

Integrating GIS Technologies with the Visual Resource Management Inventory Process

Technical Note 407



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This technical note attempts to modernize the VRM inventory process by taking advantage of advances in GIS and image processing technologies in order to accomplish the following goals:

- ## Inventory Process Model

The inventory process model described here represents a process guided primarily by a traditional VRM inventory using GIS as a storage and production medium. This model requires:

- [illegible]

[illegible]

- Local GIS support. The support could be provided by resource specialists with GIS ability or “as-needed” off-site support. Regardless of how the GIS support is acquired, it is recommended that a GIS Specialist be an active member of the interdisciplinary team performing the scenic evaluations.

Assumptions

Three assumptions guided development of this inventory process model:

- The VRM inventory process is followed as described in BLM Manual Handbook 8410-1, *Visual Resource Inventory*. It may be argued that some adjustments to the VRM inventory procedure are made with each inventory. Handbook H 8410-1, Section I, Implementation Options, states that adaptations to the inventory method may be made if they (1) provide a more cost-effective way to complete a quality inventory, and (2) keep the conceptual framework of VRM system intact. It is believed the inventory process model described here meets these criteria.
- The data generated in support of local VRM inventories will conform to the BLM Standard Theme Specifications for the Visual Resource Management Program (see Appendix A).
- The spatial component of any data generated during the VRM process will meet the guidelines for geospatial data at a scale of 1:100,000, as stipulated by the Federal Geographic Data Committee (FGDC), Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy. See the FGDC's Web site (www.fgdc.gov) for complete details.

Determining Key Observation Points and Minimum Mapping Units

Before any major analysis or mapping for the VRM inventory can be completed, two decisions must be made:

- What are the visual resource management objectives of the inventory and how will these objectives be expressed by the selection of key observation points (KOPs) or areas? Much of the analysis and mapping will be based on the locations of these KOPs and they should be selected at the beginning of the process. How this selection is made may vary from inventory to inventory.
- What is the minimum mapping unit (MMU) that will be used? The MMU is used to express what the smallest manageable VRM unit can be. It can vary from less than 100 to several thousand acres. This is important because a GIS can generate a large number of very small areas (or polygons or pixels) that, in a practical sense, are not manageable. By deciding at the beginning of the project what the minimum size area that is practical to manage will be, techniques in GIS can be used to keep the product maps as simple as possible and yet reflect realistic management objectives.

These two decisions should be based on the unique physiographic characteristics of the inventory area and the objectives driving the management of the visual resources. Since these decisions will vary from office to office, and possibly between inventories within offices, inventories conducted by different offices, or by different teams at different times, may not seamlessly fit together into a map representing a larger area.

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Data Categories

Information, or data, that must be addressed during the VRM inventory process can be divided into three main categories: data identification, data conversion, and data analysis.

Data Identification

Data identification includes data that needs to be identified, or acquired, by the VRM team prior to beginning the VRM inventory. Some examples are:

- Location of key observation points (KOPs) on overlays
- Highlighting vegetation communities and their characteristics on overlays
- Location of existing structures in the visible landscape and their proper placement on an overlay
- Acquisition of digital elevation models

Data Conversion

Data conversion refers to the type of information that may be created prior to GIS analysis being performed. Some examples are:

- Digitizing or scanning of overlays
- Registration of those same overlays
- Projection or reprojection of data

Data Analysis

Data analysis refers to the variety of GIS data that will be generated while performing the VRM inventory. Some examples are:

- Buffers at various distances
- Viewshed analysis for visible or not visible (one example is to identify seldom seen areas)

- Conversion of polygon data to grids and adding multiple grids together
- Conversion of grids back to polygons (conversion to shape files)
- Overlay (intersection or clip) to assess acreage
- Production of map products for field or office use.

The examples provided for each of the categories are not all inclusive and should not be treated as such. They are provided for guidance and to show the types of data that may be needed by the VRM team. Specific data needs will vary from team to team and from inventory to inventory.

Steps within data conversion and data analysis may require the conversion of hardcopy plots or maps to digital format by digitizing, scanning, or some form of grid conversion. Digitizing could be performed on a variety of tablets found around the agency. Grid conversion can be performed within a number of GIS applications. While the GIS application used is not critical for digitizing or grid conversion, the Bureau's default application at the time this publication went to press was ESRI's Arc/Info. ESRI provides an excellent suite of software products that will perform conversions as well as meet all the needs of the inventory teams. However, other GIS applications are capable of providing the same functionality as Arc/Info. Regardless of the application used, be sure that data formats and structures are consistent and that the application provides portability between systems via some type of exchange format.

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[illegible]

repetitive from key factor to key factor. Yet, because the key factors are so very distinctive they must be addressed and completed individually. In fact, the data capture phase is extremely critical to the success of the entire VRM inventory process. Without proper data input, the process potentially could be completed but generate invalid results. To ensure this doesn't happen, a methodical and conscientious approach when capturing the initial data is critical. Be sure the spatial data corresponds to the numerical rating generated from H-8410-1, Scenic Quality Inventory and Evaluation Chart, Illustration 2 (see Appendix B).

Landform

The rating criteria for landform is that topography becomes more interesting as it gets steeper or more massive, or more severely or universally sculptured.

Mylar overlays would be placed over the maps. Using their knowledge of the area being evaluated, team members would annotate areas of particular landform interest on the overlays. The overlays would then be digitized or

[illegible]

[illegible]

scanned and converted to grid (cell or raster) data for later analysis.

Vegetation

The rating criteria for vegetation gives primary consideration to the variety of patterns, forms, and textures created by plant life.

Vegetation is classified as described in the traditional inventory method on the Scenic Quality Inventory and Evaluation Chart and mapped on 1:100,000 scale overlays (or a scale appropriate to the inventory area). As with the discussion under landform, mylar overlays should be used by the team to capture the appropriate vegetation information. The overlays are then digitized and converted to grid for later analysis.

Water

The rating criteria for water describes it as that ingredient which adds movement or serenity to a scene; the degree to which water dominates the scene is the primary consideration in selecting the rating score.

Manual mapping of areas is rated for the dominance of visible water's contribution to the scene as described. This is mapped on a 1:100,000 scale, then digitized and converted to grid for later analysis.

Color

The rating criteria for color considers the overall color(s) of the basic components of the landscape (e.g., soil, rock, vegetation) as they appear during seasons or periods of high use. Criteria to use when rating color can be described in the context of variety, contrast, and harmony.

Based on the knowledge of the team and field visits as necessary, map areas of rich color

contrasts and variety and rate them as described on the Scenic Quality Inventory and Evaluation Chart. This is mapped on a 1:100,000 scale, then digitized and converted to grid for later analysis.

Scarcity

The rating criteria for scarcity provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique or rare. Rating scores are based on the degree of the feature's rarity and on the opportunity for consistent exceptional wildlife or wildflower viewing. This key factor allows a rating score over five with a written justification.

Landscape features that are unique or rare in the physiographic region are mapped and rated according to the criteria in the Scenic Quality Inventory and Evaluation Chart. These overlays are then digitized and converted to grid for later analysis.

Cultural Modifications

The rating criteria explains that cultural modifications in the landform/water, vegetation, and addition of structures should be considered and may detract from the scenery in the form of a negative intrusion or complement or improve the scenic quality of a landscape. This is the only scenic quality key factor that can receive a negative score, reducing the overall scenic rating.

Existing cultural modifications can be mapped in the “visible” area. Based on local knowledge and field visits where considered necessary, landscapes can be mapped and rated according to the visual impact of those features. These overlays would be digitized and converted to grid for later analysis.

[illegible]

[illegible]

Adjacent Scenery

The rating criteria describes adjacent scenery as the degree to which scenery outside the scenery unit being rated enhances the overall impression of the scenery within the rating unit. This factor is generally applied to units that would normally rate very low in score, but the influence of the adjacent unit would enhance the visual quality and raise the score.

In a practical sense, if the adjacent scenery key factor can add from 0 to 5 points to a scenic quality rating, then the preliminary scenic quality rating score must be between 7 and 11 for this factor to have an effect on the overall rating. Regardless of the analytical model, the scores for the other scenic quality key factors should be added together first. If the total score for scenic quality is between 7 and 11, only then should the adjacent scenery key factor be analyzed, scored, and added to the scenic quality total score.

For those areas determined to have a preliminary scenic quality rating of C, but are close enough to the B rating to potentially benefit from an adjacent scenery score, the team can adjust the scenic quality rating based on consensus of the influence of adjacent scenery. This is a subjective rating and adjustments to the GIS database would be done manually.

Scenic Quality Evaluation

Methodology

The proposed scenic quality evaluation methodology is divided into the following steps:

1. All grids that were created representing the scenic quality key factors are mathematically added together.

2. The product grid can be reclassified into three categories based on the scenic quality rating guidance in handbook H-8410-1, where scores of 11 or less = C scenery, 12 to 18 = B scenery, and 19 or more = A scenery.
3. Areas with scores of 7 to 11 can be extracted separately for consideration of the adjacent scenery key factor.
4. Once a final scenic quality rating grid is generated, it is vectorized and any polygons smaller than the agreed upon MMU absorbed (eliminated) into the larger surrounding units.

3. Areas with scores of 7 to 11 can be extracted separately for consideration of the adjacent scenery key factor.

4. Once a final scenic quality rating grid is generated, it is vectorized and any polygons smaller than the agreed upon MMU absorbed (eliminated) into the larger surrounding units.

An alternative to vectorizing the grid data would be to analyze for clumps of grid cells of similar value that total less than the agreed upon MMU size and absorb them into the majority surrounding rating unit.

This small area elimination process could wait until the final VRM inventory classification is complete, but may keep the overall process cleaner if it is done at this point. Regardless of when it is done, a grid should be the product of the scenic quality evaluation and it should be available for later analysis with the other major VRM components.

Sensitivity Level Analysis

The ratings for evaluating scenic sensitivity are, by design, very subjective. This component of the VRM inventory is the public's opportunity to have their feelings and opinions about areas in the landscape addressed in the ranking process. Because of this subjectivity, there could be tremendous variability in the ratings generated by adjoining offices, and GIS support of the

[illegible]

[illegible]

process could be potentially complex. Therefore, this process defers to traditional methods of acquiring this information.

Sensitivity Level Rating Units

Using traditional techniques to assess visual sensitivity, delineate sensitivity level rating units (as described in handbook H-8410-1 at 1:100,000 scale) and score their sensitivity. Digitize these overlays and convert to grid for later analysis with the other two VRM inventory component overlays.

Distance Zones

The basic assumption of distance analysis is that visual change is more significant the closer it is to the observer. In the traditional approach to this VRM component, KOPs or areas are defined at the beginning of the inventory and this component is analyzed from those.

Use of GIS technology can result in considerable savings of time and a more accurate representation of the visible landscapes from pre-mapped KOPs and areas. The result of this analysis, if documented, is also more repeatable and defensible than the traditional method.

Handbook H-8410-1 defines two distance-related zones and one zone related to landscape screening for this component.

Foreground/ 0–5 miles from KOP
 Middleground

Background 5–15 miles from KOP

Seldom Seen . . . Areas screened from view or
7–15 miles from KOP

[illegible]

GIS definition of these zones will require several steps.

The recommended methodology for computing distance zones is divided into the following steps:

1. Define and map the KOPs on 1:100,000 map overlays and digitize them.
2. Generate distance buffers from the KOPs consistent with the distances defined in H-8410-1 for the foreground/middleground and background zones. To the product map, add an attribute called "value" and assign 5 to foreground/middleground and 15 to background.
3. Conduct a viewshed analysis from the same KOP data using medium resolution terrain data (30-90 meter). The pixels that are classified as not seen are extracted to a new layer and assigned a value of 1. This represents the seldom-seen class.
4. The products of steps 2 and 3 are combined in a way that where the seldom seen exists, it replaces the distance zone pixels. (Merge or mosaic can be used, but be aware of the consequences on the outcome of the order in which maps are specified.)
5. Areas smaller than the agreed upon MMU should be absorbed into the larger classes surrounding them. The final product will be a raster layer with all three zones represented.

[illegible]

Method 1

- Then, add the reclassified raster maps together and reclassify the product as follows:

- ## Method 2

If Special Management Areas = yes,
Class I.

Or, if Scenic Quality is “B,” and
Sensitivity is “high,” and
Distance is “foreground/middle ground”,
Class II,

Or, if Scenic Quality is “B,” and Sensitivity is “medium,” and Distance is “foreground/middle ground,” Class III,

[illegible]

[illegible]

Or, if Scenic Quality is “B,” and Sensitivity is “high,” and Distance is “seldom seen,” and adjacent to Class IV, Class IV,

Or, if Scenic Quality is “C,” and Sensitivity is “high,” and Distance is “foreground/middle ground,” Class III,

Or, if Scenic Quality is “B,” and Sensitivity is “medium,” and Distance is “background” or “seldom seen,” Class IV,

Or, if Scenic Quality is “B,” and
Sensitivity is “low,” Class IV,

Or, if Scenic Quality is “C,” and Sensitivity is “high,” and Distance is “background” or “seldom seen,” Class IV,

Or, if Scenic Quality is “C,” and
Sensitivity is “medium” or “low,” Class IV.

The previous classification methods are just two possibilities. Both were based on the table in handbook H-8410-1, Illustration 11, under section A2 (see Appendix C). These analyses simply use the same products described in the handbook, but derived from various digital methods. The classification criteria used to derive the final inventory classes is the same. The crosshatching patterns described in section B of the same illustration, though elegant in their simplicity as a method to derive VRM classes, would be unnecessary.

[illegible]

[illegible]

the classes or their boundaries to conform to the management objectives defined in the RMP/EIS. These changes may take the form of manual manipulation of the data or can be generated from other GIS analysis. The changes made and methods used will be unique to each RMP/EIS. The final product of this effort will be the visual resource management classes data.

[illegible]

[illegible][illegible]

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[illegible]

[illegible]

THEME NAME: Scenic Quality Class

SOURCE: Information is based on field examination and professional judgement regarding scenic values. This information may be documented in a separate report available from previous work (done by contract or by BLM) or it may be created or updated as part of an ongoing planning activity. It must be incorporated (in full or by reference) in the management situation analysis (MSA) document for each RMP.

Class C: These areas have only features that are common to the physiographic region.

[illegible]

[illegible]

ATTRIBUTE DEFINITIONS:

VRM Inventory Class I areas are where only natural ecological changes and very limited management activities occur. Any contrast created within the characteristic landscape must not attract attention. This classification is applied to wilderness areas, visual ACEC's, key natural areas bordering scenic travel routes, and other similar situations.

VRM Inventory Class II areas are where changes in any of the basic elements (form, line, color, texture) caused by a surface-disturbing activity should not be evident in the characteristic landscape. Contrasts must not attract attention.

VRM Inventory Class III areas are where contrasts to the basic elements caused by a management activity may be evident, but should remain subordinated to the natural landscape.

VRM Inventory Class IV areas are where contrasts may attract attention and be a dominant feature of the landscape in terms of scale, but should repeat the form, line, color and texture of the characteristic landscape.

THEME NAME: Visual Resource Management Classes

PURPOSE: Visual resource considerations must be made in resource management plans (RMP's), in the implementation of projects, and in management actions.

DESCRIPTION: Each of the four Visual Resource Management (VRM) Classes allows for a different degree of modification to the basic elements of the landscape. VRM classes are assigned to BLM- managed public lands in the Record of Decision for a Resource Management Plan. They are determined by applying management constraints to Visual Resource Inventory Classes.

SOURCE: The various classes are determined for each area of public land according to alternatives and decisions considered in the land use planning process. The Record of Decision documents the applicable locations and classes for management.

DATA FEATURE TYPE: Polygon

THEME TYPE: Generated

HISTORIC RECORD: Yes

UNIQUE IDENTIFIER: Identify by State/Field Office/polygon number. For example, ut050.010 means Utah/Richfield Field Office/polygon #10.

SCALE: 1:100,000

ATTRIBUTES:

VRM Class I

VRM Class II

VRM Class III

VRM Class IV

CODES:

I

II

III

IV

[illegible]

[illegible][illegible]

Illustration 2 - Scenic Quality Inventory and Evaluation Chart

Key factors	Rating Criteria and Score		
Landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers. 5	Steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional. 3	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. 1
Vegetation	A variety of vegetative types as expressed in interesting forms, textures, and patterns. 5	Some variety of vegetation, but only one or two major types. 3	Little or no variety or contrast in vegetation. 1
Water	Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. 5	Flowing, or still, but not dominant in the landscape. 3	Absent, or present, but not noticeable. 0
Color	Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. 5	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element. 3	Subtle color variations, contrast, or interest; generally mute tones. 1
Influence of adjacent scenery	Adjacent scenery greatly enhances visual quality. 5	Adjacent scenery moderately enhances overall visual quality. 3	Adjacent scenery has little or no influence on overall visual quality. 0
Scarcity	One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc. * 5+	Distinctive, though somewhat similar to others within the region. 3	Interesting within its setting, but fairly common within the region. 1
Cultural modifications	Modifications add favorably to visual variety while promoting visual harmony. 2	Modifications add little or no visual variety to the area, and introduce no discordant elements. 0	Modifications add variety but are very discordant and promote strong disharmony. -4

* A rating of greater than 5 can be given but must be supported by written justification.

INSTRUCTIONS

Purpose: To rate the visual quality of the scenic resource on all BLM managed lands.

How to Identify Scenic Value: All Bureau lands have scenic value.

How to Determine Minimum Suitability: All BLM lands are rated for scenic values. Also rate adjacent or intermingling non-BLM lands within the planning unit.

When to Evaluate Scenic Quality: Rate for scenery under the most critical conditions (i.e., highest user period or season of use, sidelight, proper atmospheric conditions, etc.).

How to Delineate Rating Areas: Consider the following factors when delineating rating areas.

- 1 Like physiographic characteristics (i.e., land form, vegetation, etc.).
- 2 Similar visual patterns, texture, color, variety, etc.
- 3 Areas which have a similar impact from cultural modifications (i.e., roads, historical and other structures, mining operations, or other surface disturbances).

Explanation of Criteria: (See Illustration 1)

NOTE: Values for each rating criteria are maximum and minimum scores only. It is also possible to assign scores within these ranges.

SCENIC QUALITY

A = 19 or more

B = 12-18

C = 11 or less

[illegible][illegible]

Illustration 11 - Determining Visual Resource Inventory Classes

A. Basis for Determining Visual Resource Inventory Classes

1. **Class I.** Class I is assigned to all special areas where the current management situations requires maintaining a natural environment essentially unaltered by man.

2. **Classes II, III, and IV.** These classes are assigned based on combinations of scenic quality, sensitivity levels, and distance zones as shown in the following matrix:

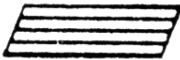
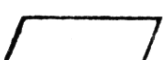
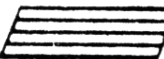
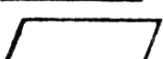
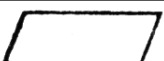
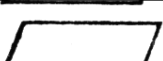
		Visual Sensitivity Levels						
		High			Medium			Low
Special Areas		I	I	I	I	I	I	I
Scenic Quality	A	II	II	II	II	II	II	II
	B	II	III	III IV*	III	IV	IV	IV
	C	III	IV	IV	IV	IV	IV	IV
		f/m	b	s/s	f/m	b	s/s	s/s
		Distance Zones						

* if adjacent area is Class III or lower, (ie - Class II) assign Class III,
if higher, (ie. Class IV) Class IV

B. How to Map Visual Resource Inventory Classes II, III, and IV.

Mapping inventory classes can be cumbersome and time consuming if not done in a systematic manner. Many systems have been developed to do this task. One that has been used effectively is:

Step I: Code each of the 3 overlays as follows:

Scenic Quality	A		B		C	
Sensitivity Levels	High		Medium		Low	
Distance Zones	F/M		B		S/S	

Step 2: Copy the codes from the overlays onto a single new overlay.

Step 3: Delineate the boundaries of the inventory classes on a new overlay using the following information as a guide:

Class II	4 or more lines	
Class III	3 lines	
Class IV	2 lines or less	

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