National Park Service
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Restoration Rapid Assessment Tool

RRAT User's Manual, v1.0

ON THE COVER
Cover design by Nicole Tancreto

The Restoration Rapid Assessment Tool
User's Manual v1.0

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Introduction

The Restoration Rapid Assessment Tool (RRAT) is an automated decision support tool used to evaluate and prioritize disturbed sites for potential ecological restoration. RRAT provides a standardized framework for quick site assessment and can reduce multi-day assessments to 1-3 hours per site.

A RRAT assessment consists of a user defining the natural condition and management goal (or desired future condition) for the site and then assessing the current condition of the site by providing a categorical score for 39 indicators. In addition, a user[1] assesses the ease of removing stressors to the site, identifies the site value, and assesses logistical constraints to restoration. RRAT calculates seven indices for each site based on the user's assessment scores: 1) Convergence, 2) Ease of Restoration, 3) Ecological Restoration Potential, 4) Gain for Effort, 5) Restoration Logistics, 6) Site Value, and 7) Stressor Removal Potential. Each site assessment produces a profile documenting the scores for the seven indices at that site. The assessment scores and results are stored within the tool, which is useful for comparisons of multiple sites.

This manual describes the framework of a RRAT assessment and the concepts behind each index (see 'The RRAT framework'). It also provides information on the use of the tool (see 'Using the tool'). The appendices provide additional information and examples. Appendix A gives definition of the various user inputs; Appendix B an example assessment; Appendix C the formulation of the output indices; an example site profile, site comparison, and excel formatted output of assessment input are provided in Appendixes D, E and F respectively; Appendix G the definitions for the export output; and Appendix H the RRAT field data sheet.

The RRAT framework

Why is RRAT needed?

[1] Note that this manual employs two terms, "user" and "observer". The observer refers specifically to the person making the assessment. User, on the other hand, may be the observer, but may also be a resource manager, park superintendent, or other person responsible for making restoration decisions.

Managers of parks and natural areas are increasingly faced with difficult decisions concerning restoration of disturbed lands. Financial and workforce resources often limit these restoration efforts, and rarely can a manager afford to address all concerns within the region of interest. With limited resources, managers and scientists have to decide which areas will be targeted for restoration, and the restoration treatments to use in these areas. A broad range of approaches are used to make such decisions, from well-researched expert opinions to gut feeling, with variable degrees of input from site visits, data collection and data analysis used to support the decision. A standardized approach including an analytical assessment of site characteristics based on the best information available, with a written or electronic record of all the steps taken along the way, would not only make comparisons among a group of sites easier, but would lend credibility through use of common, documented criteria at all sites.

In response to these concerns, a team consisting of scientists, programmers, and student researchers from the National Park Service, U.S. Geological Survey, Northern Arizona University, and University of Minnesota developed RRAT. The resulting tool is provides decision support based on a framework that incorporates observations of key indicators of site degradation, stressors influencing the site, value of the site with respect to larger management objectives, likelihood of achieving the management goal, and logistical constraints to restoration. Initial focus has been on riparian areas because they are among the most heavily impacted habitat types, and RRAT indicators (defined below) reflect this focus. Likewise, because the tool was developed under the auspices of the U.S. National Park Service, site values pertain to those of concern to national park managers. The tool is programmed in Visual Basic for Applications (VBA), which is widely available as a component of Microsoft Access. Users who wish to modify the tool for application to other habitat types and management goals may do so for their own purposes. The purpose of RRAT is not to make restoration decisions or prescribe methods, but rather to ensure that a basic set of pertinent issues are considered for each site and to facilitate comparisons among sites.

Several concepts are central to RRAT. First, the management goals of any site under evaluation should be known before the field evaluation begins. Second, so that field methods are not cumbersome, the field evaluations are based on readily observed indicators. Third, the ease with which site stressors can be removed must be factored into the evaluation. Fourth, intrinsic site value must be assessed independently of current condition. Finally, logistical considerations must also be addressed. This

manual addresses each of these aspects of RRAT in turn, followed by a concluding discussion of the indices derived from user input and their use in site evaluation and site comparisons.

User Inputs

Management Goal

Before any restoration can be undertaken, the goal for that restoration must be clearly articulated (Ehrenfeld, 2000). Prior to undertaking the site evaluation, the user must enter a description of the management goal in a text box provided by RRAT. This ensures that the goals are both firmly in mind and available to whomever does the evaluation in the field. Evaluation of indicators in the field depends on an understanding of the difference between the current and desired condition, as well as the impediments to achieving the desired condition. Thus, the user should become familiar with the indicators prior to formulating the management goal, to help ensure a comprehensive statement of restoration goals.

Indicators

RRAT indicators are easily observed site characteristics that reflect the status of underlying ecological processes. There are six types of indicators: 1) hydrology and landform, 2) soil and water quality, 3) non-native animals, 4) non-native plants, 5) native animals, and 6) native plants. These groups, and the specific indicators within them (see Appendix A), were vetted through a series of expert workshops followed by field-testing and refinement (Richey 2006). Hydrology, landform and soil indicators are based largely on descriptions in Pellant et al. (2005); these and all other indicators also benefitted from expert evaluation. Indicators were tested during the 2005 field season at national parks throughout the U.S. to ascertain their relationship to characteristics for which they were thought to be indicative (Richey 2006). In addition, the team assessed correlations among indicators; those that were strongly correlated were combined. Although redundancy can be useful in decision support tools, it is minimized in RRAT in an effort to keep assessment time to a minimum. Instead, RRAT contains a variety of advisories (discussed below) that alert users to inconsistencies.

Indicators are scored in two ways. First, the departure of current condition of the site from "natural" is scored with respect to an indicator; then, the departure of the management goal from current condition is

scored with respect to the same indicator. Thus, two pieces of information are required for each indicator, although if the management goal is "natural" a check box on the introduction page eliminates the need to enter the same answer twice for each indicator. If the departure from natural or management goal is not known or not applicable, it is scored as such. Pop-ups are available that describe the indicator and its range of values to assist the user and to ensure consistent interpretation. Although "natural" is a subjective concept, it is a useful point of comparison when several sites are being assessed. For example, a severely degraded site with a modest management goal could be judged equal to a much more pristine site that could be restored to a nearly natural condition. By including an assessment of convergence to a "natural" standard, the two sites can be separated, depending on the user's goal.

Stressor removal effort

After scoring the indicators, the user is asked to select from a list of stressors (see Appendix A) those that would require removal in the course of restoration. In addition, the user is asked to estimate the amount of effort needed to remove the stressor, ranging from "easy" (the stressor can be removed with currently available funds and personnel), through "difficult" (removal can be accomplished with difficulty, but added funds would be necessary) to "impossible". Stressors rated impossible to remove are highlighted in the output, but do not contribute to the stressor removal index (discussed below).

Site value

Reasons for wishing to restore a site are inherently subjective. For this reason, RRAT separates the intrinsic value of a site from more objective indicators of its condition. The site value scores currently included in RRAT reflect areas of importance to managers of national parks and include animal and plant community diversity, threatened or endangered species presence or habitat, recreation or aesthetic values, emblematic features, landscape rarity, or importance, and cultural or historic values. Each is scored on a scale ranging from "not valuable" to "extremely valuable". The user is instructed to place a value on the site if it were restored, rather than on the site in its current condition.

Logistical considerations

The logistical difficulty of restoring the site combines the scores of three assessments: 1) the size of the site to be restored, 2) the sites distance from a road, and 3) the sites wilderness designation.

Calculation of indices

Indices were developed to provide both a site profile and a basis for comparison among a group of sites being considered for ecological restoration. Indices fall into two general types: (1) those that relate to ecological aspects of restoration and (2) those that relate to logistical considerations. RRAT produces computationally transparent indices consisting of simple averages, ratios and easily understood functions (Appendix C). A higher index score always signifies a more favorable condition for restoration than a lower score.

Of the indices related to ecological site condition, two are calculated directly from user input: Convergence and Stressor Removal Potential. Convergence refers to the degree to which indicators approach either a natural condition or a management goal. It is calculated by assigning a value to the categorical answer the user may select for each indicator, summing the values of the selected indicators, and dividing by the total number of indicators; indicators assigned to unknown or not applicable are removed from the calculation. Stressor Removal Potential has a slightly more complex formulation, depending both upon the number of stressors that require removal and how difficult they are to remove. Because the development team assumed that overall difficulty increases at a faster rate for stressors that are more difficult to remove, RRAT uses the number of stressors in each indicator grouping, along with a multiplier specific to the degree of difficulty, to create an exponential function for each degree of difficulty. The base of the exponent also increases with difficulty. As a result of these calculations, the change in stressor removal potential has a steeper slope for more difficult-to-remove stressors than for those that are more easily removed.

Ecological Restoration Potential is a composite variable calculated as the mean of Convergence and Stressor Removal Potential. This average may be helpful when comparing sites that do not co-vary in the two indices.

Two indices directly involve the physical difficulty in conducting restoration activities at a site. Restoration Logistics takes into account the size of the disturbed area to be restored, the accessibility of the site via roads, and whether or not the site is within a designated wilderness area, which may severely

restrict the kinds of equipment that can be used. RRAT transforms categorical answers selected by the user into numerical values and averages them to obtain a value for Restoration Logistics. Ease of Restoration is a simple average of Convergence, Stressor Removal Potential and Restoration Logistics. As with Ecological Restoration Potential, the resulting score may be useful in separating a group of sites that do not co-vary for the three individual indices.

The index Gain for Effort calculates a ratio between Convergence and the sum of Restoration Logistics and Stressor Removal Potential. It provides a measure of the change made to the site to restore it to either natural or a management goal for the effort required. This index is primarily useful in a comparative sense; a site that would make a large gain for relatively little effort may be a more attractive option for restoration than one that would require a much greater effort for a smaller gain.

To calculate the Site Value index, a numerical value is assigned to the categorical user input, with "extremely valuable" receiving a value of 100, "not valuable" a score of 0, and the remaining categories receiving intermediate values (Appendix C). The mean of all aspects of site value rated is the reported Site Value index. This index may be useful in separating sites with varying values, but management goals may pertain to only one aspect of site value. The user should consider this aspect of the index with respect to their goals for the site.

The final index reported is the number of times "unknown" was selected for an indicator. Because the reliability of the assessment declines rapidly with the number of indicators that are not included in the assessment, users should consult with experts or others that are familiar with a site under consideration to determine values for as many indicators as possible.

Interpretive output

A user of RRAT may request two types of output. The Site Profile (see example in Appendix D) pertains to a single site and includes complete interpretive information for all indices as well as tabular output of site value ratings, stressors that require removal and their associated difficulty ratings, and warnings related to stressors that are impossible to remove and the number of unknowns in the assessment.

At the top of the first page of the site profile is the management goal, as articulated by the user, and basic site data such as location and size of the site. Following is the score for each index described above, with one column for comparison with natural and one for comparison with management goal. Each index has a footnote that describes it.

In each site profile, a table lists the aspects of site value that the user evaluated and the categorical values assigned to each. A second table lists the user-selected stressors that affect the site and the effort required to remove them. Any stressor deemed impossible to remove by the user is highlighted in red type and a warning advises the user to evaluate carefully their ability to achieve their management goal if the stressor cannot be removed. A third table is included only if unknown is selected for more than two indicators. This table lists the indicators for which unknown was selected and a warning advises the user to research the indicator(s) so that an appropriate response can be made.

A second form of output is a Site Comparison report (see example in Appendix E). This report consists of index scores for a group of sites selected by the user. If the user selects sites in more than one user-defined management area, a popup warns the user and asks if s/he wants to continue. For each group of sites selected, two reports are produced. One is based on comparison with natural, the other on comparison with the management goal for each site. These reports lack the tabular and interpretive output contained in the Site Profiles, but provide indices sorted in various ways to facilitate comparison as well as graphic output that plots the selected sites on four axes: Ease of Restoration, Ecological Restoration Potential, Restoration Logistics, and Site Value (see example in Appendix E).

Using the tool

Who should use RRAT?

The development team envisions two types of primary users: those doing assessments in the field and those using the assessments to develop priorities for restoration projects. The same person may or may not do both of these tasks. It is imperative that the field personnel be familiar with the ecological processes, expected flora and fauna, and history of the sites they assess. If more than one individual does site assessments for sites that will later be compared, they should work together for a period to calibrate their responses, so that differences reflect site attributes rather than observer bias.

Once several sites have been assessed, RRAT output can be used to examine the attributes of single sites or to make comparisons among sites. To make full use of the features of RRAT, the person using RRAT in this manner should have a clear idea of the restoration objectives for the sites and the constraints (e.g., funding levels, personnel, policy) under which the restoration activities will be conducted.

In addition to the two primary uses of RRAT, the team offers a few suggestions on using RRAT reflectively.

1. Sensitivity analysis – if the user is uncertain about how to score one of the indicators, s/he could enter the data once for each alternative, and see how much effect the differing scores have on the outcome. If the effect were large, research is suggested to find the definitive answer. On the other hand, if the difference is small, the uncertainty can be assumed unimportant with respect to the decision at hand.
2. Consistent use – in addition to the calibration among different users suggested above, it could be useful to check for consistency in a single field observer. Especially after a number of assessments have been made and the observer has gained substantial experience, repeating an early site can help detect shifts in the way indicators are evaluated.
3. Promoting discussion – RRAT output may be used to help stimulate discussion among decision makers.

Where should RRAT be used?

RRAT is intended to assess sites being considered for restoration. The user determines the appropriate geographic scope of their management area and site with some guidelines as follows. A management area should be defined to include only sites that can be reasonably compared. In general, the management area should encompass sites with similar ecological processes (e.g., riparian sites should be compared with other riparian sites, not with upland prairie sites), and common management policies (e.g., all the sites are eligible for the same funding source). In defining the site, the development team recommends that the user think in terms of the restoration goals and include only as much area as is needed to achieve those goals. Because one of the user inputs is the size of the site, and size is positively correlated with logistical difficulty, the user should specify only that portion of the area that requires restoration.

Starting out

RRAT is available for download as a .zip file. There are several .pdf files as well as the application .MDE file in the zip file. Make sure all these files are unzipped to the same folder. RRAT requires Access 2000 or a more recent Access version. The development team does not anticipate that versions of Access after 2000 will affect RRAT 1.0 performance.

After the user unzips the application, they are ready to begin. New users of RRAT should first review all aspects of this User's Manual. The user can enter assessment data directly into RRAT in the field using a laptop or tablet or the user can note assessment data on the supplied data sheet (Appendix H) and enter it later into the tool.

Quick tour

Each ‘page’ of RRAT has a title at the top. In this text, **bold standard text** indicates a page title and **bold underlined text** indicates a button on the application page**.** Definitions are available throughout the tool via pop-ups.

The User’s Manual is available on the entry page of RRAT (Figure 1) and through **RRAT Manual** button in the Help section of the **Main Menu** (Figure 2) of the tool.

Enter RRAT by clicking the **Continue** button.

The second page of RRAT (Figure 2) is the **Main Menu**. The **Main Menu** page provides four options for data management, three options for results management, and several help options

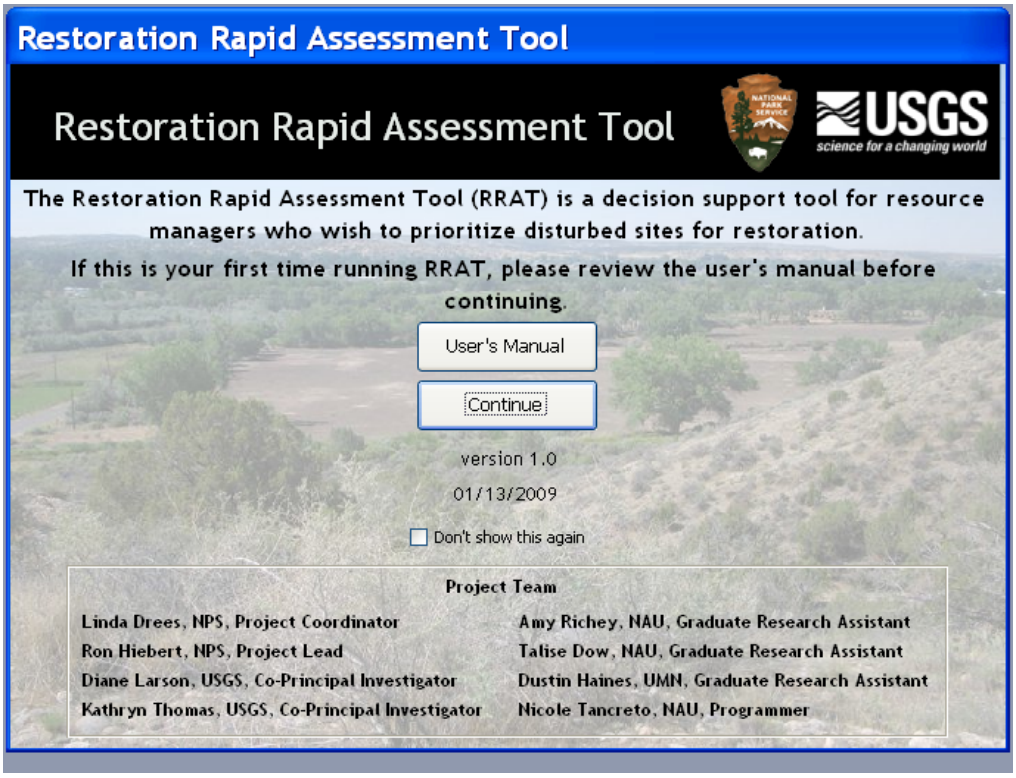

Figure 1. The RRAT entry page

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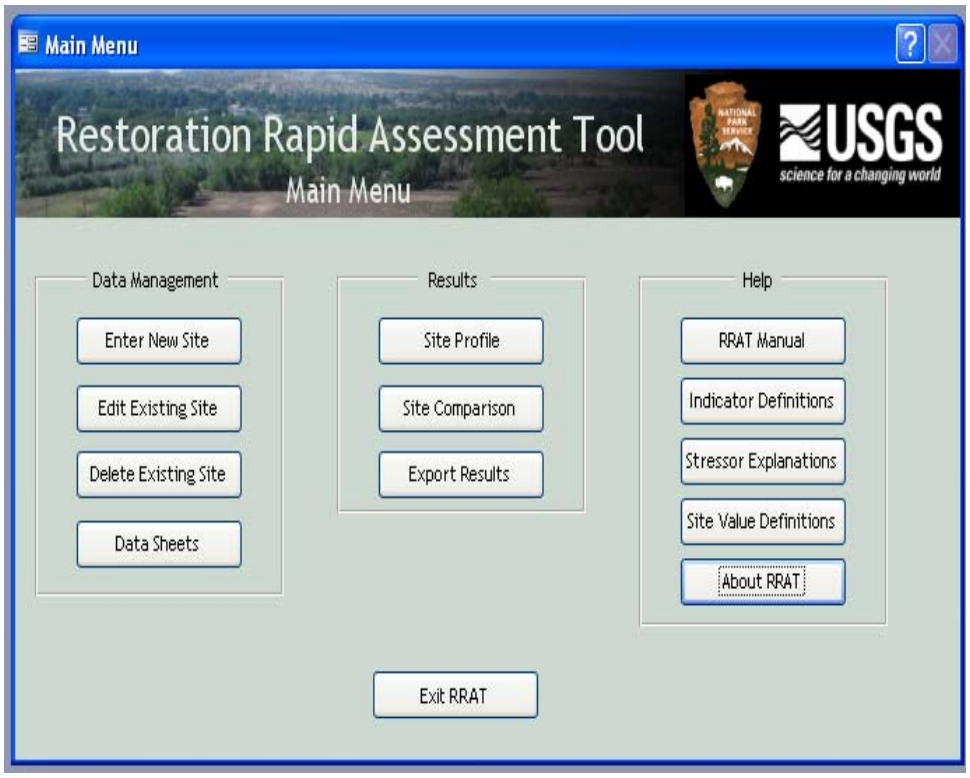

Figure 2. **Main Menu** page for RRAT showing buttons for data management features (left), results management (middle), and help (right).

Data Management

Enter New Site - the primary means by which the user initially enters data into RRAT, the **Enter New Site** button takes the observer to the **Site Data and Indicators** page **(see example Figure 3).** There the user enters information such as location, size, natural condition, and management goal for a new site. After entry, the site is automatically saved in RRAT and data can be retrieved.

Edit Existing Site - takes the user to the **Edit Site** page, which shows a listing of all sites the user has documented in the RRAT site assessment library. Here the user may select a site by highlighting it, then click the **Edit Selected Site** button in upper right, and return automatically to the **Site Data and Indicators** page. From there, the user may continue an incomplete site evaluation, change previous answers, or provide answers for those marked 'Unknown'.

Delete Existing Site – leads to the **Delete Site(s)** page, which shows a listing of all sites documented in RRAT. Select one or more sites, click the **Delete Selected Site** button in the upper right, and stored assessments of all selected sites are permanently removed from the RRAT site assessment library.

Data Sheets – here the user can print a blank data sheet (see example in Appendix H) using the **Blank Data Sheets** button, in the upper right. The observer can also print the assessment record for any site documented in RRAT using the **Data Sheets for Selected Sites** button.

Results

Each of the results buttons takes the user to a view of the RRAT site assessment library. The RRAT site assessment library contains each assessment that has been entered into RRAT. The assessments are indexed by Management Area, Site Name, and Observer. The user can access printable and downloadable profiles of single sites (**Site Profile** button) or a report comparing multiple sites for both natural conditions and the management goal (**Site Comparison** button), or may export the data to another format (e.g., Excel, with the **Export Results** button).

After clicking on the **Site Profile**, **Site Comparison,** or **Export Results** button, sites may be selected by highlighting the site name. To select multiple sites, press and hold SHIFT for consecutive sites or CTRL for non-consecutive sites. The filtering instructions at the top of the page also may be used to select sites. A toolbar opens with each report that allows the observer to print the report. The **Close** button on the toolbar returns the user to the **Site Profile** or **Site Comparison** page. The red X in the upper right hand corner of the print page will close RRAT, except when exporting to Excel.

Export Results button allows users to export assessments either to Excel spreadsheets or to text files. All data fields will be displayed if no selection is made in the 'Select Data Fields to Export' box. An example of Excel output for three sites assessed at Channel Islands National Park is shown in Appendix F. The geographical locations of multiple sites and their associated scores are useful exports if the observer wants to make a map of assessments. The exported data can be imported into a GIS to map the locations. Additionally, the raw scores or the categorical scores for each of the indices can be used as annotation on the map. Add other background data and/or images, such as aerial photography or topographic contours for better graphic display.

The scores for all indices are available for export as continuous scores or as five-value categorical scores. Appendix G provides a definition of each of the export data fields.

RRAT assigns a temporary file name to the Export Sites output in order to execute the command. The temporary file name is date coded; change the default temporary name to distinguish different Export to Excel outputs done in a single day.

Help

RRAT User's Manual – takes the user to a browseable copy of this manual.

Indicator Definitions - leads to definitions of the indicators and their scoring.

Site Value Definitions - leads to definitions for site value scoring.

Stressor Definitions – leads to definitions for stressor scoring.

Appendix A 'User input definitions' provides definitions for the indicators, site values, and stressors.

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Appendix A User input definitions

These instructions provide detailed information for RRAT user inputs.

Site documentation

Management Area: A management area is user defined. It can be, for example, the name of a park, a group of parks, a watershed, or a reach of a river. All sites must be assigned to a management area. If the management area is new, the tool will ask if the management name should be entered into the RRAT list. All sites must have a management name; the observer enters either enter yes or checks to make sure the management name is spelled correctly if the observer believes the management is already registered in RRAT but is not being automatically accepted.

Site Name: The site name also is user defined and is a unique link to one assessment. For example, My First Site is the unique identifier for a site assessment. There are two cases in which a site might be assessed more than one time: 1) the observer wishes to evaluate more than one management goal, 2) the site is assessed by another observer or 3) the site is assessed by same observer at a later time. In this case, the development team recommends that the unique identifier be modified to indicate the same site but that the assessment session is a subsequent session. For example My First Site – MG2 could be used for a second management goal at the same site as My First Site. If the site is assessed more than once (e.g., by different observers or with varying management goals), the subsequent assessments must have modified site names or the new data will replace any prior assessment with the same site name. Once the observer has entered both the management area name and the site name, an assessment is registered in RRAT, even though there may be no assessment scores.

Observer: The name of the person making the field assessment.

Date: The date is automatically entered into RRAT when the **Enter New Site** button is clicked. The date can be changed manually if the data are entered from a hard copy of the RRAT data sheet.

Latitude: Latitude in decimal degrees. An example of a decimal degree latitude is 32.2244. Use a GPS system to obtain the geographic coordinates.

Longitude: Longitude in decimal degrees. An example of a decimal degree longitude is -110.972. Use a GPS system to obtain the geographic coordinates.

Datum: Use WGS84 datum. Inconsistent datum among sites will make mapping of site locations problematic.

Location Description: A written description of how to find the site. Road or trail names and landmarks can be described so the site can be relocated with some ease.

Natural Condition Description (Natural Cond. Descr): The expected natural condition of the site. Historical information and/or comparison to a nearby, undisturbed site can guide the observer's description of the natural condition. Definition of natural conditions may require consultation with archival documents and/or consultation with experts.

Management Goal Description (Management Goal Descr.): A management goal for the site. The observer writes a brief description of the target biotic and physical environment. Determination of the management goal may require consultation with resource managers and administrators prior to field assessment.

Site logistical characteristics

Disturbance Size: The size of the site assessed, indicated by size categories.

Site Accessibility: The distance that people and/or equipment will need to travel off road in order to reach the site.

In Wilderness: Is the site within designated wilderness or not?

Assessment of Indicators

Upon completion of the site characteristics section, the observer begins the ecological assessment of indicators. There are six groups of indicators; each group appears on a separate tabbed page. The observer must select the degree of departure from natural and management goal for each indicator. Indicators marked "unknown" will be tallied and reported in the output. The reliability of a RRAT assessment declines as the number of unknowns increases. Every effort should be made to determine accurately the degree of departure for each relevant indicator. Some indicators may not be relevant to a particular site. In this case, they can be marked "not applicable" and removed from calculation of the index scores.

Hydrology/Landform Indicators

Rills are small erosional rivulets. The probability of rill formation is related to degree of disturbance and slope, but some soils are more prone to rill formation than others are. It is important to distinguish between the natural variation appropriate for the site and excessive formation caused by disturbance.

Severe: rills are much more abundant, closer together, higher and wider than expected for the site.

High: rills are somewhat more abundant and much closer together, higher and wider than expected for the site.

Moderate: rills are abundant and closer together or higher and wider than expected for the site.

Low: rills are slightly more abundant or closer together and higher and wider than expected for the site.

None: rills are as expected for the soil type and slope of the site.

Gullies are eroded channels cut by moving water. Gullies may be a natural feature of some sites, depending on the soil type and slope. Concentrated water flows, often caused by disturbances such as off-road vehicle use or overstocking of cattle, lead to increased gully formation.

Severe: gullies are numerous and have signs of active erosion, including headcuts, and little or no vegetation.

High: gullies are more abundant than expected, show signs of active erosion, but little headcutting, and have little or no vegetation.

Moderate: gullies have sloping sides, no headcutting, and some vegetation is evident.

Low: gullies have sloping sides, no headcutting, and substantial vegetation that stabilizes erosion.

None: gullies are as expected for the soil type and slope of the site.

Bare ground is mineral soil not covered by live or dead vegetation, litter, rocks, or biotic crusts. Bare soil is susceptible to erosion by wind or water. Bare ground may be a natural feature of some sites, especially those in arid environments. Therefore, even though the site description may correspond to a higher level of disturbance (e.g., Low – Severe), bare ground may, nonetheless, be as expected for the site.

Severe: the site departs from the expected amount of bare soil to the extent that it is either all bare soil when there should be near total vegetation cover or all vegetative cover when mostly bare soil is expected. Soil erosion and sedimentation processes severely impacted.

High: bare soil much less or much higher that expected. Erosion and sedimentation rates differ substantially from that expected.

Moderate: Bare soil moderately less or more than expected. Impacts to erosion and sedimentation processes moderate.

Low: Bare soil slightly less or more than expected. Negative impacts are minimal

None: Bare ground is as expected for the site.

Pedestals and/or terracettes indicate movement of soil by water or wind. Pedestals are plants or rocks perched on bits of soil that protected from erosion, while the surrounding soil has eroded away. This may also result from other processes, such as frost heave, which does not imply erosion. Terracettes, which are a result of water movement, are mounds of soil deposited behind some obstacle, such as a rock or plant.

Severe: abundant evidence of active pedestal and/or terracette formation with exposed roots common.

High: some evidence of active pedestal or terracette formation with some exposed roots.

Moderate: slight evidence of active pedestal or terracette formation with few exposed roots.

Low: active pedestal or terracette formation is rare; some evidence of past pedestal formation, especially in water flows and/or exposed slopes.

None: pedestal formation is as expected for the site; no terracette are present.

Wind scours, blowouts, or deposition areas are sites where wind has either picked up small soil particles, often leaving coarser soil or gravel behind, or where soils have been deposited by wind. Removal of vegetation or soil crusts can accelerate wind-caused erosion. Either soil removal or deposition can influence vegetation and hydrological patterns at the site. Alternatively, more vegetation than normal or interruption of disturbance processes can reduce wind scour below what is expected for some sites (e.g., dunes systems, coastal areas).

Severe: patches of soil removal or deposition are large and well connected throughout the site or patches of soil removal or deposition are extremely less than expected.

High: patches of soil removal or deposition are moderately large and somewhat connected throughout the site or patches are much less than expected.

Moderate: patches of soil removal or deposition are medium sized and widely scattered, or localized in a small portion of the site or patches are moderately less than expected.

Low: only a few patches of soil removal or deposition are evident at the site or patches are slightly less than expected.

None: soil removal and deposition is as would be expected for the site.

Litter, debris, and thatch presence and movement refers to the amount and distribution of dead plant material that remains in contact with the soil on the site. A riparian zone filled with rank non-native plants may have substantially more litter than expected for the site, while a site suffering from excessive

erosion may have substantially less litter than expected. An absence or very patchy distribution of litter may suggest that erosion is higher than desirable. Excessive litter may suggest the absence of natural herbivory or fire regimes.

Severe: litter accumulation is either extremely high or extremely low for the site; if low, litter remains only where it has been trapped by obstructions and all size classes of litter are displaced.

High: litter accumulation is either much higher than expected or much lower than expected; if low, litter is loosely concentrated around obstructions and moderate to small size classes of litter are displaced.

Moderate: litter is either somewhat higher or lower than expected; if low, only small to medium sized litter classes are displaced.

Low: litter accumulation is only slightly higher or lower than expected; if low, only small size class is displaced.

None: litter is as expected for the site.

Surface flow, including base flow, seasonal pattern, flooding regime and water table encompasses the amount and seasonality of water movement on the site. Surface flow is desirable in areas where floodplain ecosystems depend on seasonal overland water flow, and flooding can be a natural part of the seasonal cycle. When surface flow is abnormal, look for other indicators of erosion such as pedestals. A drop in the water table may be caused by invasive phreatophytes (plants with roots that reach the water table), and may result in changes in the native plant community.

Severe: surface water flow and flooding are extremely disrupted by obstructions, such as a dam or diversion structure; flow, seasonality, flooding regime, and water table are all affected. Flow may be higher or lower than expected at various times of the year.

High: surface water flow and flooding are somewhat disrupted; some aspects of flooding regime, seasonality and water table may be intact, but flows are not as expected.

Moderate: moderate disruption to surface water flow; disturbance intercepts a small portion of stream; water flow is diverted, concentrated, or impeded on only a portion of the site. Natural flooding regimes have been moderately altered, but are likely to be restorable.

Low: slight to moderate disruption of water flow. Natural flooding regimes have been slightly altered as a result of recent climatic condition and/or temporary circumstances.

None: surface water flow is as expected for the site.

Channel morphology refers to the structure of the channel through which water moves. Armoring, straightening, or otherwise modifying the channel may change water flows and patterns of sediment deposition, which result in changes in habitat for aquatic organisms.

Severe: channel has been both straightened and armored; no natural vegetation or streambed is visible.

High: channel has been straightened but not armored; sediment deposition is very different from expected for the site.

Moderate: channel moderately departed from natural contours; contact with floodplain is limited by levees or incision.

Low: channel is somewhat departed from natural contours.

None: channel morphology is as expected for the site.

Impervious surfaces and compaction refer to asphalt, improved roads, construction, and other man-made structures that repel water, as well as trails and unimproved roads where soil is compacted such that water penetration is substantially reduced. Such features increase runoff to drainages after storm events and may result in excessive flooding or contamination of water.

Severe: extensive soil compaction or presence of impervious surfaces; impacts >75% of the drainage.

High: substantial soil compaction or presence of impervious surfaces; impacts 50% - 74% of the drainage.

Moderate: moderate soil compaction or presence of impervious surfaces; impacts 15% - 49% of the drainage.

Low: low soil compaction or presence of impervious surfaces; impacts < 15% of the drainage.

None: no soil compaction or impervious surfaces in the drainage of the site.

Soil Quality Indicators

Soil surface erosion potential refers to the susceptibility of the soil surface to erosion, rather than to actual evidence of erosion, such as terracets. Absence of aggregates of organic matter or decomposing litter in physical contact with the soil, or of biological crusts, increases the likelihood of erosion, especially by water. Interspaces between plants may have different characteristics than soils beneath plants. Note that some sites may be naturally erosional, for example, badlands in the Great Plains. In this case, excessive stabilization of the soil by vegetation is considered a departure from expected conditions.

Severe: soil surface lacks any form of biological crust or organic material over the entire site; or a naturally erosional soil surface is completely protected from erosion.

High: soil surface lacks biological crusts or organic material in interspaces between plants; or only a small percentage of the soil surface that would naturally be subject to erosion is open to these processes.

Moderate: soil surface lacks biological crusts or organic material in moderately sized patches within the site; or moderate sized patches are available for erosional processes at sites where these are normally expected.

Low: soil surface lacks biological crusts or organic material in small, localized patches within the site; or only small, localized patches of the site protected from normally occurring erosion.

None: soil surface stabilized as expected for the site.

Soil loss or degradation refers to the quality of the top layer of soil, which contains most of the nutrients available to plants and most microorganisms responsible for nutrient cycling, and controls water infiltration. Lack of this organic layer makes seedling establishment difficult or impossible. In some cases, especially in sites that have been tilled, the top soil horizon is no longer distinct from those below, which also impairs its function. Note that this indicator refers to characteristics within the top soil layer, while "Soil surface erosion potential" refers to interactions with biotic material at the surface of the soil. Note that this indicator is not applied to areas in which soil is expected to be undeveloped, such as unconsolidated dune systems or river sandbars. However, it is applied to areas of developed soils between dunes.

Severe: the surface layer of the soil completely lacks structure and organic matter throughout the site.

High: the surface layer of the soil has little structure and/or organic matter throughout the site.

Moderate: the surface layer of the soil is degraded in structure and/or organic matter in one or more large patches within the site.

Low: the surface layer of the soil is degraded in structure and/or organic matter in a small, localized area within the site.

None: the soil surface layer is as expected for the site.

Soil chemistry and/or nutrient alteration can result from abiotic or biotic forces. For example, both subsurface irrigation and certain plant species can leave salt deposits at the soil surface. Certain soils are more likely to leach nutrients than are others, and abnormal pH can inhibit nutrient uptake by plants, as well. It is important for the observer to distinguish between natural processes at the site and those that would require remediation during restoration. Plant community composition and plant condition are usually good indicators of abnormal soil chemistry or nutrient status.

Severe: salt or other mineral deposits are evident on the soil surface and/or the plant community, if it exists at all, is dominated by salt or mineral tolerant plants not typical for the site; a high proportion of stunted or necrotic plants indicate severe nutrient stress across the site, or ramped vegetative growth indicating nutrient enrichment.

High: the plant community is depressed and limited to salt or mineral tolerant species not typical for the site; many stunted or necrotic plants suggest nutrient stress across the site or ramped vegetative growth is evident across the site.

Moderate: the plant community is depressed or limited to atypical salt or mineral tolerant species, stunted or necrotic plants suggest nutrient stress in one or more large patches within the site, or ramped vegetative growth in one or more patches indicates nutrient enrichment.

Low: the plant community has some atypical salt or mineral tolerant components and/or stunted or necrotic plants in a small localized area of the site. Ramped vegetative growth is evident in a small localized area.

None: there is no evidence of unnatural soil chemistry or nutrient status at the site.

Soil contamination may be a result of activities either on or upstream or upwind of the site. Knowledge of site history is required to evaluate fully this indicator. Clear signs of likely soil contamination include mine shafts or tailings, unidentified containers, or unexpected soil coloration. Unlike other indicators, this one represents a probability that the site is contaminated at all, rather than measuring the extent of contamination.

Severe: there is a known history of use of hazardous materials on the site and/or clear evidence (containers, tailings, soil discoloration) that activities that use hazardous materials took place at the site.

High: there is a known history of activity at the site that likely used hazardous materials and/or evidence that there may have been materials left at the site (e.g., unidentified containers).

Moderate: there is a known history of use of hazardous materials upwind or upstream from the site.

Low: there is evidence upstream or upwind of the site that activities that may use hazardous materials took place.

None: there is no evidence of use of hazardous materials either on the site or upwind or upstream from the site.

Sediment supply or transport often originates off-site. For example, agricultural runoff typically contains sediment that is deposited in nearby wetlands that drain the fields, resulting in unnatural filling in of wetlands and changes in the plant community around the margins of the wetlands (e.g., submerged plant species are replaced by emergent species or those that can survive drying conditions). Depending on the origin of the sediment, it may contain contaminants or fertilizers.

Severe: sediment deposition is high enough that a substantial portion of the site is unnaturally filled in and new plant communities have developed on these

High: sediment deposition has affected much of the site and differences in plant communities are evident.

Moderate: sediment deposition has affected a small portion of the site and differences in the plant communities are just beginning to become evident.

Low: sediment deposition is evident at the site but has not influenced plant community composition.

None: sediment deposition is as expected for the site.

Non-Native Animals

Presence of invasive non-native fauna is an indication that food webs and ecosystem functions may be disturbed at the site. Fauna of concern may range from earthworms in glaciated regions to domestic cattle and feral horses in native rangeland. In thinking about impacts of invasive non-native fauna, it is important to determine whether the invasive species is simply replacing the function of a native species that is no longer present, or if the invasive species represents the presence of a new function in the ecosystem.

Severe: invasive fauna are dominant in the ecosystem and have introduced new functional attributes that have changed ecosystem processes; native species have been displaced.

High: invasive fauna are common and have introduced new functional attributes that threaten to change ecosystem function (but have not yet); native species may have been displaced.

Moderate: invasive fauna are present in moderate densities but do not introduce new functional attributes to the ecosystem and have not completely displaced any native species.

Low: invasive fauna are present in low numbers but native species are still dominant.

None: no invasive fauna are known to inhabit the site.

Herbivory by invasive non-native fauna is generally associated with over-browsing or –grazing rather than lack of sufficient utilization. Excessive browsing by mammals or invertebrates may result in altered composition of both understory and canopy vegetation in riparian or forested areas. Excessive grazing may result in a change in the plant community composition to less-palatable species or to an increase in bare ground. In some cases, invasive non-native plants may be favored.

Severe: herbivory is much higher than expected throughout the site, with obvious changes in plant community composition and/or prevalence of bare ground.

High: herbivory is higher than expected in large areas of the site, with some changes in plant community composition and/or prevalence of bare ground.

Moderate: herbivory is somewhat higher than expected in at least some areas within the site; changes to the plant community are only evident upon close examination and bare ground is not substantially more prominent.

Low: herbivory is slightly higher than expected in at least some areas within the site, but no changes to the plant community composition are evident and bare ground is similar to that expected for the site.

None: herbivory is as expected for the site.

Trampling and trails are indications that animal density is high in a given area. Trampling often occurs where access to water or some other resource is localized, so that many individuals repeatedly return to the same location. Degree of damage caused by trampling and trails relates to soil compaction, erosion along trails, and loss of vegetation.

Severe: trampling has resulted in extensive areas of bare ground and compacted or disturbed soil; trails are interwoven and eroded deeply into the soil. Natural processes, such as frost heave, are unlikely to relieve effects on soil.

High: trampling has resulted in large patches of bare ground and compacted or disturbed soil; trails are separated, but eroded into the soil. Natural processes are unlikely to relieve effects on the soil.

Moderate: trampling has resulted in a few patches of bare ground and compacted or disturbed soil; a few trails are present but have not caused substantial soil erosion. Natural processes seem likely to relieve effects on the soil if trampling is discontinued.

Low: one area has been trampled and a single trail leads to this area. Natural processes will relieve effects on the soil if trampling is discontinued.

None: trampling and trails are as expected for the site.

Bioturbation refers to the digging and burrowing of fossorial animals, including invertebrates. Some level of bioturbation may be normal at the site. The observer must decide if bioturbation exceeds or is lower than that expected under normal circumstances, and if it is the result of native or invasive organisms. This factor relates to bioturbation by non-native fauna only; if native, see section on Native Fauna.

Severe: density of digging, burrows and tunnels (of mammals) or of sign of soil organisms (e.g., earthworm castings, termite mounds, ant nests) are extremely different than expected for the site. If greater, litter may be gone or sharply reduced from expected amounts.

High: density of soil disturbances from fossorial animals is very different from that expected for the site. If greater, litter layer is reduced from that expected.

Moderate: density of soil disturbance from fossorial animals is somewhat different from that expected for the site; only slight or localized differences in litter can be detected.

Low: density of soil disturbance from fossorial animals is only slightly different from that expected for the site; litter is approximately as expected for the site.

None: density of soil disturbance from fossorial animals is as expected for the site.

Ecosystem engineering refers to the ability of organisms to produce an effect on the abiotic environment that subsequently affects other members of the biotic environment. These effects may be contemporaneous with the presence of the engineer at the site, or they may be a legacy of former site occupancy, so some knowledge of site history may be necessary to fully evaluate this indicator. This factor refers to disturbances caused by non-native fauna only (see native fauna for ecosystem engineering by native fauna).

Severe: animal activity has caused extensive modification of the site, such that management goals cannot be achieved without removing the animals responsible and remediating their effects.

High: animal activity has highly modified the site; management goals will require removal of some of the animals responsible for the modification and some remediation of their effects.

Moderate: animal activity has caused some modification of the site; management goals may require thinning or otherwise decreasing the number of animals responsible for the modification but the site will return to its pre-modification state without further intervention.

Low: animal activity has slightly modified the site; management goals can likely be achieved with minor intervention.

None: animal activity is as expected for the site.

Animal waste (urine, feces) can result in eutrophication of soil and water if present in excess.

Severe: animal waste is severely affecting the site and there is evidence of eutrophication; droppings are very dense and the smell of ammonia is present.

High: animal waste is having a substantial effect on the site and there is some evidence of eutrophication; droppings are in dense patches and the smell of ammonia is present.

Moderate: animal waste is more evident at the site than expected, but there is little evidence of eutrophication.

Low: animal waste is evident, but there is no sign of eutrophication.

None: animal waste is as expected for the site.

Microbial pathogens may be normally present at the site, but evidence of excessive outbreaks may indicate that disturbance is facilitating the microbial attack. Non-native microbes may have an advantage due to lack of resistance in native organisms.

Severe: disease is severely affecting ecosystem structure, function, or composition.

High: disease is substantially affecting ecosystem structure, function, or composition.

Moderate: disease is somewhat affecting ecosystem structure, function, or composition.

Low: disease is slightly above the level expected for the site.

None: disease is as expected for the site.

Non-Native Plants

Presence of invasive non-native plants may indicate loss of biological integrity at the site. Control is likely needed if native vegetation is desired. Non-native plants may invade independently of disturbance, but often follow disturbances, especially those that result in enhanced light or nutrients.

Severe: infestations are extensive and dominate vegetative cover.

High: infestations are significant and co-dominate vegetative cover.

Moderate: infestations are moderate, yet are a conspicuous component of the vegetative cover.

Low: infestations are relatively light and constitute a minor portion of the vegetative cover.

None: no invasive non-native plants are present at the site.

Impact Type and Severity

Invasive non-native plants can cause impacts by interrupting ecological processes, changing structure and species composition of the community, or impacting individual species. The most severe impacts are those that affect ecological processes.

Severe: invasive non-native plants have severely modified driving ecological processes (e.g. fire or flooding) for the site. The result is drastic changes in community types and species composition expected for the site.

High: invasive non-native plants have highly modified ecological processes resulting in a high degree of change in species composition and structure of expected communities.

Moderate: expected ecological processes are mainly intact. Composition, density, and/or distribution of native species are modified.

Low: expected ecological processes are intact. The density, distribution, and abundance of some individual species is modified.

None: natural ecological processes, community structure and composition are intact.

Availability of areas for invasive non-native plant colonization

Disturbances increase the availability of areas for invasive non-native plant colonization**.** Such disturbances may include those that open an otherwise closed canopy or increase nutrient or water availability in the soil. Lack of remediation is likely to result in infestation; once invasive plants gain a foothold, removal is often difficult or impossible. Even openings expected for the site may provide an entry point for invasive plants; in this case, propagule sources must be controlled.

Severe: opportunities for invasive non-native species colonization occur throughout the site.

High: opportunities for invasive non-native species colonization are extensive, but only within a localized area.

Moderate: opportunities for invasive non-native species colonization are widely scattered in small patches.

Low: opportunities for invasive non-native species colonization are only within a small, localized patch within the site.

None: there are few or no opportunities for invasive colonization.

Seedbank of invasive non-natives may be long-lived, so knowledge of site history may be necessary to determine whether seeds may exist for species not currently present at the site. Invasive non-native species surrounding the site may be expected to be present within the seedbank, as well.

Severe: seedbank includes species with seed longevity > 10 years; depletion of the seedbank would require removal of topsoil, long-term control, or long-term protection from conditions that would permit germination.

High: seedbank includes species with seed longevity > 5 years; depletion of the seedbank would require multiple germination events with subsequent control prior to seedset, or the seedbank would need protection from conditions that would permit germination.

Moderate: seedbank of invasive non-native plants can be substantially reduced with a single natural or artificial germination event with subsequent control prior to seedset.

Low: seedbank of invasive non-native plants is low, or has relatively short-term viability.

None: no non-native seedbank is known to occur at the site.

External source of invasive non-native plants makes it difficult to permanently control an infestation at the site. It is important to consider the method of dispersal for surrounding infestations. For example, if a species is dispersed by birds, minimizing attractive perches for birds within the site may reduce the risk of infestation.

Severe: site is surrounded by areas extensively invaded by readily -dispersed non-native species; colonization is almost certain.

High: although not completely surrounding the site, invasive non-native plants with readily-dispersed seeds are well within expected dispersal distances.

Moderate: patches of invasive non-native species are within expected dispersal distance of the site.

Low: invasive non-native species near the site have specialized dispersal requirements that make it less likely the species will reach the site.

None: the site is surrounded by areas with no invasive non-native species.

Native Animal Indicators

Keystone or critical species must be present at the site if the site is to fully retain or recover its ecological function. Absence of a keystone species implies the absence of the process it controls, most often associated with the food web at the site.

Severe: more than one keystone species is absent from the site.

High: at least one keystone species is absent from the site.

Moderate: a keystone species, although present at the site, is at densities that are too low to fully support the process it controls.

Low: all keystone species are present at the site, but densities are not as expected due to an unusual natural event.

None: keystone species are present in densities expected for the site.

Herbivory is a natural component of most ecosystems. Lack of herbivory may have detrimental effects, as may excessive herbivory, depending on the evolutionary history of the species at the site. For example, native grasslands that are protected from herbivory may lose diversity due to a buildup of litter, while forests that suffer excessive herbivory may lose understory species. A browse line may be evident in a forest. Evidence for herbivory must also take into account the amount of biomass produced, which varies with transient seasonal climatic conditions.

Severe: herbivory is either much higher (e.g., resulting in bare ground or denuded shrubs or trees) or much lower (e.g., resulting in large amounts of litter and standing dead vegetation) than expected throughout the site.

High: herbivory is either much higher or much lower than expected in portions of the site.

Moderate: herbivory is either somewhat higher or somewhat lower than expected throughout the site.

Low: herbivory is either somewhat higher or somewhat lower than expected in isolated portions of the site.

None: herbivory is as expected for the site.

Trampling and trails are indications that animal density is high in a given area. Trampling often occurs where access to water or some other resource is localized, so that many individuals repeatedly return to the same location. Trails, and to some degree, trampling, are natural disturbances in areas with large mammals, such as bison. Degree of damage caused by trampling and trails relates to soil compaction, erosion along trails, and loss of vegetation.

Severe: trampling has resulted in extensive areas of bare ground and compacted or disturbed soil; trails are interwoven and eroded deeply into the soil. Natural processes, such as frost heave, are unlikely to relieve effects on soil.

High: trampling has resulted in large patches of bare ground and compacted or disturbed soil; trails are separated, but eroded into the soil. Natural processes are unlikely to relieve effects on the soil.

Moderate: trampling has resulted in a few patches of bare ground and compacted or disturbed soil; a few trails are present but have not caused substantial soil erosion. Natural processes seem likely to relieve effects on the soil if trampling is discontinued.

Low: one particularly attractive area has been trampled and a single trail leads to this area. Natural processes will relieve effects on the soil if trampling is discontinued.

None: trampling and trails are as expected for the site.

Bioturbation refers to the digging and burrowing of fossorial animals, including invertebrates. Some level of bioturbation may be normal at the site. The observer must decide if bioturbation exceeds or is lower than that expected under normal circumstances, and if it is the result of native or invasive organisms. (If invasive, see section on Invasive Fauna.)

Severe: density of digging, burrows and tunnels (of mammals) or of sign of soil organisms (e.g., earthworm castings, termite mounds, ant nests) are extremely different than expected for the site. If greater, litter may be gone or sharply reduced from expected amounts.

High: density of soil disturbances from fossorial animals is very different from that expected for the site. If greater, litter layer is reduced from that expected.

Moderate: density of soil disturbance from fossorial animals is somewhat different from that expected for the site; only slight or localized differences in litter can be detected.

Low: density of soil disturbance from fossorial animals is only slightly different from that expected for the site; litter is approximately as expected for the site.

None: density of soil disturbance from fossorial animals as expected for the site.

Ecosystem engineering refers to the ability of organisms to produce an effect on the abiotic environment that subsequently affects other members of the biotic environment. These effects may be contemporaneous with the presence of the engineer at the site, or they may be a legacy of former site occupancy, so some knowledge of site history may be necessary to fully evaluate this indicator. Ecosystem engineering by animals has implications for the feasibility and difficulty of the restoration. Animals such as beaver may be native to the site, yet may require removal to achieve management objectives. Removal of the structure without removal of the animals responsible for it is unlikely to be sustainable.

Severe: native animal activity has caused extensive modification of the site, such that management goals cannot be achieved without removing the animals responsible and remediating their effects.

High: native animal activity has highly modified the site; management goals will require removal of some of the animals responsible for the modification and some remediation of their effects.

Moderate: native animal activity has caused some modification of the site; management goals may require thinning or otherwise decreasing the number of animals responsible for the modification but the site will return to its pre-modification state without further intervention.

Low: native animal activity has slightly modified the site; management goals can likely be achieved with minor intervention.

None: native animal activity is as expected for the site.

Animal waste (urine, feces) can result in eutrophication of soil and water if present in excess.

Severe: native animal waste is severely affecting the site and there is evidence of eutrophication; droppings are very dense and the smell of ammonia is present.

High: native animal waste is having a substantial effect on the site and there is some evidence of eutrophication; dropping are in dense patches and the smell of ammonia is present.

Moderate: native animal waste is more evident at the site than expected, but there is little evidence of eutrophication.

Low: native animal waste is evident, but there is no sign of eutrophication.

None: native animal waste is as expected for the site.

Native microbial pathogens may be normally present at the site but normally have non-significant ecosystem effects, but evidence of excessive outbreaks may indicate that disturbance is facilitating the microbial attack.

Severe: disease is severely affecting ecosystem structure, function or composition.

High: disease is substantially affecting ecosystem structure, function or composition.

Moderate: disease is somewhat affecting ecosystem structure, function or composition.

Low: disease is slightly above the level expected for the site.

None: disease is as expected for the site.

Native Plant Indicators

Dominant plant composition and cover defines the plant communities present at the site. Presence of expected functional groups, e.g., no woody species encroachment at a site where mixed-grass prairie is expected, is an important aspect of this indicator. The site may be comprised of more than one dominant plant community, depending on size and edaphic conditions.

Severe: expected dominant plant community or major functional group of that community is not represented at the site.

High: expected dominant plant community is found only in small fragmentary patches at the site.

Moderate: relatively intact dominant plant community is found in patches throughout the site in appropriate locations.

Low: nearly intact dominant plant community is found throughout the site in appropriate locations.

None: all functional groups of the dominant plant community are found throughout the site in appropriate locations.

Uncommon or rare plants are usually components of intact native plant communities; this indicator does not refer specifically to threatened and endangered species, but rather those species that one expects to find sparsely scattered throughout the plant community. Their absence may indicate the presence of a stressor not obvious through examination of other indicators.

Severe: uncommon members of the plant community are absent from appropriate locations within the site.

High: uncommon members of the plant community are drastically reduced in abundance in appropriate locations within the site.

Moderate: uncommon members of the plant community are occasionally present in appropriate locations within the site.

Low: uncommon members of the plant community are usually present in appropriate locations within the site.

None: uncommon members of the plant community are present as expected in appropriate locations within the site.

Biological crusts may be important in some areas for functions such as soil stabilization, water retention or nitrogen fixation. Biological crusts are generally more important and abundant in arid areas. Their absence can be extremely difficult to remediate.

Severe: biological crusts are found only in protected areas and include only a limited number of functional groups.

High: intact crusts found only in protected areas.

Moderate: intact crusts are found in protected areas as well as being a minor component of interspaces.

Low: intact crusts are evident throughout the site but lack continuity between patches.

None: biological crusts are as expected for the site.

Other non-vascular plant cover, such as mosses, bryophytes, and lichens, may be expected at some sites. Their absence may be an indication of stressors not obvious through examination of other indicators. For example, lichen communities can be very sensitive to air pollution.

Severe: expected non-vascular plants are absent from the site.

High: expected non-vascular plants are much reduced from expected densities or diversities.

Moderate: expected non-vascular plants are present, but in somewhat reduced density or diversity.

Low: expected non-vascular plants are present in expected densities but diversity may be somewhat reduced.

None: non-vascular plants are present in the abundance and diversity expected for the site.

Age class of expected vegetation type, including evidence of active recruitment, is an indicator of the ability of the expected vegetation type or plant community to persist at the site. Note that succession can be a natural feature of plant communities, so it is important to distinguish lack of recruitment or persistence of the expected community due to anthropogenic stressors from natural successional processes. Natural disturbance processes, such as flooding, may be required for recruitment in some species, so lack of recruitment may indicate absence of a fundamental ecological process.

Severe: existing individuals of dominant plant species are mature or decadent and there is no evidence of seedling recruitment; processes required for recruitment are no longer operational at the site.

High: dominant plant species are generally of a single age class and there is little or no evidence of recruitment; processes required for recruitment still exist at the site, but have been changed in frequency or intensity.

Moderate: the age class distribution of dominant plant species is skewed toward older classes and recruitment is below expected levels; processes required for recruitment still exist at the site, but have been changed in frequency or intensity.

Low: the age class distribution of dominant plant species is approximately what would be expected, but recruitment is below that expected, perhaps due to an unusual event; processes required for recruitment are in place.

None: age class distribution and recruitment of dominant plant species is approximately what would be expected for the site; processes required for recruitment are in place.

Native plant seedbank must be present if a site is to harbor a native plant community. If the expected native plant communities are present and reproducing (e.g., flowering) at the site, it can usually be assumed that the seedbank also is present, unless a species relies heavily on vegetative spread. However, if the native plant community is reduced or absent, the observer must know the site history. If the native vegetation has been absent longer than the longevity of the associated seedbank, and seeds are unlikely to be dispersed from adjacent habitat (see next indicator), it can be assumed that the seedbank is depleted and reseeding or revegetation efforts will be required to restore the site.

Severe: the desired native community is absent and has been so for a time longer than the estimated longevity of its seedbank.

High: most members of the desired native community have been absent for a time longer than the estimated longevity of the seedbank.

Moderate: dominant members of the native community are present and reproducing, but less common members have been absent longer than the estimated longevity of their seedbank.

Low: all members of the native plant community are present somewhere on the site and are reproducing; seeds may not be dispersed over the entire site, however.

None: reproductive individuals of all expected native plants are present at the site.

External source of native plants may allow regeneration of native species at the site, even if the species is not currently present at the site. It is important to consider the dispersal biology of the species of interest; biotic dispersal may lend itself to manipulation more readily than would wind or water dispersal, for example. Note that this indicator may not be applicable if the site under consideration encompasses the full extent of a rare vegetation type, so that external sources would not be expected to be available.

Severe: there are no similar native plant communities within dispersal distance of the site.

High: fragments of similar native plant communities exist within dispersal distance of the site; not all desired species occur and not all species have dispersal mechanisms likely to allow dispersal to the site.

Moderate: large fragments of similar native plant communities exist within dispersal distance of the site and most species are represented.

Low: large areas of similar native plant communities are contiguous with the site and most species are represented.

None: large areas of the same native plant communities desired on the site are contiguous with the site; all species are represented.

Site Stressors

Restoration ultimately involves the removal or mitigation of site stressors. In this section of RRAT, the observer is presented with a list of all indicators for which they earlier chose a departure value of "moderate" or greater departure when assessing the Departure from Management Goal section. The observer should select all stressors that cause each of the departures and score the stressors according to the effort required to remove or mitigate them.

Stressor removal effort definitions

Impossible: There are no known methods to remove the stressor or the stressor is a result of conditions that cannot be changed for reasons independent of restoration goals

Difficult – Removal can be accomplished with difficulty, but additional funds and/or personnel would be needed.

Moderate – Removal can be accomplished relatively easily, but additional funds and/or personnel would be needed.

Easy – Removal can be accomplished with existing resources

Already removed – the stressor used to act on the site, but has been removed.

Unknown – The effort to remove the stressor is unknown.

NA – the stressor is not applicable to this site.

Stressors and their definitions

Altered hydrology: Changes in hydrology are reflected in surface water or groundwater flow, availability, seasonal changes, and flashiness that influence habitat for plants and animals

Channelization: Straightening of streams or rivers, sometimes in association with river/streambank armoring drastically changes river hydrology and geomorphology.

Climate change: Change in the local climate may be manifest as changes in phenology or seasonality of abiotic or biotic components.

Construction: Activities focused on land clearing and subsequent construction of buildings, structures, roads, etc. permanently destroy or alter habitat.

Culverts: Culverts are drainage structures, especially used under roadways, that focus water flow, therefore changing water velocity and rates of flow.

Dams: Dams, constructed for a variety of reasons, can block natural movement of aquatic wildlife, and change water temperature, seasonal flooding, erosion and deposition patterns.

Deposition/atmospheric: Nitrogen and other nutrients and pollutants can be deposited on a site from distant manufacturing areas

Deposition/water-carried: Silt or other material can be carried by water and deposited, typically due to reduction of water velocity. Siltation can reduce or change invertebrate habitat as well as safe sites for germination of aquatic vegetation.

Disease: Unnatural levels of disease in plants or animals can result from excessive microbes or insects that carry disease or contaminants or other factors that weaken organisms and make them more susceptible to disease.

Drainage: Drain tile, drainage ditches and the like are used to drain wetlands or saturated soils (e.g., for agricultural fields). Water introduced to the riparian zone via draining agricultural land may have high concentrations of nutrients and/or pesticides.

Fertilizer/nitrogen: Excessive nitrogen, which may arrive via deposition, runoff, or through fixation by invasive plants, tends to favor weedy plant species.

Fertilizer/Phosphorus: Excessive phosphorus in the water promotes eutrification; lack of phosphorus in the soil may discourage legumes.

Hard surfacing: Artificial surfaces that do not absorb rainwater such as roads, parking lots, rooftops, among others, can change the duration and intensity of stormwater events and increase contaminant runoff.

Herbivory – insects: Inappropriate levels of herbivory, either higher or lower than expected, alter the plant species cover and composition.

Herbivory – mammals: Inappropriate levels of herbivory, either higher or lower than expected, alter the plant species cover and composition.

Inappropriate fire management: Fire suppression, fuel management, perscribed burning, and the like can drastically alter natural fire regimes, or can be used to re-create a fire regime consistent with historical site records.

Inappropriate wildlife management: improperly managed wildlife, usually relating to game animals can result in unnatural wildlife concentration in reserves, parks, and other natural areas.

Instream modifications: Structures such as artificial riffles, pools, deflectors, barriers, etc. can result in changes in habitat for fish, invertebrates, and vegetation.

***Invasive non-native plant presence*:** Invasive plants can impact native flora and fauna and potentially ecosystem processes.

Invasive non-native plant seedbank: The invasive seedbank provides future opportunities for germination and growth of invasive plants for as long as the seedbank is viable.

Invasive non-native plants: external source: Adjacent infestations provide propagules that can invade or re-invade from adjacent areas.

***Irrigation*:** Irrigation can deplete water that arrives at the site or may limit changes that can be made at the site that might impact downstream flows for irrigation.

Land grading: Grading removes vegetation and topsoil and encourages erosion.

Levees: Channel stabilization using riprap and levees interferes with riparian habitat development and maintenance.

Non-native fauna: Non-native fauna can impact native flora and fauna and potentially ecosystem processes; consider ability to eradicate and effects of continued occupancy.

Pesticides/herbicides: Persistent pesticides or herbicides may have been applied to remove undesired vegetation or fauna, or may have reached the site accidentally via wind or runoff, and may affect subsequent revegetation or restoration efforts.

Piped discharge/Controlled outlet: Water is returned to the riparian zone or river after human use and can be source of pollution, and may change hydrology of the area.

Plowing/tilling/Harvesting/Etc.: Application of row-crop agriculture can result in habitat loss, fragmentation, increased erosion, and increased nitrogen pollution.

River/streambank armoring: The most common form of armoring, concrete channelization of streams, reduces habitat for fish and invertebrates and changes streamflow and water temperature, among others.

Salinity: Excessive salinity may be caused by subsurface irrigation or certain plants that deposit salts on the soil surface. Most plants and animals have fairly narrow salt tolerances.

Soil contamination/pollution: Does the site have evidence (e.g., empty barrels, mining debris), or a known history of activity that would have produced contamination that is responsible for current departure from desired condition?

Soil disturbance: Soil disturbance, resulting from either anthropogenic or natural causes, can result in erosion, establishment of invasive plants, and loss of habitat.

Stormwater inputs: Stormwater is typically associated with urban settings where there is runoff from hardened surfaces. It results in a suite of contaminants and often nutrients that enter the water and disrupt habitat for native species.

Trails: Hiking, horse, bike, ATV, and snowmobile trails cause soil compaction, disturb wildlife, and can be routes for invasive non-native plant introduction.

Transportation of products: Roads, railroads, barges, and other corridors for movement of people and goods create air, noise, and/or water pollution, and provide access routes for invasive species.

Tree removal: Tree removal can greatly increase water runoff, erosion and sedimentation; change water temperature and therefore habitat for fish and invertebrates; result in less coarse woody debris; and can change chemical characteristics of water (via changes in litter quality and quantity).

***Waste disposal*:** Uncontained waste disposal can result in soil and water pollution, and attract some wildlife while negatively influencing other plants and animals.

Water diversion structure: Diversion structures are designed for river/water regulation; depending on who has control of the structure, they may hinder or help restoration efforts.

Water removal: Water removal for agriculture or urban use can reduce water levels (water bodies), water tables, and water flow rates (rivers).

Woody debris removed: Woody debris is a very important component of some stream/riparian/river habitats, e.g., in forests of the Pacific Northwest, and provides habitat for aquatic and other riparian organisms, as well as influencing nutrient cycling rates.

Site Value

The final section of RRAT provides an opportunity for the observer or other user to indicate the subjective value of the site after restoration.

Animal community biodiversity

Extremely valuable: The site contains a largely unmodified ecosystem type that is rare in this region. It supports viable populations of all or most animal species typical of the ecosystem.

Highly valuable: The site contains a largely unmodified ecosystem that is representative of the bioregion and provides significant habitat for endemic fauna. The site is used by most animal species typical of habitat.

Moderately valuable: The site contains a fairly unmodified ecosystem that is common within the bioregion. It contains many of the animal species typical of the habitat type.

Minimally valuable: Small, fairly modified site, which supports good numbers of the animal species of the region.

Not valuable: Small, heavily modified site in need of major regeneration or restoration to provide good quality animal habitat.

Plant community diversity

Extremely valuable: The site contains a nationally threatened vegetation type, or the best representation of a nationally uncommon vegetation type, and/or species endemic to the bioregion.

Highly valuable: The site contains one of the few remaining examples of a vegetation type once widespread in the bioregion. The site retains its natural character and is large enough to be sustainable.

Moderately valuable: The site contains good quality, moderately large example of native vegetation typical of the bioregion; other larger examples exist within the region.

Minimally valuable: The site has been substantially modified but still contains the main elements of vegetation composition and structure. Other sites within the region better typify the vegetation type.

Not valuable: The site is highly modified, dominated by non-native vegetation, and has little native vegetation remaining.

Threatened, endangered species of other species of concern

Extremely valuable: The site has been identified as critical habitat for threatened or endangered species.

Highly valuable: The site contains one or more federally listed threatened and endangered species or other species of concern as residents.

Moderately valuable: The site contains one or more resident state or federally listed species of concern.

Minimally valuable: The site is occasionally used by migrant threatened and endangered species or other species of concern.

Not valuable: The site is not known to contain any resident threatened and endangered species or to be utilized by migratory threatened and endangered species or other species of concern.

Recreation or aesthetics

Extremely valuable: The site is internationally recognized and cherished for its recreational and/or aesthetic values; one of primary reasons people visit the park.

Highly valuable: The site is nationally recognized for its recreational and/or aesthetic values.

Moderately valuable: The site is mostly locally known for its recreational and/or aesthetic values.

Minimally valuable: The site is not well known for having important recreational and/or aesthetic values.

Not valuable: The site does not have recreational and/or aesthetic value.

Emblematic natural features

Extremely valuable: The site contains natural features that are unique and irreplaceable in the region or the park.

Highly valuable: The site contains natural features that are very rare in the park or region.

Moderately valuable: The site contains natural features that are only found in a few other areas of the region or park.

Minimally valuable: The site contains or is an example of natural features fairly common in the region or park.

Not valuable: The site contains no natural features unique to the area; this type of site is common.

Relation to the surrounding landscape

Extremely valuable: The site is critical to proper functioning of the surrounding landscape because of such factors as connectivity, hydrology, nutrient cycling, propagule sources, etc.

Highly valuable: The site is very important for proper functioning of the surrounding landscape.

Moderately valuable: The site is moderately important for proper functioning of the surrounding landscape.

Minimally valuable: The site is minimally important for proper functioning of the surrounding landscape.

Not valuable: The site is not valuable to the surrounding landscape.

Habitat or ecosystem rarity in landscape

Extremely valuable: The specific habitat or ecosystem type is extremely rare in the landscape, or is represented by this single area alone. It contains many endemic or unique organisms, and/or physiographic features that are very rare, or only found in this single area.

Highly valuable: The habitat or ecosystem type is rare in the landscape, represented by only a few areas. It contains rare or uncommon organisms, and/or physiographic features that are rare in the landscape.

Moderately valuable: The habitat or ecosystem type is uncommon, but found in a number of areas in the landscape. Organisms here are typically only found in this assemblage, but they can occur elsewhere. Physiogeographic features are also uncommon, but not rare.

Minimally valuable: The habitat or ecosystem is common, found regularly distributed in the landscape. The organisms found here are more common in this habitat type, but are regularly found elsewhere. Physiogeographic features are regularly found in the landscape.

Not valuable: The habitat or ecosystem type is nearly ubiquitous in the landscape, represented by large continuous areas. The assemblage of organisms is also very common and found throughout the landscape. There are no unique physiogeographic features.

Historical, cultural, and archeological

Extremely valuable: The site contains unique historical, cultural or archeological artifacts and/or is important to the image or character of the area's residents.

Highly valuable: The site represents rare and important historical, cultural, or archeological features important for research or symbolic of the park.

Moderately valuable: The site represents moderately rare and important historical, cultural, or archeological features important for research or symbolic of the park.

Minimally valuable: The site contains historical, cultural or archeological artifacts or features common to the region.

Not valuable: The site contains no known historical, cultural or archeological artifacts. Site does not represent symbolic features.

Appendix B Assessment example

An example assessment for the Channel Island National Park management area, Santa Cruz Island – Scorpion - Lowe site is shown to illustrate how an assessment is made.

Step 1: The observer fills out the site documentation. See Figure 3.

The site geographic information (Latitude, Longitude, and Datum) are directly from a GPS set to provide decimal degrees and use WGS84 datum.

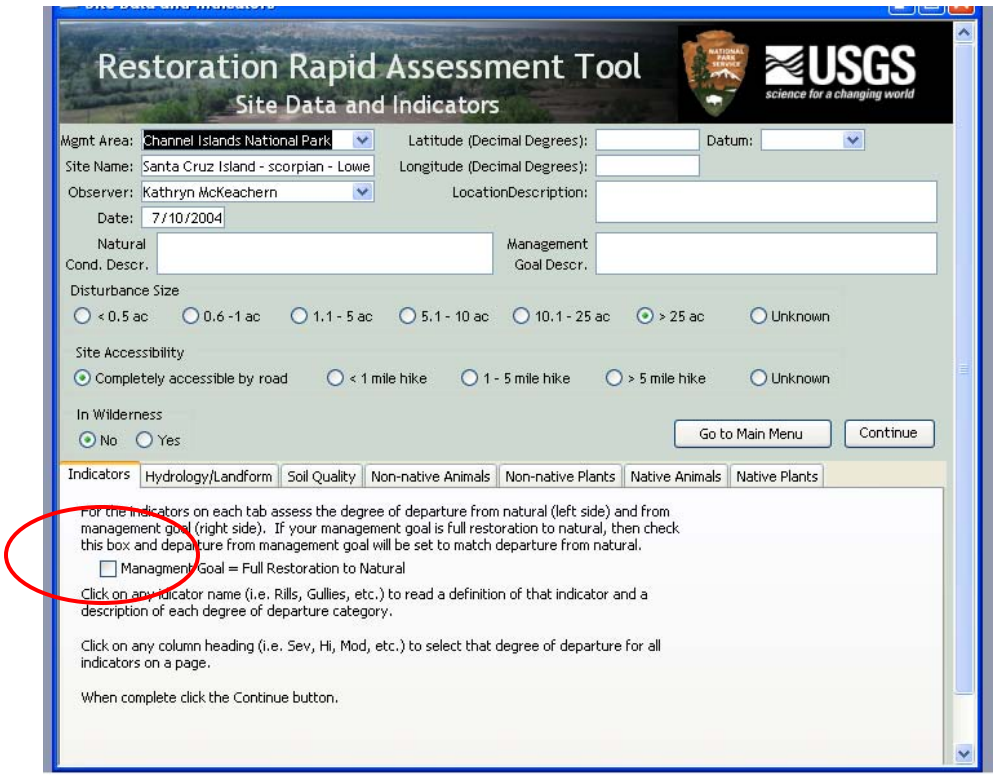


Figure 3. Santa Cruz Island – scorpion - Lowe site is registered in the RRAT site assessment library once the Management Area and the Site Name are entered. For this assessment, the observer described both a natural condition and management goal. If the observer's management goal is to restore to natural condition, then the box in the red circle would be checked and the observer would only assess the differences between the site and expected natural condition.

Step 2: The observer makes a comparison of the site to expected natural conditions and then to the management goal for all indicators. Although the example does not show the observer's description of natural conditions and the management goal, they are different in this case. If the management goal and natural condition are the same, the observer checks the box (see Figure 3) that indicates the site is being compared only to natural conditions. Once checked, the comparison to management goals automatically has the same answers as the comparison to natural conditions.

Also, if the scores for an indicator are all the same the observer clicks on the name of the score at the top of the column and all the indicator scoring areas below will fill in with that score. In the example (Figure 4), all the scores for the Hydrology/Landform indicator in the 'Departure from Management Goal' section are low except for surface water flow. The category Low was clicked to fill all the circles and then the surface water flow was adjusted to Mod (moderate). Unk (unknown) answers will degrade the assessment scores. An observer should make a best estimate or seek additional information and edit the assessment later to update the 'Unknown' responses.

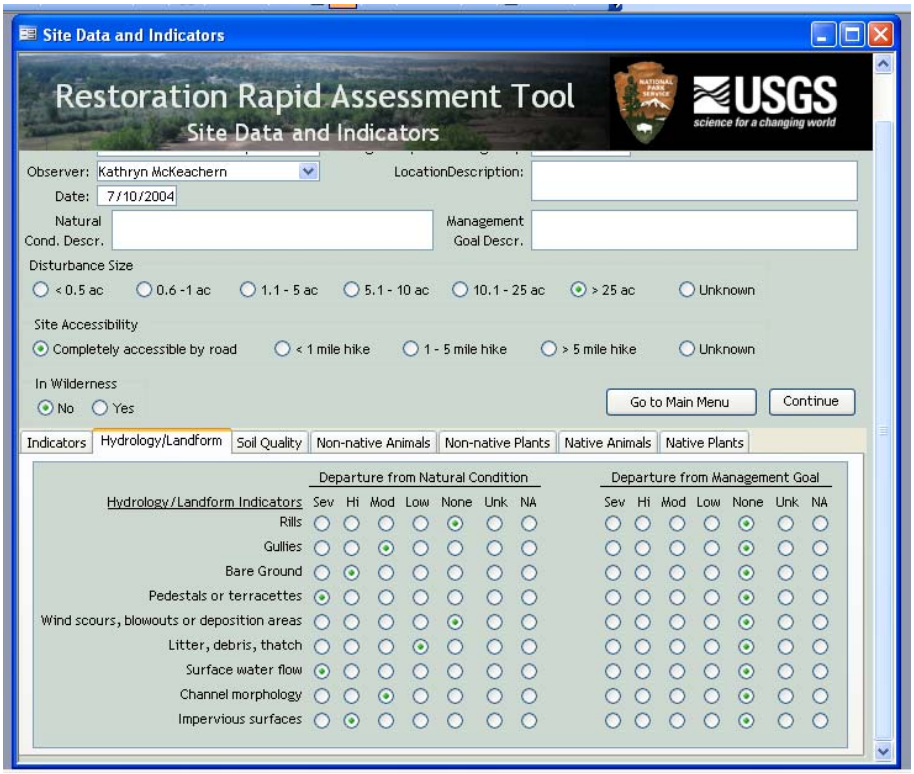


Figure 4. The Hydrology/Landform tab is selected and scores for the nine indicators in that group are shown. The observer scores all indicators under each of the six indicator tabs before clicking **Continue**

Step 3: A list of all indicators marked with Severe, High, or Moderate from the natural condition or management goal appears when **Continue** is clicked (Figure 5). This list can help guide selection of stressors and their removal effort in the next step. To change an indicator rating now or later, the observer returns to the Main Menu, presses the **Edit Existing Site** button, retrieves the site assessment using either the filter at the top of the page or scroll and clicks on the site assessment title. The assessment **Site Data and Indicators** page appears and the appropriate indicator tab can be selected to get to the indicator that needs editing.

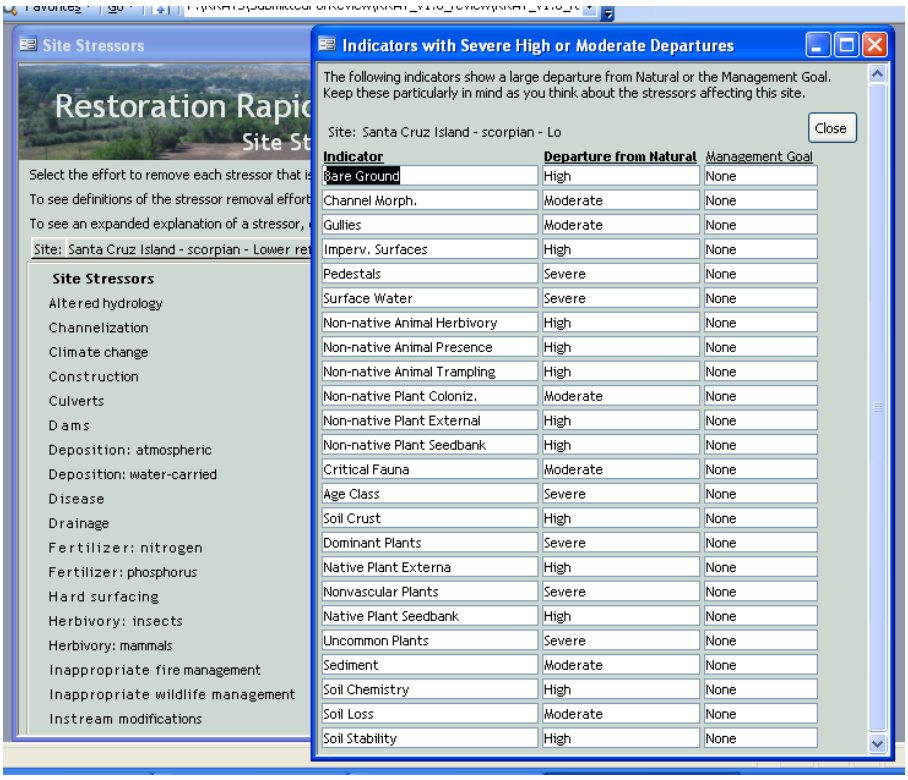


Figure 5. The list of all indicators with Severe, High, or Moderate for Santa Cruz Island – scorpion - Lowe.

Step 4. The observer assigns a stressor removal effort for each stressor present at the site. The definitions of each of the five levels of removal effort are accessible via the **Stressor Removal Effort Definitions** button (Figure 6). Also, a definition of each stressor can be viewed by clicking (left mouse click) on the stressor name in the list. The two boxes on the bottom left of the Site Stressors page help

fill in this page. In the example (Figure 7), the observer first evaluated all stressors known to the Santa Cruz Island – scorpion - Lowe site. Then the site observer clicked the 'Set blank Removal Effort fields to NA' to fill the remaining blank boxes with NA (not applicable).

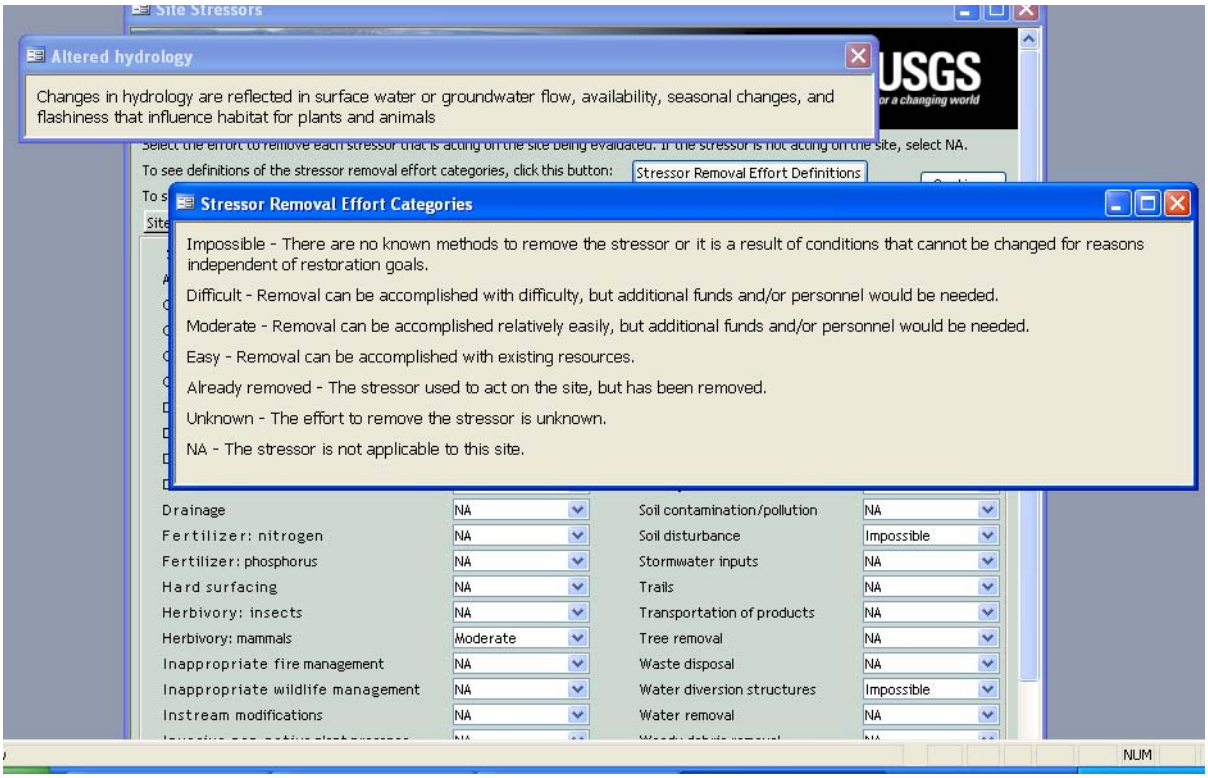


Figure 6. The definition of the 'Altered hydrology' stressor is show in a pop-up window. Also, the definition of each category for stressor removal is displayed. The stressor removal definitions appear when the observer clicks the **Stressor Removal Effort Definitions** button.

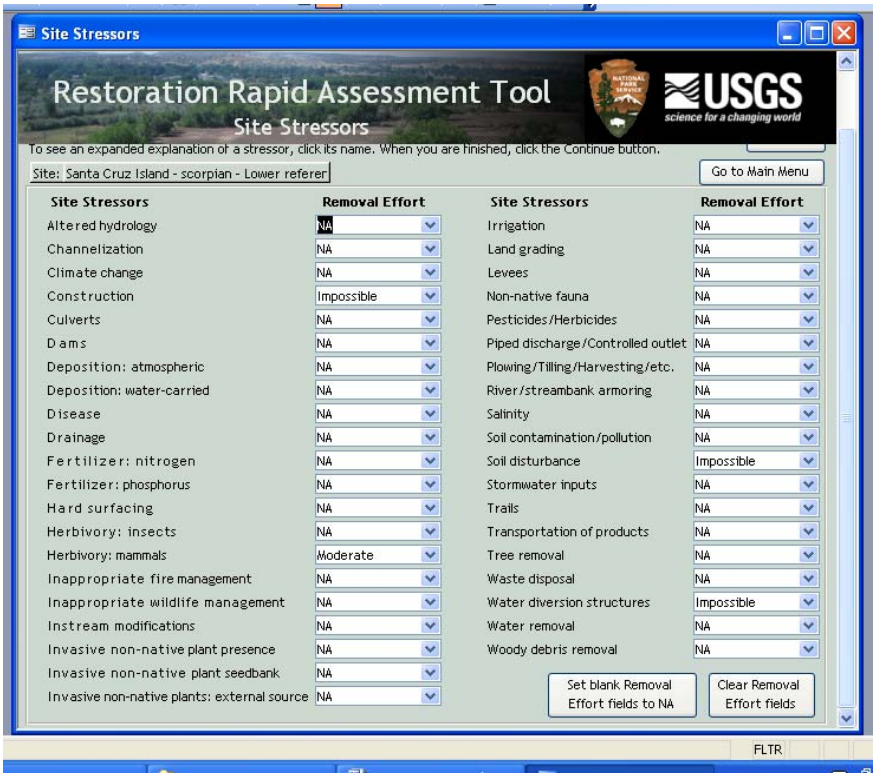


Figure 7. The stressor assessment for Santa Cruz Island – scorpion - Lowe site.

Step 5: On the **Define the Site Value** page the user enters the score for each of the eight site value descriptions (Figure 8).

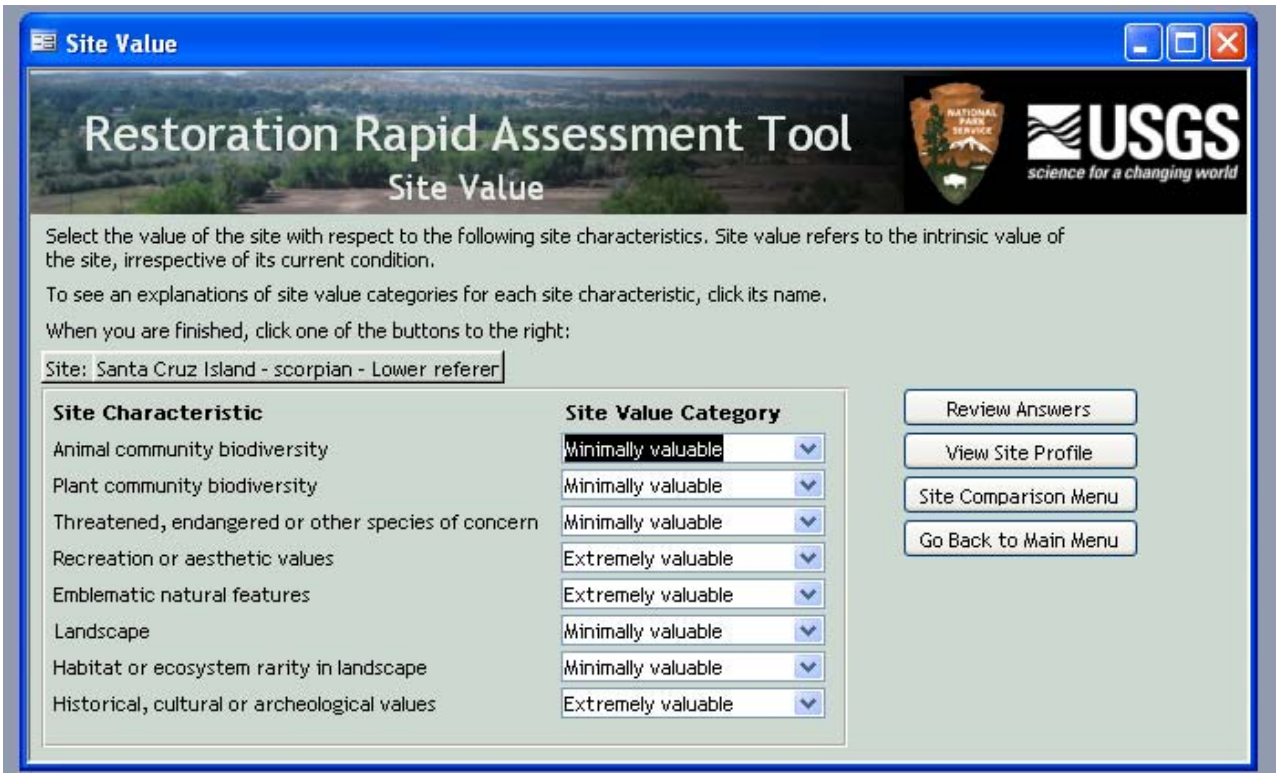


Figure 8. The site value assessment for Santa Cruz Island – scorpion - Lowe site.

Step 6. The assessment is complete. The observer may review answers before proceeding to the Site Profile. If an answer needs to be changed, the observer returns to the main menu and edits the assessment by retrieving the assessment through the **Edit Site** button as described in step 3.

Appendix C RRAT indices

Indices	Range Values	Formulation	Notes	Conversion from observer assignment to indices calculation score
Convergence (C)	0 (least similar to goal) to 100 (most similar to goal)	(I1+I2+I3+…In)/n	Indicator (I) = Departure of current condition from goal (whether natural or management defined); n (number of indicators) = 39	100 = no departure from goal, 75 = low, 5 = moderate, 25 = high, 0 = severe, Don't know/NA = indices omitted
Ease of restoration	0 (hardest to restore) to 100 (easiest to restore)	(C+RL+SR)/3		
Ecological restoration potential	0 (least potential) to 100 (most restoration potential	(C+SR)/2		
Gain for Effort	0 (least gain for effort) to 100 (most gain for effort), 999 is reported when SR+RL = 200	C/(200-(SR+RL))		
Site Value		(SVf1+SVf2….SVfn)/n	Future site value (SVf): A direct rating by observer on up to 8 different aspects of a site (Animal diversity, habitat rarity, cultural features, relation to surround landscape, emblematic natural features, plant diversity, recreation, T&E species).	100 = extremely valuable, 75 = highly, 50 = moderately, 25 = minimally, 0 = not, don't know/NA = indices omitted
Stressor removal potential (SR)		(256-((0.4)*([easy]*3))+((0.4)*([moderate]*8))+((0.4)*([hard]*16)))/2.56	Stressor removal potential (SR) = A listing of stressors is compiled for every observer rating of I =>2	Easy = number of stressors that are easy to remove; Moderate = number of stressors with moderate removal difficulty; Difficult = number of stressors that are

Indices	Range Values	Formulation	Notes	Conversion from observer assignment to indices calculation score
				difficult to remove
Number of Unknowns			Number of unknown answers on Indicators	
Restoration logistics (RL)	0 (least feasible logistics) to 100 (most feasible logistically)	(DS+SA+W)/3	Disturbance size (DS)	100= <0.5 ac., 80 = 0.5 - 1 ac, 60 = 1-5 ac., 40 = 5-10 ac., 20 = 10-15 ac., 0 => 25 ac
			Site accessibility (SA)	100= acc. By vehicle, 70 = <1 mi hike, 30 = 1-5 mi hike, 0 => 5 mi. hike
			Wilderness (W)	0 = yes, 1 00= no

Appendix D Site profile example

The next pages provide an example of a Site Profile output. The results for the natural condition assessment and the management goal assessment are both within this output.

Site Profiles are stored in the RRAT site assessment library. They are displayed by clicking on the **Site Profile** button on the **Main Menu** page and then clicking on the **View Site Profile** button on the resulting **Site Profile** page. Alternately the user can click on the **View Site Profile** button on the **Site Value** page.

The example shows an assessment done on Channel Islands National Park in July 2004.

Restoration Rapid Assessment Tool
Site Profile

Site Data

Park: Channel Islands National Park

Site Name: Santa Cruz Island - scorpian - Lower reference **Datum:**

Latitude (DD): **Longitude (DD):**

Location Description:

Mgmt Goal Description:

Date: 7/10/2004

Observer: Kathryn McKeachern

RRAT Indices	Natural Condition	Mgmt Goal
[1] Convergence	53	100
[2] Ecological Restoration Potential	71	99
[3] Restoration Logistics	67	67
[4] Ease of Restoration	73	88
[5] Site Value	53	53
[6] Stressor Removal Potential	99	99
[7] Gain for Effort	1.52	2.89
[8] Number of Unknowns	0	0

[1] Convergence is based on the user's assessment of the degree to which the site departs from natural and the managment goal. A value close to 100 indicates the site is more similar to natural or the management goal; a value close to 0 indicates the site is very different from natural or the management goal.

[2] Ecological Restoration Potential combines Convergence and Stressor Removal Potential. A value close to 100 indicates the site has high potential for ecological restoration; a value close to 0 indicates a low potential for ecological restoration.

[3] Restoration Logistics combines the disturbance size, site accessibility, and wilderness status. A value close to 100 indicates a site that presents relatively few logistical challenges; a value close to 0 will be logistically very challenging to restore.

[4] Ease of Restoration combines Convergence and Stressor Removal Potential with Restoration Logistics to give a composite estimate of how difficult the site will be to restore. A value close to 100 indicates a site that will be logistically and ecologically relatively easy to restore; a value close to 0 indicates a site that will be both logistically and ecologically very difficult to restore.

[5] Site Value indicates the user's estimate of the potential value of the site. It is a simple average of the values for each of the eight site value categories evaluated. A value closer to 100 indicates a site that has many highly valued site characteristics; a value closer to 0 indicates a site with little value in terms of the characteristics evaluated. We recommend the user consider their management goals with respect to the individual site value characteristics, listed below.

Site Characteristic	Value Chosen by User
Emblematic natural features	Minimally valuable
Recreation or aesthetics	Extremely valuable
Relation to surrounding landscape	Minimally valuable
Threatened or endangered species	Minimally valuable
Historical cultural and archeological features	Extremely valuable
Plant community biodiversity	Minimally valuable
Habitat or ecosystem rarity in the landscape	Extremely valuable
Animal community biodiversity	Minimally valuable

[6] Stressor Removal Potential indicates the combined difficulty of removing all the stressors impacting the site, depending on the removal difficulty assigned to each stressor by the user. A value closer to 100 indicates that stressors can be removed relatively easily; a value closer to 0 indicates that the stressors will be very difficult to remove.

Stressor Removal Potential takes into account only those stressors that have a removal effort of Difficult, Moderate, or Easy. In the following list of stressors acting on the site, those with a removal effort of Impossible or Unknown have been marked in red. Look at these carefully and consider whether the goals of the restoration can be achieved if these stressors are not removed.

Stressor	Explanation	Effort to Remove
Construction	Activities focused on land clearing and subsequent construction of buildings, structures, roads, etc. permanently destroy or alter habitat.	Impossible
Soil disturbance	Soil disturbance, resulting from either anthropogenic or natural causes, can result in erosion, establishment of invasive plants, and loss of habitat.	Impossible
Water diversion structure	Diversion structures are designed for river/water regulation; depending on who has control of the structure, they may hinder or help restoration efforts.	Impossible
Herbivory - mammals	Inappropriate levels of herbivory, either higher or lower than expected, alter the plant species cover and composition.	Moderate

[7] Gain for Effort: This score indicates the amount of restoration that would likely be accomplished at the site for the amount of effort expended on the restoration. The higher the score, the greater will be the return on the effort expended. A score of 999 indicates that there were no stressors to remove and the site was small, fully accessible by road and not in a wilderness area. Therefore, there were no obstacles to full restoration, and indeed no apparent reason to restore the site, since no stressors were identified that needed to be removed.

[8] Number of Unknowns indicates the number of Indicators for which the response was Unknown. Responses of Unknown quickly reduce the validity of values used in site comparisons. If there are more than 2 Unknown responses they will be listed below. The user is encouraged to research the indicator so an appropriate response can be made, or to make their best guess.

Appendix E Site comparisons example

The next pages provide an example of a Site Comparison. The results for the natural condition assessment are shown first and then the results for management goal assessment.

Site Comparisons are stored in the RRAT site assessment library. They are displayed by going to the **Site Comparison** page, either through the button on the **Main Menu** page, or by adding a new assessment or editing an existing assessment and on the **Site Value** page clicking the **Site Comparison Menu** button. The observer will be directed to the **Site Comparison** page where selection of sites to compare is made. Comparisons must be made among sites with similar background vegetation and climate. Also, comparisons among more than four sites at a time will create a graphic that is hard to interpret.

The example shows an assessment done at Channel Islands National Park in July 2004.

Restoration Rapid Assessment Tool

Comparison of Sites for Restoration to Natural

Channel Islands National Park

Sites with restoration assessment indices closer to 100 are generally considered better prospects for restoration.

Sites Sorted by Gain for Effort

Site Name	Gain for Effort
Santa Cruz Island, Scorpian - Disturb	2.13
Santa Cruz Island - scorpian - Lower	1.52
Santa Cruz Island - Upper Scorpian	1.08

Sites Sorted by Ecological Restoration Potential

Site Name	Ecological Restoration Potential	Restoration Logistics	Site Value	Ease of Restoration
Santa Cruz Island - scorpian - Lower	71	67	53	73
Santa Cruz Island - Upper Scorpian	69	57	47	68
Santa Cruz Island, Scorpian - Disturb	66	80	53	75

Sites Sorted by Restoration Logistics

Site Name	Restoration Logistics	Site Value	Ease of Restoration	Ecological Restoration Potential
Santa Cruz Island, Scorpian - Distur	80	53	75	66
Santa Cruz Island - scorpian - Lower	67	53	73	71
Santa Cruz Island - Upper Scorpian	57	47	68	69

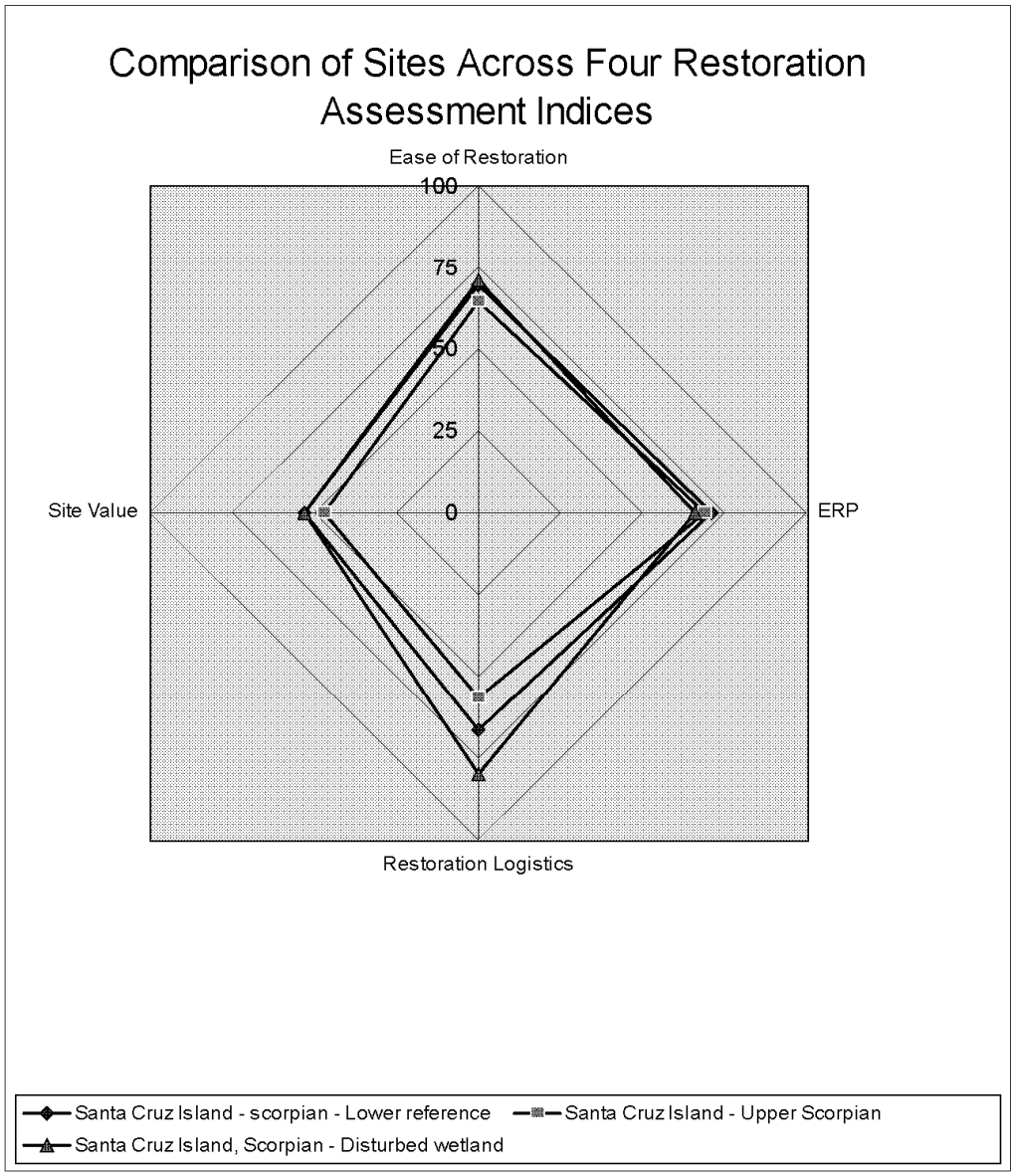
Sites Sorted by Site Value

Site Name	Site Value	Ease of Restoration	Ecological Restoration Potential	Restoration Logistics
Santa Cruz Island - scorpian - Lower	53	73	71	67
Santa Cruz Island, Scorpian - Disturb	53	75	66	80
Santa Cruz Island - Upper Scorpian	47	68	69	57

Sites Sorted by Ease of Restoration

Site Name	Ease of Restoration	Ecological Restoration Potential	Restoration Logistics	Site Value
Santa Cruz Island, Scorpian - Disturbed wetland	75	66	80	53
Santa Cruz Island - scorpian - Lower reference	73	71	67	53
Santa Cruz Island - Upper Scorpian	68	69	57	47

The following chart shows how the sites compare across the four major indices that RRAT calculates: Ecological Restoration Potential, Restoration Logistics, Site Value and Sweat Factor. Sites with more points closer to the outside of the graph have higher restoration potential.



Restoration Rapid Assessment Tool

Comparison of Sites for Restoration to Management Goal

Channel Islands National Park

Sites with restoration assessment indices closer to 100 are generally considered better prospects for restoration.

Sites Sorted by Gain for Effort

Site Name	Gain for Effort
Santa Cruz Island, Scorpian - Disturb	4.60
Santa Cruz Island - scorpian - Lower	2.89
Santa Cruz Island - Upper Scorpian	2.24

Sites Sorted by Ecological Restoration Potential

Site Name	Ecological Restoration Potential	Restoration Logistics	Site Value	Ease of Restoration
Santa Cruz Island - scorpian - Lower	99	67	53	88
Santa Cruz Island - Upper Scorpian	99	57	47	85
Santa Cruz Island, Scorpian - Disturb	99	80	53	93

Sites Sorted by Restoration Logistics

Site Name	Restoration Logistics	Site Value	Ease of Restoration	Ecological Restoration Potential
Santa Cruz Island, Scorpian - Dist	80	53	93	99
Santa Cruz Island - scorpian - Lo	67	53	88	99
Santa Cruz Island - Upper Scorpia	57	47	85	99

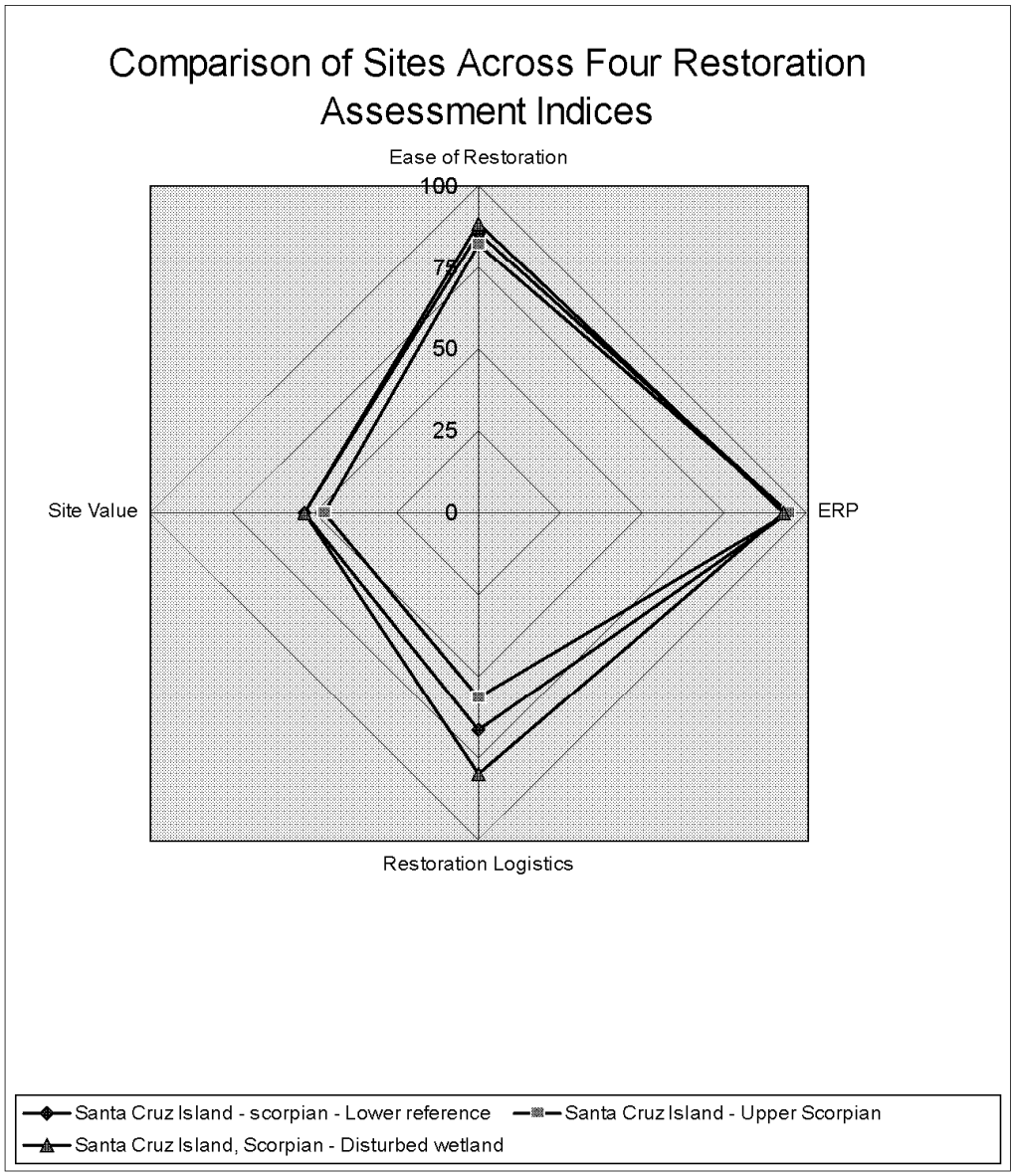
Sites Sorted by Site Value

Site Name	Site Value	Ease of Restoration	Ecological Restoration Potential	Restoration Logistics
Santa Cruz Island - scorpian - Lower	53	88	99	67
Santa Cruz Island, Scorpian - Distur	53	93	99	80
Santa Cruz Island - Upper Scorpian	47	85	99	57

Sites Sorted by Ease of Restoration

Site Name	Ease of Restoration	Ecological Restoration Potential	Restoration Logistics	Site Value
Santa Cruz Island, Scorpian - Disturbed wetland	93	99	80	53
Santa Cruz Island - scorpian - Lower reference	88	99	67	53
Santa Cruz Island - Upper Scorpian	85	99	57	47

The following chart shows how the sites compare across the four major indices that RRAT calculates: Ecological Restoration Potential, Restoration Logistics, Site Value and Sweat Factor. Sites with more points closer to the outside of the graph have higher restoration potential.



Appendix F Excel Output Example

The next pages provide an example of RRAT Export Sites output. This feature allows the user to select from a list of 28 stored input variables for any site assessment stored in the RRAT site assessment library. These variables can be downloaded as an Excel file or as a text file for one to all of the stored assessments.

The example shows selected variables (eight total) for three assessments done on Channel Islands National Park in July 2004. The raw output has been slightly reformatted to fit on the page.

MgmtArea	SiteName	Natural ERP Category	Restoration Logistics Category	Site Value Category	Ease of Restoration to Natural Category	Mgmt Goal ERP Category	Ease of Restoration to Mgmt Goal Category
Channel Islands National Park	Santa Cruz Island - scorpian - Lower reference	High	High	Moderate	High	Highest	Highest
Channel Islands National Park	Santa Cruz Island - Upper Scorpian	High	Moderate	Moderate	High	Highest	Highest
Channel Islands National Park	Santa Cruz Island, Scorpian - Disturbed wetland	High	Highest	Moderate	High	Highest	Highest

Appendix G Export output definitions

The items available for selection on the **Export Sites** page 'Select Data Fields to Export' box are listed below in the order in which they appear in the box. Note that some indices have scores that may differ when the site is compared to natural condition and for when the site is compared to the management goal. Other scores remain the same regardless of the comparison to natural condition or management goal. The scores can be exported in raw form or by categories developed by converting the raw score using these conversions:

Highest: 80-100

High: 60-79

Moderate: 40-59

Low: 20-39

Lowest: 0-19

MgmtArea: Name of management area to which observer assigned site

SiteID: Internal documentation number assigned to site in RRAT site library

SiteName: Name observer assigned to site

Latitude_DD: Latitude of site in decimal degrees

Longitude_DD: Longitude of site in decimal degrees

Datum: Datum of geographic coordinators. Use of WGS84 is encouraged. The datum for sites must be the same to make geographically correct map

LocationDescription: Observers description of site location

Observer: Observers's name

SessionDate: Date observer made assessment

NatCondDescription: Observers description of the sites expected natural condition

MgmtGoalDescription: Observers description of the management goal for the site

Convergence to Natural Score: Score for Convergence when site is compared to expected natural condition

Convergence to Management Goal: Score for Convergence when site is compared to the management goal

NaturalERP Score: Score for the Ecological Restoration Potential when site is compared to expected natural condition

NaturalERP Category: Category for the Ecological Restoration Potential when site is compared to expected natural condition

Restoration Logistics Score: Score for Restoration Logistics.

Restoration Logistics Category: Category for Restoration Logistics

Site Value Score: Score for Site Value.

Site Value Category: Category for Site Value

Stressor Removal Potential: Scores for Stressor Removal Potential

Ease of Restoration to Natural Score: Score for Ease of Restoration when site is compared to expected natural condition

Ease of Restoration to Natural Category: Category for Ease of Restoration when site is compared to expected natural condition

Mgmt Goal ERP Score: Score for the Ecological Restoration Potential when site is compared to the management goal

Mgmt Goal ERP Category: Category for the Ecological Restoration Potential when site is compared to the management goal

Ease of Restoration to Mgmt Goal Score: Score for Ease of Restoration when site is compared to the management goal

Ease of Restoration to Mgmt Goal Category: Category for Ease of Restoration when site is compared to management goal

Natural Gain for Effort Score: Score for Gain of Effort when site is compared to natural condition

MgmtGoal Gain for Effort Score: Score for Gain of Effort when site is compared to management goal

Appendix H RRAT datasheet

If a laptop or tablet computer is not available for field evaluations, the data sheet below can be printed.

Restoration Rapid Assessment Tool Data Sheet

Mgmt Area_____ Latitude (DD)_____ Datum_____

Site Name_____ Longitude (DD)_____ GPS File_____

Observer_____ Location Description

Date_____

Description of Mgmt Goal

Disturbance Size: ___<0.5 ac ___0.6-1 ac ___1.1-5 ac ___5.1-10 ac ___10.1-25 ac ___>25 ac ___Unknown

Site Accessibility:___Completely accessible by road ___<1 mile hike ___1-5 mile hike ___>5 mile hike ___Unknown

In Wilderness: ___No ___Yes

	Departure from Natural							Departure from Management Goal						
Hydrology/Landform Indicators	Sev	Hi	Mod	Low	None	Unk	NA	Sev	Hi	Mod	Low	None	Unk	NA
Rills														
Gullies														
Bare Ground														
Pedestals or terracettes														
Wind scours														
Litter, debris, thatch														
Surface water flow														
Channel morphology														
Impervious surfaces														
Soil Quality Indicators	Sev	Hi	Mod	Low	None	Unk	NA	Sev	Hi	Mod	Low	None	Unk	NA
Soil surface erosion potental														
Soil loss or degradation														
Soil chemistry/nutrient alt.														
Soil contamination														
Sediment supply/transport														
Non-Native Animal Indicators	Sev	Hi	Mod	Low	None	Unk	NA	Sev	Hi	Mod	Low	None	Unk	NA
Presence of non-native animals														
Herbivory														
Trampling and trails														
Bioturbation														
Ecosystem engineering														
Waste (urine, feces, etc.)														
Microbial pathogens														
Non-Native Plant Indicators	Sev	Hi	Mod	Low	None	Unk	NA	Sev	Hi	Mod	Low	None	Unk	NA
Presence of non-native plants														
Availability of areas for coloniz.														
Seedbank														
External source														

Site Name_____ Date_____

	Current Degree of Departure							Future Desired Condition						
Native Animal Indicators	Sev	Hi	Mod	Low	None	Unk	NA	Sev	Hi	Mod	Low	None	Unk	NA
Presence of keystone species														
Herbivory														
Trampling and trails														
Bioturbation														
Ecosystem engineering														
Waste (urine, feces, etc.)														
Microbial pathogens														
Native Plant Indicators	Sev	Hi	Mod	Low	None	Unk	NA	Sev	Hi	Mod	Low	None	Unk	NA
Dom. plant comp. and cover														
Presence of uncommon plants														
Biological soil crusts														
Other non-vascular plant cover														
Age class, recruitment														
Seedbank														
External source														

	Site Value						
Site Characteristics	Ex Hi	Hi	Mod	Min	Not	Unk	NA
Animal community biodiversity							
Plant community biodiversity							
Threatened, endangered or other species of concern							
Recreation or aesthetics							
Emblematic natural features							
Landscape							
Habitat or ecosystem rarity in landscape							
Historical, cultural or acheological values							

Site Name_____ Date_____

Stressor	Difficulty to Remove
Altered hydrology	
Channelization	
Climate change	
Construction	
Culverts	
Dams	
Deposition: atmospheric	
Deposition: water-carried	
Disease	
Drainage	
Fertilizer: Nitrogen	
Fertilizer: Phosphorus	
Hard surfacing	
Herbivory: insects	
Herbivory: mammals	
Inappropriate fire management	
Inappropriate wildlife management	
Instream modifications	
Invasive non-native plant presence	
Invasive non-native plant seedbank	
Invasive non-native plants: external source	
Irrigation	

Stressor	Difficulty to Remove
Land grading	
Levees	
Non-native fauna	
Pesticides/Herbicides	
Piped discharge/Controlled outlet	
Plowing/Tilling/Harvesting/etc.	
River/streambank armoring	
Salinity	
Soil contamination/pollution	
Soil disturbance	
Stormwater inputs	
Trails	
Transportation of products	
Tree removal	
Waste disposal	
Water diversion structure	
Water removal	
Woody debris removal	

Answer Key

I = Impossible to remove

D = Difficult to remove

M = Moderately difficult to remove

E = Easy to remove

AR = Already removed

U = Unknown

NA = Not applicable to the site