SOIL RESOURCE INVENTORY PROCEDURES

FOREST SERVICE

PACIFIC NORTHWEST REGION

REGION 6

SOIL RESOURCE INVENTORY
HANDBOOK OF
POLICY AND PROCEDURES

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PREFACE

National Level

The Forest Service has the responsibility for land management of the National Forest System lands. A large part of this responsibility is watershed management. The National Forest System lands are the most important watershed lands under a single jurisdiction in the United States. According to the Forest Service Manual (2500), "watershed management is the protection, conservation, and use of the natural resources of a drainage basin to keep the soil mantle in place, and make water available in a manner which best serves human requirements." Five principal phases of the Forest Service water management program are (FSM 2500):

1. Surveys, Analysis, and Plans
2. Protection
3. Restoration
4. Improvement
5. Use and Development

Authorities for watershed management on National Forest System lands are contained in legislation, Executive Orders, and administrative regulations (FSM 2501).

The Forest Service national objectives (FSM 2502) and policies (FSM 2503) of Watershed Management, state in part, that soil information and data needed to meet the watershed management program and to satisfy the legislation, Executive Orders, and administrative regulations for all management activities on National Forest System lands will be obtained, and potential and existing soil and water problems will be considered in planning management, development and extension of research of all National Forest System resources.

The FSM states the authority, objective and policy of soil survey interpretations and management under 2550 as follows:

Authority (FSM 2550.1)

"In discharging the responsibilities defined in the Organic Act of June 4, 1897, the Multiple Use--Sustained Yield Act of June 12, 1960, the Forest Service has a need for information on the nature and distribution of soils on National Forest System lands and a knowledge of their suitabilities for different uses and activities. The Multiple Use--Sustained Yield Act, in defining multiple use and sustained yield, specifically says '... without impairment of the productivity of the land.' Basic soil information is necessary to determine how best to meet this requirement."

Objective (FSM 2550.2)

"The broad objective is to secure correlated basic soil data applicable to intensive management of forest and rangelands. The soil program is designed to provide technical knowledge about soils in the form most usable for National Forest multiple use and resource planning, management and coordination."

Policy (FSM 2550.3)

"Forest Service policy for soil surveys is to conduct standard soil surveys of all National Forests, National Grasslands, Land Utilization Projects, Experimental Forests, seed orchards, nurseries, and other areas as needed for proper development and management of all resources and activities. The soil surveys will supply basic data about the soils and interpretations to assist in the planning and management of forests and rangelands (FSM 2550.3).

"Watershed Management responsibilities have been delegated to the Chief of the Forest Service by the Secretary of Agriculture (FSM 2501.3) to conduct surveys and studies of soil and water resources on lands administered by the Forest Service. Staff responsibility for the soils program in the Washington Office is assigned to the Division of Watershed Management. The Washington Office, Division of Watershed Management, has developed a Framework of Soil Resource Inventories as a guide to the Regions in establishing a Soil Resource Inventory program. The following is the Framework Statement issued February 8, 1972:

The Framework of Soil Resource Inventories

"A vigorous effort to obtain soil resource information on all National Forest System lands is needed to meet the increasing demands for soils information to support land-use planning coordinated both in-Service and with other planning or zoning Government units, and to give assistance to program planning for various products and services on the National Forests within the capabilities of these lands as required by the Multiple Use-Sustained Yield Act of 1960 and the Environmental Policy Act of 1970.

"At the present time, few National Forests have forest-wide soil inventories suitable for ranger district multiple-use and resource management planning. Such 'planning grade' inventories, which are now referred to as soil resource inventories, provide soil and related information that is adapted to Regional resource management planning systems and activities, that can be easily coordinated with the other resource inventories, and is timely in the sense that large areas of land can be inventoried in a relatively short period of time. Design emphasis from start to finish is on management needs.

"Soil resource inventories can be designed and coordinated to collect related information such as hydrologic and/or vegetation data. At comparable scales of reference (i.e., the same degree of refinement), a well designed and carefully prepared soil resource inventory can be a base for an integrated inventory involving all features of an ecosystem. Coordination at various stages of a soil resource inventory with the geologists, hydrologists, ecologists, engineers, foresters, and other disciplines is essential. To meet the several objectives, minimum requirements for a soil resource inventory are:

"a. The mapping units will be keyed to land features that (1) are significant to soil use and management, and (2) give rise to soil differences in kind and/or in pattern. The element of unity in the landscapes so delineated is provided by the patterns in which the distinctive land features are associated. Each relevant soil landscape unit, which collectively are the mapping units, contains a unique combination of soils, landform, underlying rocks and/or parent materials and vegetation or vegetation potential characteristics.

"b. The soils and their associated features will be recognized at three levels of refinement--at the mapping unit level which is commonly represented by an association of soils, at the component (of the association) level of the mapping unit, and at a higher level consisting of a grouping of mapping units along geomorphic, physiographic, or ecologic lines to reveal unity relationships and display patterns over larger areas of land. Depending on the complexity of the area and on one's background knowledge, mapping units may be aggregated upward to arrive at the broadest groupings or the larger areas may be divided downward into smaller, more homogenous subdivisions. The important thing is to recognize the genetic relationships between the soil units at all three refinement levels.

"c. After the mapping units have been designed to conform to the significant soil-related elements of the landscapes, delineation on suitable base maps will be accomplished through a combination of field sampling and aerial photo interpretation. Soil inventories may be made at any level of intensity but soil <u>resource</u> inventories are less detailed than is normally required for designing specific features of a given project.

"d. Identification (classification) of the soils at the most refined level--the individual components of a mapping unit--may be by soil series and phases but such use will depend on the locale and on need. Identification may otherwise be accomplished by the use of descriptive terms that suitably differentiate all soil units on a Forest. To facilitate interregional and intraregional, as well as interstate and intrastate comparisons, representative soil pedons will be placed (classified) within the System of Soil Taxonomy. Identification of the mapping units and of the higher groupings may be by appropriate descriptive terms (physiography, landtypes, etc.) or simply by map symbols.

"e. Characterization emphasis will be placed on the soil regolith as it occurs in its relevant environment--topographic, geologic, geomorphic, ecologic, climatic--plus the influences and effects of land use. Each soil unit will be evaluated for resource uses and activities appropriate to local management needs.

"f. A factual illustrated report including a compiled soil map will be prepared for each inventoried area, giving interpretive emphasis to management-related information. Applicable potentials, limitations, and hazards will be discussed at appropriate levels of detail for all units, their components, and groupings.

"g. Controls will be exercised to ensure the inventory is within accepted standards of quality and that inventory objectives are being met. These inventories are made for land use planning purposes and most design decisions will be made on the basis of their importance to management at the level of planning for which the inventory is being designed.

"The soil resource inventory as a planning tool will provide needed inputs to the planning process on National Forest System lands. Effectiveness of this inventory program will partly depend upon the involvement of the land managers. The greatest use return will come with the coordination of the soil information with that of other specialists and Forest personnel.

"The national goal for soil resource inventories should include an early target date, no later than 1980, for their completion on all National Forest System lands."

Regional Level

The Chief has delegated full responsibility and authority to conduct or arrange for soil surveys on National Forest System lands within each Region. More specifically, the Regional Forester (FSM 2550.42) shall, in part:

1. Develop and carry out a soil program for the Region following national technical standards and procedures, including establishing survey priorities; initiating, scheduling, and conducting soil surveys; and providing competent soil management service.

2. Provide technical guidance and technical training for soil scientists including (1) classification, correlation, and mapping; (2) investigations and interpretations; (3) technical writing; (4) soil management service counseling and recommendations; and (5) training of field staff officers in the use and value of soil information.

It is with this authority that a comprehensive Regional soil survey program was initiated in Region 6 in 1967 to broadly inventory the soil resource for land management interpretation and planning. This program called "Soil Resource Inventory" (SRI) is scheduled for completion in about 1976. This Handbook explains the SRI philosophy, goals and procedures.

The responsibility for the SRI program belongs to the Regional Office. Technical leadership is maintained by the Branch Chief, Soil Management Branch, Division of Watershed Management. He is responsible for the development, scheduling, and technical supervision of the program to ensure that it meets and follows National and Regional guidelines, objectives and goals. Some flexibility is allowed within the guidelines to fit the needs of a particular Forest.

Field work is conducted by soil scientists administratively responsible to Forest Supervisors. Funding for soil scientists in the SRI program may come either from the RO or a Forest. Cooperation between the RO and each Forest is essential. The Branch Chief (Soil Management) negotiates with the Forest, prepares an agreement jointly with the Forest, in which duties, controls and supervision of the soil scientist performing the SRI on each Forest are defined.

The goals of the Region 6 SRI program are to:

1. Systematically classify the soil resources of the Region broadly but uniformly so that this classification may be used consistently from Forest to Forest and Region-wide for planning purposes and establishing Regional management priorities.

2. It must be compatible with the National guidelines as stated in the Framework of SRI issued by memorandum dated February 8, 1972.

3. It must be accomplished within a short time period (by 1976).

4. It must be easily coordinated with other resource inventories.

5. It must be relatively adaptable to Forest Service resource management plans, systems and activities.

6. It must be simple to use and understand.

FRAMEWORK OF SOIL RESOURCE INVENTORIES, REGION 6

The Region 6 Soil Resource Inventory (SRI) is for the purpose of integrating soil, landform, vegetation and geologic relationships into Forest Service planning and inventory systems and procedures. The primary objective is to inventory the earth's surface properties and features, and to present that data in such a way that it is readily available for both professional and nonprofessional employees of the Forest Service doing planning and making management decisions of National Forest lands within Region 6. This is the first soil inventory ever made on the Forest level throughout Region 6 upon which both Forest and Regional priorities can be assessed.

The SRI is based on a landscape analysis considering the interaction of soils, geology, landform, climate and vegetation. Photo interpretation, field observation, sampling and measurements, laboratory analysis and research results are integrated in developing these relationships. The delineation of mapping units is based on the recognition of the relationships of land patterns and/or characteristics of the soil, geology, vegetation, climate and landforms as they are interpreted for resource use and management. A landtype represents an area of naturally occurring and identifiable land which has certain management requirements and/or interpretations. They are different from any other landtype and, therefore, have reasonable and observable differences, singly or in combinations of one or more soil, geology, landform, climate or vegetation features or characteristics. The SRI is not limited to the traditional soil classification system of mapping that is based simply on diagnostic soil horizon criteria. Such a system is not compatible with our use because it is restricted to the genetic and morphological characteristics rather than the total characteristics of land. It is not oriented to land management interpretations and is difficult for the user to understand.

The design of the SRI places its major emphasis on interpretation, behavior and use of soil resources as related to land management activities. It is not based solely upon soil genesis, morphology and the comprehensive soil classification system, nor is it purely on geology, vegetation and landform factors, but rather the interaction of these features. Interpretations and recommendations are based on anticipated reaction to selected management activities.

One of the most important aspects is to keep the mapping system clear, neat and simple. This is necessary to maintain control and consistency of the mapping and interpretations. Also, in order to present the data to the land manager in a way that he can readily understand and use it without having to decipher complex legends and technical terms, the survey must provide:

1. A simple, nontechnical legend (numerical is preferred).

2. All landtypes must have a modal location and/or description.

3. All management interpretations and recommendations based on landtypes and/or complexes of landtypes.

4. All landtype criteria, management interpretations and interpretive classes must be defined.

5. Mapping must be consistent. A uniform system must be established at the beginning and followed through the entire project.

6. Reasonable time for the project to be accomplished to meet Forest and Regional goals.

7. A system which is flexible so that additional interpretations may be made.

Extension and use is of major importance. The nonsoil scientist generally is not capable of interpreting soil surveys. He has little concept of technical soils or the relationship of soils to other factors of the environment or to use and management considerations. Even if he is interested, he does not have the time to become proficient. This work is done for him and is essentially the basic reason for doing a Soil Resource Inventory in Region 6. In a sense, this inventory is a management service function except for scale and detail. The report must tell what soils problems and impacts exist or might be encountered and some suggestions to solve them. Soil limitations, suitabilities, potentials, and capabilities must be clearly stated. Pertinent information must be provided to the land manager in a manner which relieves him of searching for or making the interpretations.

THE USER'S RESPONSIBILITY IS TO RECOGNIZE THE LIMITATION OF SCALE AND INFORMATION ACCURACY. OFTEN THE USER WILL OVER EXTEND THE SRI INFORMATION BY THINKING IT WILL ANSWER ALL HIS SHORT TERM PLANNING PROBLEMS, THAT IT IS THE ULTIMATE AND NO MORE SOIL DATA OR ASSISTANCE IS NEEDED. THE SCOPE OF THE INVENTORY IS FOR BROAD PLANNING PURPOSES. ADDITIONAL INTENSIVE INVENTORIES AND INTERPRETATIONS WILL BE NEEDED FOR DETAIL PLANNING AND PROJECT INVESTIGATION. THIS MUST BE MADE CLEAR TO LINE AND STAFF OFFICERS.

The major contribution, therefore, that can be derived from this inventory is introduction of this information into direction of land-use planning, soil resource protection, and maintenance of management production levels. Interpretations have been established in such a way that they point directly to management problems which reflect current strength and needed changes in policy and management direction in multiple use plans, transportation planning systems, timber inventories, recreation site development, etc.

The use and success of the SRI depends upon how well the information is presented; how well soil scientists understand the land managers' problems, how effectively the soil scientist can illustrate that the information is usable, and how effectively the planner incorporates land behavior as a factor in land-use planning. This is not an easy task and it is one on which primary emphasis is placed after the inventory is finished. Soil scientists cannot leave this information for the user alone. We must provide the expertise through interpretations for the land manager.

PROCEDURES

Planning

Setting of priorities for starting the SRI on forests depends upon several factors. The principal factors, though not necessarily in order or priority, include:

1. Scheduling of other Forest Service inventories such as the Regional timber inventory. If possible, the SRI will precede or match as closely as possible other inventory schedules to provide needed soils input.

2. Interests of Forests. Those Forests requesting the SRI will receive higher priority. Those Forests providing funds for soil scientists will receive the highest priority.

3. Forests with the biggest workloads and those with the greatest soil-related problems will receive higher priority.

4. Those Forests that have some level of soil survey will receive lower priority than those that have none.

5. Funding and ceiling restrictions.

6. Time schedule and progress to meet goal of 1976 completion date.

Staffing

Staffing of soil scientists for the SRI program comes from two sources: the RO and individual National Forests. At the outset of this program in Region 6, all SRI soil scientists were detailed to Forests by the RO. Recently, several Forests have established a soil scientist position on the Forest to do the SRI. When RO details soil scientists to a Forest, funds and personnel ceilings are also transferred to that Forest with the understanding that funds and ceiling will accompany that soil scientist to another forest upon reassignment. The soil scientist is usually administratively assigned to the soil and water staff or to a soil scientist of a higher grade. When a Forest establishes an SRI soil scientist position, they provide funds and ceiling, or funding may be shared by the RO. Administrative supervision of the soil scientist is the prerogative of the Forest Supervisor, but technical supervision of the SRI is maintained in the RO by Soil Management Branch Chief.

Cooperation

The SRI is an in-Service study. It is not part of the National Standard Soil Survey Program; therefore, no cooperative work plan is prepared with other agencies such as the SCS, BLM or State agencies. At the present time in Region 6, the landtypes are not being correlated. In the future, however, some kind of correlation may be done on the soils mapped in the SRI.

Coordination

Coordination of mapping is essential at common boundaries between National Forests. This is to ensure that common landtype delineations are consistent from Forest to Forest, but legends need not be common. It is the responsibility of the SRI party leaders to coordinate with on-going projects and to check previously completed SRI's for consistency.

PRE-FIELD PROCEDURES

Several pre-field activities are usually required by the soil scientist in the initial stages of the SRI prior to field activities. These activities are left to the prerogative of the soil scientist in charge, but the following are recommended:

1. Survey Area Boundary. Each National Forest will be a SRI survey area. All lands within National Forest boundaries and administered by a National Forest will be included in the SRI for that Forest regardless of ownership, including wilderness areas and National Grasslands. All land covered by a previous soil survey, such as detailed soil survey, cutbank stability survey, soil management survey report, barometer watershed survey, etc., will be re-surveyed in the SRI to provide uniformity throughout the Region. Forests not having an SRI should indicate this need on the Project Work Inventory (FSM 1312.8) as item 118.

2. Photography. All field mapping is done on aerial photographs. Scales between 1:35,000 and 1:70,000 are the most suitable. The most recent photography is usually preferred. Sources of photography include Army Map Services, U.S. Geological Survey, Forest Service, State agencies and forest and fire protection agencies. The following are addresses for various sources of photography:

   Army Map Services:
   U.S. Geological Survey
   Department of the Interior
   Washington, D.C. 20242
   Attention: Maps Information Office

   U.S. Geological Survey:
   Pacific Region Engineer
   U.S. Geological Survey
   345 Middlefield Road
   Menlo Park, California 94025

   State of Washington
   Department of Natural Resources
   P.O. Box 168
   Olympia, Washington 98501

   Oregon State Department of Forestry
   Mapping Section
   2600 State Street
   Salem, Oregon 97301

   The Division of Watershed Management usually purchases photography for each survey area; however, some photography may have to be purchased by the Forest. The Survey & Map Section of the Division of Engineering in the RO has current indexes and references to available photography.

Upon receiving photography, a photo index--usually a 1/2-inch/mile scale--must be made. Match lines and forest boundaries should be placed on the photos. This will be done in ink. Colors used are green for match line, and a wide red line for Forest boundary.

There are advantages to mapping on alternate photos. The non-mapping photo can be used for the placement of key landscape identification features such as streams, mountain peaks and roads; and for accessory data such as geologic information and roads. Pre-field identification of this information will be of valuable assistance while in the field. Roads especially should be carefully located. Often photography is older than many of the existing roads. The photo location of these roads will need to be carefully approximated from contour and/or firemen's maps. This is important as it enables better on-the-ground location when in the field. Geology taken from available geologic maps is most helpful if placed on the alternates. This ties landforms to geology as well as eliminates much checking of the geology maps.

Roads and geology should be put on alternate photos with colored pencils. Red is used for roads, yellow for geology and black for creeks, rivers and landmark names.

3. Maps and Reports. Several maps are needed for reference and use during the course of the survey. These should be obtained when the soil scientist first arrives on the Forest and starts planning work priorities:

a. Forest fire maps (1" per mile)

b. U.S. topographic quadrangle (15 or 7.5 minute)

c. Geology maps and reports

d. Other soil surveys

e. Soil management service reports

f. Climatic maps

g. Hydrologic data

h. Vegetative type map

i. Timber type map

j. Range type map

4. Equipment. Equipment for the SRI is standard equipment used in most soil survey work. Equipment is either provided by the RO or purchased by the Forest. This includes the following:

   a. Soil augers

   b. Shovels, tile spade, digging bar

   c. Clinometer or Abney level

   d. Rock hammer or geology pick

   e. Color book (Munsell)

   f. pH Kit

   g. Stereoscope -- field stereo that can easily be used in the field -- good office stereo (Old Delft Scanning Stereo is available for most SRI's)

   h. Increment borer

   i. Diameter tape

   j. 100' tape

   k. Timber Site Index Tables for common species

   l. Growth Basal Area Tables

   m. Compass

   n. Photo markers and pencils (the most suitable pencils are Mars-Omichron). The best markers found to date are Eberhardt-Faber, Design Markette (these are permanent ink).

   o. Prism, number 10

   p. Soil thermometer

   q. Hand lens

5. Communications with Forest Personnel. One of the first and most important things to do is to communicate with the Supervisor's staff and District personnel. Input from Forest staff is extremely important to help communications and to give the Forest staff participation in the SRI. A letter of introduction should be sent to each District Office containing the following points which need to be discussed:

a. Needs you may have for office space, equipment, etc., when working on each District.

b. Availability of lodging and eating facilities throughout the Forest, both commercial and Forest Service.

c. Schedule of visit to each District to meet Ranger and staff and explain SRI.

d. Soil problem areas that need investigation and priority work areas.

Throughout the course of the survey, it is vital to talk to District Rangers, District and SO engineers, foresters, recreation specialists, landscape architects, and range and wildlife specialists to discuss input to the SRI and to find what these users need and what we can produce. The objectives and final report should be discussed so line officers and staff are aware of what the SRI will include. In this way the SRI is made more useful and will be more readily accepted by the user. It is also important to have the SO staff review the rough draft of the report before publication. This will eliminate misunderstanding by the Forest of what the SRI contains. Good relations with the Forest cannot be over-emphasized.

6. Vehicle. Acquiring a vehicle to use full time is often a problem. Some Forests do not have extra vehicles and want employees on projects to use pool cars. This is very unsatisfactory because of high vehicle use and equipment to be carried. It is imperative that SRI soil scientists have a vehicle permanently assigned. There are three sources of vehicles: Forest Service, GSA, and rental. The use of rentals is generally the last consideration because of cost. If a GSA vehicle is to be used, arrangements should be made through the Division of Watershed Management on Forests that do not use GSA vehicles; on Forests that do use GSA vehicles, arrangements should be made on the Forest.

7. Logistics. Logistics should be considered very early in an SRI. This includes priority of work area, and lodging and meal facilities, both commercial and Forest Service. Work area priorities are based on the areas the Forest and/or District Ranger considered as having the greatest soil or resource allocation problems. If no priorities are given, then the soil scientist will determine mapping priorities. It is usually best to use commercial facilities when available, but some Forests may prefer use of Forest Service facilities over commercial facilities. Some Forest Service facilities are available in remote areas and may be used; however, they are usually full during the summer months and are not available. These areas should be worked during early spring or late summer when such facilities are in less demand.

8. <u>Pre-field Photo Interpretation</u>. Tentative mapping units should be made stereoscopically. Separations are made by identification of contrasting and variations of landform, geology, vegetation, soils, drainage patterns and other landscape features.

FIELD PROCEDURES

1. Safety. Safety must always be of the highest priority to field personnel. The soil scientist is responsible for keeping vehicles and equipment in safe and good operating condition. Most soil scientists on SRI projects work independently. Working alone carries with it some safety hazards. A daily check-out, check-in system must be made with the Ranger Station nearest the work area. Radios should be checked out from the SO for radio communication in case of emergency. However, some Forests are short on radios and thus radios are not always available during fire season.

   Travel on roads in mountainous terrain can be hazardous. This may be especially true of private logging roads where off highway large lumber trucks are used. Drive carefully and watch out for log trucks.

2. General Reconnaissance. A good Forest-wide general reconnaissance is extremely important. This is a basis for legend development and an overall look at the kinds of soils, bedrock, landforms and vegetation occurring on the Forest. Time should be taken to determine what basic groups will be needed in the mapping legend such as deep soils, glacial soils, unstable soils, shallow soils, bedrock types, vegetative types and landscapes. For example, an appraisal of bedrock types should be made to determine what kinds of bedrock units can be grouped together. This should be done with the following question in mind: What interpretative difference can be made between the geologic types and what is their significance? Experience shows that geologic units become the basis for a number of landtypes (this is also true of other factors).

   Each bedrock type occurs on three or four different landforms and produces two or more landtypes with two or more vegetative types. Therefore, each time a bedrock type is recognized several landtypes are recognized. It is important to group similar bedrock types together during the reconnaissance to save unneeded mapping units during the mapping phase and map legend development.

   A good reconnaissance will take three to four weeks, but is well worth the time. It is best to make the reconnaissance before any pre-field delineation, but that is not always possible.

3. In the Field. The techniques, procedures, and tools used in the SRI are common to most soil surveys. There are no special techniques that make SRI mapping any different or simpler than other kinds of soil surveys. The time-tested mapping techniques and procedures are still valid. The most important field tools in SRI's are aerial photos, stereoscopic examination of aerial photos, landform recognition, observation of geological traits, vegetative types and road cutbanks.

All landtype unit criteria definitions will be in every SRI Report. Most of these criteria are standardized in USDA Handbook #18. Management interpretation definitions have been developed for Region 6 and are included in the appendix of this R-6 Handbook. All interpretations used in each SRI must be included in the report. New interpretations for the SRI can be developed at any time, but they must be applicable to large land areas and capable of being used in other SRI's.

Most new party members to an SRI party have difficulty determining what it is they are really looking for or seeing in the field. Soils often change considerably in their properties over a short distance. When traveling along a road, these variabilities are seen at the real life scale of 1:1. However, mapping is done at a scale of about 1:65,000. Therefore, the mapper must determine what is really important about these soils within the scale and scope of mapping.

Road cutbanks are often deceptive, especially if the road is several years old. Road slough will often cover soil substratum and/or bedrock and give a false impression of soil depth. Because of this, it is necessary to do frequent checking at the cutbank by digging with a geology pick or shovel.

While mapping, it is essential to continually correlate and understand the appearance of soils, vegetation and landforms on the ground with how these features appear stereoscopically on the aerial photos. Reliable stereo identification of inaccessible areas is dependent upon how well the mapper understands the relationship of on-the-ground appearance compared to the photos. A check on the accuracy of stereo interpretation and projection can easily be done by delineating a roaded area prior to traveling the area. If this pre-mapped area appears satisfactory after on-the-ground examination, it can be assumed that inaccessible areas will be satisfactorily mapped also.

A novice mapper should spend time checking slope percentages with an Abney level or clinometer. Only by doing this and then observing the slope stereoscopically can the mapper become proficient in estimating slopes by stereoscopic methods. It usually requires considerable practice to learn to do this well. The problem is that the small scale photography used in the SRI tremendously exaggerates the steepness of slopes. In general, the smaller the scale, the greater is the exaggeration, and it requires practice to learn to compensate for this exaggeration.

<u>The importance of taking good field notes cannot be over-emphasized.</u> It is very difficult (and unreliable) to rely on memory months after the field season. Field notes should be taken in a systematic form and filed in such a manner that they will not become lost. Field notes should be taken on soils, landforms, vegetation, geology and interpretations. Many notes can be taken on forms shown in the appendix of this Handbook relating to

particular subjects such as soils, geology, management interpretations, etc. Another way is using a tape recorder. The mapper may use any method he wishes as long as good field notes are taken and recorded.

Taking pictures is also extremely important. In order to have quality pictures available for report use, it is necessary to have a large picture file. During the field season, it is difficult to anticipate the particular pictures that may be needed at a later date; therefore, it is advisable to take pictures of everything that has any general conceivable value in showing examples of soils, vegetation, bedrock, landforms and management practices. It is an asset to have a good file of both black and white, and color. The black and white can be used in the report while the color pictures can be used in slide talks and training sessions.

4. Field Legend. A current mapping legend is the most important part of the field notebook. This is the mapper's descriptive legend and must include all of the units currently being mapped. In an SRI, mapping legends are continually changing due to speed of the inventory and complexity of unit design. The nature of SRI is such that most units are not firmly established until near the end of the inventory field work. It is common for mapping legends to be changed three or four times during the course of an inventory. As the survey progresses, mapping features are continually encountered that have a degree of variance from the concepts previously established. Sometimes the concept can be expanded, and at other times, new units should be established. Even with a thorough reconnaissance, it is very difficult to foresee all the units that will eventually be needed. Certain blocks of numbers need to be set aside for related landtype units (i.e., deep soils, soils from basalt, etc.). It may well develop that more numbers are required in a given block than were originally allotted. In order to maintain a consistent and logical order in the legend, this usually requires re-numbering the legend and re-numbering the completed photos mapped to date.

   Occasionally, the decision of whether or not to add new units depends upon the extent of the area involved. There is a practical limit to the total number of landtype units that should be used. Obviously, at the scale and scope of the SRI, we cannot recognize every small area that may show variance from the norm. Sometimes a small area is significantly different from any established landtype unit, but because of its very limited extent, it is mapped with the unit it most closely represents. Use of spot symbols can sometimes aid users to recognize significant land features of limited area. Each landtype must be described so that the characteristics and features are valid and apparent, and are reflected by differing management interpretations.

   The field legend is not a part of the SRI Report. It is strictly for the mapper's use in the field to establish and organize mapping units.

Exhibits in the Appendix of this Handbook illustrate several types of mapping unit legend presentations. Each soil scientist may use any system that clearly identifies and organizes the units.

Each Forest SRI will have individual mapping legends and landtype unit identification. Correlation of landtypes from one Forest to another need not be done at time of mapping.

5. Mapping Unit Designation. A logical and systematic mapping unit identification system must be made for each survey area. This is necessary for unit design, identification and clarity to the user. Map units will represent various kinds of land features, ranging from single landtypes and complexes of landtypes to miscellaneous lands. All mapping units will be represented by 1, 2 or 3-digit numbers. Single digits are generally used for miscellaneous lands, 2 digits are mostly for landtypes, and 3 digits for complexes of landtypes.

A logical grouping of units is essential to ease of learning and use. The following is an example of landtype groupings:

Nos.	
1-9	Miscellaneous lands
10-29	Deep, transported soils of glacial, alluvial, colluvial, glacial-fluvial or lacustrine origin. Includes till, outwash, alluvium and lake deposits.
30-39	Residual and colluvial soils from schist.
40-49	Residual and colluvial soils from granitics.
50-59	Residual and colluvial soils from basalt and andesite.
60-69	Residual and colluvial soils from hard pyroclastic rocks.
70-79	Residual and colluvial soils from soft, weathered pyroclastic rocks.
115	50% landtype 11, and 40% landtype 25.
327	60% landtype 32, and 40% landtype 37.

Miscellaneous lands are those units for which no typical soil profile location representing the unit can be selected. A narrative description of the unit concept is given.

The landtype is the basic unit of landscape stratification. It delineates and identifies naturally-occurring bodies on the landscape consisting of unique, characteristic soil mantle, bedrock, vegetation, climate, hydrology and landform features which are significant to management use or interpretations. The soil characteristic representing the central concept of a landtype most nearly represents the concept of a series as defined in USDA Handbook #18. However, the landtype differs in that it is an existing land area characterized not only by a soil, but also by other specific and unique features of the land. Thus, a landtype cannot be easily compared to either the soil series or soil phase of the standard soil survey.

Complexes are composed of two or more landtype or miscellaneous land units so intimately associated that individual mapping units are not feasible at the selected map scale. The components are named and proportion of each unit is given.

The basic criteria for landtype unit establishment is the validity, accuracy and consistency of management interpretations. Landtype units will be established, using the four basic landscape features of soil, bedrock, vegetation and landform as these relate to management use or interpretation. The characteristics of each of the landscape features must be evaluated for management interpretation in establishing landtype units. Landtype unit establishment will not be made on landscape feature characteristics unless they stand the test of significant management interpretations. Landtype units will not be established, for instance, based on soil characteristics that are significant to the soil classification system unless they are also significant to management use or interpretations. Soils of each landtype are placed as accurately as possible to the appropriate family level of the Comprehensive Soil Classification System after the landtype units are established and mapped.

IT IS EXTREMELY IMPORTANT THAT SOIL SCIENTISTS DOING SRI'S KNOW AND UNDERSTAND THE MANAGEMENT INTERPRETATIONS MADE IN EACH SRI. IT IS IMPOSSIBLE TO ACCURATELY MAP ACCORDING TO SRI PRINCIPLES AND CONCEPTS WITHOUT A THOROUGH UNDERSTANDING AND KNOWLEDGE OF MANAGEMENT INTERPRETATIONS. THESE ARE DEFINED IN THIS HANDBOOK.

The problem of when to extend a landtype unit or add new landtype units is one that is continually at hand. There is such a multitude of factors to consider that it would be impossible to list all considerations.

The following illustrate some of the most common reasons for landtype unit development:

Geology

Changes in bedrock. This may be a complete change from one bedrock type to another (i.e., schist to basalt), or a change within the same bedrock such as a hard schist varying from a soft, highly weathered schist. If it is a complete bedrock change, then it must be determined if significant interpretations will result or if the new bedrock will behave similarly. For instance, a gneiss may be similar in gross characteristics to a granite and generally they can be grouped together. However, a pyroclastic is significantly different from rock types such as gneiss and must be shown as a separate landtype unit.

Soils

(a) Changes in soil depth. A shallow (1-3') residual soil should not be considered the same as a deep (10'+) colluvial soil.

(b) Significant texture changes. The system works best when textures are restricted to two classes (i.e., loams and sandy loams, loams and clay loams, etc.).

(c) Significant features in profile such as rock content, composition, clay or sand layers, etc.

Landform

Changes should be made when landform changes significantly. Breaks will always be made on steepness, dissection and unevenness of slopes or other instability indications.

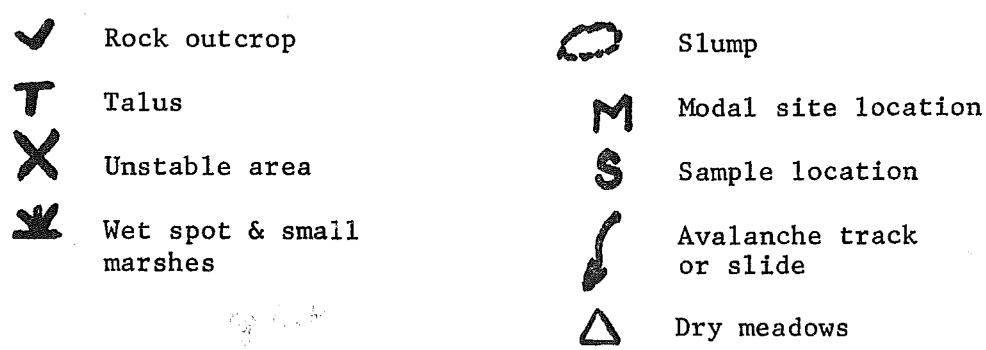
Vegetation

(a) Changes should be made when overstory and/or understory vegetation is significantly different; i.e., pine-pinegrass to pine-bitterbrush or Douglas-fir - vine maple to Douglas-fir - rhododendron.

(b) A change in Site Index or when regeneration potential differs.

All criteria and definitions for landtype units used in the SRI are given in the Appendix. Most of the soil characteristics criteria follow USDA Handbook #18. However, some changes have been made to fit Region 6 conditions and to simplify user application.

6. Spot Symbols. Spot symbols are used extensively in Region 6 SRI's. These also are similar to USDA Handbook #18 standards. Use of spot symbols may vary from Forest to Forest and a spot symbol legend for each SRI must be made, but it is important to standardize throughout the Region as much as possible. The following legend shows the spot symbols that are to be used in Region 6:



However, additional spot symbols may be added at any time as necessary.

7. Use of Aircraft. A very useful tool in broad-type mapping is aircraft, both fixed-wing and helicopter. Aircraft are available on each Forest, particularly during the fire season. Use can be made of regular aerial fire patrol and most Forests also contract helicopter use during the fire season. Use can be made of regular aerial fire patrol and most Forests also contract helicopter use during the fire season. These are available but will involve a charge; however, a few hours of helicopter time is well worthwhile, particularly in reaching otherwise inaccessible areas. Arrangements for aircraft use must be made by the soil scientist at the Forest level and must include intensive planning so that efficient time use is realized.

Aircraft are most useful near the beginning and at the end of the field mapping. A fly-over at the beginning is useful to gain perspective and familiarity with the area and near the end for mapping inaccessible areas and to recheck questionable areas. Actual mapping from aircraft is most efficient if done after the surrounding area is mapped and thoroughly understood. To map efficiently from aircraft, it is essential that the mapper knows what he is looking for and understands what he sees.

FIELD REVIEWS

All SRI's will be reviewed in the field by the Soils Branch of the Division of Watershed Management. Field reviews are held to evaluate field work, to resolve production, cartographic and classification problems, to maintain quality mapping progress throughout the Region, to ensure consistent management interpretations, and for training purposes. At least two field reviews will be made on each SRI a year. These will be scheduled yearly by the Soils Branch Chief. A report will be prepared by the reviewing soil scientist following each review.

LABORATORY ANALYSIS AND SAMPLING

Laboratory analysis for the SRI's consists of some engineering testing and some soil testing of physical properties. Engineering testing includes gradation, liquid limit, plasticity index, pH, resistivity and hydrometer analysis of fines. Testing is usually done by the Forest engineering laboratories. Soil physical testing includes mechanical analysis, bulk densities and moisture tensions of at least 1/10, 1/3 and 15 atmospheres. The moisture tensions and bulk densities are to determine for plant water availability. Soil testing is usually done by the Forest Service Hydrology Lab at Wenatchee, Washington, or Oregon State University at Corvallis. Sampling is done by the soil scientist of selected soils that are extensively mapped. Samples will be taken from the major soil layers at modal site locations.

MANAGEMENT INTERPRETATIONS

Since the primary objective of the SRI program is to provide management interpretations, it is essential that all interpretations be defined; that they are developed to fit the entire Region, and are consistently rated. Management interpretations have been developed for Region 6 SRI's. Many of the interpretations are the same on both west- and east-side Forests; however, some just apply to either the east side or west side. The interpretations are defined by describing what the interpretation is and what factors are considered in making the interpretation. Most of the interpretive classes are relative and are defined in qualitative terms. Slight variation may occur from Forest to Forest in interpretation definitions. This is permissible as long as the intent is not changed. Some Forests may wish to add new interpretations that apply only to that Forest. This is also permissible. Interpretations used in the SRI are found in the Appendix of this Handbook. Additional interpretations may be added as necessary. It is not necessary to use all of the given interpretations in each SRI. If some do not apply, they need not be used.

CARTOGRAPHY AND MAP MAKING

One of the most time-consuming parts of the SRI is final field photo editing, transfer of mapping to soil maps, and inking field photos and soil maps. The current general procedures are as follows:

(1) Make 1" to the mile scale (1:63,360) mylar base from 15' USGS Quads to serve as base map for overlay and transfer of soil mapping.

(2) Soil scientist edits all field photos.

(3) Transfer all mapping to clear mylar overlay by Kail plotter. This is done by the soil scientist or a trained draftsman.

(4) Inking of overlay and placement of press-on numbers for each delineation.

(5) Printing of soil maps. All printing to this date has been done by the Corps of Engineers, Portland, & Government Printing Office.

Printed soil map scale is 1" = 1 mi. (1:63,360). Base maps are 15' - U.S. Geological Survey topographic maps. Negatives are made from mylar overlays and topographic base maps. When printed, the base maps are screened 50 percent to make the soil mapping stand out. The soil maps become part of the Soil Atlas which also includes the Tables of Interpretations, Table of Modal Site Characteristics, Table of Bedrock Characteristics, and Table of Landtype Unit Characteristics, Qualities and Features.

The following is a detailed description of the procedures developed from experience of four SRI's in Western Washington:1/

(1) There are several steps which are completed on the photos during the editing process: (a) all spot symbols are added, (b) all mapping is completed to the satisfaction of the soil scientist in charge, (c) the legend and mapping units are finalized, and (d) complexes are finalized. This involves a thorough analysis of the complex components to determine what percentage of the mapping units each of the components occupies.

(2) After the above is complete (all mapping units are considered firm) the photos should be inked, if not inked in the editing procedure. (This step could be delayed until after Kail plotting; however, the photos are subjected to much smearing of lines). A #1 rapidograph pen with black Pelikan drawing ink or other suitable marker is used by going over all lines, numbers and spot symbols. All numbers at this time should be rewritten so that they may be read from one side of the photo. Also, a constant

1/ Mention of product name does not imply endorsement by USDA, Forest Service.

guard should be maintained for the same number appearing on both sides of a line which would mean that the line is unnecessary and should come out, or one of the numbers is wrong. After inking everything, the photos are wiped clean with pycron (obtainable from cleaners). Weak lines, numbers or spot symbols should be re-inked. Cheesecloth is a good wiping rag. A xerox copy of the photo should be made prior to inking to avoid the loss of lines, numbers and symbols. The inking procedure does not have to be done by a soil scientist. A clerk or others would be adequate. Keep the work neat and legible and make a conscious effort to catch errors.

(3) Transfer of all mapping lines, from the photo to the topographic quadrangle sheets, 1 inch per mile (1:63,360), is done by the use of a Kail plotter. This is done by a soil scientist or others who are qualified in seeing stereo and using topographic maps. The Soils Branch has two Kail plotters for loan, and Survey and Maps Section at the RO has a few which can be used on loan.

The following steps have been used in preparing the maps for printing:

(a) Mylar is anchored over the topography quadrangle (Mylar-Herculine polyester drafting film - matte one side, base thickness .003 in.). Mylar is used for ease of applying lines and erasing. Use 2H or 3H lead.

(b) Transfer lines with the Kail plotter to the mylar overlaying the topographic map. Because of distortion and other difficulties encountered in Kail plotting, there will necessarily be some line adjustments to make the mapping conform to the topography and the intended description of the mapping unit.

(c) Another sheet of mylar is placed over the penciled mylar sheet and with the use of a #1 rapidograph pen and black ink the lines are traced. Because these will be the printed lines for the Atlas, it will be necessary for the person who is doing this step to be extremely competent and neat. A #2 rapidograph is used for the soil inventory boundary.

(d) The next step is the transfer of mapping symbols. In all cases, a template should be used.

(e) The final step is the placement of numbers. The numbers being used have a sticky backing and can be obtained from the Soils Branch, RO. The numbers should be kept centered in the mapping unit, and if the mapping unit is smaller than the number, a short arrow can be used, pointing from the number to the mapping unit. After the numbers are put on, a cover sheet should be used to protect the work from damage.

To this date, all maps for the Atlas have been printed by the Corps of Engineers, Portland, and the Goverment Printing Office. Printed soil map scale is 1" - 1 mi. (1:63,360). Base maps are 15'-U.S. Geological Survey topographic maps. Negatives are made from mylar overlays and topographic base maps. When printed, the base maps are screened 50 percent to make the soil mapping stand out.

REPORT WRITING

The SRI Report will be written by the soil scientists who conducted the field work. Each report can be shaped to meet the needs of the Forest. However, some consistency will be maintained throughout the Region. The reports should include the following:

(1) Inventory Area Location Map

(2) Section on Use of Inventory Information

(3) Some type of Land Area Discussion

(4) Generalized Bedrock Map

(5) Climatic Data

(6) Definitions of Management Interpretations

(7) Summary of Interpretations

(8) Terms and Definitions of Mapping Unit Criteria

(9) Definitions and Descriptions of Mapping Units

(10) Mapping Unit Flow Chart

(11) Laboratory Data

(12) Glossary

(13) Photographs

It is essential to maintain consistency throughout the report. There are many opportunities in the report and atlas for inconsistencies to develop. These occur between many of the interpretations and tables, and between tabular and narrative sections in the report. A few of the more common are as follows:

Must agree or not conflict with:

Interpretative Tables — Land Area Discussions

Interpretations involved with bedrock

Table of Bedrock Characteristics — Landtype Unit Descriptions

Table of Modal Site — Range of Profile Characteristics

Landtype Unit Descriptions

Table of Landtype Unit Characteristics — Landtype Unit Descriptions

<u>Interpretations</u> — <u>Interpretations</u>

<u>Timber:</u> — <u>Erosion:</u>

Comparative Soil and Watershed Impact and Type of Damage Incurred from Timber Harvest Operations — Mass Movement Potential

<u>Engineering:</u> — <u>Erosion:</u>

Probability of Cutbank Failures — Water Resources Management Requirements

Soil and Water Impact from Road Location and Construction

<u>Data in Interpretations</u> — <u>Narratives in Report</u>

Typing of final drafts of SRI Reports to this date has been done in the Division of Watershed Management. Rough drafts are reviewed by the Forest Staff and Soils Branch before final typing. Reports are printed by the Corps of Engineers, Portland, Government Printing office, or Region 6 reproduction facilities. Initial printing consists of approximately 200 to 400 copies of the Report and Atlas. Storage of Reports and Atlas is maintained at the Supervisors' Offices and the Division of Watershed Management, RO. Storage of original typed report, negatives, printing plates, etc., is in the Division of Watershed Management, RO.

These reports are public documents and will be distributed to public users upon request. The Forest Supervisor should be notified when distribution is made outside of the Forest Service.

EXTENSION OF SRI USE

One of the major objectives of the SRI program was extensive use by all functions for all activities of Forest Service management. It is the responsibility of the soil scientist to encourage, understand, develop and increase the use of these reports. The SRI was designed to be readily adaptable to new Forest Service systems. Efforts are now being made in the RO to adapt this program to the Timber Inventory Program and the TRI System. A computer program is also being developed that will greatly expand the utility of the SRI. It must always be remembered that because of scale and detail, the SRI is not extendible to detailed use or project design.

APPENDIX

EXHIBIT I

MAPPING LEGENDS FOR FIELD USE AND SRI REPORTS

These exhibits illustrate several methods or systems of mapping legends. They cover both field legends and SRI Report Legends.

CONTENTS

EXHIBIT I-A

This illustrates the narrative type field mapping legend. The descriptions are brief, stating the concept of the landtype units and noting differences between units:

Mapping Legend
(Landtype Number Groupings)

Nos.	
1- 9	Miscellaneous landtypes
10-44	Deep, transported soils of glacial, alluvial, colluvial, glacial-fluvial or lacustrine origin
45-49	Alpine meadows
50-59	Residual and colluvial soils from bedded sedimentary bedrock
60-69	Residual and colluvial soils from metasedimentary and metavolcanic bedrock
70-79	Residual and colluvial soils from schist bedrock
80-84	Residual and colluvial soils from gneissic and granitic bedrock
85-89	Residual and colluvial soils from serpentine bedrock

Mapping Legend

1. Fresh sands and gravels occurring along streams.

2. Fresh morainal and till deposits occurring below glaciers.

3. Marsh land and wet meadows.

4. Talus and felsenmeer slopes. Areas may be either nonvegetated or contain vine maple, scrub willow or scrub alder. Occurs on slopes less than 35 percent.

5. Similar to Soil 4 but occurs on slopes greater than 35 percent.

6. Thin to very thick volcanic pumice and ash over very thick vitric tuff and/or interbedded brecciated lava flows. Pumice lapilli ranges from 3 inches to ½-inch in diameter. Pumice and ash may be reworked and highly stratified by ancient and existing streams. Well to excessively drained. Douglas-fir, true fir, mountain hemlock, huckleberry, vine maple. Site Class IV and V. Occurs in broad valley bottoms and on lava terrain of less than 35 percent slope.

7. Similar to Soil 6 but occurs on steep, smooth to somewhat dissected sideslopes and ridges of greater than 35 percent slope.

8. Perpetual snow and ice.

9. Steep, raw edges of dissected glacial materials.

10. Recent alluvial deposits consisting of thin to moderately thick, nongravelly to gravelly sands and loamy sands over very thick, very gravelly and cobbly coarse-textured river wash. Nonplastic. Well to moderately well drained due to high water table. Wet spots and small swamp areas are common inclusions. Douglas-fir, alder, big leaf maple overstory. Site II and III. Occurs on flats adjacent to streams.

11. Thin, weakly structured, gravelly sandy loams and gravelly loamy sands overlying very thick, very gravelly and cobbly, weakly to moderately compact, coarse-textured glacial drift and outwash. Nonplastic. Excessively drained. Douglas-fir, hemlock and lodgepole pine overstory. Understory is dominated by salal. Site IV and V. Occurs on nondissected valley bottoms on less than 15 percent slope.

12. Thin, to moderately thick, weakly structured, gravelly loams or gravelly sandy loams overlying very thick, very gravelly and cobbly, weakly to moderately compact, coarse-textured glacial drift and outwash. Thin, discontinuous layers of very fine sandy loam or silt loam may occur locally. Nonplastic. Generally well drained. Vine maple, swordfern understory. Site II and high III. Occurs on gentle, slightly dissected toeslopes of less than 35 percent.

Mapping Legend (Cont.)

13. Similar to Soil 12 except it occurs on slopes of 35 to 60 percent.

14. Similar to Soil 13 except subsoils are generally weakly compact. Occurs on steep, dissected toeslopes between 50 and 70 percent. High rate of cutbank failure and raveling. Site III and IV.

. . .

70. Metamorphic rock outcrop dominated by schist.

71. Shallow, very weakly structured, gravelly loams and sandy loams overlying hard schist bedrock. Bedrock is generally hard, competent, and moderately fractured. Soils are nonplastic and well drained. Hemlock, true fir, cedar, Douglas-fir, huckleberry and salal. Site low III, IV and V. Occurs on steep, smooth, nondissected to somewhat dissected sideslopes of greater than 35 percent slope.

72. Soil is similar to 71 but occurs on very steep, uneven and highly dissected sideslopes.

73. Shallow to moderately deep, weakly structured, gravelly loams and silt loams derived from residuum and till. Subsoils are slightly compact locally. Bedrock is fractured, competent soft schist. Slight plastic. Well drained. Douglas-fir, hemlock, cedar and vine maple. Site II and III. Occurs on smooth, slightly dissected slopes of less than 35 percent.

74. Similar to Soil 73 except it occurs on slopes of greater than 35 percent. Slopes are somewhat uneven and dissected. Schist bedrock ranges from competent to moderately competent.

75. Shallow to moderately deep, weakly structured, gravelly loams and silt loams derived from residuum and till. Subsoils are slightly compact locally. Bedrock is highly fractured, moderately competent soft schist. Slightly plastic. Well drained. Douglas-fir, true fir, cedar, huckleberry and vine maple. Site IV and V. Occurs on smooth, slightly dissected slopes of less than 35 percent.

76. Similar to Soil 75 except it occurs on slopes of greater than 35 percent. Slopes are somewhat uneven and dissected.

78. Moderately deep to deep, weakly structured, gravelly loams and silt loams derived from colluvium and till. Bedrock is generally highly fractured, moderately hard to soft, moderately competent to incompetent soft schist, but local areas include serpentinized basic igneous rocks. Soil is well to moderately well drained. Slightly plastic. Douglas-fir, hemlock, true fir swordfern, deerfern, etc. Site III and IV. Occurs in steep, highly dissected sideslope drainages. Moderately stable to unstable.

EXHIBITS I-B and I-C

These illustrate two similar tables used as field mapping legends. This system graphically uses major criteria in landtype unit establishment and shows the differences in landtypes.

LT.	TOPOGRAPHY	VEGETATION	SLOPE	DEPTH	TEXTURE	REMARKS

EXHIBIT I-C

LANDTYPE	SOIL Sh ModD D VDeep	FRAGMENTS TEXTURE	PHYSIOGRAPHIC POSITION	SLOPE & ASPECT	GEOLOGY	ELEVATION	VEGETATION Plant-Com.Type	INCLUSIONS
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							
	RANGE OF CHARACTERISTICS							

REMARKS:

EXHIBIT I-D

This flow chart graphically illustrates major criteria in determining landtypes and differences between landtypes. This is a summary of the field mapping legend which could be used in field mapping. However, it is most beneficial as part of the SRI Report as it summarizes all the landtype units in a very brief concise manner.

KEY TO LANDTYPE UNITS

Mapping Units 1 thru 9 are miscellaneous units and are not included on this key.

	Soil Unit	Type of Material: Till	Till and Colluvium	Colluvium	Stratified Till and Lacustrine	Lacustrine	Alluvium	Dominant Profile Textural Class: Coarse	Moderately Coarse	Medium	Moderately Fine	Fine	Site Class Range: I	II	III	IV	V	Percent Slope: Less Than 35 Percent	Greater Than 35 Percent	Other Percent Slope Breaks	Natural Stability: I	II	III	IV	V
Very Deep Transported Soils of Glacial, Alluvial, Colluvial, Glacialfluvial, or Lacustrine Origin.	10						X	X						←	→					0-10	X				
	11	X						X								←	→			0-15	X				
	12	X						X					←	—	→			X			←	→			
	13	X						X						←	→				X			X			
	17						X	X							←	→		X				X			
	18						X	X							←	→			X				←	→	
	19	X							←	→					←	→				20-60			←	→	
	20		X						X							←	→	X			←	→			
	21		X						X							←	→		X			←	→		
	22	X								←	→			←	→			X				X			
	23	X								←	→			←	→					35-50		←	→		
	24	X								←	→				←	→				50-75			←	→	
	25	X								←	→				←	—	→	X				X			
	26	X								←	→				←	—	→			35-50		←	→		
	29	X									X				←	→				25-65			←	→	
	30				X					←	→			←	→			X				X			
	31				X					←	→			←	→				X				X		
	32				X					←	→				←	→		X				X			
	33				X					←	→				←	→			X				X		
	34					X						X		←	—	→		X					X		
	35					X						X		←	—	→			X					←	→
	36	X							X							←	→	X			←	→			
	37	X							X							←	→			35-50		X			
	38	X							X						←	→				50-70			←	→	
	41			X					X						←	—	→		X				X		
Unique Soils	43	Deep Cinders and Ash																							
	45	Shallow Alpine Soil over Various Types of Bedrock																							
	47	Deep Alpine Soil																							

KEY TO LANDTYPE UNITS (Cont.)

	Bedrock Material	Soil Unit	Depth of Soil to Bedrock: Rock Outcrop	Shallow	Moderately Deep	Deep	Very Deep	Landform: Steep, Nondissected to Slightly Dissected Sideslopes	Steep, Highly Dissected, Relatively Stable Sideslopes	Highly Dissected Unstable Drainages and Steep Depressions	Smooth, Slightly Dissected Slopes of Less Than 35 Percent	Natural Stability: I	II	III	IV	V
Shallow to Very Deep, Residual and Colluvial Soil Derived From Bedrock	Nonmarine Sedimentary Rocks	50	X					X	X				←	→		
		51		X				X					X			
		52		X					X				X			
		54			X			X					←	→		
		56			←	—	→			X					←	→
	Meta-Sedimentary and Meta-Volcanic Rocks	60	X					X	X				←	—	→	
		61		X				X					X			
		62		X					X				←	→		
		66				←	→			X					←	→
	Schist Rocks	70	X					X	X				←	—	→	
		71		X				X					X			
		72		X					X				←	→		
		73 1/		←	→						X		X			
		74 1/		←	→			X					←	→		
		75 2/		←	→						X		X			
		76 2/		←	→			X					←	→		
		78			←	→				X				←	→	
		79				←	→			X						X
	Granitic Intrusive Igneous and Gneissic Rocks	80	X					X	X				←	→		
		81		X				X					X			
		82		X					X				←	→		
		83			←	→				X				←	→	
	Serpentinized Rocks	85	X					X	X					X		
		86		←	→			X					←	→		
	Mesozoic Extrusive Igneous Rocks	90	X					X	X				←	→		
		91		←	→			X					X			
		92		←	→				X				←	→		
	Recent Andesite, Basalt and Pyroclastic Rocks	95	X					X	X				←	—	→	
		96		X							X	X				
		97		X				X					X			

Remarks

1/ Soil Units 73 and 74 support Site Class II and III Douglas fir.
2/ Soil Units 75 and 76 support Site Class IV and V Douglas fir.

EXHIBIT I-E

This illustrates the legend of complexes showing the 3-digit number and the component parts. The percentage of each component must be given. Most complexes consist of two components, but some may have three components. No component should be less than 20 percent of the three-component complexes, and none less than 30 percent of the two-component complexes. A legend of complexes must be included in the SRI Report.

LEGEND OF COMPLEXES

Mapping Unit Number	Mapping Unit Components
174	50% mapping unit 17 and 50% mapping unit 34
185	50% mapping unit 18 and 50% mapping unit 35
215	50% mapping unit 21 and 50% mapping unit 35
264	60% mapping unit 26 and 40% mapping unit 54
336	60% mapping unit 33 and 40% mapping unit 76
371	60% mapping unit 37 and 40% mapping unit 91
505	60% mapping unit 50, 20% mapping unit 47 and 20% mapping unit 5
510	50% mapping unit 51, 30% mapping unit 50, and 20% mapping unit 5
511	60% mapping unit 51 and 40% mapping unit 31
514	70% mapping unit 51 and 30% mapping unit 41
516	60% mapping unit 51 and 40% mapping unit 36
517	60% mapping unit 51 and 40% mapping unit 37
518	60% mapping unit 51 and 40% mapping unit 38
520	50% mapping unit 52 and 30% mapping unit 50, and 20% mapping unit 5
527	60% mapping unit 52 and 40% mapping unit 37
546	60% mapping unit 54 and 40% mapping unit 56

EXHIBIT I-F

This illustrates the format for Mapping Unit descriptions and the final Mapping Unit Descriptions for the SRI Reports.

MAPPING UNIT ____

Mapping Unit ____ consists dominantly of Landtype ____ and minor amounts of landtypes __, ____

Landtype _____ is similar to Landtype _____ with the exception of _____

____

____

____

____

Landtype____ is a ____

____

____

____

____

____

____

____

____

____

____

Bedrock is ____

____

____

____

____

____

Typically, Landtype ______ occurs on ________________________________

____

____

____

This landtype ranges in elevation from ________ to ________ feet and supports ____

____

____

The soil is ____________________drained. Permeability is ____________ in the surface soils and ______________ in the subsoils.

Range of Profile Characteristics of Soil____

Litter:

Surface layers:

Subsoil Layers:

Some important landtype limitations and interpretations:

MAPPING UNIT 44

Mapping Unit 44 consists dominantly of landtype 44 and minor amounts of Landtypes 7, 30, 42, 43 and 48.

Landtype 44 is similar to Landtype 42 with the exception of Site Class, and Landtype 43 with the exception of landform.

Landtype 44 is a shallow to moderately deep (commonly 1-4 ft.), nonplastic to slightly plastic soil derived from residuum and colluvium. Surface soils are generally thin sandy loams. Subsoils are generally thin gravelly loams.

Bedrock is composed of moderately competent, highly fractured pyroclastic rocks.

Typically, Landtype 44 occurs on steep, smooth to somewhat uneven, highly dissected sideslopes of greater than 35 percent slope.

This landtype ranges in elevation from to feet and supports Site Class V and low IV Douglas-fir along with true firs and hemlock. The soil is well drained with rapid permeability.

Range of Profile Characteristics of Landtype 44

Litter:	Needles, leaves, twigs and decomposing organic matter. 1 to 3 inches thick.
Surface Layers:	Dark grayish brown to brown sandy loam (loamy sand in surface 1 or 2 inches in areas where there is ash influence); single grained ranging to weak, fine, subangular blocky structure; 10 to 40 percent subangular gravel by volume; nonsticky, nonplastic; pH ranges from 4.5 to 6.0; 4 to 12 inches thick.
Subsoil Layers:	Dark brown to yellowish brown gravelly loam ranging to gravelly silt loam; massive; 30 to 60 percent subangular gravel and cobbles by volume; slightly sticky, nonplastic to slightly plastic; pH ranges from 5.5 to 6.5; 8 to 36 inches thick.

Some Important Landtype Limitations and Interpretations

Landtype 44 has several important limitations and interpretations. These are defined under their various functions as follows:

Watershed

1. Surface Erosion - This landtype has the potential for severe surface erosion. Surface soils are weakly structured and offer little resistance to raindrop impact and dispersion, and transport by running water when the protective duff layer is removed. Steep slopes allow water to reach velocities sufficient to cause considerable erosional damage.

2. Sedimentation Yield Potential - Whenever this soil is exposed, such as in harvest units or on road cutbanks and wasteslopes, it has the potential to yield fine soil particles to streams. These particles remain in water suspension for long periods and may cause a loss to water quality and fisheries.

Engineering

1. Soil Limitations for Road Location and Construction - The steep and dissected topography requires considerable excavation and results in poor road alignment. There is a high potential for damage to the soil and water resources from sidecast waste, especially at tributary stream crossings.

2. Failure and Erosion of Road Waste and Fills has been a moderate to severe problem. The steep, dissected nature of the topography, along with bedrock that rapidly weathers upon exposure, allows for considerable raveling and sloughing. When this occurs nears streams, it provides sediment that may be damaging to the water resource.

Timber Management

1. The regeneration potential for Douglas-fir is low on this soil. Cold soil temperature in winter and summer soil moisture limitations create conditions whereby Douglas-fir regeneration is often difficult. Planting success is related to these soil temperature and moisture conditions. Most favorable temperature and moisture conditions generally occur soon after the spring snowmelt.

2. Planting Species

   Soil and climatic factors, along with observations, indicate that true fir plantings are better adapted than Douglas-fir, and would require less intensive management to ensure survival and growth.

Selected Soil and Watershed Impacts from Certain Management Practices

1. Timber Management Practices

   A. Timber Harvest Methods

      (1) Tractor- This mapping unit is generally much too steep to be tractor operable without causing excessive soil damage. Soil damage from tractor logging may result in surface soil loosening, displacement and compaction that impedes water infiltration, and a reduction of the soil capacity to store water. Also, there is greatly increased susceptibility for severe erosion by exposing soil and creating areas for water accumulation and surface runoff.

      (2) Partially suspended cable system - This method can be expected to cause moderate to severe soil damage. The steep, dissected topography often permits logs to become temporarily airborne prior to slamming into and gouging the soils. This may cause soil displacement and compaction that causes soils to be vulnerable to erosion damage. These systems also require access roads, resulting in additional soil exposure through road construction.

      (3) Fully suspended cable system - This method can be expected to cause little or no soil damage. Slight duff damage confined to small local areas is all that would be expected. Also, these systems often require fewer roads resulting in less soil disturbance associated with roads.

   B. Slash Disposal Methods

      (1) Broadcast burning - Intensive burn may reduce fertility, change physical soil characteristics (such as decreased porosity which reduces moisture-holding capacity and aeration), and promotes soil erosion over large land areas.

      (2) Total yarding - Yarding of unlimbed culls gouges soils over wide areas that can consequently erode. Burning of the cull piles is likely to severely damage soils in limited areas to the extent that production is lowered.

2. Engineering Practices

The soil impact from roads can be severe, especially on slopes over 60 percent. A major impact is from excavation waste when sidecast. Sidecast material often ravels, sloughs and erodes, and is often difficult to stabilize. This excavation waste may eventually reach nearby streams and is often damaging to water quality and fisheries.

Because of the ease with which loosened materials tend to move downslope on these steep, dissected sideslopes, road designs which tend to keep excavation quantities to the absolute minimum provide positive protection of the soil and water resources. Minimum road widths and increased allowable grades locally are two practices that would contribute effectively to this end.

End hauling of surplus waste cut from the 60 percent and steeper sideslopes will minimize damages that are often incurred from sidecast waste.

EXHIBIT I-G

This illustrates the format for and writeup of a Land Area Discussion for SRI Reports.

LAND AREA FORMAT

Land Area Description

General Description of Area

Landforms

Soils

Mapping Units

Bedrock

(Picture of Areas (oblique))

Major Soil Problems

Soil and Watershed Impacts from Management Activities

LAND AREA "B"

Shall Soils on Very Steep, Rugged and Often Highly-Dissected, Rocky Midslopes and Upper Sideslopes

This area consists of shallow soils on very steep, rocky and rugged sideslopes that occur throughout the Forest. Approximately 85 percent is between 3,500 and 5,600 feet elevation with the remaining 15 percent occurring on steep, rocky topography below 3,500-feet range.

Land Area "B" is primarily in the Upper Forest Resource Zone. The timber stand generally consists of silver fir, hemlock and Douglas-fir, with Douglas-fir comprising approximately 20 to 30 percent of the volume. The timber most often occurs in small stands or stringers between rock outcrops, drainages, narrow talus slopes and/or avalanche tracks. Douglas-fir site is generally Site Class V or noncommercial, but some areas of low Site Class IV may occur at lower elevations.

Landform

The topography consists of very steep midslopes and upper slopes ranging from 50 to over 100 percent slopes. These sideslopes contain numerous rock outcrops and are frequently highly dissected with closely spaced parallel stream patterns, narrow talus slopes and/or avalanche tracks.

Mapping Units

The mapping units on this area are 7, 8, and 440.

Soils

The soils in this area often occur intermittently (about 50 percent) with rock outcrops, stream channels, narrow talus slopes and/or avalanche tracks. The soils are generally shallow, well drained to droughty, gravelly and stony loams and sandy loams.

Bedrock

The bedrock of this area is variable and may be andesite, pyroclastic, sedimentary, granitic or metamorphic. These rocks are generally hard and competent throughout most of the area. However, rocks of only moderate hardness and competence occur locally in horizontal bands, especially on Mapping Unit 440.

(picture of area)

Caption

Major Soil Problems

1. Severe Erosion Potential - This land area has a severe erosion potential. This is due to the kind of soils present, the topographic characteristics, climate, and the easily damaged protective duff layer. The soils are fragile, weakly structured and offer little resistance to raindrop impact and dispersion when their protective vegetative cover and duff layers are removed. Vegetation and duff removal by management activities such as log skidding, slash disposal and road construction, results in soil exposure on harvest units and on road cutbanks, waste slopes and fills. Once soils are exposed on these steep slopes, raindrop impact and rapid runoff from heavy rains or melting snow can provide running water of sufficient force to cause extensive accelerated erosion.

2. Rugged and Rocky Topography - The topography of this area causes certain problems involving both road construction and timber harvest. Road construction is difficult because of the steep, rugged and dissected landforms with their associated rock outcrops, talus slopes and avalanche tracks. Road construction across these landforms is relatively expensive (both in construction and maintenance), and many of the previously constructed roads have resulted in high damage to soils and other resources. The instability of sidecast waste material that continues to ravel, slough and erode, produces scars that are difficult to revegetate.

3. Soil Factors Limiting Vegetative Growth - The soils in this area are limited in ability to support vegetative growth. Soils are shallow and contain a high percentage of gravel and stones. This limits the soil nutrient and moisture-holding characteristics. Much of the year

the soils are cold and below the optimum temperatures required for biotic and chemical activities needed for plant growth. Further restrictions to growth often occur during the summer months. This is associated with moisture stress. The hot days of summer, especially when accompanied by dessicating winds, rapidly deplete the soil moisture. These factors result in a comparatively short growing season, limited soil moisture conditions and relatively infertile soils. They are major limitations to vegetative growth and cause restrictions in time of regeneration planting.

Selected Soil and Watershed Impacts from Various Management Practices

There are different ways in which various practices will have an impact on the soil. Some of the common practices and their impacts on soils are evaluated as follows:

1. Timber Management Practices

   a. Harvest Methods

      (1) Tractor - The impact on soils from tractor operation is likely to be very severe. Damage is caused by removing the duff, loosening the soil and causing soil displacement. Soil compaction is likely to occur that impedes water infiltration, reduces the soil's capacity to store water, and allows water to accumulate and run over the surface. Raindrop impact detaching the soil particles on the exposed soils, along with water accumulating and running over the surface, is likely to cause severe erosion.

      (2) Partially Suspended Cable System - The impact of soils is likely to be severe. The skidding logs, which often become temporarily airborne across a dip in topography and then "slam" into the ground, often gouge the soils. This causes temporary destruction of the protective duff cover and also causes soil loosening and displacement. Bare soils are then exposed to erosion. The problem is intensified by the straight downslope configuration of skid trails. Running water in skid trails has the potential to reach high velocity and severely erode the soils. A further consideration of this logging method is that the required roads result in additional soil exposure in cutbanks, wasteslopes and cutslopes, and need to be extensively treated to minimize erosion.

      (3) Fully Suspended Cable System - The impact on soils is minimal during the actual harvest operation but some soil damage can occur from the required roads. Only occasional small local areas would be expected to incur duff damage during harvest, and as long as the duff is intact, there is little chance for erosion to occur. The number of required roads is often less than on the previously discussed harvest methods which reduces soil exposed in cuts and fills. This, in turn, reduces area of barren soils, requiring intensive protective measures to control erosion.

(4) Aerial Logging - The impact on soils is very minimal. Some slight duff destruction and displacement could be expected locally from the impact of felling. However, the general absence of skidding and roads removes the primary causes of soil disturbance.

b. Slash Disposal Methods

(1) Broadcast Burn - An intensive burn may reduce soil fertility by volatilizing many of the nutrients and rendering many others vulnerable to leaching. Soil structure and porosity may be destroyed that reduces aeration and moisture-holding capacity. This may cause regeneration problems. Intense burning will often destroy the surface duff and litter layers resulting in exposed soils that are more likely to erode.

(2) Total Yarding - Considerable soil damage can result from yarding of unlimbed culls. As these culls are yarded to the landing, the jagged limbs gouge the soils. Duff is destroyed and soils are displaced. Furrows are created that run straight down the slope, and water running in these furrows has the potential to severely erode the soils. There is often widespread surface soil disturbance when many culls are yarded from the harvest unit. Also, the hot burn of the piled cull material is likely to cause severe soil damage such as decreased fertility and a reduction in infiltration, porosity and moisture-holding capacity, resulting in these areas having reduced production.

c. Regeneration Practices

The soil factors previously described under "Major Soil Problems" have an effect on regeneration. The fact that soils are cold in winter and droughty in the summer has been observed to cause regeneration difficulties. This is especially true above 3,000-ft. elevation. It should be understood that seedlings or transplants grow in soil and have the best chance of survival when the soil is at its optimum condition. This occurs when the soil temperatures are warm enough to promote chemical and biotic activity, and the soil contains its highest level of moisture.

Soil temperature and moisture variations affect trees throughout their growth cycle. These variations can be somewhat modified by certain cutting practices such as the use of narrow clearcuts or smaller patches. This allows protection from temperature extremes.

Observations and soil factors indicate that above 3,000 feet true fir species are more likely to survive than Douglas-fir without the intensive management practices required for Douglas-fir survival.

2. Engineering Practices

Improperly constructed roads frequently have a severe impact on the soils in this area. Topographic features of this land area are such that sidecast excavation waste often moves downslope considerable distances, leaving raw scars and exposed soil. These scars are not only unsightly, but continue to ravel, slough and erode. They are generally very difficult to revegetate once created and require intensive treatment to minimize the problems. Also, standard Forest Service road construction is relatively expensive in this area because of the excessive cuts in the steep sideslopes, large fills, and the hard bedrock that requires considerable blasting.

Certain kinds of practices have been observed to minimize road damage. Some of these are as follows:

a. Because of the readiness with which loosened materials tend to move downslope on these steep, rocky sideslopes, road designs which keep excavation quantities to the absolute minimum provide positive protection of the soil and water resources. Minimum road widths and increased allowable grades locally are two practices that would contribute effectively to this end.

b. The adverse impacts to soil and water resources from sidecast waste are reduced by end hauling.

c. One method of treatment on steep road fills that has been observed to ensure better seeding success is to install small terraces prior to seeding. This provides a catch area for seed and helps to control soil raveling while the grass is becoming established.

EXHIBIT II

LANDTYPE UNIT CRITERIA TERMS AND DEFINITIONS[1/]
LANDTYPE UNIT DATA SHEET

The following is a list of terms and definitions used in Soil Resource Inventories. These terms and definitions are used in compiling information for the Table of Soil Characteristics of Modal Sites; Table of Some Landtype Characteristics, Features and Qualities; Table of Bedrock Characteristics of Landtypes; and the Landtype Descriptions that are part of the SRI Reports. They are also used in compiling the Landtype Data Sheets.

CONTENTS

1/ Unless otherwise noted, the following definitions were developed for use in Soil Resource Inventories, R-6.

EXHIBIT II-A

These terms and definitions pertain to soil criteria used in landtype establishment, field legend, landtype data sheet, landtype descriptions, Table of Soil Characteristics of Modal Site and in the text of the SRI Reports. Most terms and definitions are the same for west and east sides of the Region, but where different, they are given.

SOIL CHARACTERISTICS

Soil - Any and all loose, unconsolidated, weathered material on the earth's surface resting on solid, consolidated, unweathered bedrock, regardless of origin, mode of formation, or type of weathering or deposition. Generally includes any material that may be manipulated by hand tools or heavy equipment without the need of blasting except soft, unweathered bedrock. In soil horizon designation, soil materials included "A", "B", and "C" horizons.

Depth of Soil to Bedrock - Distance from soil surface to consolidated, unweathered bedrock. Depth is in feet or inches.

West Side	East Side
Shallow - less than 3 feet.	Very shallow - less than 10 inches.
Moderately deep - 3 to 6 feet.	Shallow - 10 to 20 inches.
Deep - 6 to 12 feet.	Moderately deep - 20 to 40 inches.
Very deep - greater than 12 feet.	Deep - 40 to 60 inches.
	Very deep - 60 to 144 inches.
	Extremely deep-greater than 144 inches.

Depth to Restrictive Layer in the Soil - Distance from soil surface to a layer in the soil that is highly restrictive to drainage, water transmission or root growth. Usually this is a discontinuity or stratification layer, but it may be bedrock. If it is bedrock, depth must be the same as recorded under depth to bedrock. A restrictive layer is generally not a genetic soil horizon, except in old soils that have developed claypan, hardpan, or cemented horizons. Depth is in feet.

Litter - Total depth in inches of decomposed and undecomposed organic matter.

Soil Layer - Each soil layer is a homogeneous layer of soil material. Soil layers are described when soil characteristics change significantly and have definite effects on management. Each layer may result from stratification or soil formation processes.

Soil Layer Thickness - Thickness of each soil layer in inches.

Soil Layer Thickness Classes - Thickness is in feet or inches.

West Side	East Side
Thin- less than 3 feet.	Very thin - less than 6 in.
Moderately thick - 3 to 6 feet.	Thin - 6 to 18 inches.
Thick - 6 to 10 feet.	Moderately thick - 18 to 36 inches.
Very thick - greater than 10 feet.	Thick - 36 to 72 inches.
	Very thick - greater than 72 inches.

Color - Stated in narrative Munsel notations for each soil layer. Colors are taken of moist crushed soil. Mottling is noted, if present, especially in subsoil layers.

Texture - Relative proportions of sand (2.0mm.-.05mm.), silt (.05mm. - .002mm.), and clay (less than .002mm.). Standard USDA textural classes are used for each soil layer.

Textural Classes*- These classes apply when general textural terms are used for the profile sketch in the mapping unit descriptions.

Coarse-textured soils - Sands, loamy sands.

Moderately coarse-textured soils - Sandy loam, fine sandy loam.

Medium-textured soils - Very fine sandy loam, loam, silt loam, silt.

Moderately fine-textured soils - Clay loam, sandy clay loam, silty clay loam.

Fine-textured soils - Sandy clay, silty clay, clay.

Rock Fragment Quantity, Size, and Shape*- Percent by volume occupied by consolidated fragments larger than sand size (larger 2mm.).

Size Classes - gravel, 2mm. - 3 inches; cobbles, 3 inches to 10 inches; stones, greater than 10 inches.

Shape Classes - round, thin, flat, subangular, subround, angular, blocky, etc.

* Standard USDA Handbook 18 Definitions.

Rock Fragment Classes - Used as an adjective to textural classes. Includes gravel, cobble and stone sizes.

0 - 35 percent - not noted.
35 - 50 percent - gravelly, cobbly or stony.
50 - 80 percent - very gravelly, very cobbly or very stony.
80 percent + - extremely gravelly, extremely cobbly or extremely stony.

Soil Structure *- Includes grade, size and type of structure for each soil layer. If no structure exists, then the soil is massive or single-grained. Concretions or shot are recorded, if present. Applies to aggregate structural units (aggregates and peds).

Grade - Degree of aggregation and expression of the differential between cohesion within aggregates and adhesion between aggregates.

Weak - Indistinct peds, barely observable in place.

Moderate - Distinct peds, moderately durable and evident.

Strong - Distinct peds in place, durable.

Size - Refers to size of aggregates according to five size classes and type of structure.

	Platy	Prismatic	Columnar	(Angular) Blocky [1]	Subangular blocky [2]	Granular	Crumb
Very fine or very thin.	Very thin platy; <1 mm.	Very fine prismatic; <10 mm.	Very fine columnar; <10 mm.	Very fine angular blocky; <5 mm.	Very fine subangular blocky; <5 mm.	Very fine granular; <1 mm.	Very fine crumb; <1 mm.
Fine or thin	Thin platy; 1 to 2 mm.	Fine prismatic; 10 to 20 mm.	Fine columnar; 10 to 20 mm.*	Fine angular blocky; 5 to 10 mm.	Fine subangular blocky; 5 to 10 mm.	Fine granular; 1 to 2 mm.	Fine crumb; 1 to 2 mm.
Medium	Medium platy; 2 to 5 mm.	Medium prismatic; 20 to 50 mm.	Medium columnar; 20 to 50 mm.	Medium angular blocky; 10 to 20 mm.	Medium subangular blocky; 10 to 20 mm.	Medium granular; 2 to 5 mm.	Medium crumb; 2 to 5 mm.
Coarse or thick.	Thick platy; 5 to 10 mm.	Coarse prismatic; 50 to 100 mm.	Coarse columnar; 50 to 100 mm.	Coarse angular blocky; 20 to 50 mm.	Coarse subangular blocky; 20 to 50 mm.	Coarse granular; 5 to 10 mm.	
Very coarse or very thick.	Very thick platy; >10 mm.	Very coarse prismatic; >100 mm.	Very coarse columnar; >100 mm.	Very coarse angular blocky; >50 mm.	Very coarse subangular blocky; >50 mm.	Very coarse granular; >10 mm.	

Type - Refers to relative shape of individual aggregates. There are four primary basic shapes.

Platy - Soil particles arranged around a plane, generally horizontal

Prism-like - Soil particles arranged around a vertical line and bounded by relatively flat surface (Prismatic, Columnar).

Block-like - Soil particles arranged around a point and bounded by flat or rounded surfaces (Angular Blocky, Subangular Blocky).

* Standard USDA Handbook 18 Definitions.

Type (Cont.)

Spheroidal - Soil particles arranged around a point and bounded by curved or very irregular surface (granular, crumb).

Structureless - No observable aggregation or no definite orderly arrangement of natural lines of weakness.

Massive - The soil material is coherent.

Single Grain - The soil material is incoherent.

Cementation* - Includes degree of cementation and the agent of cementation (Ca, Fe, Al, Si). Cementation is generally caused by a chemical process.

Degree of Cementation

Weak - Soil aggregates can be easily broken by hand, and usually nonrestrictive to water and roots. Example: fragipan.

Strong - Soil aggregates are difficult to break by hand or hand tools and resist movement and penetration of water and roots. Water may be perched or ponded for short periods. Aggregates can be penetrated by hand tools.

Indurated - Soil aggregates are insoluble in water and cannot be broken by hand tools. Aggregates are totally restrictive to water and roots, and usually require ripping or blasting.

Compaction - Relative increase in bulk density which is caused by natural pedogenic processes.

Degree of Compaction

Weak - Soil aggregates are easily broken by hand and are usually nonrestrictive to water and roots.

Moderate - Soil aggregates are difficult to break by hand and resist movement and penetration of water and roots. Water may be perched or ponded for short periods of time.

Strong - Soil aggregates cannot be broken by hand. The soil exhibits nearly total restriction to water and root penetration, and usually requires ripping or blasting.

Permeability - Water or air movement in and through the soil material. The classes are based on soil texture, rock fragment content, porosity and bulk density.

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* Standard USDA Handbook 18 Definitions.

Permeability (Cont.)

Class:

Very slow - Generally fine-textured soils - clay. Less than .05 inch/hr.

Slow - Generally moderately fine-textured soils - clay loams and silty clay loams. .05 inch/hr. to 1 inch/hr.

Moderate - Generally medium-textured soils - loams, silt loams. 1 inch/hr. to 5 inches/hr.

Rapid - Generally moderately coarse-textured soils, sandy loams, gravelly loams. 5 inches/hr. to 20 inches/hr.

Very rapid - Very porous soils. Generally coarse-textured soils - sands and gravels. Greater than 20 inches/hr.

Consistence* - degree of cohesion and adhesion as indicated by the resistance of the soil aggregate to deformation or rupture under various moisture conditions.

Dry:

Loose - noncoherent.

Soft - easily crushes to powder or single grain.

Slightly hard - easily broken between thumb and forefinger.

Hard - can be broken in the hands without difficulty but difficult to break between thumb and forefinger.

Very hard - can be broken in hands without difficulty.

Extremely hard - cannot be broken in hands.

Moist:

Loose - noncoherent.

Very friable - crushes under gentle pressure.

Friable - crushes easily under gentle to moderate pressure between thumb and forefinger.

* Standard USDA Handbook 18 Definitions.

Moist (Cont.):

Firm - crushes under moderate pressure between thumb and forefinger.

Very firm - crushes under strong pressure, barely crushable between thumb and forefinger.

Extremely firm - crushes under very strong pressure, cannot be crushed between thumb and forefinger.

Wet:

Stickiness is measured by pressing wet soil between fingers.

Nonsticky - practically no adherence when pressure is released.

Slightly sticky - after pressure, soil adheres to both thumb and finger but comes off one rather cleanly. Does not stretch appreciably.

Sticky - after pressure, soil adheres to both thumb and finger and tends to stretch somewhat before pulling apart from either digit.

Very sticky - after pressure, soil adheres strongly to both digits and is markedly stretched when they are separated.

Plasticity is measured by rolling wet soil and observing wire.

Nonplastic - no wire is formable.

Slightly plastic - wire forms, but soil mass easily deformed.

Plastic - wire forms, moderate pressure required to deform soil mass.

Very plastic - wire forms, much pressure required to deform soil mass.

Soil pH - intensity of soil acidity or alkalinity expressed on a scale from 1 to 14:

	pH		pH
Extremely acid	below 4.5	Neutral	6.5 - 7.3
Strongly acid	4.6 - 5.5	Slightly alkaline	7.4 - 8.4
Slightly acid	5.6 - 6.4	Strongly alkaline	8.5 - 9.0
		Very strongly alkaline	above 9.0

Classification - estimated taxonomic classification at family level.

EXHIBIT II-B

These terms and definitions pertain to landtype characteristics, features and qualities used in landtype unit establishment, field legend, landtype data sheet, landtype descriptions, Table of Some Landtype Characteristics, Features and Qualities, and in the text of the SRI. They describe properties of the landtype that result from soil characteristics, bedrock characteristics, landform and site. Most terms and definitions are the same for west and east sides of the Region, but where different they are given.

LANDTYPE CHARACTERISTICS, FEATURES AND QUALITIES

Infiltration Rate - Rate of entry of water into soil surface. The rate is dependent upon the type of surface soil texture, rock fragment content, structure, porosity, bulk density and organic matter content.

Infiltration Rate Classes:

Slow - Water stands on surface for long periods. Soils are fine-textured, poorly aggregated and puddle easily.

Moderate - Water enters soil at commensurated rates of normal rainfall or water application. Water may pond for short periods (a few days) following very intensive rainfall. Soils are medium-textured and well aggregated.

Rapid - Water rarely ponds, enters soil surface very rapidly. Soils are coarse-textured, porous, loose and usually single-grained.

Drainage Class 2/ - The rapidity and extent of removal of water from the soil. Based on soil permeability, infiltration, internal drainage and topographic position.

Poorly drained - Water table at or near the surface a considerable part of the time. Soils of this class usually occupy level or depressed sites and are frequently ponded. Water is removed so slowly that soil remains wet almost all the time.

Somewhat poorly drained - Water removed so slowly that the soil remains wet for significant periods, but not all the time.

Moderately well drained - Soil remains wet for a period somewhat longer (up to one month) than the wet season; may be due in part to a slowly permeable layer, high water table or lateral seepage.

Well drained - Water is removed from soil readily and these soils are saturated only during the wet season for short periods.

Excessively drained - Water is removed from soil rapidly and these soils are rarely ever saturated. Commonly, these soils are coarse-textured or shallow, stony and/or occur on steep slopes.

2/ Very poorly drained and somewhat excessively drained classes are not used.

Major Drainage Intensity and Pattern - Number of drainage miles per square mile and dominant drainage pattern.

Intensity Classes:

West Side

Few - 0 to 1 drainage mile per square mile.

Common - 1 to 3 drainage miles per square mile.

Many - 3 to 5 drainage miles per square mile.

Abundant - Greater than 5 drainage miles per square mile.

East Side

Few - 0 to 2 drainage miles per square mile.

Common - 3 to 6 drainage miles per square mile.

Abundant - Greater than 7 drainage miles per square mile.

Patterns (State drainage pattern):

Productivity - Combined evaluation of measured and observed production of timber and forage types. Site classes are to be used for timber types, and range condition ratings for range types.

Timber Site Classes - Class limits correspond to height (site index) of Douglas-fir and ponderosa pine at 100 years. (Also give Growth Basal Area)

Douglas-fir	Ponderosa Pine
Class I - greater than 185 S.I.	Class I - greater than 105 S.I.
Class II- 185 S.I. to 155 S.I.	Class II- 95 S.I. to 105 S.I.
Class III-155 S.I. to 125 S.I.	Class III-85 S.I. to 95 S.I.
Class IV -125 S.I. to 95 S.I.	Class IV -65 S.I. to 85 S.I.
Class V - less than 95 S.I.	Class V -55 S.I. to 65 S.I.
	Class VI -45 S.I. to 55 S.I.
	Class VII-Less than 45 S.I.

Productivity (Cont.)

Rangeland Productivity Classes:

Class I -	More than 1750#/acre -	Artemisia Tridentata (big sage) and moist shrubs below forest zone
Class II -	1000 to 1750#/acre -	Artemisia Tridentata (big sage) Festuca Idahoensis (Idaho fescue) dominant below forest zone
Class III-	500 to 1000#/acre -	Artemisia Tridentata (big sage), Agropyron spicatum (bluebunch wheatgrass), dominant in forest zone
Class IV -	200 to 500#/acre	- Artemisia Arbuscula (low sage), shallow soil with bunchgrass
Class V -	0-200#/acre.	- Scabland

Meadow Productivity Classes:

Class I -	More than 4000#/acre	- Wet meadow
Class II -	2000 to 4000#/acre	- Moist meadow
Class III-	1000 to 2000#/acre	- Dry meadow
Class IV -	500 to 1000#/acre	- Peat meadow
Class V -	Less than 500#/acre	- Eleocharis (spikesedge) Wet continuously

Fertility - Estimated inherent soil fertility and availability of plant nutrients. This rating is derived by correlating measured productivity with soil factors such as texture, pH, color and organic matter content.

High - These soils generally have medium to fine texture, dark surface colors; are slightly acid to slightly alkaline and have abundant incorporated organic matter. Nutrient quantities are adequate and readily available.

Moderate - These soils generally have one or more soil factors that limit nutrient quantity and/or availability.

Low - These soils generally have several factors that are limiting. They may be coarse-textured, strongly acid or strongly alkaline, and lacking in sufficient organic matter. Nutrient quantity and/or availability is seriously limiting.

Percent Vegetative Cover - Evaluation of total vegetative cover and the cover of three distinct levels of vegetation above the soil surface. Overstory consists of the timber stand canopy. Understory consists of woody shrubs, and timber regeneration. Ground cover consists of ferns, grasses, sedges, and mosses.

Total Ground Cover - Estimated percent of total vegetative cover with overstory, understory and ground cover combined. Maximum of 100 percent.

Vegetative Cover by Each Level - Estimated percent vegetative cover according to species composition, with overstory, understory, and ground cover estimated separately. Maximum of 100 percent for each level.

Root Distribution*- Includes root size, abundance and depth to zone of rooting. Note maximum depth of roots and zone of maximum concentration.

Size:

Very fine - 0.075mm

Fine - 1 to 2mm

Medium - 2 to 5mm

Coarse - over 5mm

Abundance:

Very few - less than 1/unit 3/

Few - 1 to 3/unit

Plentiful- 4 to 14/unit

Abundant - more than 14

Depth:

Recorded depth in inches of zone of rooting. Distance is measured from soil surface to depth of majority of roots.

Landform - Refers to the shape and configuration of a specific, identifiable part of the landscape common to the mapping unit.

Slope - Range of slope of landtype.

Aspect- Direction of slope exposure.

Elevation- Altitude above mean sea level expressed in feet.

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* Standard USDA Handbook 18 Definitions.

3/Unit is a square inch for fine to very fine; a square yard for medium and coarse roots.

EXHIBIT II-C

These terms and definitions pertain to bedrock criteria used in landtype establishment, field legend, landtype data sheet, landtype descriptions, Table of Bedrock Characteristics and in the text of the SRI Reports. Terms and definitions are the same for west and east sides of the Region.

BEDROCK CHARACTERISTICS

These terms are found in the Table of Bedrock Characteristics of Mapping Units.

Bedrock - Consolidated, competent rock which upon weathering produces loose or unconsolidated soil material. In terminology of soil horizon designation, bedrock is designated at the "R" layer. Bedrock material usually requires ripping and/or blasting. Includes soft materials that are unweathered such as some sedimentary rock which can be bladed. (Example: Sandstone.)

Composition - Bedrock components and percentage. (Example: Sandstone (20), Conglomerates (70), Mudstone (10).

Color - Color is in narrative terms for fresh, unweathered surfaces.

Hardness - Relative rating based on ease of breaking rock with geology hammer:

Hard - Rock cannot be broken or only with great difficulty.

Moderately hard - Rock can readily be broken with hammer but not by hand.

Soft - Rock can be broken by hand.

Degree of Fracturing - Based on the number or frequency of fractures and joints in a rock unit:

Highly fractured - Entire rock unit is completely dissected by fractures and joints less than 1 foot apart.

Moderately fractured - Fractures divide rock unit into units or blocks generally from 1 to 5 feet apart.

Slightly fractured - Only occasional fractures noted.

Massive - No fractures or very few fractures noted.

Fracture System - Pattern which the rock fractures follow. Example: horizontal, platy, vertical, blocky, random, etc.

Fracture Surface - Indicates the characteristics of the fracture surface and void space within fractures.

Regular - Smooth, distinct, sharp, clean-fractured surfaces.

Irregular - Rough, irregular, fragmented fracture surfaces.

Bedrock (Cont.)

Competency - Relative inherent strength of rock as it occurs on the landscape, based on degree of weathering, fracturing, hardness, stability and failures observed:

Competent - No failures within rock unit observed. Rocks of unit are stable and have strong resistance to mass movement.

Moderately competent - Some failures are noted. Rocks of the unit are moderately stable and have some resistance to mass movement.

Incompetent - Failures are common to rock unit. Rocks of the unit are soft, deeply weathered and have high potential for mass movement.

EXHIBITS II-D AND II-E

These exhibits illustrate two forms for collecting and noting necessary data about each landtype. The terms and definitions explain each of the columns and spaces to be filled in. A Landtype Data Sheet should be filled out at each soil profile description location and at each modal site location. Two to five data sheets should be completed for each landtype. This is necessary to obtain range of characteristics. The data sheet is used for all tables in the Atlas and for the text in the SRI Reports.

EXHIBIT II-D

LANDTYPE DATA SHEET

Soil No. | Forest: | District: | Location & Photo :

Depth to Bedrock : | Depth to Restrictive Layer: | Classification: | Soil Temp: | Drainage Class : | Infiltration Rate: | Litter:

SOIL LAYER	THICKNESS	COLOR	TEXTURE	ROCK FRAGMENTS			STRUCTURE	CEMEN. OR COMPACT.	PERMEABILITY	CONSISTENCE			pH
				SHAPE	SIZE	PERCENT				DRY	MOIST	WET	

SOIL FEATURES

Fert.:

Productivity:

Root Dist.:

Origin of Soil Mat.:

Vegetative Cover

Overstory	Understory	Groundcover

GEOMORPHOLOGY

Land Form:

Slope: Aspect:

Elevation:

Drainage, Pattern & Intensity:

REMARKS:

BY: DATE:

BEDROCK

Kind:

Formation & Unit :

Origin: Color:

Hardness:

Fracturing & Fracture System:

Competency:

Bedding:

SAMPLED:
YES NO
Eng:
Phy:
Moist:
DATE:

T. R.

Sec.

Soil Profile Log

Project__________ Hole #________ Location__________ Cor. Sec. ______, T-___-___, R-___-___ Logged by_______ Date______

Slope	% SURFACE RELIEF	PHYSIOGRAPHIC POSITION	SURFACE DRAINAGE	SURFACE FRAGMENTS	Land Use
Abbreviations Br-brown Lt-light L-loam Blk-black Pl-pale V-very Yel-yellow Dk-dark F-fine Ol-Olive S-sand Co-coarse Pk-pink Si-silt Wh-white C-clay	Undlt Gent Hmky V steep Roll Level Slope	All Pitu Ft. slope Hi Coll Pln Sideslope Aeo Trce Sanddune Lo Los Btm Ridgetop Till Fan Drumlin Vol	Pond Med V. slow Rap Slow V. rap	Sli Gr V Cob Ext Sto Bldr	

Depth	Texture	Munsel Color	Structure: Grade	Structure: Type	Consistance: Dry	Consistance: Moist	Cementation	Mottling	Lime (eff)	Roots	Pores	Perm	Origin	Remarks	Sample No.
	w/ tr Gr mod Cob & Stn Pm	D M W	Wk V Mod Mod St Size F V Med Co SG Stru	Grn (a-s)Bk Pri Col Ply Mass	Sli Lse V So Ext Hd Wet N-pls Sli pls Pls V. pls	Lse V Fri Ext Fi N-sti Sli sti Sti V. sti	Wk cem St cem Alt w/H_2O Indr cem So w/H_2O Ca conc Fe conc Si conc	Few Ca mot Com Fe mot Many Other	0/L 1/L 2/L 3/L 4/L	Few Sml Plnt Med Abdt. Lrg	V. few Mic Ver Ves Few Vf Hor Int Com F Obl Tub Many Med Ran Co Inped Exped	V. slow Slow Mod slow Mod Mod rap Rap V. rap	Aeo All Coll Lacu Glac Vol Res		
	w/ tr Gr mod Cob & Stn Pm	D M W	Wk V Mod Mod St F V Med Co SG Stru	Grn (a-s)Bk Pri Col Ply Mass	Sli Lse V So Ext Hd Wet N-pls Sli pls Pls V. pls	Lse V Fri Ext Fi N-sti Sli sti Sti V. sti	Wk cem St cem Alt w/H_2O Indr cem So w/H_2O Ca conc Fe conc Si conc	Few Ca mot Com Fe mot Many Other	0/L 1/L 2/L 3/L 4/L	Few Sml Plnt Med Abdt. Lrg	V. few Mic Ver Ves Few Vf Hor Int Com F Obl Tub Many Med Ran Co Inped Exped	V. slow Slow Mod slow Mod Mod rap Rap V. rap	Aeo All Coll Lacu Glac Vol Res		
	w/ tr Gr mod Cob & Stn Pm	D M W	Wk V Mod Mod St F V Med Co SG Stru	Grn (a-s)Bk Pri Col Ply Mass	Sli Lse V So Ext Hd Wet N-pls Sli pls Pls V. pls	Lse V Fri Ext Fi N-sti Sli sti Sti V. sti	Wk cem St cem Alt w/H_2O Indr cem So w/H_2O Ca conc Fe conc Si conc	Few Ca mot Com Fe mot Many Other	0/L 1/L 2/L 3/L 4/L	Few Sml Plnt Med Abdt. Lrg	V. few Mic Ver Ves Few Vf Hor Int Com F Obl Tub Many Med Ran Co Inped Exped	V. slow Slow Mod slow Mod Mod rap Rap V. rap	Aeo All Coll Lacu Glac Vol Res		
	w/ tr Gr mod Cob & Stn Pm	D M W	Wk V Mod Mod St F V Med Co SG Stru	Grn (a-s)Bk Pri Col Ply Mass	Sli Lse V So Ext Hd Wet N-pls Sli pls Pls V. pls	Lse V Fri Ext Fi N-sti Sli sti Sti V. sti	Wk cem St cem Alt w/H_2O Indr cem So w/H_2O Ca conc Fe conc Si conc	Few Ca mot Com Fe mot Many Other	0/L 1/L 2/L 3/L 4/L	Few Sml Plnt Med Abdt. Lrg	V. few Mic Ver Ves Few Vf Hor Int Com F Obl Tub Many Med Ran Co Inped Exped	V. slow Slow Mod slow Mod Mod rap Rap V. rap	Aeo All Coll Lacu Glac Vol Res		
	w/ tr Gr mod Cob & Stn Pm	D M W	Wk V Mod Mod St F V Med Co SG Stru	Grn (a-s)Bk Pri Col Ply Mass	Sli Lse V So Ext Hd Wet N-pls Sli pls Pls V. pls	Lse V Fri Ext Fi N-sti Sli sti Sti V. sti	Wk cem St cem Alt w/H_2O Indr cem So w/H_2O Ca conc Fe conc Si conc	Few Ca mot Com Fe mot Many Other	0/L 1/L 2/L 3/L 4/L	Few Sml Plnt Med Abdt. Lrg	V. few Mic Ver Ves Few Vf Hor Int Com F Obl Tub Many Med Ran Co Inped Exped	V. slow Slow Mod slow Mod Mod rap Rap V. rap	Aeo All Coll Lacu Glac Vol Res		
	w/ tr Gr mod Cob & Stn Pm	D M W	Wk V Mod Mod St F V Med Co SG Stru	Grn (a-s)Bk Pri Col Ply Mass	Sli Lse V So Ext Hd Wet N-pls Sli pls Pls V. pls	Lse V Fri Ext Fi N-sti Sli sti Sti V. sti	Wk cem St cem Alt w/H_2O Indr cem So w/H_2O Ca conc Fe conc Si conc	Few Ca mot Com Fe mot Many Other	0/L 1/L 2/L 3/L 4/L	Few Sml Plnt Med Abdt. Lrg	V. few Mic Ver Ves Few Vf Hor Int Com F Obl Tub Many Med Ran Co Inped Exped	V. slow Slow Mod slow Mod Mod rap Rap V. rap	Aeo All Coll Lacu Glac Vol Res		
	w/ tr Gr mod Cob & Stn Pm	D M W	Wk V Mod Mod St F V Med Co SG Stru	Grn (a-s)Bk Pri Col Ply Mass	Sli Lse V So Ext Hd Wet N-pls Sli pls Pls V. pls	Lse V Fri Ext Fi N-sti Sli sti Sti V. sti	Wk cem St cem Alt w/H_2O Indr cem So w/H_2O Ca conc Fe conc Si conc	Few Ca mot Com Fe mot Many Other	0/L 1/L 2/L 3/L 4/L	Few Sml Plnt Med Abdt. Lrg	V. few Mic Ver Ves Few Vf Hor Int Com F Obl Tub Many Med Ran Co Inped Exped	V. slow Slow Mod slow Mod Mod rap Rap V. rap	Aeo All Coll Lacu Glac Vol Res		

LANDTYPE UNIT INVENTORY DATA SHEET

Land-type No. ________ Forest ________ District ________ Location ________ Sec. ____ T. ____ ____ R. ____ ____ Photo ________

SOIL CHARACTERISTICS:

Depth to Bedrock (Sh ModD D VDeep) ______ Depth to Restrictive Layer Soil Temp. ________ ________

Soil Layer Thickness Class (A - VSh Sh ModD Deep VD) (B - VSh Sh ModD Deep VD) (C - VSh Sh ModD Deep VDeep)

Compaction (Wk Mod Strong) (Infiltration Rate (Slow Mod Rapid) Drainage Class (PD ID MWD WD ED)

Surface Drainage Intensity (Sl Mod Ext VExt) and Patterns (

Productivity Site Class (I II III IV V) Fertility (High Mod Low) W.H.C. ________

VEGETATION:

Dominant Overstory Species ________ % Crown Cover Density ________

Dominant Understory Species ________ % Understory Basal Density (1) ________

% Total Litter Cover ______ (2) Litter Thickness ______ Type ______ % Litter Cover ≥ ½" (4) ______

Total Ground Cover % ________ (1, 2, 3) Good Cover % ________ (1, 4, 75% of 3)

Rooting Depth ______ Root Zone Concentration ______ Plant Community Type ________

GEOMORPHOLOGY:

Landform ________ (Compx-Unif) Length ______ Slope ______ Aspect ______ Elevation ________

BEDROCK:

Composition ________ Color ______ Origin ________

Hardness (Hard MHard Soft) (Degree of Fracturing (HiFractured ModFractured SliFractured Massive)

Fracture Surface (Regular Irregular) Water Trans. (Low Mod Hi) Fracture System ________

Competency (Competent ModCompetent Incompetent) Bedding ________

EROSION AND HYDROLOGIC:

Present (Sheet Rill Gully) SURFACE Erosion Potential (VSli Slight Mod Severe VSevere)

Natural Stability (VSta Stable ModSta Unsta VUnstable) SUBSOIL Erosion Potential (Low Mod High)

Sedimentation Yield Potential (Low Mod High) Expected Sediment Size / Surface (Gr Sa Si C) Subsoil (Gr Sa Si C)

Surface Coarse Fragments ____ %(3) Bare Ground ____ % Aggregate Stability ________

EXHIBIT III

LABORATORY TEST RESULTS

This exhibit illustrates forms to be used for laboratory test results.

Contents

EXHIBIT III-A

This form is used in the SRI Reports to present engineering laboratory test data. Testing includes mechanical analysis (gradation) for Unified and ASSHO Classifications, liquid limit, plasticity index, pH, resistivity and hydrometer analysis of fine-textured portions of some samples.

Report of Laboratory Test Results

Landtype No.

			Mechanical Analysis	
Location:				
Depth:	Unified:	ASSHO:	Sieve Size	% Passing
Liquid Limit:	Plasticity Index:			
pH (by Photovolt pH meter):				
Minimum Electrical Resistivity, Ohms per cc:				
Hydrometer Analysis:				

Landtype No.

			Mechanical Analysis	
Location:				
Depth:	Unified:	ASSHO:	Sieve Size	% Passing
Liquid Limit:	Plasticity Index:			
pH (by Photovolt pH meter):				
Minimum Electrical Resistivity, Ohms per cc:				
Hydrometer Analysis:				

Landtype No.

			Mechanical Analysis	
Location:				
Depth:	Unified:	ASSHO:	Sieve Size	% Passing
Liquid Limit:	Plasticity Index:			
pH (by Photovolt pH meter):				
Minimum Electrical Resistivity, Ohms per cc:				
Hydrometer Analysis:				

EXHIBIT IV

TABLES AND DEFINITIONS OF MANAGEMENT INTERPRETATIONS

These exhibits list and define management interpretations used in the SRI Atlas and Report. They also illustrate work forms that may be used when making interpretations for final typing. Most definitions are the same for west side and east side of Region, but where they are different, they are given:

Contents

EXHIBIT IV-A

The following are management interpretations with definitions and class ratings for Region 6. These include engineering, timber management, recreation, erosion and hydrologic interpretations, and Range and Wildlife interpretations for the east side.

ENGINEERING

Interpretations for engineering include characteristics for roads, foundations, bedrock, and some miscellaneous interpretations. These are presented in two tables: One table, "Characteristics Pertinent to Roads and Airfields," is a standard engineering table for road construction based on the Unified Soil Classification System. The other table, "General Engineering Interpretations," gives other engineering interpretations which will be useful to engineers and other resource managers. These interpretations are explained and defined in this section. Generally, the following interpretations and ratings are based on the entire landtype unit including soil, bedrock and landform. Some interpretations are based only on the soil material or bedrock material. These are stated in the description for each interpretation. The interpretations pertaining to roads are based on standard Forest Service regulations and construction methods presently used.

Unified and ASSHO Classification

Each soil is classified as to its Unified and ASSHO Classification. Most soils will be classified into one class. Those soils with significant layers of different soil materials will have a classification for each layer designated. The classification will be made for some representative soils by laboratory testing. Those soils not tested will be classified by comparing their properties to those tested.

Suitability for Use as Topsoil Source

This rating evaluates each soil as to its suitability for use as topsoil. It does not specify any particular use of the topsoil. Ratings are based on soil characteristics.

Suited - Soil texture ranges from sandy loam to clay loam; gravel content is less than 30 percent and soil layer is at least 3 feet thick.

Unsuited - This rating indicates the soils do not satisfy the requirements specified under "Suited." However, soils rated "Unsuited" may still satisfy a particular requirement. See the "Table of Soil Characteristics" for soil texture, thickness and gravel content.

Suitability of Soil as Sand and/or Gravel Source

This interpretation indicates the suitability of each soil as a possible source of sand and/or gravel. It does not indicate the kind or quality of sand or gravel, or refer to any specific use of the sand and/or gravel.

Suitability of Soil as Sand and/or Gravel Source (Cont.)

Suited - This rating indicates that sand and/or gravel is present and the following conditions are satisfied: There is a layer present which is composed of 80 percent, by volume, of sand and/or gravel. This layer is at least 4 feet thick and has no more than a 5-foot overburden.

Unsuited - This rating indicates that sand and/or gravel is generally not present in amounts which satisfy the requirements under "Suited." However, soils rated "Unsuited" may still satisfy a particular requirement. See the Table of Soil Characteristics for soil depth and gravel content.

Suitability of Soil as a Possible Clay Source

This rating indicates the suitability of each soil as a possible source of clay. It does not indicate the kind or quality of clay or refer to any specific use of the clay.

Suited - This rating indicates that the soil is a possible source of clay. Soils with this rating have the following: Texture ranges from clay loam to clay. Gravel content is less than 30 percent. This layer is at least 2 feet thick.

Unsuited - Soils with this rating generally are not possible sources for clay.

Suitability of Bedrock for Road Rock

This interpretation indicates the general stability of rock when used as road rock for base course or wearing surface. These ratings are based on rock hardness, density, and susceptibility to weathering and breakdown. Soils are not rated when depth to bedrock is greater than 12 feet. (Cautionary note: This information is for broad planning purposes only. Specific onsite characterization data are required to accurately determine rock suitability.)

Unsuited - Rock is soft and breaks down rapidly under logging traffic.

Poor- Rock is only moderately hard and breaks down easily under logging traffic, usually in one or two years' time.

Fair - Rock is hard and dense but tends to break down under logging traffic after about two to four years' use.

Good - Rock is hard, dense and resists breakdown under logging traffic.

Limitations of Bedrock for Road Rock

This column indicates the major limitation of the bedrock for road rock use.

Estimate of Road Rock Thickness

This interpretation refers to estimated amount of road rock (base course and wearing surface) generally needed on heavy-vehicle, all-weather use roads constructed on each soil. Factors involved in making this interpretation include field observations, texture and plasticity of soil, depth of bedrock, drainage, and kind of subgrade the road generally will have--common material or bedrock. Ratings are based on uncompacted fills and on the use of high quality rock. (Cautionary note: This information is for broad planning purposes only. Specific onsite characterization data are required to accurately determine thickness needs.)

West Side

Very thin - Generally less than 10 inches.

Thin - Approximately 10 to 22 inches.

Thick- Approximately 22 to 36 inches.

Very thick - Generally over 36 inches.

East Side

Very thin - Generally less than 6 inches.

Thin - Approximately 6 to 12 inches.

Thick- Approximately 12 to 24 inches.

Very thick - Generally over 24 inches.

Considerations for Road Location and Construction

This column indicates the major considerations for road location and construction through each soil. The rating evaluates the impact of road construction on other resources and/or road construction problems likely to be encountered.

Method of Excavation

This interpretation refers to excavation methods most commonly used and required for each soil. This includes soil, bedrock and cemented and/or compacted layers in the soil. Methods are blading, ripping, and/or blasting. (Cautionary note: These appraisals are subject to change as machinery capabilities change.)

Cutbank and Ditch Erosion Potential

This interpretation indicates the potential for subsoil erosion by running water of each soil. Subsoil refers to that material from approximately the 5-foot depth extending to bedrock. It includes erosion which takes place along road ditches and on cutslopes. Rating is of soil material only and does not apply when cutbank or ditch is in bedrock. Factors considered in making ratings are field observations, texture and structure of subsoil materials, permeability, compaction, and climate.

Cutbank and Ditch Erosion Potential (Cont.)

Low - Factors indicate that little or no subsoil erosion is likely to occur.

Moderate - Factors indicate that the subsoils have moderate erosion potential.

High - Factors indicate that the subsoils are likely to erode severely.

Susceptibility to Cutbank Sloughing and Raveling

This rating evaluates each unit for its susceptibility to sloughing or raveling after excavation. Ratings are based on cutbanks at least 10 feet high. Factors include field observations, soil and bedrock characteristics, backslope ratio, frost action, climate and potential for revegetation.

Low - Sloughing and/or raveling is a minor problem requiring occasional road maintenance.

Moderate - Sloughing and/or raveling causes some damage. Annual road maintenance is usually adequate.

High - Sloughing and raveling occur at a rate that often plugs culverts and fills inside ditches. Frequent road maintenance with heavy equipment such as front-end loader is required.

Estimated Cutslope Ratio

This interpretation estimates the cutslope ratio which generally will result in the most stable cutbank condition. Ratings made are for cutbanks at least 10 feet high and pertain both to soil and bedrock material. Ratings are based on soil and bedrock factors and on observations. (Cautionary note: This information is for broad planning purposes only. Specific onsite characterization data is needed to determine the proper ratio.)

Steep - Cutbank ratio from vertical to ¼:1

Moderate - Cutbank ratio from about 1:1 to 1½:1

Flat - Cutbank ratio flatter than 1½:1

Probability of Cutbank Failures

This interpretation indicates the probability of failures in cutbanks following road or building excavation. The highest rate of failing will probably occur with the first two years after excavation. On soils rated as having cutbank stability I and II, there should be few failures after the initial two-year period. Soil units rated as having cutbank stability III, IV or V, will experience failures after the initial two-year period. In the case of soils rated with cutbank stability of V, failures can be expected to occur indefinitely.

Failures are considered to be at least 10 cubic yards of material in volume. It should be realized that as the probability of cutbank failures increases, so does the probability that a few of these failures will have volumes in excess of 50 cubic yards, and in some instances there will be massive failure where entire sections of the road are lost.

Ratings are based on cutbanks of at least 10 feet in height, and refer to more than a 50-percent chance of failure.

Probability of Cutbank Failures (Cont.)

I. Very stable - practically no probability of chance of cutbank failures.

II. Stable - probability of no more than 3 failures per mile of road cutbank.

III. Moderately stable - probability of 4 to 8 failures per mile of road cutbank.

IV. Unstable - probability of 9 to 15 failures per mile of road cutbank.

V. Very unstable - probability of more than 15 failures per mile of road cutbank.

Suggestions for Cutbank Stability Problems

This rating gives suggestions, when applicable, to increase stability of cutbanks or reduce damage from raveling and sloughing.

Failure Potential on Road Waste and Fills

This interpretation rates the soil units as to the susceptibility of failure occurring on fill and sidecast waste material and related damage to resources. Failures are defined as a loss or partial loss of road fill or sidecast material on the fill slope. Considered are initial and subsequent failures caused by construction, erosion and additional sidecast during maintenance. Failures result in damage to various resources. Stream sedimentation levels are increased, resulting in an adverse effect on both water quality and fisheries. Timber growth potential is affected as fill slope areas no longer contribute to production. Occasionally the failures do damage to the road itself. The ratings are based on current road construction practices and procedures and on type of soil materials, natural drainage of the site, landform, slope of the fill, and field observation.

Low - Failure on road waste and fills is sufficiently low to result in only minor damage to resource values.

Moderate - Failures on road waste and fills occur with sufficient frequency to cause moderate damage to resource values.

High - Failures on road waste and fills occur at a rate and magnitude sufficient to cause major damage to resource values.

Erosion Potential on Road Waste and Fills

This interpretation rates the soil units as to the susceptibility of erosion occurring on fill and sidecast waste material and related damage to resources. Erosion is a loss of surface soil from fill or sidecast.

Erosion Potential on Road Waste and Fills (Cont.)

This erosion contributes sedimentation to streams. Timber growth potential is affected as fill slope areas no longer contribute to production. The ratings are based on current road construction practices and procedures and on type of soil materials, natural drainage of the site, landform, slope of the fill, and field observation.

Low - Erosion on road waste and fills is sufficiently low to result in only minor damage to resource values.

Moderate - Erosion on road waste and fills occurs with sufficient magnitude to cause moderate damage to resource values.

High - Erosion on road waste and fills occurs at a magnitude sufficient to cause major damage to resource values.

Suitability of Road Waste & Fill Slopes to Seeding

This interpretation indicates the probable success of fill slope seeding. Factors considered in making ratings are soil characteristics, elevation, slope, climate, snowpack, and frost hazard. Ratings are based on current methods and practices of seeding, grass species, fertilizer application and time of seeding.

Poor - Probability of success is low. Seeding generally is not successful and requires three or more reseedings and special treatments.

Fair - Success is likely on about 50 percent of area treated. Requires one or two followup treatments. Seeding usually becomes well established within two years. Little followup seeding necessary.

Good - Probability of high success. Seeding usually becomes well established within two years. Little followup seeding is necessary.

Limitations to Road Waste and Fill Slope Seeding

This indicates the major limitations to success of fill slope seeding.

Suggestions for Road Waste and Fill Slope Seeding

This indicates special treatment to be given, when applicable, to increase the chance of success of fill slope seeding. A statement indicates the necessary requirements other than normal fill slope seeding practices carried on by the Forest.

Suitability of Cutbanks to Seeding

This interpretation indicates the probable success of cutbank seeding. Factors considered in making ratings are soil characteristics, elevation, Suitability of Cutbanks to Seeding (Cont.)

slope, climate, snowpack, and frost hazard. Ratings are based on current methods and practices of seeding, grass species, fertilizer application and time of seeding.

Poor - Probability of success is low. Seeding generally is not successful and requires three or more reseedings and special treatments.

Fair - Success is likely on about 50 percent of area treated. Requires one or two followup treatments. Seeding is usually spotty; some areas become easily established, while others fail completely.

Good - Probability of high success. Seeding usually becomes well established within two years. Little followup seeding necessary.

Limitations to Cutbank Seeding

This indicates the major limitations to success of cutbank seeding.

Suggestions for Cutbank Seeding

This indicates special treatment to be given, when applicable, to increase the chance of success of cutbank seeding.

TIMBER MANAGEMENT

Interpretations for Timber Management are of two types. One type includes some interpretations that directly affect timber management such as "Potential for Regeneration." The other type indicates the effect on soils and other resources from timber harvest activities.

Susceptibility to Brush Revegetation

This indicates the susceptibility of mapping units to revegetate naturally by brush following timber harvest. These ratings are based on soil characteristics, field observation, slope, aspect, climate and elevation.

Low - Indicates brush revegetation is insignificant.

Moderate - Indicates that some brush revegetation will occur.

High - Indicates brush revegetation is very dense.

Susceptibility to Alder Revegetation (West Side Only)

This interpretation indicates the susceptibility of mapping units to revegetate to alder following clearcut timber harvest. These ratings are based on soil characteristics, drainage, elevation, climate, topographic position and field observations.

Low - Factors do not encourage alder establishment and growth. Little or no alder revegetation occurs.

Moderate - Factors are moderately favorable for alder establishment and growth. Alder revegetation is moderate.

High - Factors are highly favorable for alder establishment and growth. Alder revegetation occurs rapidly.

Susceptibility to Pinegrass Revegetation (East Side Only)

This interpretation indicates the susceptibility of mapping interest to revegetate to pinegrass following timber harvest operations. These ratings are based on soil characteristics, drainage, elevation, climate, topography position and field observations.

Low - Factors do not encourage pinegrass establishment and growth. Little or no pinegrass revegetation occurs.

Moderate - Factors are moderately favorable for pinegrass establishment and growth. Pinegrass revegetation is moderate.

High - Factors are highly favorable for pinegrass establishment and growth. Pinegrass revegetation occurs rapidly.

Potential for Regeneration

This interpretation indicates the potential for each landtype unit to regenerate at a minimum level of stocking as set by the Forest Service. Factors included in this interpretation are soil characteristics, climate, aspect, elevation, frost potential, brush competition, and tree species. Includes planted stock and natural regeneration.

Low - This rating indicates the potential for regeneration is low. Probability of success is very limited. Major regeneration problems can be expected and reseeding or replanting may be required throughout the area. Several years may elapse before an adequate stocking level is achieved.

Moderate - This rating indicates that some problems will be encountered in attaining a satisfactory stocking level. Usually regeneration is spotty and some replanting will be necessary.

High - This rating indicates that regeneration has a high probability of success. Few problems should be encountered in attaining good stocking levels.

Limitations to Regeneration

This indicates the major soil limitations to regeneration of planted stock and naturals.

Suggested Tree Planting Species

This column lists the tree species that the soil, climate, and topographic factors indicate may be best suited for planting.

Soil and Water Impacts from Various Timber Harvest Methods

This interpretation indicates the susceptibility of soil and water resources to incur damage from various timber harvest methods. Each landtype is evaluated as to the expected impact from each of the following harvest methods: Tractor logging, cable (no suspension), cable (partial suspension), cable (full suspension), and aerial logging. The evaluation of expected impact includes soil and water resource damages from timber removal, spur roads, landings and other activities that may be associated with the harvest method being evaluated. The evaluations are based on a full operating season. Damage is caused to soils by creating soil disturbance which may destroy soil structure, cause compaction and increase erosion. This may affect other resources through loss of production, lower water quality and yield, and loss of fisheries. Field observations indicate the most important factors to consider in making these ratings are wetness of soil, soil texture and structure, percentage of coarse fragments, slope, drainage, climate, and field observations.

Soil and Water Impacts from Various Timber Harvest Methods (Cont.)

Low - This rating indicates that the impacts to the soil and water resources are minor. Little or no soil damage is expected.

Moderate - This rating indicates that the impacts to the soil and water resources are moderate. Soil and water resources are expected to incur moderate damage.

High - This rating indicates that the impacts to the soil and water resources are major. Excessive damage to soil and water resources is likely to occur.

Type of Damage Expected During and Subsequent to Timber Harvest Operations

This indicates the type of soil and water resource damage expected on each soil from various harvest methods.

RECREATION

Interpretations for recreation pertain primarily to recreation development. They are based on soil and bedrock properties, drainage, landform and vegetation. Factors such as aesthetics and accessibility are not considered when making these ratings. The following interpretations are some most generally needed for planning recreation developments.

Landtype Suitability for Recreation Area Development

This rating is based on soil and bedrock characteristics and topographic features of each unit as related to recreation development such as campground and picnic sites. Factors important to this interpretation are soil depth, texture, structure, permeability, drainage, topography, and susceptibility to flooding.

Unsuited - This rating indicates that soils and/or topography are of a nature which would prohibit recreation development without extensive modification.

Low - These soil units have major limitations to recreation development but limited development is feasible.

Moderate - This rating indicates that the soil unit is generally suitable for recreation development but has minor limitations.

High - These soils are particularly well suited for recreation development. Generally, they have no limitations.

Landtype Limitations for Recreation Development

This indicates the major soil limitations to recreation development.

Treatment to Increase Suitability

This indicates, when applicable, the treatment necessary to increase the suitability for recreation development.

Soil and Site Damage Susceptibility

This interpretation applies to recreational areas after development. Each soil that is suitable or can be made suitable for campground development is rated for its susceptibility to damage of soil and/or site by normal recreation use. Site includes vegetation as well as soil conditions. Factors used in determining ratings include erosion potential, soil compactibility, and vegetative growth potential.

Low - These soils resist compaction and have low erosion potential. The native vegetation is hardy and not readily destroyed. These soils will withstand and hold up well under continual use.

Soil and Site Damage Susceptibility (Cont.)

Moderate - These soils are not readily compacted or eroded and vegetative types are somewhat hardy. In general, these soils and site can sustain continual use but require some rehabilitation.

High - These soils are fragile and easily damaged and have vegetation that is not hardy, easily damaged and generally herbaceous. Under normal use, the vegetation will very likely be destroyed, the soil compacted and/or eroded to such a degree that periodic nonuse and major rehabilitation will be required.

Susceptibility to Dustiness

This interpretation pertains only to the soils suitable for recreation development, and applies primarily to unsurfaced roads within recreation areas.

Low - Factors indicate dust will not be a problem.

Moderate - Under normal conditions dust will not be a problem but under heavy use and droughty conditions dust very likely will be a problem.

High - Factors indicate dust will be a problem. Dust abatement measures are necessary under normal conditions and use.

Susceptibility to Muddiness

This interpretation pertains only to the soils suitable, or those that can be made suitable, for recreation development. This interpretation rates each soil as to its susceptibility to becoming muddy. The rating is limited to the surface soil under normal conditions. Factors include soil characteristics, climate and drainage.

Low - Muddiness is not likely to be a problem. Factors indicate soils are not susceptible to muddiness.

Moderate - Soils become muddy at times for short periods, occasionally causing problems. Road rock is usually necessary.

High - Soils are very likely to become muddy and stay muddy for long periods. Road rock is necessary. Campground closure may be necessary during wet periods.

Trail Suitability

This interpretation indicates the suitability of each soil for trails. Factors include soil and bedrock characteristics, drainage, climate, and slope.

Trail Suitability (Cont.)

Poor - These soils have properties which severely limit their use for trails. Extensive treatment measures are required.

Moderate - These soils have some limitations for trail development. Certain treatment measures may be required.

Well - These soils have no limitations for trail development.

Limitations for Trails

This indicates the limitations for trails.

Considerations for Trail Improvements and Protection

This indicates some treatment measures to be considered in improving suitability and protecting trails.

Suitability for Sewage Filter Field

This interpretation evaluates the soil as to its suitability as a sewage filter field. Ratings are based on soil depth, texture, permeability, drainage and slope. Only those soils suitable for recreation development are rated. Onsite investigation is recommended before design or installation of filter system.

Poor - These soils have properties which make them poorly suited as sewage filter fields. Sewage filter disposal in these soils would be ineffective and create major problems.

Moderate -These soils have properties which limit their use as sewage filter field. They require a large filter area for adequate drainage which limits the capacity of the campground.

Well - These soils are well suited to sewage filter use and offer only minor limitations, if any.

Soil Limitation to Sewage Filter Field Use

This indicates the major limitations to sewage filter field use.

EROSION AND SOME HYDROLOGIC INTERPRETATIONS

Erosion and some hydrologic interpretations include erosion and water management interpretations. Interpretations for erosion include the two major kinds of erosion--surface and mass movement. Surface erosion pertains only to surface soil loss by runoff and overland flow. Mass movement pertains to all types of soil and bedrock movement which occurs below the soil surface such as landslips, slumps, slides, rockfall and land flow.

Natural Stability

This rating is based on the relative stability of the mapping units as they occur in the natural state. This includes any movement or loss other than surface erosion, by slumps, slides, and all kinds of deep-seated failures. This rating applies throughout Region 6.

I. Very stable - No evidence of failure.

II. Stable - Occasional failures are observed.

III. Moderately stable - Several failures are observed.

IV. Unstable - Many failures are observed.

V. Very unstable - Entire area shows evidence of recent and past failures.

Nature of Mass Movement

This is an estimation of the kind and/or size of mass movement observed.

Expected Mass Movement as a Result of Man's Activities

This rating indicates the expected mass movement resulting from man's activities as compared to stability under natural conditions. Ratings are based on soil and bedrock characteristics, slopes, revegetation potential, and effects of timber removal, road construction and fire.

Unchanged - The expected mass movement is relatively unchanged from that of the natural state.

Increased - The expected mass movement is greater than that of the natural state.

Greatly increased - The expected mass movement is much greater than that of the natural state.

Surface Soil Erosion Potential

This rating is based on expected losses of surface soil when all vegetative cover, including litter, is removed. Evaluations of climate, slope gradient and length, soil characteristics, hydrologic characteristics of the soil and bedrock materials of each landtype unit are considered in making ratings.

Very slight - Practically no loss of surface soil materials is expected.

Slight - Little loss of soil materials is expected. Some minor sheet and rill erosion may occur.

Moderate - Some loss of surface soil materials can be expected. Rill erosion and some small gullies or sheet erosion may be occurring. Sheet erosion can be determined by some soil pedestals and observable accumulation of soil materials along the upslope edge of rocks and debris. At this level of erosion there is a possible fertility loss.

Severe - Considerable loss of surface soil materials can be expected. Rill erosion, numerous small gullies or evidence that considerable loss from sheet erosion may occur. Sheet erosion is indicated by frequent occurrence of soil pedestals and considerable accumulation of soil materials along the upslope edge of rocks and debris. This is accompanied by a probable fertility loss.

Very severe - Large loss of surface soil material can be expected in the form of many large gullies and/or numerous small gullies or large loss from sheet erosion. Sheet erosion loss is exhibited by numerous examples of soil pedestals and extensive accumulation of soil materials along the upslope edge of rocks and debris. This is accompanied by a fertility loss.

Subsoil Erosion Potential

This interpretation indicates the potential for subsoil erosion by water for each unit. It includes erosion which takes place after the surface soil has been removed (at least to 1-foot depth) such as in skid trails and firebreaks. Factors considered in making ratings are texture and structure of subsoil materials, slope, permeability, compaction, climate, and landform.

Low - Factors are such that little or no erosion may occur. Very little evidence of erosion.

Moderate - Considerable erosion occurring such as rills and small gullies. Factors indicate considerable erosion is likely to occur.

High - Factors indicate severe erosion may occur.

Suggestions for Controlling Subsoil Erosion

In this column suggestions are given, when applicable, for controlling erosion.

Water Yield Class

This interpretation is an indication of the rate and amount of water yield expected from each soil. It is based on factors such as soil characteristics, infiltration rates, permeability, slope, climate, vegetation, and drainage patterns.

Class I - These soils have a high water detention storage capacity and a low rate of runoff. Little water is yielded to peak flows until detention storage capacity is exceeded or unless the soils are initially saturated or frozen. They are important in sustaining high base flow due to a relatively large volume of water held in detention storage.

Class II - These soils have a moderate water detention storage capacity and a moderate rate of runoff. Water contributes to both peak flows and base flow.

Class III - These soils have a low water detention storage capacity and a high rate of runoff. The storage capacity is low and easily exceeded with most of the water contributing to peak flow. Little water is yielded to sustain base flow.

Bedrock Hydrologic Characteristics

This interpretation indicates the relative capacity of bedrock to store and transmit water. The rating is based on bedrock kind, texture, type and extent of fracturing, frequency of jointing, bedding characteristics, and degree of weathering.

Class I - This indicates that the bedrock has a relatively high capacity to store water. The water transmission rate is low unless the storage capacity is exceeded. Rocks in this class include sandstones because of their texture, fracture, and bedding characteristics, and basalts where water occurs in large tubes and other cavities or in the interflow zone between successive lava flows.

Class II - This indicates that the bedrock has a moderate capacity to store water. The rate of water transmission is moderate. Rocks in this class are generally hard to moderately hard, moderately fine textured, and moderately to highly fractured siltstone, mudstone, pyroclastics, argillite and schist.

Class III - This indicates that the bedrock has a relatively low capacity to store water. The rate of water transmission is rapid. Rocks generally in this class are fractured coarse crystalline (i.e., granite, gabbro and gneiss) and other hard-fractured rocks such as conglomerate.

Bedrock Hydrologic Characteristics (Cont.)

Class IV - This indicates that the bedrock has both low-storage capacity and low rate of water transmission. Rocks in this class are generally highly weathered, fine-textured, and lack open fracture channels.

Hydrologic Group

This interpretation is a grouping of soils into four classes, indicating the general infiltration and water movement ability of the soil and bedrock materials. This method of ratings has been developed by the Soil Conservation Service. The four groups are the standard SCS groupings and definitions.

Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively drained sands and/or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils, with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with high swelling potential, (2) soils with a high permanent water table, (3) soils with claypan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

Sedimentation Yield Potential

This interpretation indicates the potential for water sedimentation and pollution from silt and clay particles carried in suspension following timber harvest, road construction, or other activities. Factors considered in making ratings are soil texture and structure, drainage patterns, landform and climate.

Low - Sedimentation levels of silt and clay particles are not expected to be significant following management activities. Soils are generally moderately coarse-textured.

Sedimentation Yield Potential (Cont.)

Moderate - Sedimentation levels of silt and clay particles may be significantly increased following management activities with moderate loss of water quality and damage to fisheries. Soils are generally medium-textured.

High - Sedimentation levels of silt and clay particles are expected to be high following management activities. Streams become turbid and there is considerable loss of water quality and damage to fisheries. Soils are generally fine to moderately fine-textured.

Expected Sediment Size

This interpretation indicates the expected sediment size reaching the streams resulting from erosion of each unit. This interpretation is a statement of the two dominate separates expected (gravel, sand, silt or clay) from each soil unit. The ratings are presented in two columns. The first column indicates the separates expected from the surface soils, and the second indicates the separates expected from the subsoils.

RANGE AND WILDLIFE MANAGEMENT INTERPRETATIONS

Range and Wildlife Management interpretations are presented to enable better rangeland management through utilization of soil information. These interpretations are oriented toward use by domestic livestock, deer and elk.

Limitations for Domestic Livestock and Wildlife Use

This interpretation indicates the major topographic and site limitations existing on the mapping unit that would hinder use by domestic livestock and wildlife. Forage or the potential for establishing good forage is not considered in this interpretation.

Susceptibility to Soil Compaction

This interpretation indicates the soil's inherent ability to resist compaction by hoofed animals. Factors important to this interpretation are: soil texture, structure, bulk density, pore size and distribution, and rate of infiltration.

Low - Factors indicate that the soil will resist compaction.

Moderate - Factors indicate that the soil has tendencies to become compacted under livestock and wildlife use. Time of grazing on these soil units is important.

High - Factors indicate that soil compaction will be severe unless livestock use is withheld until the soils have dried adequately.

Susceptibility to Soil Displacement

This interpretation indicates the general susceptibility of the soil unit to be displaced by livestock grazing. Soil displacement is the downslope movement of soil. Animal trampling causes loosening of soil particles which are moved downslope by gravity, wind and water. Displacement ratings are based on such facts as texture, slope, and field observations.

Low - Factors indicate that displacement is insignificant. Slopes usually are less than 35 percent.

Moderate - Factors indicate that moderate soil displacement will occur.

High - Factors indicate that displacement is severe and slopes usually exceed 50 percent.

Potential for Range Improvement Through Seeding

This interpretation indicates the potential for each mapping unit to be improved through seeding. Factors used to determine the potential for

Potential for Range Improvement through Seeding (Cont.)

range improvement through seeding are climate, topography, natural vegetation and the soil characteristics that relate to water-holding capacity and fertility.

Low - This rating indicates the potential for a successful grass seeding is low. Probability of success is very limited.

Moderate - This rating indicates that some problems will be encountered in attaining a satisfactory grass cover.

High - This rating indicates that necessary conditions for a successful grass cover establishment exist.

Limitations to Range Seeding

This interpretation indicates the major limitations to successful range improvement through seeding. Limitations are based on field observations, topography, climate, and soil characteristics.

EXHIBITS IV-B, IV-C, IV-D, IV-E, IV-F, IV-G, IV-H

The following are examples of forms that may be used when making management interpretations of landtype properties. They are to be completed by the soil scientist in pencil or ink. The tables for the SRI Atlas and Report will be typed from these work forms.

EXHIBIT IV-B

TABLE OF INTERPRETATIONS

	ENGINEERING							
Land-Type No.	Unified and ASSHO Classification	Suitability for Use as Topsoil Source	Suitability of Soil as Sand and/or Gravel Source	Suitability of Soil as a Possible Clay Source	Suitability of Bedrock for Road Rock	Limitations of Bedrock for Road Rock	Estimate of Road Rock Thickness	Consideratio for Road Location and Construction

R-6, SRI (7/72)

TABLE OF INTERPRETATIONS

ENGINEERING								
Land-Type No.	Method of Excavation	Cutbank & Ditch Erosion Potential	Susceptibility to Cutbank Sloughing and Raveling	Estimated Cutslope Ratio	Probability of Cutbank Failures	Suggestions for Cutbank Stability Problems	Failure Potential on Road Waste and Fills	Erosion Potential on Road Waste and Fills

TABLE OF INTERPRETATIONS

	ENGINEERING					
Land-type No.	Suitability of Road Waste & Fill Slopes to Seeding	Limitations to Road Waste & Fill Slope Seeding	Suggestions for Road Waste & Fill Slope Seeding	Suitability of Cutbanks to Seeding	Limitations to Cutbank Seeding	Suggestions for Cutbank Seeding

TABLE OF INTERPRETATIONS

	TIMBER MANAGEMENT					
Land-type No.	Susceptibility to Brush Revegetation	Susceptibility to Alder Revegetation (West Side only)	Susceptibility to Pinegrass Revegetation (ES only)	Potential for Regeneration	Limitations to Regeneration	Suggested Tree Planting Species

SOIL & WATER IMPACTS FROM VARIOUS TIMBER HARVEST METHODS

	TIMBER MANAGEMENT									
Land-type No.	Impact from Tractor Logging	Type of Damage	Impact from Cable (no suspension)	Type of Damage	Impact from Cable (partial suspen)	Type of Damage	Impact from Cable (full suspension)	Type of Damage	Impact from Aerial Logging	Type of Damage

R-6, SRI 7/72

TABLE OF INTERPRETATIONS

RECREATION					
Land-type No.	Landtype Suitability for Recreation Area Development	Landtype Limitations for Recreation Development	Treatment to Increase Suitability	Soil and Site Damage Susceptibility	Susceptibility to Dustiness

TABLE OF INTERPRETATIONS

	RECREATION					
Land-type No.	Susceptibility to Muddiness	Trail Suitability	Limitations for Trails	Considerations for Trail Improvements and Protection	Suitability for Sewage Filter Field	Soil Limitations to Sewage Filter Field Use

EXHIBIT IV-B

TABLE OF INTERPRETATIONS

EROSION AND SOME HYDROLOGIC INTERPRETATIONS

Land-type No.	Natural Stability	Nature of Mass Movement	Expected Mass Movement as a Result of Man's Activities	Surface Soil Erosion Potential	Subsoil Erosion Potential	Suggestions for Controlling Erosion

EROSION AND SOME HYDROLOGIC INTERPRETATIONS

Land-type No.	Water Yield Class	Bedrock Hydrologic Characteristics	Hydrologic Group	Sedimentation Yield Potential	Expected Sediment Size

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TABLE OF INTERPRETATIONS

RANGE & WILDLIFE MANAGEMENT

Land-type No.	Limitations for Domestic Livestock & Multiple Use	Susceptibility to Soil Compaction	Susceptibility to Soil Displacement	Potential for Range Improvement through Seeding	Limitations to Range Seeding

TABLE OF LANDTYPE CHARACTERISTICS, FEATURES AND QUALITIES

Land-type No.	Infiltration Class	Drainage Class	Major Drainage Pattern & Intensity	Timber Site Class and Growth Basal Area	Range Productivity	Meadow Productivity	Fertility

TABLE OF LANDTYPE CHARACTERISTICS, FEATURES AND QUALITIES

		Overstory		Understory		Ground Cover	
Land-type No.	Total Vegetative Cover %	Major Species	Vegetative Cover %	Major Species	Vegetative Cover %	Major Species	Vegetative Cover %

TABLE OF LANDTYPE CHARACTERISTICS, FEATURES AND QUALITIES

Land-type No.	Root Distribution			Landform	Slope
	Size	Abundance	Depth		

TABLE OF LANDTYPE CHARACTERISTICS, FEATURES AND QUALITIES

Land-type No.	Aspect	Elevation	Origin of Soil Material	Remarks

TABLE OF SOIL CHARACTERISTICS OF MODAL SITE

Landtype No.	Location of Modal Site	Depth to Bedrock	Depth to Restrictive Layer	Litter	Soil Layer and Thickness	Color	Texture

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TABLE OF SOIL CHARACTERISTICS OF MODAL SITE

Land-type No.	Rock Fragments			Rock Fragment Class	Structure			Cementation or Compaction	Permeability
	Size	Shape	%		Grade	Size	Type		

TABLE OF SOIL CHARACTERISTICS OF MODAL SITE

Landtype No.	Consistence			pH	Estimated Taxonomic Classification	Remarks
	Dry	Moist	Wet			

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TABLE OF BEDROCK CHARACTERISTICS OF MAPPING UNITS

Land-type No.	Kind	Color (fresh surface)	Hardness	Fracture	Fracture System

TABLE OF BEDROCK CHARACTERISTICS OF MAPPING UNITS

Land-type No.	Fracture Surface	Competency	Remarks

EROSION AND SOME HYDROLOGIC INTERPRETATIONS

Landtype ______

Natural Stability

- [ ] Very stable
- [ ] Stable
- [ ] Moderately stable
- [ ] Unstable
- [ ] Very unstable

Nature of Mass Movement

____

m ________________________________

____

____

Expected Mass Movement as a Result of Man's Activities

- [ ] Unchanged
- [ ] Increased
- [ ] Greatly increased

Surface Soil Erosion Potential

- [ ] Very slight
- [ ] Slight
- [ ] Moderate
- [ ] Severe
- [ ] Very severe

Subsoil Erosion Potential

- [ ] Low
- [ ] Moderate
- [ ] High

Suggestions for Controlling Erosion ________

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Water Yield Class

Class I

Class II

Class III

Bedrock Hydrologic Characteristics

Class I

Class II

Class III

Class IV

Hydrologic Group

Group A

Group B

Group C

Group D

Sedimentation Yield Potential

Low

Moderate

High

Expected Sediment Size

A. Surface Soil ________________

B. Subsoil ________________

ENGINEERING

Landtype ______

Unified & ASSHO Classification

____

____

Suitability for Use as Topsoil Source

- ☐ Suited
- ☐ Unsuited

Suitability of Soil as Sand and/or Gravel Source

- ☐ Suited
- ☐ Unsuited

Suitability of Soil as a Possible Clay Source

- ☐ Suited
- ☐ Unsuited

Suitability of Bedrock for Road Rock

- ☐ Unsuited
- ☐ Poor
- ☐ Fair
- ☐ Good

Limitations of Bedrock for Road Rock

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Estimate of Road Rock Thickness

- ☐ Very thin
- ☐ Thin
- ☐ Thick
- ☐ Very thick

Considerations for Road Location and Construction

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Landtype __________

Method of Excavation

- [ ] Blading
- [ ] Ripping
- [ ] Blasting

Cutbank and Ditch Erosion Potential

- [ ] Low
- [ ] Moderate
- [ ] High

Susceptibility to Cutbank Sloughing and Raveling

- [ ] Low
- [ ] Moderate
- [ ] High

Estimated Cutslope Ratio

- [ ] Steep
- [ ] Moderate
- [ ] Flat

Probability of Cutbank Failures

- [ ] Very stable
- [ ] Stable
- [ ] Moderately stable
- [ ] Unstable
- [ ] Very unstable

Suggestions for Cutbank Stability Problems

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Failure Potential on Road Waste and Fills

- [ ] Low
- [ ] Moderate
- [ ] High

Erosion Potential on Road Waste and Fills

- [ ] Low
- [ ] Moderate
- [ ] High

Suitability of Road Waste & Fill Slopes to Seeding

- [ ] Poor
- [ ] Fair
- [ ] Good

Limitations to Road Waste & Fill Slope Seeding

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Landtype ____

Suggestions for Road Waste & Fill Slope Seeding

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Suggestions for Cutbank Seeding

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Suitability of Cutbanks to Seeding

- [ ] Poor
- [ ] Fair
- [ ] Good

Limitations to Cutbank Seeding

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TIMBER MANAGEMENT

Landtype ____

Susceptibility to Brush Revegetation

- ☐ Low
- ☐ Moderate
- ☐ High

Susceptibility to Alder Revegetation (West Side only)

- ☐ Low
- ☐ Moderate
- ☐ High

Susceptibility to Pinegrass Revegetation (East Side only)

- ☐ Low
- ☐ Moderate
- ☐ High

Potential for Regeneration

- ☐ Low
- ☐ Moderate
- ☐ High

Limitations to Regeneration

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Suggested Tree Planting Species

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Soil & Water Impacts for Various Timber Harvest Methods - Impact from Tractor Logging

- ☐ Low
- ☐ Moderate
- ☐ High

Type of Damage

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TIMBER MANAGEMENT (Cont.)

Landtype ____

Impact from Cable (no suspension)

- [ ] Low
- [ ] Moderate
- [ ] High

Type of Damage

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____
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____

Impact from Cable (full suspension)

- [ ] Low
- [ ] Moderate
- [ ] High

Type of Damage

____
____
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____

Impact from Cable (partial suspension)

- [ ] Low
- [ ] Moderate
- [ ] High

Type of Damage

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____

Impact from Aerial Logging

- [ ] Low
- [ ] Moderate
- [ ] High

Type of Damage

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RECREATION

Landtype ______

Landtype Suitability for Recreation Area Development

- [ ] Unsuited
- [ ] Low
- [ ] Moderate
- [ ] High

Landtype Limitations for Recreation Development

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Treatment to Increase Suitability

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Soil and Site Damage Susceptibility

- [ ] Low
- [ ] Moderate
- [ ] High

Susceptibility to Dustiness

- [ ] Low
- [ ] Moderate
- [ ] High

Susceptibility to Muddiness

- [ ] Low
- [ ] Moderate
- [ ] High

Trail Suitability

- [ ] Poor
- [ ] Moderate
- [ ] Well

Limitations for Trails

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Landtype _____

Considerations for Trail Improvements and Protection

Suitability for Sewage Filter Field

☐ Poor

☐ Moderate

☐ Well

Soil Limitation to Sewage Filter Field Use

Landtype_____

Limitations for Domestic Livestock & Wildlife Use

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____

Susceptibility to Soil Compaction

___ Low

___ Moderate

___ High

Susceptibility to Soil Displacement

___ Low

___ Moderate

___ High

Potential for Range Improvement thru Seeding

Low

Moderate

High

Limitations to Range Seeding

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SUMMARY OF MANAGEMENT INTERPRETATIONS

LT.______ Date____________________ By ________________ Loc. ________________

ENGINEERING			EROSION & SOME HYDROLOGIC INTERPRETATIONS	
Topsoil Source (S, U)		Limit. to Cutbank Seeding	Natual Stability (I - V)	
Sand, Gravel Source (S, U)		Sugges. for Cutbank Seeding	Nature of Mass Movement	
Clay Source (S, U)		**TIMBER MANAGEMENT**		
Bedrock for Roadrock (U, P, F, G)		Suscept. to Brush Reveg. (L, M, H)	Expected Mass Movement as Result of Man's Activity (Un, In, GIn)	
Limit of Bedrk. for Roadrock		Suscept. to Alder Reveg. (L, M, H)	Surface Erosion Potential (VSl, Sl, M, Se, VSe	
Est. Roadrock Thickness (VT, T, Th, VTh)		Suscept. to Pinegrass Reveg. (L, M, H)	Subsoil Eros. Potential (L, M, H)	
Consid. Road Loc. & Construc.		Potential for Regeneration (L, M, H)	Suggest. for Controlling Subsoil Erosion -	
Method of Excavation		Limitations to Regeneration	Water Yield Class (I, II, III)	
Cutb. & Ditch Eros. Poten. (L, M, H)		Suggested Tree Species	Bedrock Hydro. Character. (I, II, III, IV)	
Sloughing & Raveling (L, M, H)		Soil-Water impacts from harvest (L, M, H)	Hydrologic Group (A, B, C, D)	
Est. Cutslope Ratio (S, M, F)		Type of Damage -	Sediment Yield Potential (L, M, H)	
Prob. of Cutbank Failure (I - V)		**RECREATION**	Expected Sediment Size	
Suggestions for Cutbank Stability Problems		Landtype Suit. for Rec. Area Develop. (U, L, M, H)	**RANGE & WILDLIFE MANAGE.**	
Failure Potential Waste & Fills (L, M, H)		Landtype Limit. for Rec. Devel	Limitations for Livestock & Wildlife Use	
Eros. Potential Waste & Fills (L, M, H)		Treatment to Increase Suit.	Suscept. to Soil Compact. (L, M, H)	
Suitability of Waste & Fill to Seeding (P, F, G)		Soil & Site Dam. Suscept. (L, M, H)	Suscept. to Soil Displace. (L, M, H)	
Limit. to Waste & Fill Seed.		Suscept. to Dustiness (L, M, H)	Potential for Rge. Improvement thru Seeding (L, M, H)	
Sugges. for Waste & Fill Seed.		Suscept. to Muddiness (L, M, H)	Limitations to Range Seeding	
Suitability of Cutbanks to Seeding (P, F, G)		Trail Suitability (P, M, W)		
		Limitations for Trails		
		Considerations for Trail Improvements & Protection -		
		Suit. for Sewage Filter Field (P, M, W)		
		Soil Limit. to Filter Field		

LEGEND

U = Unsuited
S = Suited
L = Low
M - Med. or Mod.
H = High
P = Poor
W = Well
Sl = Slight
Se = Severe
Un = Unchanged
In = Increased
GIn Greatly Increased
V = Very

EROSION + SOME HYDROLOGIC INTERPRETATIONS

LAND TYPE No.	SURFACE SOIL EROSION POTENTIAL	NATURAL STABILITY	NATURE OF MASS MOVEMENT	EXPECTED MASS MOVEMENT AS A RESULT OF MAN'S ACTIVITIES	SEDIMENT EROSION POTENTIAL	SUGGESTIONS FOR CONTROLLING EROSION	WATER CLASS YIELD
1	SLIGHT	VERY STABLE	N/A	UNCHANGED	LOW	21	II
2	SLIGHT	VERY STABLE	N/A	UNCHANGED	LOW	21	III
3	SLIGHT	VERY STABLE	N/A	UNCHANGED	LOW	21	III
4	N/A	STABLE TO UNSTABLE	DEBRIS SLIDE + ROCKFALL	N/A	N/A	N/A	N/A
5	SEVERE	STABLE	SMALL DEBRIS SLIDE	UNCHANGED	HIGH	21	III
6	SEVERE	STABLE TO MOD. STABLE	DEBRIS SLIDE + ROCKFALL	INCREASED	HIGH	21	III
7	SEVERE	STABLE TO MOD. STABLE	DEBRIS SLIDE + ROCKFALL	INCREASED	HIGH	21	III
8	SEVERE	STABLE TO MOD. STABLE	DEBRIS SLIDES, ROCKFALL, AVALANCHES	INCREASED	HIGH	21	III
9	VERY SEVERE	MOD. STABLE	DEBRIS SLIDES	INCREASED	HIGH	21	III