculated by the tool based on user settings. Screening results are displayed in table, graph, and map forms, giving managers options when communicating results to stakeholders and decision-makers.

Most RPS Tools allow for the comparison of 12-digit Hydrologic Unit (HUC12) sub-watersheds (see definition here: https://enviroatlas.epa.gov/enviroatlas/glossary/glossary.html#huc) from the National Watershed Boundary Dataset maintained by USGS and the Natural Resources Conservation Service. Alternative watershed scales, such as state-specific watershed delineations, are available in some RPS Tools based on information provided by state or territory water programs.

Detailed instructions for choosing watershed indicators and conducting a screening analysis can be found within each RPS Tool and on the RPS Training and User Support website found at https://www.epa.gov/rps/rps-training-and-user-support. The following sections present a broad overview of highlights and options in RPS Tools and present specific considerations for coral reef practitioners and local governments.

Setting up an RPS Tool

As shown in Figure 2, RPS Tools use three categories of indicators (Ecological, Stressor, and Social) to compare watersheds within a state or territory. The three categories contain several different indicators that can be combined and evaluated to create a Recovery Potential Integrated (RPI) Index score.

- *Ecological* indicators measure the current condition of aquatic ecosystems and the watershed's capacity to maintain or reestablish natural structure, function, and resilience. Examples of ecological indicators include percent forest in the watershed, percent grassland in the watershed, and soil stability.
- *Stressor* indicators measure the presence and amount of human activity in the watershed that can increase pollutant loading and degrade aquatic ecosystems. Examples of stressor indicators include population density, percent agriculture in the watershed, and percent urban cover in the watershed.

- *Social* indicators address community, regulatory, economic, and/or behavioral factors that influence watershed management approaches and planning. Social indicators are not typically measured from national datasets and, therefore, are often augmented by users with information from states or territories. For this reason, pre-calculated social indicators may or may not be present in RPS Tools. Examples of social indicators include percent protected lands in the watershed, presence or absence of Marine Protected Areas, and presence of active watershed groups.

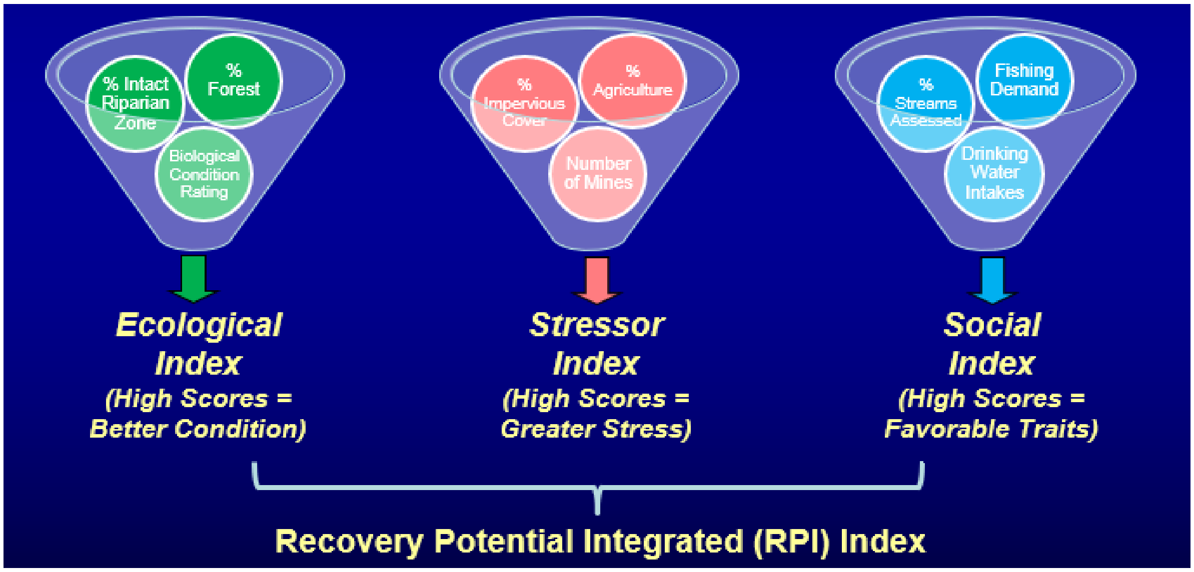

Figure 2. *Simplified graphic of how the Ecological, Stressor and Social indices are evaluated and combined into the Recovery Potential Integrated Index (RPI). Indicators within each category are combined to calculate Ecological Index, Stressor Index, and Social Index scores. In addition, an overall RPI Index Score is calculated by combining the Ecological Index, Stressor Index, and Social Index. Together, the indicators and index scores are used to compare watershed characteristics and can be identify priorities for watershed management initiatives to reduce sediment and nutrient loading to coral reef ecosystems.*

A screening run typically uses between 3 and 12 indicators per category. A list of example indicators that may be useful for sediment and nutrient screenings can be found in the "Indicators Relevant for Sediment and Nutrient Runoff to Downstream Coral Reefs" section. Including too many or too few indicators can negatively affect the usability of RPS Tool outputs. Specifically, the inclusion of too many indicators can confound distinctions between watersheds because of the way RPS scores are generated. Alternatively, using too few indicators can skew the results by neglecting relevant information. RPS Tools require users to include at least one indicator per category to conduct a screening run. Therefore, if a user does not wish to evaluate the watersheds by one of the categories, the "Neutral Variable" indicator within the category should be selected before running the screening. Selecting the "Neutral Variable" for a category tells the RPS Tool to rank all the watersheds equally for that category; therefore, the category will not influence the overall RPI index score.

Indicator selection is an important decision that should reflect the screening objectives. Each of the selected indicators should provide a different 'piece of the puzzle' within the three categories. An RPS Tool may include pairs of indicators calculated from the same dataset, but are inverses of one another and grouped into separate categories. For instance, the ecological indicator of soil stability is the inverse of the stressor indicator soil erodibility. Using both indicators in the same screening does not provide any extra information. Furthermore, they will cancel each other out in the RPI calculations. Other cases of indicator correlation may be explored as part of indicator selection. However, since RPS is a screening-level tool, a detailed analysis of indicator correlation is not commonly completed. By default, indicators are weighted equally during a screening, but a user may change the weights based on relevance to the screening objectives or expert insight. Indicators with higher weights will have a greater influence on the calculated index scores. An example weighting scheme is to assign each indicator a value of 3, 2, or 1, implying high, medium, or low relevance, respectively.

Interpreting the Results of an RPS Tool

Results from RPS Tools have been applied in various ways, including prioritizing watersheds for management actions. In general, it can be beneficial first to determine the target profile of watershed conditions for anticipated management actions (for example, highly degraded watersheds versus watersheds that are healthy but vulnerable). The Ecological, Stressor, Social, and RPI Index scores can then be reviewed together to identify watersheds that fit the desired profile.

Indicators and Index Scores/Ranks

A screening's results are generated in various formats, including tables, charts, and maps, displaying indicator values, index scores, and rank orders. Each result can provide useful information for identifying priority watersheds:

- *Single indicators* provide an opportunity to understand specific watershed-to-watershed differences. Sometimes a single indicator can be closely related to suitability for a specific restoration technique or best management practice. For example, watersheds with high scores for the stressor indicator *soil erodibility* might be ideal areas to plant vegetation stabilizing stream banks.
- The *Ecological Index, Stressor Index, and Social Index* scores combine indicators from each category into index scores that range from 0 to 1. The meaning of each index is summarized in Table 1. The Ecological Index, Stressor Index, and Social Index are intended to be reviewed in consideration of each other to identify watersheds that have preferred traits for prioritization across the three categories.

Table 1. Summary of the Ecological Index, Stressor Index, and Social Index scores.

Index Type	Directionality and Meaning
Ecological Index Score	Higher values = Better condition of natural landscapes supporting healthy aquatic ecosystems and watershed functions (hydrologic, geomorphic, and water quality regimes)
Stressor Index Score	Higher values = Greater exposure to factors (agricultural or urban land cover, nutrient or sediment loads, etc.) that could degrade the condition of aquatic and downstream marine ecosystems
Social Index Score	Higher values = Positive social characteristics for prioritization (community involvement, meeting program and policy requirements, presence of socially valued resources, data availability, etc.)

- *The RPI Index Score* combines the three indices into an overall value or score. While there is value in comparing watersheds by way of an overall score, the RPI score should not be relied upon as the only screening product. The RPI score can range from 0 to 1, with higher values corresponding to better ecological and social conditions and lower stressor exposure. In other words, watersheds in good ecological condition with a positive social context and low stressors score well. For additional information on how RPI scores are calculated in RPS Tools, please refer to the RPS Tool's User Manual found on the RPS Training and User Support website (https://www.epa.gov/rps/rps-training-and-user-support).

When reviewing index scores, it is essential to remember that the results will reflect only those indicators used in the screening. For example, if a screening only included stressor indicators related to urban development, the Stressor Index would not reflect any potential degradation from other sources such as agriculture or mining.

Rank-Ordered Tables

RPS Tools generate tables of results for the screened watersheds that can be sorted by any indicator value or index score. Rank-ordering organizes the screened watersheds from highest to lowest score for each of the four indices. Rank orders provide an easy and transparent method to identify a smaller, targeted subset of watersheds for action by selecting a specific number or percentage of favorably ranked watersheds.

The selection of priority watersheds through rank-ordering can be a straightforward approach to using RPS Tool results. However, while results are useful for characterizing significant differences between high- and low-scoring watersheds, they do not support distinctions among minimal scoring differences in RPS Tool results. One option for organizing rank-ordered lists in a more generalized ranking is to group the watersheds by quartiles or percentiles.

Bubble Plots

RPS Tools produce bubble plots that allow users to visualize the Ecological, Stressor and Social Index scores of each watershed at the same time (Figure 3). The bubble plot offers a systematic way to understand how the ecological, stressor and social characteristics of each watershed vary relative to the rest of the screened watersheds.

The bubble plot displays watersheds as circles with the Stressor Index score plotted on the horizontal axis and the Ecological Index plotted on the vertical axis. Circle size is determined by the Social Index score (a larger circle corresponds to a higher Social Index score). By default, the chart axes are set at the median of Ecological and Stressor Index values for all watersheds included in the screening. The axes split the bubble plot into four quadrants, which can provide a system for grouping and prioritizing watersheds:

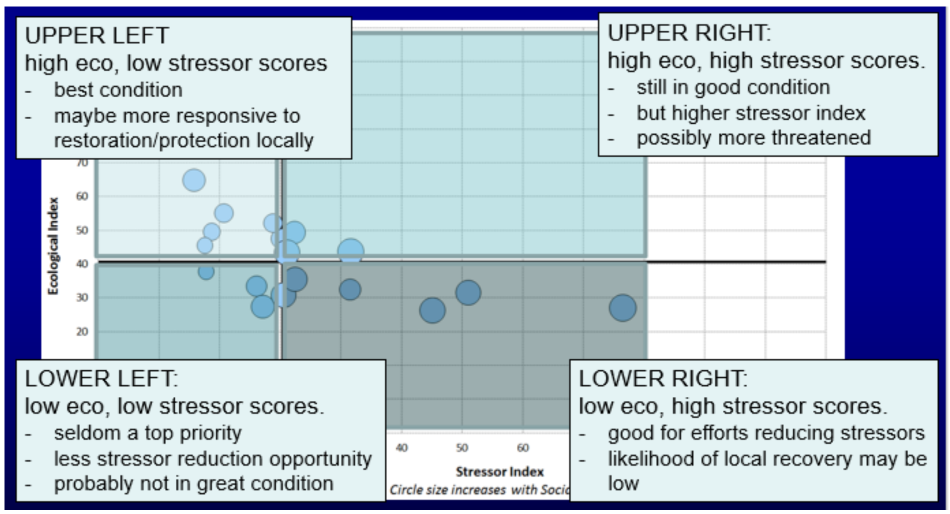

Figure 3. *Bubble plot produced by an RPS Tool. The scores are divided into four quadrants, which can provide insight to what kinds of management strategies would be suitable for each watershed.*

- The *Upper Left* quadrant contains watersheds with high Ecological Index and low Stressor Index scores. These watersheds often represent the healthiest watersheds that may be good prospects for protection, along with some minimally impaired watersheds that are not under severe pressure from stressors and may be good prospects for restoration. Reefs influenced by these healthier watersheds (less sediment and nutrient runoff) could benefit from other types of restorative activities outside of the watershed (e.g., algae/invasive species removal or implementation of an MPA). Because of the good condition, coastal zones linked to these watersheds might be considered a good option for coral outplanting.
- The *Upper Right* quadrant contains watersheds with high Ecological Index and high Stressor Index scores. These results suggest good ecological conditions, but an elevated risk from stressors. Watersheds in the upper right quadrant may be good candidates for immediate management action to reduce sediment and nutrient loading due to their vulnerable status. Reefs influenced by these watersheds may also be considered highly vulnerable due to the greater potential for a transition from relatively low to high sources of land-based pollutants compared to other watersheds in the screening. Prioritizing management activities to watersheds in this quadrant could mitigate the risk of degraded water quality before ecological degradation is experienced on the reef.

- The *Lower Right* quadrant contains watersheds with low Ecological Index and high Stressor Index scores. These watersheds may contain severely degraded aquatic ecosystems and high levels of human disturbance to the landscape and watershed functions. Watersheds in the lower-right quadrant may be good candidates for reducing large sediment and nutrient loads or other significant stressors. Still extensive time and effort may be needed for complete ecosystem recovery. Similarly, the reefs influenced by these watersheds are more likely to have greater exposure to land-based sources of pollution. Depending on stressor characteristics, watershed management plans may identify projects intended to reduce significant pollution loads to adjacent reefs but would require more complex management planning to address the greater number and types of pollutant sources. Furthermore, reefs influenced by these watersheds may be significantly altered and require more time to recover.
- The *Lower Left* quadrant contains watersheds with low Ecological Index and low Stressor Index scores. These watersheds may contain aquatic ecosystems that have been affected by other factors not considered in the group of stressor indicators selected for the screening and may be good candidates for more detailed evaluations of the sources of degraded water quality.

It is important to note that the presence of a watershed in any of the quadrants is always in relation to the other watersheds included in the screening. If more watersheds are added, or some subtracted from the screening, the quadrant for a watershed could change. This affects interpretation of the data. For example, a watershed in the upper left quadrant might be the best possible candidate for coral outplanting from among the watersheds considered, but it still may lack the environmental quality to support newly planted corals.

Maps

Maps are a useful method for visualizing a comparison of watersheds (Figure 4). Like the two techniques described above, mapping offers strengths and weaknesses for interpreting and applying RPS Tool results. Maps are commonly used to communicate results to wide audiences, but a map can only display one indicator or index score at a time. An RPS Tool includes basic mapping capabilities that allow users to develop customized maps of any indicator or index. Data tables from an RPS Tool can also be saved and transformed for additional processing in GIS software.

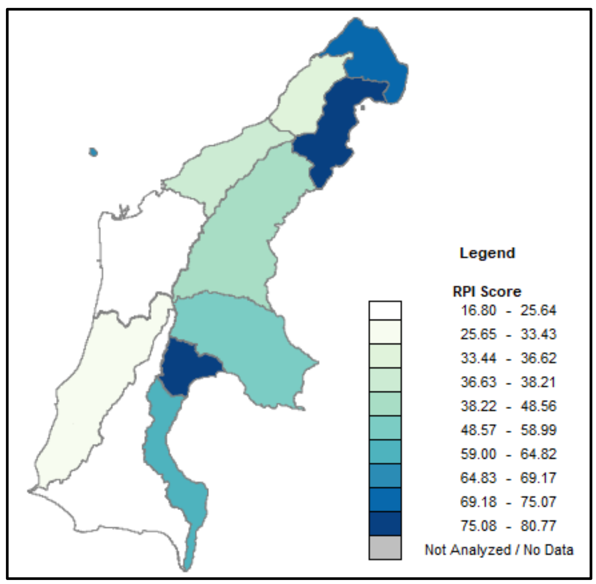

Figure 4. *A map of Saipan produced by the CNMI RPS Tool.*

Maps of screening results can reveal geographic patterns such as clusters or corridors of high or low index scores. One advantage of mapped results is the potential recognition of watersheds which, if restored, could link watersheds across a larger region that are in good condition. Maps can also support geographically based strategies for targeting priority watersheds.

Applying an RPS Tool to Prioritize Watersheds for Actions to Reduce Sediment and Nutrient Runoff to Coral Reef Ecosystems.

As noted above, excess sediments and nutrients from land can be detrimental to coral reefs by interfering with critical biological functions. However, due to the dynamic nature of ocean environments, some reefs are more influenced by land-based sources of pollution than others. Studies have shown that wave height, wave direction, and nearshore currents can influence the persistence of land-based sources of pollution near coral reefs. Nearshore currents may carry runoff from other watersheds to different reef communities. Additionally, threats such as overfishing, increasing sea surface temperatures, and invasive species introductions can impact a coral reef ecosystem's health. All of these variables can obscure connections between watershed management and coral reef health (Rodgers *et al.,* 2012). RPS Tools do not account for oceanographic variability or anthropogenic pressures in the marine environment. As such, an RPS Tool should not be used as the sole means for assessing a watershed for prioritization of ridge to reef management strategies. Rather, an RPS Tool aids in evaluating and comparing of watersheds that may produce polluted runoff to an adjacent coral reef ecosystem and should be used in conjunction with other environmental considerations. Suppose characteristics of sediment or nutrient runoff have been identified as impactful stressors to coral reefs in a state or territory. In that case, an RPS tool can help determine which watersheds to prioritize for management actions.

The listed indicators, found in the following three tables (Tables 2-4), are examples of factors that may be relevant to managing watershed nutrient and sediment runoff. The tables include the names of the indicators, their descriptions, explanations of their relevance to coral management, and the state or territorial RPS Tools that include each of them. The indicators in the first table are ecological indicators; the second table contains stressor indicators; and the last table is comprised of indicators of differing categories that are not truly features of the watershed. These non-watershed features are indicators that are depictive of the adjacent coastal/reef conditions and can provide important details for decision making. More detailed descriptions, including the data sources, can be found within each RPS Tool, on the Indicator Info tab of the Excel spreadsheet.

The indicators provided in the following tables represent a selection of indicators that can be found in the state and territory RPS Tools. Many other indicators that may be useful, depending on specific management objectives. If a specific indicator is not available in a state or territory tool please contact EPA's Healthy Watersheds Program at HWP-Team@epa.gov.

Indicators Relevant for Sediment and Nutrient Runoff to Downstream Coral Reefs

Table 2. *Ecological indicators within RPS Tools that many be relevant to managing sediment and nutrient runoff from watersheds to coral reef ecosystems.*

Ecological Indicators			
Indicator Name	**Description**	**Relevance to Corals**	**RPS Tools with Indicator**
N-Index2	Percent of the watershed classified as natural land cover (not including barren land). Natural land cover classes are captured in the N-index2 include forest, wetlands, shrubland, grassland, and aquatic beds.	Aquatic ecosystems are connected to the landscape through surface and subsurface drainage. Natural land cover throughout a watershed maintains hydrologic processes such as infiltration, evapotranspiration, and groundwater recharge, and protects aquatic ecosystems from nonpoint sources of pollution, including urban and agricultural runoff.	Hawaii and CNMI
Soil Stability, Mean in Watershed	Mean soil stability in the watershed. Soil stability is the inverse of soil erodibility, calculated as the average of erodibility grid values per subwatershed.	Natural levels of erosion supply sediment in an amount and rate that support healthy aquatic ecosystems by maintaining natural channel morphology and bed substrates. Soil stability represents the susceptibility of soil to erosion from surface runoff. Coarse-textured, sandy soils and soils high in clay have low erodibility and high stability values. Soils with a high silt content are the most erodible and the least stable. They are easily detached and produce high rates of runoff. Continual erosion and excess sediment have been linked to coral habitat degradation and may exacerbate nutrient, water temperature, or other stressors.	Hawaii
Watershed Health Index Score	The mean Watershed Health index score for the watershed. The score is an evaluation of overall watershed health, derived from the levels of human disturbances across a set of land cover classes. Scores were developed by the Hawaii Institute of Marine Biology at the University of Hawaii at Manoa.	Higher values correspond to a greater ability of the land cover types within the watershed to support higher levels of water quality and healthy ecosystems in streams and rivers. Streams and rivers with good water quality and healthy aquatic ecosystems are supportive of healthy coral reefs downstream.	Hawaii

Table 3. Stressor indicators within RPS Tools that many be relevant to managing sediment and nutrient runoff from watersheds to coral reef ecosystems.

Stressor Indicators			
Indicator Name	**Description**	**Relevance to Corals**	**RPS Tools with Indicator**
Soil Erodibility, Mean in Watershed	Mean soil erodibility in the watershed. Mean soil erodibility was calculated as the average of erodibility grid values per subwatershed.	Natural levels of erosion supply sediment in an amount and rate that support healthy aquatic ecosystems by maintaining natural channel morphology and bed substrates. Soil erodibility represent the susceptibility of soil to erosion from surface runoff. Coarse-textured, sandy soils and soils high in clay have low erodibility values. Soils with a high silt content are the most erodible and the least stable. They are easily detached and produce high rates of runoff. Continual erosion and excess sediment have been linked to coral habitat degradation and may exacerbate nutrient, water temperature, or other stressors.	CNMI, Guam, American Samoa, Hawaii, Florida, USVI
% Agriculture	Percent of the watershed classified as agriculture cover. Agriculture cover includes 'Cultivated Land' and 'Pasture/Hay' land use layers.	Croplands and pastures have been linked to a wide variety of water quality and biotic impacts. Common effects seen at moderate to high agriculture land cover include less diverse and more tolerant macrobenthic communities, increased nutrient loading resulting in turbid water, accelerated erosion and bank destabilization, suspended sediment particles carrying pesticides, pathogens, and heavy metals, habitat degradation and reduced biodiversity, and increases in specific conductivity, nitrogen, and phosphorus concentrations which can increase macroalgal growth in coastal areas.	CNMI, Guam, American Samoa, Hawaii, Florida, USVI
% Agriculture on > 10% Slope in Watershed	Percent of the watershed with agriculture cover on slopes greater than or equal to 10 percent. Agriculture cover classes include 'Cropland' and 'Pasture' land use layers.	Soil erosion is amplified on steep slopes as runoff gains energy and more readily detaches soil particles while moving downhill. Agricultural areas are prone to erosion since they often have reduced vegetative cover relative to forests and grasslands and contain soils that are disturbed by tilling or livestock. Areas that combine both agricultural land use and steep slopes are therefore a concern for high rates of export of sediment and sediment-bound pollutants such as nutrients and pesticides into nearby waters.	CNMI, Guam, American Samoa, Hawaii, Florida, USVI
% Impervious Surface	Percent of the watershed classified as 'Impervious Surface' cover. Impervious surfaces are defined as hard surfaces including rooftops, parking lots, major roads, streets, sidewalks, driveways, and surfaces that are impermeable to infiltration of rainfall into underlying soils/groundwater.	Impervious surfaces in a watershed can increase the flashiness of streamflow, including high rates of stormwater runoff, reduced infiltration, and reduced groundwater recharge. This increases the potential for polluted runoff to reach coastal areas.	CNMI, Guam, American Samoa, Hawaii, Florida, USVI

Stressor Indicators			
Indicator Name	**Description**	**Relevance to Corals**	**RPS Tools with Indicator**
% Poorly Drained Soils in Watershed	Percent of the watershed with soils rated as poorly drained. Poorly drained soils include Groups C and D in the Hydrologic Soil Group classification system applied by the US Department of Agriculture (USDA) Natural Resource Conservation Service (https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download/?cid=stelprdb1262857&ext=pdf).	The drainage characteristics of soils determine the potential for rainfall to pond and runoff into surface waters. Soils are classified into four Hydrologic Soils Groups based on properties such as depth, texture, and the presence of dense layers that restrict downward water movement. Soils with poor drainage (Hydrologic Soils Groups C and D) have high potential for surface runoff, which can transport soil particles and pollutants that accumulate on the land surface into streams, lakes, and coastal waters.	CNMI, Guam, American Samoa, Hawaii, Florida, USVI
NPDES Permit Count	Number of National Pollutant Discharge Elimination System (NPDES) permits issued to facilities located in the watershed.	Wastewater treatment plants, factories, and other point sources of discharge into surface waters are regulated NPDES. The number of NPDES permits issued in a watershed is an indicator of the presence and complexity of point source pollutant discharge. NPDES permit counts may be related to the magnitude of point source pollutant loading, but higher permit counts do not always correspond to higher pollutant loads. For example, a watershed may contain a single, large NPDES permitted wastewater treatment facility that discharges higher pollutant loads than the combined total of several smaller facilities located in another watershed. Therefore, permit counts should be used as a starting point for further investigation of the types of discharges within watersheds.	CNMI, Guam, American Samoa, Hawaii, Florida, USVI
Local /Rural Road Density in Riparian Zone	Density of local and rural roads in the riparian zone of the watershed (defined in each RPS Tool as land within 100 meters of a stream or river). Includes unpaved roads or vehicle trails and minor roads that may be paved or unpaved. Major roads such as state/territory highways or county roads are not counted in this indicator.	Roads can be important sources of pollutants to aquatic ecosystems due to the accumulation and wash off dust, soil particles, plant residue, and vehicle fluids. Unpaved roads, in particular, can have very high rates of sediment production and transport. Roads located in the riparian corridor can have greater influence on aquatic ecosystems compared to upland roads due to their proximity and increased likelihood for direct runoff into a waterbody.	CNMI, Guam, American Samoa, Hawaii, Florida, USVI
Landscape Development Index Score	The mean Landscape Development Intensity score in the watershed. Higher values are reflective of increased human disturbances to the landscape including impervious	Higher values correspond to greater extent of land cover that can degrade coral reef health.	Hawaii

Stressor Indicators			
Indicator Name	**Description**	**Relevance to Corals**	**RPS Tools with Indicator**
	surfaces, agriculture, houses, roads, and industrial infrastructure.		
% Projected Sea Level Rise Inundation, (0,1,2,3,4,5, or 6) Ft Scenario	Percent of the watershed that is inundated under various sea level rise scenarios: zero, one, two, three, four, five, or six feet of sea level rise. These data depict the potential inundation of coastal areas resulting from current Mean Higher High Water (MHHW) conditions.	Increases in sea level could result in the inundation of wetlands as well as developed areas which could impact stormwater drainage as well as sediment and nutrient runoff.	CNMI
Population Density in Watershed	Human population density in the watershed (persons per square kilometer). Source data were from the 2010 US Census.	Large human populations reduce natural vegetative cover through conversion to urban and agriculture lands, while human settlement in riparian corridors removes the buffer between waterbodies and upland development. Additionally, higher populations are associated with increased wastewater discharge from sewage treatment plants, septic systems, and industrial sites and also a greater potential for water withdrawals and hydromodification (channelization, dams, levees, etc.)	Hawaii, CNMI, and Guam

Table 4. *Indicators beyond the watershed that may influence management decisions.*

Indicators Beyond the Watershed that May Influence Management Decisions				
Indicator Name	**Category**	**Description**	**Relevance to Corals**	**RPS Tools with Indicator**
Presence/Absence of Marine Protected Areas	Social	Presence/absence of Marine Protected Areas (MPAs) in the watershed (1= presence; 0= absence).	MPAs provide alleviation of various stressors and are reflective of valued resources and potential social motivation to improve or maintain marine habitats. Pairing an MPA with upstream watershed management activities could increase the protection provided to the area.	Hawaii and CNMI
Predicted Reef Health Index Score	Ecological	The mean Predicted Reef Health Index (RHI) score for coral reef areas adjacent to a watershed. Predicted RHI scores are derived from statistical modeling of coral distribution and abundance based on environmental and fishing pressure data.	Higher values correspond to greater potential for healthy coral reefs to be present downstream of the watershed. Predicted Reef Health Index Score should be evaluated as a single indicator that is then compared to the Stressor Index score. Watersheds that have high scores for this single indicator and the high Stressor Index score are indicative of healthy reefs at risk from poor water quality. Prioritizing management activities in these watersheds could mitigate the risk of degraded water quality before ecological degradation is experience at the reef.	Hawaii
Surveyed Reef Health Index Score	Ecological	The mean Surveyed Reef Health Index (RHI) score for coral reef areas adjacent to a watershed. Surveyed RHI scores are derived from samples of coral distribution and abundance.	Higher values correspond to the presence of healthier coral reefs downstream of the watershed. Surveyed Reef Health Index Score should be evaluated as a single indicator that is then compared to the Stressor Index score. Watersheds that have high scores for this single indicator and the high Stressor Index score are indicative of healthy reefs at risk from poor water quality. Prioritizing management activities in these watersheds could mitigate the risk of degraded water quality before ecological degradation is experience at the reef.	Hawaii

Additional RPS Tool Resources

Website
The Environmental Protection Agency provides further information about RPS Tools online:
https://www.epa.gov/rps
https://www.epa.gov/rps/rps-training-and-user-support

YouTube videos
The Environmental Protection Agency has developed a series of instructional videos that can be found here:
https://www.youtube.com/watch?v=8ZLamP4hYys&list=PL7F4YD5AdOGJyOAh5RVbhqzOCSkqnnate&index=1

Contact
HWP-Team@epa.gov

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