FEDERAL REGISTER: 43 FR 38035 (August 25, 1978)

DEPARTMENT OF THE INTERIOR
Office of Surface Mining Reclamation and Enforcement

30 CFR PART 715
Appendix - Alluvial Valley Floors Technical Guidelines Notice of Public Hearing

ACTION: Proposed policy and interpretation; notice of public hearing.

SUMMARY: The Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87) establishes a comprehensive regulatory scheme for the preservation and protection of alluvial valley floors in the arid and semiarid areas of the United States west of the 100th meridian west longitude from the adverse effects of surface coal mining operations. The Office of Surface Mining Reclamation and Enforcement (OSM) is today publishing proposed guidance to assist both State regulatory authorities and OSM in the interpretation and application of section 515(b)(10) and 510(b)(5) of the act and 30 CFR 715.17(j) (42 FR 62687, December 13, 1977) to pending permit applications and mining and reclamation plans for surface coal mining operations which may be subject to those sections of the act and regulations. This guidance is proposed in order to promote uniformity of interpretation and application of the act and regulations relating to alluvial valley floors among regulatory authorities who share responsibility under the act, and to give fair notice to operators of the information which may be requested by regulatory authorities when a surface coal mining operation will or may affect the essential hydrologic functions, uses, or productivity or alluvial valley floors.

DATES: Comments or suggestions regarding the proposed policy and interpretation should be submitted on or before October 23, 1978. A public hearing regarding the proposal will be conducted on October 13, 1978, at 10 a.m. in the Auditorium (Room 269), Old Post Office Building, 1823 Stout Street, Denver, Colo.

ADDRESSES: Comments should be sent to the Regional Director, Office of Surface Mining Reclamation and Enforcement, Region V, 1823 Stout Street, Denver, Colo. 80202.

FOR FURTHER INFORMATION CONTACT: John Hardaway, Office of Surface Mining Reclamation and Enforcement, Region V, 1823 Stout Street, Denver, Colo., 80202, 303-837-5511. Additional copies may be obtained from Mr. Hardaway.

SUPPLEMENTARY INFORMATION:

While the inherent complexity of alluvial valley floor systems - the interrelationships of geologic, hydrologic, pedologic, and botanical characteristics - as well as regional and site specific diversity, make it difficult to develop absolute standards for identification and study, this paper does provide definitive interpretations of some of the issues that have arisen during implementation of the act. The proposed guidance is not a rule or a set of absolute requirements. It is the result of numerous requests for assistance in detailing criteria for alluvial valley floor identification and requirements for baseline study which would reveal the nature of essential hydrologic functions and their supporting characteristics. This guidance, though not regulatory in nature, represents OSM's interpretation of scientific and technical requirements which permit alluvial valley floor identification and study.

The primary author of this document is Jack Schmidt, Consultant to the Office of Surface Mining Reclamation and Enforcement, 1012 Billings Avenue, Helena, Mont., 59601, 404-442-0448. The proposed document was prepared under the guidance of a task force including representatives from the U.S. Geological Survey Water Resource, Geologic and Conservation Divisions; the Bureau of Land Management; the EPA; the Office of Surface Mining; and, the Office of the Solicitor. The proposed document was developed with the cooperation and assistance of representatives of the coal mining regulatory authorities in Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming, but represents only the proposed policy and interpretation of the Office of Surface Mining Reclamation and Enforcement.

TONEY HEAD, Jr.,
Assistant Director for Management and Budget.
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DRAFT
TECHNICAL IDENTIFICATION AND STUDY OF ALLUVIAL VALLEY FLOORS GUIDELINES

Office of Surface Mining
Department of the Interior
August 1, 1978; Revised August 15, 1978

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INTRODUCTION

Consideration by the Congress of the effect of surface coal mining on alluvial valley floors in western valleys was prompted by a statement in a report issued in 1974 by the National Academy of Sciences:

"In the planning of any proposed mining and rehabilitation it is essential to stipulate that alluvial valley floors and stream channels be preserved. The unconsolidated alluvial deposits are highly susceptible to erosion as evidenced by the erosional history of many western valleys which record several periods of trenching in the past several thousand years * * * Removal of alluvium from the thalweg of the valley not only lowers the water table but also destroys the protective vegetation cover by draining soil moisture. Rehabilitation of trenched valley floors would be a long and expensive process and in the interim these highly productive granting areas would be removed from use." (National Academy of Sciences, 1974, 44-45)

In considering alluvial valley floors, the Congress recognized the special role of such areas in maintaining agricultural activities and it ultimately defined alluvial valley floors and provided specifically for their protection. The role of alluvial valley floors in western agriculture was expressed as follows:
"Of special importance in the arid and semiarid coal mining areas are alluvial valley floors which are the productive lands that form the backbone of the agricultural and cattle ranching economy in these areas. For instance, in the Powder River Basin of eastern Montana and Wyoming, agricultural and ranching operations which form the basis of the existing economic system of the region, could not survive without hay production from the naturally subirrigated and flood irrigated meadows located on the alluvial valley floors." (House Rept. No. 95-218, p. 116; 1977)

Alluvial valley floors are of special concern under the United States Surface Mining Control and Reclamation Act of 1977 (Pub.L. 95-87). Under this law and adopted regulations (Department of the Interior, 1977), it is necessary to evaluate an area for the presence of alluvial valley floors, to study the alluvial valley floors identified, and then to evaluate a proposed mining and reclamation plan and its relation so the identified alluvial valley floors. (OSM Regulations, 30 CFR 715.17(j)).

This technical guidance paper includes guidelines for preliminary identification of alluvial valley floors (part I), guidelines for study of those areas preliminarily identified as alluvial valley floors in order that a final determination of alluvial valley floor status may be made (part II), and guidelines for detailed study of alluvial valley floors resulting in identification of "essential hydrologic functions" (Section 510(b)(10)(F) and associated supporting characteristics (part III).

The identification, study, and evaluation procedures (covered in this technical guidance paper) and a possible subsequent procedure for application of Pub.L. 95-87 provisions is indicated in figure 1. Figure 1 shows that at least at the time following detailed study and identification of essential hydrologic functions, determinations must be made by the regulatory authority of (1) what constitutes preservation of the essential hydrologic functions, (2) what level of change constitutes "material damage" (Pub.L. 95-87, Section 510(b)(5)(B)) to the water system supplying an alluvial valley floor, and (3) in what areas mining would "interrupt, discontinue, or preclude farming" on an alluvial valley floor (Pub.L. 95-87, Section 510(b)(5)(A)).

Relevant sections of the law include:

(1) The statutory definition of alluvial valley floors - "alluvial valley floors" means the unconsolidated stream laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits by unconcentrated runoff or flope wash, together with tallus, other mass movement accumulation and windblown deposits. (Pub.L. 95.87, Section 701(1)).

(2) Statutory provisions which apply to all alluvial valley floors which include -
General performance standards shall be applicable to all surface coal mining and reclamation operations and shall require the operation as a minimum to * * * minimize the disturbances to the prevailing hydrologic balance at the mine-site and in associated offsite areas and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by * * * preserving throughout the mining and reclamation process the essential hydrologic functions of alluvial valley floors in the arid and semiarid areas of the country. (Pub.L. 95-87, Section 515(b)(10)(F)); and
No permit or revision application shall be approved unless the application affirmatively demonstrates and the regulatory authority finds in writing on the basis of the information set forth in the application or from information otherwise

available which will be documented in the approval, and made available to the applicant, that * * * the proposed surface coal mining operation, if located west of the one hundredth meridian west longitude, would * * * not materially damage the quantity or quality of water in surface or underground water systems that supply these valley floors in (A) of subsection (b)(5). (Pub.L. 95-87, Section 510(b)(5)(B)).

(3) Statutory provisions applying to some alluvial valley floors -

No permit or revision application affirmatively demonstrates and the regulatory authority finds in writing on the basis of the information set forth in the application or from information otherwise available to the applicant that * * * the proposed surface coal mining operation, if located west of the one hundredth meridian west longitude, would not interrupt, discontinue, or preclude farming on alluvial valley floors that are irrigated or naturally subirrigated, but excluding undeveloped range lands which are not significant to farming on said alluvial valley floors and those lands as to which the regulatory authority finds that if the farming that will be interrupted, discontinued, or precluded is of such small acreage as to be of negligible impact on the farm's agricultural production. (Pub.L. 95-87, Section 510(b)(5)(A)). [Page 38037]

FIGURE 1

Diagram of a possible procedure for identifying and investigating the important characteristics of alluvial valley floors ("AVF's")

Reconnaissance evaluation of area for potential AVF	areas not AVF	PART I OF THIS GUIDELINE
Areas may be AVF Further study of probable AVF		
Final determination of status of an area as an AVF	areas not AVF	PART II OF THIS GUIDELINE
Area is an AVF		
Detailed study of AVF and surrounding area resulting in identification of essential hydrologic functions and important supporting characteristics		PART III OF THIS GUIDELINE
Determination of what constitutes preservation of the "essential hydrologic functions" of the AVF		If essential hydrologic functions cannot be preserved, mining plan not approved
Review and revision of mining plan to ensure preservation of "essential hydrologic functions"		
Determination of what constitutes "material damage" to the AVF: determination of whether mining plan will result in "material damage" during or after mining.		If material damage unavoidable from entire mining plan, plan not approved
If "material damage" unavoidable from part of mining plan, plan revised; regulatory authority finds no "material damage" from mine plan		
Determination of in what areas mining would "interrupt, discontinue, or preclude farming," excluding undeveloped rangeland not significant to farming and areas so small as to be of "negligible impact on the farm's agricultural production; applicable areas deleted from mining plan		
Plan approved in reference to AVF issue; criteria established for monitoring effects of mining 'the AVF or mining near AVF during or after mining		

[SEE TABLE IN ORIGINAL]

Note: Determinations of "material damage" and whether mining would "interrnor, discontinue, or preclude farming" may be appropriate prior to completion of efforts required to identify the important supporting characteristics in certain site specific cases. [Page 38038]

Section 515(b)(10)(F) applies to all areas of the arid and semiarid West meeting the criteria of the Section 701(1) definition. Section 510(b)(5) applies to those alluvial valley floors west of the one hundredth meridian west longitude which not only meet criteria of water availability, but are or may be "farmed." Specifically excluded from the definition of farming are "undeveloped range lands which are not significant to farming on said alluvial valley floors and those lands * * * that if the farming that will be interrupted, discontinued, or precluded is of such small acreage as to be of negligible impact on the farm's agricultural production." (Pub.L. 95-87, Section 510(b)(5)(A)).

Although the definition of alluvial valley floors establishes that the existence of a water supply sufficient for agricultural activities is a necessary characteristic of an alluvial valley floor, the Congress did not give a quantitative criteria by which the adequacy of this supply for agricultural activities should be evaluated. These guidelines, in part, are designed to overcome the lack of specificity in evaluating water availability. The guidelines are also designed to provide uniform criteria for identification of alluvial valley floors in all geographic areas. This guideline provides guidance which is not a mandatory requirement, and is intended for use by State regulatory authorities and operators to achieve uniform application of alluvial valley floor provisions contained in the statute (Pub.L. 95-87) and regulations. This paper will be used by OSM as a guideline in its own evaluation of alluvial valley floor questions. In every case, the applicant for a permit to mine should consult with the appropriate regulatory authority prior to initiating a study of potential or designated alluvial valley floors.

Regional and site specific diversity does not permit development of quantitative criteria for every important characteristic of alluvial valley floors. In many cases, it is likely that determinations and evaluations of alluvial valley floors will involve site-specific judgments by experienced personnel.

These guidelines involve examination of areas which in many cases will be beyond the limits of the area proposed to be directly affected by mining and reclamation, i.e., "off site" areas. This analysis of off site areas is necessary to meet the requirements of Section 510(b)(5) of the act which states that proposed surface coal mining operations cannot adversely affect most alluvial valley floors either directly (Section 510(b)(5)(A)) or indirectly (Section 510(b)(5)(B)). Thus alluvial valley floors within the area that may be affected by the proposed operations should be investigated. Some of this land may not be owned by the operator. The operator should endeavor to obtain access to these lands in order to complete specified studies. If access is not allowed by the landowner, the regulatory authority may try to assist the operator in obtaining access through discussions with landowners. If access is rejected after a good faith effort by the operator and regulatory authority, studies should be continued elsewhere within the designated study area, and estimates made of baseline conditions, and the effects on the restricted area should be predicted through the use and extrapolation of data collected nearby.

Each of the following parts includes specifications for data collection. Presentations of data collected by proposed operators are best when accompanied by interpretative sections which synthesize collected data. These reports should include discussions of the interrelationships among hydrologic, geologic, pedologic, vegetative, and land use data.

DRAFT

PART I - GUIDELINE FOR PRELIMINARY IDENTIFICATION OF ALLUVIAL VALLEY FLOORS

Preliminary identification of alluvial valley floors is necessary

(1) In regional evaluations which identify potential coal mining areas and possible mining constraints, such as the development of regional coal leasing programs;

(2) In evaluation of specific potential coal lease tracts by either lessees or lessors;

(3) In evaluation of a proposed mining tract by a proposed operator or regulatory authority; and

(4) In development of premining environmental baseline studies.

These guidelines of part I are intended to permit preliminary identification in each of these cases. Identification can be made by qualified professionals in the earth and botanical sciences. Land use data, interpretation of infrared aerial photography, and reconnaissance field work are the basis of the preliminary identification procedure. Mapping of the proposed area of operation is generally adequate if completed at a scale no smaller than 1:6000 but larger scales (such as 1:4800) may be necessary to show sufficient detail of complex areas. Mapping of areas beyond the proposed permit area should provide sufficient detail and have sufficient accuracy to permit identification of important topographic features. Normally, maps at a scale of 1:25000 or larger (such as a standard USGS 1:24000 topographic quadrangle) will be necessary to be sufficiently accurate or detailed.

These guidelines for preliminary identification are structured in a step-by-step fashion (figure 2). Geomorphic features are first identified (part I.A). These features typically exist in and describe any potential alluvial valley floor area and they focus attention on stream-channel areas and their nearby environments. Following identification of geomorphic features, water availability factors are evaluated (part I.B). The presence of any one of these factors is used in determining which geomorphic valley floors should be identified for further study under provisions of Pub.L. 95-87.

An underlying philosophy of these guidelines is that identification of alluvial valley floors first requires identification of hydrologic systems. Alluvial valley floors are portions of a drainage system which at some downstream location become sufficiently broad, contain suitable and sufficient soils, and begin to contain enough water in stream channels and unconsolidated valley fill material to provide sufficient water supplies for flood irrigation or subirrigation agricultural activities. The combination of these characteristics result in the special agricultural importance of alluvial valley floors. These guidelines are designed to identify an integrated geologic-hydrologic-biologic system which supplies water for observed agricultural uses or where water is available for such uses.

These guidelines describe acceptable procedures to be used by an applicant to examine the drainage basin within which the proposed operation will be located. Although an applicant's focus of concern is obviously on the proposed mine site, an understanding of the entire drainage basin in which the mine and possible alluvial valley floors are located is necessary to identify the extent to which the geologic-hydrologic-biologic system supports or may support agricultural use of valley floors. As a general rule, part I of these guidelines describes a reconnaissance examination of all lands within 2 miles of the proposed permit boundaries. A 2-mile area is justified by the occurrence of observable groundwater drawdown impacts 2 miles from an operating western strip coal mine subject to intensive studies (Van Voast, W.R., and R. Hedges, 1975). This guideline recognizes that in specific cases the limits of actual impacts may occur closer or farther away than 2 miles. More precise estimates may be developed at any stage of these guidelines but usually require detailed aquifer testing and modeling which is not included until part III of this guidance. Site conditions and the nature of cumulative effects of many mines in one area may also affect the size of the area of concern, and in each case, the study area should be reviewed with the responsible regulatory authority prior to application of this guideline.

FIGURE 2

Diagram of procedure for preliminary identification of alluvial valley floors [Page 38039]

PART I.A.

[SEE ILLUSTRATION IN ORIGINAL]

I.A. GEOMORPHIC CHARACTERISTICS

Guideline Procedure: Map all active flood plains and terraces underlain by unconsolidated material found in the lower parts of topographic valleys, in which are found identifiable stream channels. In a plan view, these terraces, together with the active flood plain and channel, would normally form one contiguous unit, separated only by minor amounts of non-alluvial materials, such as bedrock outcrops or thin layers of eolian sand or silt. Identifiable stream channels are considered here as all drainage courses shown on a USGS 1:24000 topographic quadrangle, as well as any other perennial stream channels and other drainageways at least three feet in bankfully width and/or 0.5 feet in depth at bankfull stage.

This procedure should identify all stream laid deposits associated with an identified stream channel and exclude isolated higher terraces which cannot be construed to be a part of a "valley floor." Terrace deposits along major upland

drainage divides should not be included in this identification process. The total areal extent of each deposit should be mapped, with the upslope contact drawn where the essentially flatlying stream laid deposits encounter the sloping deposits of the surrounding hillsides.

Discussion: The Act describes the geomorphic and stratigraphic features of alluvial valley floors as being "unconsolidated stream laid deposits holding streams * * * [and not including] upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits by unconcentrated runoff or slope wash, together with talus, other mass movement accumulation and windblown deposits" (Pub.L. 95-87, Section 701(1)). Alluvial valley floors thus are considered in this guidance to be near-stream environments whose general character is due primarily to the action of a stream and to the associated ground water regime.

Physiographic components. The physiographic components of an alluvial valley floor are the channel, active flood plain, and, in most cases, terraces. A *channel* is a defined water-course which carries stream-flow at some times of a year. The channel bottom is usually unvegetated, unless streamflow is infrequent. Portions of some western valleys do not have channels in them, such as headwater areas, where runoff has been insufficient to cut a channel, and in valleys cut by former glacial outwash streams. Valleys without stream channels are not considered in this paper to be alluvial valley floors, since they are not "unconsolidated stream laid deposits *holding streams* ". The applicant may consider channels to be those drainage courses shown on a standard USGS 1:24000 topographic quadrangle or map of similar scale, as well as all other perennial stream channels and those ephemeral or intermittent drainageways at least three feet in width (at bankfull stage) and/or 0.5 foot in bankfull depth, unless equivalent or more detailed specifications are appropriate for the area. Bankfull width of braided streams is measured from the edge of each bank within which flow occurs.

The channel size criteria is based on review of Apley (1976), a channel geometry study of ephemeral streams of eastern Wyoming, and review of other channel geometry studies (Hedman and Kastner, 1977; Lowham, H.W., 1976). Channel sizes of three feet in bankfull width and 0.5 foot in bankfull depth are smaller than any channels discussed in this guideline which might have water yields sufficient for flood irrigation.

An *active flood plain* is "the lowland that borders a river, usually dry but subject to flooding when the stream overflows its banks. It is that flat area constructed by the present river in the present climate" (Leopold, 1974). This definition specifically refers to the flatlying area inundated by frequent floods and does not refer to areas inundated by floods of long recurrence intervals, such as 100-year floods (Leopold, Wolman, Miller, 1964). For example, mapping by the USGS in Campbell County, Wyoming, estimates that flood plains are inundated at least once every 2-3 years (Fullerton and Kirkham, 1977). Flood plains are found along most channels, except in upland headwater areas.

A *terrace* is "a former flood plain no longer being actively constructed by the river in the present climate" (Leopold, 1974). Terraces may be found at many heights above the present channel, including hundreds of feet above large streams with a history of active erosion. Although at one time a terrace may have extended throughout the length of a stream, subsequent erosion may have eliminated much of a terrace level. This is typically the case where stream gradients steepen and where valleys narrow.

Since part I is intended to permit identification of areas clearly not alluvial valley floors and those areas which may be alluvial valley floors, it is prudent to examine all areas where detailed study might identify an alluvial valley floor. Since agricultural activities supplied by ditch system flood irrigation and subirrigation may occur on terraces higher than the lowest terrace, it is therefore necessary to investigate all terraces having potential for irrigation or subirrigation as potential alluvial valley floors during this part of the preliminary identification. Also, since rooting depth of a crop such as alfalfa has been known to reach extreme depths in excess of 50 feet (Robinson, 1958), it is prudent to include higher terraces where crops like alfalfa may be subirrigated by the alluvial ground water system.

The complex structure of terraces and valley fill is illustrated in idealized diagrams in figure 3. All terraces shown in these examples would meet the geomorphic characteristics criteria of this part. [Page 38040]

[SEE ILLUSTRATION, IN ORIGINAL]

(Leopold, L.B. and Miller, J.P., 1954 in Schumm, S.A., 1977, fig. 6-22)

Where terraces are not adjacent to other terraces, are separated by substantial bedrock outcrops, colluvial deposits, or residual material, and cannot be construed to lie in a valley floor, these areas generally are not to be included as alluvial valley floors, even if they are subirrigated or have the ability to be flood irrigated.

Relationship of surface landform (terrace) to underlying material (valley fill). To the geologist, the term terrace refers only to a surface landform. Terraces may be underlain by unconsolidated material or bedrock. Alluvial valley floors are areas where terraces are underlain by unconsolidated material. Collectively, this unconsolidated material is called a valley fill, and is mostly composed of unconsolidated or partly consolidated stream laid material, while along the margins of these areas deposits from surrounding hillslopes may be found. The distinction between alluvium (material deposited by streams either in the channel or on the floor plain) and colluvium (material deposited by hillslope processes such as slides, falls, soil creep, or sheetwash) is difficult to make in many western valleys. This guidance does not necessitate that a distinction between colluvium and alluvium in valley fills be made. Many detailed geomorphic studies conducted throughout the arid west have noted the gradational inter-fingering of alluvium and colluvium (Leopold, Emmett, Myrick, 1966). Most of the alluvial fills of the arid west are composed predominately of silt, often fine sandy silt, sometimes silty fine sand, and their alluvial origin is best determined by observing the surface landform which the material underlies (Leopold, Emmett, Myrick, 1966). Other characteristics of these deposits such as presence of gravel lenses and roundness and shape of these gravels, may be useful in identifying alluvial deposits but are more difficult to apply. Since terrace landforms are themselves indicative of a stream process origin, their occurrence is considered diagnostic of the geomorphic characteristics of an alluvial valley floor. The presence of materials typically associated with colluvial processes on a terrace created by alluvial processes shall not justify excluding the terrace and underlying fill from being part of an alluvial floor.

In some upstream areas, stream channels are found in flatlying of terraces. In these areas, the distinction between stream laid deposits and colluvium and sheetwash deposits may be even more difficult in terrace areas. In upstream areas, each type of deposit has a very gently sloping surface (0-4 percent) and may be found in the bottoms of swales and hills. These type valley fills should be included within the alluvial valley floor area if the areas adjacent to the stream course are essentially flat lying, and there is a discernible break-in-slope where flatlying areas contact hillslope deposits. If, however, valley fill deposits grade continuously upslope to surrounding hills, the stream side area alluvial valley floor.

Alluvial fans. An alluvial fan is "a low, outspread, relatively flat to gently sloping mass of loose rock material, shaped like an open fan or a segment of a cone, deposited by a stream at the place where it issues from a narrow mountain valley upon a plain or broad valley, or where a tributary stream is near or at its junction with the main stream, or wherever a constriction in a valley abruptly ceases or the gradient of the stream suddenly decreases" (Gary, et al, 1972). Review of various Congressional reports, as well as previous mapping efforts, indicates that the entire depositional surface of alluvial fans should not necessarily be designated as an alluvial valley floor (House Report 95-218; Congressional Record, May 20, 1977, pp. S8083-8096). Although alluvial fans clearly include unconsolidated debris deposited by streams, the deposits usually do not form valley landforms. Portions of a fan surface may be of various ages and usually do not relate to the existing stream which cuts through the fan. For purposes of alluvial valley floor determination, flood plains and terraces associated with an existing stream course should be identified as an alluvial valley floor, and these usually do not include the entire fan surface. Similarly, where streams cut across fans in a transverse direction, those areas with terrace landforms related to the existing stream are alluvial valley floors, but the former fan surfaces are not.

Upland areas. Statutory language specifically excludes "upland areas" from consideration as alluvial valley floors (Section 701(1)). Upland areas, although not specifically defined, are characterized as being "generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits by unconcentrated runoff or slope wash, together with tales, other mass movement accumulation and windblown deposits."

Discussion in the Senate (Congressional Record, May 20, 1977) indicates that the upland area exclusion was intended to apply in situations where "alluvial plains" occupy the entire area between "a mountain range and a flood plain of a stream" (Congressional Record, May 20, 1977, p. S5085). These areas were to be excluded from consideration as alluvial valley floors. Specifically, they may include upper portions of alluvial fans, pediment surfaces, landslide deposits, and other unconsolidated debris deposited by such processes as mudflows and debris flows. Areas underlain by bedrock and covered by residual weathered material and debris deposited by sheetwash and rillwash are also upland areas. The existence of small, isolated patches of colluvium or bedrock in a valley floor generally characterized by streamlaid deposits was not intended to be the basis of excluding those areas from alluvial valley floor consideration.

I.B. WATER AVAILABILITY CHARACTERISTICS

The water availability criteria of alluvial valley floors outlined in Pub.L. 95-87 are that those areas should have "water * * * sufficient for subirrigation or flood irrigation agricultural activities." The following steps outline a procedure for establishing water availability based on the evidence of agricultural land use, vegetative growth, and on water yield estimates

and data. During the period of detailed study outlined in part II, areas identified in part I would be examined in greater detail in order to provide a basis for a final determination as to the presence of an alluvial valley floor.

The following steps would be applied to all areas which meet the geomorphic criteria of part I.A. Areas which do not meet the part I.A. criteria are excluded from further alluvial valley floor consideration, regardless of other characteristics of the area. Areas which meet the part I.A. criteria but do not meet the part I.B. criteria are similarly excluded from further alluvial valley floor consideration. However, for an area to meet part I.B. criteria, it need only meet the criteria of one subpart. Thus, an area meets part I criteria if it falls under part I.A. and either subpart I.B.1, I.B.2, I.B.3, or I.B.4.

Guideline procedure: [Page 38041]

I.B.1. *Flood irrigation or special management activities. Map the perimeter of all areas identified in part I.A. which are flood irrigated, where old flood irrigation structures, no longer in use, once supplied water to the valley floor, and all areas that were historically flood irrigated. Also map all valley floor areas where agricultural activities involve special management of the valley floor area, including all cropped or harvested lands.*

Discussion: Alluvial valley floors include those valley floors where "water availability is sufficient for * * * flood irrigation agricultural activities" (Pub.L. 95-87, section 701(1)). Flood irrigation is "irrigation through natural overflow or temporary diversion of high flows in which the entire surface of the soil is covered by a sheet of water" (Office of Surface Mining regs., 30 CFR 710.5). Characteristically, these systems involve diversion ditches, water spreading systems such as contour dikes, contour ditches, or graded borders, and may include pipe drains. On small streams, particularly in the northern Great Plains, channels are dammed and flood flows thereby diverted to a water spreading system. Flood irrigation may also include diversion from small reservoirs constructed to retain flood flows of ephemeral or intermittent streams. Pumping from streams, reservoirs, or ground water should not be considered to meet this criteria, except in the special case where pumping simulates direct diversion and water is pumped immediately into an irrigation canal. Irrigation water must be supplied by water diverted from the stream channel associated with the irrigable land in question, and not from another stream in another drainage basin.

Areas where agricultural activities involve special management of the valley floor area include valley floor pastureland specifically fenced to manage grazing of those areas, valley floor areas with water supply systems specifically designed to encourage use of valley floor vegetation, and areas cultivated or harvested for alfalfa, native or introduced grasses, or other crops which probably use water from the valley floor hydrologic system.

Guideline procedure:

I.B.2. *Extrapolation of irrigable land using surficial geologic characteristics. Extending downstream to the confluence with the next largest stream and upstream one-half mile from each area identified in subpart I.B.1, map any area identified in part I.A. which is a similar height above the channel as those areas identified in subpart I.B.1.*

Discussion: The definition of alluvial valley floors in section 701(1) of Pub.L. 95-87 concerns areas where water availability is sufficient for floor irrigation or subirrigation agricultural activities, and does not refer only to those areas where agricultural activities currently occur, or have in the past occurred. Current or past land use, in conjunction with surficial geologic characteristics, is one basis by which to establish what other areas have water availability sufficient for agricultural activities. Since surface water flows usually increase in the downstream direction, identification of terraces of similar heights above the channel as those already irrigated or otherwise used is a reasonable process to identify additional irrigable lands. Since flood flows generally are similar through small reaches of streams, it is also reasonable to extend the identification process one-half mile upstream from the areas of agricultural activity.

Guideline procedure:

I.B.3. *Flood irrigation capability. Map all areas that have the capability of being flood irrigated.*
Areas that have the capability of being flood irrigated are those areas where:

(1) A -diversion ditch can be constructed at some point along a channel which will lead water from the same drainage basin onto the areas in question, by gravity flow through structures such as ditches, canals, or pipes; and

(2) There are 2 acre-feet of water available per acre of land which can feasibly be flood or ditch-irrigated sometime during the period May 1 to September 15 for more than one-third of most years. The 2 acre feet quantity may be adjusted to

reflect regional differences in evapotranspiration rates and specific crop needs of the area in question. Feasibility shall not be construed to include the legal right to use the water.

Discussion: The assessment of water availability is tied both to the quantity of water available and the point of its diversion. Obviously, the further upstream water is diverted, the higher are terraces which can be irrigated. However, less water is generally available from upstream sites. In performing this analysis, it should be reasonably expected that water from a ditch would be diverted to the first available sites for flood irrigation. Thus, hypothetical diversion systems must be shown to supply water not only to the area in question, but to other upstream areas irrigable from the same ditch.

Estimates of water availability should be based on gaging station data, if available, and regional studies based on streamflow analyses, drainage basin, or channel geometry characteristics. Estimates should be made of annual and monthly streamflow for purposes of this analysis.

The question of legal right to use water should not be considered in this analysis since the intent is to identify those areas where flood irrigation water is hydrologically feasible. Water rights may be transferred over time and water that is presently unavailable for irrigation of specific plots of land may become available in the future.

This analysis is intended to hypothetically evaluate all water available in a stream at its point of diversion. It may be appropriate that a given amount of water remain in the stream for other uses. These other uses should especially be considered on major streams where fish and wildlife resources would be lost if excessive diversions occurred.

Guideline procedure:

I.B.4. *Vegetation characteristics which may indicate subirrigation or flood inundation. Based on a reconnaissance vegetation survey and use of aerial photography, map all other areas where agriculturally useful vegetation is dependent on moisture supplied by ground water or frequent flood-flows.*

Discussion: This step attempts to identify all other areas where agriculturally useful valley floor vegetation is dependent on subirrigation or flood inundation. An experienced botanist or range scientist should use the best available aerial photography and reconnaissance fieldwork to identify those valley floor areas which differ significantly from the surrounding uplands. Criteria to be used in differentiating range communities should include:

(a) Significant differences in the species or species groups that are ecological dominants in the plant community;

(b) Significant differences in the proportion of species or species groups that are the ecological dominants of the plant community;

(c) Significant differences in the total potential (ungrazed) annual production of the plant community.

In addition, indicator species which may reflect subirrigation or excess moisture from frequent flooding should exist in the valley floor vegetation community. Valley floor areas, however, that have been heavily grazed may not have identifiable indicator species, and in these cases, SCS range site criteria should be used along with observations of vegetation in similar physiographic areas in better range condition. In order to warrant further study under part II, there should be an agricultural use (grazing or cropping) for the species and communities identified in this step. For example, bog and marsh areas in the glaciated portion of the northern Great Plains, which serve no useful agricultural function, would not be identified as possible alluvial valley floors since their dominant vegetation is sedges and reeds, which are not useful for grazing or cropping. In each State of the arid and semiarid West, reference should be made to the SCS lists of potential vegetation community for flood inundated and subirrigated range sites in the process of identifying indicator species of flood inundation and subirrigation.

Where adequate aerial photography is unavailable to permit mapping, color infrared photos should be taken toward the end of the growing season, especially at the time when upland growth has gone dormant, but not after the first killing frost on the valley floor. Photos should permit accurate mapping at a scale of 1:25,000 or larger.

PART II - GUIDELINES FOR FURTHER STUDY AND FINAL DETERMINATION OF THE PRESENCE OF AN ALLUVIAL VALLEY FLOOR

Following preliminary identification of alluvial valley floors (part I), further study by an applicant is necessary in order to facilitate final decisions concerning the presence of alluvial valley floors. This part of the guidelines outlines a procedure for further study of potential alluvial valley floor areas and suggests some criteria that may be useful to indicate the presence or absence of alluvial valley floors.

Areas to be studied for final determination are those areas identified as probable alluvial valley floors under the guidelines for preliminary identification (part I). Areas containing alluvial valley floors should be mapped upstream at least to the point where the total width of the valley floor (including the areas on either side of the channel) is less than 30 feet in width. Isolated areas upstream of this point should generally be larger than 10 acres in order to be identified as alluvial valley floors. These size limitations are considered the lower limit of useful agricultural advantage of alluvial valley floors and reflect the interpretation that alluvial valley floors are not discontinuous and small patches of irrigated or subirrigated lands. However, additional studies and possible designation of smaller tracts of land is possible if the smaller tracts may be agriculturally important. As a general rule, part II guidelines would best be applied to any probable alluvial valley floors within 2 miles of the boundaries of a proposed area of operations, unless obvious hydrologic or geologic features dictate otherwise.

Under the procedures of this guideline, alluvial valley floors should contain the geomorphic features of part II.A. and some part of the water availability features of part II.B. All water availability characteristics would be examined at some stage of the investigation. For example, if an area meets part II.B.1. criteria, the alluvial valley floor area should also be examined for the presence of the other water availability characteristics described in parts II.B.2. and II.B.3. It may be possible to defer these other investigations until part III of the guidance. [Page 38042]

II.A. GEOMORPHIC CRITERIA

Guideline procedure:

The area should be within the topographic confines of a valley and be underlain by unconsolidated deposits whose surface landform is characteristic of fluvial deposition (i.e., channels, flood plains, and terraces). Terraces overlain by colluvial material, as identified by lithologic logs, pits, or wells, should be included as alluvial valley floors if they meet any water availability criteria of part II.B.

Discussion: This information would have already been collected of part I.A. of the guidelines were followed. At this later stage, lithologic logs, developed from coring or geophysical logging should be compiled, if available to the applicant. Lithologic logs of all observation wells and backhoe pits described in section II.B.2 should also be compiled.

II.B. WATER AVAILABILITY CRITERIA

Guideline procedure:

II.B.1 *Flood irrigation. The area is presently or has during 5 of the preceding 20 years been flood irrigated for production of harvestable crops or grazing forage.*

Discussion: The existence of present or past flood irrigation is direct evidence that the area is an alluvial valley floor, unless flood irrigation was attempted and later discontinued because of unacceptable water quantity, quality, and/or soil conditions. If the latter case exists, it must be documented. Data for identification of these areas may be obtained from:

(a) Land use mapping based on present air photos, and conversations with landowners (work will have been completed during the preliminary identification phase, part I.B.1).

(b) Conversations with resource managers and field personnel familiar with past management problems.
Guideline procedure:

II.B.2 *Subirrigation. The area is naturally subirrigated and constitutes an agriculturally useful natural vegetation community different from those of surrounding uplands; or the area is naturally subirrigated and is cropped, otherwise mechanically harvested, or subject to special management as described in part I.B.1.*

Discussion: On the basis of water level and soil moisture measurements, one or more of the following characteristics of subirrigation should be observable in a subirrigated area:

(1) Diurnal fluctuation of the water table, due to the difference in night and daytime evaporanspiration rates;

(2) Increasing soil moisture from a portion of the rooting zone down to the water table, due to capillary action;

(3) Mottling of the soils in the root zones;

(4) Observation of an important part of the root zone within the capillary fringe or water table of an alluvial aquifer;

(5) Stream flow and ground water monitoring indicating an increase in flow immediately after the first killing frost on the valley floor.

Water level measurements should document levels during the growing season.

Guideline Procedure:

Subirrigation means irrigation of plants where water is delivered to the root systems from below, through semisaturated or saturated zones of unconsolidated deposits. The vegetation is thus able to continue growth despite extended periods of low precipitation. Subirrigation should be related to the ground water system of the valley floor in question and not be artificially maintained by reservoirs or irrigation ditches.

Subirrigation could be substantiated by demonstrating any of the characteristics listed above. Robinson (1958) has demonstrated how diurnal fluctuations of water table level result from different evapotranspiration rates of phreatophytic plants using alluvial ground waters. Water level measurements from observation wells and continuous monitoring would substantiate such fluctuations. An increase in soil moisture with increasing depth down to a saturated zone is direct evidence that capillary action is capable of carrying water upward from a water table. Soil moisture measurements, such as with a neutron probe access tube, taken in conjunction with regular measurement of water table levels would indicate these gradients. Mottling of soils in the root zone is indicative of ground water fluctuations if water levels have existed in the root zone. Direct observation of rooting depths in backhoe pits and their relation to the water table and/or capillary fringe could document subirrigation at the time of observation. Increases in stream flow and ground water levels after a killing frost may indicate that water had been used by the vegetation prior to the frost and thus be an indicator of subirrigation. If investigation showed no subsurface water present, the area would be assumed to have no subirrigated areas and the detailed studies would likely not be necessary.

In order to document the existence of subirrigation, the measurements of water levels, soil moisture conditions, stream flow and rooting depths should be completed for those areas whose vegetation or land use has indicated possible subirrigation. Identification of these areas was addressed in parts I.B.1 or I.B.4 of this paper.

Depending on site specific conditions and requirements, the applicant should establish observation wells along transects crossing the potential alluvial valley floor area in order to monitor the height of the water table of the alluvial aquifer and fluctuations during various time periods. Generally at least three well sites should be established along each transect. Wells should be completed to the base of the alluvial aquifer, and the casing should be slotted to insure reception of water from the entire saturated thickness. If more than one aquifer is found in the valley fill, it would be appropriate to complete separate wells to separate aquifers, since each well should receive water from only one aquifer. Transect locations should be located so as to describe the longitudinal stream and valley profile, as well as in representative portions of the valley. Detailed lithologic logs should be obtained from well cores or backhoe pits.

Water level in those wells identified by the regulatory authority should be continuously recorded. Water levels in all other wells should be measured monthly and all measurements should be to an accuracy [*] 0.01 foot. The accuracy is necessary to establish subirrigation relationships. Water level measurements should be taken throughout the growing season in order to establish the relationship between vegetative growth and groundwater availability.

Measurements of soil moisture within the rooting zone of different soils in different topographic locations and vegetative communities should be made in order to assess water changes with depth. Measurements should be made near observation wells in order to correlate soil moisture with ground water levels. Stream flow measurements should be taken at a point so as to record flow increases after vegetation on the valley floor has ceased growing.

Guidance Procedure:

II.B. 3. *Flood irrigation capability. The area is capable of being flood irrigated.*

Discussion: The area is capable of being flood irrigated if:

(1) A diversion ditch can be constructed at some point along a channel which will lead water from the same drainage basin onto areas identified in I.A., by gravity flow through structures such as ditches, canals, or pipes; and

(2) There are two acre-feet (unless otherwise required) of water available per acre of land to be irrigated sometime during the period May 1 to September 15 for more than one-third of all years; and

(3) The quality of surface waters, and the characteristics of the soil to be irrigated are such that the water delivered to the soil will not degrade the quality of the soil such that long-term irrigated or dryland agricultural use would be threatened.

Discussion: The evaluation of water quantity will have been completed under part I.B. 3, guidelines for preliminary identification of alluvial valley floors.

Analysis of stream flow quality and soil characteristics is necessary to place limits on the irrigability of the lands in question. For example, SAR (sodium absorption ratio) values or salinity for either soils or water might prohibit successful irrigation. Also, evaluation should be made of any historical land use data concerning poor irrigation success. This paper assumes, based on discussions with State regulatory authorities, that if significant soil degradation would take place after twenty years of hypothetical irrigation, then flood irrigation would not be considered possible.

Stream flow at least one site in the area of the potential alluvial valley floor, and stream flow at other locations as appropriate to identify changes should be analyzed for water quality characteristics. Sampling should be conducted in accordance with accepted standards and for one full year. Sampling of stream flow should be conducted for one full year. In the case of ephemeral streams, however, where flow is of short duration, samples collected from snowmelt runoff and during runoff resulting from major rainstorm events may be considered sufficient for characterization of each stream's water quality. Analyses of samples should be conducted consistent with the guidelines for water quality analyses used in the state where the mine is proposed. Analyses should focus on constituents which might affect irrigability.

A soil survey of adequate detail is needed to establish the effect of irrigation on soils and to assess capabilities of the soils as plant growth mediums. The soil survey should be conducted in accordance with standards of the National Cooperative Soil Survey (U.S.D.A. Handbooks 436 and 18). The survey should cover the alluvial valley for under consideration. The soils should be described and mapped to the phases of series or series variants. Common soil series names or numbers should be correlated to the described soils. Soil mapping units may consist of more than one component where delineation to individual phases of series or series variants is impractical or unnecessary to meet the objectives of the survey. Phases of series or series variants that are greater than 2.0 acres should be delineated when such distinction is necessary. When soil mapping units consist of more than one component, the relative percentage of each component should be adjusted to represent the affected lands. The soil inventory map submitted in the application should be on a single contour map or aerial photograph (scale 1:6,000 or larger). [Page 38043]

Map unit descriptions which are consistent with the National Cooperative Soil Survey should be included in the application. For each series phase or series variant of a soil unit occurring on affected lands, a profile typical of the soil within the permit area should be described. The location of the described profile should be marked in the field and shown on the soil inventory map. Percent of coarse fragments by volume, amount and depth of roots, relative amount of carbonates, and evidence of a water table, should be noted in the description of each series phase or series variant. The range in characteristics of a soil over the affected area should be described if significantly different from the described typical profile.

Soils should be described for their dryland and irrigated capability. Detailed chemical and physical analyses or soils, based on the guidelines for the state in which mining is proposed, should be conducted for all soil types. Water holding

properties of soils should be documented through bulk density, texture, and percent organic matter tests conducted on selected representative soil horizons within the root zones.

PART III - GUIDELINE FOR DETAILED STUDY OF DESIGNATED ALLUVIAL VALLEY FLOORS TO DETERMINE IMPORTANT CHARACTERISTICS

Following final determination of alluvial valley floor status, detailed study is necessary to identify those important characteristics which support the essential hydrologic functions of a particular alluvial valley floor with a sufficient degree of certainty. Part III identifies more detailed studies that may be necessary to develop a reclamation plan that adequately addresses the performance standards of section 510(b)(10)(G) of the Act. Detailed investigations might focus on leaky aquifer conditions, prezometric surfaces, perched water tables and zones of high moisture content, discharge and recharge of alluvial and bedrock aquifers, natural changes in surface flows, and vegetation surveys. Detailed study is generally necessary for alluvial valley floors lying within the proposed permit area and for alluvial valley floors which receive water from the mined and reclaimed areas.

The area for detailed study should be determined as part of a multiphase program designed to project any surface and subsurface effects of mining. Sufficient aquifer pump tests to permit estimation of drawdown effects in all affected aquifers should be performed to establish the area of potential influence on ground waters, and the area for further ground water study. It is recommended that two or more pump tests be performed in each hydrologically distinct area to be mined and in any adjacent alluvial valley floor.

The initial hydrologic and geomorphic study described in part II will generally identify the area of surface water influence. These investigations, may, in specific cases, be insufficient to determine the effects of proposed mining on alluvial valley floors in proximity to the proposed area of operations and more study of flow and quality, often of longer duration, may be necessary, in order for the regulatory authority to make a scientifically reliable decision.

As a general rule, the following criteria will be considered to determine the boundaries of the area of detailed study:

Case A. Where part of an alluvial valley floor is within the proposed area of operations, the study area may consist of:

(1) That part of the alluvial valley floor within the proposed area of operations;

(2) Any lands within an area two miles in radius about the boundaries of the area described in (A)(1); and

(3) Any other lands within the proposed area of operations.

Case B. Where part of an alluvial valley floor is within two miles of the boundary of the proposed area of operations, the study area may consist of:

(1) That part of the alluvial valley floor within two miles of the boundary of the proposed area of operations;

(2) Any lands within an area two miles in radius about the boundaries of the area described in (B)(1); and

(3) Any other lands within the proposed area of operations designated by the regulatory authority.

These guidelines should be altered to the degree justified by analysis of the hydrologic, hydrogeologic, topographic and land use data collected during all parts of the study. Discussions should be held with the regulatory authority prior to initiating and prior to completing these studies.

Study requirements differ in scope depending on whether an area is designated an alluvial valley floor because of flood irrigation characteristics (subparts II.B.1. and II.B.3), subirrigation characteristics (subpart II.B.2.), or both. Table 1 outlines study requirements as a function of the characteristics which lead to an alluvial valley floor designation. In making submittals of these data, accompanying interpretative tests are of great assistance.

*5*TABLE 1 - .
Detailed study guideline outline

	Study prior to final determination (parts I, II)	Study after final determination based on flood irrigation characteristics (no subirrigation)	Study after final determination based on subirrigation characteristics (no flood irrigation)	Study after final determination based on subirrigation and local irrigation characteristics
III.A. *Surface Hydrologic Data Specifications:*				
III.A.1 Streamflow records	X	X		X
III.A.2 Streamflow analyses	X	X		X
III.A.3 Estimates of runoff, tributary flow, and sediment yield from proposed area of operations		X		X
III.A.4 Surface water quality analyses	X	X		X
III.B. *Geohydrologic Data Specifications:*				
III.B.1 Observation well establishment (bedrock) and water level measurements			X	X
III.B.2 Groundwater contour maps			X	X
III.B.3 Aquifer testing			X	X
III.B.4 Well and spring inventory			X	X
III.B.5 Groundwater quality analyses			X	X
III.B.6. Observation well establishment (alluvium), water level measurement	X		X	X
III.C. *Geologic Data Specifications:*				
III.C.1 Geologic, geologic structure, surficial geological maps	X	X	X	X
III.C.2 Geologic cross-sections		X	X	X
III.C.3 Overburden analyses			X	X
III.C.4 Field geomorphic surveys and geomorphic study		X		X
III.C.5 Lithologic logs of any previous drilling activity in alluvial valley floor	X			
III.D. *Soils Data Specifications:*				
A Soil Survey (scale 1:6000)	X	X	X	X
B Chemical and	X	X	X	X

*5*TABLE 1 - .
Detailed study guideline outline

	Study prior to final determination (parts I, II)	Study after final determination based on flood irrigation characteristics (no subirrigation)	Study after final determination based on subirrigation characteristics (no flood irrigation)	Study after final determination based on subirrigation and local irrigation characteristics
physical analyses				
C Soil moisture	X			
III.E.*Vegetation Data Specifications:*				
III.A. Vegetation inventory	X	X	X	X
III.F. *Land Use Data Specifications:*		X	X	X
III.F.1 Crop yields		X	X	X
III.F.2 Current uses of land map	X	X	X	X

III.A. SURFACE HYDROLOGIC DATA SPECIFICATIONS

III.A.1. *Stream flow gaging and records.* At least one continuous discharge measurement site should be established in the channel of each affected alluvial valley floor. Other gaging station sites may be required to ascertain recharge areas, discharge areas, runoff and changes in water quality. Where flumes are used for gaging purposes, crest stage gages should be located upstream of the flumes so that major flows, which might wash out the flume, can be estimated. In northern areas where low temperatures would necessitate heat sources during winter for proper functon of gaging stations, it may be permissible to allow stations on intermittent or ephemeral streams to be non-operational for the coldest period of the winter months. In some cases, data from adjacent stream reaches where stations already exist may be substituted for this data. Stream flow records for a one-year period, as well as rating curves used to relate stage to discharge, should be prepared. [Page 38044]

III.A.2. *Stream flow analyses*. Where nearby gaging station records are sufficiently long and are applicable to the initially designated alluvial valley floor, flood frequency and low flow analyses should be undertaken. Where records are not available or adequate, flood flow estimates should be made for the reach of alluvial valley floor in question. Using this data, the area inundated by selected recurrence floods (up to 100-year) should be identified. Estimates of average annual and average monthly stream flow will have been completed under part I.B.3 in the evaluation of Water availability for flood irrigation.

III.A.3. *Estimates of runoff and tributary flow contribution.* Estimates should be made of the runoff contribution and sediment yield from the proposed area of operations to the alluvial valley floor. Estimates should be made for runoff and sediment yield from hillsides and flow and sediment transport in tributary channels to the alluvial valley floor. In the case of estimates of overland flow and sediment yield, a soil survey and soil characteristics such as infiltration rate; vegetation characteristics, such as plant cover; and topographic characteristics, such as slope steepness, should be evaluated in relationship to expected precipitation events of various recurrence intervals. Wherever possible, actual erosion rates and sediment delivery rations should be measured. The use of rainfall simulators and ring infiltrometers may be helpful in this effort. In the case of estimates of flow from tributary channels, channel and drainage basis characteristics and regional flow estimation techniques based on similar basin and climate characteristics should be used to estimate average annual and peak flow contributions to the alluvial valley floor.

Determination of runoff characteristics may require establishment of gaging stations, or crest stage gages on any major tributaries in order to describe the surface hydrology. Estimates of sediment transport in tributary channels may be accomplished by suspended and bedload sediment sampling, and establishment of scour chains and channel surveys.

III.A.4. *Other data specifications.* Surface water quality data collected during parts I and II of this paper may have to be increased during the more detailed study (part III) to include water quality sampling for a longer period and to include other sampling sites if extreme variability on longer term trends are suspected.

III.B. GEOHYDROLOGIC DATA SPECIFICATIONS

III.B.1. *Observation well establishment (bedrock) and water level measurement.* Observation wells should be established in the various bedrock aquifers which likely discharge to or are recharged from the alluvial valley floor. Individual observation wells should be completed into separate aquifers. Specific location of observation wells will be a function of site geology, and should be located in concert with a regional hydrologic program in order to facilitate the necessary analysis of accumulative hydrologic impacts. The location of wells should permit identification of flow patterns, direction of vertical movement, extent of interaquifer leakage, and relationship of bedrock and alluvial aquifer systems. Detailed lithologic logs of each well site should be obtained by either coring or geophysical logging. Water level should be measured continuously on one well in each aquifer and monthly in other wells. Measurements should be to an accuracy of 0.01 foot in order to identify any influence of vegetation, barometric pressure or recharge on the depth to water within the root zone or in areas supplying alluvial valley floors.

III.B.2. *Groundwater contour maps.* Contour maps (scale 1:6000 or larger for proposed area of operation and scale 1:25,000 or larger for the entire affected area) of water table and/or potentiometric surface water in each bedrock aquifer which subcrops or underlies the valley fill and which will be disturbed by mining should be prepared. Topographic base maps should be used and their accuracy must be to within 1.5 feet horizontally and 3 feet vertically.

III.B.3. *Aquifer testing.* Tests should be conducted on observation wells completed into each aquifer to determine hydraulic conductivity, transmissivity, storage coefficients and other relevant aquifer characteristics. Aquifer test methods and the number of tests should be based on sound hydrologic principles.

III.B.4. *Well and spring inventory.* Inventory all wells and springs in the alluvial valley floor for a distance five miles downstream of the boundary of the proposed area of operations. Areas outside of alluvial valleys need not be inventoried. Data should be presented in tabular form and locations shown on a topographic map (scale 1:25,000 or larger). The following information should be collected if obtainable: location, indicated condition of well, land surface elevation, well depth, aquifer source(s), pumping water level, discharge and drawdown during pumping, length of pumping test, discharge from springs, and any available water quality data. Investigation should include monitoring of spring discharges on a weekly basis for a period of not less than one month.

III.B.5. *Ground water quality analyses.* Water quality analyses should be completed for each existing well or spring whose source of water is an aquifer of an alluvial valley floor identified within the area of the well and spring inventory. Water quality analyses should also be completed for each aquifer for which observation wells have been completed. Samples should be repeated six months after the first samples are collected. As with all ground water tests, sampling should be immediately preceded, if reasonably possible, by continuous pumping of not less than three times the volume of water present in the well, Constituents to be sampled should conform to sampling guidelines and analytical quality controls connected with State and Federal requirements.

III.B.6. *Other data specifications.* Observation wells and backhoe pits will have been developed into the alluvial aquifer. Water level measurements will have been taken on these wells and should be continued during the detailed study period.

III.C. GEOLOGIC DATA SPECIFICATIONS

III.C.1. *Geologic, geologic structure, surficial geologic maps.* Geologic, geologic structure, and surficial geologic maps (scale 1:25,000 and 1:6000) for the study area should be prepared. Data for these maps should be based on field mapping, drill hole data, and other geologic data. The geologic map should show each distinguishable and mappable lithologic unit, faults, and prominent fracture zone. The geologic structure map should show structure contours on each coal bed proposed for mining. The surficial geologic map should distinguish, for example, between flood plain alluvium, terrace alluvium, alluvial fan deposits, lake and pond sediments, landslide deposits, and residual deposits.

III.C.2. *Geologic cross-sections.* Detailed geologic cross-sections (scale 1:6000) of alluvial valley floors within the study area, based on detailed lithologic logs, showing significant changes in subsurface lithology within the alluvial fill as well as in underlying bedrock units. Cross-sections should be developed along each transect and longitudinally along the valley axis. Transect cross-sections should extend horizontally one mile into the surrounding bedrock areas and to a depth showing all bedrock units proposed for mining.

III.C.3. *Overburden sampling and analyses.* Detailed chemical and physical analyses characterizing all overburden material scheduled to be disturbed within the proposed permit area should be completed. These data are necessary to project the

effect of mining and reclamation on ground water quality. These data should be correlated to the geologic maps and cross-sections and lithologic logs. Subsurface sampling intervals should not be greater than ten feet and need not be less than two feet. Sampling intensity should be determined by the degree of variability of the stratigraph and lithology at the site should be compatible with any requirements developed by the State within which mining is proposed.

III.C.4. *Field geomogrphic surveys and geomorphic study.* Field surveys should be made of the longitudinal profile of the thalweg, flood plain, and one terrace surface of the alluvial valley floor, for the entire length of valley within the proposed area of operations. For each longitudinal survey, indicate depth of bedrock along the profile, and variations in depth. Survey ground surface elevation at several cross-sections across the alluvial valley floor, with cross-sections extending entirely across terrace surfaces, to upland slopes on each side of the valley, and determine depth to bedrock along the cross-section. Cross-sections should be located with sufficient frequency to give the representative geologic (and hydrologic) information and should include areas near observation well transects. Representative bed and bank material samples should be collected at each cross-section site, and mechanically analyzed. All geomorphic data should be reported in a format consistent with that used for Vigial Network sites (Mmett, W.W. and R. F. Hadley, 1968), and should be located so that cross-sections can be resurveyed at later times. These data are of use in channel restoration and in monitoring channel changes. Cross-section and longitudinal profile data should be reported at scales sufficient to show valley physiographic details. [Page 38045]

Based on the best available geomorphic, geologic, soils, and other relevant information, a description of the geomorphic history of the valley floor in question should be prepared. Particular attention should be paid to erosional or depositional trends identified in the valley system.

III.C.5. *Other data specifications.* Lithologic logs of any drilling activity of relevance to these studies will have been submitted under part II.

III.D. SOILS DATA SPECIFICATIONS

Soil survey, chemical, and physical analysis of soil types, and soil moisture data will have been collected during part II studies. Soil moisture studies should be expanded to quantitatively assess soil moisture characteristics of the alluvial valley floor.

III.E. VEGETATION DATA SPECIFICATIONS

A vegetation map (scale 1:6000) of areas designated as alluvial valley floors, showing vegetation types and plant communities, should be submitted. A narrative description should be provided of each vegetation type, describing and defining it so that similar mapping could be repeated by an independent worker. The narrative description should also list all species found in the vegetation type and rank each species in the vegetation type as to relative dominance. Quantitative data should be collected for each vegetative type separately. Specific items to be measured are: (1) Percent cover by species, (2) percent litter, and (3) percent bare ground. Annual above ground production should be measured by species at the end of the growing season. Care should be taken in controlling the effects of grazing by large animals prior to measurement. Generally, measured areas should be excluded from grazing for a one-year period prior to study. Rooting depths for predominant species on each terrace level for each vegetative type should be recorded in the field and the type of root (tap, fibrous) should be note. The actual and potential animal unit months per acre should be calculated for each vegetative type and the condition class and trend should be evaluated. Possible reasons for trends should be given.

III.F. LAND USE DATA SPECIFICATIONS

III.F.1. *Crop yields.* For any cultivated or harvested crop areas on alluvial valley floors within the study area, crop yield measurements representing different precipitation and temperature conditions should be analyzed.

III.F.2. *Land use mapping.* Current uses of land within alluvial valley floors should be presented on a map (scale 1:6000), with categories to include managed grazing land, wild hay lands, seeded hay lands, alfalfa and other crop lands, irrigated lands. Fence lines should be shown.

REFERENCES

Apley, Theodore E., 1976. The hydraulic geometry of the ephemeral channels of the eastern Powder River basin, Wyoming: Laramie, master of science thesis, University of Wyoming Department of Agricultural Engineering, 78 pp.

Congressional Record, 1977, Vol. 123, No. 87 (May 20), pp. S8083-S8097.

Emmett, W.W. and R. F. Hadley, 1968, The vigil network: preservation and access of data: U.S. Geological Survey Circular 460-C, 21 pp.

Fullerton, David S. and Robert M. Kirkham, 1977, Surficial geologic map of The Gap quadrangle, Campbell County, Wyo.: U.S. Geological Survey Miscellaneous Field Studies Map MF-897.

Gary, Margaret, Robert McAfee, Jr., and Carol L. Wolf, ed., 1972, Glossary of geology: Washington, D.C., American Geological Institute, 805 pp.

Hardaway, John E., Dan B. Kimball, Shirley F. Lindsay, Jack Schmidt, Larry Erickson, 1977, Subirrigated alluvial valley floors: Denver, U.S. Environmental Protection Agency Office of Energy Activities Report.

Hedman, E.R. and W. M. Kastner, 1977, Streamflow characteristics related to channel geometry in the Missouri River basin: U.S. Geological Survey Journal of Research, vol. 5, No. 3, P 285-300.

House of Representatives, 1977, Surface Mining Control and Reclamation Act: House Report 95-218, Committee on Interior and Insular Affairs, 199 pp.

House of Representatives, 1977, Surface Mining Control and Reclamation Act: House Report 95-493, Committee of Conference, 116 pp.

Leopold, Luna B., 1974, Water: a primer: San Francisco, W. H. Freeman & Co., 172 pp.

Leoplod, Luna B., William W. Emmett, and Robert M. Myrick, 1966, Channel and hillslope processes in a semiarid area, New Mexico: U.S. Geological Survey Professional Paper 352-G, 61 pp.

Leopold, Luna B., M. Gordon Wolman, and John P. Miller, 1964, Fluvial processes in geomorphology: San Francisco, W. H. Freeman & Co., 522 pp.

Lowham, H.W., 1976, Techniques for estimating flow characteristics of Wyoming streams: U.S. Geological Survey Water-Re-sources Investigations 76-112, 46 pp.

Malde, Harold A. and J. Michael Boyles, 1976, Maps of alluvial valley floors and strippable coal in forty-two 7 1/2 minute quadrangles, Big Horn, Rosebud, and Powder River Counties, southeast Montana U.S. Geological Survey Open File Report 76-162.

National Academy of Sciences, 1974, Rehabilitation Potential of Western coal lands: Cambridge, Bollinger Publish. Co., 198 pp.

Office of Surface Mining, 1977, Final interim regulations: FEDERAL REGISTER pp. 42-62639 to 42-62716.

Robinson, T.W., 1958, Phreatophytes: U.S. Geological Survey Water-Supply Paper 1423, 84 pp.

Schmidt, Jack, 1977, Alluvial valley floors in east-central Montana and their relation to strippable coal reserves: U.S. Environmental Protection Agency Office of Energy Activities Report 8908-4-77-001, 42 pp.

Schumm, Stanley A. 1977, The fluvial system: New York, John Wiley & Sons, 338 pp.

Soil Conservation Service, 1976, National range handbook.

United States Congress, 1977, United States Surface Mining Control and Reclamation Act of 1977, 91 Stat. 445-532.

Van Voast, W.A. and R. B. Hedges, 1975, Hydrogeologic aspects of existing and proposed strip coal mines near Decker, southeastern Montana: Montana Bureau of Mines and Geology Bulletin 97.

Williams, Van S., unpublished, Surficial geologic map of the Rawhide School quadrangle, Campbell County, Wyo.: U.S. Geological Survey Miscellaneous Field Studies Map.

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