

THE SOIL SURVEY PROGRAM

OF THE BUREAU OF LAND MANAGEMENT

PAST, PRESENT, & FUTURE

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by

James A. Pomerening

OCTOBER 1980



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by

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and

Intergovernmental Personnel Act (IPA) Soil Scientist Division of Rangeland Management Bureau of Land Management Washington, D. C. 20240

October 1980

Dedicated to all the BLM Soil Scientists - Past, Present and Future

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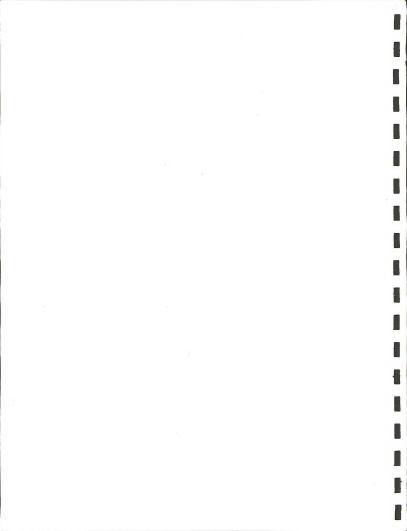


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1. Introduction

The purpose of this project was to evaluate the Bureau of Land Management's (BLM's) soil survey program and to recommend improvements. The study was made by a soil scientist who is not a career BLM employee. The recommendations and opinions expressed in this report are solely those of the author.

The study was made between October 1, 1979 and May 31, 1980. During that period the author was on a half-time Intergovernmental Personnel Act (IPA) appointment to the Division of Rangeland Management in the BLM Washington Office. The Division of Rangeland Management became responsible for administering the BLM's soil survey program on October 1, 1979 as a result of a major reorganization within the BLM (Koenings, 1979). Prior to the reorganization, the soil survey program had been administered by the Division of Watershed which was abolished by the reorganization.

The author's duty station was the Division of Resource Inventory Systems at the Denver Service Center (DSC), because the soil scientist position with responsibilities for coordinating the soil survey program in the Division of Rangeland Management was not filled until April, 1980. Until that position was filled, the soil scientist in the Division of Resource Inventory Systems was delegated major responsibilities for coordinating the BLM's soil survey program at the national level.

The 1979-80 academic year was a timely period to evaluate the BLM's soil survey program. It coincided with the turbulent beginnings of the re-organization; closely followed the time when the BLM had agreed to follow the standards of the National Cooperative Soil Survey (NCSS); and occurred when the magnitude of the soil survey program was reaching a peak level of production in most of the western states.

The author began to see the need for this study in June 1978, when he learned that as of May 8, 1978 the BLM agreed to make all soil surveys according to the standards of the NCSS. He could foresee a period of turmoil in the BLM's soil survey program because he was familiar with the existing nature and scope of the BLM's soil survey program through his experiences as a summer temporary BLM soil scientist in Oregon since 1971. He knew there were conflicts between the standards and procedures of the NCSS and the soil survey directives of the BLM; that the BLM district offices were decidedly understaffed to meet the ambitious soil survey goals as determined by the environmental impact statement (EIS) schedule; and that the Washington Office was not adequately staffed and organized to conduct its share of the interagency and intraagency responsibilities of the NCSS. He wondered if the soil survey program would be funded adequately. He had first-hand experiences with the problems of maintaining the quality of soil surveys made by private contracting firms, and with the anti-soil survey attitude that existed

among some of the BLM line and staff administrative officers. He believed that a comprehensive evaluation of the BLM's soil survey program could produce findings which would improve the quality, utility, cost-effectiveness, and operations of the soil survey program.

The position description for this assignment included six specific duties. They were: (1) determine the nature and scope of the problem areas associated with the BLM's affiliation with the NCSS; (2) determine the BLM's organization and staff requirements for the soil survey program; (3) determine the policy, procedures, equiment and manpower needs to complete the soil survey of the public lands administered by the BLM by 1989; (4) determine the relative costs of making a soil survey by using either in-house BLM soil scientists, Soil Conservation Service (SCS) soil scientists, or private contractor soil scientists; (5) determine the relative quality of soil surveys made by the BLM, the SCS, or private contractors; and (6) evaluate the BLM directives regarding the soil survey program.

The major problems the BLM is experiencing with respect to its affiliation with the NCSS are: (1) many of the soil surveys initiated after May 8, 1978 do not conform with all of the standards of the NCSS; (2) the BLM cadre of qualified soil scientists and party leaders is inadequate for the BLM to "take the leadership for the soil surveys of the public lands under its jurisdiction"; (3) the level of financial support is inadequate to meet the scope of the soil survey workload without sacrificing quality; and (4) the level of administrative support is inadequate in some offices for obtaining sound soil survey data for making sound resource management decisions. These problem areas are covered in greater detail in Chapter 4, "The Quality, Status and Needs of the BLM's Soil Survey Program as Viewed by the BLM State Soil

The BLM does not have an adequate organizational structure or staff to properly coordinate and conduct its soil survey and soil management programs. The Division of Rangeland Management in the Washington Office is not an appropriate office for coordinating the soil survey program because soil survey information is equally applicable to forest land, wildlife habitat, wilderness area, and recreational area management. The staff of soil science specialists at the Denver Service Center and Washington Office is too small to provide the technical guidance and training requirements of the field offices. The number of soil correlator positions is inadequate for the BLM to properly exercise its responsibilities for maintaining the quality of the soil survey program. There is an insufficient number of qualified BLM soil survey party leaders to complete quality soil surveys. The leading soil scientist in the state office should be a GS 13 to produce equity with comparable positions of responsibility in the Forest Service and Soil Conservation Service. These items are expanded upon in Chapter 4," The Quality, Status and Needs of the BLM's Soil Survey Program as Viewed by the BLM State Soil Scientists"; Chapter 8, "Recommended Changes in the

BLM Manual Sections on Organization, and Duties and Responsibilities of Offices in Relation to the Soil Survey Programs"; and Chapter 7, "Recommended Revisions in the BLM Manual Sections Pertaining to Soil Surveys and Soil Management".

The BLM's policy of making soil surveys according to the standards of the NCSS is sound. Likewise, the soil survey procedures presented in the National Soils Handbook are adequate for making good soil surveys to meet the BLM's resource planning and management objectives. A strict enforcement of the established policy and procedures will ensure completion of the soil survey work by 1989 provided the staffing and funding is adequate. It will take approximately 1000 work-years of direct work and 200 work-years of support work to complete the soil survey of the 110 million acres remaining to be surveyed after 1979. The support for equipment and supplies has been adequate except for office space and field camp living facilities. These items are covered in greater depth in Chapter 2, "The BLM's Policies and Practices Relative to Soil Surveys, 1964-1978"; Chapter 5, "Calculated and Estimated Costs of the BLM's Soil Survey and Vegetation Inventory Programs"; and Chapter 9, "The BLM's Soil Survey Program for 1980: Who is Doing the Work, and Kinds of Work Performed by the BLM and SCS Soil Scientists".

Regardless of who does the work, if each group uses the same standards and procedures and if the quality of the product is the same, the cost for making soil surveys is the same. The BLM's cost reporting system has severe limitations for making an accurate cost analysis of the soil survey program. Based on data in the Program and Cost Reports, soil survey costs were between 13 and 79 cents per acre among the ten western states in 1978, and between 7 and 97 cents per acre in 1979. The Bureauwide average cost was 33 cents per acre in 1978 and 25 cents per acre in 1979. There was no apparent relationship between these unit costs and the agency responsible for making the soil surveys. The cost analysis portion of this report is described in Chapter 5, "Calculated and Estimated Costs of the BLM Soil Survey and Vegetation Inventory Programs" and Chapter 6, "Recommended Changes in the Component and Job Descriptions Relative to Soil Surveys and Other Natural Resource Inventories".

The quality of the BLM soil surveys has not been firmly established because few have been subjected to the quality control and correlation standards of the NCSS. As is the case for the cost of soil surveys, there will be no difference in the quality of soil surveys, regardless of what agency makes them, if each agency uses the same standards and procedures, maps at the same intensity level, and has the same degree of competency in its party leader and crew. Several of the soil surveys made by private contractors have been of substandard quality because the mapping units were too broadly defined, the mapping pace was too fast, most of the quality control process was omitted, and the soil survey interpretations were inadequate. The BLM began to be more strict with

the quality control phase of the soil survey process on all surveys in 1979. Naturally, as the quality is improved, the unit cost is increased. More is said on this subject in Chapter 4, "The Quality, Status and Needs of the BLM's Soil Survey Program as Viewed by the BLM State Soil Scientists".

The BLM's policy and procedures pertaining to the soil survey and soil management programs are scattered throughout many manual sections and instruction memos. Much of the content of these directives became obsolete when the BLM agreed to abide by the standards of the NCSS on May 8, 1978. Sometimes the manual sections contradict each other; other times two different manual sections duplicate each other. Important procedures of the NCSS are commonly omitted from the manual. There is an urgent need to update and consolidate the BLM manual sections pertaining to the soil survey and soil management programs. More specific comments are in Chapter 7, "Recommended Revisions in the BLM Manual Sections Pertaining to Soil Surveys and Soil Management".

The history of the BLM's soil survey program is summarized in Chapter 3. This information was mostly supplied by the pioneers of the BLM's soil survey program. For the first time, the scattered bits of information about the people, places, dates and events concerned with the origins of the BLM's soil science programs are compiled in one place. If this information had not been gathered for this report, much of it would have been lost forever because it was only available in the memories of the pioneers. The history was valuable for evaluating the current organizational structure, policy, practices, and staffing levels of the soil survey program. The past, present, and future BLM soil scientists will all benefit from this history. The pioneers deserve to be recognized and remembered for the contributions they have made to the soil survey program. It is hoped that present as well as future soil scientists will be inspired to build upon the foundation established by their predecessors and will gain a proper perspective of the existing level of development of the soil survey program from this history.

The long-range plans for the BLM's soil survey program are included in Chapter 5. The future impact of the soil survey program on the quality of the environment and the socio-economic conditions of the communities partially supported by public lands under the jurisdiction of the BLM is presented in Chapter 10.

The BLM's soil survey program is off to a good start. It is based on a strong foundation — the standards of the National Cooperative Soil Survey. There have been tremendous improvements made in the program in the past year. Most of the problems encountered have been normal growth pangs associated with attempting to do too much, too soon, with too few funds, and too small of an experienced staff.

The future of the BLM's soil management program is bright. It will begin to flourish after the soil survey program is completed. The

soil survey program will supply much of the information needed to manage the soils and associated natural resources for sustained yields and a favorable environmental quality. The BLM's Policies and Practices Regarding Soil Surveys from 1964 to 1978.

The Bureau first issued policy guidelines for soil surveys in Instruction Memo No. 64-555, "Soil Surveys on BLM Administered Lands", on November 2, 1964. The policy regarding the need for soil surveys was decidedly negative and essentially brought soil surveys on grazing lands to a standstill for more than a decade.

The policy statement contained the following criteria for guiding future BLM efforts to obtain soil survey information:

- "1. Proposed cooperative soil surveys on public lands, which require an expenditure of Bureau funds, will clearly show the need, justification, and proposed use of soils data. All such proposed surveys and supporting statements will be submitted to the Washington Office for review and approval prior to consummation of any agreement.
- "2. Soil inventories entered into by BLM will primarily be limited to areas proposed for long-term multiple resource management and where it has been demonstrated that soil surveys will furnish additional information needed for the solving of critical problems involving reforestation, range rehabilitation, intensive land treatment, critical watersheds, agricultural potential, etc. Costs of soil surveys appear to be prohibitive, when applied to all wildlands administered by BLM and are justifiable only on selected areas.
- "3. In the formulation of district and state programs, soil surveys of studies will be identified in the programming system in the same manner as other activities. This will require advance planning and inclusion of proposed soil surveys in program plans and annual work plans. Soil surveys will not be included on "spur of the moment" actions, but will be predicated upon a definite need recognized and presented in the programming and planning systems.
- "4. The development of management plans will not be predicated on the need for soil surveys prior to initiation of intensive management and rehabilitation.
- "5. In public land area where soil surveys have been or will be conducted with the approval of BLM, but without BLM cooperating or contributing funds, the soils information will be utilized as appropriate. However, interpretations made by agencies other than BLM will not be binding on BLM management decisions.
- "6. Interpretion of soil survey data on areas administered by BLM will be the complete responsibility of BLM. Consultation and advice from other agencies will be sought; however, BLM has the

The second criterion recognizes the need for soil surveys "for the solving of critical problems," but goes on to say that they "are justified only on selected areas" because the costs appear to be prohibitive when applied to all "wildlands" administered by the Bureau. These criteria resulted from a staff report on the "Use of Soil Surveys by BLM," (Luscher, 1964). The staff preparing that report determined that the cost of soil surveys averaged 20 to 24 cents/acre, and concluded that this was prohibitive when applied to all wildlands. The staff report was based on findings of pilot soil survey studies conducted in cooperation with the Soil Conservation Service in Montana, Newada, and New Mexico.\(^1\)

The conclusion that a cost of 20 to 24 cents/acre is prohibitive is debatable. A good soil survey is useful for at least 30 years, and a cost of less than one cent/acre/year would not appear to be prohibitive or excessive.

It may be that the pilot study soil surveys were done at a higher level of intensity than was necessary for the needs of the areas, and therefore were too costly. The mapping units for the survey areas in New Mexico and Montana were mostly consociations (phases of a single soil series) and those in Nevada were mostly soil associations. The staff considered different levels of intensity and stated: "at present, much work needs to be done to determine the intensity of survey required for wildlands."

The fourth criterion states that soil surveys are not needed for the development of management plans. The staff report points out some deficiencies in the soil survey interpretations for grazing land, and the long time lag between the initiation of a soil survey and publication of its results. Therefore, the opinion is that soil survey information is not essential for developing BIM management plans.

The staff members who prepared the staff report were not soil scientists and perhaps did not fully realize that knowledge about soil behavior obtained from a sample site can be extended to all other areas of that same soil. They commented that: "The stocking rate necessary to protect and properly utilize the forage resources can be conclusively proven only through use and management." Granted, this is an accurate method, but it is extremely time consuming and costly. To condemn soil surveys because they take too long and are too costly, and to say at the same time that the only way to learn about soil productivity is through long-term use and management of each area reveals a lack of understanding of the basic function of soil surveys, which is that the behavioral knowledge of any soil, gained by observation and experience,

^{1.} Soil Survey Publications 1, 10, and 20 in Appendix 2.

from a sample site can be applied to other areas with the same kind of soil. The staff report does not estimate the time or cost of getting the information needed for preparing management plans by using their system. It obviously would take many, many years and much more than a penny an acre per year to do so. Using range conservationists to evaluate the utility of soil surveys for the Bureau's program is somewhat analogous to using plant pathologists to evaluate the utility of Einstein's theory of relativity.

Criteria 5 and 6 both allude to the fact that the Bureau is responsible for developing soil survey interpretations germaine to public land management. This is the way it should be, and this is the way it is today. In 1964, the Bureau had no staff of soil scientists to accomplish this task. Ten years later, Oregon had a sizable staff of soil scientists at the field level who were actively engaged in developing soil survey interpretations specifically designed to meet the Bureau's needs.

The knowledge of soils and their behavior under different levels of management will never be perfect and complete. Therefore, the development of new interpretations and the refinement of existing interpretations are never-ending processes that need to progress as new knowledge is gained or as changes in technology make existing criteria and methods obsolete. It will take a staff of knowledgeable soil scientists to do this.

The staff report criticized the soil associations used in the Nevada pilot study area. It states: "grouping of dissimilar soils resulted in a unit in which the soil lost identity and location," and "grouping of unlike soils into a mapping unit will be of little value to BIM." Such statements suggest a lack of understanding of mapping unit design in regard to soil associations. The extent and geographic location of soil association components can be determined in the field when such mapping units are properly defined and adequately described. When contrasting soils make up an association, it is still possible to use each according to its need by applying the specific interpretations for each of the various components.

The staff report was positive regarding the need for soil scientists within the Bureau. It stated: "BLM should develop expertise in soil survey procedures to fulfill its critical needs for such information"; "BLM must assume complete leadership in the field of priority needs for soils information, mapping units and intensity, and interpretation and use of data collected on the public lands under its jurisdiction"; "Efforts should be initiated to secure a Washington Office soil scientist assigned to the Soil and Watershed Staff technically qualified in both soils and resource management and experienced in areas comparable to BLM-administered lands"; "A training program should be initiated to familiarize field personnel with the use of soils data which is existent or may become available"; and "BLM and SCS should enter into a cooperative agreement, at the Washington level, setting forth the areas of responsibility for each agency in the initiation and conduct of soil surveys on lands administered by the BLM and interpretations of the data."

Note that in 1964 there was a Soil and Watershed Staff in the Washington Office even though soil information was not deemed necessary for preparing range management plans and the Bureau had only one soil scientist at the time (Walter Stone, in New Mexico). Sometime later, "Soil" disappeared from all office titles in Washington, never to return.

Although it took many years to secure a Washington Office soil scientist, the Bureau established soil scientist positions in both the Portland and Denver Service Centers in 1965. Jim Hagihara was appointed to the Portland Service Center position in June 1965, and Lyle Linnell began his tenure at Denver in November 1965. LeRoy deMoulin, the first soil scientist in the Washington Office, was assigned to the Division of Watershed from August 1975 to August 1977. Since then, there had been no soil scientist at the Washington Office until April 1980 when Jack Chugg was appointed to the Branch of Rangeland Policy and Program Development. The Division of Watershed was abolished in the reorganization of 1979, and many of that Division's responsibilities have been assigned to the Branch of Rangeland Policy and Program Development.

The cooperative agreement between the BLM and SCS, referred to in the 1964 staff report, finally came to pass on May 8, 1978. It stipulates that the Bureau will follow National Cooperative Soil Survey Standards, but that the Bureau reserves the right to develop its own soil survey interpretations.

Not everyone in the Bureau agreed with the policy on soil surveys when it was released in November 1964. On December 11, 1964, George Turcott, Chief, Soil and Watershed Staff, sent a memo to the Director on the subject of "Need for Soils Information in BLM Programs." Among other things, Mr. Turcott pointed out that: "Soils information is useful to varying degrees in most Bureau programs." He recognized the need for adapting the intensity of the soil survey to the intensity of land use and projected management levels. He suggested using two levels of soil survey intensity: reconnaissance surveys to provide the necessary soils data for most resource management activities, and detailed soil investigations for areas where intensive rehabilitation measures are encountered. He listed three alternatives for securing the soil surveys: (1) contracting with the Soil Conservation Service; (2) contracting with research institutions (universities); and (3) using BLM personnel.

Advantages and disadvantages for each of these alternatives were listed and it was recommended that alternatives 2 and 3 be combined, so that a BLM technician would be assigned to work with a selected research institution to design a reconnaissance soil survey system. The reasons for excluding the SCS in this endeavor included: (1) the proposed system

^{2.} Memorandum of Understanding for the making of Soil Surveys on Lands administered by the BLM. May 8, 1978. BLM/SCS.

probably will not meet National Soil Survey Standards set by SCS; therefore, they will be reluctant to work on methodology that does not meet these standards, and (2) the BLM has intensively reviewed SCS soil survey procedures and generally finds that they are not adaptable to Bureau programs.

A factor that may have led to the recommendation not to work with the SGS on the Bureau's soil survey program was a recent experience with a cooperative agreement between the Bureau and two Soil Conservation Districts in northern California and Nevada. Those districts pressured the Bureau to give financial and personnel support for a soil survey that they insisted was prerequisite to developing a land use program. The Bureau made a small contribution to the soil survey program, but never met the full requests of the Soil Conservation Districts' governing boards.³

Those two Soil Conservation Districts are the Vya District in Humbolt and Washoe Counties, Nevada, and the Surprise Valley District in Modoc and Lassen Counties, California. The Vya District consists of 2,712,576 acres, of which 1,474,685 acres are administered by the Susanville BLM District in California, and 489,126 acres are administered by the Winnemucca BLM District in Nevada. The Surprise Valley District has 587,514 acres, of which 268,000 acres are administered by the Susanville BLM District.

In 1961, the governing boards of the two Soil Conservation Districts agreed to initiate a joint, coordinated land use program covering all public and private lands. They decided to unite in this endeavor because they shared the same problems, objectives, land ownership and grazing rights. All the board members of the Vya Soil Conservation District of Nevada were ranch operators living in the Surprise Valley of California. About 90 percent of the privately owned land in the Vya District belonged to ranch operators from the Surprise Valley.

The Soil Conservation Districts listed the agencies involved in administering the public lands, including BIM, as cooperators who were to assist in the overall planning effort.

The Soil Conservation Districts were adamant about the need for a soil survey: "The district boards firmly believe that the basic determinant to recognizing a potential for the soil resource comes only through a comprehensive soil survey. A full realization of the inner limitations and capabilities of the soil will give a sound basis for planning of future resource development programs."

The Bureau began contributing financial assistance to the soil survey in this area in 1962. The annual BLM contribution was about \$4,500 in 1962 and in 1963. The public land surveyed was in the Home Camp area of the Vya Soil Conservation District.

The correspondence about this event is extremely interesting and enlightening. Major reference items are listed at the end of this chapter.

On June 20, 1963, the presidents of the two Soil Conservation Districts wrote a joint letter to John A. Carwer, Jr., Assistant Secretary, Department of Interior, in which they requested that the \$2,500 budgeted for soil surveys in the Vya SCD be used for one BLM soils technician for Fiscal Years 1964 and 1965. They sent copies of this letter to Senators Bible and Cannon from Nevada; Senators Kuchel and Engle from California; and Representatives Johnson and Baring.

Robert M. Mangen, Deputy Assistant Secretary of the Interior, responded to that letter on July 17, 1963. He referred the request for a soils technician to the BLM State Director of California who is responsible for managing most of the public lands in the Vya Soil Conservation District. Mr. Mangen's letter also hinted of the BLM study on the use of soil surveys by saying "Complete appraisal of the soils study program now in progress is scheduled for this coming fall."

Apparently the California State Director did not commit a soils technician to the soil survey, because in October 1963, the secretaries of the two Soil Conservation Districts wrote a joint letter to Charles Stoddard, Director, BLM, in which they asked: "Would you give us some assurance that BLM will continue to participate in gathering the basic data for this coordinated program, preferably with a trained soils man?"

There was never any assurance given concerning the trained soils man, but the Bureau continued to financially support the soils survey. Between 1962 and 1967, the Bureau contributed \$21,500 toward the soils survey for 1,400,000 acres of public land. That amounts to 1.5 cents per acre, a far smaller figure than the 20 to 24 cents per acre quoted in the staff report.

In 1964, the two Soil Conservation Districts and the Soil Conservation Service issued a "Kange Renewal" project which proposed expenditures of \$5,348,758 to accelerate rehabilitating the range resources. The impetus for this "joint, coordinated land use program" was ELM's adjudication program which was reducing livestock numbers to conform to available forage. Reductions were drastic, with some as high as 75 percent.

The Bureau was not pleased with parts of the range renewal program and thoroughly evaluated it in the Division of Range Management Staff Report 1964-1, "Range Renewal Project - Surprise Valley and Vya Soil Conservation Districts." The range renewal program had not been submitted to the BUM State office or Washington Office for review prior to publication. Only a limited participation by Bureau personnel was possible at the district level because of small staffs and other program commitments. The range renewal program was heavily slanted toward grazing use of the land and failed to indicate the multiple-use relationship of wildlife, watershed, recreation, and other resource management programs.

The report indicated that soil surveys provided the basic information for the plan, yet soil surveys were only completed for 1.1 of the 2.9 million total acres at the time the plan was developed. The report concluded: "SCS should confine its efforts to providing technical assistance on private lands unless otherwise requested."

Two memorandums written in October 1964 and dealing with the range renewal program state that: "Development of plans should not be predicated on the need for soil surveys prior to initiation of intensive management and rehabilitation." In November 1964, that statement became Criterion No. 4 in Instruction Memo 64-55, which was the Bureau's policy on soil surveys for at least a decade. Thus, it would appear the Bureau's experience with the Surprise Valley - Vya Soil Conservation Districts may have been as influential in setting Bureau policy on soil surveys as the results of the pilot studies in Montana, Nevada, and New Mexico. The staff report on use of soil surveys does not identify the location of the study areas any more closely than by state. The pilot study areas were the Powder River Area, Montana; the Tuscorora Mountain Area, Newada; and the Cabezon Area, New Mexico.

In 1964, another study team investigated the cooperation processes regarding the Soil and Water Conservation Districts (Brinser et. al., 1964). Quite likely, the Bureau's experience with the united Surprise Valley and Vya Soil Conservation Districts was partially responsible for this study.

The study team's mission was: (1) to learn the current procedures used to develop soil and water conservation district programs where public lands make up a large part of the total area; (2) to evaluate the effectiveness of these procedures in bringing about a recognition of basic needs and problems; and (3) to consider the program of the several natural resource agencies.

The study team was composed of four members — one from the Soil Conservation Service, one from the BLM, one from a Soil and Water Conservation District, and one from a university.

The study team reviewed the Surprise Valley, Vya, and San Rafael (Utah) Soil Conservation Districts and completed their report on November 1, 1964. Six recommendations grew out of this review which led to stricter guidelines in cooperative agreements, or memorandums of understanding, regarding coordination procedures and methods, service and management responsibilities; and definition of the physical, institutional, and economic environment of any Soil and Water Conservation District.

Recommendation Five suggested that BLM issue a policy statement concerning its position on soil surveys on public domain lands. Probably no study team recommendation has ever been adopted more quickly than that one. On November 2, 1964, one day after the study team signed their report, the Bureau issued its policy on the use of soil surveys, although the study team did not formally present its report to the BLM Director until January 6, 1965.

Cooperation between the Bureau and Soil Conservation Districts began before 1960 on a small scale. The impetus for formalizing cooperative agreements with the Soil Conservation Districts came after February 5, 1963, when the Secretary of Interior, Stewart Udall, announced to the National Association of Soil Conservation Districts that the Department of Interior was prepared to enter into a working agreement with the Soil Conservation Districts to integrate land use programs on Federal lands. On March 27, 1964, Secretary Udall sent a memorandum to the Bureau heads instructing them to enter into agreements with the Soil Conservation Districts and telling them in broad terms how to do so.

Soon after the Bureau entered into formal cooperative agreements with a number of the Soil Conservation Districts, a power struggle began. Instead of greater harmony, the cooperative arrangements seemed to produce friction in some cases.

The main cause of the friction was an unclear understanding of the jurisdictional responsibilites for the public land within the boundaries of a Soil Conservation District. Even though the memorandums of agreement specifically stated that the cooperative agreement shall not be constructed to affect the jurisdiction of the public land which may lie within the boundaries of a Soil Conservation District, some Soil Conservation Districts were apparently overzealous in their mission to develop and implement plans for the conservation and development of the natural resources within their boundaries. There were instances in which the Soil Conservation Disticts installed conservation and development practices on public lands without the Bureau's knowledge. At one time, the Nevada State Conservationist, SCS, proposed that the Soil Conservation Districts take over the administration of the public lands within their boundaries. The sagebrush rebellion apparently is not a new idea in Nevada. The reaction of one BLM staff member to this power struggle was: "As I understand it, the SCS and their districts would like very much to fatten up their program."

Between 1935 and 1940, the Department of Agriculture did indeed have the authority to coordinate and direct all activities relating to soil erosion on public land, as well as on private land, according to the Soil Conservation and Domestic Act of April 27, 1935. However, on June 30, 1940, upon adoption of The Reotganization Plan No. 4, the Department of Agriculture soil conservation operations on Interior lands were transferred to Interior. Thereafter, there should have been no question about who had jurisdiction for implementing soil and water conservation measures on BLM-administered land. The BLM did not come into existence until 1946.

In 1965, it was decided that the Department of Interior could construct soil and water conservation works on land under its jurisdiction that would fully or partially benefit lands not under Interior jurisdiction. This determination was made in Solicitor's Opinion M-36677, February 23, 1965.

The 1940 Reorganization Plan also gave the Department of Interior the right to enter into agreements with any other agency, governmental or otherwise, to accomplish soil and water conservation on the public land. Consequently, cooperative agreements between the BLM and the Soil Conservation District were encouraged, despite the problems some of them had caused in the early 1960's. By 1974, there were 213 such agreements in effect among the ten western states, including: Arizona, 24; California, 11; Colorado, 25; Idaho, 15; Montana, 22; Nevada, 26; New Mexico, 25; Oregon, 25; Utah, 27; and Wyoming, 13, (Lea, 1974). In 1964, the cooperative agreements began including a statement similar to: "It is not proposed that the BLM will work on planning conservation programs on private lands, nor will the BLM surrender its leadership and responsibility for planning and conducting conservation programs of the public lands." Once jurisdictional boundaries were established, true cooperation could take place.

Although the mechanism was present by the mid-1960's for the BLM to develop natural resource management plans, not much was generated because the Bureau did not know the nature, extent, or location of these resources. Furthermore, on November 2, 1964, it set forth the policy that soil survey information was not needed to develop management plans for wildlands. Consequently, there was very little soil survey activity on the public lands in the late 1960's and early 1970's.

The Bureau began to gather some soil inventory information for its Watershed Conservation and Development (WC&D) system for arid and semiarid areas beginning in 1986 (BLM Manual Section 7322). However, the soil inventory system was not tied to the soil taxonomy system and considered only a few soil properties selected to arrive at a measure of potential soil productivity. The selected properties were: effective root depth (ERD), soil texture of the top four inches, and soil texture of the remainder of the ERD.

Effective root depth was defined as the depth where the abundance of roots changed from common to few, or to the depth of a root restricting layer. The deepest allowed ERD was arbitrarily set at 25 inches. Soil texture was classified into five classes: coarse; moderately-fine; and fine. No account was made of the rock fragment content within the ERD, even though this has an important bearing on the water and nutrient supplying capacity of soils.

A highly misleading method of computing the average ERD — the weighted mean computation — was used for areas with a mixture of rock outcrop and a soil. For example, an area of 90 percent rock outcrop with no ERD, and 10 percent soil with an ERD of 25 inches was presented as having an average ERD of 2.5 inches (90 X 0 + 10 X 25) \div 100 = 2.5). That approach is similar to the case in which a person having one foot in scalding water, and the other in ice water, is supposedly comfortable — on the average. This simply illustrates the lack of understanding within the Bureau at that time of the design and definition of mapping units. This lack of understanding was partly responsible for the decision not to require soil surveys, because the soil association used in the Nevada pilot study consisted of unlike soils, and the Bureau did not know how to cope with them.

Few soil pits were dug to measure the ERD and soil texture within each watershed. The minimum size of a sample watershed was 20 square miles (12,800 acres), and it could range up to 400 square miles (256,000 acres). One pit was dug per transect. Each transect was located in an area that represented at least five percent of the total watershed area. They were selected to represent specific conditions within the vegetative subtypes identified in the watershed. Thus, the smallest transect would represent 640 acres for a 12,800 acre watershed (.05 \times 12,800 = 640). The upper limit for a transect area was set at 10,000 acres. Therefore, the number of excavations ranged between one per section to one per 15.6 sections. Few areas in the western states have but one kind of soil in a section. The pacers were instructed to cross drainages and not follow the contour. Soils in drainageways, however, are often different than those on upland positions.

Soil pits were to be dug next to the most vigorous plants "because they provide more roots from which to determine ERD." That instruction was bound to yield biased results in the positive direction. Soil scientists recognize variation among individuals in a taxonomic unit and more realistically give a range of values for things like ERD.

Part of the inventory system for the WC&D program was to measure soil surface factor (SSF), which gave an estimate of the existing erosion condition. The SSF is a number arrived at by observing and measuring, in relative terms, the amount of disturbance of seven items: soil movement, surface litter, surface rock fragments (if present), pedestalling, rills (if present), flow patterns, and gullies (if present). Numerical values for the SSF can range from 0 to 100. The larger the number, the more severe is the erosion. Five condition classes were recognized and defined in terms of the SSF values as: Stable, 0-20; Slight, 21-40; Moderate, 41-60; Critical, 61-80; and Severe, 81-100.

The SSF method unfortunately does not differentiate between geologic erosion and accelerated erosion, and therefore is of little value as a management tool for giving guidance in selecting land use or erosion reduction practices. The National Cooperative Soil Survey uses a method to evaluate accelerated erosion based on comparing the amounts of truncation and channelling on eroded soil with that on the same kind of soil for areas that have not been affected by accelerated erosion. It also identifies five degrees or classes of erosion: none, slightly, moderate, severe, and very severe. Many areas that are measured as being in critical or severe condition by the SSF method are in the none or slight accelerated erosion classes of the National Cooperative Soil Survey system. The National Cooperative Soil Survey soil erosion classes are conventional phase criteria for the definition of soil mapping units where considered significant.

The National Resource Defense Council was critical of the extent of the public land administered by the Bureau that is in critical and severe erosion condition (Flanery, 1978). Had the Bureau been using a method of evaluating only accelerated erosion, the results would not have appeared as negative.

In addition to evaluating existing SSF for the WC6D inventory, the evaluator was also called upon to estimate three kinds of future SSF, including: (1) the SSF in 15 years without any changes in use or management; (2) the SSF in 15 years if improved management practices were initiated today; and (3) the SSF in 15 years if additional treatments were also applied today. There is so much crystal-ball gazing involved in this method that it is literally an exercise in futility. A more objective approach for making such predictions would be the Universal Soil Loss Equation involving all the factors affecting erosion by water, including the amount of soil cover (from vegetation, rock fragments, and litter) and conservation treatments or practices. Also, it would consider the erodibility of each kind of soil and include a tolerance factor, or average annual soil loss that can be tolerated without suffering irreparable damage to the soil or off-site areas.

In summary, the soils information gathered by the WC&D inventory system did little to increase the Bureau's knowledge about the location, extent, and nature of the soils on the public lands. This effort continued from about 1968 until about 1978. A number of environmental statements have been written with so-called existing data on the soil resources for the area. Unfortunately, most of that data is not very reliable or meaningful.

Around 1970, things began to happen that eventually led to a reversal of the Bureau's policy concerning the need for soil surveys. Passage and approval by Congress of the National Environmental Policy Act (NEPA) in 1969 was instrumental in bringing about this policy reversal, although the time lag before the adoption of a favorable policy on soil surveys was at least seven years.

NEPA declared a national policy to promote efforts to prevent or eliminate damage to the environment, and to enrich the understanding of the ecological systems and natural resources. All Federal agencies were mandated to use a systematic, interdisciplinary approach in planning and decision making, and were instructed to prepare a detailed environmental impact statement for any proposed action significantly affecting environmental quality. It established a Council of Environmental Quality, which monitors the current and foreseeable trends in the quality of the environment and the various natural resources.

The requirements for a systematic interdisciplinary approach to planning and for environmental impact statements were key factors that eventually led to a policy favoring soil surveys of Bureau-administered land.

In the early 1970's, the Bureau developed a comprehensive and systematic approach to multiple-use and activity planning, which was released between 1973 and 1975 as BLM Manual Sections 1601 through 1609. The planning system, however, did not require soil surveys. A key element of the planning system is the Unit Resource Analysis (URA), which describes the current situation and potential development opportunities for realty transactions, minerals, timber, livestock forage, watershed, wildlife habitat, and recreation. A knowledge of the nature, location, and extent of soils is basic to a determination of the existing and

potential development opportunities for most of these land uses. Yet, Manual Section 1605.1B (Unit Resource Analysis) states: "The URA is not intended to be an original inventory for any resource. It is based upon existing resource inventories. However, it may be necessary to obtain additional basic inventory data for completion of a URA to have a relatively comparable data base for all resources. This should not require any major inventory effort, but should be limited to filling important inventory gaps. Where quantifiable data are lacking, professional estimates should be made based on the best knowledge available. These data must be identified as estimates with limitations of use."

What good is it to use an elaborate planning system if it does not demand accurate, objective data as its foundation? As the automatic data processers say, "Garbage in - garbage out."

A court case in 1974 finally made the Bureau realize that a standard soil survey was a necessary prerequisite for its planning and management processes. The Natural Resources Defense Council, Inc. (NRDC) accused the BLM of not abiding by the requirements of the National Environmental Policy Act (NEPA) on the grazing land it administers. On December 30, 1974, the U.S. District Court for the District of Columbia issued a judgment that the BLM was required by Section 102 (2) of NRPA to prepare environmental impact statements (EIS) discussing in detail the environmental effects of livestock grazing, and alternatives thereto, on specific areas of the public lands under BLM jurisdiction. NRDC and the BLM agreed upon a schedule for preparing the environmental impact statements on April 11, 1975, and the court supplemented its earlier judgment with this agreement on June 18, 1975 (Dose, 1976; Turcott, 1976).

The schedule provided for the completion of one EIS to serve as a model for subsequent statements by the end of the fiscal year 1976, and for the completion of ten additional EIS's by the end of fiscal year 1977. The BLM did not meet these deadlines. Although it requested and received two time extensions to prepare the model statement on the Challis, Idaho, Planning Unit, the BLM conceded that the final version was inadequate as late as September 1977. None of the statements scheduled for 1977 were issued on time.

On September 1, 1977, the BLM filed its third delay notice for preparing the EISs. The hearing for this was held on January 13, 1978. BLM argued that the existing resource data concerning the lands was insufficient and additional time was needed to gather new information. Here we can see that the Bureau was finally beginning to realize that it was operating on an insufficient resource data base. The court did amend the EIS schedule on April 14, 1978, but the amendment was based on an NRDC compromise proposal rather than on BLM's proposed schedule (Flanery, 1978).

The Bureau's experience with the Challis Area model EIS revealed a deficiency in basic inventory information by early 1977. On January 27, 1977, the BLM Associate Director wrote a memorandum to the Assistant Director, Resources, in which he stated: "The Bureau has recently committed itself to the gathering of baseline soils and vegetation data

now lacking and deemed necessary for range management planning, preparation of environment statements and the basic inventory to implement the Organic Act," (Turcott, 1977). Resources was assigned the responsibility for developing and implementing the inventory procedures by the beginning of the 1977 field season.

A team of resource specialists was quickly formed and began working on February 7, 1977, to develop a site inventory procedure. By May 1977, the team had developed the Site Inventory Method (SIM). On May 17, 1977, Instruction Memo No. 77-262 was issued to the State Directors and District Managers, informing them that SIM had been approved by the Director and that it will be used in conducting soil and vegetation inventories beginning in FY 1978. It was recommended that Wyoming and New Mexico consider using SIM in 1977.

SIM called for mapping soils at the third order of intensity, with mapping units defined in terms of phases of soil series. The base map had a scale of 1:24,000. These standards prevail today and generally meet BLM resource management objectives in grazing areas. SIM required a detailed sampling of the vegetation in every site area. There were major changes in the vegetation inventory procedures after 1977.

Nevada proposed that the soil survey mapping units be phases of soil families instead of soil series for the SIM inventory (Rowland 1977; 1978). This proposal was not accepted primarily on the basis that such a method would not permit the transfer of soil survey interpretations from place to place (Petty, 1978). The National Cooperative Soil Survey procedures do not allow for correlation above the soil series level.

A SIM-Vegetation Allocation Review Task Force made a complete analysis of the Site Inventory Method in the fall of 1977 (Lieurance, 1977). The task force report recommeded that the basic soil and vegetation mapping units should be defined in terms of phases of soil series, and potential and existing vegetation communities. It also recommended the Bureau adopt the Ecological Site Classification procedure as outlined in USDA, SCS National Range Handbook-1, July 13, 1976, with modifications and additions necessary to meet BLM multiple-use responsibilities. Proposals were also made to simplify the vegetation sampling procedure, and to reduce the number of transects by a stratification technique.

The task force also estimated the cost of doing the soil and vegetation inventories by three alternative methods. The soil survey cost was estimated at \$0.50 per acre regardless of the alternative, because the alternatives dealt with differences in the intensity of data collection for the vegetation. The cost of the vegetation survey ranged from \$0.13 per acre to \$0.64 per acre, with \$0.31 per acre being the cost that eventually was adopted in 1978.

In early 1978, the Site Inventory Method (SIM) was revised and renamed the Soil-Vegetation Inventory Method (SVIM) (Turcott, 1978). On July 31, 1978, Instruction Memo No. 78-406 was issued to all field offices notifying them that SVIM had been approved by the Director for use in conducting basic soil and vegetation inventories on public land (Petty, 1978). It also said that a Manual section on SVIM was being developed, and that all new soil and vegetation inventories should follow the SVIM procedures. The Soil Vegetation Inventory Method was issued as Manual Section 4412.14 on August 10, 1979, although draft copies were issued on May 3, 1978, for field use and testing.

The Organic Act, mentioned above in the Associate Director's memo of January 27, 1977, is also commonly referred to as FLPMA, "The Federal Land Policy and Management Act" of 1976 (U.S. Congress, 1976). It established Bureau policy regarding multiple-use planning and management, the use of the basis of sustained yield, and several other issues. Most significant to soil surveys, it stipulated in Section 102(a)(2) that: "The national interest will be best realized if the public lands and their resources are periodically and systematically inventoried and their present and future use is projected through a land use planning process coordinated with other Federal and state planning efforts." That could be interpreted to mean the soil on all the public lands administered by the Bureau will have to be surveyed, including those that were bypassed for the EIS areas that relied on existing soils data which did not come from a systematic soil survey.

Procedures and standards for the Bureau's soil survey program were formalized on May 8, 1978, when the BLM and Soil Conservation Service administrators signed the "Meomorandum of Understanding between the Bureau of Land Management and the Soil Conservation Service, Relative to The Making of Soil Surveys on Lands Administered by the Bureau of Land Management." This occurred 14 years after it was first proposed by the task force that evaluated the use of soil surveys by the Bureau in 1964. The Bureau was perhaps the last Federal agency with public land administration responsibilities to enter into a cooperative agreement at the national level with the Soil Conservation Service on the matter of making soil surveys.

The memorandum of understanding specifically states: "Soil surveys on public lands administered by the Bureau will meet the technical standards of the National Cooperative Soil Survey." It also stipulates that a cooperative soil survey work plan following National Cooperative Soil Survey guidelines will be developed for each area containing public lands administered by the Bureau for which a soil survey is to be made. Since FLPM requires periodic and systematic resource inventories on all public lands administered by the Bureau, eventually the soils on all the lands will be surveyed according to these standards. Field offices are currently completing the cooperative soil survey wro plans (now called memorandums of understanding for specific soil survey areas), where they do not already exist.

The national-level memorandum of understanding gives the Bureau major responsibility for initiating and conducting soil surveys in areas of predominantly public lands administered by the Bureau. In those areas, the Bureau will take the <u>leadership</u> to ensure that the specific provisions of the soil survey work plan are carried out, such as field reviews for quality control, preparation of descriptive legends, data collection for needed soil interpretations, and report preparation.

This responsibility carries with it the need for a cadre of wellqualified soil scientists capable of performing those tasks according to the National Cooperative Soil Survey (NCSS) standards. The Bureau does not have that cadre in most states at the present time. Consequently, it is entering into interagency agreements with the Soil Conservation Service, and in some states, contracting with private consulting firms to perform these tasks. In other words, the Bureau is relinquishing some of its leadership responsibilities for the conduct of soil surveys. This is due to personnel ceilings imposed by the Office of Management and Budget (OMB), and to the crash program to prepare quality soil surveys to meet the Grazing Land EIS schedule. Many BLM districts had no soil scientists before 1976; some have none today. Furthermore, it takes a well-experienced, highly trained GS-11 Soil Scientist to carry out these leadership responsibilities. Many times, the first soil scientist to be employed by a district office does not have these qualifications and capabilities. Without on-the-job training under the supervision of a qualified person, he will seldom ever acquire these qualifications and capabilities.

The Bureau has reserved the right to develop, use, and publish any soil survey interpretations it decides are significant to the management of the public lands in the national-level memorandum of understanding. The 1964 task force, which studied the use of soil surveys by the Bureau, also made that recommendation. This is a precious privilege and needs to be put into practice. It takes time, effort, and money to establish criteria that are significant to specific land use and treatment practices. It takes teamwork, in which the soil scientists work with the other natural resource specialists. It takes a training program to teach land managers the meaning and utility of the interpretations. It takes coordinaton betweeen states and districts to ensure that the same standards and criteria are applied for a specific applied objective on a specific kind of soil no matter where that soil occurs. It also takes compromise, good judgment, and experience, research, and studies. An agency named "Bureau of Land Management" is obligated to follow through on the generation and application of soil survey interpretations that will facilitate its charge to manage all the resources on the land under its jurisdiction for the greatest benefit of mankind on a sustained yield basis. By not generating meaningful soil survey interpretations, much of the time, money, and effort spent on soil surveys will be wasted!

The NCSS standards leave no doubt about the need to publish soil survey data. Soil survey information can be useful to many groups and individuals outside the Bureau if it is in an eastly accessible form

and in a format that allows for speedy retrieval of items of particular interest to the user. Since the national-level memorandum of understanding allows flexibility in publication format, the Bureau should devote considerable time and effort to developing soil survey publication formats that will make their contents readily available to natural resource managers and other users. Soil surveys are reference-type documents. In developing soil survey publications that are easy to use, caution must be exercised to avoid making them too simple and brief.

The Bureau does not have a central holding place for soil survey reports at either the Denver Service Center or the Washington Office at this time. This severely hampered the progress of this report, especially when evaluating the relative quality of soil surveys prepared by different groups (private contractors, SCS, BLM in-house). Many of the soil survey reports by private contractors are available in the Denver Service Center, but the soil map is missing and available only in the pertinent BLM district office. It is hoped that in the future these soil surveys will be published. At that time, both the Washington Office and the Denver Service Center should be depositories for those publications. Some of the soil surveys published by the Bureau in Oregon are in the Department of Interior Library, others are not. A library with holdings of a million items is not very useful when the one item you want is not there. A soil survey report without the soil map has little utility.

The training of Bureau soil scientists by the SCS is provided for in the memorandum of understanding in the form of scheduled workshops. Although the type of training obtained at workshops is valuable, especially to those who have had some field experience and have come upon problems they could not solve themselves, it is no substitute for onthe-job training under the supervision of a highly qualified soil scientist. The Bureau must recognize that it cannot expect a newly appointed, inexperienced GS-5 or -7 level soil scientist, working alone, to handle the responsibilities of maintaining the National Cooperative Soil Survey standards. Also, it takes more than one year of such training to gain that level of proficiency in most cases.

Presently, the Bureau is on a well-defined course for making soil surveys. But, it is suffering the pangs of a new birth and rapid growth. The responsibilities and obligations outlined in the national-level memorandum of understanding for making soil surveys are apparently not completely understood by the administration.

Corrective measures are already being taken to overcome many of the problems associated with the Bureau's gigantic soil survey program, which is working under a new set of rules. The rules are good and will result in a worthy product if they are adhered to. It is doubtful that the Bureau will have to change the rules in the middle of the soil survey program as it tends to do for other activities. The Bureau should recognize that "Maste makes waste"; the adage "The Bureau never

has enough money to do it right the first time, but always finds money to do it over again" comes from within the Bureau and not from without. Nevertheless, those outside the Bureau are concerned about the efficient use of taxes they pay to support Federal programs.

One cannot properly manage the natural resources supported by the numerous and varied soils without knowing where they occur, and what their capabilities and limitations are for a host of alternative uses. The soil surveys being prepared by the BLM according to the NCSS standards will provide this information.

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 History of the Bureau's Soil Science Program in the Washington Office, Portland and Denver Service Centers, and the Western States.

The BLM has been legally responsible for conserving and managing the soils on the public lands under its jurisdiction since its establishment in 1946 when it was formed by the merging of the Taylor Grazing Service, the General Land Office, and the Oregon and California (O&C) Administration (Clawson, 1951). The Taylor Grazing Act was passed in 1934 primarily to halt the soils and vegetation damage on the public domain rangeland that was brought about by years of overgrazing. The O&C Act, passed in 1937, established a Federal agency to manage railroad grant lands that had reverted back to the Federal Government. It was one of the first national laws to require multiple-yield production of the renewable resources. Thus, the need for soil science principles and practices by those responsible for managing the public lands goes back to 1934 for the public domain grazing lands, and to 1937 for the O&C lands.

The application of those soil science principles and practices to management of the public lands administered by the BLM did not begin until at least a decade after the Bureaui's formation, and then only on a very limited basis. An appreciation of soil science for resource planning and management programs evolved slowly and sporadically within the Bureau.

For the first 10 to 15 years after the Bureau was created, the major emphasis was on developing a more favorable balance between the carrying capacity of the grazing land and its actual use by grazing animals to halt the deterioration of these lands (Gregg, 1979). This process, called "adjudication," involved preliminary field evaluation of the existing carrying capacity of the land. The persons making this field determination noticed that special soil and water conservation practices were necessary for some of the badly deteriorated lands. Consequently, by the late 1950's the Bureau began employing watershed specialists to assist in applying soil and water conservation practices. At the Washington Office, the BLM recognized the significance of soil science and in the late 1950's, created a Soil and Moisture Staff, which became the Soil and Watershed Staff in the Division of Resource Management in the early 1960's. The Division of Watershed was established around 1970, and "Soil" was removed from the name of all BLM offices. There were no soil scientists on any staffs in the Washington Office until 1975. However, the Chiefs of the Soil and Moisture Staff, Soil and Watershed Staff, and the Division of Watershed were always assigned the professional title of "Soil Conservationist."

A few state and district offices began to employ soil scientists in the early 1960's. New Mexico hired one in 1961; Colorado, in 1965. The Portland and Denver Service Centers also received their first soil scientist position in 1965. Other states added soil scientist positions in the late 1960's, and early 1970's and Utah, in 1978, was the last state to employ soil scientists.

The application of soil science to the BLM's management program for its grazing lands suffered a severe set-back on November 2, 1964, when a formal policy was issued deemphasizing the need for soil survey information in developing rangeland management programs. That policy was strongly adhered to for at least five years. It gradually dissipated in the early 1970's as a result of the National Environmental Policy Act (NEPA) in 1969, and a growing awareness of environmental Policy Act (NEPA) in 1969, and a growing awareness of environmental Policy and Management Act (FLPMA) of 1976 also emphasized the need for soil and other natural resource inventories for the BLM's planning and management systems, and, in essence, killed the November 2, 1964 anti-soil survey policy. Finally, on May 8, 1978, the Bureau agreed to make soil survey saccording to National Cooperative Soil Survey's standards.

Thus, 32 years passed before the BLM officially agreed on a proven and systematic approach to collect the soils data base required to meet its responsibility to conserve the soil resources. The time planned for acquiring the soils data base is much shorter — about 10 years, except for Alaska. The major impetus for this accelerated pace of data collection was a suit brought by the Natural Resource Defense Council against the BLM in 1974 (Flanery, 1978). The application of the soil science data base to the Bureau's multiple—use management system will never end.

The evolution of the BLM's soil science program is summarized below by major office. Much of this historical information was supplied by the prior and existing soil scientists assigned to those offices. Ron Kuhlman, a non-soil scientist, and Lee deMoulin, who coordinated the soil science program from within the Division of Watershed between 1966 and September 30, 1979, supplied most of the information for the W.O. level.

Washington Office

The Bureau made little use of soils information in its resource management programs during the first 20 years of its existence. What little application of soil science that was made prior to 1966 was largely administered at the local state and district levels. A Soil and Watershed Staff in the Division of Resource Program Management in the early 1960's probably coordinated the soil management and watershed protection activities at the national level at that time.

In August 1966, Ronald L. Kuhlman joined the Division of Watershed and assumed responsibility for coordinating the Bureau's soil science program at the national level. Mr. Kuhlman, a hydrologist, was employed

by the Soil Conservation Service at the Western Technical Service Center, Portland, Oregon, before joining the BLM. A year earlier, the Bureau had hired soil scientists at the Portland and Denver Service Centers, who began preparing BLM Manual Sections for soil management. the time Mr. Kuhlman arrived, the manuals were ready to be approved and distributed. Mr. Kuhlman began providing technical soils input into the planning and management needs for rangeland, forestry, wildlife, recreation, and minerals, and convinced the representatives of these activities of the role of soil information in their programs. He was also responsible for getting the soil budget justification assembled and into the annual work plan, and established cooperative efforts with the SCS in relation to soil surveys. Once established, he represented the BLM at the National Cooperative Soil Survey biennial meetings, coordinated the soils function in the planning system at the Washington level, and made sure that soil scientists were involved in the Energy and Minerals Rehabilitation Inventory Analysis (EMRIA) program in the mid-1970's.

In August 1974, Mr. Kuhlman transferred to the Denver Service Center to head the newly formed EMRIA group. He was replaced in the Division of Watershed by LeRoy deMoulin about a year later. Mr. deMoulin, the first soil scientist to coordinate the soil science activities at the national level, continued most of the functions Mr. Kuhlman had developed for the soil science program.

Mr. Kuhlman returned to the Washington Office in late 1976 to head the Division of Watershed, and the next year in August Mr. deMoulin was transferred, at his request, to the Denver Service Center, Division of Standards and Technology, Watershed staff. Upon Mr. deMoulin's departure from Washington, Mr. Kuhlman resumed the coordination functions for the Bureau's soil science program until September 30, 1979. On October 1, 1979, the coordination functions of the soil science program were transferred to the Division of Rangeland Management. Since then, James Hancock, Watershed Specialist, has coordinated the soil science program at the Washington level, although Mr. Kuhlman is still lending moral support to the program. Mr. Kuhlman headed the Water Resources Policy Staff after the reorganization which dissolved the Division of Watershed.

Mr. Jack Chugg, Soil Scientist, Division of Resource Inventory Systems at the Denver Service Center was also delegated major responsibilies for soil survey planning and technical services activities following the demise of the Division of Watershed in the Washington Office. In April 1980, Mr. Chugg filled a recently created CS-14 Soil Scientist position in the Branch of Rangeland Policy and Program Development, Division of Rangeland Management, to coordinate the Bureau's soil science program at the national level. Mr. Chugg is the only BLM soil scientist in the Washington Office. The Bureau can never be accused of being top-heavy with soil scientists.

Mr. Kuhlman's last two years with the soil survey program led to two achievements that will have a lasting impact on the Bureau's soil survey program. He was a leading force behind the May 8, 1978, memorandum of understanding between the BLM and SCS for making soil surveys according to National Cooperative Soil Survey's standards. He also coordinated the development of a memorandum of understanding with the SCS for a soil correlator's position to facilitate the soil correlation process for the BLM soil surveys. That position is filled by Mr. Richard Dierking at the SCS, Western Technical Service Center, in Portland, Oregon.

During his last year of direct involvement with the soil survey program, Mr. Kuhlman also arranged for my appointment to a half-time, temporary position under the Intergovernmental Personnel Act to study the BLM's soil survey program. Whether or not that action will have any lasting effects remains to be seen.

One other national-level soil scientist with the Bureau is Alan E. Amen, who joined the Special Projects Environmental Impact Team (SPEIT) in November 1979. Although SPEIT is a Washington Office group, it is located in Lakewood, Colorado. Mr. Amen was a soil scientist with the Soil Conservation Service prior to his appointment with the BLM, and served as party chief for the soil survey of Jefferson County, Colorado, which includes the Lakewood area, at the time he left the SCS.

The Portland and Denver Service Centers

Soil scientist positions were established at the Portland Service Center and Denver Service Center in 1965 as a result of a task force study in 1964 (Luscher) on the use of soil surveys by the Bureau. One of the task force recommendations was to secure a Washington Office soil scientist to initially formulate procedures for using soil information for training, and for liaison with cooperating agencies, and to determine needs and priorities for soil surveys. The decision was made to have soil scientists at each of the Service Centers instead of one at the Washington Office.

James S. Hagihara was the first soil scientist at the Portland Service Center. He began that position in June 1965 in the Watershed Staff and remained there until December 1971, about the time the Portland Service Center was abolished. In November 1965, Lyle D. Linnell was appointed as soil scientist in the Watershed Staff at the Denver Service Center and held that position until September 1973 when he became the first State Office soil scientist in Alaska.

The two new soil scientists were responsible for developing and improving procedural directives, guidelines, and manuals for the Bureau's soil management program. They were instrumental in coordinating the soil survey program with the SCS, training, and evaluating the soil management program. Mr. Hagihara took leadership responsibilities for developing Manual Sections 7312.2, Soil Inventory Procedures; 7160, Soil Management Policy; 7161, Soil Inventories and Surveys; 7162, Soil Interpretations; and 7312.2, Soil Management Interpretations. These manuals, released in 1968 and 1969, have subsequently been revised and modified.

Mr. Hagihara began his career as a soil scientist with the Soil Conservation Service in Oakley, Kansas, in May 1956 and Joined the Bureau in October 1960 in the Nevada State Office as a realty specialist. He moved to the Las Vegas District Office in April 1962, serving first as a realty specialist and two years later, as an Area Manager. He was appointed the first soil scientist in the Portland Service Center in June 1965 and remained in that position for six years before becoming Chief of the Resource Planning Branch, California Desert Planning Staff, in December 1971. After Mr. Linnell left the Denver Service Center in September 1973, Mr. Hagihara took his place in the Watershed Staff of the Division of Standards and Technology. He remained in that position until March 1977, when he became a research management coordinator for the BLM with the interagency Research Evaluation Technics (RET) group at Fort Collins, Colorado. He is presently in that position.

After the Portland Service Center was abolished in 1971, and until the Fall of 1974, there was only one soil scientist above the State Office level to coordinate the BLM's soil science program. Mr. Linnell held that position from 1971 to 1973; and Mr. Hagihara, from 1973 to the end of 1974. As mentioned earlier, the Bureau has never been top-heavy with soil scientists.

Starting in 1974, the Denver Service Center began to expand its expertise in the area of soil science in the Division of Standards and Technology. In October 1974, the number of soil scientists at the Denver Service Center was doubled, with the appointment of Jack Chugg to the EMRIA staff. The EMRIA program was a major impetus to the BLM's soil survey program since Mr. Chugg and Mr. Kuhlman realized the need for soils information for the reclamation of mined areas.

Before joining the BLM, Mr. Chugg had 20 years of experience with soil surveys. He began his career with the Soil Conservation Service in 1954 on the Gem County, Idaho, Soil Survey and worked on soil surveys in seven counties in Idaho before transferring to New Mexico in 1962. Small tracts of public land administered by the BLM were included in many of these soil surveys, without any reimbursement from the BLM. Rangeland soils were correlated with their potential native plant communities or range sites. While in New Mexico he was party chief and area soil scientist for the soil surveys in the southeastern part of the state, where relatively large tracts of public lands were commonly included in the progressive soil surveys.

In 1966, Mr. Chugg resigned from the SCS in New Mexico, and took a position as Associate Soil Scientist with the University of Idaho at Moscow. He was project leader for general soil surveys in 15 counties in southern Idaho in cooperation with the SCS and the Idaho Water Resource Board. In 1967, the BLM approached the University of Idaho for a reconnaissance soil and vegetation survey in the Owyhee County Area of the Boise District. Mr. Hagihara, Portland Service Center, negotiated a contract for \$7,800 with the Department of Blochemistry and Soils for part of this survey. The soil and vegetation survey was published in 1968 by the Idaho Agricultural Experiment Station and Soil Conservation Service in cooperation with the Idaho Water Resource Board. Upon completion of the general soil survey project by the University of Idaho in 1969, Mr. Chugg returned to the SCS and became soil survey party Leader in the five northern counties of Idaho. He remained there until his appointment with the ELM in October 1974.

While with the EMRIA Staff, Mr. Chugg assisted in assessing soils for the reclamation of surface-mined lands administered by the Bureau. Initially, the BLM entered into interagency agreements with the Bureau of Reclamation for site specific soil studies, ranging in size from 2,400 to 20,000 acres with potential for coal mining. The survey areas were in Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming. Most of the studies were single-purpose surveys designed to show the suitability of the soil overburden for topsoil or as a medium for plant growth. A few were conventional soil surveys with mapping units defined in terms of soil phases of soil series.

Starting in 1975, the Bureau entered into a number of interagency agreements with the Soil Conservation Service for third-order soil surveys of selected areas or counties of concern to the Bureau's energy development program. These interagency agreements for soil surveys with the SCS were also for areas in Colorado, Montana, New Mexico, Utah, and Wyoming. Funds for these agreements came from the energy accounts instead of the usual watershed accounts, and ranged from about \$25,000 to \$45,000 per state per year.

The states were encouraged to enter into separate contractual arrangements with the Agricultural Experiment Stations for the Laboratory support phase of the soil surveys. Some of the Laboratory analyses were also performed at the National Soil Survey Laboratory at Lincoln, Nebraska, under an interagency agreement with the SCS. Agricultural Experiment Stations that entered into contracts with the BLM include: Colorado, Montana, New Mexico, Utah, and Idaho. The contract with Colorado's Agricultural Experiment Station was for \$30,000 and included a determination of toxic elements.

In the mid-1970's the Bureau's EMRIA program also partially supported a research project under the leadership of the Science and Education Administration (SEA), U.S. Department of Agriculture Experimental Station at Mandan, North Dakota. The project was to develop a standard

set of laboratory and field procedures for the characterization of disturbed soils and overburden. The results of this cooperative endeavor were published in USDA Agricultural Handbook 525 in 1978. The Soil Conservation Service used the results of this project in developing new criteria to interpret soils for the reclamation or reconstruction of drastically disturbed areas and for a redefinition of topsoil, and incorporated these into the National Soils Handbook in 1978.

No accurate record is available of either the acres surveyed or the dollars spent on soil surveys under the EMRIA program, but the amount is substantial. Much of the soil survey progress in Wyoming came from these funds.

On October 26, 1975, the size of the soil scientist staff at Denver was once again increased. On that date, Dr. Gary Madenford began his appointment on the Colorado Salinity Team of the Division of Science and Technology. The Bureau is involved in an interagency effort to develop means for controlling the salinity levels of the Colorado River throughout its course to the Mexican border. Considerable public land, administered by the Bureau, is in the upper Colorado River Basin. Some of the soils, such as those from the Mancos Shale Formation, are important contributors of salts.

Dr. Madenford also assisted in the Big Sandy Soil Survey in Wyoming while at Denwer. In 1976 and for the first half of 1977, he was primarily involved in reviewing the adequacy of soil surveys for environmental impact studies. He left the Denwer Service Center to become the Idaho State Office soil scientist in June 1977. The soil scientist position on the Colorado Salinity Team was not filled after Dr. Madenford's departure.

Mr. Hagthera left the Watershed staff in March 1977, and Mr. Chugs transferred from the EMRIA Staff to the Watershed Staff to fill the vacated position. After Mr. Hagthara and Dr. Madenford left, the sole source of coordination and technical service for the BLM's soil science program at the Denver Service Center was Mr. Chugg.

That situation was temporary, however, for in August 1977, Lee deMoulin transferred to the Watershed Staff at Denver from the Division of Watershed in Washington. There were then two soil scientists in the Watershed Staff at Denver, but none at Washington because Mr. deMoulin apparently brought that postion with him. Mr. deMoulin developed outlines for Manual Sections on soil survey, classification, and interpretation; prepared outlines for soil survey training courses, maintained liason with the SCS; assisted in soil survey field reviews; and initiated an audio-visual training module for the use of soil survey information by the BLM's natural resource management programs. Mr. deMoulin resigned from the BLM in February 1979 to become a soil scientist with the Office of Surface Mining, Reclamation and Enforcement, in Washington, D.C.

Shortly after the EMRIA program spurred the BLM's soil survey program in areas with potential for mining coal and oil shale, an event took place that will eventually lead to a soil survey of all the grazing public lands administered by the Bureau in the western states. That was the decision requiring an environmental impact statement for each of the grazing area planning units. Consequently, it would be necessary to know the present and potential soils' productivity and their capabilities and limitations for wildlife habitat, outdoor recreational use, water—shed protection, and other uses. The Denver Service Center Range and Watershed Staffs played a key role in developing methods for conducting the inventory of the soils and the vegetation on the public lands.

In December 1976, Acting Director George T. Turcott directed the Denver Service Center to develop a soil and vegetation inventory procedure for the allocation of vegetation among such uses as domestic livestock, wildlife, and wild horses and burros, and for watershed protection and recreation. In January 1977, a team was formed to develop the inventory procedures. The team leader was Dr. Floyd Kinsinger, a range scientist. Jack Chugg was the soil scientist. Other team members were John Baker, Range Scientist; Merle DeSpain, Range Conservationist; Ronnie Clark, Natural Resource Specialist; Richard Kerr, Wildlife Biologist; and the late Kenneth Brown, Biologist. Other specialists from the Service Center were resource consultants.

The team was given 60 days to produce procedures to inventory the soils and the vegetation. After evaluating alternative procedures, the team decided to adopt the methods used by the SCS for mapping soils and for determining the range sites or potential plant communities. It adopted the BLM and Forest Service techniques for mapping and sampling the present plant community. A draft BLM Manual Section of the proposed procedures was prepared for peer review by late February 1977.

The procedures were reviewed and field tested in Arizona in March 1977. Representatives from the BIM, SCS, Forest Service, and the University of Arizona participated in the field test, which was conducted on the Santa Rita Experimental Range near Green Valley, Arizona. The basic concepts of the procedures for mapping the soils and vegetation and for sampling the vegetation were generally accepted by the reviewers.

The inventory procedure was named the Site Inventory Method (SIM). The draft BIM Manual Section was revised after the field test. In April 1977, the SIM team held a training session for about 60 BIM employees at Salt Lake City at a field training area located about 60 miles west of Salt Lake City. The Site Inventory Method encompassed mapping soils as phases of soil series and determining the range site, or potential native plant community, for each soil phase. Existing vegetation communities were also mapped, and allotment boundaries were delineated because the data was to be used for the vegetation allocation by

allotment. Each delineation was called a site writeup area (SWA). SIM called for sampling the vegetation by a prescribed transecting method in every SWA.

After the April 1977 training session, it was decided that SIM would be used during the 1977 field season in the Worland District of Wyoming and the Las Cruces District of New Mexico. As a result of these two trials, it was found that the principal problems were the training of field crews in the procedures and the high cost of the procedure (about \$2.10 per acre). The cost was determined to be excessive and it was necessary to revise the procedure.

In the summer of 1977, the Nevada BLM State Office requested that the soil mapping units in SIM be defined in terms of phases of soil families instead of phases of soil series. The request for this modification was based on arguments of reduced costs without significantly sacrificing quality. To study the matter, BLM and SCS representatives met in Ely, Nevada, in October 1977. Representatives from the Soil Conservation Service included: Klaus Flach, Assistant Administrator for Soil Survey; Victor Link, Director, Soil Survey Operations; Edmund Nathan, Nevada State Soil Scientist; Thomas Shiflet, Director, Ecological Sciences and Technology; and Donald Pendleton, Chief Range Conservationist. BLM representatives were: Ronald Kuhlman and James Hancock from the Washington Office, and Dr. Kinsinger, John Baker, Merle DeSpain, and Jack Chugg from the Denver Service Center.

The participants at this meeting decided that soil series were required in defining the soil map units since the soil survey interpretative data are made, compiled, and stored for that level, and are not developed or recorded at the family level of categorical generalization. Thus, soil survey data collected at the soil series level is transferable, whereas it is not transferable when collected at the soil family level. In February 1978, at the Western Regional National Cooperative Soil Survey Conference, the question of using soil families for defining soil map units for BLM soil surveys came up again. Dr. Flach ended the debate by proclaiming that the SCS would not correlate soils at any level above soil series. Since the BLM was about to commit itself to making soil surveys according to NCCS standards (in May 1978), Nevada lost its case. On June 8, 1978, the BLM Director notified the Nevada State Director that: "Phases of series will be the dominant taxon. Mapping at the phases of families will be limited to small areas where it is not feasible to map at the series level."

To investigate the problem of high costs for the 1977 Site Inventory Method and to develop a modified procedure, the Director appointed a task force in late 1977. The task force was headed by Maxwell T. Lieurance, Chief, Division of Rangeland Management, and team members included: John Boyles, Rex Cleary, James Hancock, Larry Woodard, Gerald Magnuson, Chadwick McBurney, Keith Norris, and Marlyn Jones.

The task force submitted a 20-page report to the Director on December 1, 1977, entitled "Task Force Report on Assessment and Recommendations Concerning Vegetation Allocation, Site Inventory Method (SIM) and Baseline Inventory Procedures." It recommended altering SIM by "Stratifying the inventory for site writeup areas (group SWA's into strata)," thus implying that not all the SWA's would be sampled, which would reduce the time and cost requirements. The development of specific methodology was left up to the Bureau's technical staffs. Soil map units were to continue to be defined as phases of series.

The original Denver Service Center team that had developed SIM was assigned the task of revising it according to the task force recommendations. Again they were told to move fast. The revision was called Soil-Vegetation Inventory Method (SVIM), and included stratification of the SWA's on the basis of range sites. It estimated condition class and called for sampling of a minimum of two SWA's in each stratum. Instruction Memorandum 78-406, dated March 11, 1978, made SVIM operational, and on August 10, 1979, SVIM was issued as BLM Manual Section 4412.14. Some portions of SVIM have met with resistance from the field offices after being put to test, and some of the requests for modification of the procedures have been granted by the Washington Offices.

A tremendous amount of data is generated by the vegetation sampling phase of SVIM. Much of the data will be processed with the computer facilities at the Denver Service Center, and a program has been developed to assist with the forage allocation process. The potential is tremendous for learning a great deal about the existing productivity of the soils on over 170 million acres of public land. The scope of the data base, along with short-term deadlines, has caused some problems with data processing, but these problems are currently being overcome.

The history of the development of the procedures to inventory the soil and vegetation resources can be summarized by two poems written by John Baker, Range Scientist, Denver Service Center, a member of the method's development team, and currently the key technical vegetation resource person for SVIM.

A SOLILOQUY OF SIM 1978

There once was a team at DSC, Who upon receiving the charge, developed an inventory. "Looks good!" said George T., "Go!" declared George Lea. Then, with a new charge, came along Max's group.

They said, "This SIM procedure is full of poop!"
"We managers from the battle front have the real scoop."
The official word of these public land rectors,
Is, "We just don't need all those transectors."
"Besides, we just cannot afford all these grass inspectors."

After a great deal of soul searching and study of our plight, They attempted to determine just what scheme would be right. They decided to classify it all into an ecological site. We certainly hope the NRDC will be appeased with an inventory of this sort,

The Pacific Leval Foundation and the ramphor, too great he

The Pacific Legal Foundation and the rancher, too, must be satisfied, without retort.

Or surely, once again, we will end up in court!

THE GAME WE'RE IN 1980

Let me give you a little history of the game we're in. Three years ago we developed the procedure called SIM. "Looks good!" said George T., "Go!" declared George Lea. And we were off and running with a brand new inventory.

"Whoa!" said the field, "We can't afford all this rangeland scoop!" The Bureau's natural reaction was to form a task force called Max's Group."

So after much soul searching, the result was called SVIM. Off and running on a brand new system, the Bureau charged once again.

In May 1977, we recognized a computer system be designed posthaste. So that all this data being collected wouldn't go to waste. The W.O. chastised us, and slapped our hands.

Everybody knows, we don't circumvent the holy strategic plan.

Then a year ago last November, the SVIM data project was begun. And we have spent all this time trying to get the dadburn computer to run.

We are gathered here today to review the data system we hope will win.

When asked by the field about the data, we simply say, "It's in there," with a smug grin.

In 1977 and 1978, Mr. Chugg, while heavily involved in the development of SIM and SVIM, took the leadership in preparing a long-range soil inventory plan for the Bureau. Each state office was asked to evaluate its soil inventory needs and to develop a schedule, on an acres per year basis, for completing the task in order to meet the environmental impact statement schedule. The soil survey plan was summarized for all the western states in 1978, and was revised in 1979. Approximately 110 million of the 175 million acres of public land remain to be surveyed. About 16 million acres were completed in 1979, and another 20 million acres are scheduled for completeion in 1980.

Mr. Chugg has been the key person for providing technical service to State Offices regarding the Bureau's soil survey program since moving to the Watershed Staff in early 1977. The problem of quality control and soil correlation for the soil survey program has demanded considerable attention, because of the various ways soil surveys are obtained (contracts, interagency agreements, and in-house), and because BLM is not entirely accustomed to the National Cooperative Soil Survey standards. Some of the soil surveys prepared by private contractors in 1976, for example, are of such low quality that they have been discarded and the areas are being resurveyed. By 1978, more rigid guidelines for managing soil survey quality control had been developed and included in the Requests for Proposals (RFP) for soil survey contracts. These guidelines were mainly developed by Mr. Edward Nathan, SCS State Soil Scientist in Nevada. Mr. Chugg reviewed them and included them in the Bureau's soil survey program. Mr. Chugg also assisted Mr. Kuhlman in the Washington Office on developing the Memorandum of Understanding with the SCS for the services of an SCS Soil Correlator on an annual and reimbursable basis, which will have positive influence on the quality of the BLM's soil surveys.

Between March and December 1978, the EMRIA staff employed Dr. Maynard A. Fosberg, Professor, Department of Biochemistry and Soils, University of Idaho, on a part-time, temporary basis under the Intergovernmental Personnel Act. Dr. Fosberg wrote EMRIA Report 31, submitted in 1979, called "Evaluation of Ongoing Mineral Reclamation on Selected Coal Mines in North Dakota, Montana, Wyoming, New Mexico, and Colorado".

There was a short period in 1978 when the Denver Service Center had three and a fraction soil scientist positions. They were filled by Jack Chugg and LeRoy deMoulin on the Watershed Staff, and James Wardlaw and Maynard Fosberg on the EMRIA Staff. Mr. Wardlaw came to Denver from California in mid-1978, where he had been working on the Saline Valley Area soil survey for the Bakersfield BLM District in Inyo County. He returned to the California State Office in May 1979 on a WAE appoint—ment, and pursued a graduate degree at the University of California at Davis. His appointment with the BLM ended in March 1980. Mr. deMoulin resigned his position in February 1979 and transferred to the Office of Surface Mining, and Dr. Fosberg returned to the University of Idaho in December 1978. After Mr. Wardlaw's departure in May 1979, Mr. Chugg was the soil soil scientist at the Denver Service Center.

The EMRIA Staff was amalgamated into the Division of Special Studies, which was created as a result of a reorganization in 1979. The Division of Special Studies appointed Scott Fisher as soil scientist in March 1980. Perhaps Mr. Fisher occupies the soil scientist position vacated by Mr. Wardlaw. Prior to his appointment to the Division of Special Studies, Mr. Fisher had worked for the Soil Conservation Service, the Montana State Department of Natural Resources, the Agency for International Development (in Africa), the Fish and Wildlife Service, and Ball State University at Muncie, Indiana.

The reorganization, which became effective on October 1, 1979, was a major one at the DSC. It dissolved the Division of Standards and Technology, which included the Watershed Staff, the EMRIA Staff, and several other natural resource staffs. However, a new Office of Technical and Scientific Services was established. Under that Office are the Division of Special Studies (mentioned above), the Division of Resource Inventory Systems, and several other divisions.

After the reorganization, Jack Chugg was assigned to the Division of Resource Inventory Systems and was delegated special authorization from the Washington Office to continue coordinating the BLM's soil survey program, since he was the only BLM soil scientist above the State Office level capable of managing the program. Mr. Chugg reported to the Branch of Rangeland Policy and Program Development, Division of Rangeland Management, Washington Office, on April 28, 1980 as the senior soil scientist with the BLM. His chief responsibility is to coordinate the BLM's soil survey program.

Dr. James Stone was appointed to the soil scientist position in the Division of Resource Inventory Systems in October 1980. Dr. Stone began working for the BLM as a soil scientist in the Socorro District of New Mexico in 1976.

Alaska

In October 1960, the U.S. Government Printing Office released the report, "Soil Survey and Vegetation of the Northeastern Kodiak Island Area, Alaska." This is perhaps the first soil survey publication in which the BLM was an official cooperator in the National Cooperative Soil Survey. Actually, the BLM's contribution was to the vegetation inventory for this publication. The three BLM employees who made the vegetation inventory in 1956 were: Eugene Wunderlich, Carl Rice, and William Larramendy.

The Bureau began using the services of a soil scientist in Alaska in September 1973 when Lyle D. Linnell was appointed State Office Soil Scientist in the Division of Resources. In that capacity he was the technical specialist in charge of the watershed program. This included providing direction and assistance to the district offices and State Office divisions on surface protection, soil inventories, soil management interpretations, recreation site plans, research, and training. He also supplied soil and watershed information to the districts for the Bureau Planning System.

Mr. Linnell left Alaska in September 1976 to become Nevada's first State Office Soil Scientist. He was succeeded in Alaska by Kent Brakken. During the summer of 1976, Kevin Meyer was appointed as the first district soil scientist in the Anchorage District Office. To date, he is the only district soil scientist in Alaska.

Dr. Brakken accepted a position with the Office of Surface Mining near the end of 1978, and in March 1979, Mr. Linnell left Nevada to once again become the State Office Soil Scientist in Alaska. He is presently program manager for the Soil, Water, and Air Management Program. In addition to having been the first State Office Soil Scientist in two different states, Mr. Linnell was also one of the first soil scientists to work for the Bureau. He statted his tenure with the Bureau as a soil scientist in November 1965 at the Denver Service Center.

So far, the soil survey program has been small in Alaska. The Bureau has had soil surveys prepared for some utility corridors and development corridors through interagency agreements with the Soil Conservation Service (SCS). There is an Exploratory Soil Survey of the State of Alaska (fifth order) which was released in 1979 by the Soil Conservation Service. Alaska was not included in the Natural Resource Defense Council court case judgment which mandated the preparation of an environmental impact statement for all the grazing land administered by the Bureau in the western states.

The Bureau currently administers over 295 million acres of public land in Alaska. At this time, the Bureau has not developed a plan for preparing a soil survey of all the public land it administers in Alaska.

Arizona

In Arizona, the Bureau began recognizing the need for soil science in 1966 when it hired William Carter. Mr. Carter was assigned to the Engineering Section of the State Office to assist, as a soil scientist, in the design and construction of structures for watershed protection.

Mr. Carter was appointed as Arizona's first state soil scientist in 1970. Soon after, the need for soil survey information was recognized and in 1973 the Bureau entered into an agreement with the Soil Conservation Service to prepare a soil survey of the San Simon Resource Area in the Safford District. This soil survey was followed in 1977 by a second interagency agreement with the Soil Concervation Service for a soil survey of the Vermillion Resource Area in the Arizona Strip District.

In 1978, Mr. Carter became Environmental Coordinator in Arizona and was succeeded by Gary Tucker as State Soil Scientist. Until 1978, the Bureau never had more than one soil scientist in Arizona. In that year three soil scientists were hired for the districts. In the Phoemix District, Tom Craft was hired as District Soil Scientist, and Jim Behm was hired to work on the soil survey. Veer Mortenson was hired as District Soil Scientist in the Arizona Strip District. The Safford and Yuma Districts have never had a district soil scientist, but it is expected that each district will employ one in 1980.

In 1979, a soil correlator/coordinator position was added in the State Office and was filled by Mon Yee in May of that year. The Bureau entered into another agreement with the Soil Conservation Service in 1979 for a soil survey of the Ajo-Rainbow-Greenbelt Area in the Phoenix District. The soil correlator/coordinator position was added because of the increased need for the Bureau's involvement in soil survey quality control and correlation efforts as the scope of the cooperative soil survey program grew.

Gary Tucker left the Bureau in July 1979 for a soil scientist position with the Office of Surface Mining. At that time, Mon Yee was named State Soil Scientist, while continuing to carry on his commitments in quality control and correlation.

The Bureau administers about 12.6 million acres of public land in Arizona. Soil surveys have been completed for about 6.1 million acres of this, and another two million acres are scheduled for soil survey in 1980. All the land is expected to be surveyed by 1985.

California

In California, the Bureau began funding soil surveys in 1962 beginning with a survey in Washoe County, Nevada, and Lassen County, California, both of which are administered by the Susanville District. This may be the earliest case in which the Bureau reimbursed another agency for soil surveys. The survey was being conducted jointly by the united Surprise Valley, California, and the Vya, Nevada, Soil Conservation Districts, with technical assistance by Soil Conservation Service soil scientists. The Bureau paid a total of \$21,500 for the five-year soil survey of about 1.4 million acres - an average cost of 1.5 cents per acre.

The Bureau continued to reimburse the Soil Conservation Service for soil surveys in the Folsom District between 1964 and 1968. During that period, nearly 275,000 acres of public lands were surveyed for a total cost of \$35,349, or an average cost of 13 cents per acre. The scattered, intermingled public lands were in Fresno, Mariposa, Nevada, Yuba, Placer, and Monterey Counties. During this period, soil surveys were also made on 102,000 acres of public land under the jurisdiction of the Bureau in San Benito County without reimbusement from the Bureau. Also, in the Bakersfield District 25,000 acres of public lands were surveyed in Kern County in 1965 without cost to the Bureau.

The cooperative agreement procedure for the Monterey County soil survey was conducted similar to that for the interagency agreements today. The BLM requested the Soil Conservation Service conduct a soil survey in that County beginning in April 1966, a half year after the Bureau had appointed soil scientists to the Denver and Portland Service Centers. By the spring of 1966, formal procedures had been developed for entering into a cooperative agreement with the SCS specifically for a soil survey. On April 19, 1966, the California State Director requested the approval of the Director for a cooperative medium intensity survey of 34,000 acres of public land in Monterey County "in compliance with part 7121.1 of the Bureau Manual" (Dunn, April 1966). There is no longer a Manual Section 7121, but it evidently pertained to the process of entering into a cooperative agreement for soil surveys.

The Director approved the cooperative soil survey agreement on May 6, 1966 (Matthews, 1966). The survey covered two quarters of FY 1967 and two quarters in FY 1968. The Sacramento (Folsom) District Manager requested that the acreage be increased from 39,000 to 79,000 on June 9, 1966 (Dunn, June 1966). The Chief, Division of Resource Program Management, Washington Office, approved this change on June 24, 1966, with the provision that the district come up with the additional funds (Zaidilz, 1966). The SCS charged the BLM 15 cents per acre for this medium intensity survey.

Between 1968 and 1974, the Bureau did not acquire any new soil surveys for the public land under its jurisdiction in California. In the early 1970's, interest in soil survey information was renewed in California for planning and management purposes due to passage of the National Environmental Policy Act in 1969, which specifically identified the

California Desert Area for a special planning effort. A California Study Staff was created, and in May 1973, Al Edno was appointed soil scientist for that staff. Mr. Edno was the first Bureau soil scientist to be appointed in California.

The requirement for environmental impact statements, resulting from the National Resources Defense Council (NRDC) case in 1974, was also an impetus for soil surveys in the other California districts. The Ukiah District appointed a soil scientist in 1974, the Riverside and Bakersfield Districts in 1976, and the Folsom, Redding, and Susanville Districts in 1977. The California State Office did not have a soil scientist until February 1977, at which time Martin A. Townsend was appointed to that position. Mr. Townsend had over 20 years of experience as a soil scientist when he took this position. He had worked in Nevada as a soil scientist for the Soil Conservation Service from 1956 to 1969, and had worked for the Bureau since 1970, first as a district soil scientist in Coos Bay, Oregon from 1970 to 1976, and later as a soil scientist with the Nevada State Office Planning Coordination and Environmental Staff from 1976 to 1977.

Beginning in 1974, the Bureau began obtaining soil surveys for portions of the California Desert Area. The first year, 450,000 acres were surveyed, most of which were located in the Yuha Desert Planning Unit west of the Salton Sea and the Imperial Valley. These surveys do not meet National Cooperative Soil Survey (NCSS) standards and may well have to be done over again. No attempt was made to correlate the soil taxonomic units. A BLM progress review report on the Yuha Planning Unit, dated November 15, 1974, pointed out deficiencies in mapping unit design and in the various soil survey interpretations (Rudd, 1974).

In 1975, the Bureau began a series of contracts with the Earth Sciences Department, University of California, Riverside, for soil surveys. A 1975 contract was for the East Mojave Planning Unit, and a 1976-77 contract was for the Saline Valley Planning Unit. The East Mojave soil survey will have to be done over to meet NCSS standards, and the Saline Valley soil survey had to be completely revised by Bureau soil scientists to meet these standards (Pfulb. 1976).

The Bureau made at least three mistakes regarding the contracts with the University of California: (1) hiring an agency without the necessary technical expertise in soil survey procedures, (2) not being specific enough about expected products in the contract statement-of-work, and (3) overestimating the potential of remote sensing for preparing quality soil surveys (Thompson, January, June, and October, 1976).

A review of the East Mojave Soil Inventory Report, dated June 4, 1976, found so many deficiencies in map unit design and description, and in the soil survey interpretations that it was recommended final payment be delayed until these deficiencies were corrected. That recommendation was not accepted, however, because it was determined that the contractor

had fulfilled the contract commitments. In other words, the statementof-work was not originally designed to make a worthwhile soil survey.
Also, because of the lack of technical competence within the contracting
agency, the California Desert Staff soil scientist ended up training
University of California, Riverside (UCR) field personnel in soil
inventory procedures and working with them on a daily basis. Eventually
the recommendation was made that "renewal of the contract with UCRDepartment of Earth Sciences (Geography Program) is not recommended
because they have not demonstrated the capability to conduct a soil
inventory as a contractor."

In 1977, California entered into interagency agreements with the Soil Conservation Service for soil surveys on a reimbursable basis. Contracts with consulting and research agencies were also used for this purpose since 1977, but greater care was taken to award the contracts to firms with the required technical expertise. Relatively small acreages are also being surveyed by BLM soil scientists. Also, the Soil Conservation Service has included intermingled public lands in some progressive soil surveys without any reimbursement in such areas as San Diego County, Northeast Kern County, Mojave River, and others.

Currently, California has 12 permanent and when-actually-employed (WAE) soil scientist positions and periodically uses additional temporary positions. Two of these are assigned to the State Office, four to the Bakersfield District, and one each to the Folsom, Redding, Riverside, and Ukiah Districts, and one to the Desert Planning Staff. There are one or more vacancies among these positions.

The Bureau has jurisdiction over 15,582,427 acres of public land in California. Approximately 11 million acres of these remain to be covered by a third-order soil survey. In 1979, nearly 1.4 million acres were surveyed - about 600,000 acres by the Soil Conservation Service, nearly 700,000 acres by competitive contractors, and over 100,000 acres by BIM soil scientists. California plans to complete soil surveys for over 800,000 acres in 1980, and for its remaining acreage by 1990.

Colorado

Colorado has the double distinction of being the state with the Bureau's first district soil scientist and the first state soil scientist. Ernest Wesswick filled both of these positions.

Mr. Wesswick was employed as a soil scientist in the Canon City District in August 1965 under the Frail Lands Program. He had statewide responsibilities while in this position. In 1966, he became the Colorado State Office Soil Scientist in the Division of Resource Program Management. Mr. Wesswick still holds this position (1980) and therefore is the "dean" of the Bureau's state soil scientists.

For more than a decade, Mr. Wesswick was the only Bureau soil scientist in Colorado. Then, in 1976, David Murdough was hired as the Craig District Soil Scientist. Since then, six more soil scientists have been hired and at present there are three soil scientists in the Craig District, two in the Montrose District, one in the Canon City District, and one in the Grand Junction District.

The Bureau administers nearly 8.4 million acres of public land in Colorado. The soil survey is being accomplished mostly through cooperative arrangements with the Soil Conservation Service. The first formal interagency agreement with the Soil Conservation Service in Colorado was in 1975 to obtain soil survey information in Rio Blanco County, part of the White River Resource Area in the Craig District. The impetus for this survey was energy development, namely, oil shale. Prior to 1975, an unknown amount of public land was included in progressive soil surveys conducted by the SCS without reimbursement by the Bureau.

The Bureau's funding for the Rio Blanco County soil survey was \$45,000 in 1975. Its allocations to the Soil Conservation Service for soil surveys has increased on an annual basis since the advent of the Soil Vegetation Inventory Method (SVIM) in 1978. The extent of the increased funding is reflected in the 1980 budget, in which reimbursement to the SCS will total about \$400,000 for soil surveys of 900,000 acres located in there resource areas. Approximately 17 work years of SCS time will be funded by this agreement. These soil surveys are to provide basic soils data for future resource management plans (RMP's), especially for the forage allocation process.

Colorado has completed soil surveys on about 5.6 million acres of the public land administered by the BLM, or about 67 percent of the total 8.4 million acres. Colorado plans to have all its public land surveyed by 1983.

Idaho

Idaho was one of the first states to hire a BLM soil scientist, when on September 11, 1967, Wern Webb became the soil scientist for the Boise District. Mr. Webb had previously been a soil scientist with the Soil Conservation Service. While District Soil Scientist, Mr. Webb made soil investigations for range seedings, desert land entries, and other resource management activities.

Mr. Webb was transferred to the Idaho State Office on October 18, 1970, to become Idaho's first State Office Soil Scientist. There, he established cooperative arrangements with the Soil Conservation Service for soil surveys, and, until 1975, the Soil Conservation Sevice mapped the soils without reimbursement. Beginning in 1975, the Bureau entered into a formal interagency agreement with the Soil Conservation Service for a soil survey of the public lands in the Idaho Falls District.

Idaho's second BLM soil scientist is Robert Roudabush, who was hired in April 1976. Mr. Roudabush was stationed in the Idaho State Office, but was detailed to the Soil Conservation Service Office in Gooding to assist on the soil survey for the Shoshone Environmental Impact Statement Area. Mr. Roudabush did some mapping, but devoted most of his efforts to the correlation of soils with vegetation communities (range sites) and to writing range site or ecological site descriptions. At this time, Mr. Roudabush and Mr. Webb were making a strong effort to promote the adoption of the Soil Conservation Service's range site concept by the Bureau. Their efforts were effective since that concept was included in SVIM.

Three district office soil scientist positions were made available in 1976 and 1977 in Idaho. William Harris reported to the Shoshone District in November 1976, but was detailed to the Salmon District to work on the Challis Planning Unit Soil Survey in 1977. The environmental impact statement for the Challis Area was the first to be prepared for the grazing lands, and was to serve as a model for future EIS's. On January 2, 1977, Vern Webb relinquished his State Office position to become the Coeur d'Alene District Soil Scientist. And, on April 17, 1977, Robert Roudabush was designated as the Boise District Soil Scientist.

The State Office vacancy was filled by Gary Madenford on June 5, 1977. Dr. Madenford had previously been with the Colorado Salinity Team Staff at the Demver Service Center and the Ukiah District in California.

In 1978, the Bureau began its first major in-house soil survey in Owyhee County from the Boise District. Three WAE soil scientists and Mr. Roudabush made up the party. The Idaho Falls District hired its first soil scientist in February 1979. He is Darwin Jeppesen, who transferred from the Prineville District in Oregon. Mr. Jeppeson had considerable experience with SVIM, having been party leader of a large SVIM survey in the Prineville District in 1978. He began his career with the SCS in Idaho and had used the range site and condition class interpretations during that period. His belief in the range site concept largely convinced his colleagues and supervisors in the Prineville District and in the Oregon State Office of its potential for the Bureau.

In 1979, the BLM completed a soil survey of the Big Desert Area, with a final correlation by the Soil Conservation Service based on NGSS standards. Four new WAE soil scientists were hired in the Salmon District, and one new temporary soil scientist worked in the Idaho Palls District in 1979.

In Idaho the Bureau obtains its soil surveys either by interagency agreements with the Soil Conservation Service, or by using in-house soil scientists. The Bureau administers nearly 12 million acres of public land in Idaho. Soil surveys have been completed for approximately half of that land. Idaho plans to complete another 2.4 million acres in 1980 and all the public lands by 1984.

Montana

The Bureau began supporting soil surveys in Montana in 1961. The Powder River Area in the Miles City District was one of three pilot study areas selected for evaluating the utility of soil surveys made according to NCSS standards for the BLM Resource Management Program. Robert E. Adams, Range Conservationist, Miles City District, was assigned to work on this soil survey with the SCS during the summers of 1961, 1962, and 1963. The other two pilot study areas were in Nevada and New Mexico.

In 1966, Mr. Adams assisted Lyle Linnell, DSC Soil Scientist, on the "Soil Inventory of the Gilbert Creek Community Allotment and Isaac Allotment within the C.M. Russell National Wildlife Range, Montana". Sometime after 1966, Mr. Adams was reclassified as a soil scientist in the Miles City District, and ten years later was transferred to the Ukiah, California, District Office.

Myron (Mike) B. Rollins was appointed the first State Office Soil Scientist in July 1974. He was the Prineville, Oregon, District Soil Scientist for five years prior to this appointment, and had been with the Agricultural Research Service, USDA, before 1969.

Soon Montana began to hire soil scientists for all the district offices, beginning with the Lewiston and Butte Districts in 1975, and the Dickinson District Office in early 1976. Today there are 11 Bureau soil scientists in Montana: one in the State Office, four in the Butte District, two in the Lewistown District, three in the Miles City District, and one in the Dickinson District. Most of the Resource Area Offices have soil scientists, except the Phillips and Valley Resource Areas in Montana and the Belle Fourche Resource Area in South Dakota.

The Bureau began entering into cooperative agreements with the Soil Conservation Service for soil surveys in 1971. The first was for Valley County. Most of the public lands have been mapped by the SCS in Montana. About 750,000 acres of the Dillon Resource Area, Beaverhead County, were mapped by the University of Montana under a contract, and another 137,000 acres in the Billings Resource Area, in Musselshell and Golden Valley Counties, have been surveyed by a private consulting firm. The Bureau soil scientists have also surveyed some of the soils in Montana.

In Montana, the BLM administers a total of 8.5 million acres, including 68,000 acres in North Dakota and 276,000 acres in South Dakota. About 85 percent of the lands have been surveyed, and another 0.5 million acres are scheduled for survey by 1980. All will be surveyed by 1983 or 1984.

Nevada

Nevada has much more public land under the Bureau's jurisdiction than any other state and currently has the most ambitious soil survey program of any state. It plans to survey four to six million acres per year for the next seven or eight years.

The Bureau began evaluating the utility of soil surveys for its programs in Nevada in 1961. In that year, the Elko District assigned a range conservationist to work with the SCS soil survey party in the Tuscarora Mountains to evaluate the correlation of soils with potential vegetation relationships, and to determine if soil surveys would facilitate the BLM range inventories. This was one of the three pilot study areas that led to the Bureau's policy, issued in November 1964, that soil surveys were not needed for the Bureau's resource management program. Consequently, no more public lands under the Bureau's jurisdiction in Nevada were surveyed for a decade. Some public land in Nevada that was administered by the Susanville, California, District was surveyed after 1961. This is discussed under the California section.

Cooperation with the Soil Conservation Service resumed in 1973 when the Bureau entered into an interagency agreement with the SCS for a soil survey of part of the Ely District. A year later, soil surveys began in the Winnemucca District, also under an interagency agreement with the SCS.

In 1974, James Gegan was appointed the first BLM soil scientist in Nevada. Stationed in the Las Vegas District, he was primarily concerned with assisting staff members in the planning system, and preparing unit resource analyses.

Lyle Linnell was the first Nevada State Office Soil Scientist, assuming that position in September 1976. Mr. Linnell transferred from Alaska where he had been that State's first State Office Soil Scientist since 1973. In March 1979, he transferred back to Alaska. While in Nevada, Mr. Linnell was responsible for the technical aspects of the ELM soils program. He provided direction and assistance to Nevada's six district offices and to other State Office divisions on soil inventories, soil management, research, and training. He also provided soils information to the districts for the Bureau Planning System since the Las Vegas District was the only district employing a soil scientist until 1977.

About the time Mr. Linnell became State Office Soil Scientist, Martin Townsend was appointed as soil scientist to the Nevada State Office Plannning Coordination and Environmental Staff. In Pebruary 1977, he was appointed as the BLM California State Office Soil Scientist.

The Bureau in Nevada began contracting for soil surveys with private industry in 1976. The first contract was for approximately 150,000 acres in the Tonopah Environmental Statement Area. Quality control guidelines for the survey were loose, and the final product was less

than adequate. In 1977, a second contract was let for a soil survey of 300,000 acres in the Shoshone-Eureka Environmental Statement Area. It provided for SCS assistance for quality control and correlation. Although this soil survey was better than the one in 1976, it lacked the detail the BLM required. From this experience, Edmund Nathan, the Soil Conservation Service State Soil Scientist in Nevada, and Mr. Linnell developed a more rigid set of guidelines for the quality control of soil surveys prepared by private consultants.

These new quality control guidelines have resulted in soil surveys that more nearly meet the NGSS standards. However, they have caused problems for the contractors in meeting deadlines and avoiding cost overruns. For the three contracts issued in 1978 and later, one contract has completed a satisfactory third-order soil survey of 1.1 million acres in the time frame allowed. Both the other contracts are behind schedule. One finished the field work but submitted an inadequate report. The other spent the budgeted funds with only 65 percent of the field work completed, and is now in the process of negotiating the next course of action. Because of the difficulties Nevada has had with private contractors for soil surveys, the plan is to rely entirely on interagency agreements with the SCS in a year or so, although BLM soil scientists will do a large share of the work under the supervision of SCS party leaders.

In 1978, the Bureau in Nevada entered into an interagency agreement with the SCS to supply soil survey party leaders for BLM soil survey parties. At that time the BLM districts began adding soil scientists to their staffs and now have an average of three soil scientists per district. Having the BLM soil scientists working under a Soil Conservation Service party leader was tried in 1977 in the Winnemucca District.

After Mr. Linnell transferred to Alaska in 1979, he was replaced by Jerry Harmon on June 6, 1979, as the State Office Soil Scientist. Mr. Harmon began his career as a soil scientist with the SCS in Colorado. For the two years prior to his appointment with the Bureau he was Assistant State Soil Scientist for the SCS in Iowa.

Beginning in 1979, the transfer of funds from the Bureau to the SCS for the soil survey program in Nevada has been substantial. It amounted to \$380,000 in 1979, This provided reimbursement for six party leaders, a full-time soil correlator, soil analyses from the Lincoln, Nebraska, Soil Survey Laboratory, and for 1-1/2 range conservationist positions to correlate range sites with the soil mapping units. In 1980, the Bureau will reimburse the SCS for \$970,000 for the soil surveys of about four million acres. Another \$600,000 will be spent on private contracts for the survey of about 2.5 million acres in 1980. The SCS will be in charge of quality control for all the soil surveys. It is projected that the BLM/SCS interagency agreements will exceed \$1.2 million annually for at least the next five years to meet the environmental statement commitments in Nevada.

The Bureau administers 47 million acres in Nevada. By the end of 1979 about seven million acres had been surveyed. Over six million acres are scheduled for soil surveys in 1980. All the public land is scheduled for completion by about 1987.

New Mexico

New Mexico is one of the first states for which the Bureau funded a soil survey, and which had a BLM soil scientist. In 1961, Walter Stone was hired as a soil scientist in the Bureau's Santa Fe Office. In 1961 and 1962, he and James Folks, Soil Scientist, Soil Conservation Service, made the soil survey of the Cabezon Area, New Mexico. The published survey lists Mr. Stone as a coauthor and explains that it was a cooperative soil survey between the SCS and the BLM. It was one of the pilot study cooperative soil surveys that led to the 1964 Bureau policy that soil surveys are too costly and complex to be of value for the Bureau's Resource Management System.

After the Cabezon Area Soil Survey, the Bureau did not support soil surveys for more than a decade. Mr. Stone remained with the Bureau as a soil scientist until the late 1960's and worked on soil and watershed management problems after 1962.

In the early 1970's, it became apparent to the Bureau in New Mexico that more soils information and expertise was required to address the increased planning and environmental commitments. In July 1974, Verlyn Saladen was hired as the first New Mexico State Office Soil Scientist in response to these needs (Saladen, 1978).

Not much of the public land administered by the Bureau had a soil survey in 1974. The SCS had included some of the public lands in progressive soil surveys, without reimbursement, but these were generally for areas that were privately owned and developed for agriculture. The counties with large areas of public grazing lands had not been surveyed. The Bureau's immediate needs for soil survey information were located in areas where soil surveys had not been initiated.

The next step was to obtain district office soil scientists. Between 1976 and 1979, positions were authorized and personnel became available. Tom Bargsten was hired in the Albuquerque District in June 1976. He had been an SCS Soil Scientist in Colorado. Clem Chastain, formerly an SCS Soil Scientist in New Mexico, was hired in the Socorro District in August 1976. Clarence Seagraves, also an SCS Soil Scientist from New Mexico, began his tenure with the Bureau in the Roswell District in February 1977. Finally, Bruce Call was hired in the Las Cruces District in early 1979. Mr. Call was a recent graduate of New Mexico State University who had previously been a member of the SVIM team in the Las Cruces District.

In 1974, the Bureau lacked soil surveys for about six million acres of land which were needed almost immediately to meet the environmental statement schedule. Two approaches were used to obtain the soil surveys. One was to reimburse the SCS for making soil surveys on some

of the public land. The other was to form a BLM soil survey team to work in conjunction with the SCS. A cooperative agreement was signed with the SCS in May 1976 to accomplish soil surveys through the introduction of annual work plans for designated areas and specific amounts of funding.

The BLM soil survey team was first located in the Socorro District and was under the field supervision of an SCS party leader. This provided good quality control and training. The first two BLM soil scientists on the team were Paul Zwerman, a retired professor from Cornell University, and James Stone, a Soils Assistant from Cornell University. Dr. Zwerman later became BLM District Soil Scientist at Susanville, California, and retired in 1979. Mr. Stone is now the soil scientist in the Division of Resource Inventory Systems, Denver Service Center.

The mapping team was originally made up of four BLM soil scientists, but has varied in size from two to seven positions. The present members are: Harold (Jerry) Wall, Carol Marchio, Charles Fischer, Paul Meyera, Ray (Chip) Meador, Cheryl Roy, and Katherine Bolger. Some of the team members are recent university graduates, while others are older and have had previous soil survey experience with the SCS and the Forest Service. Since 1976, the team has completed soil surveys for 869,000 acres of public land in Socorro County, 200,000 acres in Valencia County, and 929,000 acres in Catron County. Having the BLM soil scientist team working under an SCS party leader has been a beneficial venture in New Mexico.

In November 1976, the Bureau entered into a contract with New Mexico State University for the laboratory analyses of samples from the benchmark and new soil series discovered during the surveys. Each year samples from an average of 38 soil profiles are analyzed and this schedule will continue until a third-order soil survey for all of the public lands administered by the Bureau has been completed.

In 1978, the Bureau entered into a cooperative arrangement with the SCS and the Forest Service to determine soil temperature regimes and soil moisture regimes where such data are lacking. This project is in support of the soil survey program and will continue for at least five years.

As the requirements for environmental impact statements increased, the demand for soil scientists also grew. Richard Bird, formerly with the SCS in New Mexico, recently became a member of the coal environmental impact statement team in Albuquerque. Russ Pigors is now an area soil scientist in the Farmington detached area office. He was a member of the BIM soil survey team.

In March 1980, the soil survey team was divided into smaller groups since no other large areas of public land remained to be surveyed. Two team members will remain in Socorro, two will go to Gallup, one to Grants, one to Chama County, and one will become a member of an upcoming environmental impact statement team. After 1982, when all public lands will have been surveyed, these soil scientists may be assigned to the districts as area soil scientists to aid in implementing the management programs identified in the environmental statements.

The Bureau administers about 13 million acres of public land in New Mexico, including 7,000 acres in Oklahoma. All but 2.3 million acres have been surveyed, and 1.5 million acres are planned for completion in 1980. New Mexico expects to have all the public lands surveyed by the end of 1983 - sooner than any other of the western states.

Oregon

The Bureau began actively supporting soil surveys in Oregon in 1966 and had supported them continuously ever since. Soil surveys were being made on public lands administered by the Bureau in Oregon during much of the period when soil surveys were in the doldrums in the other western states because of the 1964 decision that soil surveys were not needed for resource management. Oregon won approval for soil surveys during this period because the O&C lands in the humid western part of the state are largely productive timber lands and thus amenable to "intensive" management.

The first Bureau soil surveys in Oregon were made in the Willamette River Drainage Basin, which includes parts of the Salem and Eugene Districts. The Oregon State Office cooperated in the Northwest River Basin Group and was responsible for obtaining an unspecified type of soil inventory for Segment II of the Willamette River Basin. Segment II is the private and public land in the foothills and mountainous areas of the Coast Range and Cascade Mountains between the valley floor (Segment II) and the National Forests (Segment III). In the Coast Range (west side), Segment II extends to the crest of the mountains, which is the divide between the drainage to the Willamette River and the more direct route to the Pacific Ocean. In the Cascade Mountains, the higher positions are all under the jurisdiction of the Forest Service.

The BLM approached the Soils Department of Oregon State University to conduct a mantle stability survey of Segment II. A mantle stability survey is a single-purpose survey to show the tendency of the soils for slumping. The Forest Service was making such surveys in Oregon at the time and classified the stability of the mantle by counting the number of roadcut failures larger than 10 cubic yards per mile of road. The stability classes were correlated with geologic formations and hillslope gradient. Murl Storms, who later became State Director in Oregon, presented this request to Professor Gerald Simonson and graduate student Byron Thomas at OSU. They persuaded Mr. Storms that a reconnaissance soil survey would yield much more information than just stability and would not be much more costly. The BLM agreed to this proposal, a contract was arranged, and Mr. Thomas was put in charge of the field mapping.

Mr. Thomas began making the soil survey in the spring of 1966, and was joined by James A. Pomerening during the summers of 1966 and 1967.

Mapping units were mainly soil associations defined in terms of slope phases of soil series and were mapped at the scale of one inch per mile. Base maps were aerial photographs at that scale and 15-minute topographic maps. Newly identified soil series were assigned a distinctive number instead of a tentative series name. The SCS provided identification and descriptive legends for portions of the area. Quality control was maintained primarily by the two mappers with some review by Dr. Simonson. Where available, as in Marion County, the completed SCS soil surveys were generalized for the reconnaissance soil survey. Field work

was completed in 1967 for the 1,967,000 acres (not all public land because of the checkerboard pattern of land ownership in the area). Heavy reliance was made on aerial photograph interpretation after learning the relationship between the soils and their geomorphic location. Poison oak was a key indicator plant for differentiation between the xeric and udic moisture regimes. The manner in which the well aggregated argillic horizons sloughed on vertical road cuts could be used to differentiate them from cambic horizons while traveling at 30 miles per hour on a narrow, winding logging road with a loaded logging truck bearing down on you.

When the soil mapping was completed and presented to the BIM, Mr. Thomas and Dr. Simonson pointed out that with more financial support, a great deal of useful soil survey interpretative information could be developed and put into a report. The BLM agreed to this proposal and employed Mr. Thomas between January 15 and September 30, 1978, to prepare the interpretative tables and the soil survey report. He consulted with foresters in the Salem and Eugene BLM Districts while developing the interpretations for reforestation, and also relied upon the standard interpretations used by the SCS. The report was accepted by the BLM, and subsequently published by the Oregon Agricultural Experiment

In the early part of 1969, the Bureau was given a substantial increase in permanent positions for administrating the O&C lands. Some of the positions were for soil scientists and fishery biologists. The decision to hire soil scientists and fishery biologists may have been heavily influenced by the 1968 moving picture, "Pass Creek", which depicted a recent logging operation that resulted in a severe degradation of part of Pass Creek. Pass Creek, a tributary of the North Umpua River in the Roseburg District, was a popular fishing spot for sportsmen, including a free-lance documentary film maker from Hollywood. The film caused quite a stir among the viewers who were concerned about the environment, and they let timber managers know about their displeasure. The particular clearcut featured in the film was not on land administered by the Bureau, but logging practices on public land were similar at the time.

The Oregon State Office received one of the soil scientist positions, as did the Salem, Eugene, Roseburg, Medford, and Coos Bay Districts in Western Oregon. The Prineville District in Central Oregon also got a soil scientist position in 1969, which was justified by the Watershed Conservation and Development inventory that showed that the Bear Creek Watershed deserved an intensive management plan.

Byron Thomas expressed an interest in the State Office position, but informed the BLM he would not be available until June, 1970 in order to complete the requirements for his PhD degree. Nevertheless, the Bureau hired him on an intermittent appointment between June 15, 1969 and June 27, 1970, to coordinate the ongoing soil survey and soil management work

among the BLM soil scientists and to develop procedures, standards, and guidelines for their endeavors. On June 28, 1970, Dr. Thomas became Oregon's first permanent full-time State Office Soil Scientist.

The Western Oregon districts filled the new soil scientist positions in 1969. The Eugene District hired George Chalfant, a student at Oregon State University, who stayed with the Eugene District until 1979 when he took a position with the Office of Surface Mining in West Virginia. Steve Wert was hired by the Roseburg District and remained there until about 1978 when he resigned and started a private consulting business in Roseburg. Mr. Wert completed his M.S. degree at Oregon just before joining the BLM in Roseburg. Lee deMoulin was the first soil scientist in the Medford District. He was an experienced soil scientist who had worked for the SCS and had worked in Africa. He left the Medford District in 1975 to become the first BLM soil scientist in the Washington Office. In 1977, he transferred to the Denver Service Center, and in 1979, took a position with the Office of Surface Mining. William Power became the Salem District Soil Scientist in the summer of 1969, coming from the SCS in Jackson County, Oregon. Mr. Power remains at Salem today. The Prineville District position was filled by Mike Rollins, who became Montana's first State Office Soil Scientist in 1974. The Coos Bay District did not fill its soil scientist position until 1970, when Marty Townsend was selected for it. Mr. Townsend became the first California State Office Soil Scientist in 1977.

During the summer of 1969, Joel Norgren was hired on a temporary basis to train George Chalfant and Steve Wert in the Eugene and Roseburg Districts in soil survey procedures. Mr. Norgren was a graduate student at Oregon State University who had worked for the SCS. He eventually got his PhD degree and is now working for a private consulting firm that has contracted with the BLM to do soil surveys in Wyoning and Nevada.

From 1965 to about 1975, the Bureau also provided limited funding to the SCS for soil surveys in the upper Willamette Valley (Eugene District).

The initial welcome given to the new soil scientists in 1969 was not always warm. The first time Dr. Thomas visited the Medford District, he was greeted with: "What the hell are we going to do with a soil scientist?" by the assistant district manager. Ten years later, that same district had four soil scientists, including one for each of the three resource areas. After the soil scientists proved the importance of soil surveys for determining soil productivity, road location and design, logging systems, hillslope stability, forest rehabilitation, and a dozen other things, the resource managers found them indispensible. When Mike Rollins left the Prineville District, the district debated whether or not it should use the position for a soil scientist or for some other specialty. It was finally decided that it is easier to train a soil science. So they hired another soil scientist in sciences.

Darwin Jeppesen, a soil scientist with the SCS, filled the vacancy. Mr. Jeppesen was well versed in the range site and condition class concepts and their utility for determining both potential and existing productivity of grazing lands. He persuaded Larry Walker, Range Conservationist, and Wayne Elmore, Wildlife Biologist, from the Prineville District, of the usefulness of the range site concept for the Bureau's planning and multiple-use management programs. They, in turn, convinced Dr. Thomas, who worked with members of the task force that developed the Soil-Vegetation Inventory Method (SVIM) which encompasses the range site concept.

James Pomerening started working for the BLM in Oregon as a temporary soil scientist in the summer of 1971. That summer he completed most of the field work and the first draft of the report for the Stinking Water-Van-Drewsey Area in the Burns District. Dr. Thomas finished the mapping later, and James Hancock, who started as a watershed specialist in the Burns District in 1971, completed the interpretations dealing with grazing and the final report. That soil survey report was the first to be published by the BLM. Mr. Hancock is currently with the Division of Rangeland Management in the Washington Office.

During the summer of 1972, Dr. Pomerening assisted Lee deMoulin on the soil survey of the Medford District, and in the summer of 1973, he surveyed in the Coos Bay District. Since the summer of 1974, he has been assigned to the State Office, but provides technical assistance and training to the various district offices. In the summer of 1974, he mapped soils in the Roseburg District including the Pass Creek Area. The Medford District Soil Survey was the second to be published by the Bureau, the Roseburg District Soil Survey was the third, and the Coos Bay District was the fourth.

The BLM informally cooperated with the SCS for these soil surveys and field reviews were held with correlators from the SCS, although no memoranda of understanding were drawn up for the surveys, and they do not meet all the NCSS standards. Today there are formal memoranda of understanding for the surveys in Coos, Klamath, Lake, Jackson, and Josephine Counties.

Except for the Prineville District, the eastern Oregon and Spokane Districts did not hire soil scientists until quite recently. The Burns District hired Jim Scheidt as its first soil scientist in 1974. Mr. Scheidt left in 1976 and was replaced by Lisa McNair. Ms. McNair transferred to the Oregon State Office Environmental Impact Statement Team in 1978, and was replaced by Dr. Russell Krapf.

The Spokane District hired Gary Yeager in 1977 and the Vale District hired Ed Dimick in 1978. The Baker District hired Barry Williams. The Lakeview District hired Jeanie Geschke in 1978.

Oregon was the first state with a BLM soil correlation position in the State Office. It was filled by Joe Cahoon in 1978. Mr. Cahoon started his career with the Bureau of Indian Affairs, and was a party chief with the SCS for a number of years before joining the BLM.

Oregon has had a SVIM crew consisting of soil scientists and range conservationists attached to the State Office since 1978. They have been in the Prineville District since then, working on the surveys for the Brothers and the Two Rivers Environmental Impact Statement Areas. The soil scientists on this team are Scott Wittaker, Kenneth Van Etten, and Ted Hasss.

Oregon relies mostly on Bureau soil scientists for completing the soil surveys, although portions of the Ironsides Environmental Statement Area were surveyed by a private contractor in 1976. The quality control was so deficient, however, that the survey had to be redone by BIM soil scientists. In 1980, the Bureau has an interagency agreement with the SCS to survey about 100,000 acres in the Medford District.

The incumbant district soil scientists, for the districts which have had recent personnel changes, are: Larry Thomas, Prineville; Jim McLaughlin, Eugene; Craig Garland, Coos Bay; and Dennis Hutchison, Roseburg. Barry Williams has moved from the Baker District to the Eugene District. The Roseburg District has also recently hired David Roberts as a resource area soil scientist.

The Oregon State Office administers about 16 million acres of public land, including about 300,000 acres from Washington. Nearly five million acres have been surveyed. Oregon plans on completing soil surveys on only about 700,000 acres each year and does not expect to complete all areas until about 1995.

Utah

The soil survey of the public lands in Utah did not begin until 1976. In that year the Bureau entered into an interagency agreement with the SCS and also contracted with a private consultant for the soil survey of 356,200 acres in the Henry Mountain Resource Area of the Richfield District. The need to rehabilitate areas drastically disturbed by coal mining prompted the soil survey in the Henry Mountain Area.

Interagency agreements with the SCS have been continued every year since 1976, and the bulk of the soil surveys of the public land in Utah has been accomplished by this arrangement. However, private contractors have prepared soil surveys for sizable acres, including another 900,000 acres of public land in the Henry Mountain Resource Area of the Richfield District. In 1980, a contracting firm will prepare a soil survey for 149,000 acres of public land in the Grand Resource Area. The contracts awarded after 1976 have been for both soil and vegetation inventories (SVIM ecological sites). Utah is probably the first state to award such contracts. Utah's Agriculture Experiment Station also supports several soil scientist positions. These Individuals work with SCS field parties and have mapped some of the public land.

Utah was the last of the western states to employ BIM soil scientists. The Cedar City District first hired a soil scientist by the name of Max Hodson in January 1978. Charles Case began his assignment as state soil scientist on March 12, 1978. The Vernal District hired Keith Chapman in April 1978, and the Richfield District hired Weston Warren in August 1978. Ms. Doran James was the first soil scientist hired in the Salt Lake District. She started in December 1978, left the Eureau in September 1979, and was replaced by Dee Leavitt a month later. The Moab District hired two soil scientists in May 1979: David Hansen and Wayne Sve jnoha. The Cedar City District added a second soil scientist in January 1979, named Robert Smith. All five districts in Utah have had at least one soil scientist since May 1979.

The Bureau administers over 22 million acres of public land in Utah, of which about 10 million acres have not been surveyed. It plans to obtain soil surveys for nearly two million acres in each of the next five years, and to complete the surveys by the end of 1984.

Wyoming

The Bureau began obtaining soil surveys for its public lands in Wyoming in 1971 by interagency agreements with the SCS. Between 1971 and 1974, the SCS prepared soil surveys for a total of 617,000 acres for the planning phase of the Watershed Conservation and Development System. However, the districts never followed up with the planning. These soil surveys are for 187,500 acres in the Sage Creek Watershed of the Rawlins District, 56,000 acres of the Blue Rim Area of the Rock Springs District, 303,500 acres of the Nowater Watershed of the Worland District, and 70,000 acres of the Red Creek Watershed of the Rock Springs District, springs District.

Beginning in 1975, the need to prepare environmental impact statements for energy and grazing areas provided the impetus for soil surveys. The SCS made most of the soil surveys under interagency agreements until 1977 when the BLM's needs for soil surveys exceeded the SCS's capacity. In 1975, the SCS completed the field work for 69,120 acres of the Red Rim Area in the Rawlins District, and EMRIA (Energy Minerals Rehabilitation Inventory Analysis) funds were used to reimburse the SCS. In 1976, the SCS completed the field work for 46,080 acres of the Potter Mountain Area in the Rock Springs District. Again, the funds came from EMRIA. In 1977, the SCS completed the field work for 773,311 acres in the Rock Springs, Rawlins, and Casper Districts.

A fourth-order soil survey was prepared for 2.5 million acres of the Sandy Environmental Impact Statement Area in the Rock Springs District in 1976 and 1977. This was a joint SCS-BLM effort and relied mainly on aerial photograph interpretation of infrared imagery with some field checking with a helicopter. Only three and a half work months were devoted to this survey, and the total cost was \$37,700, including \$22,000 for helicopter time. It does not meet the NCSS standards.

Private contracting began in 1978 for soil surveys in Wyoming when the need for the surveys exceeded the SCS capability. In 1978, private contractors made soil surveys for 1.6 million acres of public land in the Salt Wells and Grass Creek Planning Units. Quality control was maintained by the SCS, which also mapped several hundred thousand acres in that year. In 1979, approximately 2.5 million acres were mapped under private contract, with the SCS providing quality control. The SCS mapped 400,000 acres. In 1980, about three million acres will be surveyed under private contract, and the SCS will map another 600,000 acres.

The Bureau began hiring soil scientists in Wyoming in 1973. In that year, William Crane became the State Soil Scientist. A year or so later, soil scientists were being added to the district office staffs. By 1976, the Rawlins District had two soil scientists, Richard Larson and Edward Shepard; the Pinedale Office had one, Rick Canterbury; the

Casper Office had two, Robert Adams and David Hollenbeck; the Buffalo Office had one, Edwin Bunger; and the Rock Springs Office had one, Michael Lett. In 1977, the Worland District added two postitions for soil scientists, and one was filled by Thomas Vochem and the other was vacant. The Rawlins District added a third position in 1979 which was filled by Larry Thomas who came from the Bureau of Indian Affairs and later became the Prineville District Soil Scientist in 1979. The Rock Springs District added Jack Norman as their second soil scientist in 1977, and the Kemmerer Area Office added Dennis A. Heape as a soil conservationist in that year. The field office soil scientists collectively make soil surveys for a few hundred thousand acres annually in Wyoming. They are largely responsible for giving technical guidance to the Bureau's planning and resource management activities.

The Bureau administers about 18 million acres of public land in Wyoming. So far, nearly eight million acres have been surveyed. About 3.6 million acres will be surveyed in 1980, and the survey is planned for completion by the end of 1983.

 The Quality, Status, and Needs of the BLM's Soil Survey Program as Viewed by BLM State Soil Scientists.

A list of 72 questions was sent to each of the BLM state office soil scientists in December 1979 to determine how well the BLM soil survey program conformed with NCSS's standards; the relative quality of soil surveys made by the BLM, the SCS, and private contractors; and the kinds of items needed to improve the soil survey program.

Eight state soil scientists completed the questionnaire and returned it. One was forbidden to respond, supposedly because the task had not been included in his annual work plan. The information received is of great value to this report because it came from those who are in the best position to evaluate the quality, status, and needs of the BLM's soil survey program. Their efforts and comments are sincerely appreciated. This report's most meaningful and beneficial information is contained in this chapter, thanks to them.

The answers are summarized below, but information is not identified by individual or state. There is room to improve the quality, stature, and credibility of BLM's soil survey program. However, the technical soil science staff's efforts to improve the program are sometimes hindered by administrative actions and inactions. Some of the responses in that regard were rather forthright; hence, the attempt to hide the origin of the remarks.

1. What is the status of statewide memoranda of understanding between cooperative agencies regarding the soil survey program?

Statewide memoranda of understanding between the agencies involved in the National Cooperative Soil Survey are optional, but do exist in most states between the SCS and the state Agricultural Experiment Stations. In some states, they have been developed to include all cooperative state and Federal agencies. The example of a statewide memorandum of understanding for soil surveys, given in Exhibit 202.1 No. 2, Part II of the National Soils Handbook, includes all the state and Federal agencies involved in the soil program for Michigan. The purpose of a statewide memorandum of understanding is to recognize the joint and individual responsibilities of the cooperators in developing and using soil surveys in a state.

Of the eight BLM states that reported their status regarding a statewide memorandum of understanding: three are included in such a memorandum, one is in the process of becoming included, and four are not included.

Three of the states that are not included in a statewide memorandum of understanding with the SCS reported they do have a statewide interagency agreement with the SCS, one of the major cooperating agencies. An interagency agreement serves a different function than a memorandum of understanding. It provides for the transfer of a specific amount of

funds between two Federal agencies for specified amounts and kinds of work in a particular fiscal period and has to be renewed or revised each year. It generally does not list the overall joint and individual responsibilities of the cooperating agencies involved in the soil survey program for a state.

One of the states reported that the national level memorandum of understanding between the SCS and BLM for soil surveys was determined to be a good substitute for a statewide memorandum of understanding. An appraisal team, consisting of representatives from the SCS and BLM who reviewed the BLM's soil survey program in that state made that determination. The national level memorandum of understanding spells out the joint and individual responsibilities of the BLM and the SCS, but does not include other cooperators. In all states, the Agricultural Experiment Station should be involved in the soil survey program of public lands administered by BLM in at least the field review and quality control phase. Generally, the Agricultural Experiment Stations can contribute to the laboratory support phase and special studies or research phase of the soil survey program. In many states, the Forest Service, as well as the BLM, administer public lands. Knowledge about the soils on the public lands administered by any one agency could be more easily transferred for application to comparable soils on lands administered by other agencies if all the cooperating agencies were included in the same memorandum of understanding.

Although statewide memorandums of understanding for soil surveys are not mandatory, the BLM would benefit from being included in them because:
(1) they establish the responsibilities for all the cooperating agencies involved in the soil survey program; (2) they establish the specific responsibilities of BLM in a general manner for that endeavor; and (3) they make both the line administrative officers and the technical staff specialists at all levels and in all agencies aware of the nature and scope of the total soil survey program for a state.

It is recommended that BLM state offices enter into a statewide memorandum of understanding relative to the soil survey program in each state having significant amounts of public land under its jurisdiction and that those responsible for administering public lands in two or more states enter into statewide memorandum of understanding for each state. The model statewide memorandum of understanding in the National Soils Handbook (Exhibit 202.1 No. 2) is a good one for the BLM to follow. The specific responsibilities of the BLM would be similar to those listed under the Forest Service in that model. The mutual responsibilities of all agencies listed in that model would also generally serve the needs of the BLM for its involvement in the NCSS. It is also recommended that a copy of the statewide memorandums of understanding be sent to the BLM Washington Office and Denver Service Center Soil Scientists involved in the soil survey programs.

 $2.\,$ What is the status of an individual soil survey area memorandum of understanding between BLM and SCS?

A memorandum of understanding for an individual soil survey area (formerly called a soil survey work plan) is a requirement of the National Cooperative Soil Survey. It is specifically referred to in the national level memorandum of understanding between the SCS and BLM relative to the making of soil surveys. Each such memorandum records the purpose of the survey, describes the area, lists cooperators and their responsibilities, and sets down specifications for making, interpreting, and publishing a soil survey for a specific area.

Five of the eight states reporting on this subject have prepared memorandums of understanding for the individual soil survey areas in their state, two have cooperative soil survey work plans for most of their soil survey areas, and one state has neither memorandum of understanding nor work plan.

It is recommended that a memorandum of understanding be prepared and approved for every BLM soil survey area according to the outline in Section 202.1(b) of the National Soils Handbook. A memorandum of understanding for a soil survey area is required even when BLM enters into an interagency agreement with SCS for that same soil survey area. The interagency agreement is for the exchange of funds between BLM and SCS for a specified amount of work, generally for one fiscal year. The memorandum of understanding is a fairly detailed account of all the jobs and specifications required to make the soil survey of a specific area, and designates who is responsible for each kind of job. It is also recommended that a copy of the memorandum of understanding for individual soil survey areas be sent to the BLM Washington Office and Denver Service Center soil scientists involved in the soil survey program.

 $\ensuremath{\mathfrak{3}_{\bullet}}$ Who is the BLM approving officer for soil survey memorandums of understanding?

All states reported that the BLM State Director signed both the state-wide and the individual soil survey area memoranda of understanding where they exist.

There are conflicting instructions in the BLM Manual regarding responsibilities for approving cooperative soil survey work plans and agreements. Manual Section 7161.21Ala6 states that: "Proposed cooperative soil surveys are to be submitted to the Director (meaning the Washington Office Director) for review and approval prior to finalization." This apparently is not being done, probably never has been done, and probably was not a very good idea to begin with. It is likely that the Director has more important things to do than to review soil survey memoranda of understanding at either the statewide or the individual soil survey area levels. It is recommended that Manual Section 7161.21Ala be deleted from the Manual.

Manual Section 7100.04A4 states that: "The District Manager is responsible for developing and completing all activities involved in conducting soils inventories...," and "This includes: a. Making all preliminary preparations for new inventory areas including a soil inventory work plan." A strict interpretation of these instructions would mean that the District Manager should be at least one of the BLM approving officers for the individual soil survey area memorandum of understanding since he is solely responsible for preparing the soil survey work plan. In practice, the memorandum of understanding for soil survey areas is probably prepared jointly by the SCS and BLM state soil scientists, or their representatives, with input from SCS and BLM

The National Soils Handbook, Section 202.1(c) includes specific instructions for the review, approval, and distribution of the memorandum of understanding for a soil survey area. The approving SCS officer is the state conservationist. For cooperating agencies it states that it will be signed by the "appropriate official". The appropriate official of BLM is the State Director. This has been the standard practice for those soil survey areas already covered by a memorandum of understanding. It is recommended that the responsibilities of the state and district managers in regard to the memorandums of understanding for individual soils in Manual Sections 7100.04A3 and 7100.04A4 be revised to reflect current conditions and procedures.

It is recommended that the final approving officer be the BLM State Director for both the statewide and individual soil survey area memoranda of understanding.

4. Do the boundaries and sizes of BLM soil survey areas meet the standards of the National Cooperative Soil Survey?

Soil survey area boundaries are set by the SCS State Conservationist after consultation with cooperating agencies. The boundaries will conform to county boundaries wherever practical according to the National Soils Handbook. Soil survey areas will be of a size and shape that can be published efficiently. The minimum size should be about 200,000 acres. The maximum size should be about five million acres if published at a scale of 1:24,000.

BLM district boundaries commonly do not coincide with county boundaries. Neither do many BLM resource areas and environmental impact statement areas.

Six of the eight reporting BLM states have developed soil survey areas with the SCS whose boundaries and sizes meet NCSS standards. Of the two remaining states, one indicated that slight boundary revisions are needed for all of the BLM soil survey areas, and the other stated that the BLM soil survey areas are designed to fit the environmental impact statement areas.

It is recommended that the boundaries of all BLM soil survey areas be made to conform to the NCSS's standards. When county boundaries are not used, it is important that all other land between the established boundaries of any two soil survey areas be included with other survey areas for publication at a later date. It is essential that all soil survey areas have a reasonable size and shape. Odd shaped areas increase costs.

5. Is there a problem caused by the fact that the boundaries of BLM districts, resource areas, and environmental statement areas commonly do not coincide with county boundaries or other conventional boundaries of soil survey areas?

Five of the eight reporting states answered "yes," and three answered "no." The major problem is that the BLM soil surveying is being done mostly by environmental impact statement area. Their boundaries generally do not conform with the boundaries of the soil survey areas to be published. Private lands may make up a considerable proportion of environmental impact statement area. Most states are temporarily living with the problem by: (1) mapping the public lands first to meet the EIS schedule (with plans to map the remaining land after meeting that deadline); and (2) mapping that part of the soil survey area covered by high priority EIS areas (with plans to survey the remaining areas according to the overall EIS schedule). Although the SCS has generally been very cooperative with the BLM in meeting the soil survey needs for the EIS schedule, soil survey publications cannot be prepared until an entire area is surveyed. One state pointed out that the lack of conformance between the boundaries of the EIS areas and the soil survey areas required juggling acreage figures for soil survey work done by both the SCS and the BLM.

It is recommended that the BLM continue to give top priority to the soil surveys of the EIS areas with the understanding that eventually all soils within the soil survey areas planned for formal publication will be completed. It is too late to alter the boundaries of the EIS areas to conform with county or other political boundaries. It would be beneficial to many agencies if BLM district boundaries were adjusted to more closely coincide with county, and even in some cases, state boundaries. The BLM in Nevada manages part of the public lands in Oregon and California, and the BLM in California, Idaho and Oregon manages some of the public lands in Nevada. The SCS in each state, on the other hand, deals only with land in its state. This situation is bound to create problems in juggling "acreage figures" when the time comes to report private and public lands by designated NCSS soil survey areas. The lack of common boundaries between BLM districts, SCS districts and county lines creates similar problems when reporting acreages of accomplishments.

6. Have the BLM soil survey areas been named according to the standards of the National Cooperative Soil Survey? Each soil survey area has a name that is used on all records and publications for the area, including the memorandum of understanding for the soil survey area. The conventions for naming soil survey areas are given in Section 2011 of the National Soils Handbook. County names are almost always included in the names of the soil survey areas.

All eight reporting BLM states indicated that the soil survey areas have been named according to NCSS conventions and standards. Some of the survey areas have long names because they include parts of several counties.

7. What are the names of the soil survey areas begun in 1978 or 1979, and planned for initiation between 1980 and the expected year of completion of the soil survey program on the public lands?

This list will not be given here to save space and to conceal the identity of the states that responded. Three of the states provided soil survey area names that conform with NOSS conventions and standards, whereas, the other five used names of EIS areas, planning units, resource areas, parts of a BLM district, etc. This occurred even though all eight states reported in response to the previous question that the soil surveys were named according to the NCSS's conventions and standards. Questionnaires can be designed for cross-checking purposes.

It is recommended that all BLM soil surveys be named according to NCSS's conventions and standards. These names will be part of all records for the survey areas including the memorandums of understanding for individual soil survey areas. The BLM Washington Office and Denver Service Center soil scientists will check these names when they receive their copies of the memorandums of understanding.

8. Are the BLM soil surveys "progressive" or "nonprogressive"?

A progressive soil survey has an approved current memorandum of understanding for the area, an asssigned party leader, an approved current descriptive legend, and definite plans for publication. A nonprogressive soil survey has no plans for completion within six years and usually does not have a current memorandum of understanding for the survey area. Standards for quality of soil mapping and documentation are the same for both kinds of survey.

Seven of the eight reporting states indicated that the BLM soil surveys are progressive, and one indicated it is nonprogressive. Two of the states indicating they do not have a current memorandum of understanding for BLM soil survey areas claim to be making progressive soil surveys. This is a contradiction.

It is recommended that all BLM soil surveys be progressive. A nonprogressive survey can be converted to a progressive survey by conducting an initial field review, determining how older mapping will be used, and then meeting all requirements for a progressive survey.

9. Will older, existing soil surveys of public lands, not up to par with the NCSS's standards, ever be converted to progressive or nonprogressive soil surveys?

After a published soil survey becomes outdated, the area can be converted to a nonprogressive or progressive survey status after an interdisciplinary group of NCSS cooperators and users determine and document that the survey is inadequate for current needs.

Four states responded that the outdated soil surveys administered by BLM would definitely be or were being, converted to progressive soil surveys. The remaining four states gave a qualified positive response, or were unsure. The conversion would depend upon the availability of funds and positions, and BLM goals, after the soil survey was completed to meet the EIS schedule.

It is recommended that soil surveys be made of all the public lands under the jurisdiction of the BLM according to the NCSS's standards. FLPMA calls for periodic and systematic inventories of the natural resources on the public lands. That is a requirement that BLM cannot ignore.

10. Should the BLM Washington Office be involved in the review and approval process for statewide and individual soil survey area memoranda of understanding?

Five of the states responded negatively, explaining that Washington Office involvement would be time-consuming and nonproductive because the states are more cognizant of the local needs and conditions for soil surveys. As long as there is only one soil scientist in the BLM Washington Office, his or her time and effort should be devoted to Bureau-wide policy issues and interagency coordination.

The two states that responded positively to this question believed that involving the Washington Office in at least the review process would lend support to the actions and recommendations of the BIM state soil scientists. Apparently in some states, the state soil scientist needs all the support he can get from the Washington Office to maintain a viable soil survey program. One state did not answer this question.

It is recommended that the Washington Office not be involved in either the review or approval processes of the statewide and soil survey area memoranda of understanding. However, approved copies of new and revised memorandums should be provided to the Washington Office and Denver Service Center soil scientists involved in soil survey programs.

11. Should an appropriate Washington Office official receive a copy of each interagency agreement related to the soil survey program?

In most states, BIM is entering into interagency agreements with the SCS for portions of soil survey work on public lands administered by BLM. Within SCS, copies of the signed interagency agreements (called cooperative agreements by the USDA) are sent to the Director, Technical

Service Center, and the Director, Soil Survey Operations Division. Within BLM, Washington Office approval is required before states can enter into an interagency agreement that exceeds \$10,000. Once that approval has been granted, the states handle the arrangements for entering into the agreement.

Four of the responding states indicated that the Washington Office soil scientist should receive a copy of the interagency agreements, reasoning that the Washington Office soil scientist should have them in his record as he can use them in his budgeting process for BLM's soil survey program. The remaining states answered negatively, saying the interagency agreement would be of no value to the Washington Office BLM representative because the funds involved in the agreement would have already been requested and obligated.

- It is recommended that the Washington Office soil scientist involved in the soil survey program be sent a copy of each interagency agreement related to soil survey work. This information will be useful in making cost analyses for soil survey work between the states and for coordinating BLM and SCS soil survey support budgets by states at the national level. The SCS is concerned with the problem of not knowing about the level of BLM support for the soil survey program in the western states far enough in advance to avoid excesses or deficiencies in state allocations to the states for soil surveys.
- 12. Are the state Agricultural Experiment Stations and other cooperating agencies included in the statewide memoranda of understanding for soil surveys?

The four states that are or will be included in a statewide memorandum of understanding also include the Agricultural Experiment Station and such agencies as the Forest Service as cooperators in that agreement. One state has a separate broad cooperative agreement with the state university. Two do, or plan to, include other cooperators, such as the Agricultural Experiment Station, in "umbrella" kinds of interagency agreements. One state shows no cooperative relationships with the Agricultural Experiment Station.

An interagency agreement is used specifically for the transfer of funds between two Federal agencies. State Agricultural Experiment Stations are not Federal agencies. Therefore, they cannot be effectively covered by an interagency agreement.

- It is recommended that all cooperators in the soil survey program, including the state Agricultural Experiment Stations, be listed in a statewide memorandum of understanding along with their individual and joint responsibilities to the soil survey program.
- 13. What involvement, if any, does the state Agricultural Experiment Station have in the BLM's soil survey program?

Two of the responding states said there is absolutely no involvement of the Agricultural Experiment Stations in BLM's soil survey program. The remaining six said there was some minimal involvement, including participation in the Annual State Soil Survey Planning Conference; laboratory analysis; soil survey report manuscript review; participation in field reviews; training, especially in relation to the effects of geomophology on pedogenesis; and supplying information on vegetation, erosion, and land treatment practices.

Every state Agricultural Experiment Station has at least one representative faculty member with responsibilities for the National Cooperative Soil Survey. Many of these stations have laboratory facilities for doing soil characterization work for a fee, and all have responsibilities for land-use and management of all the land in their state, including the public lands. The small degree of involvement by these stations in BLM's soil survey program is somewhat surprising.

It is recommended that BLM strengthen its cooperative relationships with the state Agricultural Experiment Stations. The stations should be involved to a greater extent in cooperative research projects that will provide information needed to manage the public lands on the multiple-use and sustained-yield bases while maintaining or improving the quality of the environment. They should participate in all field reviews, and should be included in the soil survey report manuscript process and in the training process.

A workload analysis is prepared to determine time requirements for each specialist from each cooperating agency to meet the scheduled completion date. The National Soils Handbook places the responsibility for preparing the workload analysis with the party leader under the direction of the area conservationist or other designated SCS representative. The analysis is reviewed and updated annually and is approved by the state conservationist and state soil scientist. These instructions are appropriate for a conventional soil survey on private land in a soil conservation district, but must be revised to accommodate soil survey areas dominated by public lands and areas where the soil survey is primarily conducted by an agency other than SCS, except for the soil correlation phase.

Five of the responding states do much of their soil work under interagency agreements with SCS, and they reported that the workload analysis is being done by SCS. The remaining three said that the workload analysis was not formally being done.

It is recommended that a workload analysis be made for all BLM soil survey areas. This will help ensure that high quality soil surveys are made at a reasonable cost. For in-house BLM soil surveys, the workload analysis should be prepared by the party leader under the direction of

the district manager or other designated BLM representative. The analysis would be reviewed annually and approved by the state director or his designated representative. The BLM state soil scientist would be involved in the review process. For BLM soil surveys made by private contractors, the workload analysis would include the time assignments of BLM and SCS specialists in the soil survey, and would be prepared by the BLM district office soil scientist. (It is assumed that every district office will soon have a soil scientist.)

 $15. \ \ \mbox{Has the BLM coordinated the scheduling of individual soil survey areas with the SCS?}$

Coordinated scheduling of soil survey areas is essential to maintain a uniform flow of work and publications. NCSS cooperators coordinate soil survey schedules for which they have major responsibilities during annual State Soil Survey Planning Conferences.

All eight responding states are coordinating scheduling with SCS and other cooperators during the conferences. One state indicated that coordination was not in the detail described in the National Soils Handbook.

16. Is a soil survey plan of operations prepared for each BLM soil survey area on an annual basis by the party leader?

According to the National Soils Handbook, "A Plan of Soil Survey Operations" is prepared annually for each area in which soil survey time is planned. It is prepared by the party leader under the direction of the area conservationist, or his equivalent, if there are no administrative areas. Plans for individual survey areas are used to develop the plan of operations for states, and the SCS state soil scientist then prepares the state plan of operations. These instructions are written primarily for soil survey areas where the work is done by the SCS. They should be amended to meet the needs of other agencies that have NCSS leadership responsibilities.

Four of the responding states generally do prepare a plan of operations for each soil survey area, and four of them do not.

It is recommended that a plan of operations be prepared for each BLM soil survey area on an annual basis. The party leader will prepare the plans under the direction of the district manager. The BLM state soil scientist will consolidate the plans of operations for the individual soil survey areas into a state plan of operations.

17. Does each BLM state office maintain a map showing the status of the BLM soil survey program?

A map showing the status of the soil survey program is a part of the state soil survey plan of operations. It is a convenient procedure for showing past accomplishments and future expectations of the soil survey program by county, BLM district, and state, and is an excellent visual aid for briefing sessions.

Five of the responding states indicated that the BLM does maintain its own soil survey status map, and the remaining three states do not, but rely on the status map prepared by SCS. The legend for showing soil survey status may depart from the recommended one in the National Soils Handbook on those maps prepared by the BLM.

It is recommended that each BLM state office maintain a soil survey status map. A copy of these will be sent annually to the BLM Washington Office soil scientist or the Denver Service Center soil scientist, who will consolidate the information into a national map. The national map will be a valuable visual aid for BLM briefing sessions and regional and national soil survey planning conferences. Gold stars will be awarded to states on the national map which surpass their goals. Black crosses will be used to indicate states that failed to meet their goals.

18. Does the BLM prepare an annual state soil survey plan of operations in each state?

All BLM State Offices are required to prepare an annual plan of operations for the soil survey program for their annual work plans (budget process), and for BLM's long range soil survey plan. The state plan of operations described in the National Soils Handbook is more inclusive than these plans. It includes: (1) the minutes of the annual Soil Survey Planning Conference, (2) the soil survey status map, (3) a priority list for soil survey areas, (4) needs for soil investigations, (5) training needs, (6) use evaluation of newly published surveys, (7) other items for planning, (8) schedule of field reviews and correlations, (9) list of soil scientists, by agency, (10) list of party leaders, (11) contributions to the soil survey, and (12) mapping goals for the year. The SCS apparently prepares such a plan of operations for all soil survey areas that are part of the National Cooperative Soil Survey. All BLM soil surveys are part of the National Cooperative Soil Survey. Therefore, there is no reason to duplicate the SCS efforts in preparing a state soil survey plan of operations.

Six of the responding states indicated they are preparing an annual state soil survey plan of operations, and two are not. It is likely that some of the states answering in the affirmative were referring to the plan needed for the annual work plan of the budget process instead of the formal plan described in the National Soils Handbook.

It is recommended that the BLM not duplicate the efforts of the SCS in the development of a state soil survey plan of operations. The BLM should provide the SCS with the pertinent information of the BLM's soil survey program for the plan, however. The SCS should provide a copy of operations to the BLM State Office and other cooperators.

19. Are the soil series descriptions prepared by BLM Soil Scientists being made according to the standards and procedures of the National Cooperative Soil Survey?

Soil series are the most homogenous classes in the soil taxonomy system. Descriptions of representative pedons of each series are essential for the establishment of a record of the characteristics and geographic setting of each soil. Such information is needed to properly classify the soils, and to interpret them for applied use and treatment objectives. Good pedon descriptions are the backbone of the soil survey program. They are needed to develop the identification and descriptive legends in the early stages of the survey, and to prepare the soil survey interpretations in the latter phases of the survey.

Seven of the eight responding states answered this question affirmatively, and the eighth state has no BLM soil scientists at the district level in positions to prepare soil series descriptions.

20. Who is responsible for preparing the initial review draft for soil series descriptions and the Form SCS-Soils-5 for proposed series?

The SCS has the responsibility for assigning names to soil series. A request for the tentative recognition of a proposed soil series must be accompanied by two copies of the initial review draft of the official soil series description and the accompanying Form SCS-Soils-5. Requests for proposed series are made to the SCS State soil scientist and can be made by any cooperating agency in the National Cooperative Soil Survey.

Five of the responding states said that BLM soil survey party leaders prepare the initial review drafts and SCS-Soils-5 forms for proposed soil series. In one of these states, the materials are reviewed by a BLM soil correlator before being transmitted to the SCS. The remaining three states rely entirely on the SCS party leaders to prepare the documentation for proposed soil series.

21. Do all BLM soil survey party leaders have access to the National Soils Handbook?

One of the eight responding states has no BLM soil survey party leaders; the remaining seven states all responded affirmatively to this question. One state indicated they have had to loan copies to the party leaders of private contracting firms, a request which should leave serious doubts about the firm's cababilities to make soil surveys according to the NGS's standards.

22. Have the established procedures for quality control and soil correlation been adhered to for all BLM soil surveys started in 1978 or later?

On May 8, 1978, the BLM agreed to make soil surveys according to the standards of the National Cooperative Soil Survey. The procedures for

maintaining good quality survey work, and for correlating the soils with the taxonomic system, are quite rigid and require a series of reviews and reports.

All seven states answered this question affirmatively; one state qualified its answer by saying that the standards were adhered to for soil surveys done by the SCS, but not for those done by the BLM. One state said the quality control standards of the NCSS were not being adhered to.

It is recommended that all BLM soil surveys be done according to the standards of the National Cooperative Soil Survey, including the quality control and soil correlation work. This is mandated by the SVIM Manual and by Manual Section 7100.06A.

23. Does the BLM plan to abide by the soil correlation process of the National Cooperative Soil Survey for all soil surveys started in 1980 and thereafter?

All eight reporting states said yes to this question as long as the soil surveys were done by the SCS. One state reported that it does not have the administrative backing to make this possible for soil surveys made by BLM soil scientists.

All BLM soil surveys must be made according to the standards of the National Cooperative Soil Survey. Field Office Administrators who do not understand their responsibilities in this regard will have to be reminded of them and told to abide by official bureau policy by the Director or his representative.

24. Does the BLM State soil scientist or his representative participate in all the initial, progress, and final field reviews for all BLM soil surveys?

All eight reporting states said yes to this question. Some indicated they had to sometimes miss parts of the reviews because of scheduling conflicts and/or lack of time and manpower at the State Office level.

It is important that someone from the BLM State Office be a participant in all soil survey reviews to maintain the good quality of the soil surveys and to represent the special needs of BLM in the soil survey program with regard to soil survey interpretations, mapping unit design, and uses of the soil surveys for multiple-resource planning and management. An office that has the responsibility to "oversee standards, quality of soil inventory work, and evaluate technical performance" (BLM Manual Section 7100.04A2h) cannot afford to delegate this responsibility to someone at the district level or from another agency. The BLM state soil scientist or his representative should also participate in the field reviews of soil surveys under the leadership of other cooperators, such as the Forest Service and the SCS.

25. Has a satisfactory descriptive legend and Soil Handbook been developed for each BLM soil survey begun since 1978?

The descriptive legend is the basic document that governs the conduct of every soil survey. It consists of three parts: (1) descriptions and classifications of the soils; (2) identification legend; and (3) conventional and special symbols legend. A soil handbook consists of the descriptive legend, plus the basic contents of a published soil survey in preliminary form. It is used to provide information and maps before the soil survey is published.

All eight states reported that the descriptive legends and Soil Handbooks are being prepared in good form if the soil work is being done by the SCS. The BLM soil scientist party leaders are apparently doing a satisfactory job in this regard in some states, but not in others. One state reported that the private contractors do not always do an adequate job.

It is recommended that the descriptive legend and Soil Handbook be prepared according to the standards of the National Cooperative Soil Survey regardless of who is doing the work for the soil survey.

26. Is it appropriate to report acreage of soil survey work accomplished in the budget process at the time the Soil Handbook is compiled, considering that the official BLM policy is that acreage is not to be reported as accomplished for soil surveys until "the inventory and required reports are completed"?

The required report for a standard progressive soil survey might be considered the final soil survey publication. Others might consider the required report to be some form of interim report or the Soil Handbook. Some apparently report acreage as being accomplished even though no report has been completed.

Three states answered this question with an unqualified "yes". The remaining states made constructive comments because they have experienced difficulty in reporting progress of soil surveys in terms of acreage accomplished. The comments from one state are: "Reporting acreage as part of the budget process is of little value. The printouts seldom reflect the actual work done because most of the emphasis is placed on dollars in the budget process." Another state said, in effect, that it would be best to report acreage completed on a quarterly basis because it takes considerable time to assemble these data. To them It makes little sense to wait until the "required report" is finished before reporting the acreage accomplished, because the soils information is available as soon as the Soil Handbook is prepared. Another state reported: "Acreages are a tentative item, even if the field work is completed. This has created problems over the years on how to report accomplishments. One doesn't know the final acreage until publication."

The definition of Job 73-Inventory in BLM Manual Section 1684 is a horrendous hodge-podge which requires the services of a Philadelphia lawyer for interpretation and deciphering. Recommendations concerning the budget record-keeping system for natural resource inventories are made in another part of this report. Suffice it to say that it was recommended to discard Job 73 for soil surveys in favor of a new method.

27. Who measures the acreage of accomplished soil surveys and how is it done? Are there any problems related to measuring acreage?

In two states, the SCS does all the measuring. Surveys done by private contractors are measured by the contractors with some spot-checking by the BLM or SCS. Surveys made by BLM, and jointly by the BLM and SCS are measured by the BLM.

Measurements are made with planimeters and dot-counters. In some states the measurement is made by the soil scientists as they finish each field sheet; in others, the measurements are made by temporary clerical assistants.

None of the reporting states are experiencing any problems with measuring the acreage of accomplished soil survey work. In reviewing one of the soil survey reports completed by a private contractor, it was noted that the acreage table was missing. The reason given was that there was a dispute between the acreage contracted for and the acreage actually mapped, with the latter being the greater amount. The contractor appealed for, and eventually was granted, a higher payment to compensate for the difference.

Some states are reporting acreage by mapping unit only, including soil associations and soil complexes. Other states report the acreage for each soil phase. They calculate the acreage of each phase component of an association, or complex, based on their average percentage composition as determined when defining the composite mapping units and as described in the mapping unit descriptions. It is easier and faster to report acreage by mapping unit. However, for planning and management purposes it is important to know the acreage of each kind of soil phase and miscellaneous area. It is also more meaningful to present the soil survey interpretations by soil phase than by soil association, or complex, in the soil survey report, especially when the components of the composite mapping units are contrasting.

It is recommended that the acreage be measured or computed by soil phase instead of by mapping unit in the case of composite mapping units. Furthermore, it is recommended that the acreage measurements made by private contractors be spot-checked on a systematic basis.

 $28 \raisebox{-0.15ex}{\raisebox{-0.15ex}{$\scriptscriptstyle \bullet$}}$ Are all the BLM soil surveys being done at the third-order level of intensity?

The SVIM Manual calls for a third-order soil survey. Most of the BLM soil survey areas are being planned to meet the environment statement schedule requirements which gave rise to the soil survey procedures in the SVIM Manual.

Five of the eight reporting states said that all the soil surveys are at least as intense as third-order survey. Two of these states reported that small acreages are mapped at the second-order level, especially in forested areas. One state said that some of the surveys are more general than third-order soil surveys. Another state reported it is difficult to evaluate the intensity level because of lack of quality control.

It is recommended that all BLM soil surveys be at least as intense as a third-order soil survey according to policy established in the SVIM Manual. The Washington Office and state directors should deny all requests to deviate from the official BLM policy regarding the intensity level of soil surveys. Fourth-order soil surveys made as part of "modified" SVIM inventories will have to be done over again.

29. Are most of the mapping units soil associations?

Associations are the principal mapping units in third-order soil surveys, according to the National Soils Handbook. They are composed of two or more kinds of soil, or miscellaneous areas, that occur together in a regular geographic pattern and in areas individually large enough to be delineated separately at the scale of mapping. Complexes, on the other hand, consist of a mixture of two or more soils or miscellaneous areas in which the pattern is so intricate they cannot be delineated separately at the scale of mapping.

Seven reporting states indicated that soil associations are the most common mapping unit being used. Consociations and complexes are used wherever appropriate. One state said that consociations are the most common type of mapping unit.

In the SVIM process the site writeup area (SWA) delineations are for a specific vegetation condition class of a particular range site. Many soil associations include two or more range sites, correlated with soil series or miscellaneous areas. Therefore, it would be helpful to the range conservationists in the SVIM process if consociations were the usual soil mapping unit. The extra time spent by the soil scientist using this system would be more than compensated for by the time saved by the vegetation mapper and sampler.

30. Are there any problems in the selection of the location of the transects for the vegetation sampling phase of the vegetation inventory of the SVIM process in soil associations? Do most soil associations include more than one kind of range site? How are the problems, if any, being resolved?

The vegetation sampling (transecting) phase of the vegetation inventory method is done by site writeup area (SWA). A SWA consists of a specific range site in a specific condition class, unless it is a complex.

Six of the eight reporting states acknowledged that there are problems in the selection of the sampling transects in soil associations. All eight states acknowledged that associations generally include more than one kind of range site.

The problem of selecting the two or more places for vegetation sampling in an association with two or more range sites is conveniently handled when the SWA's and the soil mapping units are delineated at the same time by a mapping team consisting of a soil scientist and a range conservationist. Selecting the proper places to sample the vegetation in a soil association becomes more difficult when the range conservationists map the SWA's later, after the soil survey has been made.

One state reported four major kinds of problems in the selection of vegetation sampling transects in soil associations. They are: (1) the present vegetation bears no resemblance to that described in any of the four condition classes of the range sites correlated with the soils in the soil association; (2) inclusions of soils and their related range sites make up too large a percentage of the mapping unit area and therefore confuse the vegetation mapping team; (3) some of the mapping units called soil associations are actually soil complexes; and (4) the soil mapping unit descriptions often inadequately describe the landscape position of the various soil association components.

These kinds of problems commonly require bringing in a soil scientist and a range conservationist to remap the disputed areas. In some states the range conservationists are trained to identify the major soils occurring in the soil identification and descriptive legends, becoming adept at accurately delineating the SWA's to conform with the component soils of a soil association.

It is recommended wherever possible that the SWA's be delineated at the same time that the soil survey is being made by using a mapping team consisting of both a soil scientist and a range conservationist. That way, SWA's that are not typical of anything in the soil descriptive legend or the range guide can be resolved on the spot by arbitration, good judgment, and common sense. If need be, additions to the soil legend and to the range guide can be recommended to the party leader if the troublesome areas are extensive enough. Furthermore, as mentioned in the previous question, consociations should be the usual soil mapping unit for SVIM inventories.

31. Are the BLM District Soil Scientists well enough trained and experienced to be competent soil survey party leaders? Do they have ample time to serve as a party leader, as well as meet their other duties?

The states reported that some of the district soil scientists are qualified to be competent soil survey party leaders and others are not. For all the reporting states, collectively about half the district soil scientists appear to be capable of leading a soil survey party. In some states the majority of the BLM Soil Scientists were rated as not capable. One state has equal numbers in both classes.

All eight states said that the district soil scientist does not have sufficient time to be both a soil survey party leader and to carry on his or her other duties. They are heavily involved in the planning process and the resource management process. Lacking adequate supervision and time, it is difficult for an inexperienced BLM soil scientist to gain the knowledge required to be a soil survey party leader.

It is recommended that BLM districts with active soil survey programs have two GS-11 soil scientists: one who is a competent soil survey party leader and one who will primarily be responsible for the planning and resource management activities.

32. When are range sites and condition classes determined in the SVIM surveys — at the time of soil mapping or later?

Four of the responding states reported that range site and condition class determinations are made at the same time as the soils are mapped. One of these reported that verification of the condition class determination is made at the time of sampling the vegetation. Four of the states reported that the condition class (SWA) determinations are made by a second vegetation mapping process. These, naturally, are the same states which are experiencing the most problems with determining the sampling (transecting) locations in soil associations.

It is recommended that wherever possible the condition classes be determined and the SWA's be delineated at the same time that the soil survey is being made. This will result in more accurate and useful maps of both the soils and the vegetation and will save time and money while preserving harmony and good fellowship between the disciplines and between agencies.

33. Is the soil survey work being done for the SVIM process being published as an interim or special soil survey report for in-service use as specified in the SVIM Manual?

Four of the reoprting States indicate they are violating this policy and four indicate they are publishing an interim or special soil survey report for in-service use.

It is recomended that the SVIM Manual be revised to substitute the word "compiled" for "published" in the policy statement on soil survey reports. The Soil Handbook will generally suffice as a soil survey report until the soil survey area is formally published.

34. Are enough copies of the Soil Handbook being prepared, so that they could be made available to individuals from BLM Offices or other agencies outside of the District in which the soil survey was made?

Five of the responding States indicated that copies of the Soil Handbook are not available to persons or offices outside of the concerned District. The other three said sufficient copies are available, or can be made available upon request.

It is recommended that at least sufficient copies of the Soil Handbook, or a comparable interim soil survey report, be compiled, so that they can be made available to individuals in other areas with similar soils that have an on-going, or are preparing for, soil surveys. They would be very beneficial for defining and designing mapping units and for identification legend development. They would also save duplication of effort, and bring about greater uniformity, in making soil survey interpretations. They should also be made available to Forest Service and SCS soil survey parties working in areas adjacent to BIM soil surveys. Likewise, the BLM should have access to the Soil Handbook from other cooperators in the National Cooperative Soil Survey.

35. The SVIM Manual says, "the SVIM party normally consists of a party chief, a soil survey team, a mapping team, and a vegetation inventory (transecting) team." Are the names of the various teams clearly differentiated and understandable?

Four of the responding states believe the names given to the various teams are confusing, and four states believe they are adequately and clearly differentiated.

The "mapping" team really refers to the "vegetation" mapping team, but can be confused with the soil survey team which also includes a "mapping" team. For many SVIM inventories the "mapping" team is actually composed of a soil mapper and a vegetation mapper working side-by-side. The vegetation inventory (transccting) team is really the vegetation sampling team. The word, inventory, is a general term referring to all phases of a survey or inventory system, and is not just the sampling phase of any inventory system. Transccting is part of the procedure for the sampling process and is too specific a term for what is intended by the title of the team. In some SVIM inventories there are two party leaders, one for the soil survey, and one for the vegetation inventory. The name of SVIM should be: Soil and Vegetation Inventory Methods, instead of Soil-Vegetation Inventory Method, because it

It is recommended that the description in the SVIM Manual of the labor force required to make the soil and vegetation inventories be revised to read: The soil and vegetation inventories are normally made by mapping teams composed of a soil scientist and a range conservationist. The vegetation is sampled by a vegetation sampling team after the SWA's have been delineated and stratified. A party leader is in charge of all members of the mapping and sampling teams. The second in command (assistant party leader) will be of the opposite discipline as that of the party chief (either a soil scientist or a range conservationist). When the vegetation inventory is made after the soil survey, the party chief and his assistant will normally both be range conservationists.

36. Is degree of accelerated erosion being used to define soil mapping unit phases on BLM soil surveys?

Five of the responding states said that accelerated erosion is never used as a phase criterion, one said it was seldom used, and two said it is commonly used.

On cultivated land, moderate to high degrees of accelerated erosion are known to reduce soil productivity and to have an influence on land use and land treatment practices. Some areas of rangeland probably have also been subject to enough accelerated erosion, because of excessive removal of ground cover, to impair soil productivity and the quality of the surface runoff water. Not much research has been done on rangeland to determine the level of accelerated erosion that causes an impairment of productivity and which requires special erosion controlling management and treatment practices. The BLM does not differentiate between accelerated erosion and geologic erosion in their system for measuring erosion condition class. That system is required on all SWA's selected for sampling of the vegetation. It has five degrees or classes of erosion condition. Quite likely, most of the areas determined by that system to be in the two highest degrees of erosion (critical and severe) are areas with high degrees of geologic erosion caused by natural sparse cover, steep slopes, and shallow soils, or by high winds combined with sandy, droughty, infertile, or salty soils.

Considering that it is BLM policy to determine the erosion condition class of each SWA selected for vegetation sampling and that little is known about the critical limits of accelerated erosion to rangeland soil productivity impairment in the western states, it is recommended that the degree of accelerated erosion generally not be used as a phase criterion for defining soil mapping units. Small areas obviously severely affected by accelerated erosion can be shown by spot-symbols on the soil mapp.

37. Is the determination of the Soil Surface Factor (SSF), or Erosion Condition Class useful in planning and management? Four of the responding states gave unqualified affirmative answers to this question; the remaining four gave negative or noncommittal answers. Two states said its grantest use is for predicting future erosion conditions under present and proposed management systems, if it is used by experienced or qualified evaluators.

38. Is there any difference in the quality of BLM soil surveys made by the BLM, the SCS, and private contractors?

Four of the responding states have received a lower-quality soil survey from private contractors than from either the SCS or the BLM. The consensus is that the soil scientists employed by the private contracts are capable of making good soil surveys, but because of the short contract period, produce a product with errors in mapping, and/or that is too general. The soil scientists are often pushed to map larger acreages than is practical. The tendency among most states is to reduce the number of soil surveys made by private contractors and to increase the number of soil surveys made by the SCS under interagency agreements,

One of the states could not make a comparative evaluation, because all the BLM soil surveys had been made by the SCS. One state commented that the quality of the survey depended upon the competency of the party leader, regardless of who he worked for. Two states rated the SCS and BLM as about equal in this endeavor, and both are good. One state rated the SCS soil surveys as the best.

Theoretically, there should be little difference in the quality of the soil surveys, regardless of who is doing the work, if the quality control and correlation work is done according to the standards of the National Cooperative Soil Survey. The BLM has major responsibility for quality control. The SCS has the responsibility for soil correlation. These items will be spelled out in the statement-of-work (SOW) of the request-for-proposal (RFP) for contracts, as well as in the memorandum of understanding for the soil survey area and in the annual plan of operations for the soil survey area.

39. Are there any problems with obtaining base map coverage, supplies, and equipment for the BLM's soil survey program?

Four of the responding states have not experienced any problems in getting maps or any other materials and equipment for the soil survey program. The remaining four states have all experienced some delays in getting the orthophoto maps. Vehicles and office space were also mentioned as being in short supply by one state.

40. Is the BLM following the guidelines of the National Soils Handbook for writing the mapping unit descriptions in the descriptive legend? Is the BLM making use of the computer-assisted-writing (CAW) technique for writing mapping unit descriptions? All eight responding states are preparing the mapping unit descriptions according to the guidelines of the National Cooperative Soil Survey. Furthermore, six of the eight states are making use of the CAW as part of the cooperative working relations with the SCS.

41. Does the BLM need special soil survey interpretations and information on soil behavior to meet its soil use and management needs, which are not normally included in conventional soil survey publications?

Seven states responded to this question affirmatively, and one state did not respond at all. Examples of items recommended to be included, or expanded upon, in BLM soil survey reports include:

- Proper range and watershed management techniques,
- 2. Erosion susceptibility,
- 3. Seeding Suitability,
- 4. Brush conversion suitability,
- Juniper invasion hazard,
- Regeneration hazard,
 Species adaptability.
- 8. Prescribed burning suitability.
- 9. Soil compaction hazard, and
- 10. Impacts of multiple land-use activities.

One state has considered publication of supplemental reports, or attachments to the soil survey reports, which would be devoted entirely to soil behavior information in a form easily usable by resource managers. The BLM and SCS would collaborate in the development of these supplemental soil behavior reports. This approach is similar to the Technical Guide concept of the SCS, and seems worthy of adoption by the BLM.

42. Are the identification legends prepared according to the guidelines of the National Soil Handbook for BLM soil surveys?

All eight responding states reported in the affirmative to this question. One state said the soil surveys made entirely by BLM soil scientists do deviate from these guidelines.

43. Do the mapping unit symbols conform to the standards of the National Cooperative Soil Survey for BLM soil surveys begun since 1978?

All eight responding states said "yes" to this question. That means each state is probably violating the guidelines for the symbolization of soil taxonomic units which is prescribed in BLM Manual Section 7312.13E3a. The four digit symbols required to identify a soil series make it impossible to symbolize a soil association in harmony with the standards of the National Cooperative Soil Survey. Manual Section 7312

needs to be revised to conform with more recent policy of the BLM concerning the standards and procedures for making soil surveys. Obsolete materials in the BLM Manual should be deleted as soon as possible.

44. Are there any problems associated with having the initial, progress, and final field reviews all in the same calendar year?

Four of the responding states have experienced difficulty conducting all the quality control field reviews for a soil survey in one calendar year, especially with contracted soil surveys. Considerable mapping time is lost in making preparations for, and in conducting, the field reviews. Representatives from other cooperating agencies seldom attend the reviews. Considerable support time is expended by correlators, range specialists, and party leaders under this arrangement.

The four states who have not experienced this kind of problem generally are having their soil surveys made by the SCS. Perhaps they seldom have to complete all field reviews for a soil survey area in one calendar year.

Wherever possible, a soil survey should be scheduled over at least two field seasons.

45. Can the BLM make all the soil surveys required to meet the environmental statement schedule, while at the same time, meet all the standards of the National Cooperative Soil Survey?

Four of the eight responding states said it is not possible to meet both objectives of this question, and the remaining states said they are doing the job but with some difficulty. The ones who said they are sacrificing quality at the expense of quantity claimed a shortage of manpower, funds, and time to do the job adequately. One comment was: "Sin in haste - repent in leisure!" Another state response was: "Unrealistic time schedules have been the problem from the very beginning. If worse comes to worse, I would rather complete 55 percent of the area, maintaining quality, and project on the balance of the area, than complete 100 percent, and not have anything to go to court with. It is simply amazing to me, even after all these years with the government, that we have time to redo something, but never enough time to do it right the first time."

46. Who in the BLM signs the field review reports for the soil surveys?

According to the National Soil Handbook: "Representatives of cooperating agencies are given the opportunity to sign all review reports. Representatives of cooperating agencies are encouraged to sign review reports when their agency accepts the responsibility for or is scheduled to carry out a specific action indicated in the review, or to indicate their participation or concurrence in the report."

Oddly enough, no one from the BLM has been signing field review reports in five of the eight states, despite the scope of the BLM's soil survey program, and the fact that the Bureau has the major responsibility for quality control up to the final correlation step for those soil survey areas dominated by public lands. One of the states which has had no BLM person approving the field review reports, will use the BLM state soil scientist to perform that task in 1980.

In two of the states, a BLM soil correlator signs the field review reports, and in one of the states it is done by the BLM state soil scientist.

It is recommended that the BLM soil correlator (if available) or the state soil scientist endorse all field review reports.

47. Does a representative of the private contractor sign field review reports?

This question was only applicable to three of the responding states: two answered negatively, one answered posttively. However, the remedial actions required as a result of the field review are always thoroughly discussed with the contractor's representative during the review closeout session.

48. Has the field and laboratory soil characterization support phase of the soil survey program been adequate for BLM soil surveys?

Four of the responding states answered "yes" to this question. One of them has an interagency agreement with the Soil Survey Laboratory at Lincoln, Nebraska, specifically for this item. The other three rely heavily on their State Agricultural Experiment Stations for laboratory support work, but also may use the laboratory at Lincoln, Nebraska.

The remaining four states said the soil characterization work is minimal or inadequate. One state commented that: "There is not enough manpower or administrative support to do these things."

One state said they cannot keep up with the soil characterization work during the mapping period, but they are planning to do the soil characterization work in the following year. The results will then be available for interpreting and properly classifying the soils when the soil survey report is written.

One state had used private laboratories to make the chemical and physical property measurements, but found the results to be unreliable. It is important that the analytical procedures be consistent for the various measurements, so that the data are transferable. Ideally, it would be best if all the BLM's laboratory support work were done at one laboratory, the Soil Survey Laboratory at Lincoln, Nebraska. When the analyses are performed at Agricultural Experiment Stations, it should be

requested that their analytical procedures be the same as those used by the Soil Survey Laboratory.

49. Who in the BLM reviews and edits the manuscripts for BLM soil surveys?

The manuscripts are being reviewed by one or more BLM employee in seven of the eight responding states, but no one from the BLM has been reviewing the manuscripts in the eighth state. Generally, both the district soil scientist and the state soil scientist, or his representative, review the manuscripts. In one or more states, they are also reviewed by the COAR; the Chief, Division of Resource; and the state range conservationist, or his representative.

Careful review of these manuscripts by the BLM is essential to ensure inclusion of the special needs of the BLM in these reports. They will be pouring in at a big rate in the next few years. Ample time should be allotted to this task in the annual work plan process.

50. Should a BLM representative from the Washington Office and/or Denver Service Center be involved in the soil survey manuscript review process?

The reaction from the states was mixed in response to this question. Five of the states do not think the Washington Office or the Denver Service Center should be involved in the review process because of lack of manpower and expertise at those levels, and because the SCS already has an expert staff for that process that will be involved in every soil survey report made by the National Cooperative Soil Survey.

Three of the states thought that someone above the state office level should review the manuscripts to ensure greater uniformity in the products.

It is recommended that neither the Washington Office nor the Denver Service Center need be Involved in the soil survey manuscript review process because the district and states can review them for content of special interest to the BLM, and the SCS can review them for style and rhetoric.

51. Are interim soil survey reports being planned for publication for the BLM soil surveys?

Four of the states do not plan on publishing interim soil survey reports; three do; and one is undecided.

Those who do not publish interim or special soil survey reports are violating the official policy in that regard given in BIM Manual Section 4412.12C1, the SVIM Manual. A good Soils Handbook serves most functions of an interim report.

It is recommended that the requirement to publish an interim soil survey report be deleted from the SVIM Manual.

52. What year will each state complete the mapping stage of the soil survey process on a once-over basis?

The eight responding states plan on completing the soil mapping in: 1983 (three states); 1985; 1986 or 1987; 1989, 1990; and 1995. The goal of the National Cooperative Soil Survey is to complete the soil mapping of the United States on a once-over basis by 1996. The BIM goals are within that time frame.

53. Has the BLM developed any special soil interpretative groupings for their own needs?

Three of the responding states have not developed any special interpretations, and apparently have not made use of those developed in the other states. The remaining five states all reported the development of one or more special interpretation. These include: (1) a timber production capability classification; (2) groupings of cultural and paleontological value; (3) groupings of pristine or relict vegetation; (4) groupings of gem or rock-hound significance; (5) wildlife habitat groupings; (6) range seeding suitability; (7) seral communities for condition classes of each range site; and (8) wildlife relations to the seral communities.

It appears that the development of special soil survey interpretations is primarily a state level of activity, and there is little coordination and sharing of these actions between states within the BLM. It is recommended that the Washington Office and/or Denver Service Center Soil Scientist coordinate the soil survey interpretation efforts for the entire BLM.

54. Has the training of BLM soil scientists been adequate?

Item 10, of the national level memorandum of understanding regarding making soil surveys states that: The Service (SCS) will provide training for Bureau soil scientists at scheduled workshops.

Two of the states are satisfied with their soil scientists' training, but the other six are not. Some states have never had a BLM soil scientist attend a scheduled SCS workshop. Others had had one or two soil scientists accepted for the workshops over the years. One state complained that BLM administrative approval was not attainable, even if the SCS could accommodate more BLM soil scientists at their workshops.

The best kind of training is on-the-job training under a qualified party leader and mentor. This is not always possible because of the lack of qualified party leaders in the BLM. In some states arrangements have been made where the BLM soil scientists work under the tutelage of an SCS party leader. This is a very satisfactory arrangement and should be

encouraged wherever possible. In some states, inexperienced BLM soil scientists have been detailed to districts with qualified BLM party leaders. This is just as effective as the SCS working arrangement if the training period is long enough to merit it; however, it is commonly for only a few weeks, and that is not sufficient. Workshops are of greatest value to someone who has some good field experience in addition to their classroom studies. A person will never develop into a competent soil scientist by sitting in the classroom and reading books.

55. Has the BLM soil survey program been funded adequately?

Three states report they have been funded adequately, and five states claim they have not. Some states have had to cut back their soil survey program because of the lack of support. Consequently, the soils data going into the planning system for the environmental statements is in-adequate.

States depending upon the SCS for soil survey work are burdened with the dilemma that the SCS can only be paid for services rendered on public lands after the survey has been completed; meanwhile, the BLM has to request and obligate funds at the beginning of the effort. Both the requests for funds and the reimbursements are based on an acreage figure. To make the initial requests equal to the final reimbursements requires much skill, but more luck.

The BLM Washington Office often waits until the year the soil survey is to be completed before allocating any funds for that survey; therefore, the inventory phase of the planning and environmental statement process is too short. It is hoped the new Washington Office soil scientist will be able to rectify this problem, as according to the position announcement for that job, he has the authority to appropriate funds and positions.

One state has been receiving 25 percent less than their cost target for the soil survey program. Another state has recently had to give up a half-time, WAE soil scientist position, and lacks funds for adequate quality control and manuscript review.

56. What kinds of duties are performed by BLM district soil scientists other than the soil survey work?

Most BLM district soil scientists have other duties in addition to those related to the soil survey program. The duties include: (1) writing URA's (Unit Resource Analyses); (2) revising and developing range sites with the range conservationists; (3) preparing contracts for special studies; (4) leading the water and air management programs; (5) contributing to the annual work plan and four-year authorization documents; (7) coordinating with other agencies; (8) contributing to State Office BLM Manual supplements; (9) participating in district functional evaluations; (10) providing technical assistance to other

resource specialists and managers; (11) reviewing training needs; (12) contributing to the entire planning process; (13) conducting on-site investigations for roads, dams, fences, landings, etc.; (14) making reviews of projects involving timber sales, seeding, mining, oil and gas exploration, burns, etc.; (15) keeping up with the literature and correspondence regarding soil management and land use; (16) planning and conducting trips for industry, schools, and the public; (17) assisting in developing AMP's (Allotment Management Plans); (18) monitoring water and air quality; (19) selecting sites for grazing studies, exclosures, etc.; and (20) supervising summer temporary employees working on soil, water, and air inventory and management programs.

Some BLM administrators involved in the budget allocation process believe that the soil scientists devote, or can devote, most of their time and energy to the soil survey program. States with relatively large numbers of BLM soil scientists have been accused of not using them effectively in the BLM's soil survey program. What has been needed is a fuller description of a soil scientist's various duties.

57. Does every BLM district have at least one soil scientist?

Six of the eight reporting states have at least one soil scientist in every district office. The other two are anticipating that each district will have one soon (maybe in 1980). It is inconceivable that an agency responsible for managing the soils so that they last forever does not have a soil scientist on the staff of the office that has the prime responsibility for that goal.

58. In districts without a soil scientist, who prepares the soil survey work plan (memorandum of understanding for a soil survey area)?

In all eight states this job is done by the State Office soil scientist. In fact, it is commonly done by the state soil scientist, even when there is a district soil scientist. Manual Section 1700.06448 gives this responsibility solely to the district soil scientist. The manual should be revised to conform with actual practice or actual practice should be made to conform with official BLM policy.

59. What are the comparative advantages and disadvantages of having BLM soil surveys made by in-house BLM employees, by SCS employees, and by private contractors?

Advantages of using in-house BLM soil scientists were given as follows:

- 1. The BLM maintains direct control of the progress of the soil survey.
- 2. The BLM maintains direct control of the quality of the survey, including the special needs of the BLM.

- 3. The training of inexperienced BLM soil scientists can better be accomplished because the party leader is well qualified.
- 4. Knowledge gained about the area and the natural resources during the mapping process stays in the district as long as the soil scientists remain there and in the BIM as long as the soil scientists remain with the BIM.
- 5. Good quality is easier to maintain, because the soil scientists are familiar with the intended uses of the survey, and know they will be around to be held accountable for errors and omissions.
- 6. Items and features of special interest to recreational uses, wildlife habitat, watershed management, and natural or cultural history areas are more apt to be mapped by BLM soil scientists because they appreciate their significance to the BLM's programs.
- $7. \ \ \,$ There are fewer personnel problems because of stability of location and continuity of employment.

Disadvantages of using in-house BLM soil scientists for the BLM soils surveys were listed as:

- 1_{\star} BLM soil scientists are sometimes poorly trained and do not understand the standards of the National Cooperative Soil Survey.
- $2\,\text{.}\hspace{0.1in}$ They have too many other duties and responsibilities to give proper attention to the soil survey program.
- 3. The BLM administration does not give proper support to BLM soil surveyors because they do not understand the work-load demands, time frames, equipment needs, office needs, etc. of the soil survey program.
- $4 \hspace{0.5mm} \cdot$ The BLM lacks the expertise and personnel to monitor quality control adequately.
 - 5. There are few qualified party leaders within the BLM.
- $6\, \cdot \,$ The required number of soil scientist positions cannot always be obtained because of personnel ceilings and an unstable funding base.

The advantages of using the SCS, or mixed SCS/BLM soil scientists were listed as:

- 1. The soil scientists are very well trained.
- 2. Quality control is very good.
- The soil scientists appreciate the ultimate uses of their product, and take pride in their work. They are true professionals, generally.

- 4. The SCS may not be as limited as the BLM by personnel ceilings.
- 5. The SCS has good laboratory facilities.
- 6. The SCS administration understands the soil survey process, gives the soil scientist good support, and adheres to planned schedules of operations. SCS soil scientists do not have to abruptly change horses in the middle of the stream nearly as often as do the BLM soil scientists. BLM soil scientists must be able to SVINK or SVIM!

Disadvantages of using the SCS soil survey parties were listed as:

- 1. Some SCS soil scientists lack experience making third-order soil surveys and tend to be too detailed and slow.
- Many SCS soil scientists lack knowledge and experience about the use of soil survey information for functions other than farming.
 - 3. The publication schedule is too slow.
- 4. The SCS soil scientists may have to find temporary quarters and be moved periodically.
- 5. The SCS state conservationist may not be willing or able to alter his work-force for a few years to meet the temporary needs of the BLM.

- 1. There is no problem with personnel ceilings because funds for contracts are easier to attain than are positions.
 - 2. No training is involved by the BLM.
 - 3. Soil survey areas are finished quickly and more cheaply.
 - 4. Contractors furnish most of their own equipment.
 - 5. Employment is given to retired ex-civil service employees.
 - 6. Contractors are more mobile.

The disadvantages of using private contractors were listed as:

- 1. Poor quality of product.
- Large amount of time by COAR and other BLM employees to monitor quality control and administer the contractual arrangements.
 - 3. Unrealistic short time-frames in the survey statement-of-work.

- Some contracting soil scientists do not appreciate the BLM needs in relation to multiple-use resource management for the soil survey.
 - 5. Most contractors do not have laboratory facilities.
 - 6. Soil survey reports are sometimes inadequate.
- 7. The knowledge gained by the mapper during the survey stays with the individual when he leaves the area.
- 8. Expertise shown in the bid for a contract is top-heavy for window-dressing purposes while the actual soil mappers who show up have minimal qualifications.
 - 9. Contractors resist the quality-control work that is required.
- $10. \ \,$ Contractors sometimes use soil engineers instead of pedologists for the mapping.

Several states commented that the SCS or joint SCS/BLM arrangement was the best for making soil surveys, and that the contractor method was the least desirable. Most states have had little experience with using the in-house BLM employee method.

60. Are the costs for making BLM soil surveys ever charged to other subactivities or $\underline{\text{vice versa}}?$

Four of the responding states have no knowledge of the costs of the soil survey work ever being charged to other functions or subactivities. One of these made an exception concerning helicopter time one year, when other subactivities were invited to make "free" use of the helicopter because the soil survey program had overestimated the hours of use for that program.

The other four states reported that soil survey work had, at times, been charged to such accounts as EMRIA, Forest Management, and Range Management.

61. Which agency is responsible for determining the range site associated with each soil series or soil phase?

Five of the responding states said the SCS is primarily responsible for this determination, and the remaining three said the BLM is taking the major responsibility. There generally is a cooperative effort between the BLM and SCS regardless of which agency has the primary responsibility. One state has an SCS range conservationist on detail in the BLM State Office to assist in defining, describing, updating, and assigning range sites. Another state employs a retired SCS range conservationist on a temporary basis to do this. Some states assign a BLM range conservationist to work with the SCS range conservationist on this effort.

Bureau of Land Management Library Bldg. 50, Denver Federal Center Denver, CO 80225 As the BLM becomes more familiar with the range site concept, it is anticipated they will take on a greater share of the responsibility for the revision and establishment of range sites.

62. Are there cases where a soil series is associated with more than one kind of range site because of phase (mapping unit) differences?

Five of the responding states said "yes" to this questions. It is possible to have more than one kind of range site associated with a single series based on differences in the soil that are defined at the phase level of the mapping units. One state indicated that occasionally a single phase of a specific soil series may even have two different range sites.

Two states responded that the same soil series can have different condition classes, but not different range sites. Another state was not aware of any cases where more than one range site was associated with a single soil series.

One of the greatest needs of the SVIM process is a formal range sitesoil correlation system. Until this is done, the transferability of the range site information between states and perhaps between adjacent soil survey areas in the same state will be seriously hampered. It is recommended that the BLM join forces with the SCS and other cooperating agencies, such as the Forest Service and Agricultural Experiment Stations, to develop a formal range site-soil correlation system. The BLM is gathering a wealth of soil and vegetation data from the SVIM process that can be used for the range site correlation process.

 $\,$ 63. Is there a need for BLM soil correlator positions since the SCS has the final authority for soil correlation?

Four of the responding states said there is a definite need for BLM soil correlators because the surveys are being conducted on lands administered by the BLM and the BLM is responsible for providing adequate, pertinent data to meet resource and management needs. The BLM is responsible for quality control even though the SCS is responsible for the final correlation process.

The four states who responded in the opposite manner to this question had most of their soil survey work done by the SCS under interagency agreements. One of these states remarked that a State Office "coordinator" is needed to maintain quality, however.

The state soil scientist has many duties and responsibilities related to the soil survey and the soil management programs. Many state soil survey programs have expanded to the point that it has become impossible for one state soil scientist to satisfactorily accomplish all the duties he is obliged to perform. It is recommended that the states with significant soil survey goals remaining have at least two State Office soil

scientist positions. One of these would have prime responsibility for the control of the quality of the soil surveys. He would ensure that BLM soil surveys are made according to the standards and procedures of the National Cooperative Soil Survey. The title of soil correlator would be appropriate.

64. How is the party leader selected in mixed BLM-SCS soil survey parties or mixed BLM-other agency parties?

Six of the responding states reported that to date the party leader of a mixed BLM-SCS party has always been from the SCS. Reasons for this are that the BLM soil scientists lack the necessary experience and qualifications. However, in one or two states the time is ripe for having a BLM soil scientist serve as party leader of a mixed crew.

One of the states reported that the party leader of a mixed party is selected by mutual agreement of the SCS and BLM District Office and State Office technical supervisors after reviewing the qualifications of potential party leaders from both agencies. The best person is selected regardless of for whom he or she works.

The eighth state has had essentially all of its soil survey work done by the SCS and has not used mixed SCS-BLM parties.

It is important to have a party leader who commands the respect of each party member and only the most competent of the party will do that. It is recommended that party leaders for either mixed or unmixed parties be selected solely on the basis of competency for the job. The pace and the quality of the soil survey is determined by the leadership displayed by the party leader.

65. How have the problems been handled which are associated with BLM soil survey areas containing significant amounts of private and state land interspersed with the public lands administered by the BLM?

The BLM cannot pay for soil surveys made on land other than that under its jurisdiction. In some areas the public land is in a checkerboard pattern with alternate sections controlled by different agencies or individuals. Even in vast areas of contiguous public lands there are either two or four sections of state lands per township in most states. To delete these areas from a soil survey map makes for an odd looking product, as well as one that is less useful than one which includes all of the land within its boundaries. Sometimes the BLM administers scattered outlying sections or fractions of a section that make up a small proportion of the total area. This also causes cartographic problems, as well as logistical problems while doing the mapping. A soil survey area made according to the standards and policies of the National Cooperative Soil Survey, on the other hand, cannot exclude areas because of differences in ownership. The problems associated with a multiple-ownership land pattern are most troublesome for soil surveys made by contractors and by BLM parties.

Five of the responding states reported the land ownership pattern does not create any problem because the SCS is involved in the soil surveys. If the survey crew is mixed, persons from either agency map the land regardless of its ownership. If the party is composed of only SCS personnel, the interagency agreement is prepared to pay only for the work done on the public lands, but the soil scientists map all the land.

Two of the states reported that where the party is made up of BLM employees, they map the public land and some "other" land to block out the surveyed areas in a reasonable manner. Acreage is tabulated for both the public land and the "other" land, but naturally the "other" land is not surveyed at BLM expense. On paper, the soil survey of the "other" land is free. The SCS eventually will have to follow through and complete the mapping of the private and other non-BLM administered lands in such areas.

Contractors naturally are reluctant to map any land they are not paid for mapping. They show isolated quarter-sections and half-sections of public land on the soil map as mapped and the remaining land is left blank. Again, the SCS will have to follow through the same area and complete mapping all the land not administered by the BLM. This leads to inefficiencies in the use of manpower, funds, and energy, but apparently is necessary to abide by the law.

The states have generally developed good, practical solutions to this kind of problem that is caused by bureaucratic regulations. One state offered the sound advice: "As long as the Washington Office does not get involved in technicalities, we at the state level can get it accomplished."

66. Will the soil maps prepared from the SVIM process be printed in the soil survey publications at the same scale as that of the field sheers?

Six of the responding states believed that the map publication scale would be the same as that of the field sheets (commonly 1:24,000), but not all were sure of that. The hesitation in the responses suggests that the memorandum of understanding for individual soil survey areas need to be completed, as map publication scale is one of the items described in that document. The published map scale has a bearing on the design of mapping units and should be agreed upon before the development of the identification and descriptive legends.

Two of the responding states said that the scale of the published soil map will be, or probably will be, smaller than that of the field sheets.

67. Manual Section 7100.04A assigns the Washington Office responsibility for the BLM soil programs to the Chief, Division of Watershed. As a result of a recognization in 1979 the Division of Watershed was abolished and this responsibility was assigned to the Chief, Division of Rangeland Management. Is the Division of Rangeland Management the appropriate office for this responsibility?

Five of the states emphatically said "no" to this question; two said "yes" and one preferred not to respond. Comments and alternative suggerstions from the states opposed to the current organizational arrangement at the Washington Office regarding the soils program include:

- 1. There should be a Division of Soils at the Washington Office level and it should be staffed accordingly to oversee the BLM's soil program. Range people do not have the proper training or perspective to satisfactorily handle the BLM soils program. There is a complete lack of understanding on the part of the administration as to the significance of an ongoing soils program to the entire resource management system. This lack of understanding is pervasive at all levels of the Bureau's organizational structure. It prevails because many of the administrators have risen from the ranks of the range conservationists and they lack the proper training and perspective to handle the soils program. Unless a soils division or branch is set up at the Washington Office, very little can be accomplished at the local level.
- The responsibility for the soils program at the Washington Office level should be shared equally by the Chief, Division of Rangeland Management and the Chief, Division of Forestry.
- 3. The responsibility of the soils program should be under Washington Office 211, Water Resources Policy Staff, and that office should be renamed the Soils and Water Resources Staff. Soils are a natural resource that interact with all the other natural resources, not just with the forage for livestock and wild horses and burros. However, it is improbable that the BIM will establish a Division of Soils, because little revenue is gained from selling soil and the public is not outraged about the way the soils have been managed on the public lands. The Division of Rangeland is not a bad second choice now for administering the soils program because the current grazing environmental impact statement schedule has done much to improve the BLM's soil survey program.
- 4. It is difficult to find the proper slot for the soils program in the present Washington Office organizational structure, but it does not belong under the Division of Rangeland Management. The soils program should have its own Division Chief under the Assistant Director for Renewable Resources possibly it should be under the Deputy Director for Lands and Resources. The office might be designated as Division of Soils Inventory, Management and Protection. Being buried under the Division of Rangeland Management or any other functional division is totally undesirable.
- 5. The soils program would be more responsively administered within a Division of Watershed than within the Division of Rangeland Management because of the more diversified needs for and uses of soil

data. The soil survey program is only a portion of the total BLM soils program and therefor the total soils program should be in a position where it can effectively support all of the related activities and functions.

It is recommended that the Bureau study the matter of the appropriate office for the administration of the BLM soils program at the Washington Office level and that this soils program responsibility should be assigned to an office that is responsive to the needs, goals, and objectives of the total program.

 $68.\,$ Has the extent of policy, guidance, and technical leadership received from the Washington Office been adequate in regard to the soils program?

Seven of the eight states emphatically said "no" to this question and the eighth state refused to comment.

Manual Section 7100.04Al states that the Division of Watershed "provides policy, guidance and technical leadership for all phases of the soils program." Most of this responsibility has fallen upon the shoulders of a non-soil scientist in the Division of Watershed who also had equal responsibilities to the water, air, endangered plant species, and earth science programs. This situation was altered on April 28, 1980, when Jack Chugg assumed these responsibilities from within the Division of Rangeland Management.

Further comments from the states in response to this question include:

- 1. Washington Office has not been providing updated manuals, policy, etc. in a manner to keep up with the needs in environmental statements, energy, and other fast-moving areas. Most of this updating work related to the soil survey program must be accomplished at the SCS and BLM State Office level.
- Little policy guidance and technical leadership has come down from the Washington Office. Perhaps Jack Chugg can turn things around when he gets to the Washington Office.
- 3. Little guidance and technical leadership was expected from the Washington Office while there was no soil scientist there, despite the promises made in the BLM Manual. Ron Kuhlman and Jack Chugg did commendable jobs filling the gap.
- Most of the guidance and technical leadership has been received from the Denver Service Center, not the Washington Office.
- The policy guidance and technical leadership received from the Washington Office have been nebulous and ill-defined. Perhaps this was the intent.

There is apparently considerable malcontent among the State Office soil scientists about the degree of guidance and technical leadership they have been receiving from the Washington Office. It is encouraging to know that the Bureau has finally decided to establish a soil scientist position at that level. However, it should be recognized that much of the Washington Office soil scientists' time will be devoted to long and short range planning, budgeting, interagency relations, and interdepartmental coordination. He probably will be able to provide guidance on broad policy issues but will not have sufficient time to give much specific technical guidance related to soil surveys, soil management, or soil protection. This is what the soil scientists at the Denver Service Center might be able to do.

69. Has the technical guidance and training received from the Denver Service Center been adequate in regard to the soils program?

Manual Section 7100.4A2 states the Denver Service Center provides: "technical guidance and technical training for soil scientists in classification and correlation, soil mapping, soil investigations and applications of soil inventory information and writing technical reports: provides technical assistance at field reviews; and oversees interstate soil correlations on public lands."

The reaction of the states was mixed in response to this question. Four states said they have not been getting enough technical support from the Denver Service Center, two said "yes, considering the source of the information," and two refused to commit themselves.

Comments made in response to this question include:

- 1. The guidance received from the Denver Service Center has been fairly adequate. There are problems coordinating the training needs with the training opportunities that are available. There has been insufficient guidance about energy related actions as they pertain to the soils program. For example, what level of toxic substances can be tolerated in overburden from strip mining coal areas in different geographic regions.
- 2. It is physically impossible for the one Denver Service Center soil scientist to provide the services listed in the BLM Manual to all the western states. Because of travel restraints and other duties, it is likely that he will be able to provide only a small amount of these services to each state. The new organizational structure and staffing does not permit the Denver Service Center Director to carry out his responsibilities to the soils program.
- 3. The Denver Service Center has been accomplishing these tasks to the degree that one man can perform them. The recent reorganization makes it more difficult than ever for the Director of the Denver Service Center to give assistance to the states regarding the soils program. A fair share of what service has been available has been received.

4. Little technical guidance has been received from the Denver Service Center. What has been received came mostly from the Division of Resource Inventory Systems.

BLM Manual Section 7100.04Al is obviously out of date because of the reorganization and apparently not in keeping with actual practice even before then, mainly because no one person could do all the things required in the Manual. When and if Manual Section 7100.04Al is revised, the responsibilities should be kept in tune with the size and the expertise of that work force. There should be no window dressing and hogwash type materials in the official policy and standards document of the BLM, namely its Manual. If the revised responsibilities of the Director, Denver Service Center for the soils program remain similar to those in Section 7100.04Al, then the size of the work force at Denver will have to be at least four well qualified and highly dedicated soil scientists.

70. Manual Section 7161 includes: "(3) Soils data are of use in most resource management decisions. Therefore, consideration (in making soil surveys) should be given to protating costs to all activities utilizing this (sic) data . ." Is this approach being practiced within the BLM at any level of organization, and is it a realistic approach?

Four of the responding states did not know of any cases where this approach was being implemented; three said that part of the soils survey program is being funded from rangeland management funds; and one state did not commit itself. Three states thought the approach as written is a good one; four did not agree with it; and one was non-commital.

Several of those states who are opposed to paying for soil surveys from the activity budgets utilizing a soil survey information argue that it is difficult to identify segments of the soil survey costs with each benefiting activity. How can one trace the costs of a portion of a soil survey to each benefiting function or action? It is unrealistic to operate a viable soil survey program where its support would be obligated to each minute action. If the soil surveys had to be financed from the budgets of utilizing activities, it would devastate the soil survey program.

States agreeing with the existing policy concerning the source of funds to pay for the soil survey program did not substantiate their preference with supporting arguments.

Manual Section 7161, relative to the proration method for paying for the soil surveys, is obviously not being universally adhered to. Furthermore, the arguments against it, presented above, are convincing. It is recommended that soil surveys be paid for out of a fund specifically established for it. This will make it possible to use the budget records for evaluating the cost of the soil survey program. Of greater

importance is the fact that soil surveys are applicable to every natural resource activity the BLM is involved with. It is impossible to prorate the costs among these benefiting programs in an equitable manner.

71. Should there be a technical line of authority for the soil science program in the BLM?

Soil scientists hold technical support positions at all levels within the BLM. They do not have the authority, however, to give directions or orders. This is reserved for administrative line officers. The staff person makes recommendations to the administrative officer on various matters including those which can result in issuing orders. Administrative officers, below the Washington Office Director, have been delegated the authority to make decisions and orders in the BLM. In some organizations, the president is the only person who has the authority to make these decisions or issue orders. In these organizations, the administrative line officers are only making recommendations or passing on the president's orders and decisions when they make pronouncements of their superiors or subordinates.

Four of the responding states did not believe the BLM should set up a technical line of authority for its soil science program, and four said "Yes" to the question.

One state supporting a technical line of authority indicated it did so because there currently is no local direction for the soil science program from the administrative line officers. None of the other states indicating a preference for the technical line of authority explained why.

Those against the technical line of authority argued that the BLM has no such authority and actions must go through the proper administrative channels. Many times the actions and directions desired by the technician are unresponsive to the needs of the field. The technician can achieve the same goals under the administrative chain of command as by a more direct route, although not quite as quickly. It is important that the administrators be kept informed of all actions taking place within their domain.

Having a technical line of authority has the potential pitfalls of anarchy. It is not recommended for the BLM's soil science program.

72. What are some ways for improving the BLM's soil survey program?

Many suggestions were received from the states. They are summarized as follows:

1. Have a soils branch or division at the State Office, Denver Service Center, and Washington Office levels. The State Soils Branch should have at least three positions consisting of a State Soil Scientist, Assistant State Soil Scientist, and a State Soil Correlator or Coordinator.

- 2. Each district needs at least one soil scientist.
- 3. Improve the training system for new and old BLM Soil Scientists.
- 4. Appoint only those persons to be state directors, district managers, resource area managers, and other resource specialists, who are committed to the BLM's soil science program and who understand its significance to multiple-resource use and the sustained yield concept.
- 5. Rely more on in-house soil scientists for making the soil surveys on the public lands administered by the BLM.
- 6. Make greater use of soils information in the BLM's management system in lieu of using it only as "window dressing" in the planning system.
- 7. Create in-house SVIM teams attached to the State Office (Division of Resources) so as to maintain independence and avoid interference from the District Office while conducting soil and vegetation inventories.
- 8. Update the BLM Manual Section 7100 series and revise all manual sections referring to the soils programs. Make the BLM manual consistent with the National Soils Handbook.
- 9. Never fill a soil scientist position with a soil conservationist, a surface protection specialist, or any discipline other than a soil scientist.
 - 10. Have a soil scientist for each resource area.
- 11. Districts (and resource areas) should not have positions for a hybrid soil scientist-hydrologist because persons with those combined qualifications are extremely rare. The water management program and the soil management program are both important enough to warrant a position at the district level.
- 12. Management is not on the same frequency as the dictates of FLPMA concerning the needs for basic soil survey information for multiple-use management purposes and needs to be tuned in so that the orchestration is no longer off-key.
- 13. Charge the name of the National Soils Handbook to the National Cooperative Soil Survey Handbook.

- 14. There should be three soil scientists at the Washington Office level. One would head the soils program (soil surveys, interpretations, Idaison with National Cooperative Soil Survey cooperators, and guidance for soils input into the BLM's planning and management systems). One subordinate would coordinate soil survey operations, and the other would coordinate soil interpretations.
- 15. Soil scientist support is needed from the Denver Service Center. This staff would serve as liaison between the Washington Office and the State Office level. The staff would include soils specialists in the forestry, range, energy, and soil survey systems or activities.
- 16. The state director should be able to direct the district manager to use his soil scientists for soil science work, and not for other details such as being a member of a Desert Land Entry team, making stream surveys, and the like. District managers should use each soil scientist according to his capabilities and treat each soil scientist according to the needs of the BLM's soils program.
- 17. Districts should only employ well-qualified soil scientists to fill vacant positions. Fresh college graduates in soil science are not qualified to carry out the responsibilities and to perform the duties of the BIM soils programs without gaining some field experience under a qualified mentor.
- 18. Convert all state soil scientist positions to the GS-13 level, to achieve parity with the Soil Conservation Service and Forest Service for comparable positions, and to be in harmony with the scope of the duties and responsibilities of that position.
- 19. Make greater use of new procedures and techniques in the soil survey program including: remote sensing, and computer assisted report writing.
- 20. Cooperate more with the Agricultural Experiment Stations and Universities for research projects on erosion, sedimentation, and soil condition problems. The Universities have fewer priority restraints than does the ELM, and will be free to operate. Working with them will help ease controversial issues.
- 21. Develop more cooperative BLM-SCS soil survey teams, with a Soil Conservation Service beam leader for making soil surveys to meet the environmental statement schedule. Make the team leader a GS-12 to be in harmony with the scope of his responsibilities for supervision, training, and logistics.
- 22. Make greater use of helicopters with appropriate ground preparatory work to speed up the rate of soil surveying.
- $23 \star \;$ Bring the older soil surveys up to the standards of the National Cooperative Soil Survey.

- 24. Establish a firm commitment with the Soil Conservation Service for continued and improved training relations. BLM soil scientists need specialized training in (a) basic inventory, (b) soil mechanics, (c) soil classification and correlation, and (d) the Soil Science Institute. These are no less important than the training programs available to the other specialists at the Phoenix Training Center.
- $25.\,$ The Denver Service Center should take leadership in educating BLM soil scientists on how their role fits into the planning and management systems.
- 26. Qualified soil scientists should be appointed as resource area managers and resource division chiefs.
- $27 \star \,$ The soil science program should receive more funds and more positions.
- 28. The soil science research program should be more active and strongly supported with funds.

5. Calculated and Estimated Costs of the BLM's Soil Survey and Vegetation Inventory Programs.

One of the charges of this study was to determine the cost of making soil surveys on the public lands administered by the BLM. Because of the close association of the soil survey program and the vegetation inventory program in the SVIM process, the cost of the vegetation inventory program was also evaluated. The calculated cost determinations were based on the BLM's Program and Cost Reports by States and by Office. The estimated cost determinations were from various sources which are identified when presented below.

More time was devoted to the cost determination portion of this study than to any other phase. Yet the calculated cost determinations have questionable validity because of inherent limitations and deficiencies in the BLM's cost reporting system for natural resource inventories. These limitations are discussed in the following chapter, along with recommendations to improve the cost reporting system for natural resource inventory programs.

A form of circular reasoning is involved in using the data in the Program and Cost Reports for calculating soil survey and range inventory costs. The Bureau has a fixed amount of funds to distribute among the states each year for the soil surveys and vegetation inventories. The total acres to be surveyed or inventoried each year is also prescribed by state because of the Grazing Environmental Impact Statement schedule. The cost per acre for the Bureau is determined by dividing the total appropriation for the inventories by the acres needing inventories to meet the EIS schedule. This cost per acre value for the Bureau is used to a large extent in prorating funds among the states. Thus, if the appropriation for soil inventories and the total acres to be surveyed in 1978 were of the right magnitude to produce a quotient of 26 cents per acre, then the cost at the end of the fiscal year will be about 26 cents

The cost per acre can be based on several kinds of costs presented in the Program and Cost Reports. The two basic kinds are work-month (MM) related costs and total costs. Each of these two basic kinds can be subdivided into three classes of costs: direct, support, and total. Total work-month related costs are the sum of direct work-month related costs and support work-month related costs.

Work-month related costs include many items besides salaries, including some items that might be considered as supplies, services, materials costs, travel costs, including aircraft or helicopter costs and per diem expenses. They also include such fixed costs as rent, utilities, telephones, janitorial services, miscellaneous office supplies, and copy machine rental. Work-month related costs include the cost of items not

listed in the procurement and equipment portions of the BLM budget, such as goods and services obtained by contracts, interagency agreements, real property leases, GSA work orders, other requisitions and work orders, and store purchases. Total costs are the sum of the work-month related costs and the procurement and equipment costs.

Support costs are those involved in giving managerial direction, program evaluation, program coordination, technical program development, budget development, clerical support, training, and other functions. Note that clerical work for the soil survey program is not a direct work-month related cost. Direct work-month related costs also exclude the salary and benefits paid to employees while on leave and the retirement and other fringe-benefit accruals while on leave.

Support costs are not given below the component level (such as 4340-53 Soil management) in the Program and Cost Report. One must use a proration method to calculate the portion of component support costs that apply to a specific job, such as 73 - Inventory, based on the ration of the direct job costs to the direct component costs multiplied by the support costs for the component. For example, if the direct costs for the soil inventory job were \$300,000, the direct costs for the soil management component were \$900,000, and the total support costs for the soil management component were \$240,000, then the caluculated support costs for the soil inventory job would be \$80,000 (300,000 ÷ 900,000 x 240,000).

The BLM's costs for making soil vegetation inventories were evaluated for FY 78 and FY 79. Data older than FY 78 were not examined because the BLM used a different job and component coding system before that. Also, the kinds of soil and vegetation inventory systems used prior to the adoption of SVIM in 1978 negates the comparison value of that data with the post FY 78 data.

Table I shows the cost per acre for doing soil surveys in FY 78 by state and for the Bureau. The costs given are for both total direct costs and total costs (direct and support costs). The average value for all western states based on direct costs is 26 cents per acre, and, based on total costs, is 33 cents per acre. These average values are weighted means, not arithmetic means. That is, they are calculated by dividing total costs by total acres, instead of dividing the sum of the individual state values by the number of states.

Table 1. Direct Costs, Total Costs (Including Support Costs) and Cost per Acre for Soil Surveys in FY 78 by States.*

	Costs (\$000's)	Acres Surveyed	Cost	Acre
State	Direct	Total	(000's)	Direct	Total
AZ	\$ 140	\$ 172	440	\$0.32	\$0.39
CA	228	294	370	0.62	0.79
CO	165	214	335	0.49	0.64
ID	330	378	950	0.35	0.40
MT	175	231	488	0.36	0.47
NV	357	429	694	0.51	0.62
NM	295	355	528	0.56	0.67
OR	226	278	2,039	0.09	0.13
UT	153	212	1,658	0.11	0.14
WY	84	143	864	0.10	0.17
DSC	10	13	0		
BLM	\$2,163	\$2,719	8,366	\$0.26	\$0.33

^{*}Data are from the Program and Cost Report.

For the direct cost determination, the range among the states is between nine cents per acre for Utah, and 62 cents per acre for California. Such variation causes one to doubt the validity of these calculations. Possible reasons for such a divergence are: (1) California did not report all the acres really accomplished; (2) Utah was using a lower degree of intensity level for its inventory system than was California; or (3) the reported cost figures are either too high for California or too low for Utah. The mid-point between the nine and 62 cents per acre range is 34.5 cents per acre, or 8.5 cents per acre greater than the mean. Yet, none of the states have a cost per acre within five cents per acre of the mean. Only three states have a cost per acre less than that of the mean, but each of these states accomplished relatively large acreages of soil surveys in FY 78.

Oregon's relatively low value of 11 cents per acre is because more than half of the two million acres reported as completed was a simple revision of a fourth-order soil survey by two summer temporary employees. One of the problems of the Bureau's budget recordkeeping system is that it combines all forms of soil survey work under one job code number. How much of the 8.366 million acres of soil surveys accomplished in FY 78 meets NCSS standards is unknown. However, a large share of those surveys probably were not correlated by the SCS, and a soil survey report has probably more been written for most of them.

There is not a good correlation between the amount of area surveyed and the cost per acre in Table 1. One would expect, because of economies of scale, that the bigger the output, the cheaper the unit cost. However, Idaho, Nevada, and Wyoming, which each mapped about the same amount, have unit costs of 35, 51, and ten cents per acre, respectively.

Adding the support costs to the direct costs increases the average unit cost by seven cents, or about 27 percent. The state with the highest support cost on a percentage of direct cost basis is Wyoming, where it is 70 percent. However, the actual support cost per acre in Wyoming is seven, the same as it is for all states combined. Wyoming's unit cost is low because much of its soil survey work was financed by funds from the Energy Component Account in FY 78. These costs do not show up in the Program and Cost report under 4340-53, Soil Management.

Table 2 presents the cost analysis data for soil survey work in FY 79. According to these data, it was cheaper for BLM as a whole to make soil surveys in 1979 than in 1978. Wyoming and several other states used funds from the Energy Account to support soil survey work in FY 79. Sometimes soil survey work was also charged to the Range Management Account (4320-4473) during the SVIM process. The reverse may also occur.

The costs of aerial photographs, helicopter time, and other expenses that serve both the soil and vegetation inventories, may all be charged to either the soil survey or the vegetation inventory.

The production of total acreage accomplished doubled between FY 78 and FY 79. Idaho mapped one-fourth of the total acreage in FY 79. Direct costs were only a nickel an acre in Idaho, suggesting that not all the 4.8 million acres reported as accomplished were third-order surveys made according to NGSS standards.

Table 2. Direct Costs, Total Costs (Including Support Costs), and Cost per Acre for Soil Surveys in FY 79 by State.*

		\$000's)	Acres Surveyed	Cost/	Acre
State	Direct	Total	(000's)	Direct	Total
AZ	\$ 186	\$ 220	489	\$0.38	\$0.45
CA	384	519	534	0.72	0.97
CO	211	284	383	0.55	0.74
ID	251	331	4,815	0.05	0.07
MT	198	253	981	0.20	0.26
NV	649	778	1,381	0.47	0.56
NM	462	534	2,346	0.20	0.23
OR	301	380	1,409	0.21	0.27
UT	367	473	2,097	0.18	0.23
WY	177	253	2,051	0.09	0.12
DSC	28	29	0	-	
BLM	\$3,214	\$4,054	16,486	\$0.19	\$0.25

^{*}Data are from the Program and Cost Report.

California's unit cost was as high in 1979 as it was in 1978. A small amount of its acreage was a second-order soil survey, and some of the contracted soil survey work planned for that year could not be reported as accomplished because the required report was not completed by the end of the fiscal year. Some states abide by the rule of reporting only the acreage accomplished when the required report is completed. Others do not.

For FV 79, the midpoint between the highest and lowest direct unit costs is 40.5 cents per acre. This is 21.5 cents per acre greater than the mean value of 19 cents per acre. However, Arizona is the only state within five cents per acre of the midpoint, whereas four states are within five cents per acre of the mean. In other words, the states unit costs produce a bimodal frequency distribution with California, Colorado, and Nevada being grouped above the midpoint of 40.5 cents per acre, and the remaining states being grouped below the midpoint. Such a distribution creates doubt about the equity in the original allocation process. On the other hand, the bimodal distribution may be entirely due to the errors and limitations inherent in the budget reporting system. In any case, it is doubtful that good quality soil surveys, made according to NCSS standards, can be made for a direct cost of 19 cents per acre, or for a total cost of 25 cents per acre, or for a total cost of 25 cents per acre.

It is not known to what extent the 16.5 million acres soil surveys accomplished in FY 79 were correlated. Most acres were not covered by the required memorandum of understanding for an indivudual soil survey. Consequently, many of these areas may someday require more work and financial support to meet NCSS standards as mandated in the SVIN Manual.

The Bureau uses three main methods for its survey program: (1) contracting with private firms, (2) interagency agreements with the SCS, and (3) using BLM soil scientists. It would be interesting to know if there is any difference in costs between these three methods for the same quality of product. If the private consultants could do the job more economically and at the same quality as another method, the BLM might decide to depend primarily on that method for their soil survey work.

The data in Tables 1 and 2 are inconclusive in showing comparison costs between different sources of the soil survey work. Wyoming relies heavily on private contractors, and it appears to be one of the least expensive states for soil survey work. Unfortunately, many of these costs are not charged to the soil inventory job and so are not included in this analysis. California, which uses private contractors as well as interagency agreements and in-house surveys, has the highest unit costs for making soil surveys. Nevada and Utah also use some contracts for parts of their soil surveys. Nevada's unit costs are far above the BLM average cost, whereas Utah's unit values are below that average. Some of Utah's contracts for soil surveys were charged to components other than soil management.

BLM soil scientists make some or most of the soil surveys in Montana, New Mexico, and Oregon. In Arizona, Colorado, Idaho, and Nevada, much of the work is done by the SCS. There is some evidence that the in-house surveys are less expensive than the interagency agreement soil surveys. However, this comparison is obscured by the fact that the in-house surveys made in Oregon include low intensity revisions of existing soil surveys, as well as new third-order soil surveys. SCS work probably meets the standards of a good third-order soil survey. Thus, soil surveys made by the SCS will be at least as costly as the other two methods. Some of the relatively inexpensive surveys made by private contractors have been of poor quality in California and Oregon. The adage, "You get what you pay for", applies to soil survey work. that all BLM soil surveys have to be made according to the same standards and undergo the scrutiny of the SCS for final correlation, it is likely that the unit cost for any survey area will be about the same regardless of who is doing the work.

The Soil Conservation Service's cost of making soil surveys is given in Table 3. The unit costs in Table 3 for FY 77, 78, and 79 are actual costs, and those for FY 80 are projected costs. The actual costs for all states combined are at least twice as high as those determined for the BIM in Tables I and 2. Note that California again has the most expensive soil surveys. Many of the surveys made by the SCS in California are fairly detailed second-order surveys. Compare the values of California with those of New Mexico. In New Mexico, the SCS was making many third-order soil surveys under interagency agreements in FY 79.

Table 3 also gives the productivity of the soil scientists in acres surveyed per work-year. Comparing the productivity of the soil scientists in California with those in Arizona and New Mexico explains the difference in unit costs among those states. Each soil scientist can survey at least 100,000 acres per year on a third-order soil survey. That rate of production would keep the unit cost of the work at about 30 cents per acre.

Table 4 gives the estimated cost of making a hypothetical third-order soil survey on public lands in 1979. It was prepared by Richard Dierking, Soil Correlator, SCS, who is responsible for correlating the BLM soil surveys under an interagency agreement. His estimates are based on making a soil survey of 1.2 million acres in two years with a party of four soil scientists. Each soil scientists would average 150,000 acres per year. The total cost would be \$377,000, and the unit cost would be 31 cents per acre. Roughly half the costs are direct labor costs and the other half are for equipment, supplies, services, and support. The laboratory support costs used by Mr. Dierking are probably greater than those being used by the BLM for its soil surveys. On the other hand, the productivity of 150,000 acres per year per soil scientist is ambitious. The final cost of 31 cents per acre is in line with actual cost data shown in Tables 1, 2, and 3.

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Table 3. Acres Mapped per Work-Year, and the Cost Per Acre for Soil Surveys by the Soil Conservation Service for Selected Western States in FY 77 to FY 80*.

States	Thousa	nds of acre	es per work	-year	Average Cost/Acre				
	FY 77	FY 78	FY 79	FY 80	FY 77	FY 78	FY 79	FY 80	
AZ	104	135	48	162	\$0.28	\$0.23	\$0.63	\$0.23	
CA	16	29	34	47	1.66	0.94	0.86	0.90	
co	98	64	70	57	0.39	0.56	0.46	0.47	
ID	44	44	94	77	0.76	0.93	0.44	0.53	
MT	52	40	46	53	0.51	0.79	0.78	0.47	
NM	113	126	115	132	0.28	0.24	0.27	0.31	
NV	66	33	78	91	0.46	0.92	0.44	0.30	
OR	50	53	50	54	0.53	0.62	0.89	0.64	
UT	91	181	69	100	0.34	0.18	0.56	0.37	
WA	62	46	53	87	0.40	0.58	0.55	0.48	
WY	84	67	65	87	0.49	0.65	0.73	0.51	
VE.	71	74	66	86	\$0.55	\$0.60	\$0.60	\$0.47	

^{*}Data supplied by the Soil Survey Operations Division, Soil Conservation Service.

Table 4. Estimated Total and Per Acre Costs of a Hypothetical Third-Order Soil Survey.*

Item	Description	Costs
Size of area	1,200,000 acres	
Survey party	1 GS-11 leader at \$22,000 2 GS-9's at \$17,000 each	
Dir. labor costs Sup. labor costs	1 GS-7 at \$13,000 Annual Annual (25% of dir. labor	\$ 69,000
	costs)	17,250
Ann. mapping period	100 days	
Ann. office period	100 days	
Mapping rate/person	1,500 ac/day; 150,000 ac/yr	
Mapping rate/party	600,000 acres	
Dir. labor costs	2 years	138,000
Sup. labor costs	2 years	34,500
Other costs:		
 Imagery, maps 	Aerial photos, etc.	15,000
 Laboratory 	100 pedons @ \$1,500/pedon	150,000
Backhoe		15,000
4. Helicopter	100 hours @ \$250/hr	25,000
Total Costs		\$377,000
Total Cost/Acre		0.31
Labor Cost/Acre		0.14

^{*}Prepared by Richard H. Dierking, Soil Correlator, SCS, Western Technical Service Center, Portland, Oregon, October 1979.

Additional estimated unit costs of making soil surveys on public lands are shown in Table 5. These data are from the BLM State Office Annual Work Plan submissions for FY 80. They are given by state and by soil survey area in most cases. The average unit cost for all the states is 34 cents per acre. It is reasonable to expect FY 80 costs to be somewhat higher than in previous years because of inflation. Many of the individual survey areas are projected to cost between 30 and 35 cents per acre. However, the range is from 17 cents per acre for the Grand, Utah area to 56 cents per acre for the Big Dry, Montana survey area.

Variations in the unit costs of soil survey work between areas are to be expected because of differences in area size, continuity of the public lands, accessibility of the area, proximity of the area to the home office, amount of survey work done in adjacent areas, and other factors. These kinds of factors are taken into consideration when developing the memorandums of understanding for the individual soil survey areas. Funding soil survey work for FY 80 at the average rate of 34 cents per acre would not be excessive.

Table 5. Estimated Cost per Acre for Soil Surveys of Selected EIS Areas for FY 80.*

State	EIS Area	Acres (000's)	Cost/ Acre
CA	Bodie Coleville	250	\$0.37
1	S. Sierra Foothills	95	0.33
	Pit River	178	0.33
co	San Juan/San Miguel	475	0.46
	Little Snake	400	0.50
ID	Big Lost-Mackey	299	0.29
MT	Big Dry	252	0.56
	Headwaters	175	0.31
NV	Lahonton	1,350	0.30
	Elko	793	0.31
OR	Harney	100	0.29
UT	Grand	1,083	0.17
1	Tooele	766	0.30
	Bookscliffs	443	0.32
WY		1,700	0.25
BLM			\$0.34

^{*}Data taken from state office Annual Work Plan submissions for FY 80.

In 1978, when SYIM was developed, each BLM State Office was asked to estimate the cost of making an inventory of the soil, vegetation, and wildlife habitat resources. These estimates are sumarized in Table 6. The average unit cost for the soil surveys for all the western states was 31 cents per acre, approximately the same value determined by Mr. Dierking in Table 4, and by the states for the FY 80 budget in Table 5. The estimates in Table 6 for soil surveys range from 21 cents per acre in Wyoming to 45 cents per acre in Montana. The midpoint is 33 cents per acre—only two cents per acre more than the arithmetic mean. These estimates more nearly fit a normal bell-shaped curve than do the actual unit cost data given in Tables 1 and 2, which tend to be bimodal.

Table 6. Estimated Cost per Acre for the Soils, Vegetation, and Wildlife Habitat Inventory Phases of SVIM for FY 78 by State.*

		Cost/A	cre	4 14 1
State	Soils	Veget.	Wildlife H.	Total
AZ	\$0.25	\$1.01	\$0.45	\$1.71
CA	0.40	0.64	1.35	2.39
CO	0.30	0.40	0.14	0.84
ID	0.25	0.67	0.12	1.04
MT	0.45	0.45	0.32	1.22
NV	0.40	0.50	0.50	1.40
NM	0.28	0.35	0.03	0.66
OR	0.28	0.68	0.04	1.00
UT	0.26	0.36	0.27	0.89
WY	0.21	0.56	0.43	1.20
BLM	\$0.31	\$0.63	\$0.36	\$1.30

^{*}Data taken from memos sent by the state directors to the Director in April and May 1978.

The states generally estimated it would cost more to make the vegetation inventories and the wildlife habitat inventories than it would to make the soil surveys in 1978. The sampling phase of the vegetation inventory process is costly. By now, the states have some experience to more accurately estimate the cost of the vegetation inventory. Table 7 gives these estimates for FY 81, which were taken from part of the budget planning process for that year. The estimates for FY 81 average 18 cents per acre less than the estimates for FY 78. One reason is that a number of simplified modifications have been made in the stratification and vegetation sampling phases of the inventory process since 1978.

Table 7. Estimates of Cost per Acre for the Vegetation Inventory Phase of SVIM by State for FY 81.*

State	Delineating SWA's	Veget. Sampling	Compilation	Total
AZ	\$0.11	\$0.30	\$0.03	\$0.44
CA				1.00
co				0.31
ID		· (0.45
MT				0.45
NV				0.29
NM		-		0.29
OR			1 i	0.44
UT	0.15	0.20	0	0.35
WY				0.45
BLM				\$0.45

^{*}Data taken from state office Range Management Decision Unit Narratives for FY 81 Annual Work Plan directives.

The variability among the states for the estimated cost of the wildlife habitat inventory ranges from three cents per acre in New Mexico to \$1.35 per acre in California. Such a range reflects a difference in interpretation of the instructions in the SVIM Manual for this endeavor. Certainly, there would be a wide variation in quality of product associated with this wide range in expenditure for the wildlife habitat inventory.

It will cost at least \$1.00 per acre to complete the inventory of the soil, vegetation, and wildlife habitat resources on the public lands administered by the BLM. The total cost will be at least \$175 million. Once the inventories are completed, the BLM resource managers will be able to make intelligent multiple-use management decisions on a sustained yield basis and will be able to meet their mission as mandated by FLPMA.

Table 8 shows the actual cost for making the vegetation surveys in FY 78 by state based on the data in the Program and Cost Report, and Table 9 shows the actual costs for FY 79. The average unit direct cost was 34 cents per acre in FY 78, and 27 cents per acre in FY 79. These actual costs are significantly lower than the estimated unit costs presented in Tables 6 and 7. However, the total unit costs, which include support costs, are 42 cents per acre for FY 78 and 33 cents per acre for FY 79. These values are somewhat closer to the 45 cents per acre estimate given in Table 7 for FY 81.

The major reason for the average cost figure of 27 cents per acre in FY 79 was that the total allocation for vegetation inventories was proportioned in the budget process at about that value. There are many "modified" SVIM data hidden in the calculations in Tables 8 and 9 that make the cost lower than that of a vegetative survey made according to SVIM Manual procedures.

Only a fraction of the 4.3 million acres of vegetation inventory reported as completed for Oregon in 1979 was actually done according to SVIM requirements. The remaining acres were covered by a superficial estimation process to meet the EIS schedule. These acres will have to be mapped over again someday to meet the FIPMA mandates.

As is true of any kind of resource inventory, the vegetation inventory acreage accomplished is not to be reported until the required report is finished. The SVIM Manual is not clear on the format and content of the vegetation inventory report. This will have to be clarified in the next revision of the SVIM Manual.

Table 8. Direct Costs, Total Costs (Including Support Costs), and Cost per Acre for Vegetation Inventory in FY 78 by State.*

State		osts				Survey	ed		Cost	/Ac	re
	 Dir	ect	Т	otal	((000's)		1	Direct		Total
AZ	\$	190	\$	240		250		\$	0.76	\$	0.96
CA		285		369		310			0.92		1.19
CO		151		207		548			0.28		0.38
ID		398		473	1	,318			0.30		0.36
MT		502		583	1	,797			0.28		0.32
NV		442		557		563			0.79		0.99
NM:		823	1	,014	6	,964			0.12		0.15
OR		141		171		521			0.27		0.32
UT		539		677		808			0.67		0.84
WY		437		530		430			1.02		1.23
DSC		601		780		0					
WO		47		107		0			'		
BLM	\$4,5	556	\$5.	708	13	,509		s	0.34	s	0.42

^{*}Data taken from the Program and Cost Report.

Table 9. Direct Costs, Total Costs (Including Support Costs), and Cost per Acre for Vegetation Inventory in FY 79 by State.*

State		(\$000's)	Acres Surveyed	Cost/Acre		
	Direct	Total	(000's)	Direct	Total	
AZ	\$ 407	\$ 577	1,930	\$ 0.21	\$ 0.30	
CA	359	475	899	0.40	0.53	
co	338	397	1,021	0.33	0.39	
ID	573	681	2,734	0.21	0.25	
MT	782	924	3,644	0.21	0.25	
NV	1,536	1,893	7,700	0.20	0.25	
NM	972	1,162	2,631	0.37	0.44	
OR	388	464	4,327	0.09	0.11	
UT	904	1,083	580	1.56	1.87	
WY	944	1,058	1,255	0.75	0.84	
DSC	1	1	0			
BLM	\$7,204	\$8,715	26,721	\$ 0.27	\$ 0.33	

^{*}Data taken from the Program and Cost Report.

Beginning in FY 80, the data and graphics preparation and entry work (Job 82) will be separated from the data collection phase of the range inventory process in the financial management records system. The data processing stage will have to be accomplished before a report can be written. Someone will have to decide when to report the acreage accomplished - after the report has been completed or at the point that the data is ready for entry into the computer. If the latter is used, to what job will the report preparation work be charged? Perhaps another job description is needed for resource inventories to prepare the report. Lumping all phases of an inventory process into one job (73) creates problems in evaluating the inventory costs as well as in reporting accomplishments at the appropriate time.

The information in the Program and Cost Reports for FY 78 and FY 79 were averaged together as part of this cost analysis. This was done to determine if some of the variation in unit costs between states might be reduced, since some surveys take two or more fiscal years to complete and acreages not reported as accomplished in FY 78 might be reported in FY 79. Thus, a relatively high unit cost for FY 78 would be offset by a lower unit cost in FY 79, or vice versa.

The average cost analysis data for two fiscal years is presented in Table 10 for both soil surveys and range inventories. All the values are weighted averages except those in the bottom line which are arithmetic average values. The weighted average values are the only meaningful ones to the budget planning and evaluation process. A state that completed a large proportion of the total acres mapped at a relatively low unit cost will have a greater impact on the weighted average value than it will on the arithmetic average value.

The total unit costs for FY 78 and FY 79 combined average 28 cents per acre for the soil surveys, 36 cents per acre for the range inventories, and 64 cents per acre for both kinds of inventories. There is a wide divergence from these averages among the states since parts of the soil surveys were financed by the Energy Fund. Consequently, the values for Wyoming, and perhaps for some of the other states, are low for the soil surveys work. States that show a relatively small average unit cost value probably deviated from NCSS standards for all of their soil surveys and from the strictest standards of SVIM for their vegetation inventories. States that show a relatively high unit cost value probably failed to report all the acres actually accomplished. Some of the variation among states is real and is due to difference in the size of the survey areas, the continuity of public lands, their accessibility, terrain, uniformity, and the amount of prior work done in adjacent

Table 10. Weighted Average Annual Cost per Acre for Soil Surveys and Vegetation Inventories for FY 78 and FY 79 combined, and the Total Cost per Acre for Both Soil and Vegetation Surveys by State.^a

	Weight	ed Ave. Ar	nnual Cost,	/Acre		tal cre for
State	Soil S	urveys	irveys	Soil & Veg. Survey		
	Direct	Total	Direct	Total	Direct	Total
AZ	\$ 0.35	\$ 0.42	\$ 0.27	\$ 0.38	\$ 0.62	\$ 0.80
CA	0.68	0.90	0.53	0.70	1.21	1.60
CO	0.59	0.69	0.31	0.39	0.90	1.08
ID .	0.10	0.12	0.24	0.28	0.34	0.40
MT	0.25	0.33	0.24	0.28	0.49	0.51
NV	0.48	0.58	0.24	0.30	0.72	0.88
NM	0.26	0.31	0.19	0.23	0.45	0.54
OR	0.15	0.19	0.10	0.13	0.25	0.32
UT	0.14	0.18	1.04	1.27	1.18	1.45
WY	0.09	0.14	0.82	0.97	0.91	1.08
BLMp	\$ 0.21	\$ 0.28	\$ 0.29	\$ 0.36	\$ 0.50	\$ 0.64
BLWc	\$ 0.31	\$ 0.39	\$ 0.40	\$ 0.49	\$ 0.71	\$ 0.88

a Data taken from the BLM Program and Cost Report.

b Weighted average, whereby the total BLM costs are divided by the total acres surveyed.

C Arithmetic average, whereby the sum of the cost per acre for each state is divided by the number of states.

SVIM also calls for an inventory of the wildlife habitat, kinds of wildlife, cultural resources, natural history features, and recreational uses, especially on those Site Writeup Areas (SWA's) selected for vegetation sampling. No attempt was made to evaluate the Program and Cost Reports for the costs of these items. Most likely, some of the work is being charged to the vegetation inventory since it was done rather incidentally by the vegetation sampling crew members. On the other hand, some or most of the costs of the inventory work for resources or items other than soils and vegetation may be charged to the proper kind of inventory. The fact that some states estimate the cost for the wildlife habitat inventory at less than a nickel per acre, and others estimate more than a dollar per acre, indicates a wide interpretation of a wildlife habitat inventory. The SVIM Manual does not address the question of format and content of the required reports for these extraineous kinds of inventories except by Form Sheets. It is likely that these extraneous inventories are being reported as accomplished prior to the completion of a report, either as part of the vegetation inventory, or separately by appropriate component and subactivity. This should be accounted for in the next revision of the SVIM Manual. If inventory data is not formally summarized in a well-organized report, it is of little value.

The Program and Cost Reports give the direct work-months expended for making inventories and the total acres accomplished. These data can be used to calculate the productivity of those directly involved in the inventories in units of acres per work-month. Table 11 shows the productivity of the average inventory party member per work-month by state for soil surveys in both FY 78 and FY 79. For all western states the average productivity was 16,000 acres per work-month in 1978, and over 19,000 acres in 1979. For a 100-day, or five work-month field season, these values are equivalent to 80,000 and 95,000 acres per year, respectively. The annual values are considerably smaller than the 150,000 acres used by Mr. Dierking in his analysis in Table 4, but closely match the values determined by the SCS in Table 3.

The work-months expended on the soil survey program are only those of BLM employees. Soil surveys done largely by contractual and interagency agreements, therefore, will show a relatively high level of production per work-month by this method of analysis. Also the acreage reported as accomplished is a mixture of solid, third-order soil surveys and superficial revisions of preexisting soil surveys for some of the states. Combining all degrees of intensity of inventories into the same job code (73) makes the data in the Program and Cost Reports of limited value for making a valid cost analysis.

Table 11. Acres Accomplished, Direct Work-Months Used, and Acres Accomplished per Work-Month for Soil Surveys in FY 78 and FY 79 by State.

. !		FY 78		İ	FY 79	
State	Acres (000's)	WM's	Ac/WM	Acres (000's)	WM's	Ac/WM
AZ	440	80.0	5,500	489	29.3	16,689
CA I	370	45.3	8,168	534	99.6	5,361
∞ i	335	20.6	16,262	383	24.7	15,506
ID	950	68.7	13,828	4,815	88.0	54,716
MT	489	11.5	42,522	981	28.1	34,911
NV	694	72.1	9,626	1,381	89.6	15,413
NM	528	75.7	6,975	2,346	201.2	11,660
OR	2,039	82.5	24,715	1,399	140.3	9,971
UT	1,658	37.6	44,096	2,097	88.5	23,695
WY	864	27.1	31,882	2,051	59.8	34,298
BLM	8,367	521.1	16,056	16,476	848.9	19,409

Table 12. Acres Accomplished, Direct Work-Months Used, and Acres Accomplished per Work-Month for Range (Vegetation) Inventories in FY 78 and FY 79 by State.

1		FY 78		İ	FY 79	
State	Acres (000's)	WM's	Ac/WM	Acres (000's)	WM's	Ac/WM
AZ	250	72.8	3,434	1,930	125.0	15,440
CA	310	138.0	2,246	 899	120.0	7,492
00	548	108.3	5,060	1,021	170.3	5,995
ID	1,318	254.8	5,173	2,734	326.9	8,363
MT	1,797	133.0	13,511	3,644	253.3	14,386
NV	563	248.5	2,266	7,700	623.8	12,344
NM	6,964	512.7	13,583	2,631	518.4	5,075
OR	521	96.4	5,405	4,327	145.1	29,821
UT	808	288.1	2,805	580	391.0	1,483
WY	430	187.8	2,290	1,255	425.1	2,952
BLM	13,509	2,040.4	6,621	26,721	3,098.9	8,622

Table 12 shows the average production in acres per work-month for the vegetation inventories performed in FY 78 and FY 79 by state. The productivity of the vegetation inventory crew members is only about half that of the soil surveyors. The vegetation sampling phase of the vegetation inventory is a time-consuming process if done properly. One would expect the field mapping and sampling phases of the vegetation inventory to be at least twice as costly as the field mapping stage of the soil survey based on these values. The variation in productivity between the states is extreme for the vegetation inventory, ranging from about 1,500 acres per work-month in Utah in 1979 to over 15,000 acres per work-month in Arizona for that year. Obviously there are vast differences between these two states in the intensity level of the vegetation sampling stage. It would appear that the resource managers in Utah will have much more reliable data for making use and management decisions than will the managers in Arizona. On the other hand, it is possible that not all the acres accomplished in Utah in 1979 were actually reported in the Financial Management Data System. All research results are operational, meaning that the reliability of the data depends upon the operations or methods used to obtain the data. The cost analyses in this report are based on the data in the Program and Cost Reports. Since there are serious limitations with these data, all interpretations of these analyses should be made with that in mind.

The Program and Cost Reports contain both the acreage planned and the acreage accomplished for soil and vegetation inventories. These data are summarized by fiscal year and by state for soil surveys in Table 13, and for vegetation inventories in Table 14. The acreage expectations generally exceed the actual accomplishments for both kinds of inventories. Occassionally, however, a state's accomplishment exceeded its expectation in one fiscal year, but the opposite occurred in the other fiscal year. Notice the soil survey figures in Table 13 for Oregon and Utah for both FY 78 and FY 79. California was far short of its accomplishments in FY 78 for both soil surveys and vegetation inventories. Much of the vegetation inventory work in 1978 was planned for the California Desert Conservation Area, but it has not been accomplished, and The Draft Plan for the CDCA shows the deficiency of good reliable data for multiple-use planning and management. The BLM will eventually have to obtain this data by systematic inventory efforts to meet the mandates of FLPMA.

In general, the divergence between acres planned and acres accomplished for the vegetation inventories is not great with the exception of California in 1978. Once each soil survey area has an approved memorandum of understanding or work plan, as called for in the National Soils Handbook, there should also be a correlation between expectations and accomplishments for soil surveys in each state and in each year.

Table 13. Acres of Soil Inventories Planned and Acres of Soil Inventories Accomplished by State for FY 78 and FY 79.*

State		Y 78	FY 79 Acres (000's)		
	Acres	(000's)			
	Planned	Accomplished	Planned	Accomplished	
AZ	820	440	1,619	489	
CA	1,654	370	971	534	
co	485	335	458	383	
. ID	1,161	950	4,306	4,815	
MT	1,872	489	1,223	981	
NV	1,344	694	1,586	1,381	
NM	734	528	1,887	2,346	
OR	1,724	2,039	2,083	1,399	
UT	1,040	1,658	3,600	2,097	
WY	1,013	864	2,486	2,051	
BLM	11,847	8,367	20,219	16,476	

^{*}Data are from the Program and Cost Reports by State.

Table 14. Acres of Range (Vegetation) Inventories Planned and Acres of Range Inventories Accomplished by State for FY 78 and FY 79.*

		Y 78	FY 79		
State	Acres	(000's)	Acres (000's)		
İ	Planned	Accomplished	Planned	Accomplished	
AZ	490	250	1,432	1,930	
CA	11,306	310	1,102	899	
co	708	548	1,018	1,021	
ID	1,267	1,318	2,439	2,734	
MT	400	1,797	3,283	3,644	
NV	227	563	7,100	7,700	
NM	6,506	6,964	3,091	2,631	
OR	844	521	4,376	4,327	
UT	1,996	808	2,847	580	
WY	2,069	430	1,950	1,255	
BLM .	25,813	13,509	28,638	26,721	

^{*}Data are from the Program and Cost Reports by State.

The unit cost values for soil and vegetation inventories presented in Tables 1, 2, 8, and 9 are based on total costs, which include the procurement contracting, interagency agreement, and equipment costs, as well as labor or work-month related costs. It is of some interest to also know the unit costs (as Cost/Acre) for only the work-month related costs. The work-month related costs and be divided into direct work-month related costs and total (including support) work-month related costs. The work-month related costs and total fincluding support of the soil surveys in FY 78 in Table 15, and in FY 79 in Table 16.

Table 15. Work-Month Related Direct Costs, Total Costs (Including Support Costs), and Costs per Acre for Soil Surveys in FY 78 by State.

	WM Costs (\$000's)		Acres Surveyed	WM Cost/Acre	
State	Direct	Total	(000's)	Direct	Total
AZ	\$ 106	\$ 138	440	\$0.24	\$0.31
CA	82	130	370	0.22	0.35
∞	99	131	335	0.30	0.39
ID	115	155	950	0.12	0.16
MT	128	178	488	0.26	0.36
NV	112	156	694	0.16	0.22
NM	131	165	628	0.12	0.15
OR	143	191	2,039	0.07	0.09
UT	72	132	1,658	0.04	0.08
WY	59	129	864	0.07	0.15
DSC	10	13	0		
BLM	\$1,059	\$1,519	8,366	\$0.13	\$0.18

Table 16. Work-Month Related Direct Costs, Total Costs (Including Support Costs), and Costs per Acre for Soil Surveys in FY 79 by State.

	WM Costs (\$000's)		Acres Surveyed	WM Cost/Acre	
State	Direct	Total	(000's)	Direct	Total
AZ	\$ 67	\$ 80	489	\$0.14	\$0.16
CA	163	255	534	0.31	0.48
CO	48	72	383	0.13	0.19
ID	199	258	4,815	0.04	0.05
MT	57	87	981	0.06	0.09
NV	340	401	1,381	0.25	0.29
NM	187	238	2,346	0.08	0.09
OR	272	341	1,309	0.19	0.24
UT	195	286	2,097	0.09	0.14
WY	102	152	2,051	0.05	0.07
DSC	28	37	0		
BLM	\$1,658	\$2,208	16,486	\$0.10	\$0.13

The direct work-month related costs for soil surveys averaged 13 cents per acre in FY 78, and ten cents per acre in FY 79. Adding the support work-month related costs to these values raises them to 18 cents per acre in 1978 and 13 cents per acre in 1979. The work-month related costs for soil surveys are about half the total costs on a per acre basis (see Tables 1 and 2). One would expect that states relying heavily on contracts and interagency agreements for their soil survey work would have relatively low work-month related costs, but this does not always hold true. Oregon does most of its soil survey work with BLM soil scientists, yet in FY 78, its direct work-month related costs were only seven cents per acre. Wyoming, on the other hand, relies heavily on private contracts. Its direct work-month related costs were also seven cents per acre in 1978. In 1978, much of Wyoming's contracted soil survey work was actually charged to the Energy and Range Management Subactivities and Components, so the direct costs shown in Table 15 are low.

In Oregon, in 1978, over half the acres reported as surveyed were a superficial revision of an existing fourth-order soil survey by two summer temporary employees. The direct work-month related costs of the solid soil survey work in Oregon were probably about 19 cents per acre, as it was in FY 79.

The work-month related costs for the vegetation inventory work is summarized in Table 17 for FY 78, and in Table 18 for FY 79. Vegetation inventory work-month related costs are about two-thirds of the total costs on a per acre basis (see Tables 8 and 9).

The reason labor costs for the vegetation inventory process are a greater proportion of the total costs then they are for soil surveys, is that less of the vegetation work is done by contractors or other Federal agencies under interagency agreements. The low unit cost for range inventory work in New Mexico in FY 78 probably resulted from much of the work being some kind of a low intensity "modified" SVIM procedure. In FY 79, New Mexico was one of the more costly states for doing vegetation inventories on a work-month related basis. The work-month related costs in Utah were relatively high in both fiscal years. Perhaps Utah samples a high percentage of the SWA's. The acres accomplished in 1979 for Oregon include considerable inventory work that does not meet SVIM requirements. Therefore, the seven cents per acre value for the direct work-month related cost in that year does not truly reflect the actual costs of making a good vegetation inventory.

Table 17. Work-Month Related Direct Costs, Total Costs (Including Support Costs), and Costs per Acre for Range (Vegetation) Inventories in FY 78 by State.

	WM Costs (\$000's)		Acres Surveyed	WM Cost/Acre	
State	Direct	Total	(000's)	Direct	Total
AZ	\$ 145	\$ 204	250	\$0.58	\$0.81
CA	213	292	310	0.69	0.94
00	142	187	548	0.26	0.34
ID	380	394	1,318	0.29	0.30
MT	364	432	1,797	0.20	0.24
NV	342	427	563	0.61	0.76
NM	777	899	6,964	0.11	0.13
OR	123	179	521	0.24	0.34
UT	419	529	808	0.52	0.65
WY	246	317	430	0.52	0.74
DSC	5	60	0		
BLM	\$3,156	\$3,918	13,509	\$0.23	\$0.29

Table 18. Work-Month Related Direct Costs, Total Costs (Including Support Costs), and Costs per Acre for Range (Vegetation) Inventories in FY 79 by State.

	WM Costs (\$000's)		Acres Surveyed	WM Cost/Acre	
State	Direct	Total	(000's)	Direct	Total
AZ	\$ 346	\$ 424	1,930	\$0.18	\$0.22
CA	177	246	899	0.20	0.27
00	269	331	1,021	0.26	0.32
ID	481	573	2,734	0.18	0.21
MT	521	644	3,644	0.14	0.18
NV	1,019	1,212	7,700	0.13	0.16
NM	907	1,048	2,631	0.34	0.40
OR	313	392	4,327	0.07	0.09
UT	764	914	580	1.32	1.58
WY	715	865	1,255	0.57	0.69
DSC	-599	-595	0		
BLM	 \$4,913	 \$6,054	26,721	\$0.18	\$0.23

One can compute the average monthly work-month related costs from the cost and work-month values given in the Program and Cost Reports. They can be computed on a direct cost basis, and on a total cost basis. Table 19 presents the average monthly direct work-month related costs for both soil surveys and vegetation inventories in FY 78 and FY 79 by state. Table 20 shows the comparable data based on total costs. The BLM average direct work-month costs are about \$2,000 per month for soil surveys, and a few hundred dollars less per month for the range inventories. Considerably more use is made of nonprofessional temporary employees for the sampling stage of the vegetation inventory, than for the soil surveys. That may explain the difference in labor costs between the two types of inventories.

Table 19. Average Monthly <u>Direct</u> Work-Month Related Costs for Soil Inventories and Range (Vegetation) Inventories in FY 78 and FY 79 by State.

State		nventories	Range Inventories		
	FY 78	FY 79	FY 78	FY 79	
AZ	\$ 1,330	\$ 2,288	\$ 1,996	\$ 2,771	
CA	1,799	1,639	1,544	1,473	
00	4,821	1,963	1,307	1,579	
ID	1,673	2,258	1,493	1,471	
MT	11,162	2,033	2,737	2,057	
NV	1,551	2,091	1,376	1,633	
NM	1,736	1,691	1,515	1,750	
OR	1,737	1,937	1,279	2,155	
UT	1,925	2,200	1,454	1,955	
WY	2,167	1,700	1,309	1,684	
BLM	\$ 2,017	\$ 1,932	\$ 1,546	\$ 1,779	

Table 20. Average Monthly Total (Including Support) Work-Month
Related Costs for Soil Inventories and Range (Vegetation)
Inventories in FY 78 and FY 79 by State.

- 1		nventories	Range Inventories		
State	FY 78	FY 79	FY 78	FY 79	
AZ	\$ 1,320	\$ 2,152	\$ 1,895	\$ 2,586	
CA	1,928	1,789	1,591	1,568	
00	3,884	2,004	1,337	1,612	
ID	1,800	2,243	1,298	1,466	
MT	7,282	2,225	2,659	2,076	
NV	1,658	1,707	1,367	1,636	
NM	1,768	2,244	1,490	1,679	
OR	1,797	2,006	1,332	2,135	
UT	1,945	2,369	1,412	1,935	
WY	2,740	1,973	1,365	1,667	
BLM	\$ 2,079	\$ 2,024	\$ 1,533	\$ 1,766	

The cost of \$11,000 per work-month for Montana in 1978 is ridiculous. Apparently, either too few work-months or too many dollars were reported in the program and Cost Report. Colorado's soil inventories figure is also excessive for 1978. Montana and Arizona show relatively high monthly costs for doing range inventories, but they are not as high as those for the soil survey work in Montana and Colorado in FY 78

Including the support costs, surprisingly, has little effect on the average work-month related cost for all western states combined. For some unknown reason, the inclusion of the support costs raises the value for soil survey work, and lowers the value by a few dollars for the range inventory work. One would expect much of the support work for planning, coordination, and program supervision to be conducted by employees with higher salaries than those who directly collect the data. This would increase the values based on total costs over those based on direct costs. Apparently enough clerical support work by lower-salaried persons is done in the range inventories to more than offset the increased costs of the coordinators and supervisors.

Inclusion of the support costs in this analysis did reduce the work-month related costs for Montana and Colorado in FY 78, but they are still unrealistically high. Wyoming's value for this item was significantly increased by adding the support costs.

In summary, a reasonable average monthly total work-month related cost is about \$2,050 for soil survey work, and \$1,750 for vegetation inventory work. The difference between the two inventory systems is probably due to a greater reliance on nonprofessional temporary employees for the range inventory work, expecially the sampling stage of that process.

Budget analysts need to know the proportion of total costs of a program or activity which result from such costs as: direct work-month related costs, support work-month related costs, and direct and support total costs. The information in the Program and Cost Reports can be evaluated to produce these kinds of data. Table 21 shows the ratio of the total work-month related costs to direct work-month related costs. The proportion of the total work-month costs used for the support work-month jobs is the difference between the rations given in Table 21 and the value of 1.0. The work-month related cost ratios are given both for soil surveys and for vegetation inventories, and for both FY 78 and FY 79.

Table 21. Ratio of Direct Work-Month Related Costs to Total
Work-Month Related Costs for Soil Inventories and Range
(Vegetation) Inventories in Fy 78 and Fy 79 by State.

		entories	Range Inv	entories
tate	FY 78	FY 79	FY 78	FY 79
AZ	0.77	0.84	0.71	0.82
CA	0.63	0.64	0.73	0.72
ω	0.75	0.67	0.76	0.81
ID	0.74	0.77	0.97	0.84
MT	0.72	0.65	0.84	0.81
NV	0.72	0.85	0.80	0.84
NM	0.80	0.79	0.86	0.87
OR	0.75	0.80	0.69	0.80
UT	0.55	0.68	0.79	0.84
WY	0.46	0.67	0.78	0.83
BLM	0.70	0.75	0.80	0.83

For all western states combined, direct work-month related costs comprised 70 percent of the total work-month related costs for soil surveys in 1978, and 75 percent in 1979. For the vegetation inventories, the comparable values are 80 percent in FY 78, and 83 percent in FY 79. Thus, soil inventories required about 8 to 10 percent more support work-month related expenses than did the vegetation inventories. Part of the difference in support costs between the soil and vegetation inventories may be due to differences in the amount of support labor costs for quality control between the two types of inventories. Also, a higher proportion of the soil inventories are done by contractual or interagency agreement. It takes considerable time and effort to prepare the requests for proposals, statements-of-work, and interagency agreements, and to administer the contract for soil inventories once they have been granted. Wyoming, which relies heavily on private contractors for its soil survey work used only 46 percent of its total labor costs for direct work in FY 78, and 54 percent of the total labor costs went for support labor in that year. Utah and California also entered into contracts with private consultants, so their support labor costs are also relatively high in both FY 78 and FY 79.

The most anomolous value in Table 21 is the FY 78 range inventory value for Idaho. It indicates that 97 percent of the total labor costs were direct costs and only 3 precent were support labor costs. One explanation is that many of the support costs for the vegetation inventory in that year were actually charged to the soil survey program. This can happen in the SVIM process because the two kinds of inventories share many expenses in the pre-planning state, including time spent obtaining the base field maps and aerial photography.

There was a tendency to use less of the total labor costs for support in FY 79 than in FY 78 for both kinds of inventory. This can be partially explained by the fact that many states were just getting involved in these inventories in 1978, and therefore needed more support labor time for planning. It would be interesting to follow this trend for FY 80 and succeeding years to see if the amount of support labor costs do decrease as the inventory programs become established.

Table 22 shows the proportion of the total direct costs (not just total labor costs) used by the direct work-month labor costs for both kinds of inventories in FY 78 and in FY 79. These data show a marked difference between the soil surveys and the range inventories for this item for all western states combined. For soil surveys, roughly half the total direct cost, including procurement and equipment items, is used for direct work-month related costs. For range inventories about 80 percent of the total direct costs are consumed by the direct work-month related costs. This difference is due to the fact that much of the soil survey costs are the result of contracts and interagency agreements where labor is performed by non-BLM employees. Note the costs for both kinds of iventories in Oregon, the proportion of the total direct costs attributed to the direct labor costs is relatively high for soil survey work, and there is not much difference for these values between the two kinds of inventory.

Table 22. Ratio of Direct Work-Month Related Costs to Total
Direct Costs for Soil Inventories and Range
(Vegetation) Inventories in FY 78 and FY 79 by State.

		ventories	Range Inventories		
tate	FY 78	FY 79	FY 78	FY 79	
AZ	0.76	0.36	0.76	0.85	
CA	0.36	0.42	0.75	0.49	
co	0.60	0.23	0.94	0.80	
ID	0.35	0.79	0.95	0.84	
MT	0.73	0.29	0.73	0.67	
NV	0.31	0.52	0.77	0.66	
NM	0.39	0.27	0.94	0.93	
OR	0.63	0.90	0.87	0.81	
UT	0.47	0.42	0.78	0.85	
WY	0.70	0.58	0.56	0.76	
BLM	0.49	0.52	0.80	0.77	

Why the variations in values is so great between FY 78 and FY 79 for soil survey work in Arizona and Montana is not obvious. Perhaps some error was made in either the total direct cost or the direct work-month related cost data reported in the Program and Cost Reports in one or both of these years.

Table 23 gives the proportion of the total costs (direct and support costs) that were devoted to the total direct costs for both kinds of inventories in FY 78 and FY 79.

Here there is little difference between the two kinds of inventories in terms of the proportion of total costs made up from the direct costs. The value is about 80 percent for both inventories in both years. Consequently, it can be concluded that for all the western states, the total support costs average about about 20 percent of the total costs. For some reason, the soil survey values for Wyoming in Table 23 are relatively low. The work done by contractors should have no bearing here, because the total costs include that kind of cost. One reason for this anomoly could be that the soil survey work in Wyoming was charged to subactivities and components other than Soil Management (4340-53).

Table 23. Ratio of Total Direct costs to Total Direct and Support Costs Combined, for Soil Inventories and Range (Vegetation) Inventories in FY 78 and FY 79 by State.

		rentories	Range Inventories		
tate	FY 78	FY 79	FY 78	FY 79	
AZ	0.79	0.82	0.81	0.83	
CA	0.80	0.74	0.78	0.84	
co	0.76	0.82	0.72	0.83	
ID	0.87	0.79	0.84	0.83	
MT	0.78	0.75	0.87	0.84	
NV	0.84	0.83	0.80	0.83	
NM	0.86	0.87	0.87	0.87	
OR	0.79	0.78	0.74	0.85	
UT	0.69	0.81	0.77	0.82	
WY	0.50	0.70	0.76	0.89	
BLM	0.79	0.80	0.79	0.84	

Once a more or less realistic unit cost value for making soil surveys has been determined, projections about what the BLM's soil survey program will cost knowing something about the size of the program or the acres to be surveyed can be made. Table 24 shows the estimated work-years and total costs for making soil surveys of all the public lands administered by the BLM, by States. This table is based on the assumptions: that none of the public lands have been surveyed to date (an erroneous assumption); that 110,000 acres will be surveyed per work-year; and that unit cost is 30 cents per acre. From Table 24, it is obvious that one full-time soil scientist could make soil surveys of all 175.5 million acres in about 1,600 years, or 160 full-time soil scientists could do the job in only 10 years. The total costs will be about 52.6 million dollars. If this total cost were evenly spread over 10 years, the annual cost would only e \$32,875 per year.

The data in Table 25 are more realisitic than those in Table 24 because they reflect soil survey work already reported as being accomplished on the public lands. Roughly 65 million acres meeting NCSS standards have already been surveyed according to data supplied by BLM state office soil scientists. If a single full-time soil scientist started working in 1980 on the remaining acres to be surveyed, he could finished the job by 2984. On the other hand, 100 full-time soil scientists could do the job in 10 years. Spread over 1,004 years, the annual cost would be 3.3 million dollars. Spread over 1,004 years, the annual costs would still be \$32,875.

Table 24. Estimated Total Work-Years and Costs for Soil Surveys of All BLM-Administered Public Lands in the Western States.

State	Public Land Acres (000s)	Work-Years ^a	Cost ^b (\$000s)
AZ	12,595	114	\$ 3,779
CA	16,585	151	4,975
co	7,996	73	2,399
ID	11,949	109	3,585
MT	8,485	77	2,545
NV	49,118	477	14,735
NM	12,854	117	3,856
OR	16,035	146	4,810
UT	22,076	201	6,623
WY	17,793	162	5,338
Totals	175,586	1597	\$52,645

a. Calculated at the rate of 110,000 acres/work-year. b. Calculated at the rate of \$0.30/\$acre.

Table 25. Total BLM Acres Remaining to be Soil Surveyed and the Estimated Work-Years and Costs for Making the Soil Surveys by State.

 State	Remaining Acres (millions)	Work-Years ^a	Cost ^b (\$000s)
AZ	5.8	53	\$ 1,740
CA I	15.8	144	4,740
CO	2.7	25	810
ID	6.1	55	1,830
MT	1.1	10	330
NV	42.1	383	12,630
NM I	2.8	25	840
OR	13.0	118	3,900
UT	9.8	89	2,940
WY	11.2	102	3,360
Totals	110.4	1004	\$33,120

a. Calculated at the rate of 110,000 acres/work-year.

b. Calculated at the rate of \$0.30/acre.

Each BLM state office soil scientist has projected the annual acreage to be soil surveyed in his State between FY 80 and to the fiscal year the job is to be completed for that state. These projections were used to prepare the data in Tables 26 and 27, where the projected acreages are given by state and fiscal year, along with the estimated costs to do that job at a unit cost of 30 cents per acre. Table 26 projects costs for FY 80 through FY 84. Fiscal years 80 and 81 will be the most costly because about 20 million acres will be surveyed each year. Therefore, the BLM appropriation will have to be about 6 million dollars for the soils survey program in each year.

From FY 82 to about FY 90, the job will be less costly because the acreage will diminish. A few states will need no soil survey support funds after FY 83, and most will need no soil survey funds after FY 84. Nevada has the biggest job and will need well over one million dollars per year until FY 88. Oregon and California do not have the amount of acreage that Nevada does, but they are spreading the work load over a longer time span than most of the other states. After 1995, the BLM appropriation for soil survey work will be nil, assumming all the 65 million acres mapped so far and from now on are done according to NGSS standards. If some of the soil surveys do not meet these standards, they will have to be either brought up to standard, or done over.

Table 26. Estimated Acres to be Soil Surveyed between FY 80 and FY 84, and Estimated Annual Costs at 30c/acre by State.

				Fi	scal Year					
		80		81		82		83	94	
State	Acres (Millions)	Cost (\$000s)	Acres (Millions)	Cost (\$000s)	Acres (Million	Cost (\$000s)	Acres (Millions)	Cost (\$000s)	Acres (Millions)	Cost
AZ	1.5	\$ 450	1.4	\$ 420	1.3	\$ 390	0.8	\$ 240	0.5	\$ 150
CA	0.7	210	2.4	720	1.4	420	1.9	570	1.1	330
СО	0.9	270	0.8	240	0.6	180	1.4	420	0	0
ID	2.4	720	2.3	690	1.2	360	0.1	30	0.1	30
MT	0.5	150	0.3	90	0.1	30	0.1	30	0.1	30
NV	6.5	1,950	5.6	1,680	6.1	1,830	4.3	1,290	4.6	1,380
NM	1.7	510	0.8	240	0.3	90	T	15	т	15
OR	0.7	210	0.9	270	0.8	240	0.8	240	1.0	300
UT	1.8	540	1.9	570	2.1	630	2.1	630	1.9	570
WY	3.6	1,080	3.5	1,050	2.1	630	2.0	600	0	0
1										
tal	20.3	6,090	19.9	5,970	16.0	4,800	13.5	4,065	9.3	2,790

Table 27. Estimated Acres to be Soil Surveyed between FY 85 and FY 89+, and Estimated Annual Costs at 30c/acre by State.

				Fi	scal Year					
	-	85		36	. 8	7		88		89+
State	Acres (Millions)	Costs (\$000s)	Acres (Millions)	Costs (\$000s)	Acres (Millions)	Costs (\$000s)	Acres (Millions)	Costs (\$000s)	Acres (Millions)	Costs (\$000s)
AZ	0.3	\$ 90	0	\$ 0	0	\$ 0	0	\$ 0	0	\$ 0
CA	1.2	360	1.5	450	1.3	390	1.9	570	2.4	720
CO	0	0	0	0	0	0	0	0	0	0
ID	0	0	0	0	0	0	0	0	0	0
MT	T	15	0	0	0	0	0	0	0	0
NV	4.2	1,260	3.4	1,020	4.1	1,230	2.5	921	0.8	240
NM	0	0	0	0	0	0	0	0	0	0
OR	0.8	240	0.8	240	0.8	240	0.8	240	5.6	1,680
UT	0	0	0	0	0	0	0	0	0	0
WY .	0	0	0	0	0	0	0	0	0	0
otal	6.5	1,950	5.7	1,710	6.2	1,860	5.2	1,560	8.8	2,640

The BLM uses helicopters for many of its soil surveys. Compared with using trucks, helicopters have the advantages of: (1) reducing the transportation time between field examination sites; (2) reducing the transportation time between the headquarters and the daily survey area; (3) improved accessibility; (4) allowing the mapper a birds-eye view of the area; and (5) increasing the rate of mapping.

The major disadvantages of using helicopters for soil survey work are: (1) the high cost per hour; (2) the inability to land on sloping topography and in brushy or forested areas; (3) the inability to fly in inclement weather; (4) the inconvenience to the passengers in terms of noise, cramped quarters, motion-sickness, and difficulty in loading and unloading; and (5) the inability of the mapper to observe subtle changes in the topography, vegetation, soils, rockiness, erosion, land use, and features of cultural and natural historical significance.

A key question concerning the use of helicopters for soil surveying is whether the increased costs are offset by the increased rate of mapping. The Montana BLM State Office Soil Scientist, Mike Rollins, has made cost analyses of helicopter use for three soil survey areas in 1977 and 1979 (Rollins 1977; 1978; 1979). These analyses are summarized in Tables 28, 29 and 30. Each analysis is compared with the estimated cost of doing the same job with 4-wheel-drive pickup trucks.

The estimated cost analysis for the ground vehicles is based on an operating cost rate of 18 cents per mile in 1977 and 20 cents per mile in 1979. The Denver Service Center, Branch of Property Management, has determined that the operating cost rate for a 4X4 pickup, weighing between 6,000 and 8,500 pounds, is 19 cents per mile for 1980. The average daily driving distance was set at 100 miles per day, and means that about three to five hours per day would be spent riding. Travel speed ranges from about 2 mph on cobbly, washed-out ways to 55 mph on paved roads. The mapping rate was set at about 1,600 acres per day per mapper, or 160,000 acres per 100-day field season. This is a relatively high mapping rate, but not nearly as high as that achieved by using helicopters. Whether the quality of the helicopter survey, (where up to 11,600 acres per day per person were mapped) meets NCSS standards will be determined when these survey areas are checked during the final field review for the soil correlation process. From personal experiences, it has been observed that soil surveys made at a fast rate by using helicopters in the Vale and Baker Districts of Oregon do not meet the standards of a third-order soil survey as defined in the National Soils Handbook. The average monthly work-month related costs were set at \$1,800 for 1977 and \$2,000 in 1979.

The 1977 soil survey cost analysis is shown in Table 28. The survey area was 350,000 acres in the southern part of Phillips County, Montana-Six soil scientists mapped the area in one work-week. This translates to only 1.5 work-months $(685 \div 20)$. Therefore, the labor costs were \$2700 (1800X1.5). Each soil scientist mapping an average of 11,667

acres per day, and the unit work-month related cost was only 0.8 cents per acre. A six-person party using trucks would need 10.5 work-months to map the 350,000 acres at 1,667 acres per person per day. Therefore, the labor costs would be \$18,900, or 5.4 cents per acre. Consequently, the labor costs were nearly seven times greater when using trucks than when using thelicopters, because the mapping rate for the truck method was about one-seventh that of the helicopter method. The total transportation cost for the helicopters was \$8895. This includes per diem cost for the flight crew, as well as \$469 per hour for flight time. The average helicopter transportation costs were 2.5 cents per acre.

The total transportation costs for the trucks was \$3964, or 1.1 cents per acre. The lower transportation costs for trucks was not sufficient to offset the higher labor costs of the truck method. The unit cost for both labor and transportation is 3.3 cents per acre for the helicopter survey, and 6.5 cents per acre for the truck survey. Tables 15 and 16 show that the direct work-month related costs for soil surveys in Montana was 26 cents per acre in 1978, and only 6 cents per acre in 1979. The BLM includes both ground and aircraft travel costs in work-month related costs. The average direct work-month related costs for soil surveys in all western states averaged 13 cents per acre in 1978, and 10 cents per acre in 1979 (see tables 15 and 16). Even the 6.5 cents per acre unit cost calculated for the truck survey seems low when compared to the actual data in Tables 15 and 16. Nevertheless, for this survey area, the helicopter method was less expensive than the truck method. Whether or not the quality of the soil surveys made by the two methods is equal is an open question.

Table 28. Actual Field Mapping Costs Using Helicopters, and Estimated Field Mapping Costs Using Trucks for the Soil Survey of the Southern Part of Phillips County, Montana in 1977.*

Item	Actual Helicopter Survey	Estimated Truck Survey	
Size of area (acres) No. of Soil Scientists (apping Period (days) Total work-days Total work-months Ave. cost/work month Fotal work-month costs twe. area mapped/work-day twe. We. Wost/acre	350,000 6 5 30 1.5 \$1,800 \$2,700 11,667 \$0,008	350,000 6 35 210 10.5 \$1,800 \$18,900 1,667 0.054	
Vehicles:		0.034	
Kind Number Jost rate Jost rate Jost of each/day Jostal use of each Jostal use of all Jostal cost of all Jught crew per diem Jostal transp. cost We. trans. cost/acre	Bell 212 \$469/hr 3.6/hr 17.9/hr 17.9/hr \$8,395 \$500 \$8,895 \$0,025 \$0.033	4X4 Pickup 6 18c/mi 100/mi 3,670/mi 22,020/mi \$3,964 \$0.011 \$0.065	

^{*} Actual data supplied by Montana State Office Soil Scientist (Rollins, 1977).

Table 29 summarizes the actual field mapping costs using helicopters, and the calculated mapping costs using trucks for a 140,000 acre survey area in parts of Hill, Liberty, Toole, and Chouteau Counties, Montana in 1978. The public land was somewhat scattered. The soil scientists using helicopters mapped an average of 4,667 acres per day per person. The job took a week and involved six soil scientists. The unit labor cost was 2.1 cents per acre.

With trucks it would have taken six soil scientists 15 days to map the area at 1,555 acres per person per day. Therefore, the labor costs are three times greater by the truck method than by the helicopter method.

Two smaller helicopters were used in the 1978 soil survey instead of the one large helicopter used in the 1977 survey. Each helicopter averaged 5.4 hours of flight time per day (see Table 29). This is a high value, but each helicopter was serving three soil scientists.

The total helicopter transportation costs were \$17,195, including special costs for the fuel truck (at 40 cents per mile) and living expenses for the helicopter crew members. Consequently, the unit transportation cost was 12.3 cents per acre.

The six trucks would cost a total of \$1,800 if each were driven 100 miles per day for 15 days at 20 cents per mile. The unit transportation cost would be 1.3 cents per acre.

For this survey, the savings in labor costs by using helicopters was not sufficient to offset the increased transportation costs of that method. The unit cost for labor and transportation was 14.4 cents per acre for the helicopter survey, and 7.7 cents for the truck survey. Therefore, when the mapping rate is less than 5,000 acres per day, when using helicopters, it would be more cost effective to use trucks, (assuming the area is accessible by ground vehicles).

Table 29. Actual Field Mapping Costs Using Helicopters, and Estimated Field Mapping Costs Using Trucks for the Soil Survey of Parts of Hill, Liberty, Toole, and Chouteau Counties, Montana in 1978.*

Item	Actual Helicopter	Estimated Truck	
	Survey	Survey	
Size of area (acres)	140,000	140,000	
No. of soil scientists	6	6	
Mapping period (days)	5	15	
Total Work-days	30	90	
Total Work-months (WM)	1.5	4.5	
Ave. Cost/WM	\$2,000	\$2,000	
Total WM costs	\$3,000	\$9,000	
Ave. acres mapped/work-day	4,667	1,555	
Ave. WM cost/acre	\$0.021	\$0.064	
Vehicles:			
Kind	Bell 206	4X4 Pickup	
No.	2	4A4 IICKUP	
Cost rate	\$280/hr	20 /mi	
Use of each/day	5.4/hr	100/mi	
Total use of each	27/hr	1500/mi	
Total use of all	54/hr	9000/mi	
Total cost of all	\$15,120	\$1,800	
Fuel truck cost	\$995	0	
Flight crews per diem	980	0	
Total transp. costs	\$17,195	\$1,800	
Ave. transp. cost/ac.	\$0.123	\$0.013	
Total WM & transp. cost/acre	\$0.144	\$0.077	

^{*} Actual data supplied by Montana State Office Soil Scientist (Rollins, 1978).

In 1979, Montana used helicopters for a 750,000 acre area in parts of Prairie, Custer, and Fallon Counties. Six soil scientists mapped the entire area in three weeks at an average rate of 8,333 acres per person per day (see Table 30). Total labor costs were about \$9,000, for an average unit cost of 1.2 cents per acre.

Using trucks would require about an 80-day period to survey the area with a party of six, mapping at an average rate of 1,562 acres per person per day. Total labor costs would be \$48,000, and unit labor costs would be about 6.4 cents per acre. Since the mapping rate for the helicopter method is about five times greater than that of the truck method, the unit labor costs of the helicopter method are about one-fifth that of the truck method.

The same two helicopters used for the soil survey referred to in Table 29 were used for this survey. Each flew an average of 5.2 hours per day for a total of 78 hours over the 15-day survey period.

The total transportation cost for both helicopters, including the costs for the fuel truck and for living expenses of the flight crew, was \$47,473. The unit transportation cost for the helicopter method was 6.3 cents per acre.

The total truck transportation costs would be \$9,600 based on the assumptions used for the previous two analyses. The unit transportation cost for the truck method would be 1.3 cents per acre.

For this survey, the savings in labor costs by the helicopter method offset the increased transportation costs. Unit costs for both labor and transportation were 7.5 cents per acre for the helicopter method, and 7.7 cents per acre for the truck method.

Based on the analyses for all three soil surveys, one can conclude that soil surveys can be made less expensively with helicopters if the mapping rate is at least 8000 acres per person per day, compared with the mapping rate of about 1,600 acres per person per day when using trucks. There are 12.5 sections in 8,000 acres. A soil scientist who can map an average 8,000 acres per day must have a thorough knowledge of the geographic soil pattern for the area before beginning the survey. The identification and descriptive legends must be fully developed, and the soil pattern must be broad and uniform. Either few soil pits will be dug each day, or each pit will be very shallow. Few field notes will be taken, and lunch will be eaten while in-flight between ground observation points.

Table 30. Actual Field Mapping Costs Using Helicopters, and Estimated Field Mapping Costs Using Trucks for the Soil Survey of Parts of Prairie, Custer, and Fallon Counties, Montana in 1979,*

Item	Actual Helicopter Survey	Estimated Truck Survey	
Size of area (acres)	750,000	750.000	
No. of soil scientists	750,000 6	750,000	
Mapping period (days)	15	6	
Total work-days	90	80	
Total WM	4.5	480 24	
Ave. cost/WM	\$2,000		
Total WM costs	\$9,000	\$2,000	
Ave. acres mapped/work-day	8,333	\$48,000	
Ave. WM cost/acre	\$0.012	1,562 0.064	
Vehicles:			
Kind	Bell 206	4X4 Pickup	
No.	2	6	
Cost rate	\$280/hr	20¢/mi	
Use of each/day	78/hr	8,000 mi	
Total use of each	156/hr	48,000 mi	
Total cost of all	\$43,680	\$9,600	
Fuel truck cost	\$1,273	0	
Flight crew's per diem	\$2,520	0	
Total transport. cost	\$47,473	\$9,600	
Ave. transp. cost/acre	\$0.063	\$0.013	
Total WM & Transp. cost/acre	\$0.075	\$0.077	

*Actual data supplied by Montana State Office Soil Scientist (Rollins, 1979).

 Recommended Changes in the Component and Job Descriptions Relative to Soil Surveys and Other Resource Inventories.

The BLM's Financial Management System is codified and described in Manual Section 1684. The objective of the coding system is to provide a standardized system of grouping similar types of work for use in accounting, programming, planning, budgeting, and constructive analysis of Bureau work accomplishments.

All the BLM work is coded to 49 activity classes and 77 subactivity classes. There is little difference between the names of the activity and the subactivity classes, except the subactivities differentiate between the work done on the public domain land and the Oregon-California (0 & C) land. For example, soil work is listed under 4340, 6340 - Soil, Water and Air Management activity. At the subactivity level, soil work is listed under either 4340 - Soil, Water and Air Management, or 6340 - Soil, Water and Air Management (0 & C).

Within subactivities, work is classified according to kind of component. There are 59 component classes or elements. Each identifies specific program areas for which the BLM is responsible. A component description identifies work elements of the subactivity to the degree of detail necessary for describing actual program thrusts. For example, the Soil, Water and Alr Management Subactivity becomes identifiable as six distinct work elements: 01-Support; 52-Water Management; 53-Soils Management; 54-Alr Quality Management; 58-Endangered Resource Protection; 59-Earth Sciences.

The lowest level of the Financial Management System is the job level. This level defines the specific action taken to meet the objectives of the given component involved. There are 84 kinds of jobs. Jobs are universally titled to lend uniformity across all program (component and subactivity) levels. The component code with which a job code is identified lends specificity to the general definition of the individual job. For example, job 73 is named, Inventory. When combined with component 53-Soil Management, it refers to soil surveys (5373). When combined with component 52-Water Management, it refers to water inventories (5273). Soil surveys done on public domain land are coded under 4340-5373. Those done on 0 & & C land are coded under 6340-5373.

The BLM's Financial Management System's coding system has severe limitations for use in accounting, programming, planning, budgeting, and constructive analysis of Bureau work accomplishments in regard to soil surveys and other types of natural resource inventories. The data periodically published in the Program and Cost Reports do not give reliable determinations of the costs of doing soil surveys on a per acre basis. The major limitations of the current coding system are summarized below, followed by proposed changes in the description of components and jobs that specifically relate to natural resource inventories. These proposals should be considered for further study and implementation if the

Bureau is serious about using the coding system for accounting, programming, planning, budgeting, and constructive analysis of its work accomplishments.

Some of the problems associated with the present coding system of the Financial Management System are:

- 1. All kinds and degrees of natural resource inventories are charged to the same job code 73. Whether a soil survey is made according to NCSS standards or involves only reconnaissance work to update an existing soil survey, it is all charged to the same job code. When two or more intensity levels of soil inventories are being used in a state, the State Office Program and Cost Report data is a composite average of all the inventories. The same is true for the District Office Program and Cost Reports when two or more kinds of soil surveys are being conducted in the same district in the same fiscal year.
- 2. Resource inventory progress (in acres) is to be reported only when the required reports are completed. The field season ends at about the end of the fiscal year for many areas. All soil inventories require a soil survey report. Most soil survey areas are planned to accomplish a specified number of acres for a fiscal year. Commonly, it takes more than one fiscal year to survey the entire area and to write the report. The soil survey report is not compiled until the entire soil survey area is mapped and the soils have been correlated. Some offices report acres of survey accomplished before the required soil survey report is completed. Others do not. These problems would be reduced if the mapping and report preparation stages of the soil survey were assigned separate job codes, and reported individually as completed or accomplished.
- 3. Soil survey work is sometimes charged to subactivities other than 4340 (6340), Soil, Water, and Air Management, such as, 4110-Energy, Onshore, and 4320-Range Management. When this happens, the Program and Cost Report data under the code, 4340 (6340) 5373, does not include all the information needed for making a cost analysis, or for budget planning purposes. Many times the soil survey work charged to a subactivity other than Soil Management is mingled with other types of inventory work for the same district or state, and it is not possible to identify the proportion of work-months and costs devoted exclusively to the soil survey. Soil survey work should all be charged to the same subactivity to alleviate this type of problem.
- 4. It is not possible to determine the costs of doing the various phases of a soil survey, because all charges for all phases have to be assigned to the same job code 73. This problem could be overcome if there were separate job codes for the various phases, such as base map preparation, legend development, field mapping, laboratory support, quality control, and report preparation.

- 5. Some soil survey costs apparently are always charged to sub-activities other than 4340 (6340), and are omitted in any cost analysis. These costs are included in jobs: 01-Stores; 04-Equipment Operations; 05-Fixed Costs; 07-Managerial Direction; 67-Maintenance-Building, Recreation, Roads, Yards; and 72-Maintenance Equipment, tools. None of these jobs can be charged to subactivity 4340 (6340). However, some of these costs, such as equipment operations, may be prorated to all sub-activities in work-month related costs.
- 6. The laboratory analysis phase of the soil survey program has sometimes been charged to job 25-Studies and Research, even though the job description explains that job 25 does not include extensive inventories such as soil surveys. In any one office, the cost of the laboratory support phase of a soil survey may be mingled with the costs of other kinds of research and studies.
- 7. Errors are made in reporting both the acres of soil surveys planned, and the acres of soil surveys accomplished. Some offices have reported the same acres planned in two succeeding years, even though the acres were reported as accomplished at the end of the first year. Some offices have reported vast acreages planned, but have never reported any acreage as accomplished, even though significant amounts of work-month related costs and total costs were expended on the survey.
- 8. Soil inventories are sometimes mingled with range inventories, and both are reported together either under subactivity 4320 (6320) or 4340 (6340). Some persons involved in the SVIM process are obligated to devote some of their time to inventorying wildlife, cultural features, natural history features, and recreational use. Some of the time devoted to these inventories is being charged to range inventories and soil surveys.
- 9. Subactivity 4340 (6340) Soil, Water and Air Management includes five diverse and somewhat unrelated components: 52-Water Management; 53-Soils Management; 54-Air Quality Management; 55-Radangered Resources Protection; and 59-Earth Sciences. Soils Management should be changed to Soil Management. Why use Soils Management, unless one also uses Waters Management of Airs Quality Management? Component 58 should be moved perhaps to subactivity 4320 Range Management, or to both 4310, Forest Management and 4320, Range Management. Component 59 should be moved to a subactivity under 4100-Energy and Minerals, perhaps to 4130-Nonenergy, Onshore. If components 58 and 59 are to remain in 4340 (6340), the subactivity name will have to be changed to: Soil, Water, Air, Endangered Resources, and Earth Sciences Management.
- 10. Many of the jobs presently listed under component 53-Soil Management, deal with work items that should be, and are being, charged to subactivities other than 4340 (6340). These jobs are: 26-Environmental Assessment; 27-Environmental Statement; 54-Project Survey and Design; 55-Vegetation Manipulation; 56-Land Treatment; 60-Pences, Enclosures,

Exclosures; 61-Maintenance, Facilities; 68-Maintenance, Land and Vegetation; 70-Maintenance, Fences, Enclosures; and 71-Maintenance, Management Facilities. Most of these jobs actually are already being charged to the subactivities that initiate the action for the work or expenses involved in these jobs.

The subactivities that initiate the action for the Jobs listed above include: 2110 (6110)-Building Construction; 2120 (6120)-Recreation Construction; 2130 (6130)-Transportation Construction; 2140 (6140)-Land and Easement Construction; 2120 (6220)-Building Maintenance; 2220 (6230)-Transportation Maintenance; 4110-Energy, Onshore; 4130-Nonenergy, Onshore; 4210-Lands and Realty Operations; 4310 (6310)-Porest Management; 4320 (6320)-Range Management; 4320 (6330)-Recreation Management; 4320 (6350)-Wildlife Habitat Management; 8100-Range Improvements, Fublic Land; 8200-Range Improvements, Land Utilization; 9130-Raod Maintenance, Western Oregon; 9140-Road Maintenance, Public Land; 9200-Recreation Development and Operations; and 9400-Land and Water Conservation Fund.

il. The description for job 73-Inventory is a horrendous hodge-podge as written in Manual Section 1684.43. The reason is every inventory system used by the BLM has to be charged to that one job, and there are dozens of kinds of inventories. Also, all phases of each inventory, from the beginning to the final report stage, have to be charged to this job. Consequently, it is impossible to use the financial records for doing a cost analysis of the various phases of an inventory system. Furthermore, all intensity levels of the same kind of inventory have to be charged to job 73. Therefore, any cost analysis for a particular kind of inventory will only give an average determination of the several degrees of intensity.

It might be best to eliminate job 73 altogether and start over to set up job descriptions that will differentiate between the various phases of an inventory system. Jobs that are common to the inventory systems for most resources are: (1) work or activity plan development; (2) base map and reference materials assembly and preparation; (3) identification and descriptive legend development; (4) field mapping; (5) special field and laboratory characterization studies; (6) quality control; (7) data and graphics preparation; and (8) report preparation and publication. There are existing job descriptions in Manual Section 1684 that fit, or nearly fit, some of these jobs. Others would have to be added.

Some proposed job descriptions for the various phases of an inventory system follow. Representatives of the various BLM groups dealing with resource inventories and of the budget and financial management systems may wish to take these proposals into consideration for developing a record-keeping system that will enable a valid analysis of a specific kind of inventory. In the following job descriptions, where existing descriptions have been amended, additions are underlined, and deletions are marked with slash marks.

Job 20. Reports: (Máń Work-months). Include costs of preparing and submitting reports required on a regular, or one-time, basis by regulation, legislation, BLM Manual, etc. Includes such reports as Annual Grazing Statistical Report, Annual Caseload Report, Resource Inventory Reports, Public Land Statistics, etc. Does not include reports defined elsewhere, e.g. Affirmative Action Plan (see Job 14), regular Progress Reports (see Job 11). REPORT PROGRESS when report is ready for distribution.

Job 25. Studies and Research: (Number). Includes costs and time spent in planning, initiating, conducting, administering, or reviewing topical or site-specific study and research efforts whether contracted or prepared inhouse. Includes work such as use studies, (e.g. recreation forage); feasibility studies for telecommunication, APP. EMRIA, etc.; characterization studies for resource classification and user—interpretations; as well as research work. Also includes the cost of SO 2974 actions related to OCS environmental studies. Does not include studies to evaluate an activity (see Job 30) or other phases of extensive inventories, such as forest inventory (see Jobs 20, 35, 76, 86, 87) REPORT PROGRESS when final written study or research report has been accepted.

Job 29. Activity Plans: (Number). Includes all costs of preparing activity plans such as AMP's, <u>resource inventory area work plans</u>, or memoranda of <u>understanding</u>, timber sale plans, HMP's, transportation plans, etc. <u>Does not include costs</u> of acquiring data necessary to support development of the plan, e.g. archeologic <u>or vegetation</u> inventory, or site-specific data collection, such as spot checking vegetation thick range site and condition <u>class</u>. REPORT PROGRESS when the plan is approved.

Job 82. Data and Graphics Preparation and Entry: (Man Work-months). Includes all time and costs of collecting, organizing, coding, digitizing, and entering data, maps, plats, or other material for use in an automated system. Includes editing, error correction, map registration, ground truthing, or other review resulting in clean data that can be used in an automated application. Do not include data collection from the mapping phase of resource inventories (see Job 86). REPORT PROGRESS when all data and maps scheduled for automated data processing in the work-plan are ready for entry.

Job 84. Inventory Materials Preparation: (Work-months). Includes the costs of assembling, preparing, and cataloging all the maps, supplies, and reference materials needed for a resource inventory. Includes indexing, drafting match-lines, and trimming all field sheets; assembling all ownership status, road, and resource reference maps and publications; and assembling all tools, supplies, equipment and materials. Does not include preparation of legends (see Job 85). REPORT PROGRESS when all the resource inventory materials are available for the mapping stage of the inventory.

Job 85. Inventory Legend Development: (Work-months). Includes all costs of preparing the identification and descriptive legends for a resource inventory. Includes the field and office work required to define and describe the mapping units. Does not include the resource characterization work required for classifying and interpreting the taxonomic units (see Job 25). REPORT PROCRESS when the identification legend and descriptive legend are available to the mapping crew members.

Job 86. Inventory Mapping: (Work-months). Includes all costs of the mapping phase of a resource inventory, such as the costs of interpreting aerial photographs and other types of imagery, and the field survey time. Does not include the costs of quality control (see Job 87), or of resource characterization (see Job 25). REFORT PROGRESS when the mapping stage of the planned inventory area is complete.

Job 87. Inventory Quality Control: (Work-months). Includes all costs for field and office work related to the quality control of a resource inventory. Includes costs of preparing for, and conducting field reviews, and for preparing the quality control review reports. REPORT PROGRESS when all the quality control work of the inventory work plan has been completed.

The present description for component 53-Soils Management regarding the purpose for doing soil management work on the public lands administered by BLM is restrictive. It states that soil management work is done, "for the express purpose of controlling unnatural or nongeologic soil movement." Erosion control is but one of many aims of soil management. Soil management may be defined as applying any practical, economically feasible practice to the soil to maintain or improve its productivity without damaging the environment. Common soil management practices include tillage, drainage, irrigation, reclamation of saline and sodic soils, fertilizing, amending with chemicals or organic materials, and accelerated (unnatural) erosion control.

A proposed redefinition of component 53 follows.

53-Soil Management: Includes all costs of inventorying, analyzing, interpreting, planning, and managing the soils on the public lands for the express purpose of controlling administration notified soil

The proposed revised coding system for the Bureau's soil management program is summarized as ${
m follows:}$

4340 Soil, Water and Air Management 6340 Soil, Water and Air Management (0 & C)

01- Support

02- Capitalized Equipment

03- Non-capitalized Equipment

08- Evaluation

09- Program Coordination

10- Technical Program Direction

11- Budget and Program Development

13- Clerical Support

15- Training

18- Public Information and Inquiry

99- Error

52- Water Management

53- Soil Management

20- Reports

25- Studies and Research

29- Activity Plans

30- Evaluation/Revision of Activity Plans

82- Data and Graphics Preparation and Entry

84- Inventory Materials Preparation

85- Inventory Legend Development

86- Inventory Mapping

87- Inventory Quality Control

54- Air Quality Management

7. Recommended Revisions of BLM Manual Sections Pertaining to Soil Surveys and Soil Management.

According to BLM Manual Section 1221.11, "BLM Manual is the basic source of permanent written policy and guidance for the Bureau," and "Instruction in the BLM Manual are (sic) mandatory, not optional." Bureau policy and guidance for soil surveys, is scattered among several sections. Much of that policy became obsolete when the Bureau officially agreed to make soil surveys according to the NGSS's standards on May 8, 1978. Therefore, the need to revise the Manual sections pertaining to soil surveys is urgent. For two years the BLM has been making soil surveys according to Instructions in the National Soils Handbook. The contradictions between those instructions and the ignored "mandatory", but obsolete, instructions in the BLM Manual for soil surveys are making all of those involved in the Bureau's soil survey program insufferable, insubordinate insurrectionists.

Some steps have been taken to update and consolidate the policy and guidance for the soil survey program in the Manual. The most recent "Subject-Function Classification Chart" in Appendix 1, Manual Section 1220, "Paperwork Management" (dated 10/6/77) contains a reasonably good outline of topics related to soil surveys for the Manual. Unfortunately, because of the lack of personnel and time, it has not been possible to complete the development, approval, and distribution of these Manual topics. There are some flaws in the proposed outline, however, that should be amended before the sections are fully developed.

The Manual is organized first by major programs, such as: 4000-Range Management; 5000-Forest Management; 6000-Outdoor Recreation; 7000-Watershed Management; and others. Many of the sections pertaining to soil survey and soil management are included in 7000-Watershed Management. That is appropriate because the items included under Watershed Management mostly deal with soil and water. One unusual item included in Watershed Management is the management of threatened or endangered plant species. Logically, that item should be within a major division that deals with managing plants, instead of the soil and water resources. Manual Section 4400 deals with Range Management Studies. A subsection of it might be an appropriate place for the policy and guidance statements on threatened and endangered plant species.

Major subdivisions of Manual Section 7000 are: 7100-Soil and Vegetation Management; 7200-Water Management; 7300-Watershed Systems and Plans; and 7400-Surface Protection and Watershed Practices. The title of Section 7100 is misleading. The only kind of vegetation considered in that section is the threatened and endangered plant species. Furthermore, nearly all the soil science items deal with the soil survey process instead of soil management. Therefore, a more appropriate name for Section 7100 would be Soil Survey Procedures, or Soil Survey Management. Manual Section 7100 was released on December 20, 1978.

Between 1977 and mid-1979, the Denver Service Center soil scientists, Jack Chugg and Lee deMoulin, worked on updating the BLM Manual for the soil survey program. A manual section outline recently prepared by Mr. Chugg is as follows:

7100 - Soil and Vegetation Management

7110 - Soil Survey Operations Management

7120 - Soil Classification and Mapping

7130 - Applications of Soil Survey Information

7140 - Soil Investigations

7150 - Soil Erosion?

7160 - Threatened and Endangered Plant Species?

7170 - 7190 (Unassigned).

Mr. Chugg had reservations about the placement of Soil Erosion and Threatened and Endangered Plant Species under Manual Section 7100. Soil Erosion might be included in section 7400 - Surface Protection and Watershed Practices, and Threatened and Endangered Plant Species might be included in section 4400 - Range Management Studies. Then Section 7100 could be named "Soil Survey Management".

The names of sections 7110, 7120, 7130, and 7140 in this outline are taken directly from Sections II-200, II-300, II-400, and II-500 of the National Soils Handbook. Essentially everything in these sections is germane to the BLM's soil survey program since the Bureau is a member of the National Cooperative Soil Survey. Each BLM soil scientist has access to the National Soils Handbook, and the Handbook should become part of the BLM Manual. If not, its contents will have to be copied into the BLM Manual, and that seems like a dreadful waste of time and duplication of effort.

There is a precedent for having a document similar to the National Soils Handbook becoming a part of the BLM Manual. It is a 165 page summary of a U. S. Forest Service Handbook on basic principles of soil science, which became the Appendix to BLM Manual Section 7312. A similar approach should be pursued for incorporating the National Soils Handbook into the BLM Manual. The first sentence in the National Soils Handbook is: "The purpose of the National Soils Handbook (NSH) is to provide policy and procedure for carrying out the National Cooperative Soil Survey program." No other justification should be needed to make it a part of the BLM Manual, or other directives for the Bureau's soil survey program. Perhaps, it could be considered a Manual Supplement as defined in Manual Section 1221.11A.

The National Soils Handbook was prepared primarily by the Soil Conservation Service and therefore may contain some policy matters that are not applicable to the BLM and other cooperating agencies, and it may omit policy matters that do apply to the BLM and other cooperating agencies. It could be amended to make it a standard for policy and technical guidance for all the cooperating agencies. This would involve the efforts of a task force with representatives from all the cooperating agencies. The BLM could take the leadership in initiating this kind of action because of the scope of its involvement in the National Cooperative Soil Survey. The title of the document might be: National Cooperative Soil Survey Manual. A format should be selected that is compatible with the requirements of all the cooperating agencies. Certainly all the Federal agencies should be using the same format for their policy and procedural guidance directives.

Items pertaining to soil management are scattered in several Manual Sections, when soil management is defined as the application of any economically feasible practice to maintain or improve the productivity of the soil without damaging the environment. These practices include tillage, erosion reduction, use of fertilizers and chemical amendments, drainage of wet soils, irrigation of dry soils, leaching saline soils, reclaiming sodic soils, rehabilitating the vegetal ground cover, controlling weeds and other soil pests, and so forth. Currently, erosion control is included in Manual Section 7170, and erosion inventory procedures are defined in Manual Section 7317. Land treatment technicques, such as brush and weed control, tillage, seeding, planting, water control structures, fertilizing, and soil conditioners, are all provided for in Manual Section 7400, Surface Protection and Watershed Practices. Many soil management interpretations are currently defined in Manual Section 7312, and are planned to be defined in Section 7130. Technical guidance for the management of saline soils, sodic soils, wet soils needing drainage, dry soils needing irrigation, and soils with toxic amounts of chemical constituents is missing from the Manual, or hidden in such a manner that it does not appear in the alphabetical index of Manual Section 1220 - Paperwork Management.

It would be convenient if all the soil management practices were included in one major Manual section. Manual Section 7400, Surface Protection and Watershed Protection, already covers many of the soil management practices. All that is needed to bring all the soil management practices together in one place in the Manual is to add erosion control, soil drainage, irrigation, reclamation of saline and sodic soils, etc. to that Manual Section. The guidelines and criteria for rating or ranking soils in various kinds of interpretations should remain under Manual Section 7100, Soil Survey Management. Many of these guidelines and criteria are in the National Soils Handbook. The soil management procedures for specific kinds of practices would be included in Manual Section 7400.

Until Manual Sections 7110 and 7120 are revised and released, Manual Section 7161, Soil Inventories and Surveys, provides the policy for the acquisition of soils data through inventories conducted by Bureau soil scientists and through contractual agreements with other organizations. It was released on May 27, 1971, and contains many statements and concepts that became obsolete after the Bureau agreed to become part of the National Cooperative Soil Survey. It refers to only two of the

five levels or degrees of soil survey intensity. It refers to interagency agreements as cooperative agreements, and does not clearly differentiate between interagency agreements and contracts. No mention is made of the need to use the soil taxonomic system for defining soil mapping units. The need for quality control is not adequately covered. The guideline for the mapping rate is 30,000 to 50,000 acres per year; far short of the rate being accomplished in the past few years. It states that the Service Center contracting officer must sign all agreements in which the BLM's reimbursement exceeds \$2,500.

All proposed cooperative soil survey plans have to be submitted to the BLM Director for approval according to Section 7161. The statement, "Agreements for the completion of soil surveys must be initiated by the requesting organization rather than the Bureau", is ambiguous. It can be inferred from that statement that the Bureau is not the requesting organization, and they do not desire a completed soil survey. Since instructions in the BLM Manual are "mandatory, not optional", it is imperative that the Manual Sections on soil surveys be updated as soon as possible. If the Bureau's soil survey program actually operated according to the provisions of Manual Section 7161, the rate of output would be less than half of what it is, and the quality of the product would be poor.

Manual Section 7310, Inventories and Interpretations, was released on November 6, 1969. It is a one page release (No. 7-19) that outlines and reserves subject classification numbers, such as: 7312 - Soils (Reserved); 7311 - Geology (Reserved); and even .01 - Purpose (Reserved). Sections such as this should be removed from the BLM Manual.

Manual Section 7162, Soil Interpretations, was released on January 4, 1974. It contains no policy and technical guidance information, but refers to Section 7312.2 for the guidelines and instructions for developing soil interpretations and lists management activities for which soil survey interpretations can be made. It cautions, "Soil interpretations must be coordinated within the Bureau and with other organizations making interpretations." Most of Section 7162 should be removed from the Manual, and any meaningful parts of it should be included in the proposed Section 7130, Soil Survey Interpretations.

Manual Section 7312, Soils, is really the guts of the Manual on soil survey interpretations for resource management at this time. However, and that not been updated since January 1974, and contains some policy and procedural guidelines that became obsolete upon the adoption of the NGSS standards in 1978. Section 7312 is also incomplete in regard to the contents of the National Soils Handbook, which contains the official policy and procedures for carrying out the National Cooperative Soil Survey program. Manual Section 7312 has two main parts: 7312.1, Soil Inventory Procedures and 7312.2, Management Interpretations. It also includes a 165-page appendix, Basic Soil Principles, that was developed

from the USDA Forest Service Handbook on Soils, 1961. The revised portion of Section 7312.1 will be incorporated in the reserved Sections 7110 and 7120, and the revised portion of Section 7312.2 will be incorporated into reserved Section 7130.

The current appendix to Section 7312 should be deleted from the Manual. It is primarily a summary of the contents of a textbook for an introductory course in soil science that deals with the properties of soils, rather than "basic principles of soils". BLM soil scientists will have such textbooks in their private library, which generally will be more current than the 1961 Forest Service Handbook.

The fact that material such as the appendix of Section 7312 can become part of the BLM Manual is a good indication that the same can be done with the National Soils Handbook. Therefore, the development of Sections 7110, 7120, 7130, and 7140 should be a simple matter. The review process will be uninvolved, and the approval, printings and distribution steps should take place shortly after the drafting stage.

Manual Section 4412.14, Soil-Vegetation Inventory Method, also refers to the soil survey process. It states: "It is Bureau policy to make soil inventories that meet the standards of the National Cooperative Soil Survey as stated in the SCS National Soils Handbook, Soil Survey Manual, Soil Taxonomy, and BIM Manual Section 7312 Soils" in Section 4412.14Cl. The SVIM Manual was released on August 10, 1979. It gives the correct Bureau policy for the standards for making soil surveys of public lands administered by the Bureau. Saying that NCSS standards are stated in BIM Manual Section 7312 is stretching the truth a bit. Some items in 7312 conflict with the National Soils Handbook, such as: (1) the need for a memorandum of understanding for each soil survey area is missing from Section 7312; and (2) the symbolization of soil taxonomic units in 7312 conflicts with instructions in the National Soils Handbook.

The SVIM Manual also says that the BLM's basic soil inventories will be consistent with Manual Section 7161, Soil Inventories and Surveys. Hopefully that is not being followed because it would restrict the annual output of soil surveys to 50,000 acres or less per person, and would double either the time or the work-force required to make the soil surveys and to meet the EIS schedule.

Manual Section 4412.14Cl states: "The soil survey is <u>published</u> as an interim or special soil survey report of areas for in-service use." The verb "published" probably should be changed to "prepared" or "compiled". Eventually, all Bureau soil surveys will be published since it is required by the National Cooperative Soil Survey, but not on an interim basis.

The SVIM Manual is a subdivision of Manual Section 4410, Management Studies. The purpose of Section 4410 is to provide guidance and instructions for the conduct of vegetation inventories, forage surveys,

studies, and evaluations of the effectiveness of grazing management programs. Nothing is said about soil survey. The term SVIM is sometimes used as though it only includes an inventory of the vegetation by some employees of the BLM. Manual Section 4410.01 should be revised to include soil surveys.

Manual Section 4412.14Al deals with the inventory plan for SVIM. It should be amended to refer to the memorandum of understanding for the specific soil survey area which is required by the NCSS.

The composition of the inventory party for SVIM is given in Manual Section 4412.14A4. It lists the components as a party chief, a soil survey team, a mapping team, and a vegetation inventory (transecting) team. The names of the mapping team and the vegetation inventory team are confusing. The mapping team should be called the vegetation mapping team because its responsibility is to delineate the condition classes or present vegetation communities. The soil survey team is also a "mapping team". The vegetation inventory (transecting) team should be called the vegetation sampling team or the vegetation transecting team. The term "inventory", as used in the acronym, SVIM, refers to the overall method of gathering basic information about the soil and vegetation resources for a planning unit or survey area. The term as used in the vegetation inventory team refers to the more specific task of collecting site specific vegetation data using a detailed sampling procedure. It is confusing to use the same term for two different concepts in the SVIM Manual.

Experience has shown that when a soil scientist and range conservationist work together in preparing a map of the soils and condition classes, a better quality survey results than when the soil scientist works ahead of, and more or less independently of, the range conservationist. It is easier and less expensive for the two specialists to reach an agreement on a range site and condition class when they are observing the same area at the same time, and observing the soil and vegetation characteristics for the same sample site or sites of the delineation, than when they are separated by a time period and spatial interval. Therefore, it is suggested that a SVIM party be comprised of a party chief, a soil and vegetation survey team, and a vegetation sampling team. The exception would be where the party consisted of separate and distinct soil survey teams and vegetation survey teams. This suggested approach would reduce the confusion of the range conservationists who try to figure out why the soil scientist has assigned a specific range site to a certain area. It would also lessen the friction between soil scientists and range conservationists in some survey areas, and would result in a more accurate map that would facilitate the job of the vegetation sampling team. It probably would reduce the costs of the soil and vegetation survey.

The title of Manual Section 4412.14B, Field Inventory Mapping, should be changed to "Vegetation Survey" to eliminate redundancy, and to differentiate this topic from Section 4412.14C, Soil Considerations.

Manual Section 4412.14B1, Sources and Criteria for Mapping, should be renamed "Sources and Criteria for Mapping Vegetation", because the subject matter pertains only to mapping the vegetation community. Soil survey procedures are discussed under Section 4412.14C, Soil Consideration, and this should be renamed "Soil Survey", to be consistent with the format used to identify Section 4412.B, Vegetation Survey.

Manual Section 4412.14Clc states that the symbols used to identify soil series are defined in BLM Manual Section 7312. This has to be amended because the symbol system of Section 7312 is inconsistent with NGSS standards. Section 4412.14Cl states that it is Bureau policy to make soil surveys according to NGSS standards.

Section 4412.14D, Vegetation Field Inventory, should also be renamed "Vegetation Sampling" to eliminate the ambiguity of the term "inventory" throughout the SVIM Manual and to more accurately describe the contents of that section.

The discussion under Manual Section 4412.14B2c, Mapping Without a Completed Soil Survey, is confusing and can be wrongly interpreted as meaning that SVIM can be accomplished without including a soil survey. All that needs to be said is that the soils and vegetation will be surveyed if a soil survey does not already exist for the area.

The last two words of Manual Section 4412.14Cl, "inventory plan", should be replaced with, "memorandum of understanding for the survey area".

Manual Section 4412.14F is titled Wildlife Resources Field Inventory. "Wildlife Habitat Survey" might be more consistent with the proposed titles of "Vegetation Survey" and "Soil Survey" for Sections 4412.14B and C, respectively. The first sentence of Section 4412.14F2 begins with, "During the inventory of a SWA . . .". Changing it to read, "After delineating a SWA . . .", would remove the ambiguity of the term, inventory in SVIM, and would more accurately define the time frame for the wildlife habitat survey items.

SVIM, or Soil-Vegetation Inventory Method, includes procedures for surveying the wildlife habitat, recreational visitor use, undefined kinds of incidents, cultural features, and significant historical features. The instructions for surveying the recreational, cultural, and historical features are limited, and are only to be used on the SWA's for which the vegetation is to be sampled. Most of the items noted on Form 4412-39 by the vegetation sampling team probably will have been previously noted by the local recreational and archeological specialists. On the other hand, many features, previously noticed by the soil and vegetation mapping teams on SWA's not selected for the vegetation sampling phase, are not to be recorded according to SVIM Manual instructions.

The vegetation sampling team should concentrate on sampling the vegetation, and not be distracted by assessing the usage by recreational visitors and by surveying cultural and natural history features. The teams making the original soil and vegetation surveys should be assigned this task, and should be provided with a map showing the locations of the cultural and historical features that have already been identified in the area to prevent duplication of effort. Mamual Section 4412.14G, Recreation Field Inventory, should be dropped from SVIM. The title is a misnomer anyway, because it includes cultural and natural history features as well as recreational and wildlife observations.

The instructions for surveying the wildlife habitat are also rather meager and unspecific. The permissive verb, "may", is used extensively throughout the instructions instead of the mandatory "will", "must" or "shall". It is mandatory that any wildlife observed during the inventory be recorded on Form 4412-39, however, for each SWA sampled. Again this is distracting for the vegetation sampling team members. Halting their vegetation transecting activities to record "any" kind of wildlife scurrying within or across the SWA is bound to cause lapses and errors in the vegetation sampling process. Also, failure to observe wildlife on the SWAs that are not sampled may lead to an erroneous estimate of the size of the wildlife populations. The same segment of the population may be counted several times because of the mobility of some forms of wildlife, since it is mandatory to record any wildlife observed on each SWA sampled.

It is also mandatory that all potential, as well as existing riparian areas be mapped and sampled, according to Section 4412.14F3. No instructions are given for identifying "potential" stream courses or lake shorelines on the grazing lands of the western states. The time required for a river system to change its pattern and location is usually so great that trying to predict "potential" riparian areas will be of little relevance to wildlife management for many centuries. There is no requirement in Section 4412.D, which deals with the stratification of SWAs for sampling purposes, that states all (existing and potential) riparian areas must be sampled. This should be corrected.

If the wildlife habitat survey is to remain part of SVIM, the title of Manual Section 4412.14 should be, "Soil, Vegetation, and Wildlife Habitat Inventory (or Survey) Methods." If it is not to be a part of the process, the title should be, "Soil and Vegetation Inventory Methods" or "Soil and Vegetation Survey Methods". The hyphenated soil-vegetation term now being used is inaccurate because a hyphen is used between the parts of a compound word or the syllables of a divided word. The SVIM Manual gives procedures for doing a soil survey and a vegetation survey. It says that in the first sentence of Manual Section 4412.14. There is no single method for surveying both the soil and the vegetation resources of an area. Therefore, the plural form, methods, is needed for the title, "Soil and Vegetation Survey Methods".

In summary, the BLM Manual contains many contradictory and obsolete policy and guidance statements regarding the Bureau's soil survey program. Also, the information on soil surveys and soil management is scattered among several sections of the Manual. It is important that this information be updated and consolidated. The key policy and procedural document for the soil survey program is the National Soils Handbook. It would save money and time if that document could be incorporated into the BLM Manual.

A proposed BLM Manual section outline of the subject areas related to the Bureau's soil survey and soil management programs is as follows:

7100 - Soil Survey Management.

7110 - Soil Survey Operations Management.

7120 - Soil Classification and Mapping.

7130 - Soil Survey Interpretations.

7140 - Soil Investigations.

7150-7190 - (Reserved or Unassigned). "Soil Erosion" would be incorporated into 7400, and "Threatened and Endangered Plant Species" would be incorporated into 4400. The National Soils Handbook would become part of 7100.

7400 - Surface Protection and Watershed Practices, would be amended to include all soil management practices, including erosion control, drainage, irrigation, etc.

Section 4412.14 would be renamed "Soil and Vegetation Survey Methods" and carefully edited to remove conflicts with the National Cooperative Soil Survey and to eliminate confusion in the use of the words inventory, mapping, survey, classification, sampling, and delineation.

A SWA is delineated on a base map during the mapping stage of an inventory or survey process. The mapping unit for a SWA is defined in terms of classes or taxa from soil and plant community classification systems. Natural objects, including plant communities, may be classified without being inventoried. The mapping phase of the inventory process shows the location and extent of the various classes on a suitable base map. Sampling and other characterization work provides data that is used to determine the nature, properties, limitations, and capabilities of the various classes used to define the mapping units. An inventory or survey of natural objects that is not based on a firm classification system for defining the mapping units will result in an inventory of limited utility for resource planning and management. Before the wildlife habitats can be successfully inventoried, it will be necessary to develop a satisfactory wildlife habitat classification system. Also, it is futile to determine the potential forage productivity of a SWA if the SWA is not partially defined in terms of a soil taxonomic unit.

The following BLM Manual Sections should be removed:

7161 - Soil Inventories and Surveys

7162 - Soil Interpretations

7310 - Inventories and Interpretations

7312 - Soils (all parts)

Manual Section 7100 should be completely revised, expecially 7100.04, Responsibility. The responsibility for the Bureau's soil survey program is exercised through the Chief, Division of Watershed. However, there is no Division of Watershed in the current table of organization. The Service Center Director is responsible for the BLM's soil survey program, including "soil correlation on public lands". Only the SCS is responsible for soil correlation.

 Recommended Changes in BLM Manual Sections on Organization and Duties and Responsibilities of Offices Relating to the Soil Survey Program.

A number of BLM Manual sections describe and define the agency's organizational structure as well as the duties, responsibilities, and interrelationships of the various levels from the Washington Office to the district and resource area offices. Section 1201, Organization Management, briefly describes the organizational levels in the Bureau and basic principles of organization theory as applied to the Bureau. Section 1202, Organization Control, gives the procedures for proposing changes to the organizational structure and functions.

The functions and responsibilities of the various offices are described in Sections 1211, Headquarters Office; 1212, State Offices; and 1216, Service Center. Specific administrative guidelines for the Bureau's soil management and inventory programs are set down in Section 7100, Soil and Vegetation Management, and Section 7312, Soils.

Some of the statements in these sections are conflicting and misleading as they relate to the resource inventory systems, including the soil survey program. Some of the duties and responsibilities described for specific offices are not always in harmony with actual practice and logical needs. Sometimes the training task has been eliminated, or is not explicitly mentioned for offices where it is an essential responsibility and is being accomplished. Some of the language is awkward, with such words as "integrated", "coordinated", and "inventory having different meanings in different parts of the Manual. The uses for inventory information that are mentioned in the Manual sometimes include only the planning phase and fail to include the most important phase of resource management. BLM is the Bureau of Land Management, not the Bureau of Land Planning.

Recommendations are given below for eliminating some of the contradictions, for correcting omissions, for making the duties and responsibilities of offices more consistent with actual needs and practices, and for making the language more clear. These proposed changes are primarily of concern to resource inventory systems, including the soil survey program. Proposed changes are given below by underscoring additions and by slashing over deleted words or phrases.

The duties and responsibilities of the Deputy Directory for Lands and Resources are described in Manual Section 1211.3. Any reference to "menagement" or "multiple-use" of the natural resources are conspicuously absent from this section. It refers to "resource use allocation", but without a clear differentiation between the use and allocation of the resources by a single user and by several users simultaneously. It is recommended that the first sentence of Manual Section 1211.3 be revised to read:

The Deputy Director for Lands and Resources exercises leadership and authority for the Bureau program missions and functions relating to <u>multiple</u> resource use, <u>management</u>, and allocation.

The third sentence should be revised to read:

He/she provides policy interpretations, program direction leadership, and line management for high Highly the following: The Bureau environmental policy program, substitutible for the Bureau provides the substitution of the su

The Office of Planning, Inventory and Environmental Coordination is directly under the Office of the Deputy Director for Lands and Resources. Manual Section 1211.31 describes its duttes and responsibilities as being "responsible for the overall administration, coordination and integration of natural resource inventory efforts" and "develops and maintains a comprehensive Bureauwide resource inventory strategy and plan to support planning, environmental assessment and resource program actions." These duties have a direct effect on the Bureau's soil survey program.

There is a discrepancy between the manual policy and actual practice regarding the overall administration, coordination, and integration of natural resource inventory efforts, and the development and maintenance of a comprehensive Bureauwide resource inventory strategy and plan. Most of the coordination of the soil and vegetation inventory efforts is taking place within the Division of Rangeland Management. That division has recently added a GS-14 soil scientist position whose primary responsibilities are to coordinate and monitor the Bureau's soil survey program.

Up to now, most of the development of strategy and plans for the soil survey program have come from the Division of Resource Inventory Systems, Denver Service Center. The Office of Planning, Inventory and Environmental Coordination does not have anyone on its staff with the expertise to develop a strategy for meshing the Bureau's soil survey program with the planning, environmental assessment, and multiple-use resource and management programs, or to administer, coordinate and integrate the soil survey program efforts. The same can probably be said about the vegetation, wildlife habitat, water resources, and the several other natural resource inventories.

The proper place for the soil scientist position with expertise in soil classification and soil survey, is in an office directly below the Office of the Deputy Director for Lands and Resources. Soil survey information is equally applicable to the multiple-use management of rangeland, timber land, wildlife habitat, water resources, energy and nonenergy mineral extraction, wild horse and burros, wilderness areas, recreation, and realty and right-of-way transactions. Therefore, the Division of Rangeland Management is not the appropriate office for coordinating and administering the soil survey program.

The duties and responsibilities of the Office of Planning, Inventory and Environmental Coordination as written in Section 1211.31, already include a place for a soil scientist position with special qualifications in soil classification and survey. A simple approach for ensuring that official policy and actual practice mesh would be to transfer the Washington Office soil scientist from the Division of Rangeland Management to the Division of Planning, Inventory and Environmental Coordination.

Politically, however, there is opposition to this solution from those involved in the management of the soils and other natural resources. They argue that the staff in the Division of Planning, Inventory and Environmental Coordination treats planning as an end in itself, and are not fully aware of the uses of inventory information for resource management purposes. Also, they tend to think in terms of planning at a broader scale than is necessary for specific timber harvest areas, pastures, recreational sites, road corridors, and the like. Few of the staff are knowledgeable about the principles and practices of classification and inventory of natural resources. They are unable to adequately administer and coordinate the natural resource inventory programs because they have no concept of the kinds and intensity levels of the inventory systems that are needed to make resource use and management decisions. They tend to be satisfied with knowing a little about some of the resources on all the lands, instead of learning a great deal about all of the resources on all the lands.

Most of those who were asked about the proper placement of the natural resource classification and inventory experts in the Headquarters Office said it was not in the Division of Rangeland Management because information obtained from the vegetation, water, soil, and wildlife habitat inventories is significant to many Bureauwide management functions, not just to rangeland. Also leaving the soil survey and vegetation inventory responsibilities in the Division of Rangeland Management could lead to a situation where the needs of the other functional groups would be short-changed because it is natural for a person to bow to the wishes of his boss especially when he is subject to personnel evaluations by that

Few of those asked agreed with the simple solution of placing the resource classification and inventory experts in the Office of Planning, Inventory and Environmental Coordination for the political reasons already discussed. Some said the soil and water resource inventories

should be administered from a Division of Watershed. That was the situation until 1979, and it apparently operated quite successfully.

Others proposed setting up a Division or Office of Soil Management, either at the same level as the Office of Planning, Inventory and Environmental Coordination, or under the Assistant Director, Renewable Resources. Another alternative would be to set up an Office of Natural Resource Inventory Coordination under the Deputy Director for Lands and Resources and to remove Inventory from the Office of Planning, Inventory and Environmental Coordination. The Office of Natural Resource Inventory Coordination would be staffed with classification and inventory system experts from each of the concerned natural resources.

It is recommended that the proper placement of those responsible for classifying and inventorying the natural resources in the organizational structure at the Headquarters Office be studied and that action be taken to arrive at a solution that is logical and politically feasible. When errors are made by reorganizational upheavale, they must be rectified as quickly as possible to avoid waste, duplication of effort, poor quality of products, and low morale. Organizational changes are most successful when they are based on grass-roots input and support. This obviously was overlooked in the 1979 reorganization of the Bureau's structure and administration.

There is a duplication of natural resource inventory duties between the Office of Planning, Inventory and Environmental Coordination at the Headquarters Office and the Division of Resource Inventory Systems at the Denver Service Center. Section 1211.31B5 states that the Office of Planning, Inventory and Environmental Coordination "develops procedures, systems and a Bureauwide plan to provide for comprehensive, coordinated and integrated inventory processes for the matural resources on public lands." Section 1216.48D1 states that the Division of Resource Inventory Systems "develops methods, procedures and systems for conducting resource inventories on public land."

In practice, the development and adaptation of natural resource classification and inventory systems is being accomplished mostly by the Division of Resource Inventory Systems. The office of Planning, Inventory and Environmental Coordination staff has no expertise to meet this obligation. It is recommended that Section 1211.31B5 be deleted from the BLM Manual or amended to delete all reference to the development of inventory procedures and systems.

Section 1211.32 describes the duties and responsibilities of the Assistant Director, Renewable Resources. At this organizational level, the responsibility for "managing" the renewable resources, including soil, is duly recognized. Section 1211 also describes the duties and responsibilities of three divisions under Renewable Resources: Rangeland Management, Forestry, and Wildlife and Endangered Species. There is

also an Office of Water Policy at this level which was added after Section 1211 was released. The Rangeland Management and Forestry divisions both have responsibilities for protecting the soil resources. There is, however, no soil scientist on the Worestry Division staff.

The soil scientist in Rangeland Management is primarily involved with the Bureauwide soil survey program. Therefore, it is recommended that consideration be given to developing an Office of Soil Management or Watershed Management at the Washington Office level. The staff of soil scientists should include specialists in forest soil management, rangeland soil management, and soil classification and survey management. The soil science staff would provide technical guidance to all the natural resource functional groups.

Section 1212 describes the duties and responsibilities of the State Offices. It also spells out organizational relationships in Section 1212.2, and Section 1212.21B explains the relationships between the Denver Service Center and the State Offices. It lists seven kinds of services provided by DSC, including: personnel processing; administrative services, financial management services, management analysis services; training; data processing; and cadastral survey and engineering services. Oddly, "technical services" has been omitted from this list. Yet Section 1201.118 states that the Denver Service Center provides technical assistance to the field offices, and Section 1201.14 explains that a service center provides advice, guidance, and support to field units.

In practice, much of the efforts of the technical staff at DSC is devoted to giving technical service to the state and district offices. Therefore, it is recommended that Section 1212.21B be amended to include an eighth item, "technical services", and an appropriate descriptive paragraph be written for that subject.

Section 1216 describes the duties and responsibilities of DSC and its various offices and divisions, but fails to mention the training function under its objectives or in the job descriptions of the various subdivisions. It is recommended that Section 1216.02 be amended to read: "The Service Center provides administrative, technical, and training services, support and assistance to the Headquarters Office and field offices to facilitate the accomplishments of Bureau programs."

The field offices are dissatisfied with the amount of training assistance being given by DSC. Those responsible for developing technology are generally well qualified to instruct others in the use of that technology. Many items of a technical nature require instruction in application and use before they can be properly implemented. The Service Center should emphasize its training service. The middle name of the Denver Service Center should never be forgotten by its administrators and staff members.

Section 1216.48 states the responsibilities and duties of the Division of Resource Inventory Systems. Before a natural resource inventory system can be developed, there should be a classification system for that resource. Not everybody involved in the Bureau's planning and management system is aware of this. Therefore, it is important to note the distinction between a classification system and an inventory system in the BLM Manual. The Division of Resource Inventory Systems would be the logical office in which to make this distinction, and it could be recognized in the the Division's name.

The Division of Resource Inventory Systems is responsible for developing methods, procedures, and systems, but in practice, it adapts existing procedures and systems to meet the needs of the BLM. The Manual instructs the Division staff to coordinate with various offices at the Washington Office and Denver Service Center while developing inventory systems, but fails to mention any coordination with the field offices which are in the best position to know the kinds and intensity levels of resource inventory systems that are required to meet the Bureau's resource use and management goals.

The recommended revisions for Section 1216.48 are given below.

- .48 Division of Resource Classification and Inventory Systems.
- A. General Responsibility. The Chief, Division of Inventory Systems is responsible for providing leadership to the development and adaptation of standards and procedures for egordinated and threstated tespotee tragatories and systems of classifying, mapping, and interpreting the natural resources, which are coordinated among all offices of the Bureau and integrated with similar systems used by other agencies, for use in landfuld planning, applyity planning, environmental impact assessment and sixe specific blanging and aggige, and multiple resource management activities at all levels of planning and management. The Division staff members develop new and adapt existing resource classification and inventory systems within the policy framework established by the Headquarters Office to meet FLPMA requirements regarding systematic and periodic resource inventories. They coordinate the development and utilization of the classification and inventory systems with the Headquarters Office functional divisions; the Office of Planning, Inventory, and Environmental Coordination; #\$ yall #\$, the Headquarters Office of Information Systems, and the DSC Office of Data Systems, and the State Offices.

They also oversee testing and field implementation of the coordinated //wyenyeny systems for classifying and inventorying natural resources, and identify needs for the revision of existing systems, or the addition of new systems. They provide technical guidance and training programs to the field offices in regard to the implementation and utilization of the resource classification and inventory systems.

- B. Program Development. The Division Staff:
- Assesses the current and continuing needs and requirements for fifffiff natural resource classification and inventory systems for the Bureau.
- 2. Assists Headquarters and State Officials in the AvyAlbphylvi plementation and utilization of MARYINGS standards and procedures ANN SYSTEMS for the Bureau's resource THYSTIFFY Classification, mapping, and interpretation Programs.
 - C. Public Liaison. The Division Staff:
- l. Provides liaison with other resource agencies, institutions and groups to obtain common use and understanding of information about <u>resource classification</u> and inventory procedures and methods.
- D. Technical Development and Services. The Division Staff:
- l. Develops and adapts methods, procedures, and systems for classifying and symbolicities fixed the inventorying resources on public lands.
- 2. Develops and <u>adapts classification</u> and inventory systems to provide for the integration of basic resource data into the various resource <u>planning</u> and <u>multiple-use</u> <u>management</u> programs.
- 3. Develops and adapts standards, procedures, and systems of resource classification and inventorying is sussification and inventorying is sussification and inventorying is sussification. The inventor
- 4. Evaluates resource classification and inventory methods and technology to determine which are best suited and more appropriate to the Bureau's needs. Recommends use and incorporation of the supple procedures and systems from other agencies if they will add in meeting Bureau goals, and will provide for interagency information sharing.

- 5. It haddet that Coordinates with the Headquarters Office and the State Offices in the Identified determination of the standards and Investor Typication that is needed for different levels of resource Activity, planning, and management.
- 7. Provides technical guidance and training programs to the field offices on the implementation and utilization of the resource classification and inventory systems.
- E. Administration. (See Common Functions and Responsibilities,.1.)
 - F. Program Operations. The Division Staff:
- 2. Oversees the testing of resource classification and inventory systems for the Bureau and recommends needed changes in existing systems, or development of new systems to the Headquarters Office.
- 3. Coordinates and Labitable the implementation of the classification and inventory systems with the Headquarters Office functional divisions; office of Planning, Inventory, and Environmental Coordination; Office of Information Systems; and the State Offices. **Implemental Coordinates and monitors and the compilation and analysis of the data from the inventory systems with the SC Office of Data Systems.
- 4. Provides technical guidance and training programs to the field offices in regard to the implementation and utilization of the resource classification and inventory systems.

 The BLM's Soil Survey Program for FY 80, Who is Doing the Work, and Kinds of Work Performed by BLM and SCS Soil Scientists.

Each BLM State Office soil scientist was asked to submit an estimate of the acres planned for soil surveys in FY 80, and the size of the planned work force to accomplish the task. They were also asked to estimate the number of work-years soil scientists would devote to soil survey and non-soil survey activities, and subdivisions of these two major kinds of Jobs. Information about the planned expenditures for contracts, interagency agreements, and equipment was obtained from the Branch of Procurement at the Denver Service Center.

The BLM plans to make soil surveys for 20.4 million acres in 1980, using 189.1 work-years, at a cost of \$5,890,000. The soil scientists will come from the BLM, SCS, commercial contracting firms, and a state agency.

Table 31 shows the distribution of the soil scientists by state and agency. The SCS will supply about 55 percent of the work-years under interagency agreements with the BLM, but the extent of assistance ranges from 2.4 work-years in New Mexico to 29 work-years in Newada. The BLM soil scientists will perform about a third of the soil survey work in 1980. Again the variation among states is great, ranging from 1.8 work-years in Colorado to 15.5 work-years in Nevada. Nevada has, by far, the most ambitious soil survey plans for 1980. It plans on surveying over 6 million of the 20.4 million acres planned for the BLM. In Colorado, the SCS will do most of the surveys.

Private contractors will do slightly less than 10 percent of the work, and will be working in four states. They will perform nearly half the soil survey work in Wyoming. Nevada leads all states in the number of work-years to be performed by private firms. Idaho is the only state in which a state agency officially contributes to the BLM soil survey program on a reimbursable basis. Since either two or four sections of state lands per township occur over much of the original public domain land, it would seem reasonable that some sort of cooperative arrangement between the BLM and a state agency would be valuable in all states for soil survey work.

Table 31. Work-years of BLM, SCS, Private Contractor, and State Agency Soil Scientists to be Devoted to BLM Soil Surveys in FY 80 by State.

			Work Years		
State	BLM	SCS	Pvt. Cont.	St. Agcy.	Total
AZ	4.0	7.0	-	-	11.0
CA	4.5	7.5	1.0	-	13.0
co	1.8	16.9	-	_	18.7
ID	7.0	14.0	-	4.0	25.0
MT	4.0	5.0	-	-	9.0
NV	15.5	29.0	9.0	~	53.5
NM	11.0	2.4	-	-	13.4
OR	7.0	3.0	-	-	10.0
UT	5.5	15.0	1.7	-	22.2
<u>WY</u>	2.9	3.8	6.6		13.3
Total	63.2	103.6	18.3	4.0	189.1
% of					
Total	33.4	54.8	9.7	2.1	100.0

Table 32 shows the relationship between the size of the workforce and the size of the job for the soil survey program by state in 1980. In general, the more acres planned, the larger is the number of planned work-years to do the job. The correlation, however, is rough. The BLM average workload in each state would be around 108,000 acres per workyear. However, the range is between 48,000 and 271,000 acres per workyear for Colorado and Wyoming, respectively. Differences such as size of survey area; its geographic pattern, location, and accessibility; length of field season; and the complexity of the soils pattern account for some of this variation among states. There most likely will be a difference in intensity of a soil survey and in the quality of the final product between those done at the rate of less than 100,000 acres per work-year, and those done at the rate of more than 150,000 acres per work-year. Experienced soil scientists can make good quality thirdorder soil surveys at the rate of 100,000 to 150,000 acres per year, but a rate beyond that is likely to result in a poorer quality product.

Comparing the data in Table 32 with that in Table 31 shows there is no good correlation between output per work-year and originating agency of the soll scientists. Some states that rely heavily on interagency agreements with the SCS will produce less than 60,000 acres per work-year, while others will produce over 100,000 acres per work-year. Wyoming, the highest producer, relies heavily on contracts, whereas Arizona, the second highest producer, has no private contracts. Oregon and Montana, which rely heavily on BLM soil scientists, have among the lowest output per work-year. One generalization that seems to hold is the larger the planned acreage for 1980, the larger the expected output per worker. Arizona, Nevada, and Wyoming all plan on completing soil surveys for over two million acres in 1980, and each has a relatively large expected output per work-year.

Table 32 - Total Planned Work-Years and Acres, and Average Acres per Work-Year for FY 80 by State

	Work	-Years	Planned A	cres	Acres/ Work-Year
State	WY	%	(000s)	%	(000s)
AZ	11.0	5.8	2,000	9.8	182
CA	13.0	6.9	700	3.4	54
CO	18,7	9.9	900	4.4	48
ID	25.0	13.2	2,400	11.8	96
MT	9.0	4.8	500	2.5	56
NV	53.5	28.3	6,400	31.4	120
NM	13.4	7.1	1,500	7.4	112
OR	10.0	5.3	600	2.9	60
UT	22.2	11.7	1,800	8.8	135
<u>WY</u>	13.3 _		3,600	17.6_	271
Total	189.1	100.0	20,400	100.0	108*

*Average annual mapping rate for all states.

Table 33 shows the estimated total and per acre costs for the planned soil surveys in 1980 by state. The work-year related costs were estimated at \$24,000 per work-year for State and District Office soil scientists, and more for the Denver Service Center and Washington Office soil correlator positions. These costs include wages, travel, per diem, and other personnel charges. The costs for contracts, interagency agreements, and equipment were obtained primarily from the contract files and FY 80 procurement report at the Denver Service Center. Some BLM State Office soil scientists were also contacted in regard to these items, and the Annual Work Plan directives for FY 80 were also searched, but the information in them was usually presented in a manner that was difficult to pinpoint to the soil survey program. The final Bureauwide cost of 29 cents per acre corresponds to that of the Washington Office which divided the total dollars available for soil surveys in 1980 by the total planned acres by the Bureau, and found that the cost of doing soil surveys would average about 28 cents per acre in 1980.

The variation in cost per acre of soil survey work is wide among the states. Arizona and Wyoming have much lower expected costs per acre than the BLM average. In fact, the costs are so low in those states that they brought down the BLM average so far that seven of the remaining eight states have costs per acre greater than the average. Idaho's cost is below average. Nevada, New Mexico, and Utah's cost is not much greater than the average cost per acre. The bulk of the soil survey work in Wyoming will be done under a contract that went for a bid of about 17.5 cents per acre. Arizona, on the other hand, is relying on BLM and SCS soil scientists to do the work. Why Arizona is getting less than half as much per acre as states like Montana, Oregon, and Utah is not easy to explain. Perhaps some costs for soil surveys will actually be charged to the vegetation inventory instead of the soil inventory fund number in 1980 in Arizona.

Table 33. Estimated Total and Per acre Costs for BLM Soil Surveys in FY 80 by State

	BLM Work- Cost:		Contracts, IAs & Equip	Total Costs	Planned Acres	Cost/ Acre
State	Work-Years	(000s)	(000s)	(000s)	(millions)	
AZ	4.0	\$ 96	\$230	\$326	2.0	\$0.16
CA	4.5	108	215	323	0.7	0.46
CO	1.8	43	415	458	0.9	0.51
ID	7.0	168	390	558	2.4	0,23
MT	4.0	96	130	226	0.5	0.45
NV	15.5	372	1,570	1,942	6.4	0,30
NM	11.0	264	230	494	1.5	0.33
OR	7.0	168	60	228	0.6	0.38
UT	5.5	132	480	612	1.8	0,34
WY	2.9	70	595	665	3.6	0.18
DSC	0.5	16	0	16	0	-
_WO _	1.0	42		42	0	
7		A. F.				

<u>Total</u> 64.7 \$1,575 \$4,315 \$5,890 20.4 \$0.29 *Estimated at \$24,000 per year for state and district soil scientists.

Table 34 shows the proportion of the total BLM soil survey funds for 1980 that were allocated to each state. It also gives a calculated "fair" share for each state based on an even distribution of 28 cents per acre. It is not meant to suggest by this example that each state should receive the same amount per acre for soil surveys. Usually the states with vast areas of blocked-in public lands with existing soil surveys around the perimeters of the new area will be able to accomplish soil surveys relatively inexpensively. However, the data in Table 34 does suggest some inequities. For example, Arizona plans on surveying nearly ten percent of the BLM's total target acreage, yet is receiving only 5.5 percent of the funds; whereas, Colorado plans on surveying 4.4 percent of the total and will receive nearly 8 percent of the total funds. The disparity between the percent of allocated funds and the planned acres in the negative direction is greatest for Arizona and Wyoming. The disparity in the opposite direction is greatest for California and Colorado. About one percent of the total funds are skimmed off the top before allocations are made to the states to reimburse a SCS soil correlator from the Washington Office, and to pay for about half of the DSC soil scientist's salary and travel costs.

Table 34. Distribution of BLM Soil Sruvey Funds, "Fair" Share Funds*, and the Planned Soil Survey Acres by State Acres by State for FY 80

State	Total Rec'd (000s)	Percent of Total	"Fair" Share (000s)	Percent of Planned Acres
AZ	\$ 326	5.5	\$ 560	9.8
ĊA	323	5.5	196	3.4
СО	458	7.8	252	4.4
ID	558	9.5	672	11.8
MT	226	3.8	140	2.5
NV	1,942	33.0	1,792	31.4
NM	494	8.4	420	7,4
OR	228	3.9	168	2.9
UT	612	10.4	504	8.8
WY	665	11.3	1,008	17,6
DSC	16	0.3	16	0
_WO	42	0.7	42	<u>0</u>
Total	\$5,890	100.0	\$5,770	100.0

^{*}Based pm 28 cents per acre.

Some persons in high places in the Bureau believe that each BLM soil scientist is available to devote all of his time to the Bureau's soil survey program. They have little appreciation for the soil scientists' services to the Bureau's planning and resource management programs. Table 35 shows the major kinds of jobs being performed by the BLM soil scientists in 1980 - soil survey and non-soil survey planning and management) activities. For all the states combined, the time devoted to each of these functions is equally divided. For individual states, the proportion of the work-years devoted to soil surveys ranges from less than 33 percent in Colorado, Oregon, and Wyoming to more than 67 percent in Idaho, Nevada, New Mexico, and Utah.

Oregon will have nearly 26 work-years of soil scientists in 1980, yet only 7 of these will be engaged in making soil surveys. The Medford, Oregon District has four scientists who are devoting essentially all of their efforts to the Bureau's planning and resource management systems. As the value of soil survey information becomes better known, the total number of BLM soil scientists is sure to increase, and the proportion of their time devoted to soil surveys will decrease from what it is in 1980. When the planning system is completed, the soil scientists will be able to devote the bulk of their time to the major task of the Bureau of Land Management, namely, multiple-use resource management.

Table 35. Projection of the Major Kinds of Jobs to be Performed by BLM Soil Scientists in Work-Years and Percent of Total Work-Years by State for FY 80.

	Tot. BLM		Kind	of Job	
	Soil Sci.	Soil	Survey	Planning &	Managmt
State	W-Y	W-Y	%	W-Y	%
AZ	7.0	4.0	57.1	3.0	42.9
CA	12.0	4.5	37,5	7,5	62.5
CO	8.0	1.8	22.5	6.2	77.5
ID	10.0	7.0	70.0	3.0	30.0
MT	11.0	4.0	36.4	7.0	63.6
NV	20.0	15.5	77.5	4.5	22.5
NM	15.6	11.0	70.5	4.6	29.5
OR	25.8	7.0	27.1	18.8	72,9
UT	8.0	5,5	68,8	2,5	31.2
_ <u>W</u> Y	11.0	2.9_	26.4	8.1	_ 73.6_
otal Data s	128.4	63.2	49.2	65,2	50.8

Data supplied by the State Office soil scientists.

Table 36 shows more specifically than table 35 how the BLM soil scientists' time is spent for subdivisions of the two major functions. These data are for only six of the ten western states because the remaining states did not show the breakdown of work-year activities below the two major functions. The data represent the allocation of job responsibilities for 75.4 out of the total 128.4 work-years of soil scientists for 1980.

Slightly less than 70 percent of the BLM soil surveyors' time is devoted to actual field mapping. About 15 percent is devoted to quality control, and 17 percent to related soil survey activities in the office and in the field. Training of other soil scientists is included under other soil survey jobs. Data compilation and report writing should also be a major item. A BLM soil survey party chief devotes most of his time to quality control and other activities. Some soil survey crew members may devote most of their time to soil mapping during the field season, but may be engaged in planning and management in the off-field season.

Planning and resource management activities take up the bulk of nonsoil-survey function time, with each taking about equal amounts of time (42 to 45 percent).

1.13

Table 36. Specific Jobs to be Performed by BLM Soil Scientists* in Work-Years and Percent of Total Work-Years Devoted to Each Function and to All Jobs in FY 80. 1

Kind of Job	Total	Percent of	
	W-Y	Major Function	All Jobs
Soil Survey			
Soil mapping	22.0	68.3	29.2
Quality control	4.7	14.6	6.2
Other	_ 5.5	<u>17.1</u>	7.3
Total	32.2	100.0	42.7
Non-Soil Survey			
Resource managmt	19.4	44.9	25,8
Planning	18.2	42.1	24.1
Other	_ 5.6	<u>_13.0</u>	7.4
Total	43,2	100.0	57,3
Total	75,4	_	100.0

^{*}Arizona, Colorado, New Mexico, Oregon, Utah, Wyoming only.

Table 37 shows the specific kinds of jobs performed by SCS soil scientists making soil surveys for the BLM under interagency agreements. Again, these data are for six states only. This sample represents 49.2 of the total 103.6 SCS soil scientists who will work on BLM soil surveys in 1980. Essentially, all the SCS soil scientists' time is devoted to the job they are hired for — making soil surveys. The proportion of their time devoted to field mapping is higher than that of the BLM soil scientists, and the amount devoted to other soil survey activities is lower. There is not much difference between SCS and BLM soil scientists in the time spent on quality control. In some states, the BLM employs SCS party chiefs and soil correlators to maintain quality control. In other states, BLM soil scientists perform most of the quality control. In all states the SCS conducts the final soil correlation because this is required by the National Cooperative Soil Survey.

No data are available to show the breakdown of jobs performed by the soil scientists working for private contracting firms. Undoubtedly, the proportion of their rime devoted to quality control would be quite small because the BLM has responsibility for the quality control of its soil surveys unless it delegates this responsibility to the SCS by an interagency agreement.

Table 37. Special Jobs to be Performed by SCS Soil Scientists
Working on BLM Soil Surveys* in Work-Years, and
Percent of Total Work-Years Devoted to Each Major
Function and to Jobs in FY 80.

Kind of Job	Total	Percent of		
	Work-Years	Major Function	All Jobs	
Soil Survey				
Soil mapping	36.8	76.3	74.8	
Quality control	6.5	13.5	13.2	
Other	4.9	10.2	10.0	
TOTAL	48.2	100.0	98.0	
Total non-soil survey	1.0	100.0	2.0	
TOTAL	49.2		100.0	

^{*}Arizona, Colorado, New Mexico, Oregon, Utah, Wyoming only.

10. The Future of the BLM's Soil Management Program.

The soil survey program is just the beginning of the BLM's soil management program. Applying soil survey information to the management of the renewable resources on a sustained yield basis is just beginning in most states. The soil management program cannot mature until the soil survey program is completed, and until the significance of soil survey information to multiple-use management is widely recognized by natural resource managers. Paralleling the availability of soil survey information and its application to resource management, the kinds and numbers of soil scientist specialists at the various administrative levels will change. The future of the Bureau's soil management program is bright.

Most of the states plan to complete the soil survey of the public lands by 1987 or sooner, and all expect to complete it by 1995. The National Cooperative Soil Survey's goal is to map the entire nation by 1996. Nothing must prevent the completion of the Bureau's soil survey program. A soil survey is the only scientific way to determine the location, extent, capabilities, and limitations of all the kinds of soil in an area. The BLM also needs comparable information about the other resources and the socio-economic conditions to properly manage its resources.

Some people believe that once a soil map and accompanying report are available for an area, the need for soil scientists is diminished. This is not true. In fact, experience in the BLM districts in western Oregon has shown the opposite to be the case. Those districts have had soil survey information available for five years or more. Generally the districts had only one soil scientist position available during the period the soil survey was being made. Now that the surveys are available, the resource managers have discovered how important soil information is for managing the land and associated resources. They also realize that it takes a person with specialized training in soil science to explain the capabilities, limitations, and management needs of each kind of soil for alternative uses and levels of management. Consequently, the trend is to employ at least one soil scientist in each resource area. The resource area managers would no more trust the soil science problems to a non-soil scientist, than they would trust a tree surgeon to perform open heart surgery on themselves. And right they are in this judgement, because the morphology and functions of a soil are much more complex than the anatomy and physiology of the human heart. Furthermore, the variation in kinds of soils is infinitely greater than the variation among human hearts. Publishing textbooks does not dispense with the need for schools and teachers. Neither does a soil survey publication do away with the need for a soil management program and soil scientists in the BLM.

As the soil survey program approaches completion, the kinds of soil science specialists in the BLM will change. This is the case in the BLM districts where soil survey information has been available for several

years. The trend is to assign soil scientists with special qualifications in soil interpretation and management to each of the resource areas. The Bureau will need more specialists in forest soils, rangeland soils, soil physics, soil fertility, soil microbiology, and soil conservation, and fewer specialists in soil classification and survey in the future. Only a few of the specialists will be assigned to the state offices, the Denver Service Center, and the Washington Office. The soil management specialists will be assigned to every district office, and commonly to each resource area office.

The Washington Office will not need a large staff of soil scientists, but will need more than the one position it now has. The soil science program deserves its own office at the Washington level. There are offices for desertification, wild horses and burros, and water policy programs; none of which has the impact that soil science does on the use and management of the public lands administered by the BLM.

The administration of the BLM's soil management program in the Washington Office has always been by a non-soil scientist. The chief of the Division of Watershed was a titular, "soil conservationist," but his actual discipline was in some area other than soil science. By Civil Service Commission standards, a graduate from almost any natural resource curriculum can qualify as a soil conservationist. Many soil conservationists do not know the difference between an Aridisol and a Mollisol, and could care less. Quite properly, the Division of Forestry is supervised and manned mainly by foresters, and the Division of Rangeland Management staff is dominated by range conservationists. Nature abhors a vacuum, so it is only a matter of time before the true stature and status of the soil management program will be recognized in the organizational structure at the Washington Office.

The staff of technical soil scientists may need to be larger at the Denver Service Center than at the Washington Office if it is to perform the function of its middle name - "service". The field offices call upon the Denver Service Center for specialized technical guidance and training. The level of expertise for managing the resources will undoubtedly become greater in the future as new scientific developments and population pressures increase. This will increase the demand for more specialized and refined technical guidance and training. No one soil scientist can be an expert in all phases of soil science. Therefore, the soil science staff at the Denver Service Center may eventually consist of soil physicists, soil chemists, soil mineralogists, soil microblologists, as well as specialists in soil genesis, morphology, classification and survey.

Some of these specialists may also be in the state offices depending upon the needs of the individual states for their soil management programs. Right now there is a need for a soil correlator, or soil survey quality control position in most of the western states. A single BLM state soil scientist cannot satisfactorily manage the soil survey program according to the standards of the National Cooperative Soil

Survey, and at the same time carry on all the other duties and responsibilities of the soil management program. When the soil survey program has been completed for a state, the soil correlator position can be abolished, or converted to another specialty position.

Soon all soil survey information from all agencies and for all the land in the United States will be compiled and stored in a centralized computer. Later, these data will be available for all the land on the Earth. This is the mission of the Interagency Resources Evaluations Techniques (RET) Group at Fort Collins, Colorado. The BLM needs to continue to increase its support for this program, since it will only come about if there is universal agreement among the suppliers and users of the information regarding the soil classification system, soil survey procedures, and reporting methods.

In the future a soil scientist at the resource area or district office level will be able to supply the resource manager with the capabilities and limitations of the soils for a specific pasture for a variety of alternative uses simply by recalling the information from the central data bank. Likewise, the state office soil scientist will be able to obtain soil information within seconds for the entire state or any part of it. This information will also be available to anyone else at any location equipped with the appropriate terminal, including such places as the BLM Washington Office, the land planning office in a state capitol, a soil science professor's office at Cal Poly, Pomona, and the Food and Agricultural Administration's headquarters in Rome, Italy.

A major historical event in the BLM's soil survey program will take place in about 1995, when the last soil delineation on the public lands administered by the BLM will be mapped. There should be a tunultuous celebration for that event. Hopefully, by that time there will be complete harmony concerning the need for good resource inventory data and its application to multiple-use management. The harmony will exist among all BLM employees, the American Livestock Growers Association, the local, state and federal politicians from the western states, the Slerra Club, the Wildlife Federation, and the Natural Resource Defense Council. The sagebrush rebellion will have been forgotten and denied by the governors and congressmen. The care given to the natural resources on the public lands under the jurisdiction of the BLM will be appreciated by everyone because of the resulting beneficial effects on the social and economic welfare. The news media will make repeated reports of the BLM's successful management system to all parts of the nation.

The ceremony given to recognize the completion of the BLM's onceover soil survey program should be held at the site where the last soil mapping unit has to be delineated. Pioneers of the BLM soil survey program should be honored guests. Distinguished representatives from all the agencies involved in the National Cooperative Soil Survey will be linked arm-in-arm with representatives from all the professional organizations, conservation groups, political bodies, commercial societies. and the private sector. They also will be spiritually united on the signifigance of this event toward multiple-use resource management for sustained yields while maintaining the quality of the environment. The local high school band will open the ceremony with "America the Beautiful". At the conclusion of the speeches, and just prior to the happy-hour and barbecue, the entire assemblage will join in a boisterous rendition of: "This Land is Your Land! This Land is My Land". It would be appropriate if this event should take place on August 10, the date the SVIM Manual was released in 1979, and also the birthday of Jack Chugg who coordinated the BLM's soil survey program during its early years.

The benefits of the soil survey program to the BLM's resource management program will not be fully expressed by 1995, because some of the semiarid and arid lands take more than 15 years to "heal". However, by 2046, the effects of good management practices should be fully expressed. That being the centennial year for the BLM might be another cause for celebration. By then, the productivity of the soils should be restored to near what is was in 1500. The purity of the streams passing through the public lands will resemble that of the days prior to settlement by immigrants from Europe. The populations of wild beasts, fowls and fishes will be balanced by natural processes and events, and will be in harmony with each other. There will be no beer cans and other waste materials outside of waste receptacles. Every obsidian chip and point worked on by the aborigines will remain unmolested at the place it hit or fell. Off-road vehicles will be a thing of the past, except for a few museum pieces. The annual harvest of meat, wool, timber products, pinyon pine "nuts", and other products will never exceed the annual allowable productive capacity of any parcel of public land. Kids will brag about their Dads and Moms working for the BLM. BLM employees will proudly proclaim in a crowded pool hall in a small ranch town that they work for the BLM. Fence-line contrasts between ownership boundaries will have disappeared because everyone will be following the good example of the BLM. The state legislatures will be asking the BLM to take over the management of state-owned land.

It is a wonderful feeling to realize that these things will come about because of the May 8, 1978 decision by the BLM that it would henceforth make soil surveys according to the standards of the National Cooperative Soil Survey. The future of the BLM's soil management program is very bright!

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APPENDIX 1

List of BLM Soil Scientists - Spring 1980.

	DISC OF BEI	Soft Scientists - Spring 1960.	
Name	2	Office	
1 · 2 ·		W.O., Division of Rangeland Management W.O., Special Project Environmental Impact Team (at Denver, Colorado)	
3. 4.	Vacant Scott Fisher	DSC, Division of Resource Inventory Sys DSC, Division of Special Studies	stems
5. 6.	Lyle D. Linnell Kevin G. Meyer	Alaska State Office Fairbanks District	
7. 8. 9.	Mon S. Yee James W. Behm Thomas J. Craft Vear L. Mortenson		
11. 12. 13. 14. 15. 16. 17. 18.	Martin A. Townsend Albert S. Endo John A. Adams Robert E. Adams Daniel C. Cressy John W. Key Theodore A. Klaseen Corey L. Unfried Daniel E. Vaughn Vacant	California State Office Ca. SO, Ca. Desert Team (Riverside). Riverside District Uktah District Bakersfield District Bakersfield District Bakersfield District Bakersfield District Bakersfield District Bakersfield District Bakersfield District Bakersfield District	ricans ricans ricans ricans
21. 22. 23. 24. 25. 26. 27. 28.	Ernest L. Wesswick Robert L. Addison James E. Collins Terry L. Hueth Eric R. Johnson John E. Kornfield William G. Ypsilantis Vacant	Colorado State Office Canon City District Craig District Craig District Craig District Craig District Grand Junction District Montrose District Craig District	
29. 30. 31. 32. 33. 34. 35.	Gary Mandenford William T. Harris Glenn A. Hoffman Don B. Jackson Darwin J. Jeppesen Robert D. Roudabush Janes S. Renthal Vermon S. Webb	Idaho State Office Shoshone District Salmon District Boise District Idaho Falls District Boise District Boise District Coeur d'Alene District	

	List of BLM Soil	Scientists - Spring 1980,
Name		Office
37.	Myron B. Rollins	Montana State Office
38.	Vito A. Ciliberti	Butte District
39.		Lewistown District
40.	William C. Fanning	Butte District
41.		Miles City District
42.		Dickinson District
43.	William C. Schurger	Butte District
44.	Clarence Seago	Miles City District
45.		Lewistown District
46.	William P. Volk	Miles City District
47.	Vacant	Butte District
48.	Jerry B. Harman	Nevada State Office
49.		Las Vegas District
50.	Chris A. Anderson	Carson City District
51.	Terry E. Bowles	Winnemucca District
52.		Las Vegas District
53.		Las Vegas District
54.	Charles D. Carroll	Las Vegas District
55.	James T. Delaureal	Ely District
56.		Winnemucca District
57.	Bruce R. Kenny	Elko District
58.	Cheryl K. Lane	Battle Mountain District
59.	Calvin McKinlay	Battle Mountain District
60.		Winnemucca District
61.		Battle Mountain District
62.		Winnemucca District
63.	Vacant	Battle Mountain District
64.	Verlyn D. Saladen	New Mexico State Office
65.	Tom S. Bargsten	Albuquerque District
66.	Richard A. Bird, Jr.	Albuquerque District
67.	Katherine E. Boulgar	Socorro District
68.	Bruce G. Call	Las Cruces District
69.		Socorro District
70.		Socorro District
71.	Carol E. Marchio	Socorro District
72.	Raymond E. Meader, II	Socorro District
73.	Paul J. Meyer	Socorro District
77	D 11 17 D1	411 24 4

Clarence R. Seagraves Roswell District

74. Russell W. Pigors

Cheryl L. Roy

77. Harold G. Wall, Jr.

75.

76.

Albuquerque District

Socorro District

Socorro District

List of BLM Soil Scientists - Spring 1980, Continued

		. 0
Name	2	Office
78.	Byron R. Thomas	Oregon State Office
79.	Joe S. Cahoon	Oregon State Office
80.		Vale District
81.		Coos Bay District
82.	Jeannie G. Geschke	Lakeview District
83.	Ted Hass	OSO SVIM Team
84.	Geard J. Hubbard	Medford District
85.		Roseburg District
86.	Scott R. Imus	Spokane District
87.	Mark E. Johnson	Salem District
88.	Russell W. Krapf	Burns District
89.	Robert J. Lenhard	Medford District
90.	Charles F. Leonard	OSO SVIM Team
91.	James McLaughlin	Eugene District
92.	William E. Power	Salem District
93.	David Roberts	Roseburg District
94.	Steven P. Shade	Medford District
95.	John A. Simons	Medford District
96.	Lawrence C. Thomas	Prineville District
97.	Kenneth B. Van Etten	OSO SVIM Team
98.	Scott D. Whittaker	OSO SVIM Team
99.	Barry D. Williams	Eugene District
100.	Gary J. Yeager	Spokane District
101.	Vacant	Baker District
102.	Charles W. Case	Utah State Office
103.	Cory E. Bodman	Vernal District
104.	Keith J. Chapman	Vernal District
105.	Benjamin J. Hamm	Richfield District
106.	David T. Hansen	Moab District
107.	Max V. Hodson	Cedar City District
108.	Verr D. Leavitt	Salt Lake City District
109.	Mark A. Mackiewicz	Moab District
110.	Robert B. Smith	Cedar City District
111.	Wayne M. Svejnoha	Moab District
112.	Warren I. Weston	Richfield District
113.	William E. Crane Jr.	Wyoming State Office
114.	Edwin L. Bunger	Worland District
115.	Jeannie L. Holm	Rawlins District
116.	Richard L. Larson	Rawlins District
117.	Renee Laviolette	Rock Springs District
118.	Robert E. Long	Rawlins District
119.	Charles R. Neal	Worland District
120.	Steven H. Strenger	Rawlins District
21.	Colin W. Voight	Rock Springs District
122.	James C. Whitmore	Worland District

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APPENDIX 2

Soil Survey Publications and Interim Reports

The soil survey publications and interim reports listed below are for soil survey areas which include public land administered by the BLM, and in which the BLM was either an official cooperating agency, or the primary source of financial support. This list only represents the soil survey publications available in the Denver Service Center, and is not meant to be a complete listing of all the soil surveys for which the BLM has made a contribution. There are a number of soil survey publications for areas in several of the western states which include public lands under the jurisdiction of the BLM, but which were not supported by the BLM. Those are not listed here.

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