Final Report:

Technical Support for Trail Restoration and Maintenance for Arches and Canyonlands National Parks

By

Henry Shovic, PhD

Rocky Mountain Cooperative Ecosystems Study Unit
Department of Ecology, Montana State University

May 4, 2009

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NOTE APPENDICES ARE NOT INCLUDED IN THIS VERSION.

Final Report:
Technical Support for Trail Restoration and Maintenance for Arches and Canyonlands National Parks

Henry Shovic, PhD
Rocky Mountain Cooperative Ecosystems Study Unit
May 5, 2009

Objectives and Summary

This report is part of RM-CESU Cooperative Agreement Number: H1200040001 (IMR) titled "Technical Support for Trail Restoration and Maintenance for Arches and Canyonlands national Parks". It is designed to be a pilot project to support a larger effort to increase road and trail sustainability in these National Parks, responding to growing visitor use, increasing resource damage, and climate change.

Scope: The present tasks and products are designed to be a pilot project to support a larger effort to increase road and trail sustainability in these National Parks, responding to growing visitor use, increasing resource damage, and climate change.

Because this is a pilot project, data collection is limited to available GIS data, other spatial data, and field review as specified below. Specifications or tasks may, however, be modified to fit emerging needs as they are identified. To assure project objectives continue to be relevant, the cooperator will coordinate closely with National Park Service (NPS) personnel, especially with Trails and Roads, GIS, and Resource Management.

Following are the project objectives and the sections in this report that address each one.

Objective One: To provide a synthesis of current trail maintenance methods and a perspective on the sustainability program in Arches and Canyonlands National Parks.

- Task A: Research and synthesize technical documents and methods of trail restoration used in arid landscapes, including literature used in the BLM, USFS, and NPS; and field review with trails and roads specialists. This includes both general soil conservation and erosion control recommendations for trails and roads, and specific methods used in Arches and Canyonlands National Parks.

The reports listed under Objective Two include specific reference to trail maintenance and construction methods used in Arches and Canyonlands National Parks and their effectiveness. A general literature search was performed to locate both government and NGO documents pertaining to trails, including the most up-to-date information used in

Federal land management agencies. An annotated bibliography is included in Appendix Five.

Objective Two: Re-route projects - alternative development analysis and support.

- Task A: Provide site-specific project services, including analysis and display of vegetation, landscape, and soils information in map form and development of reroute alternatives using landscape data, visitor use information, local NPS management and specialist input. This can include 3-D scientific visualization, viewshed analysis, quantitative analysis of potential soil and vegetation impacts, and field review and documentation.

Three project areas were investigated and reported. These were by request of Park Management.

- *Arches National Park – Devil's Garden Trail System – Appendix Two*
- *Canyonlands National Park – Fort Bottom Trail System – Appendix Three*
- *Canyonlands National Park – Salt Creek Road Analysis – Appendix Four*

Objective Three: to help inventory and prioritize potential trouble areas, as well as support decision making on use management, as well as to provide factual support for trail condition classification for one National Park (selected by NPS).

- Task A: Synthesize and spatially present available soil survey and landscape data (including elevation, vegetation, slope, and available condition inventories).
- Task B: Develop and implement a way of spatially showing potential trouble areas in on a Park-wide basis for management. This spatial analysis will use geology, soils surveys, landscape data, interviews with resource specialists, and site visits.
- Task C: Increase the factual database of effects and conditions on the ground, including representative field observations and expert opinion of resource specialists.

Two map/posters were developed showing various aspects and interpretations of existing landscape spatial data, in particular the old published soil surveys of both Parks, and the new draft vegetation mapping for both Parks. An attempt was made to obtain new, nearly completed soils information, but the request to the Region was turned down.

An example structured decision model was developed and presented for showing potential trouble areas on a Park-wide basis for managers. This is included in this report.

Factual effects and conditions on the ground were documented by the three project reviews shown above.

Products: Products include reports, maps, spatial data, site reviews with specialists, and presentations for management. For the defined scope of this pilot project, the following are anticipated.

- Up to 10 different maps at 36 in by 48 in and 8.5 x 11 size suitable for presentation (provided in hard-copy, Adobe Acrobat (pdf), and images for Powerpoint (jpg) at appropriate resolution).
- 3 documents in WORD format presenting results under each objective.
- 1 presentation of results for on-site managers.
- Remote briefings as requested.
- Two field excursions of 3 days each (GPS data collection and QA/QC field verification, and final presentations of project results).
- Spatial and analysis data provided via FTP or DVD, including collected and synthesized base data, metadata, and all GIS analysis projects. All new spatial data will meet all NPS spatial data standards.

Two field excursions were completed (Nov, 2008 and April, 2009) of three days each. A zip file has been created containing all generated spatial data, maps in PDF and image format, analytical products, literature, and this document. A presentation for on-site managers was made on April 14, 2009. The Powerpoint slides are included in the zip file. Copies of the presentation maps and reports were forwarded to Jeff Troutman on or before this date.

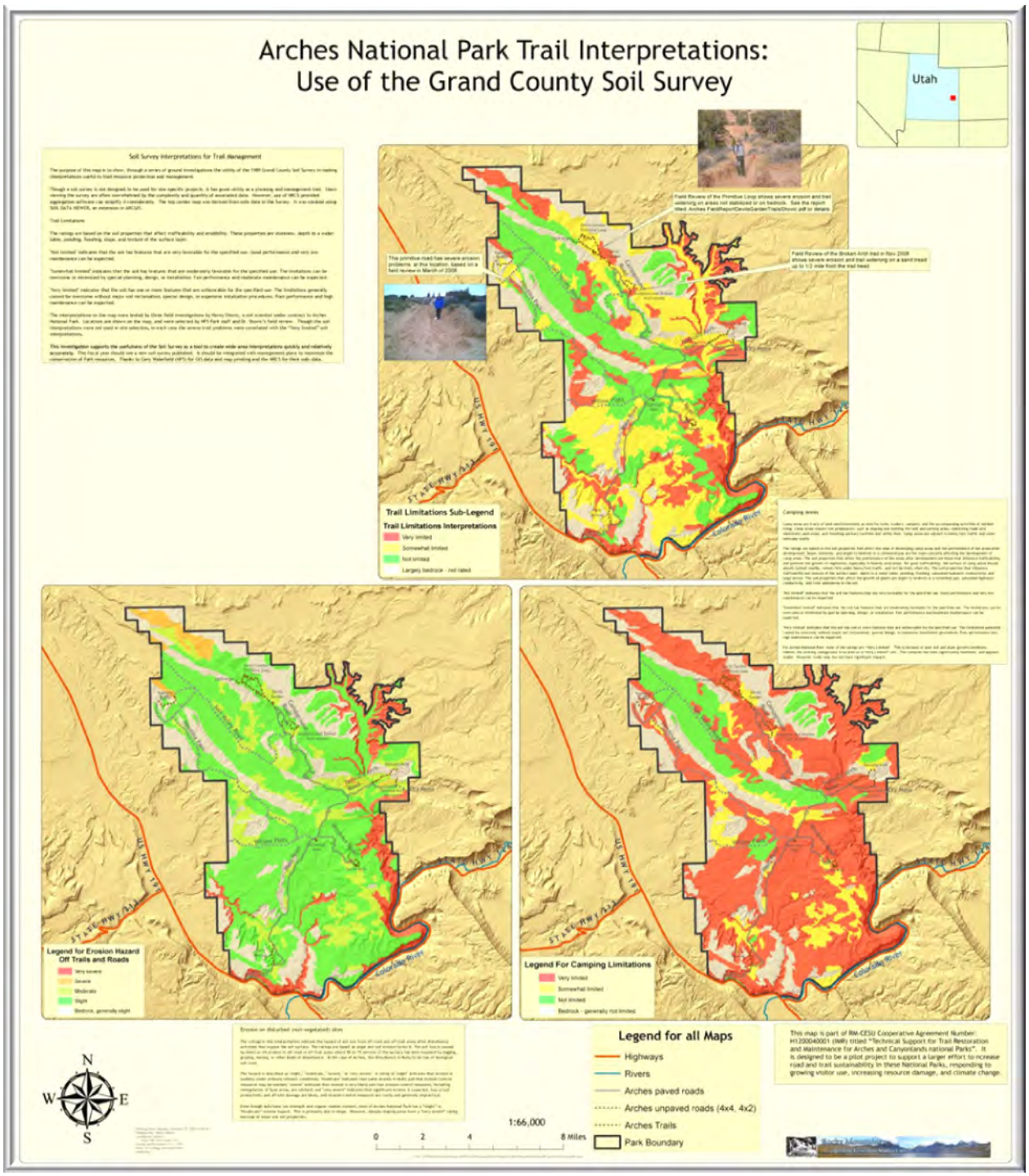
Results

Soil Survey Interpretations for Trail Management

The purpose of this map is to show, through a series of ground investigations the utility of the 1989 Grand County Soil Survey in making interpretations useful to trail resource protection and management.

Though a soil survey is not designed to be used for site-specific projects, it has great utility as a planning and management tool. Users viewing the survey are often overwhelmed by the complexity and quantity of associated data. However, use of NRCS-provided aggregation software can simplify it considerably. The top-center map was derived from soils data in the Survey. It was created using SOIL DATA VIEWER, an extension in ARCGIS.

This investigation supports the usefulness of the Soil Survey as a tool to create wide-area interpretations quickly and relatively accurately. This fiscal year should see a new soil survey published. It should be integrated with management plans to maximize the conservation of Park resources. Thanks to Gery Wakefield (NPS) for GIS data and map printing and the NRCS for their soils data.



Arches National Park Trail Interpretations: Use of the Grand County Soil Survey Full Map

Trail Limitations

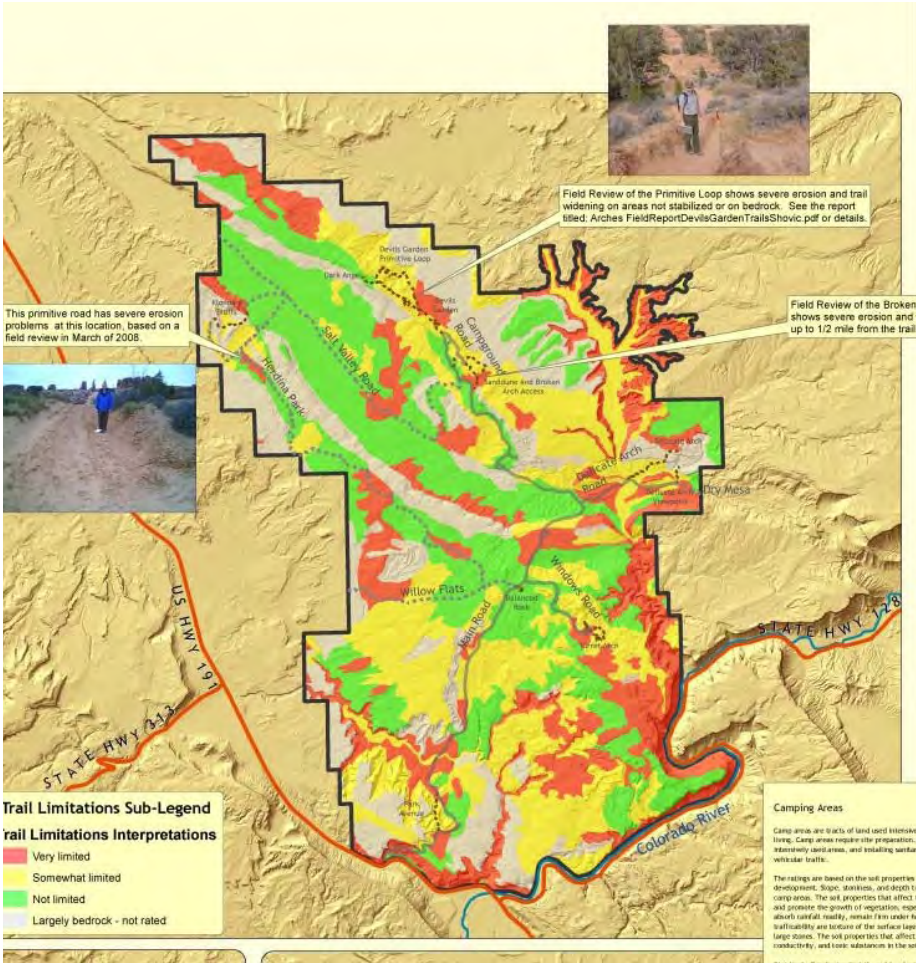
The ratings are based on the soil properties that affect trafficability and erodibility. These properties are stoniness, depth to a water table, ponding, flooding, slope, and texture of the surface layer.

"Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected.

"Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected.

"Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

The interpretations on the map were tested by three field investigations by Henry Shovic, a soil scientist under contract to Arches National Park. Locations are shown on the map, and were selected by NPS Park staff and Dr. Shovic's field review. Though the soil interpretations were not used in site selection, in each case the severe trail problems were correlated with the "Very limited" soil interpretations.



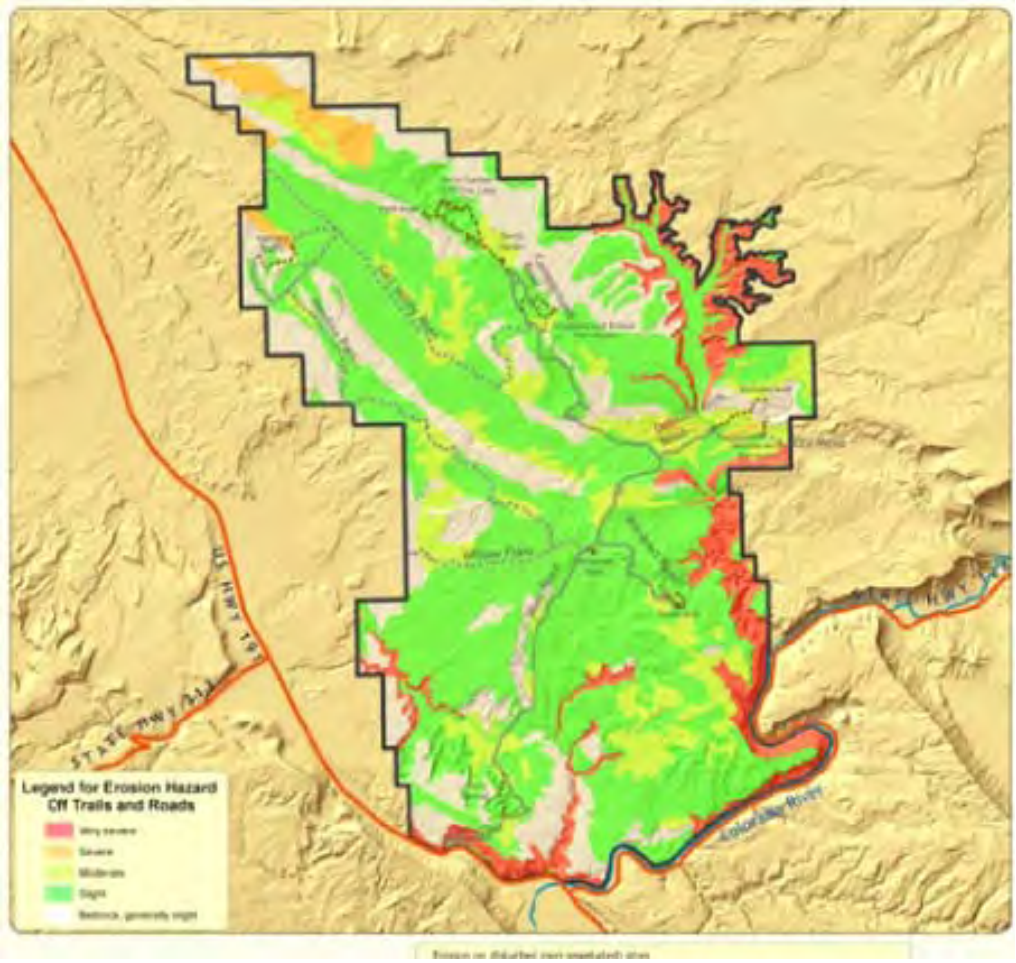
Trail Limitations

Erosion on disturbed (non-vegetated) sites

The ratings in this interpretation indicate the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope and soil erosion factor K. The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance. In the case of Arches, the disturbance is likely to be loss of biological soil crust.

The hazard is described as "slight," "moderate," "severe," or "very severe." A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions; "moderate" indicates that some erosion is likely and that erosion-control measures may be needed; "severe" indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Even though soils have low strength and organic matter content, most of Arches National Park has a “slight” or “moderate” erosion hazard. This is primarily due to slope. However, steeply-sloping areas have a “very severe” rating because of slope and soil properties.



Erosion Hazard

Camping Areas

Camp areas are tracts of land used intensively as sites for tents, trailers, campers, and the accompanying activities of outdoor living. Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic.

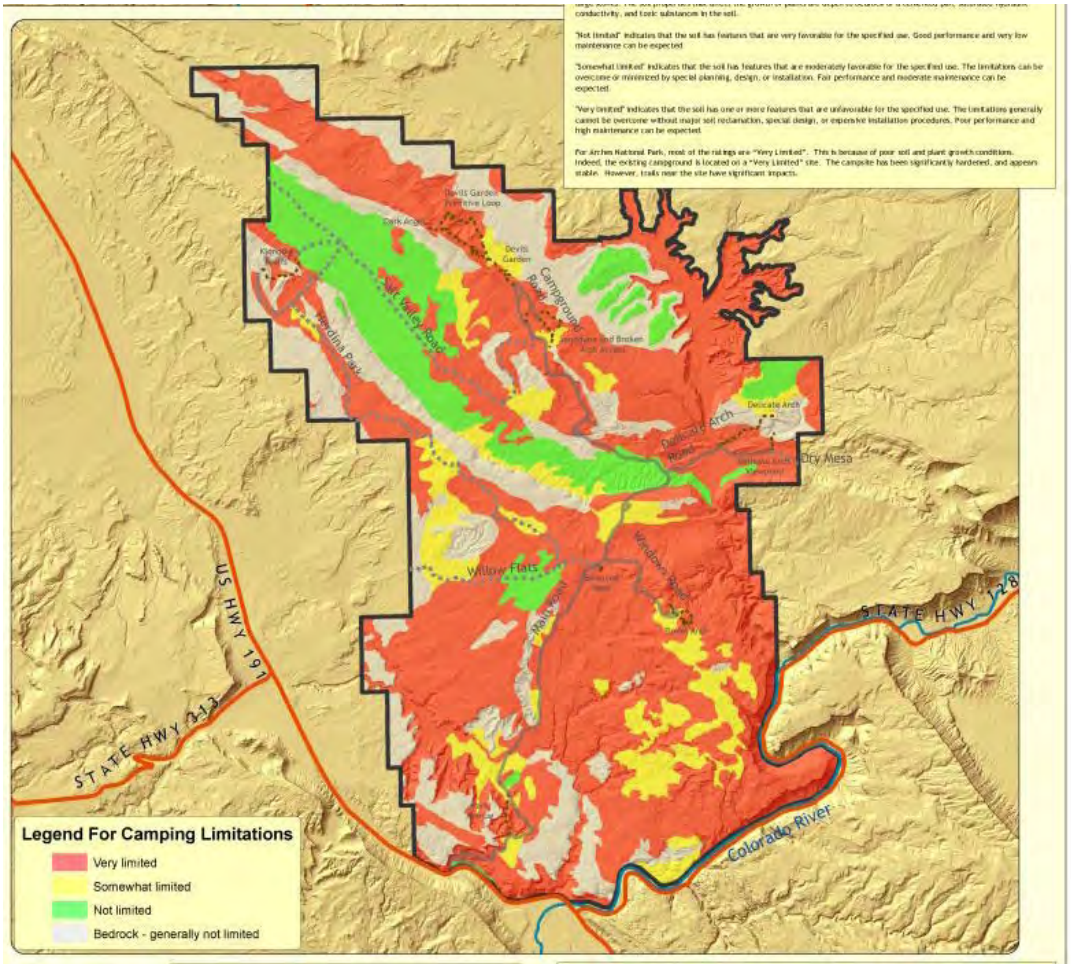
The ratings are based on the soil properties that affect the ease of developing camp areas and the performance of the areas after development. Slope, stoniness, and depth to bedrock or a cemented pan are the main concerns affecting the development of camp areas. The soil properties that affect the performance of the areas after development are those that influence trafficability and promote the growth of vegetation, especially in heavily used areas. For good trafficability, the surface of camp areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, saturated hydraulic conductivity, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, saturated hydraulic conductivity, and toxic substances in the soil.

"Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected.

"Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected.

"Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

For Arches National Park, most of the ratings are “Very Limited”. This is because of poor soil and plant growth conditions. Indeed, the existing campground is located on a “Very Limited” site. The campsite has been significantly hardened, and appears stable. However, trails near the site have significant impacts.



Camping Limitations

Biological Soil Crusts, Soils, and Vegetation

Biological soil crust retention and restoration are important management issues for all desert National Parks. Much is known about crust composition, importance to ecosystem health, ecosystem and soil relationships, and disturbance effects. However, no explicit maps of crust distribution have been developed.

This exploratory project uses simple geostatistics techniques to make a first cut at biological soil crust distribution in Arches National Park. Two additional maps are included on soils surface texture and draft vegetation data to help visualize potential soil/vegetation relationships.

Biological Soil Crust

Independent crust distribution Preliminary was created using plot data from the National Park Service Inventory and Monitoring Program. Three components of ground cover on plots were used (ground lichen, dark cyanobacteria, and moss). Note this refers to absolute proportion, not relative proportion compared to total ground cover. Defined this way, these results show biological soil crusts cover 0 to 97% of the ground surface and have significant geospatial "hot spots" of high and low crust cover (see top map). The reasons for these "hot spots" may not be readily apparent. Gypsiferous soils are not shown here, but may be a significant influence. Relating absolute ground cover to total non-crust cover and past use patterns could also prove useful. Using a more robust geostatistics method could also potentially provide better results (a relatively simple method (inverse distance weighting)) was used in this exploratory project. Transforming the data and applying more sophisticated techniques should improve its usability. Finally, there is a conceptual difference between present crust condition and status of crust recovery. This would need further require further exploration of the data.

Soils

Some general relationships have been discovered using monitoring data from the USGS. In Arches National Park, coarse-sandy soils show some crust recovery from grazing and other disturbances. Because of their low productivity, invasive species are not common. However, growth rates are low. This is probably due the unstable nature of these sandy soils.

Silty soils show poor recovery. Though soil productivity is much higher, annual invasives compete for habitat. Soils on Mancos shales have very poor recovery, probably because their high shrink-swell properties. Gypsic soils have high stability and few invasives, so have high crust cover. Some of these properties are shown on the map of surface soil texture, excepting gypsic soils and Mancos shales.

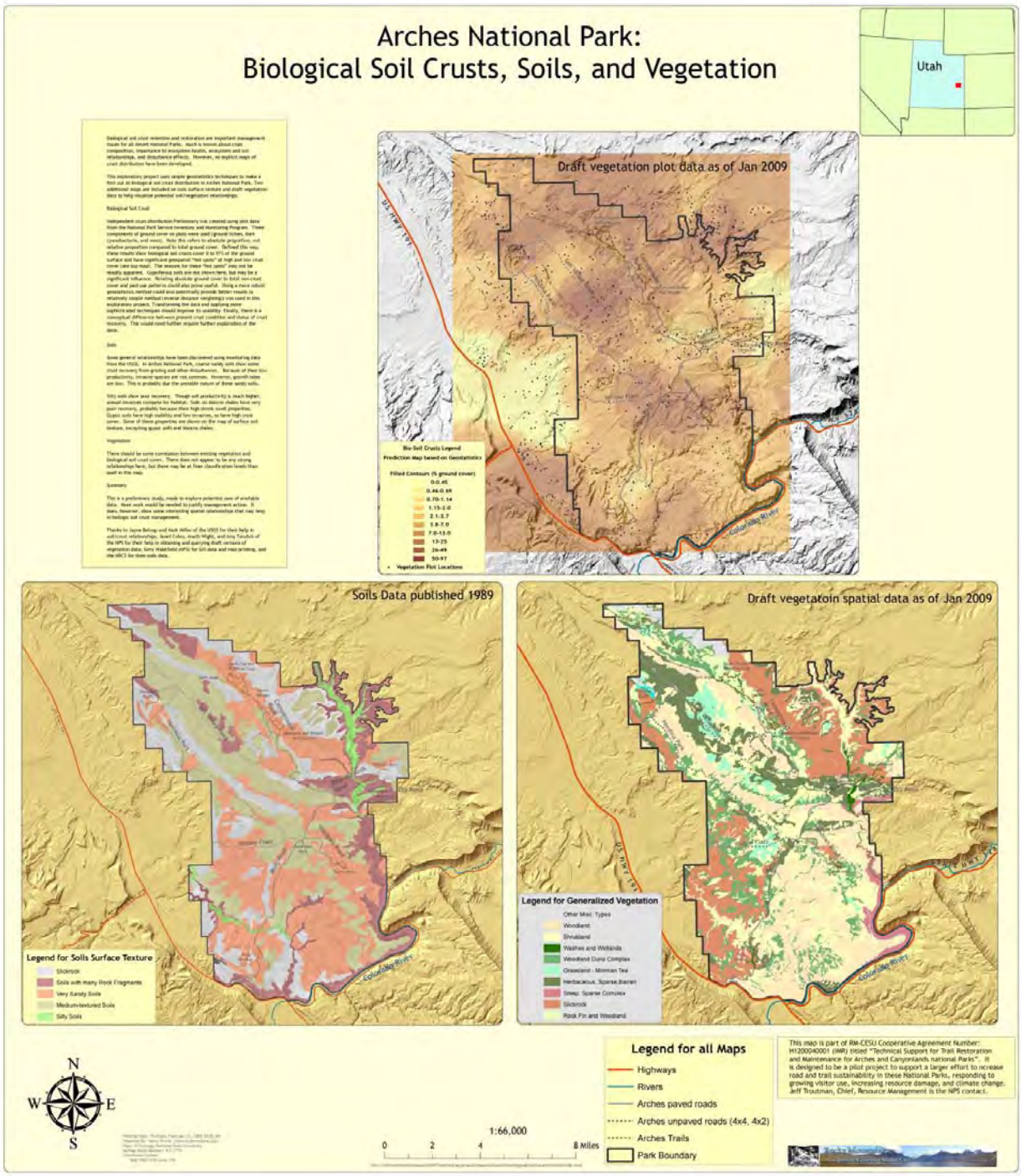
Vegetation

There should be some correlation between existing vegetation and biological soil crust cover. There does not appear to be any strong relationships here, but there may be at finer classification levels than used in this map.

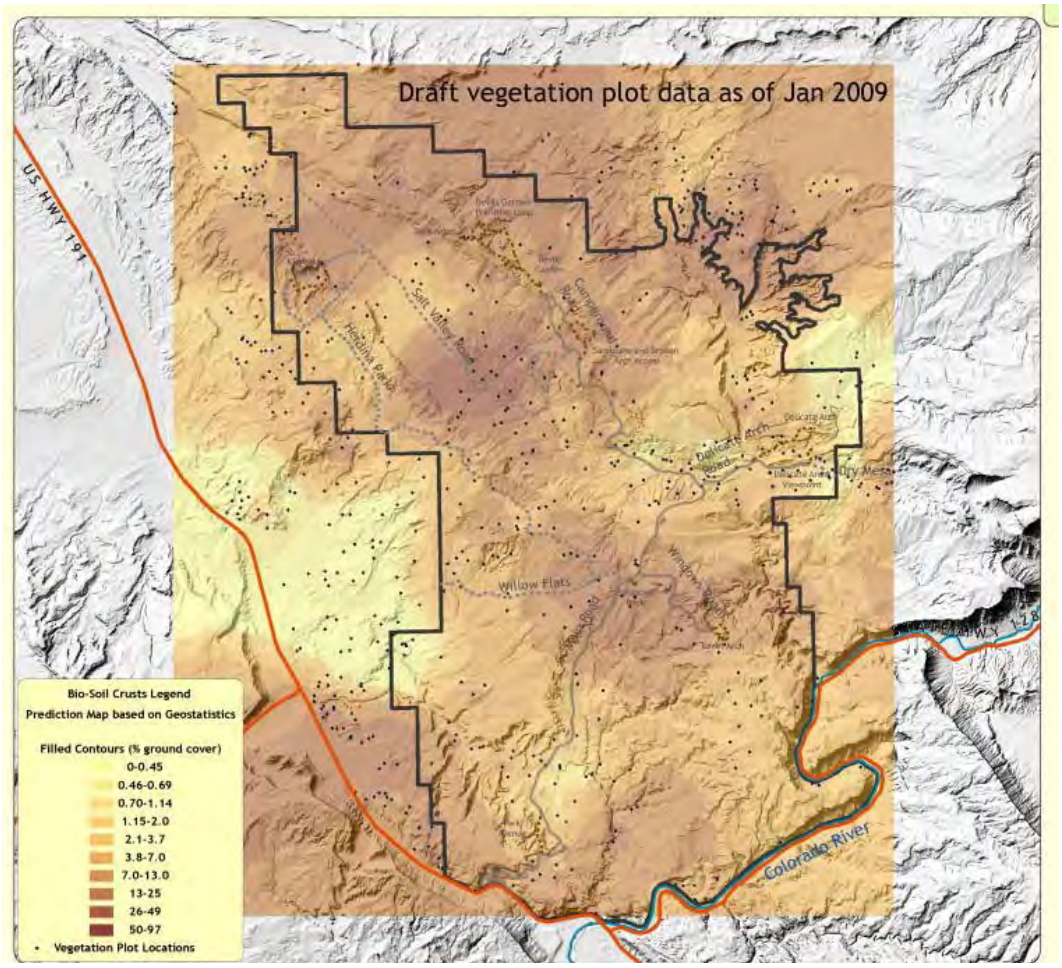
Summary

This is a preliminary study, made to explore potential uses of available data. More work would be needed to justify management action. It does, however, show some interesting spatial relationships that may help in biologic soil crust management.

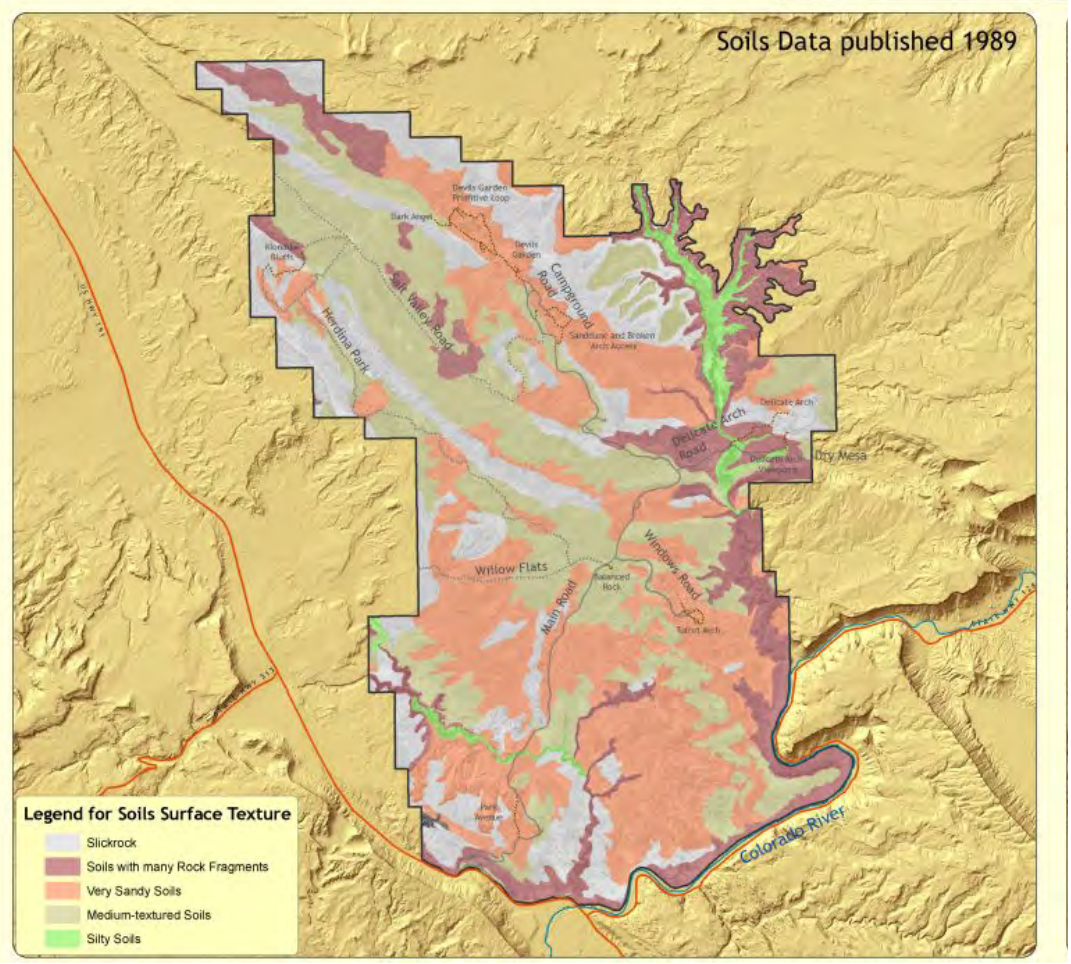
Thanks to Jayne Belnap and Mark Miller of the USGS for their help in soil/crust relationships; Janet Coles, Aneth Wight, and Amy Tendick of the NPS for their help in obtaining and querying draft versions of vegetation data; Gery Wakefield (NPS) for GIS data and map printing, and the NRCS for their soils data.



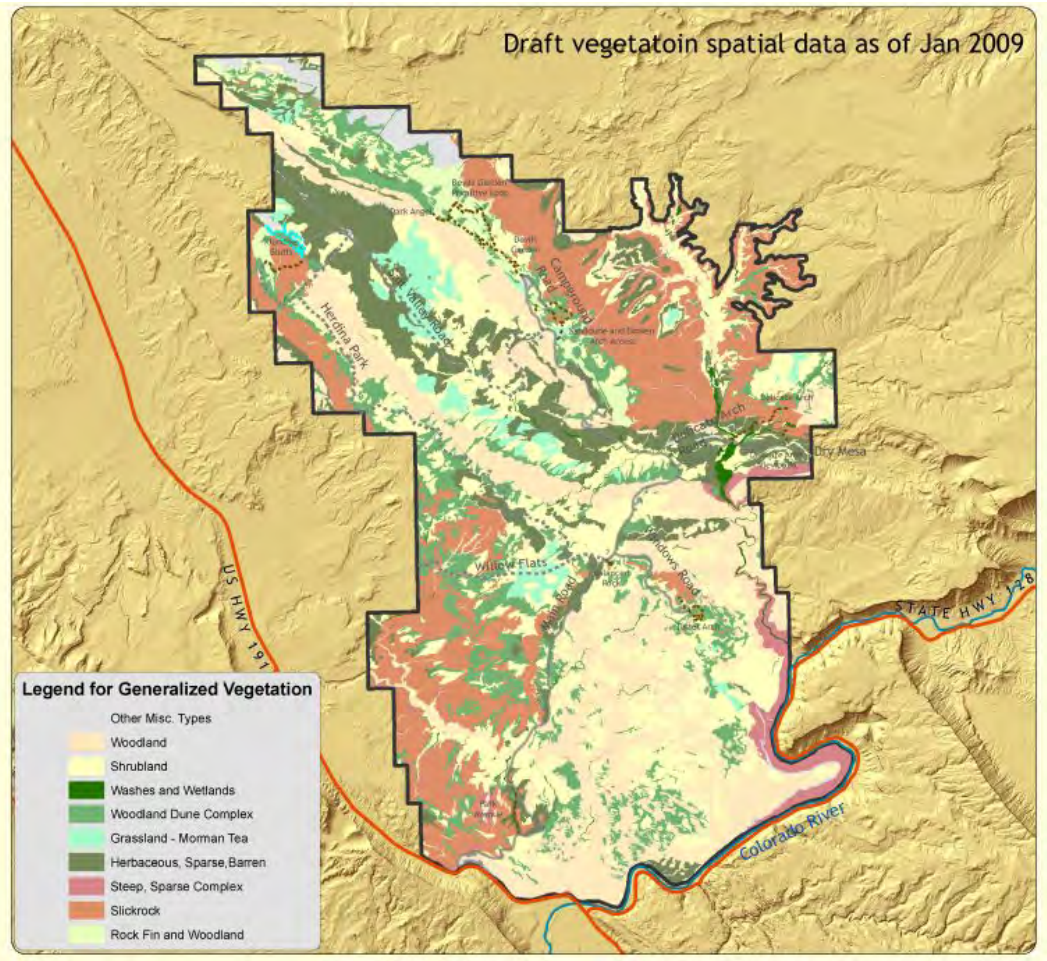
Arches Biological Soil Crusts, Soils, and Vegetation Full Map



Bio-Soil Crust Interpretations from Vegetation Mapping



Soils Surface Texture



Vegetation of Arches

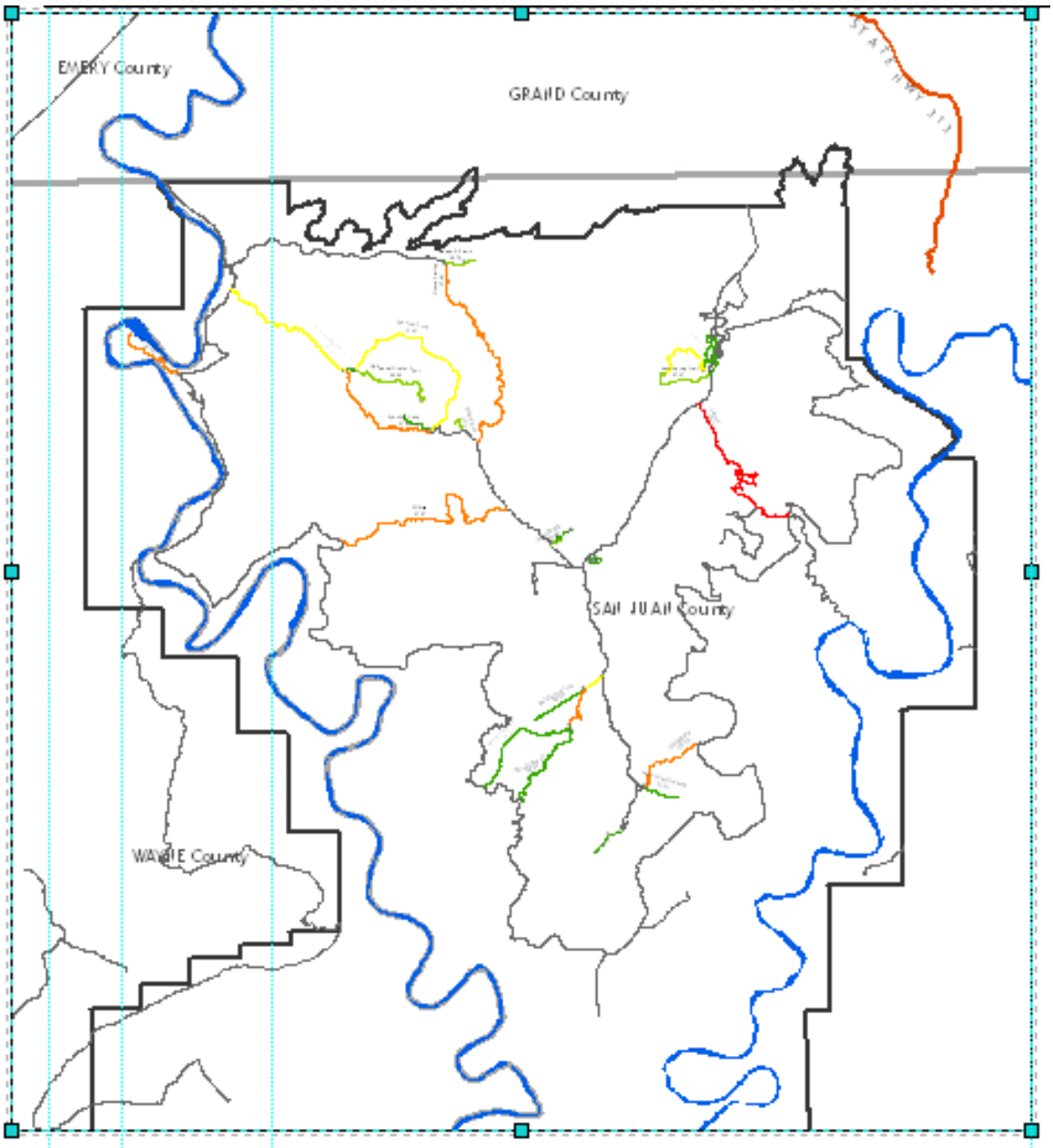
Canyonlands National Park Decision Support Systems: Giving Structure to Decision Making

This section presents a conceptual way of structuring decision making for trail management. It can help prioritize potential trouble areas and support structured use of information in decision making. The system is made up of two parts: Spatial presentation of interpretations on a comprehensive basis, rating all trails for physical sensitivity to erosion; and secondly a way of integrating those interpretations with management decision factors to rate all trails for management priority.

The Island in the Sky District of Canyonlands National Park was use as an example. Since the San Juan Soil Survey was not particularly accurate for soils or interpretations, a physical model was developed on more reliable data. In this case, field data and existing spatial data were used to determine what factors are important, and then to apply those factors across the landscape. A trail spatial layer was attributed from the following spatial query. Sensitive trails were defined as:

- Not bedrock and
  - Slope > 20 or
  - Geology = Moenkopi, and Veg = barren, and slope > 10 or
  - Eolian deposits

Spatial representations came from the geology layer, a 5m slope layer, and the recently-completed draft vegetation layer.



Spatial representation of Trail Sensitivity for Island in the Sky District, Canyonlands National Park

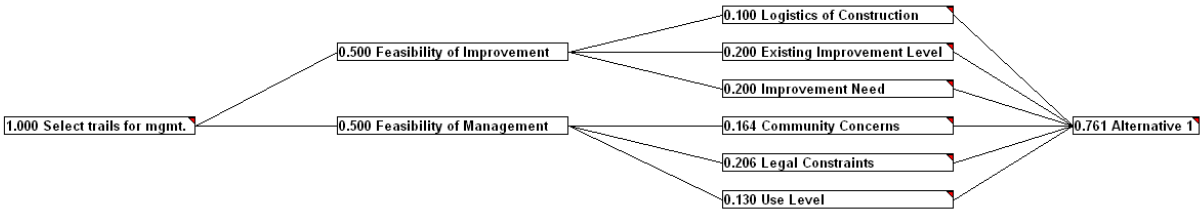
Though this is a useful product on its own, it does not reflect feasibility criteria that Management uses to prioritize actions, such as resource allocations, political considerations, legal constraints, logistical considerations, and use levels. These criteria are captured in the second part of the the decision making system. This part was developed from EMDS (Ecosystem Management Decision Support) , created by the Forest Service and used by many agencies. The modification made here retains the integration of spatial factors, the documentation system, the systematic decision-making process, but replaces the complex physical factor model with a simpler, more usable one.

The software used for this is based on DECISION PLUS (© Criterium Software), and a spatial linkage (PRIORITY ANALYST) developed by that company used in ARCGIS. It includes a structured way of developing criteria, a method of rating those criteria for importance to management, and a spatial linkage to both obtain spatial data and to output results. For this example 40 trail segments were rated, making manual calculations difficult, but easily handled by this software.

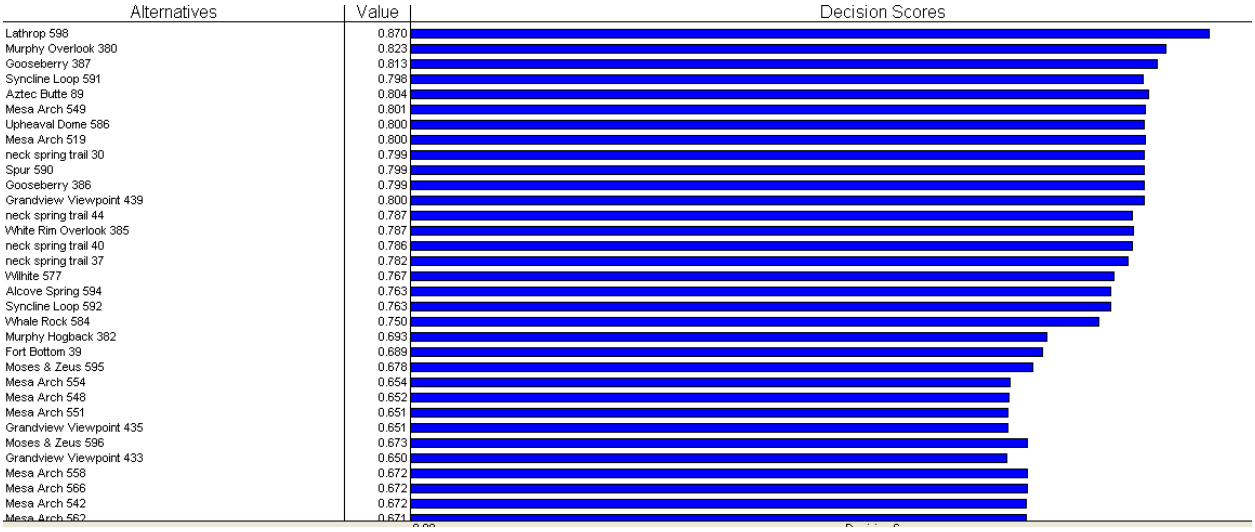
The decision factors used in this example include:

- Feasibility of improvement
  - Logistics of construction (trail length)
  - Existing improvement level (present trail surface)
  - Need for improvement (Sensitivity)
- Feasibility of management
  - Community Concerns
  - Legal Constraints
  - Level of Use (Distance to paved road)

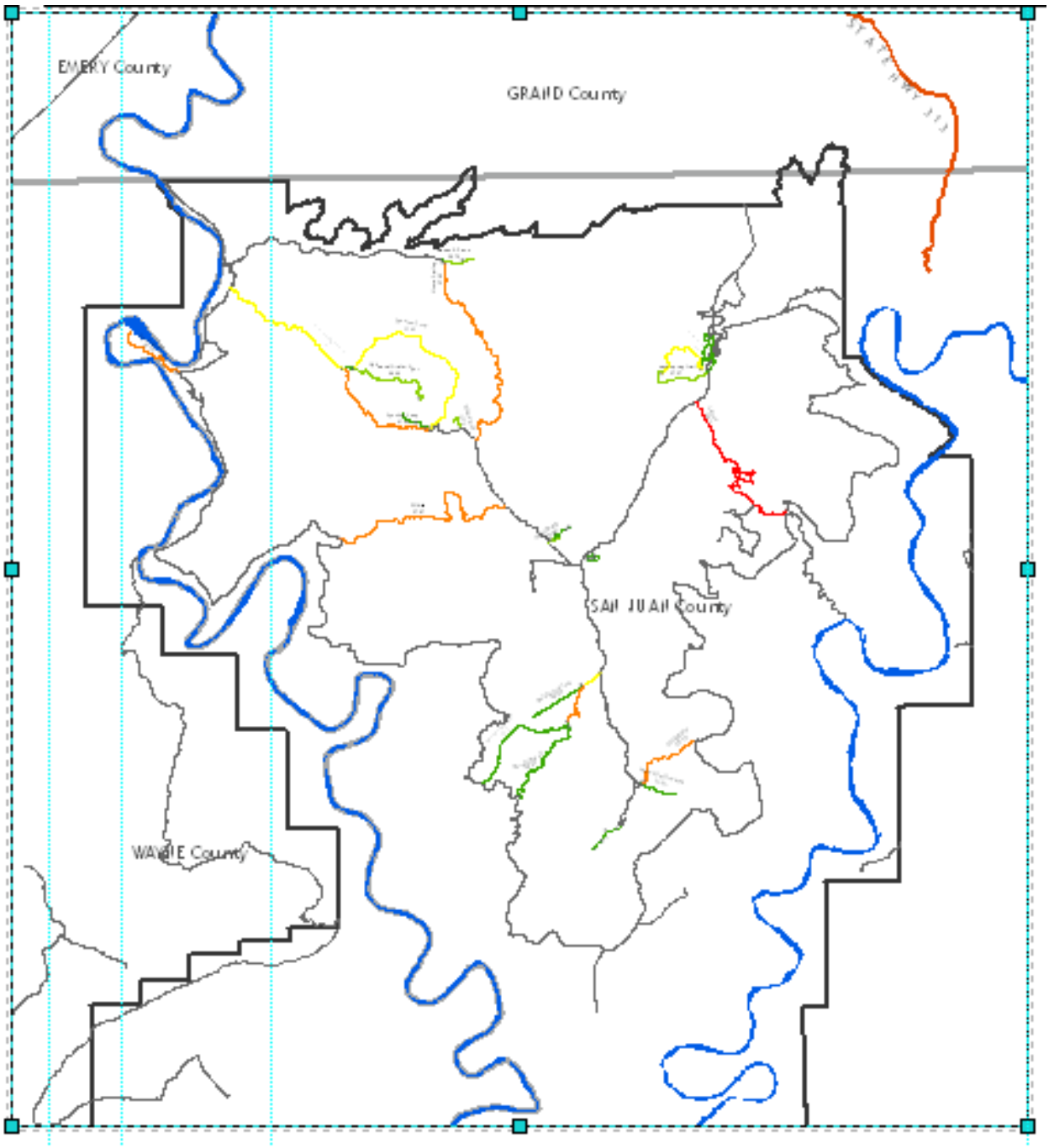
Though legal and community concerns are all rated identically in this example, they could easily be changed in actual applications. The decision model is shown below. Note the numbers next to criteria are weights developed by Management to show relative importance of factors.



Results can be shown in many graphical and tabular forms.



Spatial results are shown below. Note colors refer not to trail sensitivity as shown above, but to the total score of the ratings for all the factors, giving Management a tool for structured decision support, documentation, and the ability to run scenarios of many different weightings and factor ratings. Compare this with the trail sensitivity shown above.


EMERY County
GRAND County
SAN JUAN County
WAYNE County

.

Appendix One: The Project Description

RM-CESU Cooperative Agreement Number: H1200040001 (IMR)

PROJECT COVER SHEET

TITLE OF PROJECT: Technical Support for Trail Restoration and Maintenance

NAME OF PARK/NPS UNIT: Arches and Canyonlands National Parks

NAME OF UNIVERSITY PARTNER: Montana State University

NPS KEY OFFICIAL:
Jeff Troutman, National Park Service, Chief, Resource Management, 2282 S. West Resource Blvd., Moab, Utah 84532; Phone: 435-719-2130 Email: jeff_troutman@nps.gov

PRINCIPAL INVESTIGATOR:
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Montana State University
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Bozeman, MT 59717-3460
406 994-4548
droberts@montana.edu

RESEARCHER:
Henry Shovic, PhD, Montana State University, Department of Ecology, hshovic@bridgeband.com

COST OF PROJECT:

Direct Cost: $13,075
Indirect Cost (17.5% University-CESU overhead): $2,288
Total Cost: $15,363

NPS ACCOUNT NUMBER: 1341-1000-NZI

NAME OF FUND SOURCE: Park Base

PROJECT SCHEDULE, FINAL PRODUCTS, AND PAYMENTS:

Date of Project Initiation: September 15, 2008 with a completion date six calendar months from project initiation, subject to weather constraints.

List of Products: Products include: reports, maps, spatial data, site reviews with specialists, and presentations for management. For the defined scope of this pilot project, the following are anticipated.

- Up to 10 different maps at 36 in by 48 in and 8.5 x 11 size suitable for presentation (provided in hard-copy, Adobe Acrobat (pdf), and images for Powerpoint (jpg) at appropriate resolution).
- 3 documents in WORD format presenting results under each objective.
- 1 presentation of results for on-site managers.
- Remote briefings as requested.
- Two field excursions of 3 days each (GPS data collection and QA/QC field verification, and final presentations of project results).
- Spatial and analysis data provided via FTP or DVD, including collected and synthesized base data, metadata, and all GIS analysis projects. All new spatial data will meet all NPS spatial data standards.
- Final completion report due to the RM-CESU

Payment Schedule: Payment of regular invoices from the University, as received by the NPS.

> Invoices are payable only if the reports and/or products have been received and approved by the NPS key official. The NPS will withhold payment of the final 10% of project funds until the NPS Key Official receives and approves the final report and/or products. The NPS will not pay invoices for less than $200, unless it is the last invoice to close the project account.

Due Date for Final Report and/or Other Products: October 30, 2009

End Date of Project: March 1, 2010

CONTRIBUTION OF PROJECT TO OBJECTIVES OF CESU:

The NPS RM-CESU Research Coordinator indicates, by initials here, that this project contributes to the purpose of the CESU and is consistent with the approved Mission Statement, Strategic and/or Annual Work Plan.

/s/ Initialed by Kathy Tonnessen, RM-CESU Research Coordinator, on August 7, 2008

ATTACHMENTS

Attach, to this project cover sheet: 1) a Scope of Work that includes a detailed budget, list of products, and project schedule; and 2) Attachment Form 4.9 (substantial involvement and public purpose).

FINAL REPORT: DISTRIBUTION

Upon project completion, the NPS park/unit must submit a copy of the final products and/or final report (electronic copy required; paper copy optional) to the NPS RM-CESU Research Coordinator and to the RM-CESU host university (The University of Montana). Send electronic copies to **rmcesu@forestry.umt.edu** and/or kathy_tonnessen@nps.gov. Mail paper copies to RM-CESU, The University of Montana, College of Forestry and Conservation, Missoula, MT 59812.

In addition, send a copy of the final report to the NPS Technical Information Center, which is the official repository for all NPS technical reports: National Park Service, Technical Information Center, P.O. Box 25287, Denver, CO 80225.

RM-CESU CONTACTS

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DETAILED SCOPE OF WORK, SCHEDULE, PRODUCTS

Scope: The present tasks and products are designed to be a pilot project to support a larger effort to increase road and trail sustainability in these National Parks, responding to growing visitor use, increasing resource damage, and climate change.

Because this is a pilot project, data collection is limited to available GIS data, other spatial data, and field review as specified below. Specifications or tasks may, however, be modified to fit emerging needs as they are identified. To assure project objectives continue to be relevant, the cooperator will coordinate closely with National Park Service (NPS) personnel, especially with Trails and Roads, GIS, and Resource Management.

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- Task A: Research and synthesize technical documents and methods of trail restoration used in arid landscapes, including literature used in the BLM, USFS, and NPS; and field review with trails and roads specialists. This includes both general soil conservation and erosion control recommendations for trails and roads, and specific methods used in Arches and Canyonlands National Parks.

Objective Two: Re-route projects - alternative development analysis and support.

- Task A: Provide site-specific project services, including analysis and display of vegetation, landscape, and soils information in map form and development of reroute alternatives using landscape data, visitor use information, local NPS management and specialist input. This can include 3-D scientific visualization, viewshed analysis, quantitative analysis of potential soil and vegetation impacts, and field review and documentation.

  Two project sites are included:
  - Salt Creek Re-route – Canyonlands N. P.
  - Maze District “Fault-line” Trail – Canyonlands N. P.
  - Fort Bottom Ruin Social Trail Problem – Canyonlands N. P.

Objective Three: to help inventory and prioritize potential trouble areas, as well as support decision making on use management, as well as to provide factual support for trail condition classification for one National Park (selected by NPS).

- Task A: Synthesize and spatially present available soil survey and landscape data (including elevation, vegetation, slope, and available condition inventories).
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BUDGET

Professional Services	
H. Shovic, PhD	
(256 hours @ $40/hr)	$ 10,240
Travel (6 working days; two site visits)	
PerDiem (meals, incidentals)	$ 307
Lodging	$ 420
(waived if NPS provides powered trailer pad)	
Mileage	
2968 miles (two site visits)	$ 1,409

@$.475	
Materials	$ 200
GIS equipment and license	$ 500
Total Direct Costs	$ 13,075
IDC @17.5%	$ 2,288.
Total	**$ 15,363**

SUBSTANTIAL INVOLVEMENT DOCUMENTATION

Task Agreement No. or PR No._____

Project Title: Technical Support for Trail Restoration and Maintenance, Arches and Canyonlands National Parks

Type of funds to be used for this project (select one): ONPS

l. Why was this cooperator selected?

Dr. Shovic was selected because of his knowledge of and experience working with soils, geology, and geomorphology related to trail planning, trail building, and trail maintenance. Mr. Shovic also has GIS related skill that will prove useful to this project.

2. Explain the nature of the anticipated substantial involvement?

The NPS will provide guidance in objective-setting, monitor results, provide site-specific requirements and data, and act as liaison with Park Management. Estimated involvement is as follows.

- 20 hours Trails Coordinator
- 5 hours Resource Manager
- 5 hours GIS specialist
- Available digital spatial data and trail documentation

The NPS Resource Manager and the cooperator will jointly participate in developing, reviewing and modifying project proposals, data, and or reports. The NPS Resource Manager and cooperator will jointly participate in project research and/or fieldwork. The NPS will have substantial direct involvement prior to project activity to insure compliance with the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA). The project findings will be incorporated into NPS operations for maintaining trails and backcountry roads.

3. Why is the substantial involvement considered to be necessary for this project?

Site specific analysis by the resource manager with local knowledge of use, previous problems/fixes and associated resource issues combined with the scientific knowledge and hands on skills of Dr. Shovic is necessary to provide solutions to the trail/road problems facing managers.

4. What are the products expected?

- Up to 10 different maps at 36 in by 48 in and 8.5 x 11 size suitable for presentation (provided in hard-copy, Adobe Acrobat (pdf), and images for Powerpoint (jpg) at appropriate resolution).
- 3 documents in WORD format presenting results under each objective.
- 1 presentation of results for on-site managers.
- Remote briefings as requested.
- Two field excursions of 3 days each (GPS data collection and QA/QC field verification, and final presentations of project results).
- Spatial and analysis data provided via FTP or DVD, including collected and synthesized base data, metadata, and all GIS analysis projects. All new spatial data will meet all NPS spatial data standards.

5. What is the purpose of the agreement?

Research and synthesize technical documents and methods of trail restoration used in arid landscapes, including literature used in the BLM, USFS, and NPS; and field review with trails and roads specialists. This includes both general soil conservation and erosion control recommendations for trails and roads, and specific methods used in Arches and Canyonlands National Parks.

Provide site-specific project services, including analysis and display of vegetation, landscape, and soils information in map form and development of reroute alternatives using landscape data, visitor use information, local NPS management and specialist input. This can include 3-D scientific visualization, viewshed analysis, quantitative analysis of potential soil and vegetation impacts, and field review and documentation.

Help inventory and prioritize potential trouble areas, as well as support decision making on use management, as well as to provide factual support for trail condition classification for one National Park (selected by NPS).

6. Explain why the project or activity entails a relationship of <u>assistance</u> rather than a contract for services.

This project involves sharing skills, work experience and local knowledge to improve the capacity of NPS Staff to plan for trails in appropriate areas, build trails, maintain trails and keep appropriate records to monitor trail conditions/maintenance needs. Site specific analysis by the resource manager with local knowledge of use, previous problems/fixes and associated resource issues combined with the scientific knowledge and hands on skills of Mr. Shovic will provide solutions to the trail/road problems facing managers. Properly designed and well maintained

trails will improve public safety and enjoyment of our National Parks and promote stewardship of these public lands.

7. How was the determination made that the costs proposed are accurate and proper?

Cost estimates were based on government per diem rates, mileage figures from maps, estimates of hours of work based on past experience with similar projects, and actual costs of needed materials to support the work.

Jeff Troutman		08/05/2008	
Key Official/ATR	Date	Contracting Office	Date

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