to commencing with soil salvage activities in the Area D or developing the access road through the riparian zone U.S. Fuel will consult with the regulatory authority to determine if any design changes in connection with the stream crossing are required.

Each borrow area will be cleared of vegetation immediately prior to utilizing the substitute topsoil material from that area. The vegetation will be stacked near the perimeter of the borrow area to provide for additional wildlife habitat or distributed over reclaimed areas to facilitate moisture retention if deemed desirable.

A combination of scrapers, front end loaders, track mounted tractors, belly dump and/or end dump trucks will be used to load, transport and redistribute the substitute topsoil material. When the desired volumes have been obtained and removed from the borrow areas, reclamation procedures will commence.

Topsoil has been removed from several small disturbed sites in the Hiawatha area. The topsoil has been stockpiled and protected. See R645-301-231.400 for a description of each stockpile.

## Equipment Storage Yard East of Slurry Pond No. 5

The Equipment Storage Yard is a 5.5 acre fenced storage area located east of Slurry Pond No. 5. It is shown on Exhibit II-1 and II-4.

The Equipment Storage Yard was constructed in 1978. Prior to using the area to store equipment, the upper six inches of topsoil material was excavated and stockpiled. A patrol grader was used to remove a uniform depth of soil. During each pass of the grader the blade would be set on an angle. As the grader moved forward the soil would be excavated and windrowed on the side. A large scraper would then move along the windrow picking up the soil. The soil was then hauled to the stockpile and stabilized. Between two and three passes were made by the grader before topsoil salvage activities were completed. On the upper portion of the equipment storage yard over six inches of soil was excavated to create a relatively flat surface for the site. A total of 4,480 cubic yards of topsoil was salvaged and stockpiled. See R645-301-231.400 for details of the stockpile.



This area, currently classified as a small area exemption, will be used as a substitute topsoil borrow site for final reclamation and is included within Borrow Area A. The physical and chemical characteristics of the soils in the storage yard are identical, the same soil series and phase of the series, to the soils in Borrow Area A. Therefore, the laboratory test results, located in Table II-1 are representative of the soils in the equipment storage yard.

During April, 1985 a seven foot deep test pit was dug in the middle of the equipment storage yard and a channel sample of the soil was taken for laboratory analysis to verify its similarity to those samples taken for

Borrow Area A. The sample results are presented in Table II-21 and can be compared with those in Table II-1. The results show that the two sites are quite similar and can be treated as a single borrow area.

## Reclamation of Roads

### Canyon Roads

The roads in South Fork, Middle Fork and North Fork will not be totally reclaimed but will be left in place to support the post mining land use as discussed in Chapter IV. These roads will be reclaimed to an unimproved condition by removing and disposing of the pavement, ripping the underlying surface and revegetating with plant species favorable to wildlife. Existing drainage structures will be left in place to serve a single lane road. The full width of the existing subgrades will be left as is and no regrading to approximate original contour is proposed. A request for variance from approximate original contour is included as Appendix IV-7 in Chapter IV. Fertilizer, seed and mulch will be applied by hand broadcasting or by use of farm type equipment. Seed mixtures 1 or 2 will be used in the vicinity of Hiawatha and seed mixture No. 3 (less nursery grown stock) will be used at higher elevations. Mulch will be applied at the rate of 1.5 tons per acre and will be crimped into the soil by discing.

### Access Road to Sediment Pond D003

A short unpaved access road exists between the preparation plant area and sediment pond D003 (see Exhibits II-4 and II-5). Only limited excavation was necessary to construct the road, therefore, it will be reclaimed by ripping the surface and revegetating the insitu soils. Fertilizer, seed and mulch will be applied by hand broadcasting or by use of farm type equipment. The soil is the same Haverdad series comprising substitute borrow areas B, C, and D. Seed mix No. 1 for sagebrush dominated borrow areas (described in Chapter III) will be used. Mulch will be applied at the rate of 1.5 tons per acre and will be crimped into the soil by discing.

### Truck Runaway Spur to Middle Fork Haul Road

The truck runaway spur is shown on Exhibit V-6. The only excavation required to construct the road was to blade off the vegetation, cut a runoff diversion ditch and install a 24 inch culvert. A mound of gravel (approximately 18 inches high) was placed down the center of the road to retard potential runaway vehicles. Reclamation will involve removing the culvert and gravel and regrading the diversion ditch. The surface of the disturbed area will then be ripped to a depth of 18 inches and the insitu soils revegetated. Fertilizer, seed and mulch will be applied by hand broadcasting or by use of farm type equipment. Seed mix No. 2 will be utilized. Mulch will be applied at the rate of 1.5 tons per acre and will be crimped into the soil by discing.

### Substitute Topsoil Haul Roads

Roads which will be used to access substitute topsoil sites currently exist and have been in place for at least 30 years, no topsoil was salvaged. Except for one short section (200 feet) of cutslope, the topsoil is still in place, although it is highly compacted. Therefore,

substitute topsoil materials will be distributed over the regraded road areas only where needed. After completing the reclamation of the given borrow area, the haul road leading to that borrow area will be reclaimed. The roads will be backfilled and/or regraded where necessary to blend with the existing topography. Only the access roads leading directly to the borrow area will be reclaimed, specifically the short access road between the paved highway and borrow area A and the section of road which leads from the top of the bench down to borrow areas B,C and D. The road which leads from the paved highway to the top of the bench will continue to be used for access to other properties after mining operations have ceased. Prior to distributing topsoil, in the areas where it will be required (in most of the areas the road runs directly on the in-situ soil profile and this material will be used for the reclamation of that section of road), the roadbed will be ripped to an 18 inch depth. In areas where topsoil is needed, from 6 to 12 inches of topsoil will be distributed to supplement the existing disturbed soils. The exact depth distributed will depend on the amount of topsoil that has been lost since the installation of the road. The road will then be seeded and fertilized at the prescribed rate of applicable seed mix which was used for the borrow area. Mulch will be applied at the rate of 3,000 pounds per acre and will either be crimp-disced into the soil. The total acreage for reclamation associated with the haul roads is approximately one acre.

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further testing of that community will be required (i.e. there is no difference between the disturbed community and the reference area).

At a meeting with Division personnel on Feb. 10, 1993, several methods for evaluating the diversity, utility, effectiveness and seasonality of reestablished vegetation were discussed with Paul Baker, Division Reclamation Biologist. After review of information provided, U.S. Fuel has chosen to use a method described by Sandra L. Emrich, Reclamation Specialist, with the Colorado Mined Land Reclamation Division. This method is included as Appendix III-8. Further discussions with Paul Baker on Feb. 22, 1993 resulted in the following modifications to the method presented in Appendix III-8.

1. The number of species contributing greater than 3% relative cover in the reference areas will designate the number of species, the life forms, and the seasonality to be established in the reclaimed area.

2. Trees planted in reclaimed areas will probably not be big enough at the time of evaluation for final bond release to match the relative importance of trees in the reference areas. To account for this, other life forms can be substituted for trees. For example, if the diversity standard calls for 2 grass species, 1 forb, 2 shrubs, and 2 trees, the tree requirement could be distributed among any of the life forms, including trees. That is, the standard could be met with 4 grasses, 1 forb and 2 shrubs or with 3 grasses, 1 forb, 2 shrubs, and 1 tree, etc. This will allow flexibility in evaluating the amount of growth attained by the trees.

3. The statement on page 45 of the Emrich paper (Appendix III-8), that the combined relative cover of the species to be established on the reclaimed area should not exceed 75% and that a maximum dominance of 40% relative cover be set for each species, may not be practical based on species present in the existing reference areas, therefore, these requirements will not be considered restrictive.

An erosion classification system developed by the BLM and modified by OSM will be used for evaluating the effectiveness of vegetation for erosion control. This system, also recommended by the Division, is presented in Appendix III-9.

## 341.300 Field Trial Test Plots

At the request of OSM and DOGM, U.S. Fuel conducted a field trial program that consisted of five field test plots at different locations and field work to follow the progress of the sites and summarize the results of the program. The intent of the program was to verify that reclamation can be

accomplished at various sites around the permit area. The complete program summary and monitoring results can be referenced in Appendix III-5.

## R645-301-342 FISH AND WILDLIFE ENHANCEMENT - POSTMINING PHASE

342.100 The primary post-mining land use that reclamation will attempt to provide for is wildlife habitat and secondarily for cattle grazing. The mine site areas will be reclaimed primarily with wildlife usage in mind, while the reclamation around Hiawatha will be designed to accommodate both wildlife and cattle grazing.

Revegetation in the mine plan area will seek to enhance forage values of the reclaimed area sites thus tailoring them to the needs of wildlife and minimizing the undesirable shrubs found in adjacent areas.

Existing culverted stream diversions will be removed during the regrading operations at the mine sites. Open channels will be restored and riparian habitat re-established along the channel. Riprap will be placed in the channel to prevent excessive erosion.

342.200 Species of plants to be utilized for reclamation purposes have been chosen based on their nutritional value for wildlife and their ability to enhance the wildlife habitat long after bond release has been obtained. The selected plants will be grouped and distributed in a manner which optimizes the edge effect, cover, and other benefits they will provide.

## R645-301-350 PERFORMANCE STANDARDS

## R645-301-351 GENERAL REQUIREMENTS

All coal mining and reclamation operations will be carried out according to plans provided under R645-301-330 through R645-301-340.

## R645-301-352 CONTEMPORANEOUS RECLAMATION

Revegetation on land that was disturbed by the active, permitted mining plan will occur as contemporaneously as practicable.

## R645-301-353 REVEGETATION: GENERAL REQUIREMENTS

A vegetative cover that is in accordance with the approved permit and reclamation plan or otherwise acceptable, will be established on regraded disturbed areas. The cover will be: diverse, effective and permanent; comprised of native species or desirable introduced species approved by

the Division; equal in extent of cover to the natural vegetation of the area; and capable of stabilizing the soil surface.

The reestablished plant species will: be compatible with the approved postmining land use; have the same seasonal characteristics of growth as the original vegetation; be capable of plant succession and self-regeneration; be compatible with the plant and animal species of the area; and meet the requirements of applicable Utah and Federal species laws or regulations.

Species having the qualities to meet the above mentioned vegetative cover requirements, as well as rates of application of seeds and transplants, have been proposed in consultation with the Division and OSM (see Tables III-5 through III-8).

## R645-301-354 REVEGETATION: TIMING

Disturbed areas will be planted during the first normal period for favorable planting after replacement of the plant-growth medium.

## R645-301-355 REVEGETATION: MULCHING AND OTHER SOIL STABILIZING PRACTICES

Suitable mulch and other soil stabilizing practices will be used on areas that have been regraded and covered with topsoil when necessary to control erosion and stabilize soil. Specific details for various sites can be found in Chapter II (Soils) and part 341.230 of this chapter.

## R645-301-356 REVEGETATION: STANDARDS FOR SUCCESS

For areas which were not disturbed by mining prior to SMCRA, the standards for success will be those outlined in R645-301-356.100 through 356.240. For areas which were previously disturbed by mining prior to SMCRA, the standards for success will be those outlined in R645-301-356.250. Methods for determining the success of revegetation are discussed under R645-301-341.250.

This rule states that minimum stocking and planting arrangements will be specified by the Division after consultation with other Utah agencies. During the mid-term Technical Deficiency Review (March 4, 1992) it was noted that the consultation had been performed and the standards decided upon are as listed on the following page:

| Habitat Type | Success Standard for Trees and Shrubs (number per acre) |
|---|---|
| Mixed Conifer | 484 trees<br>2,000 shrubs |
| Pinyon-Juniper | |
| Mine pad areas | 2,590 shrubs, no trees |
| Other areas | 2,185 shrubs, no trees |
| Mountain brush | 2,051 shrubs |
| Riparian | 2,448 trees and shrubs |
| Sagebrush | 3,000 shrubs |

Siltation structures will be maintained until removal is authorized by the Division and the disturbed area has been stabilized and revegetated.

## R645-301-357 REVEGETATION: EXTENDED RESPONSIBILITY PERIOD

The average annual precipitation at Hiawatha is 12 inches, therefore, the period of responsibility will continue for a period of not less than ten full years.

## R645-301-358 PROTECTION OF FISH, WILDLIFE AND RELATED ENVIRONMENTAL VALUES

The operator will, to the extent possible using the best technology currently available, minimize disturbances and adverse impacts on fish, wildlife, and related environmental values and will achieve enhancement of such resources where practicable.

## Chapter III References

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# APPENDIX III-9

# SYSTEM FOR EVALUATING THE EFFECTIVENESS OF VEGETATION FOR EROSION CONTROL

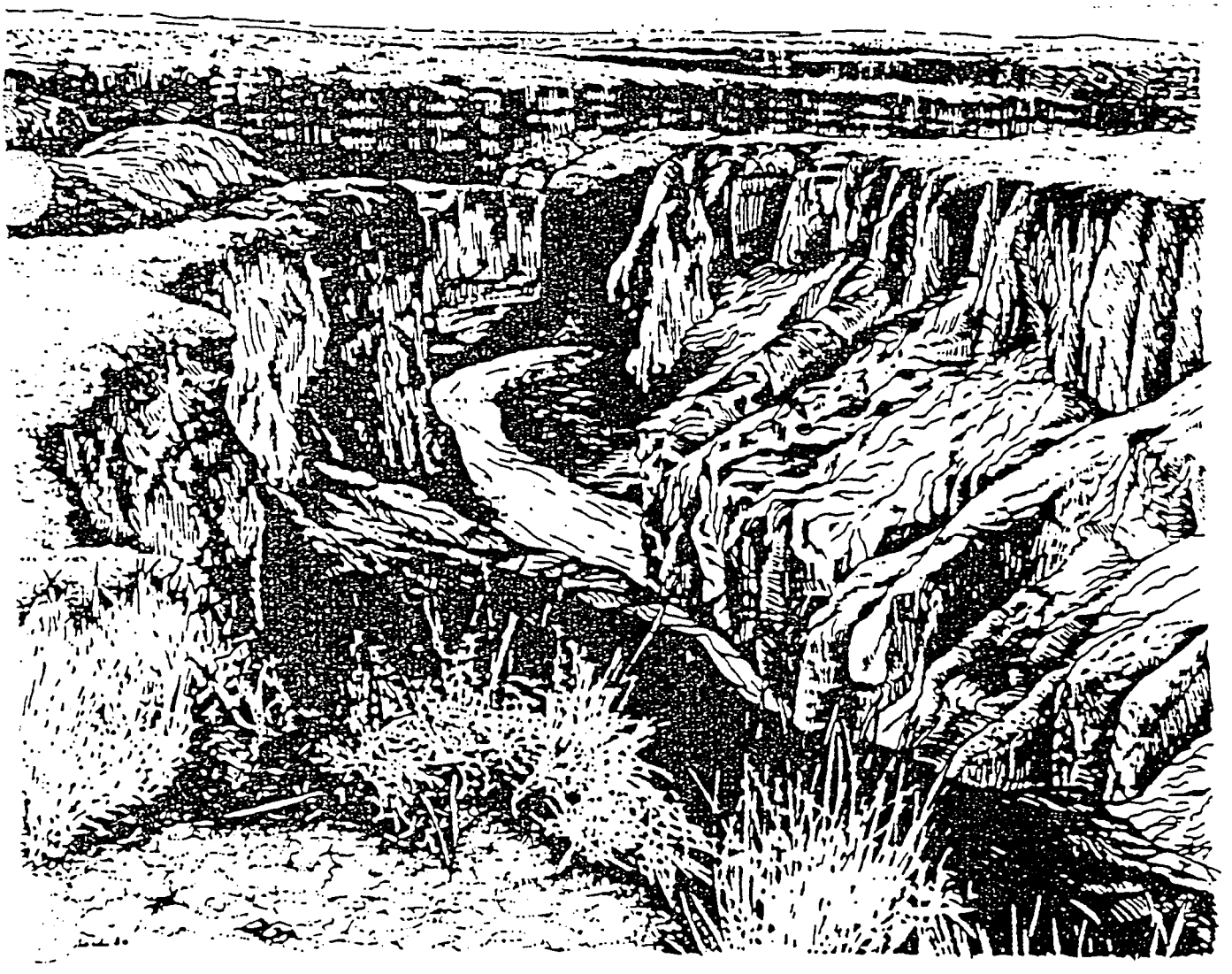
DIFFERENCE BETWEEN OBSERVERS #31

TECHNICAL NOTE

U.S. DEPARTMENT OF THE INTERIOR – BUREAU OF LAND MANAGEMENT

# EROSION CONDITION CLASSIFICATION SYSTEM

by Ronnie Clark



# WAYS TO IDENTIFY THE EROSIONAL FEATURES

## Highlight

Seven indicators of soil movement are described and their reliability for indicating soil loss (erosion) is explained. The indicators are: (1) soil movement, (2) pedestalling, (3) surface litter, (4) surface rock fragments, (5) flow patterns, (6) rills, and (7) gullies. The qualitative approximation of soil movement due to erosion has proved to be reasonably reliable.

## Soil Movement

The real cause of soil movement on watersheds lies in soil instability. Some of the factors affecting soil instability are: (1) splash erosion, wind, velocity; (2) soil texture, structure, infiltration, and permeability; (3) slope gradient and length; and (4) cover, such as vegetation, litter, mulch, and stones. However, any disturbance of cover, such as by land use and fire, can accentuate the natural soil instability.

Soil movement is most obvious during windstorms, heavy rainstorms, sudden snowmelt or when intensive land uses (livestock grazing by trampling) are occurring on loose soils. Dust clouds and muddy stream runoff as examples of obvious soil movement, but much of the soil movement occurs without such obvious signs.

A certain amount of soil movement is natural on most wildlands. Rodent and ant activity and frost heaving frequently causes soil movement. However, soil movement is abnormal if the soil mantle is disturbed to create soil losses in excess of those which occurred under natural conditions.

## Soil Movement Indicators

A single feature of soil loss cannot be used to accurately determine the erosion condition. It must be supported by additional evidence when evaluating the erosion condition of a site writeup area or sampling unit. For example, soil movement alone is a poor indicator of ecological trend. By the time erosion is apparent, profound changes usually have taken place in cover or a drastic change in soil mantle disturbance (as shown in Fig. 6). Inadequate soil cover may be obvious as an indicator of accelerated soil movement. Where ground cover is depleted to less than the minimum density required to protect the soil mantle, soil movement from relatively small areas may increase at an accelerated rate. A fourfold increase in soil loss as bulk density increases from 0.8 to 1.4 may occur if ground cover is significantly decreased.

Other indicators of unstable soil may be gullied drainageways with active bank cutting and sediment deposition in water bodies and at channel confluences.

Soil and litter movement on steeper slopes is obvious when significant accumulations of soil and litter material have moved downslope as a result of siol mantle disturbance from grazing animal trampling. However, on level or gentle slopes, trampling may result in "churning" the soil to dust or mud. This churning changes the soil structure and contributes to subsequent soil displacement during wind or rainstorms.

Soil movement usually becomes more obvious as slope steepness increases and occurs most readily when antecedent soil moisture is very low or very high. However, two items may be necessary to minimize soil erosion: (1) a ground cover of at least 70 percent (as shown in Fig. 7) and, (2) a soil bulk density of 0.70 or less (Packer, 1961).

Evidence of soil displacement takes two forms on sloping rangeland.

(1) With excessive trailing by livestock or wildlife, the surface is imprinted with nearly level terraces. The banks between these terraces are often steep, exposing soil to subsequent downward movement by water and gravity. The terrace may become a watercourse during rain and serves to concentrate runoff into a water flow with erosive force.

(2) Trampling displacement, not concentrated in trails but more generally distributed over the slope, is marked by soil accumulations on the uphill side of perennial plants and by mounds or ridges downslope. Such displacement is less easily observed than terrace trails but probably is more serious. Terrace trails suggest a degree of stability, possibly only temporary, in which the surface has been reformed over time to accommodate an animal concentration. In contrast, general trampling displacement over the slope suggests that there is no stability except where soil may accumulate on the uphill side of a fairly permanent obstruction.

Lichen lines or breaks, are indicators of soil movement. These lines appear if the surface soil has eroded around stones and rocks covered with lichen. Since lichen only grows on the aboveground portion of stones and rocks, there will be an abrupt, horizontal, break between lichens and rock area that originally was below soil surface (Fig.8).

Lichen growth will keep pace with normal geologic erosion and possibly slightly accelerated erosion. Pronounced lichen lines on stones and rocks are reliable evidence of soil movement at a moderate to severe rate. The space between the lichen lines and the present soil surface indicates the amount of soil movement that has occurred.

Lichen lines are more obvious on elevated terrain, i.e., ridges and mesas. They may not appear on lower slope areas where soil losses may be replaced by deposition of soil or litter that has moved from farther upslope.

Caution: Frost heaving of stones and rocks may create lichen lines, giving a false soil loss appearance.

## Pedestalling

Pedestalling may be observed as small soil pinnacles or plains (Fig. 9). Like miniature mesas remain in position after the soil between mesas has been eroded away.

Pedestals are formed under the protection of stones or pebbles, residue, or vegetation that may consist of a single plant or a small island of a plant community. The latter are more positive indicators of pedestals than single-plant pedestals as indicators because in certain soils single plants often are elevated on a pedestal by frost heaving.

This indicator has value where a former soil surface can be established by the uniform height of pedestals or islands. Similarities of the soil horizons in sections of surface soils of pedestals and islands are excellent for establishing the reliability of this erosional feature. The reliability is good where the soil profile characteristics between the pedestals and islands resemble the soil characteristics at the same depth within the pedestals and islands.

Elevated islands and pedestals may be caused jointly by erosion and deposition, where a part of the eroded area in the locality may supply loose soil to be deposited by wind in clumps of vegetation. The identification of aeolian deposits is discussed under Flow Patterns (in Wind Erosion Prone Areas).

Soil pedestals under stones or litter are formed on some kinds of soil by the impact of raindrops and sheet waterflow over barren, adjacent areas. Where a pebble or stick protects the soil from the impact of raindrops, the original soil under the protecting object is retained, whereas the soil in bare areas is churned by raindrop impacts and easily washes away. Pedestals also are formed on certain soils where the soil ped (a unit of soil structure) is resistant, whereas the soil material in the fracture between peds is less cohesive and susceptible to erosion. Close observation soon after the storm usually is needed to denote these soil pedestals because after a few hours or days of sunshine they may crumble. These pedestals formed during a known period are clues to the sheet erosion rate that has occurred. This indicator is especially valuable as convincing evidence of current soil movement during storms of moderate intensity or duration, which may not form gullies or alluvial deposits.

## Frost Heaving

Frost heaving is common in many soils. Care must be exercised to distinguish between soil remnants that are solely the result of erosion from those that are at least partially the result of frost heaving. Distinguishing precisely how much pedestal elevation is due to heaving and how much to erosion is difficult and probably impossible.

Frost heaving often occurs following decimation of the vegetational stand and organic ground cover between plants, which in turn exposes the soil to the effects of periodic low air temperatures. With frost heaving, single plants elevated on pedestals usually characterize the vegetation. These plants commonly are tilted; the crown is not horizontal as it was when it grew as a part of a stable plant community.

The probability that frost heaving has occurred also can be supported by the soil type. The following soils are highly susceptible to frost heaving:

(1) Clay subsoils fairly close to surface.

(2) Pumice (ash) soils.

(3) Soils with greater than 3 percent of material smaller than 0.02 mm.

(4) Soils of high silt (0.05-0.002 mm) and very fine sand (0.10-0.05 mm) if a soil water supply is available.

(5) Soils having a large capillary water capacity if antecedent moisture is available to move to the freezing point. (U.S. Department of Agriculture, 1971).

Surface Rock Fragments (Erosion Pavement)

Surface rock fragments or erosion pavement being referred to here consist of gravel or cobbles concentrated on the soil surface due to the moving of finer soil particles that formerly surrounded them. This surface rock appearance is normal if there is no truncated soil profile and subsurface soil consists of altered rock fragments and parent material. Surface rock relocation due to erosion is substantiated by erosion indicators nearby (Fig. 10).

Caution: Differentiate between eroded soils and soils that naturally have a high gravel or cobble content in the soil surface layers.

It is important to note that evenly distributed surface rock effectively protects the soil surface and slows soil movement. It curtails evaporation, promotes greater moisture holding capacity and reduces runoff velocity if surface rock does not exceed 50 percent of ground cover. It may have an effect similar to vegetation in reducing erosion.

Flow Patterns (in Wind Erosion Prone Areas) - (See Fig. 11)

These are shallow basins varying from a few inches to several feet across in bare soil between vegetated sites from which wind has carried away fine soil particles. This wind action is easily recognized by a residue of small pebbles or sand particles that are too large to be transported by wind and that remain on the scoured surface of the

shallow basin. Fresh scouring by wind on the shallow basins appears as lines etched in the soil surface paralleled by tiny streamlined ridges of fine soil in the leeward side of obstructions (vegetation, litter, pebbles).

Caution: Do not confuse barren areas or ant disks caused by ant colonies with wind-scoured depressions. A collection of sand particles is common and removal of fine soil material by wind from ant disks does occur. Particles of coarse sand and pebbles will occur quite uniformly over a wind-scoured depression; whereas in an ant disks, coarse particles will be aggregated near the center of ant habitation.

The material from wind-scoured depressions or basins is transported to other areas to form aeolian deposits. These deposits, known as dunes, mounds, or hummocks usually occur adjacent to the eroded basin or within the eroding area. Airborne material, because of air current patterns, may occasionally be dumped on distant non-eroding areas such as leeward slopes.

On a smaller scale, deposits may be observed on the leeward side of plants or other obstructions. Such deposits consist of fine, well-sorted soil particles. However, rodent activity may have introduced coarse fragments to the site.

Depositional volume may be determined by cutting a vertical section through a mound and the obstructing material to expose the original soil surface. A comparision should be made to differentiate between the adjacent scoured area and the deposition volume. Relative deposit age may be determined by decomposition rate of buried organic material (vegetation and litter). In older deposits, it may be impossible to identify buried vegetation (organic material).

Flow Patterns (in Areas Subject to Water Erosion) - (See Fig. 12)

Soil materials that have been dislodged, transported and redeposited over the watershed by water are known as alluvial deposits. These deposits are easily discernible as little fans at the end of small channels or behind obstructions in channels (flow paths) where the velocity of runoff has been reduced. They also may be formed as accumulations of soil material or litter on the uphill side of obstructions on the soil surface. As used in this inventory, they are referenced as deposits on the site writeup area (inventory unit), not to fans at major channel mouths.

Hint: Fine soil materials in alluvial deposits indicates slow runoff, whereas coarse soil particles indicates violent or fast runoff.

## Rills

Rills are small channels, less than 6 inches deep, which are formed by flowing water (Fig. 13). They are so small as to be obliterated by surface soil disturbance or during soil movement associated with weathering. The soil profile may be gradually truncated by rilling. If obliterated, the next storm will cause a new set of rills to form, and these in turn may be obliterated by excessive soil surface disturbance. A high volume of soil can be moved in a short time frame by this process. Often "sheet erosion" is actually rill erosion.

The presence of rills is an excellent indicator of current erosional activity when evaluating changes in erosion produced by land management treatments (Fig. 14). Rills can be measured to produce a quantitative estimate of soil loss by use of the Alutin Method (Hill and Kaiser, 1965).

## Gullies

Channels, called gullies, of greater than 6 inches in depth, may be cut into the soil mantle by runoff. Gullies within the sample site generally will be tributaries of intermittent or permanent stream channels that continue outside of the sample site delineation. An active gully is easily detected by unstable sidewalls with little or no vegetation or recent soil loss by erosion. Active cutting, which is called "head-cutting," may be occurring at the channel head.

A healing gully is easily detected by the reestablishment of vegetation on the sidewall and reduction in soil loss in the channel bottom and by the absence of head-cutting activity (as shown in Fig. 15).

A rill enlarges into a gully if repeated cutting and entrenchment occurs. Negligible channel blockage or filling occurs with soil movement during storm runoff.

## SUMMARY

Thus, the features that indicate erosion are:

1. Percent soil movement
2. Surface litter movement
3. Surface rock fragment distrubance
4. Flow pattern development
5. Pedestalling
6. Rilling
7. Gullying
8. Lichen lines
9. Disturbance of rooting plants
10. Wind-scoured depressions
11. Wind (aeolian) and water (alluvial) deposits
12. Channel sedimentation
13. Channel scouring and ripping

The SSF's explained in this Technical Note and fully evaluated by use of Form 7310-12, Determination of Erosion Condition Class (when totaled) indicate the erosion condition class for use in describing erosion conditions for a specific sample site. After the erosion condition class has been determined for all the major landscape positions in an inventory area, the erosion condition status will be known for each pasture, allotment, resource area, district, state or Western States, collectively. Then, resource managers will be able to apply proper land use and management practices to maintain or enhance soil productivity and a favorable environmental quality.

## APPENDIX 1. Glossary of Terms.

antecedent moisture condition (AMC): Amount of soil moisture at the storm beginning.

bare ground: All land surface that is not covered by vegetation, litter, gravel, cobbles, stones or rock outcrop.

bulk density: (Of a soil). The oven-dry weight of measured volume of soil including pore spaces. Expressed in grams per cubic centimeter.

cover: Material covering soil and providing protection from, or resistance to, the impact of raindrops and the energy of overland flow. Expressed in percent of the area covered. Composed of vegetation, litter, gravel, cobbles, stones and rock outcrop, which are lying on or within 20 feet of the ground surface.

erosion: Wearing away of land surface by running water, wind, ice, or other geologic agents. Includes such processes as gravitational creep, detachment and movement of soil or rock by water, wind, ice, or gravity.

accelerated erosion: Primarily as result of influence of man's activities or, in some cases, of animals.

erosion pavement: Layer of coarse fragments of gravel and cobbles on ground surface remaining after removal of fine particles by erosion.

erosion condition class: Condition or grouping of erosion conditions based on degree of erosion or on characteristic erosion patterns applied to total erosion situation. No attempt is made to differentiate among accelerated, normal, natural, or geological erosion. Five classes are recognized (stable, slight, moderate, critical, and severe). Water and wind erosion are both considered.

geologic erosion: Normal or natural erosion caused by geologic processes. (See natural erosion.)

gully erosion: Erosion process whereby water accumulates in narrow channels and, over short periods, removes soil from narrow area to considerable depths, ranging from 6 inches to as much as 75 to 100 feet.

natural erosion: Wearing away of earth's surface by water, ice, or other natural agents under natural environmental conditions of climate or vegetation, undisturbed by man. Synonymous with geologic erosion.

normal erosion: Gradual erosion of land used by man which does not greatly exceed natural erosion and is not greater than the rate of formation of the soil mantle by natural weathering processes.

rill erosion: Erosion process in which small channels of less than 6 inches depth are formed.

sheet erosion: Removal of a fairly uniform layer of soil from land surface by runoff water flowing in a sheet instead of in defined channels.

splash erosion: Spattering of small soil particles caused by impact of raindrops on soils. Loosened and spattered particles may or may not be subsequently transported by surface runoff.

flow patterns: Arrangement of soil particles, surface litter, coarse rock fragments, and pedestals which reflect surface-water flow or wind movement.

gullies: Distinction between gullies and rills is depth. Gullies are over six inches deep. A gully is a channel or miniature valley cut into soil mantle by concentrated runoff through which water only flows during and (immediately after) rains or during snowmelt.

infiltration: Water passage into soil surface.

litter: Organic debris composed of freshly fallen or slightly decomposed organic materials. Includes all undecomposed dead organic matter either lying on the surface or standing within 20 feet of ground surface. Litter includes lichens and moss less than 1/16 inch thick unless they are growing on rock fragments or rock outcrop.

overland flow: Rain water or snowmelt over land surface toward channels.

pedestalling: The process of forming a small elevated plane by the erosion of adjacent areas from around an object. Does not pertain to pedestals created by heaving from frost action.

rills: Small, intermittent watercourse in soil mantle, less than six inches deep with steep sides. It may be obliterated easily by surface disturbance or slight soil movement associated with weathering. Yet in the process the soil profile is gradually truncated.

scour: To abrade and wear away; the wearing away of terraces, diversion channels, or streambeds.

sediment load: Total sediment, including bedload, being moved by flowing water in a stream at a specified cross section.

soil movement: Displacement of the soil mantle by water, wind, ice, gravity, or land use.

soil surface factor (SSF): Numerical expression of surface erosion activity caused by wind and water as reflected by soil movement, surface litter, erosion pavement, pedestalling, rills, flow patterns, and gullies. Values vary from 0 for stable erosion condition to 100 for a severe condition.

surface litter: Nondecomposed dead organic matter lying on ground surface or near enough to it to be affected by water or wind acting on eroding surface.

surface rock fragments: Rock fragments of all sizes lying on or in soil surface; those of primary concern are small enough to reflect movement by water and wind. Includes gravel, cobbles, and stones.

vegetation: Includes all living vegetation within 20 feet of the ground surface, such as the canopy of trees and shrubs, and lichens and moss, more than 1/16 inch thick and only the basal area of grasses and forbs. All live organic floral materials, regardless of form, are to be grouped into vegetation; exceptions to this are the lichens and mosses that are growing on rocks. For the purpose of this survey if the lichens and/or moss has not accumulated a thickness in excess of 1/16 inch, it should be recorded as rock fragments. Lichens and moss on bare ground having a thickness less than 1/16 inch should be recorded as litter rather than vegetation.

# EROSION EVALUATION

Observer_____Date_____

Site_____

## SHEETWASH EROSION

### Surface Litter and Mulch

| | | | | |
|---|---|---|---|---|
| Accumulating in place | May show slight movement | Moderate movement is apparent, deposited against obstacles | Extreme movement apparent, large and numerous deposits against obstacles | Very little remaining (use care on low productive sites) |

### Soil Scouring

| | | | | |
|---|---|---|---|---|
| No visual evidence of flow patterns, scouring of soil or soil movement | Some movement of soil particles with evidence of small microterraces or beginning of rock/plant pedestals and noticeable flow patterns | Moderate movement of soil is visible as evidenced by small rock and plant pedestals occurring in flow patterns and slight terracing less than 1" in height | Soil appears to move with each event, with soil and litter deposited against minor obstacles, terracing and rock/plant pedestals generally evident | Most rocks and plants pedestalled and roots exposed, flow patterns are numerous and obvious, terraces are also numerous and higher than 2 inches |

### Sediment Deposition

| | | | | |
|---|---|---|---|---|
| No deposition of rock or soil material in evidence | Rocks and or soil appear to be accumulating in flow patterns | Soil and/or rocks are occasionally accumulating behind minor obstacles and at slope breaks | Soil and/or rocks are obviously being distributed by wind or water as evidenced by obvious accumulations behind obstacles and the infrequent presence of sediment fans at slope breaks | Fans of sediment are frequent and in association with most flow patterns. Rock, if present, has been washed away. Area is characterized by rill and gully formation |

CONCENTRATED FLOW EROSION

| | | | |
|---|---|---|---|
| **Rills** | | | |
| Rills, if present are mostly 1-3 inches deep | Rills mostly 3-6 inces deep | | |
| Rills generally at infrequent intervals >10 ft apart (estimate distance) | Rills generally at 10 foot intervals | Rills generally at intervals of 5 to 10 feet | Rills generally at intervals of <5 ft |
| **Gullies** | | | |
| Gullies, if present, gonerally 6-12 inches deep | Gullies generally 1-2 feet deep | Gullies generally 2-4 feet deep | Gullies generally greater than 4 feet deep (estimate depth) |
| Overall width of gullies, if present, generally 6-12 inches | Overall width of gullies generally 1-2 feet | Overall width of gullies generally 2-4 feet | Overall width of gullies generally >4 ft. (estimate width) |
| Gullies, if present are at infrequent intervals of >200 feet (estimate distance) | Gullies generally at 100 to 200 foot intervals | Gullies generally at 50 to 100 foot intervals | Gullies generally at intervals <50 feet (estimate distance) |
| Gullies, if present, appear to be well stabilized with vegetation cover on 80% of channel bed and sides, appear to be healed | Gullies appear to be active with vegetation cover on less than 50% of channel bed and sides | Gullies are actively eroding with vegetation on less than 25% of the channel bed and sides and bank failure is evident along reach | Gully is totally, or nearly totally void of vegetation, headcut is present (mouth, middle or upper portion of reach), bank failure is severe along reach |

MASS MOVEMENT

| | | | |
|---|---|---|---|
| Backfill Slope Failure | | | |
| No cracks along the backfilled highwall observed | Cracking along the backfilled highwall observed, opening is 80% vegetated and appears to be stabilized | Disturbance associated with slope cracking is approximately 50% vegetated and it is uncertain whether this area is actively eroding or is stabilized | Severe cracking of backfilled material observed, disturbance is void of vegetation and appears to be actively eroding |
| Subsidence | | | |
| No subsidence pockets observed | Subsidence is evident, however the disturbance is 80% vegetated and appears to be stabilized (estimate size of feature) | Subsidence disturbance is approximately 50% vegetated, it is uncertain whether this area is actively eroding or is stabilized (estimate size of feature) | Severe subsidence observed, disturbance is void of vegetation and appears to be actively eroding (estimate size of feature) |

Form 7310–12
(May 1973)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

By | Date

Location

Treatment affecting the SSF

# DETERMINATION OF EROSION CONDITION CLASS
## SOIL SURFACE FACTORS (SSF)

| | | | | | |
|---|---|---|---|---|---|
| SOIL MOVEMENT* | No visual evidence of movement<br>0 1 2 3 | Some movement of soil particles<br>4 5 | Moderate movement of soil is visible and recent. Slight terracing generally less than 1" in height.<br>6 7 (8) | Occurs with each event. Soil and debris deposited against minor obstructions.<br>9 10 11 | Subsoil exposed over much of area, may have embryonic dunes and wind scoured depressions<br>12 13 14 |
| SURFACE LITTER* | Accumulating in place<br>0 1 2 3 | May show slight movement<br>4 5 6 | Moderate movement is apparent, deposited against obstacles<br>7 (8) | Extreme movement apparent, large and numerous deposits against obstacles<br>9 10 11 | Very little remaining *(use care on low productive sites)*<br>12 13 14 |
| SURFACE ROCK* | If present, the distribution of fragments show no movement caused by wind or water<br>0 1 2 | If present, coarse fragments have a truncated appearance or spotty distribution caused by wind or water<br>3 4 5 | If present, fragments have a poorly developed distribution pattern caused by wind or water<br>6 7 (8) | If present, surface rock or fragments exhibit same movement and accumulation of smaller fragments behind obstacles<br>9 10 11 | If present, surface rock or fragments are dissected by rills and gullies or are already washed away<br>12 13 14 |
| PEDESTALLING* | No visual evidence of pedestalling<br>0 1 2 3 | Slight pedestalling, in flow patterns<br>4 5 6 | Small rock and plant pedestals occurring in flow patterns<br>7 8 (9) | Rocks and plants on pedestals generally evident, plant roots exposed<br>10 11 | Most rocks and plants pedestalled and roots exposed<br>12 13 14 |
| FLOW PATTERNS* | No visual evidence of flow patterns<br>0 1 2 3 | Deposition of particles may be in evidence<br>4 5 6 | Well defined, small, and few with intermittent deposits<br>7 (8) 9 | Flow patterns contain silt and sand deposits and alluvial fans<br>10 11 12 | Flow patterns are numerous and readily noticeable. May have large barren fan deposits.<br>13 14 15 |
| RILLS | No visual evidence of rills<br>0 1 2 3 | Some rills in evidence at infrequent intervals over 10'<br>4 5 6 | Rills ½" to 6" deep occur in exposed places at approximately 10' intervals<br>(7) 8 9 | Rills ½" to 6" deep occur in exposed area at intervals of 5 to 10'<br>10 11 12 | May be present at 3" to 6" deep at intervals less than 5'<br>13 14 |
| GULLIES | May be present in stable condition. Vegetation on channel bed and side slopes<br>0 1 2 3 | A few gullies in evidence which show little bed or slope erosion. Some vegetation is present on slopes.<br>4 5 6 | Gullies are well developed with active erosion along less than 10% of their length. Some vegetation may be present.<br>7 8 9 | Gullies are numerous and well developed with active erosion along 10 to 50% of their lengths or a few well developed gullies with active erosion along more than 50% of their length<br>10 11 12 | Sharply incised gullies cover most of the area and over 50% are actively eroding<br>13 14 15 |
| SITUATION | TOTAL | | | | |
| | | | | | |

*(Instructions on reverse)*

Erosion Condition Classes: Stable 0–20; Slight 21–40; Moderate 41–60; Critical 61–80; Severe 81–100

# OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT
# DETERMINATION OF EROSION CONDITION
# SOIL SURFACE FACTOR (SSF)

## DESCRIPTIONS OF DIFFERENT DEGREES EACH OF THE EROSION FACTORS

| | | | | | | TOTALS OBSERVED/POTENTIAL |
|---|---|---|---|---|---|---|
| **Soil Movement** | Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between 0 and .1 in. (0 to 2.5 mm).<br>0 or 1 2 3 | Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated area, is between .1 and .2 in. (2. to 5 mm).<br>4 5 6 | Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .2 and .4 in. (5 to 10 mm).<br>7 8 9 | Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .4 and .8 in. (10 to 20 mm).<br>10 11 12 | Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas is over .8 in. (20 mm).<br>13 14 | ____ ____ |
| **Surface Litter & Mulch** | No movement, or if present, less than 2 percent of the litter has been translocated and redeposited against obstacles.<br>0 or 1 2 3 | Between 2 and 10 percent of the litter has been translocated and redeposited against obstacles.<br>4 5 6 | Between 10 and 25 percent of the litter has been translocated and redeposited against obstacles.<br>7 8 9 | Between 25 and 50 percent of the litter has been translocated and redeposited against obstacles or removed from that area.<br>10 11 12 | More than 50 percent of the litter has been translocated and redeposited against obstacles or removed from the area.<br>13 14 | ____ ____ |
| **Surface Rock Fragment** | Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is less than .1 in. (2.5 mm).<br>0 or 1 2 3 | Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is between .1 and .2 in. (2.5 to 5 mm).<br>4 5 6 | Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is between .2 and .4 in. (5 to 10 mm).<br>7 8 9 | Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments, is between .4 and .8 in. (10 to 20 mm).<br>10 11 12 | Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is over .8 in. (20 mm)<br>13 14 | ____ ____ |
| **Pedestalling** | Pedestals are mostly less than .1 in. (2.5 mm) high and/or less frequent than 2 pedestals per 100 sq. ft.<br>0 or 1 2 3 | Pedestals are mostly between .1 to .3 in. (2.5 to 8 mm) high and/or have a frequency of 2 to 5 pedestals per 100 sq. ft.<br>4 5 6 | Pedestals are mostly between .3 to .6 in. (8 to 15 mm) high, and/or have a frequency of 5 to 7 pedestals per 100 sq. ft.<br>7 8 9 | Pedestals are mostly between .6 and 1 in. (15 to 25 mm) high, and/or have a frequency of 7 to 10 pedestals per 100 sq. ft.<br>10 11 12 | Pedestals are mostly over 1 in. (25 mm) high, and/or have a frequency of over 10 pedestals per 100 sq. ft.<br>13 14 | ____ ____ |
| **Flow Patterns** | None, or if present, less than 2 percent of the surface area shows evidence of recent trans - location and deposition of soil and litter.<br>0 or 1 2 3 | Between 2 and 10 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.<br>4 5 6 | Between 10 and 25 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.<br>7 8 9 | Between 25 and 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.<br>10 11 12 | Over 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.<br>13 14 15 | ____ ____ |
| **Rills** | Rills, if present, are mostly less than .5 in. (13 mm) deep, and generally at infrequent intervals over 10 ft.<br>0 or 1 2 3 | Rills are mostly .5 to 1 in. (13 to 25 mm) deep, and generally at infrequent intervals over 10 ft.<br>4 5 6 | Rills are mostly 1 to 1.5 in. (25 to 38 mm) deep, and generally at 10 ft. intervals.<br>7 8 9 | Rills are mostly 1.5 to 3 in. (38 to 76 mm) deep, and at intervals of 5 to 10 ft.<br>10 11 12 | Rills are mostly 3 to 6 in. (76 to 152 mm) deep, and at intervals of less than 5 ft.<br>13 14 | ____ ____ |
| **Gullies** | No gullies, or if present, less than 2 percent of the channel bed and walls show active erosion (are not vegetated), gullies make up less than 2 percent of the total area.<br>0 or 1 2 3 | Between 2 and 5 percent of the channel-bed and walls show active erosion (are not vegetated), or gullies make up between 2 and 5 percent of the total area.<br>4 5 6 | Between 5 and 10 percent of the channel bed and walls show active erosion (are not vegetated), or gullies make up between 5 and 10 percent of the total area.<br>7 8 9 | Between 10 and 50 percent of the channel bed and walls show active erosion (are not vegetated), or gullies make up between 10 and 50 percent of the total area.<br>10 11 12 | Over 50 percent of the channel bed and walls show active erosion (are not vegetated) along their length, or gullies make up over 50 percent of the total area.<br>13 14 15 | ____ ____ |
| | | | | | | ____ ____ |

TOTAL SSF _____/_____X100
(Observed/Potential x100)

EROSION CONDITION CLASSES:
STABLE 0-20 SSF, SLIGHT 21-40 SSF, MODERATE 41-60 SSF, CRITICAL 61-80 SSF, SEVERE 81-100 SSF

SSF's DISRUPTIVE TO POSTMINING LAND USES:
Cropland and Forestry 41-100 SSF, All Other Uses 61-100 SSF

POSTMINE LAND USE: _____

## Physical Processes Governing Sediment Yield from Small Areas

### 1.) Raindrop Impact

a.) amount of soil detactment depends upon the energy of the rainfall.

b.) rainfall intensity increases, the amount of soil detactment increases.

### 2.) Transport of the Sediment Supply by Overland Flow

a.) the sediment transport capacity of overland flow depends on its velocity and depth.

b.) velocity and depth depend on the amount of rainfall excess ( i.e. the amount rainfall which has not infiltrated, been intercepted by vegetation, or been caught in depressions), the overland slope, and the slope roughness.

c.) ground cover decreases the amount of rainfall excess by increasing infiltration and interception and increasing slope roughness and depression storage.

### 3.) Overland Flow Detactment

a.) if the sediment transport capacity of the overland flow exceeds the supply of sediment, then it is possible for an additional sediment supply to be derived from the flow detactment of the soil surface.

b. ) soil type also controls sediment supply.

c.) "supply controlled" versus "transport controlled"

### 4.) Settlement and Deposition of Sediment

a. deposition occurs when the transport capacity is reduced (i.e. ponds, silt fences, staw bales, surface roughness etc.)

b. sediment particles will settle out dependent on their own weight and hydraulic conditions; larger particles will settle rapidly and smaller sizes will take a long time to settle

## Surface Protection Measures

* Surface protection measures include utilization of various types of mulches, vegetation, and erosion control products such as excelsior matting.

* These measures interact with the erosion process in a number of ways.

  a.) They reduce the amount of bare soil exposed to raindrop impact. The amount of raindrop detactment will decrease in direct proportion to the amount of cover provided by surface protection measures.

  b.) Increase infiltration and surface roughness decreasing velocity and flow, the two important components of sediment transport.

* **The most effective form of sediment control**

## Physical Process Approach to Sediment Control

1.) The largest source of sediment supply in small areas results from raindrop detactment.
a.) Only one erosion control group acts to control this supply, and that is **surface protection measures** (i.e. mulches, revegetation, matting, etc.)

2.) Methods which reduce the amount of runoff **(surface protection and Mechanical treatment)** will control the transport of sediment from the slope. When used in combination can be extremely effective.

3.) Methods which rely primarily on the settling of sediment **(i.e.diversions, detention structures)** will be most effective on larger sediment sizes.

4.) Any effective sediment control system for a small (or large) area will require **a stable conveyance system.**

Erosion Control Methods can be eliminated simply on the basis of:
**1.) Availability of material or equipment**
**2.) Specific soil types and topography**
**3.) nature of construction activity and its potential impacts on surrounding environments**

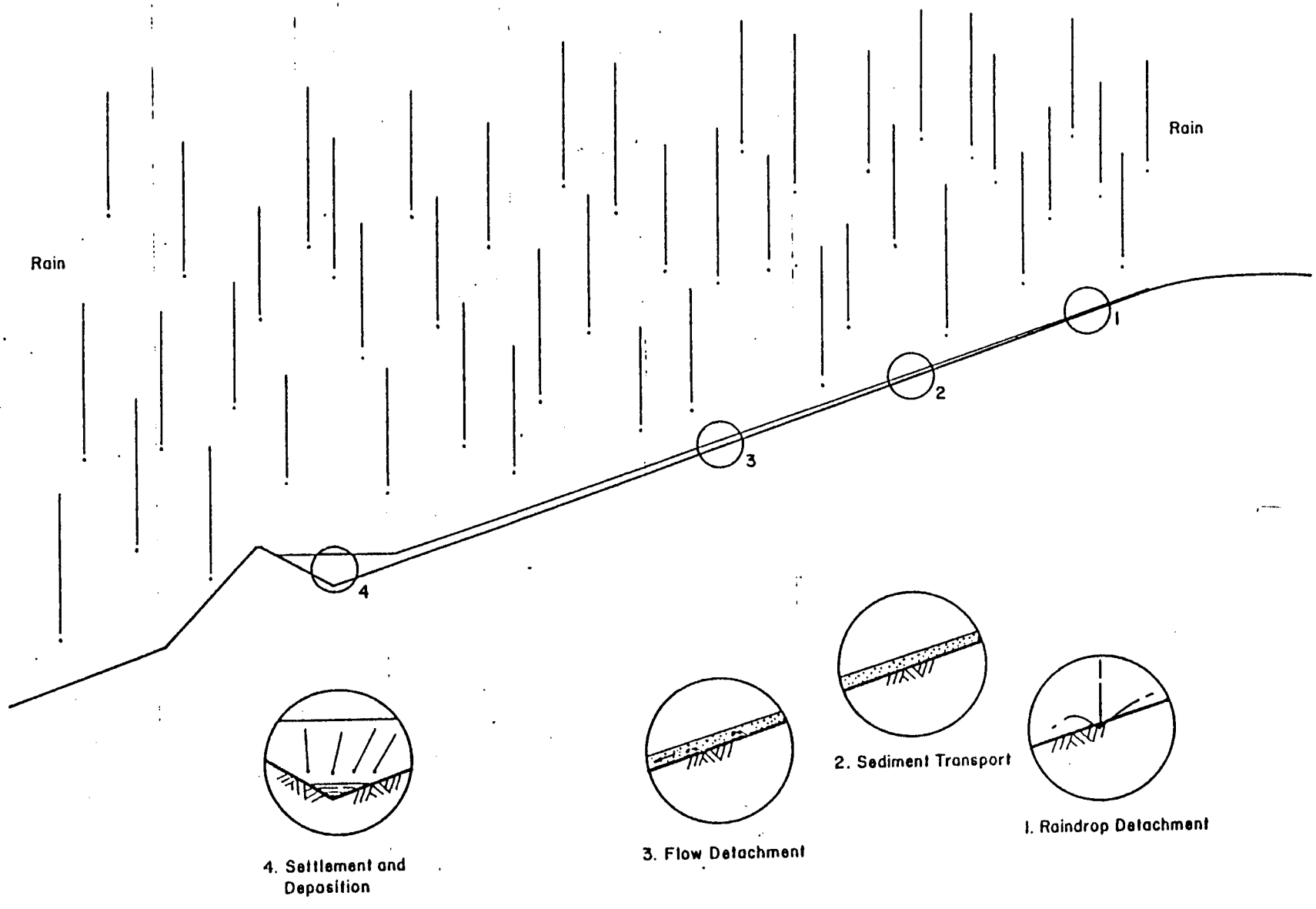



Figure 2.1. Physical processes governing sediment yield.

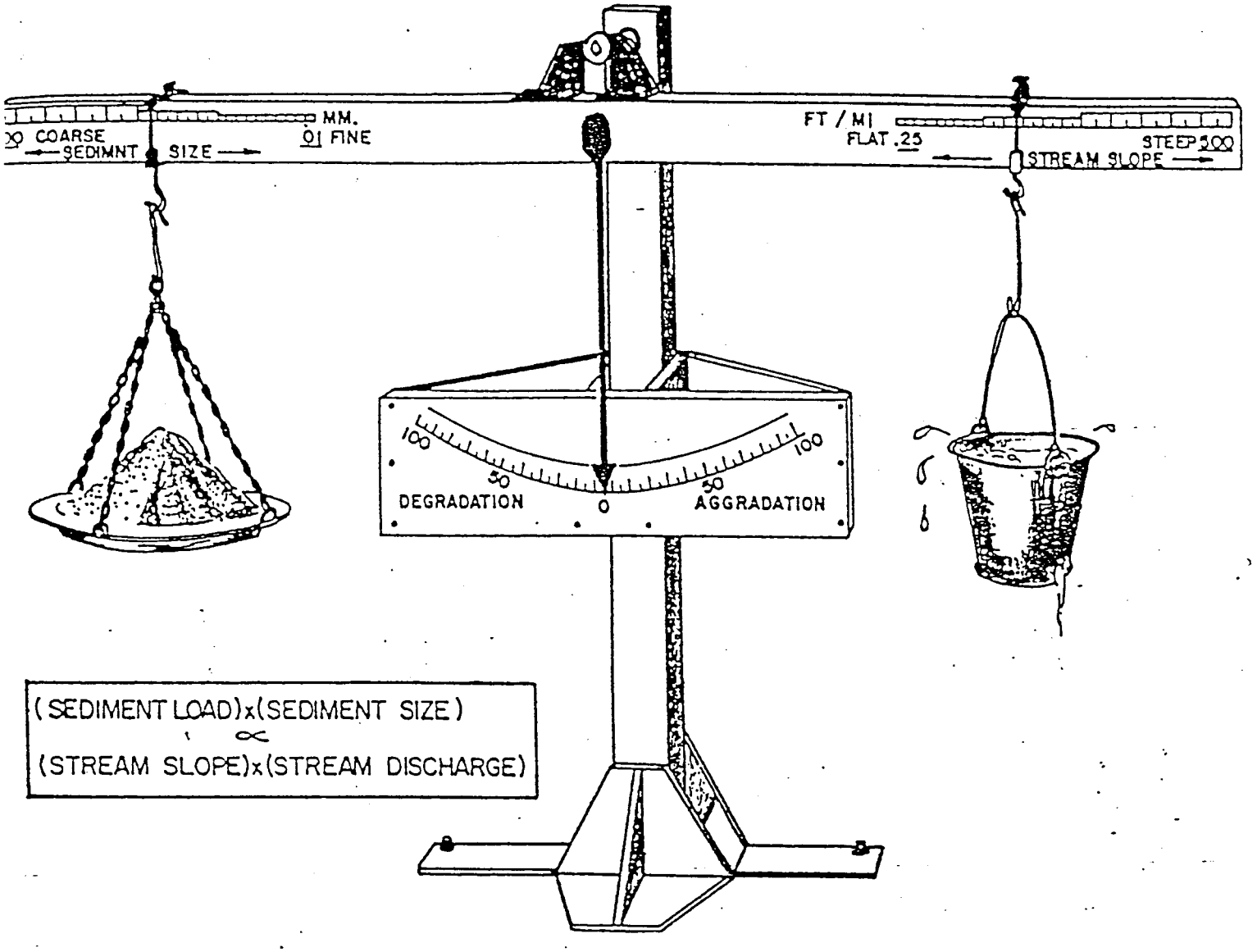



Figure 4.—Stable channel balance. (Sediment loads times sediment size) varies as (stream slope times stream discharge). (Courtesy of the American Society of Civil Engineers; from Lane, E. W. 1955. The importance of fluvial morphology in hydraulic engineering. American Society of Civil Engineers Proceedings Hydraulic Division 81:745-1 to 745-17.)

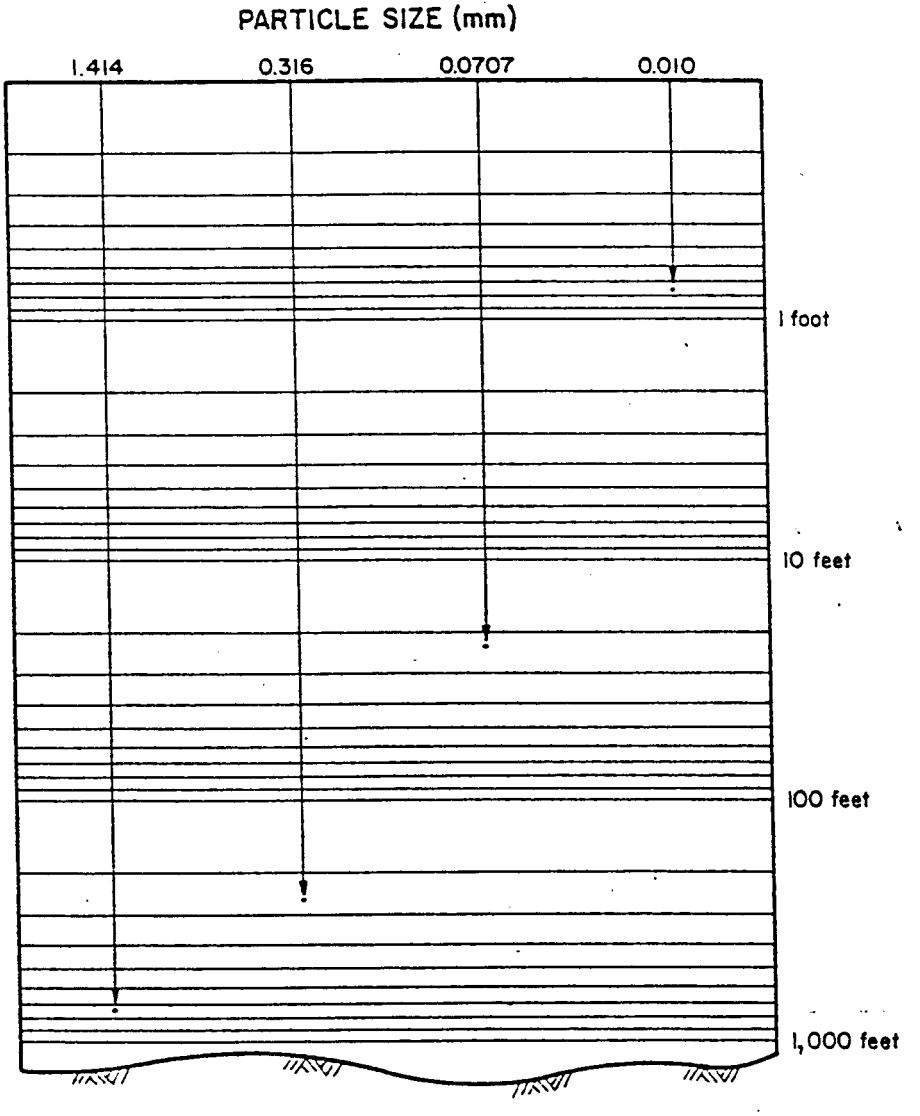



Figure 7.1. Settling distance for different diameter particles based on a 30-minute time interval.

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## R645-301-412 RECLAMATION PLAN

### 412.100 POST-MINING LAND USE PLAN

After the recoverable coal reserves have been extracted and final reclamation accomplished it is expected and anticipated that the current status of the existing land use area will remain unchanged. Mining in this immediate area has been ongoing since the turn of the century without any significant disruptions to existing land use.

The permit area and surrounding lands are classified as recreation, forestry, grazing and mining lands under local county zoning ordinances.

United States Fuel Company's post-mining land use plan is to utilize the land presently within the permit area for wildlife habitat, livestock grazing (ranching) and outdoor recreation. Towards this end, the access roads leading to the mine sites are not proposed to be totally reclaimed but will be left in place to support these activities.

**WILDLIFE HABITAT**

In response to U.S. Fuel's requests, the Division of Wildlife Resources commented on U.S. Fuel's post-mining land use plan on 2/14/84 and again on 4/12/92. In their 1984 letter DWR noted they would prefer that roads along with other surface facilities be reclaimed with habitat more suitable to wildlife. In their 1992 letter DWR did not comment on retention of roads but rather expressed concern about possible subsidence effects on wildlife habitat and loss of water resources.

In the interest of enhancing wildlife and related environmental values, U.S. Fuel proposes to reclaim canyon access roads to an unimproved condition. This will be achieved by removing and disposing of the pavement, ripping the underlying surface and revegetating with plant species favorable to wildlife. Existing drainage structures will be left in place to serve a single lane road on the revegetated surface. Reclaiming the roads to an unimproved condition will provide additional forage and cover as well as restricting access to high value wildlife habitats during the cold weather period from late fall to early spring.

**LIVESTOCK GRAZING**

U. S. Fuel owns ranch sites and agricultural lands outside the permit boundary on Miller Creek and Cedar Creek. U. S. Fuel also holds water rights and approved diversions for industrial, municipal, domestic, livestock watering and irrigation purposes on both streams.

The 640 acre Millerton ranch and the 794 acre Cedar Creek ranch along with 11,000 acres of mountain rangeland (all privately owned) comprise a viable and ongoing enterprise which has been leased to local ranching families for many decades.

The canyon roads are an asset to modern ranching operations and contribute to the value of the land for that purpose. Cattle are trucked to the mouths of the canyons from distant lowland winter ranges in the spring and trucked back in the fall. Roads provide ready access to gates and fences required to confine livestock to selected grazing sites and to rotate them between forage areas as the summer progresses. Roads also allow quick inspection of the location and condition of widely scattered groups of livestock.

**OUTDOOR RECREATION**

The canyons and surrounding lowlands in the vicinity of Hiawatha are scenic, diverse in land forms and vegetation and historically significant to local, state and county residents as well as out of state visitors. Many former residents of Hiawatha, now living in other states, return to visit the area during the spring, summer and fall months for sentimental and recreational purposes.

In review of U.S. Fuel's post-mining land use plan, Carbon County has expressed concern about any possible road closures (see letter in Appendix IV-5). The county would like to retain all roads that provide access to otherwise inaccessible regions of the county. Access to historic and scenic areas provide recreation to county residents and enhance the local economy by attracting and holding out of state visitors.

**VARIANCE FROM APPROXIMATE ORIGINAL CONTOUR**

To retain the canyon access roads as part of its post-mining land use plan, U.S. Fuel Company is requesting a variance from approximate original contour in accordance with R645-302-270. This request is presented in Appendix IV-7.

412.110 The proposed post-mining land use will be achieved by regrading and revegetating mining related disturbed areas, except canyon access roads, to support wildlife habitat, livestock grazing and outdoor recreation. If the roads are removed during reclamation operations they will almost certainly be regraded at some time thereafter and very likely without any of the currently existing runoff and drainage control structures.

412.120 Range and grazing is one of the proposed post-mining uses. The Soil Conservation Service, at the request of U. S. Fuel Company, compiled a grazing plan for the mine property area.

This plan identifies five range types and addresses soils, vegetation and productivity. The plan is given in Appendix IV-3. The range site locations are shown on Exhibit IV-4.

412.130 No land use different from the pre-mining land use is proposed.

412.140 Consideration has been given to making all of the proposed coal mining and reclamation operations consistent with surface owner plans and applicable Utah and local land use plans. Letters describing U. S. Fuel's proposed post-mining land use plans and requesting comments, approvals or authorizations have been sent to the following Agencies:

U. S. Forest Service
Carbon County
Emery County
Southeastern Utah Association of Governments
Utah Division of Water Rights
Utah Division of State Lands and Forestry
Utah Division of Wildlife Resources

Copies of letters sent and responses from those agencies which chose to respond are given in Appendix IV-5.

412.200 **LAND OWNER OR SURFACE MANAGER COMMENTS**

Surface land status of the mine plan area is a combination of fee lands on the eastern side and the Manti-LaSal National Forest lands on the western portion.

Ownership of the surface is detailed on Exhibit IV-1 with the subsurface ownership detailed on Exhibit IV-2. Specific legal descriptions of property control are provided in Chapter I, Appendix I-1.

Surface managing authorities consist of two separate and distinct agencies. United States Fuel Company fee lands are bordered on the east, southeast and northeast by the Bureau of Land Management, with the United States Forest Service Manti-LaSal National Forest bordering the fee lands on the west, southwest and northwest. Federal surface control is illustrated on Exhibit IV-1.

Utility corridors traversing the eastern edge of the United States Fuel Company property consist of two Utah Power & Light Company transmission lines. The first transmission line is a 340 KV north-south line connecting Huntington to Provo, Utah. The second transmission line is a 45 KV north-south line connecting into a substation southeast of the town of Hiawatha that supplies electricity to the mine and town. The Utah Railway Company holds title to a railroad corridor bisecting the eastern portion of the property.

Special use permits and leases are limited primarily to grazing leases issued by the Bureau of Land Management and the United States Forest Service Manti-LaSal National Forest region.

The only coal leases on the property are federal leases which are listed below:

SL-069985
SL-025431
U-026583-058261 (combined)
U-51923

These leases are confined mainly to the western portion of the property and are illustrated on Exhibit IV-2. Appendix I-1 in Chapter I gives the legal description and land area of each lease. Comments and stipulations relating to these federal lands are made a part of each lease document. Appendix IV-4 gives a listing of these comments and stipulations.

Mineral ownership in the area is comprised of fee and federal lands. Coal is the only valuable commodity mined in the area.

412.300 **SUITABILITY AND COMPATIBILITY**

Plans for final fills and surface regrading operations for each disturbed site are discussed in Chapter V. Materials to be utilized for final reclamation have all proven to be of a quality suitable for reclamation purposes. See Chapter II, (Soil Resources) and the five year vegetation test plot study given in Appendix III-5.

## R645-301-420 AIR QUALITY

## R645-301-421 COMPLIANCE WITH THE CLEAN AIR ACT

Coal mining and reclamation operations at U. S. Fuel Company's properties are conducted in compliance with the Clean Air Act and the Utah State Department of Health Air Conservation Regulations. All new and previously existing potential sources of air pollution are inspected on a regular basis by the Utah Bureau of Air Quality.

## R645-301-422 COORDINATION AND COMPLIANCE WITH UTAH BUREAU OF AIR QUALITY

All new installations which could be a source of air pollution constructed after the implementation of the Clean Air Act have been reviewed by and received approval orders from the Utah Bureau of Air Quality. U. S. Fuel submits annual emission inventory reports which include the rate and period of emissions, specific plant sources of pollution, composition of

contaminants and types and efficiencies of control equipment. A copy of the most recent air quality approval order is included in Appendix IV-6.

## R645-301-423 AIR POLLUTION CONTROL PLAN

U. S. Fuel Company does not project production rates exceeding 1,000,000 tons of coal per year during the term of this permit, therefore, no air quality monitoring program is required.

Fugitive dust is controlled by enclosed facilities, conveyor belt covers, transfer chute covers and watering of unpaved haul roads.

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U. S. Forest Service, Intermountain Region, 1979, Land Management Plan, Ferron-Price Planning Unit, Manti-LaSal National Forest, Price, Utah.

U. S. Department of the Interior, Final EIS, Development of Coal Resources in Central Utah, 1979.

**FOOTNOTES**

1. Cook, Moreau and Peterson, Soil and Water Conservation Plan For U. S. Fuel Company, Price River Conservation District, USDA Soil Conservation Service, May, 1979.

2. U. S. Forest Service, Intermountain Region, 1979, Land Management Plan, Ferron-Price Planning Unit, Manti-LaSal National Forest, Price, Utah, page 28.

3. Clayton W. Scribner, Timber Survey, Hiawatha Compartment of Manti Working Circle, Manti National Forest, Nov. 1929, page 28.

4. Forest Service, OP. CIT., p. 165.

# APPENDIX IV-7

# REQUEST FOR VARIANCE FROM APPROXIMATE ORIGINAL CONTOUR

**UNITED STATES FUEL COMPANY**

**REQUEST FOR VARIANCE FROM APPROXIMATE ORIGINAL CONTOUR**

In accordance with R645-302-270, United States Fuel Company hereby requests a variance from approximate original contour for its canyon access roads in its Mining & Reclamation Permit area. U.S. Fuel proposes to reclaim the Middle Fork and South Fork canyon access roads by removing and disposing of the pavement and ripping and revegetating the underlying surface. Existing drainage structures will be left in place to serve a single lane, unimproved road on the revegetated surface. The full width of the existing subgrade will be left as is and no regrading to approximate original contour is proposed. Justification for this proposal is outlined as follows:

271.100 U.S. Fuel feels that a higher and better use can be achieved by retaining the access roads to support its post-mining land use plan discussed under R645-301-412.

U.S. Fuel is the landowner having jurisdiction over the lands. There is reasonable liklehood for achievement of the post-mining land use (see discussion under R645-301-412.100). The proposed use does not present any actual or probable hazard to public health or safety or threat of water diminution or pollution. The proposed use is not impractical or unreasonable. It is not inconsistent with applicable land-use policies or plans and it will not involve unreasonable delay in implementation or cause or contribute to violation of Federal, Utah or local law.

271.200 All other applicable requirements of the State Program are addressed in our Mining and Reclamation Permit.

271.300 Consultation with the appropriate land use agencies has been conducted (see letters in Chapter IV, Appendix IV-5) and the potential use, as discussed under R645-301-412, is shown to constitute an equal or better economic use.

271.400 Federal, Utah and local government agencies with an interest in the proposed land use have had an adequate period of time in which to review and comment on the proposed use (see requests for input from Federal, Utah and local government agencies in Appendix IV-5).

271.500 After reclamation, the lands to be affected by the variance within the permit area will be suitable for an industrial, commercial, residential or public post-mining land use (including recreational facilities).

271.600 United States Fuel Company is the surface landowner of the lands within the permit area and hereby requests, as part of the permit application, that a variance be granted so as to render the land, after reclamation, suitable for industrial, commercial, residential or public use (including recreational facilities).

271.700 The watershed of lands in the vicinity of the access roads will be improved by the proposed operations when compared with the condition of the watershed if the approximate original contour were to be restored because the land surface of the roads will remain in a relatively flat or less steeply inclined condition as compared to the adjacent canyon slopes. The greatest portions of the access roads already conform approximately to the original contour since they were constructed on the flat, bottom parts of the canyon profiles. The beneficial effects to the watershed of the flatter portions of the roads, which essentially approximate a terrace, outweigh the detrimental effects of the relatively few steep side cuts.

271.710 The amount of total suspended solids or other pollutants discharged to ground or surface water from the road areas will be reduced, so as to improve the public or private uses of the ecology of such water. This will be accomplished because the relatively flat road surfaces will be more favorable to soil stabilizing vegetation types, as well as to vegetation growth (because of moisture retention), than the adjacent steep canyon slopes and the existing road drainage structures are proposed to remain in place. Flood hazards from the watersheds containing the roads will also be reduced for the same reasons.

271.720 The total volume of flow from the revegetated road surfaces, during every season of the year, will not vary in a way that adversely affects the ecology of any surface water or any existing or planned use of surface or ground water.

271.800 Certification of the proposed design plan for the variance is given under R645-301-512.260.

**UNITED STATES FUEL COMPANY**

**VARIANCE FROM APPROXIMATE ORIGINAL CONTOUR**

**CERTIFICATION**

I certify that the design of the canyon access roads for the proposed variance from approximate original contour, as described under R645-301-537.200 through 537.250 and R645-302-270, is in conformance with professional standards established to assure the stability, drainage and configuration necessary for the intended use of the sites.

Michael P. Watson P.E.

UMC 784.12 OPERATION PLAN: EXISTING STRUCTURES (ACR RESPONSE)

Existing structures are shown on maps included with this chapter. Structures existing prior to the Act have been examined for their compliance with performance standards. Sediment ponds, catchment basins, berms and diversion ditches have been constructed and maintained to ensure protection of the hydrologic balance for previously existing structures. Stability investigations have been undertaken for all slurry ponds and refuse piles in accordance with 30 CFR 77. Outslopes have been flattened to increase stability and reduce erosion. Results of stability investigations, as well as descriptions and construction methods are given in Appendices XII-3. All impoundments which meet the size requirements of 30 CFR 77.216 (a) are inspected on a weekly basis. Exposed underground openings which are no longer used in connection with current operations have been cased, sealed or fenced to prevent access. Maps showing plans, sections and design features of existing and proposed roads are given in Chapter XIII.

In response to ACR comments relating to the adequacy of slurry pond 5A to serve as a sedimentation pond, please see attached calculations which show that the pond is adequate to store runoff from a 10-year, 24 hour storm.

FOR: UNITED STATES FUEL COMPANY. DATE: JULY 8, 1983

SUBJECT: CHECK POND SIZE FOR RUN-OFF & EFFLUENT VOLUME PAGE: 1 OF 2

RUN-OFF VOLUME: 10 YR - 24 HR. STORM:

$V_1$ - RUN-OFF TRIB CULVERT #12: A = 0.175 SQ.MI. Q = 1.31"

$V_1 = (0.175 \times 640 \times 43560 \times 1.31 \div 12) 7.481$ = 3,984,333 GAL.

$V_2$ - RUN-OFF TRIB CULVERT #2: A = 0.228 Q = 0.98"

$V_2 = (0.228 \times 640 \times 43560 \times 0.98 \div 12) 7.481$ = 3,883,356 GAL.

$V_3$ - RUN-OFF FROM PLANT - 800 GPM. - 16 HRS.

$V_3 = 800 \times 60 \times 16$ = 768,000 GAL.

$V_4$ - RUN-OFF FROM COAL STORAGE TRIB AREA:
A = 0.036 Q = 0.245

$V_4 = (0.036 \times 640 \times 43560 \times 0.245 \div 12) 7.481$ = 153,290 GAL

NOTE!
FOR CULVERT RUN-OFF DATA SEE ENCLOSURE #1 CH. VII, 7.5 APPENDICES VII-1

MAX FLOW TO POND 8,788,979 GAL.

f. VOLUME AVAILABLE:

POND DIMENSIONS: 900 x 300 x 50 - TOP 4 FT OF POND ARE EMPTY.

$V_5$ - VOLUME AVAILABLE IN TOP OF POND:

$V_5 = 900 \times 300 \times 3 \times 7.481$ = 6,059,610 GALS.

$V_6$ - VOLUME OF VOIDS AVAILABLE IN POND:

EST. % VOIDS:
COAL "IN PLACE" = 80#/FT³
FINES "IN POND" = 60#/FT³
% VOIDS = 20 ÷ 80 = 25%

$V_6 = 900 \times 300 \times 46 \times 0.25 \times 7.481$ = 23,228,505 GALS.

TOTAL VOL. AVAIL. = 29,288,115 GALS.

REGISTERED PROFESSIONAL ENGINEER #3697 CHARLES J. JAHNE STATE OF UTAH

REGULATIONS:

UMC: 784.12(a)(4)
OSM: 784.12(a)(4)

FOR: UNITED STATES FUEL COMPANY, DATE: JULY, 8, 1983

SUBJECT: CREEK POND 5A FOR RUN-OFF + EFFLUENT VOLUME PAGE: 2 OF 2

1 WATERSHED AT COAL STORAGE YARD AREA DISCHARGING TO NEW WATER MAIN YARD.

REF. DWG.: EXHIBIT VII-20 :

| A | CN | ℓ | Y | S | L | $T_p$ | P | Q | q |
|---|---|---|---|---|---|---|---|---|---|
| 0.036 | 70 | 2500 | 8.8 | 4.28 | 0.297 | 0.348 | 2.25 | 0.245 | 12.27 |

A = AREA (SQ. MI.) Y = SLOPE (%) S = 1000/CN-10

CN = CURVE NUMBER L = WATERSHED LAG $= \frac{(\ell^{0.8})(S+1)^{0.7}}{1900\sqrt{Y}}$ $T_p = 1.17\,L$

ℓ = HYDRAULIC LENGTH (FT.) P = PRECIPITATN DEPTH (IN.)

Q = RUN-OFF VOL.-(IN.) = (P-0.25)÷(P+0.85) q = PEAK DISCHARGE (FT.³/SEC.)

S = (1000÷70)-10 = 4.28

$L = [(2500^{0.8})(4.28+1)^{0.7}] \div 1900\sqrt{8.8} = 0.297$

$T_p = 1.17 \times 0.297 = 0.348$

$q_{PLANT} = 800 \div 60 \times 7.481 = 1.8$

$Q = (2.2 - 0.2 \times 4.28) \div (2.28 + 0.8 \times 4.28) = 0.245$

$q = 484 \times 0.036 \times 0.245 \div 0.348 = 12.27$

CHECK DEPTH OF WATER STOP POND AT PEAK FLOW = VEL. = 5 FPS.

$q_{CUL.\#12} = 482.4$

$q_{CUL.\#2} = 540.7$

$q_{CONV.ST.\#3} = 12.3$

$q_{PLANT} = 1.8$

$MAX\ q = 1037.2$

$A = 1037.2 \div 5 \times 300 = 0.69\ FT = 8.3"$

POND 5A HAS SUFFICIENT VOLUME AND SIZE TO CONTAIN PLANT AND WATERSHED RUN-OFF AND EFFLUENT.

UMC 784.11 OPERATION PLAN: GENERAL REQUIREMENTS (ACR RESPONSE)

All dams, embankments, impoundments and diversion structures will be routinely inspected and maintained by Company personnel during mining operations. Vegetative growth will be cut where necessary to facilitate inspection and repairs. Ditches and spillways will be cleaned and repaired when conditions indicate a need. Sediment will be removed from sedimentation ponds when the volume of sediment accumulates to 60 percent of the design sediment storage volume. All impoundments having embankments greater than 20 feet in height or storage volumes greater than 20 acre feet and which have not been abandoned in accordance with MSHA guidelines, will be inspected on a weekly basis. Impoundments will be examined for structural weakness, erosion, and other hazardous conditions by a person certified under MSHA requirements.

A narrative explaining the construction, modification, use, maintenance and removal of topsoil storage areas is included in our plan for Removal, Storage and Redistribution of Topsoil under UMC 784.12 (b) (4) included with this ACR submittal.

A plan for noncoal waste storage and disposal was submitted to the Division on August 13, 1981. A copy of the Division's approval letter is included following this response.

# UNITED STATES FUEL COMPANY

HIAWATHA, UTAH 84527

August 13, 1981

Utah Department of Natural Resources
Division of Oil, Gas and Mining
1588 West North Temple
Salt Lake City, Utah 84116

Re: Plan for disposal of
non-coal wastes.

Dear Sirs:

The following plan is being submitted by U. S. Fuel for disposal of non-coal wastes.

## NON-COAL WASTE DISPOSAL

The following designated sites shall be used for disposal of non-coal wastes:

### DISPOSAL SITES

The first proposed waste disposal site is to be located on the west side of the Middle Fork yard. Drainage from that portion of the yard flows to the sediment pond below the coal loading facility. (See Map #1, sites denoted by blue shading on each map.)

The second site will be located near the upper coal storage facility, off from the Middle Fork canyon road. Any leachate or runoff from this area will be collected by a sediment pond below the tracks. (See Map #2)

The third site specified for non-coal wastes is located in the lower yard in the slurry impoundment area. All runoff from the lower yard areas is diverted to several sediment ponds. (See Map #3)

### PLACEMENT

Placement and storage in these areas will take place in a controlled manner such that leachate and runoff does not degrade surface or ground water fires are prevented and the area remains stable and suitable for reclamation and revegetation.

TIME ALLOTMENT

Consolidation and storage of non-coal waste materials in these sites shall begin upon approval of the designated areas and be completed within a 6 month time frame.

Disposal of waste materials will be made on a regular basis and/or when necessary.

The three aforementioned areas shall constitute U. S. Fuel's non-coal waste disposal sites and be constructed and maintained according to UMC 817.89.

Yours very truly,

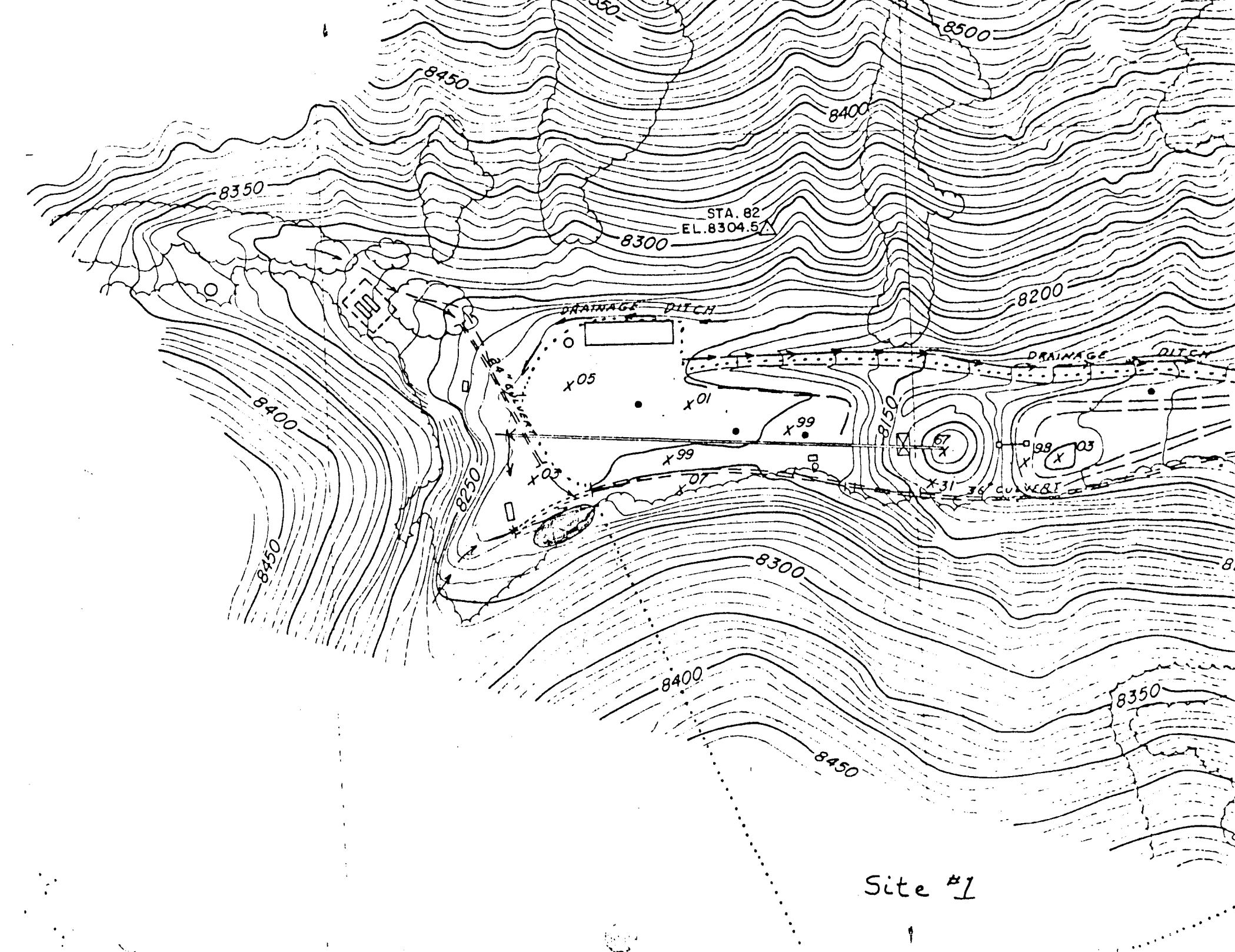
Jean Semborski

Jean Semborski,
Engineering Assistant

JS/ds

Enclosure(s)

cc: V. Posner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8300
8200
8150
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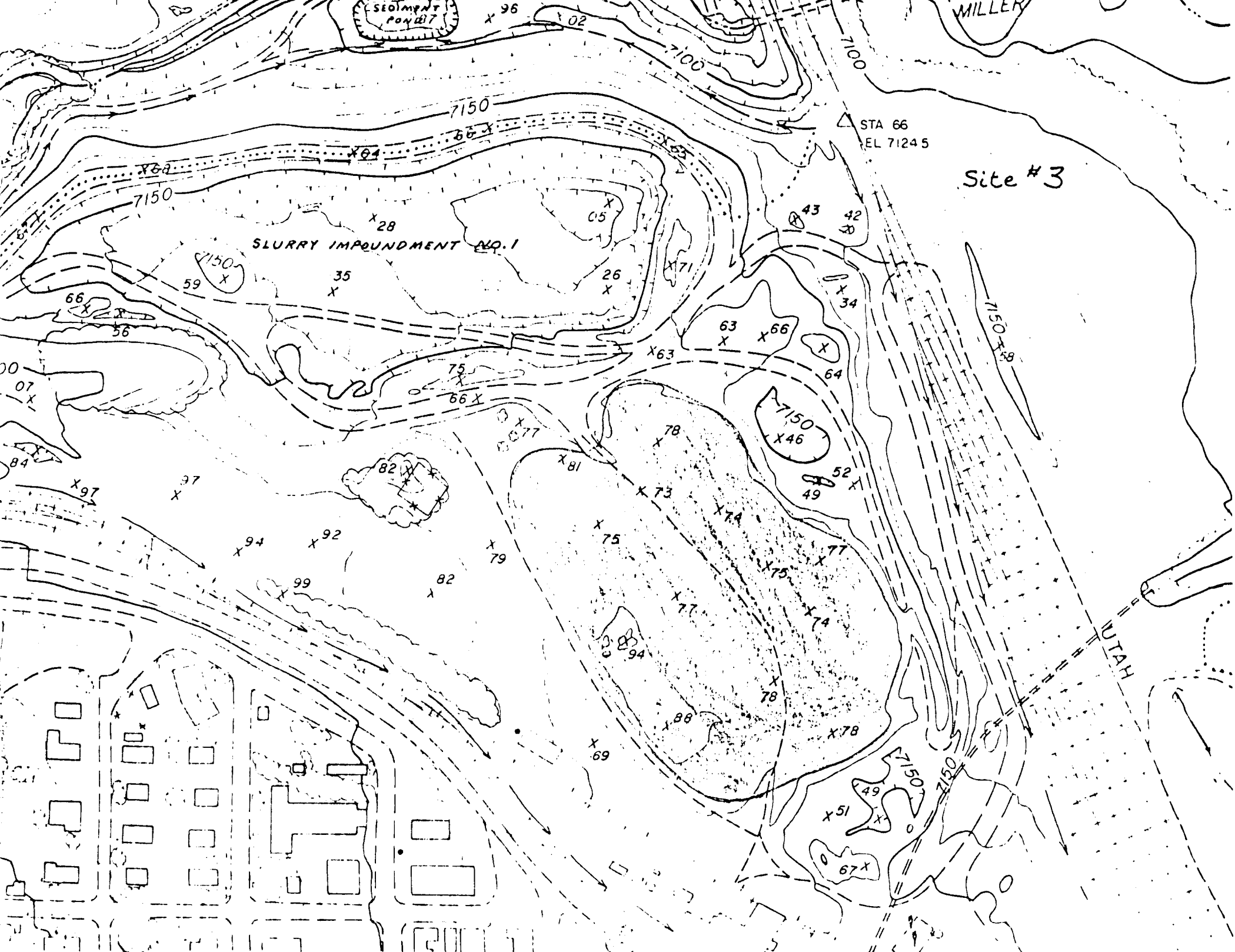
STA. 82
EL. 8304.5
DRAINAGE DITCH
DRAINAGE DITCH
24" CULVERT
36" CULVERT
X05
X01
X99
X99
X03
X07
X31
67
98
03

Site #1


Site #2
7300
RUINS
RUINS
AREA
RET
WALL
STA 66-6
E. 7369.8
7300
7250
67 X
SEDIMENTATION
POND
01 X
7350
HAUL


SEDIMENT POND #7
SLURRY IMPOUNDMENT NO. 1
STA 66
EL 7124.5
Site #3
MILLER
UTAH
7100
7150

**STATE OF UTAH**
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS, AND MINING
1588 West North Temple
Salt Lake City, Utah 84116
(801) 533-5771



September 28, 1981

Mr. Jean Semborski
Engineering Assistant
United States Fuel Company
Hiawatha, Utah 84527

RE: Plan for Non-coal Waste Disposal
U.S. Fuels Company
Hiawatha Complex
ACT/007/011
Carbon County, Utah

Dear Mr. Semborski:

The Division has reviewed your latest submission in request of three (3) non-coal waste disposal sites. We cannot approve these sites at this time until the following questions are answered:

1. Due to the large amount of area designated for non-coal waste disposal, raises the question as to what types of non-coal wastes are being disposed of. Please define the type of waste to be disposed of in the proposed disposal sites.

Depending on the type of waste, additional information may be required or additional measures may need to be implemented to assure proper containment of the wastes and protection of the surface and ground-water systems.

2. How and/or will undisturbed runoff be diverted around or away from these disposal sites? Will there be any additional surface disturbance created? If so, are the ponds adequately sized to handle the additional runoff from these areas?

Are the ponds total containment, or are they covered by an N.P.D.E.S. permit? Are oil skimmers designed into the discharge structures?

3. Is there an SPCC plan in effect at the mine site which may be applicable to cover spillages in these areas?

4. If new areas are to be disturbed, has there been a raptor survey done to cover these areas?

Will any critical wildlife habitat (i.e., riparian vegetation) be disturbed? If so, what mitigation measures are proposed to compensate for any losses of habitat? Have any threatened or endangered species (plants or animals) been identified in conjunction with these areas?

5. What soil types are present? What is the plan for topsoil removal, storage and redistribution? Plan must comply with the requirements of 817.21-.25 at a minimum.

6. If this is a new disturbance, what vegetation type(s) will be affected? Has baseline data been obtained for these areas (UMC 783.19)?

7. What are the final reclamation plans for these disposal sites? Each must comply with 817.89(b). Revegetation must conform to UMC 817.111-.116.

8. What is the "ruin" indicated in disposal site #2? Has this site been cleared with State History?

Before the Division can proceed with a final determination on approving these proposed disposal areas, U.S. Fuels Company will need to provide the information requested above.

If you have any comments or questions, please contact me.

Sincerely,

D. Wayne Hedberg

D. WAYNE HEDBERG
RECLAMATION HYDROLOGIST

DWH/te

cc: Bob Hagen, O.S.M.
Jim Smith, DOGM
Joe Helfrich, I&E

# UNITED STATES FUEL COMPANY

HIAWATHA, UTAH 84527

November 3 , 1981

Department of Natural Resources
Division of Oil, Gas and Mining
1588 West North Temple
Salt Lake City, Utah 84116

Dear Mr. Hedberg:

Upon request from your department, U.S. Fuel has submitted a plan for sites where non-coal wastes would be stored. We feel this plan has complied with UMC 817.89 a). for the following reasons:

1). The materials to be placed in these sites would be primarily old machinery and parts and would be stored for future use or disposal. (This area would not be used for materials which are taken to a sanitary landfill.)

2). The placement and storage areas are in a designated portion of the permit area and are protected by sediment ponds sized for that area.

3). Final disposal of any materials in the areas would be taken care of at the time of final reclamation of the mine or when that area is abandoned.

The disignated sites have been chosen and developed in concordance with written regulations.

The questions listed in the letter dated Sept. 28, 1981 will be answered below by reference to their number.

1). Materials to be stored at these sites are , for example: old machinery, culverts, conveyor rollers, timbers, roof bolts and wire. We are not aware of any restriction on the amount of area in the designated areas as long as it is in the permit area and drainage from it is adequately controlled. We request that all disturbed areas having adequate protection (i.e. mine yards with runoff diversion structures and sediment ponds) be designated for storage of non-coal material. We assume that temporary placement of non-coal materials within these protected areas will be at our discretion.

2). The runoff will remain as is presently established. There should be no additional runoff or surface disturbance. (All three areas are presently accessible). The existing sedimentation ponds, built according to the results of a study conducted on the area, are designed to handle the 10 year, 24 hour precipitaton event. (Chapter VII). The ponds are total containment and have oil skimmers in the discharge structures. The ponds were also designed to store 0.1 acre foot of volume for each acre of disturbed area within the upstream drainage area.

3). Should a spill occur in the mining area, (including the proposed sites) efforts would be made to contain the spill as soon as possible and then clean it up. The mine superintendent, vice-president and general manager, and the general supervisor of surface operations would be notified immediately. In the proposed areas, it is doubtful that materials posing a serious threat from spillage would be stored there. No significant amounts of chemicals, fuels lubricants, or transformer fluids should be stored in these areas. Minor amounts of oil and grease from old equipment would be the extent of this type of material that might occur there. Runoff from this area is carried to a sediment containment pond.

4). A raptor survey has been performed on the entire mine operation (including the designated areas). It was determined that the poles in the area did not pose a significant threat and would not require protection devices.

No new areas or wildlife will be disturbed through the use of the specified areas. No threatened or endangered species are known to exist in these areas.

5). The soil consists of rocky alluvium, coal fines and slurry in sites 1,2 and 3 respectively. As these areas were previously disturbed, no significant amount of topsoil was present on them. The area will be graded, scrified and topsoil distrubuted over the affected areas at the time of reclamation and after the materials stored there are removed. Topsoil redistribution will be in accordance with UMC 817.24 b. The area will be reseeded. The reclamation will follow the procedure as stated in the mine plan (Chapter III).

6). The areas have been previously disturbed, prior to the Surface Mining and Reclamation Act. A baseline study of the mine area can be found in the U.S. Fuel mine plan.

7). Final reclamation plans are to remove any remaining materials stored there and continue relamation as in the other areas of the mine. Final disposal of non-coal wastes stored at the sites will be disposed of in designated areas or if possible, covered by a minimum of two feet of soil. Slopes will be stabilized and revegetation accomplished in accordance with UMC 817.111-817.117. Areas will be graded and topsoil placed over the previously disturbed area. The area will be revegetated with the recommended species.

8). The ruin in the upper coal storage yard is part of an old foundation and has no particular importance. The entire mine area has been cleared with Utah's Department of State History (Chapter V and Appendix V-1 of the U.S. Fuel mine plan)

In addition to the three sites previously submitted, we would like to have two additional sites located in the South Fork (King 6) mine yard. Due to the size and physical separation (by canyons) of the U.S. Fuel mines,

more sites are needed to avoid transporting materials long distances. Location makes the site more useful and apt to be used and does not necessarily reflect a large quantity of this type of scrap material.

In conferance with Tom Portle on the subject of non-coal waste disposal sites, he agreed with our locations of sites, the need to have several, and felt they were located in adequately protected areas and didn't threaten the environment.

The fourth site would be located in the disturbed area of the South Fork mine yard to the east of the present maintenance shop. The area is protected by the sediment containment pond below the disturbed area. Drainage from this area is drawn on the enclosed map.

At present, there are materials stored here which were generated from an earlier mine in this area. Some materials have been displaced over the edge of the bench on which they and the maitenance shop are situated. A violation was issued on the material over the edge. Efforts have been made to pull this material back from the edge but were hampered by the presence of construction crews on the slope below. A berm exists alon the edge to prevent water from the bench causing erosion down the embankment.

We would like to propose retrieving the over bank material and storing it in the present storage area on the bench which is back against the canyon wall. Furthur clean up efforts will be delayed until approved non-coal wastes disposal sites are available for placement of these materials. This area is already disturbed, adequately protected and convienently located. The berm on the edge would be re-established to prevent erosion on the downslope. The mine yard sites would be reclaimed concurrent with reclamation of the mine yard.

The bench is composed primarily of rock. As this site was previously disturbed, no recoverable top soil is present.

No additional surface disturbance will be required for occupation of this site. The present sediment containment pond is adequately handling the run off and wont need to be increased due to the continued use of this site.

The type of waste to be stored in this area would include: old rail, wire, old mining equipment and timbers. No critical wildlife habitat or vegetation will be endangered through the use of this site.

The fifth site would be located on the bathhouse level, above the level of the fourth site. Materials such as those described for the other site have been stored here for many years. We would like to continue to store them at this site in the disturbed area.

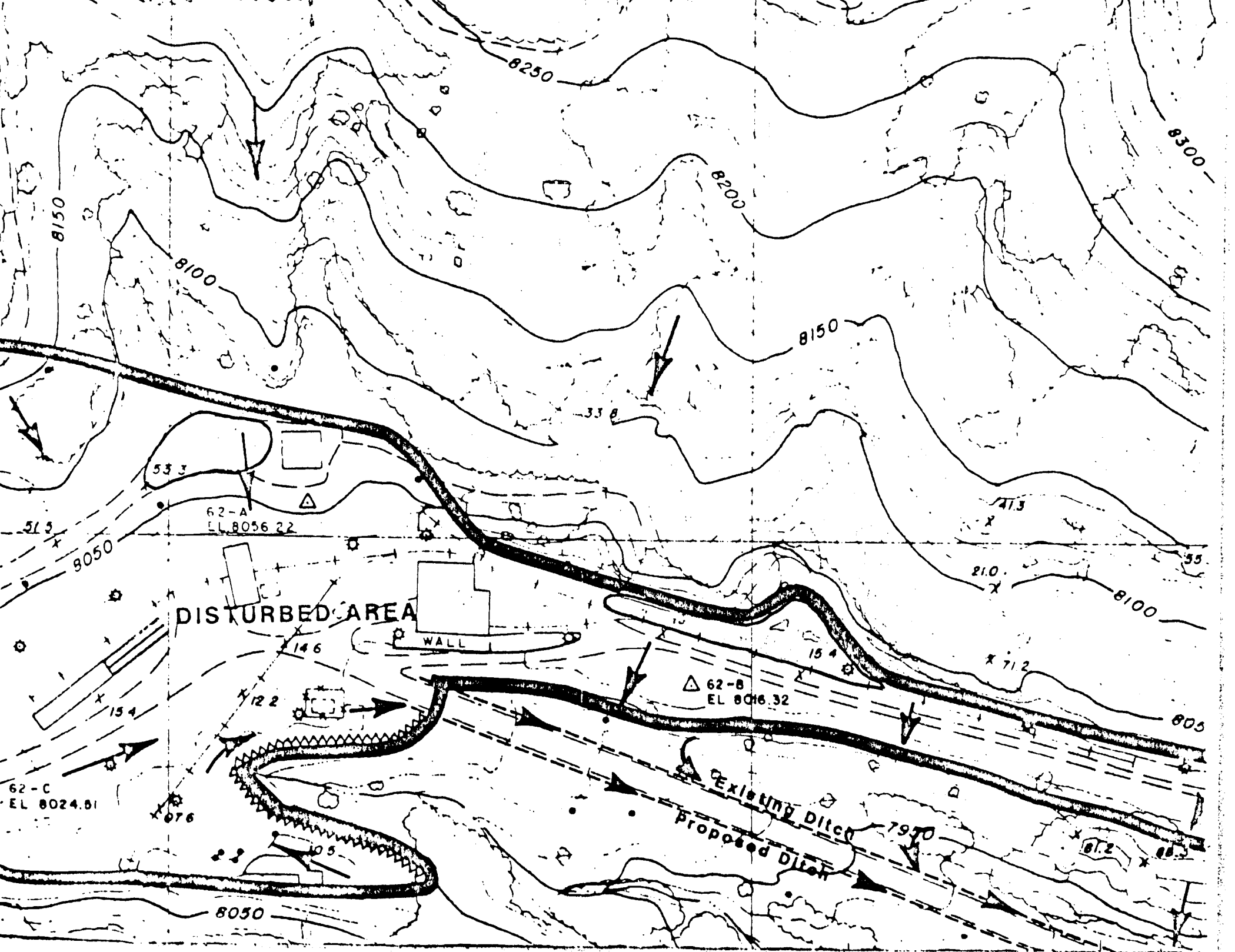
The site is primarily underlain by rock, is quite stable, wouldn't endanger any wildlife or vegetation and is protected by the sediment containment pond. Drainage from this area passes through the mine yard to the sediment pond.

We hope your questions have been answered satisfactorially and the additional areas are discribed clearly.

Sincerely,

Jean Semborski

Ms. Jean Semborski
Engineering Assistant
U.S. Fuel Company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10.5
Existing Ditch
Proposed Ditch
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8050

STATE OF UTAH
NATURAL RESOURCES & ENERGY
Oil, Gas & Mining

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Cleon B. Feight, Division Director

4241 State Office Building • Salt Lake City, UT 84114 • 801-533-5771

January 25, 1982

Ms. Jean Semborski
Engineering Assistant
U.S. Fuel Company
Hiawatha, Utah 84527

RE: Noncoal Waste Disposal Plan Response
Hiawatha Complex
ACT/007/011
Carbon County, Utah

Dear Ms. Semborski:

The Division has reviewed your most recent response to our September 28, 1981 letter regarding U.S. Fuel Company's plan for disposal of noncoal wastes at the Hiawatha Mining Complex.

The Division is issuing conditional approval for the five (5) sites as designated on the maps submitted, but in accordance with U.S. Fuel's acceptance and response to the following stipulations:

1. In regard to the statement provided by U.S. Fuel on page one (1), reason #1, concerning storage and disposal of noncoal waste material to be taken to a sanitary landfill:

   What types of material are being disposed of at the "landfill"? Are or have any of these waste materials been classified or designated as hazardous or toxic according to State Health and/or EPA definition and regulation? If the answer is affirmative, then specific permit(s) for handling storage and disposal (temporary and permanent) of these materials should be obtained from these agencies.

   There are state and federal provisions whereby certain types of solid and liquid wastes which are utilized or generated by mining operations, (including coal operations) that are uniquely characteristic to that mining operation, may be granted a variance or exemption from these regulations.

   A listing of these materials and the criteria defining the exemption(s) is available from the Utah State Department of Health, Bureau of Solid Waste Management.

What landfill site is being utilized? Does U.S. Fuel need or possess a permit from the local sanitary landfill to dispose of the noncoal wastes generated at the Hiawatha Mining Complex?

2. In reference to the response provided on page two (2), answer #1:

The interpretation of regulations is incorrect. UMC 817.89(a) states: A-Noncoal waste shall be placed and stored in a controlled manner in a designated portion of the permit area, and B-Placement and storage shall ensure that leachate and surface runoff do not degrade surface or ground water. This does not infer that the entire disturbed area may be used as a noncoal waste storage site. With the understanding that mine operators are often limited by space it would be in the operators best interest to use as small an area as possible for noncoal waste storage and to consolidate these materials for ease of handling. Also, the operator is responsible for any materials which hinder the intended disturbed and undisturbed drainage scheme in any way. By consolidating materials in one small area it will reduce the probability of obstructing drainage. Therefore, we cannot approve your request as outlined for utilization of all disturbed areas as storage areas for noncoal materials.

3. In reference to the response as outlined on page two (2), answer #3:

On page 2, it is stated that, "no significant amounts of chemicals, fuels, lubricants, or transformer fluids should be stored in these areas".

A condition of approval for these sites would require that no amounts of these types of material be stored or disposed of in these areas. Some minor amounts of oil and grease from old equipment may be excluded providing they do not present any significant environmental impacts.

If you have any comments or questions pertaining to this conditional approval, please contact me.

Sincerely,

D. Wayne Hedberg

D. WAYNE HEDBERG
RECLAMATION HYDROLOGIST

DWH/te

cc: Jim Smith, DOGM
Richard Dawes, OSM
Kent Montaque, DSH
Joe Helfrich, I&E

# UNITED STATES FUEL COMPANY

HIAWATHA, UTAH 84527

Jan. 28, 1982

D. Wayne Hedberg
State of Utah, Natural Resources and Energy
4241 State Office Building
Salt Lake City, Utah 84114

Dear Mr. Hedberg:

United States Fuel will implement the five designated sites as outlined in our non-coal waste disposal plan and in accordance with the stipulations listed in your January 25 conditional approval.

Refering to your concerns expressed in stipulation #1, materials taken to the sanitary landfill come from the mine dumpster. Based on casual evaluation, the dumpsters commonly contain paper, wood, empty cans and other non-hazardous and non-toxic wastes. The landfill site to which these materials are taken is the discretion of the contractor providing the service. No permits are required for these materials.

Sincerely,

Jean Semborski

Jean Semborski

STATE OF UTAH
NATURAL RESOURCES & ENERGY
Oil, Gas & Mining

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Cleon B. Feight, Division Director

4241 State Office Building • Salt Lake City, UT 84114 • 801-533-5771

February 10, 1982

Ms. Jean Semborski
Engineering Assistant
U. S. Fuel Company
Hiawatha, Utah 84527

RE: Noncoal Waste Storage
Site Approval
Hiawatha Complex
ACT/007/011
Carbon County, Utah

Dear Ms. Semborski:

The Division has received U. S. Fuel Company's letter, received February 1, 1982, accepting the conditions of our stipulated approval for the five (5) temporary storage and disposal sites for noncoal wastes at the Hiawatha Mining Complex.

U. S. Fuel is hereby granted final approval to implement the use of these sites in accordance with the plans provided and the accepted conditions.

The Utah Department of State Health, Bureau of Solid Waste Management, has requested that in the future we direct the applicant to also contact their Division when permitting these types of issues to insure that all applicable state and/or federal laws and regulations which may be pertinent are properly addressed.

If there are any questions or comments pertinent to this approval, please contact us.

Sincerely,

D. Wayne Hedberg

D. WAYNE HEDBERG
RECLAMATION HYDROLOGIST

cc: Jim Smith, DOGM
Richard Dawes, OSM
Kent Montaque, DSH
Joe Helfrich, I & E

DWH/btb

UMC 784.14 RECLAMATION PLAN: PROTECTION OF HYDROLOGIC BALANCE (ACR RESPONSE)

The primary source of the Hiawatha town culinary water supply is derived from the old Morhland portal in Cedar Creek canyon. Water from this source is piped approximately 4 miles along the Utah Railroad right-of-way. The old Mohrland portal is presently sealed with backfilled earth material. Water is derived from an opening near the portal where a small inlet structure is housed with a metal covering. This water supply system is proposed to be turned over to the town of Hiawatha upon final abandonment of mining operations.

A secondary branch of the Hiawatha culinary water supply system extends from the town water tank to the King 3 mine portal. From there it is connected via a 4 inch pipe line through the old King 3 mine and Hiawatha No.1 mine to a reinforced concrete bulkhead in the Hiawatha No.2 manway portal. Water stored behind the bulkhead in the Hiawatha No.2 mine is derived through an old ventilation opening and a 10 inch pipeline from a diversion point on the North Fork of Miller Creek. The ventilation opening is inaccessible due to natural caving of the portal over time. Water diverted into the underground reservoir is covered under Certificate of Appropriation No. 2159. The reservoir has the capacity to store 100 million gallons. The actual volume stored at any given time can be estimated by the known extent of mine workings and water pressure indicated on a gauge at the bulkhead.

Upon final abandonment, the King 3 portal and the old Mohrland portal will be sealed by backfilling as shown on plate III-4. Water lines extending from these portals are proposed to be left in place to serve the Hiawatha town which will be responsible for water system maintenance at that time. The Hiawatha No.2 portal will not be sealed in front of the bulkhead since access will be needed to service valves, check pressure gauges and maintain a chlorination unit within the portal.

UMC 783.13 (5) REVEGETATION PLAN(ACR RESPONSE)

Reclamation plans for the King VI mine surface facilities in South Fork Canyon have been submitted as a separate application, therefore, revegetation and other reclamation efforts in that area will be undertaken according to those submittals. Copies of the King VI plans are included in Chapter III appendices.

SCHEDULE OF REVEGETATION

Final revegetation will be initiated following backfilling, grading and placement of topsoil on all disturbed surface areas related to mining operations. Seeding will be done in the fall of the same year as regrading and topsoil placement. If necessary, additional seeding and planting will be done in the spring of the following year. If revegetation cannot be done contemperaneously with backfilling and grading, due to lack of favorable planting conditions, then a temporary cover of small grains, grasses or legumes will be planted until a permanent cover is established.

SPECIES AND AMOUNTS PER ACRE OF SEEDS AND SEEDLINGS

All disturbed lands, except road surfaces approved as part of the postmining land use will be seeded to achieve a diverse, effective, and permanent vegetative cover compatible with postmining land use.

Eleven reference areas, representing five vegetative communities have been established in the vicinity of existing and proposed disturbance sites at U.S. Fuel Company properties, see Exhibit IV-1. Plant species identified at these sites are given in Tables 20 through 30 of the Vegetation Survey included in Appendix IV-1 of the permit Application. The Utah Division of Wildlife Resources has recommended

plant materials and rates of application for restoring wildlife habitat in a variety of vegetative associations. This data is given in Tables 1 through 12 of Fish and Wildlife Resources Information in Chapter X of the permit application.

This revegetation plan proposes to implement the seeding recommendations of the Division of Wildlife Resources as refered to above. Plant species and rates of application will be utilized in accordance with their outline for specific vegetative habitats. Introduced species, compatible with plant and animal species of the region, recommended in their listings, are proposed to be used to facilitate a quick stabilizing cover to aid in controlling erosion.

METHODS TO BE USED IN PLANTING AND SEEDING

Methods of planting and seeding will include hydroseeding, drilling, and hand broadcasting and raking. Methods to be used will depend, to a large extent, on the size access, and surface configuration of the area to be planted. Experience with revegetation on numerous small sites in the mine plan area has shown that hand broadcasting and raking in late fall without mulch or fertilizer produces very good results.

Large areas on steep slopes will be planted by hydroseeding. Treatment will be comprised of wood fiber or straw mulch at 1500 lbs./acre, a chemical tackifier (150 lbs./acre), seed mixture as required for specific areas, and fertilizer if found to be necessary.

Large, relatively flat areas, will be either hydroseeded or harrowed and seeded by use of a rangeland drill. Harrowing and drilling will be done in a direction along the contour in order to minimize erosion.

Shrubs and trees will be hand transplanted as necessary to meet revegetation standards.

MULCHING TECHNIQUES

Suitable mulch or other soil stabilizing techniques will be used where necessary to control eroision, promote germination of seeds or to increase moisture retention. Wood fiber or straw mulch will be used in connection with hydroseeding and will be applied at a rate of 1500 pounds per acre. A chemical tackifier will be used to anchor the mulch. Straw mulch will be used where required in connection with broadcasting and will be used at a rate of 3000 pounds per acre. Straw mulch will be held in place with nylon netting or crimped into the soil surface using a caterpillar tractor or sheeps foot roller.

IRRIGATION

Irrigation will be used only if alternative measures fail to produce an effective and permanent vegetative cover. Pest and disease control and restriction of livestock access will be implemented where found to be necessary.

MEASURES PROPOSED TO DETERMINE SUCCESS OF REVEGETATION

Success of revegetation will be measured by comparison of ground cover and productivity with established reference areas on adjacent undisturbed land. The results of final revegetation will be monitored annually for the first 5 years and semi-annually during the next 5 years (except annually for the last two years). Monitoring will be conducted during late July to early August when plant cover is near maximum. Reference areas will be monitored annually during the last two years of the responsibility period.

Parameters to be monitored include cover, production and woody plant density. Cover and production will be measured in 0.5 $M^2$ quadrats located randomly in permanently located areas in the disturbed communities. At least one permanent location will be established in each disturbed area to be revegetated. Total cover and cover by species will be ocularly estimated in each quadrat. Production will be estimated by clipping current annual

growth of species in each quadrat. Woody plant density will be estimated using randomly located 1x2 M quadrats.

For previously disturbed areas that were not reclaimed prior to the act, the ground cover of living plants will not be less than can be supported by the best available topsoil or other suitable material in the reaffected area, will not be less than the ground cover existing before redisturbance, and will be adequate to control erosion.

The ground cover and productivity of other revegetated areas will be considered equal if they are at least 90 percent of the ground cover and productivity of the reference area with 90 percent (80 percent for shrublands) statistical confidence.

INTERIM REVEGETATION

Existing areas presently being reclaimed on an interim basis include the King VI coal loading facility in South Fork, the King IV ventilation tunnel site in North Fork, outslopes of sediment ponds, topsoil stockpiles and several small disturbed sites.

Interim revegetation at the King VI facility is discussed in the Revegetation Plan for the King VI Mine prepared by Bio/West, Inc. and included in Chapter III appendices.

Interim revegetation near the North Fork ventilation tunnel was initiated during the fall of 1980. This work involved regrading slopes, redistributing topsoil and seeding. Seeding was done by hand raking the topsoil and hand broadcasting. No mulch or fertilizer was used. The seed mix included the following grasses and farbes, distributed at a rate of 20 pounds per acre.

Western Wheatgrass
Canada Wildrye
Smooth Brome

Orchard Grass
Intermediate Wheatgrass
Alfalfa
Utah Sweetvetch
Arrowleaf Balsamroot
Small Burnet

Outslopes of sediment ponds, topsoil stockpiles, and other small disturbed sites were revegetated by raking and hand broadcasting. No mulch or fertilizer was used. Visual monitoring of these areas show very favorable results.

Reclamation efforts, including backfilling, grading, topsoil replacement and revegetation will be undertaken as contemporaneously as practicable on all disturbed areas requiring interim revegetation. Where these sites will be located cannot be reliably specified at this time since they will be governed by the actual configuration of future surface facilities. Reclamation will comply with plans specified earlier in this section.

UMC 784.20 SUBSIDENCE CONTROL PLAN (ACR RESPONSE)

Underground mining operations at U.S. Fuel Company's properties have been ongoing since the turn of the century. All previous mining was done by room and pillar methods. No significant subsidence effects have been observed to date. Other than access roads, fences and three or four stock watering ponds, there are no structures existing above past or projected mining areas. The majority of existing roads and ponds occur above areas that have been mined out more than ten years ago. No significant effects on these structures are evident.

Future plans include longwall mining and room and pillar mining with full extraction. These methods could possibly have some effects on renewable resource lands. If subsidence occurs, it should occur uniformly over mined out panels. Fractures resulting from subsidence could contribute to changes in existing water patterns. Springs seeps, and stream flows could possibly be affected. Diminuation of existing surface and ground water sources could possibly affect some livestock and wildlife watering sites at higher elevations. Water presently being used for municipal, industrial and irrigation purposes should not be diminished to any great extent since water diverted into the ground would most likely return to mine openings, springs and streams near the top of the Star Point sandstone formation. No mining will be done below this horizon which is well above municipal, industrial and irrigation points of use.

A cooperative agreement between U.S. Fuel Company and the U.S. Forest Service exists for the monitoring of subsidence. U.S. Fuel Company has constructed and maintains target monuments at designated locations. See Exhibit IV-3. The Forest Service has agreed to take aerial photographs,

perform aerial triangulation and make point readings for subsidence monitoring. The Forest Service has also agreed to assist and cooperate with U.S. Fuel to determine the effects of undermining upon surface resources.

All surface lands above existing and proposed mining operations are owned by either U.S. Fuel or the U.S. Forest Service. There are no other surface owners. In the event subsidence results in significant damage to structures, they will be repaired or replaced to the reasonable satisfaction of the surface owner. Where material damage or significant diminuation of value of the forseeable use of lands occur, it will be restored to the extent reasonably possible to the satisfaction of the surface owner. Where significant livestock or wildlife watering sites are diminished and found necessary to be replaced, they will be mitigated by constructing watering ponds or troughs and pipelines from alternate water sources.

UMC 784.19 UNDERGROUND DEVELOPMENT WASTE (ACR RESPONSE)

For the most part, underground development waste is disposed of underground. Only minor amounts of development waste is generated and these are most efficiently and economically disposed of underground near the point of generation. In some cases, such as developing new mine portals, minor amounts of development waste would facilitate construction of the yard areas. In such cases, it is proposed that this material be mixed with other material derived from portal face-up operations and used to construct the yard for portal facilities.

UMC 784.18 RELOCATION OR USE OF PUBLIC ROADS (ACR RESPONSE)

There are no public roads on U.S. Fuel Company property in the Mohrland area. No public roads exist within 100 feet of proposed surface distrubance in this area. The existing access road, from where it enters Company property in S½ SW¼, Sec. 11, T16S, R8E to where it crosses the line common to Range 7E and 8E on the West, has always been considered a private road by U.S. Fuel Company. An Easement was granted to the United States for use of the road for access to raw materials important to national defense during the Second World War. All rights were immediately reverted to U.S. Fuel Company one year after termination of the war. Permits to use the road, excluding possession of any part of the road, have been issued by the Company from time to time in the past.

UMC 784.26 AIR POLLUTION CONTROL PLAN (ACR RESPONSE)

The State Department of Health, Division of Environmental Health, Bureau of Air Quality inspects U.S. Fuel Company's facilities for compliance with Utah Air Conservation Regulations on a regular basis. A letter documenting this compliance is included following this response.

Scott M. Matheson
*Governor*

James O. Mason, M.D., Dr.P.H.
*Executive Director*
*801-533-6111*

**DIVISIONS**
*Community Health Services*
*Environmental Health*
*Family Health Services*
*Health Care Financing*

**OFFICES**
*Administrative Services*
*Community Health Nursing*
*Management Planning*
*Medical Examiner*
*State Health Laboratory*

STATE OF UTAH
DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
150 West North Temple, P.O. Box 2500, Salt Lake City, Utah 84110-2500

Marv H. Maxell, Ph.D., Acting Director
Room 474 801-533-6121

REGULATIONS:
UMC - 784.26 & 817.95 & 782.19
OSM -

January 20, 1983
533-6108

Charles J. Jahne
Sharon Steel Corporation
136 East South Temple
Salt Lake City, Utah 84111

RE: U.S. Fuel, Co., Hiawatha, Utah
Site, Compliance to UACR

Dear Mr. Jahne:

This letter is in response to your letter dated January 5, 1983, requesting verification of compliance of the U.S. Fuel Company's Hiawatha site with the Utah Air Conservation Regulations (UACR).

The State Bureau of Air Quality did not find the Hiawatha site in violation of the UACR during the last inspection on August 17, 1982. The plant was evaluated for visible emissions from point sources, fugitive sources, and area sources as required by Sections 3.1 (5/22/81 approval order) and 4.5 (fugitive dust) of the UACR.

The Hiawatha site is inspected on a regular basis by personnel from this office.

Sincerely,

Brent C. Bradford
Director
Bureau of Air Quality

LRM:wml
cc: O, G & M (Jim Smith)
2248

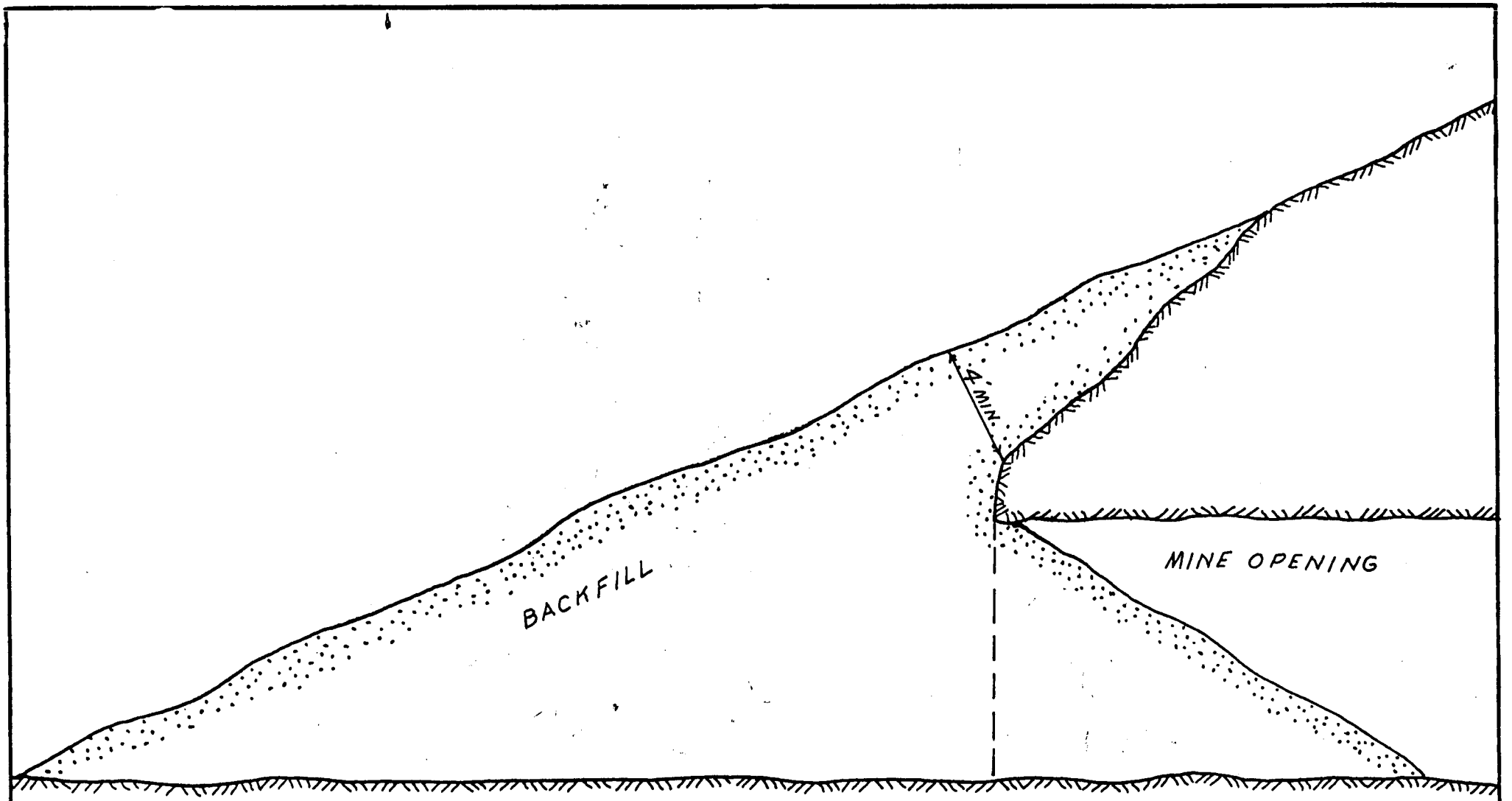
UMC 784.13 RECLAMATION PLAN: GENERAL REQUIREMENTS

UMC 784.13 (b) (8) Sealing of Mine Openings and Bore Holes

Upon final reclamation, all abandoned mine openings, bore holes, wells and other openings will be capped, sealed or backfilled in such a way as to prevent access by people, livestock, machinery, fish and wildlife and to prevent acid or toxic drainage from entering ground or surface waters. Mine openings will be sealed by backfilling as shown in plate III-4.

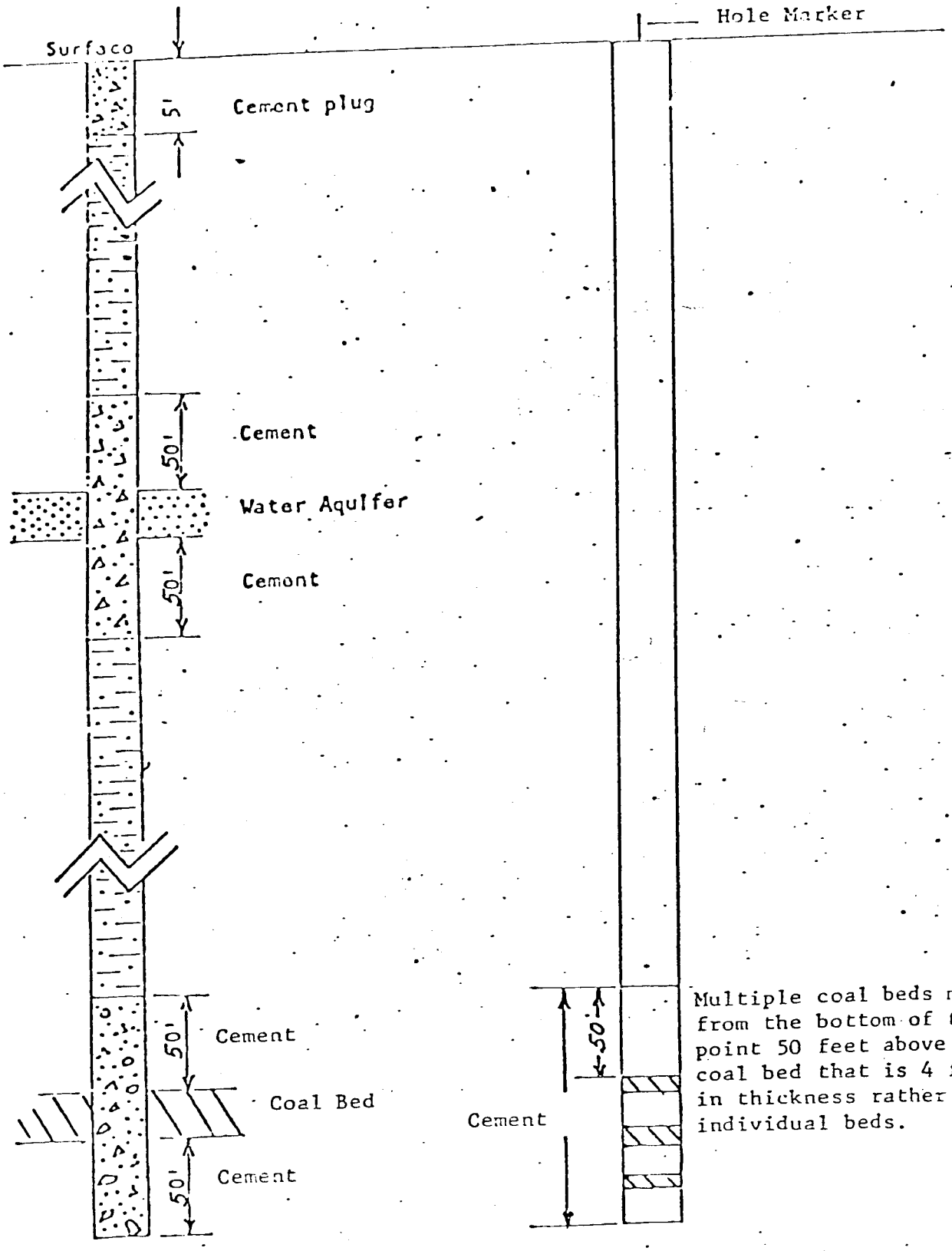
Past monitoring has shown that mine water discharges are of good quality. No acid or toxic drainage has been detected. Mine water has been used for culinary purposes at Hiawatha for many years, therefore, it may be desirable to allow mine water to be piped through seals in some cases.

In the past, exploration bore holes have been sealed according to a plan recommended by the U.S.G.S., whereby, multiple coal beds are cemented from the bottom of the hole to a point 50 feet above the highest coal bed that is 4 feet or greater in thickness. The hole collar is plugged with 5 feet of concrete. See plate III-5. It is proposed to use this same method in the future unless holes are approved for water monitoring.




| SCALE: | DATE | UNITED STATES FUEL CO. HIAWATHA, UTAH | MINE OPENING BACKFILL PLAN | NO. PLATE III-4 |
|---|---|---|---|---|
| DR'N: R.E. | 5-20-83 | | | |
| CKD: | AP'VD: | | | |

Abandonment of Drill Holes
Western Rocky Mountain Area




Multiple coal beds may be cemented from the bottom of the hole to a point 50 feet above the highest coal bed that is 4 feet or greater in thickness rather than cement individual beds.

| | | |
|---|---|---|
| UNITED STATES FUEL CO.<br>HIAWATHA, UTAH | BOREHOLE SEALING METHOD | NO.<br>PLATE III-5 |

## UMC 784.13 PLAN FOR BACKFILLING, SOIL STABILIZATION, COMPACTING AND GRADING

All mining related areas affected by surface operations will be backfilled, stabilized and graded within two years following final abandonment of each individual site. Existing environmental protection structures such as diversion ditches,berms and sediment ponds will be maintained up until that time. Disturbed areas will be returned to approximate original contour where the need is indicated by postmining land use. In the vicinity of steep, narrow canyons, it may be advisable to leave some yard areas in a relatively flat configuration to reduce erosion, assist plant growth and provide better access for wildlife and livestock. In most cases it would be beneficial to post mining land use if roads are left in place. This would facilitate recreation and access to rangelands and culinary water supply systems.

Where advisable, earth material will be transported, backfilled, compacted and graded to eliminate highwalls, spoil piles and depressions. Backfilled material will be placed to minimize adverse effects on ground water, minimize off-site effects, and support the approved pastmining land use. Highwalls which exceed the angle of respose will be backfilled to a moderate slope sufficient to achieve a minimum static safety factor of 1.5. Land above the highwall will not be disturbed unless approved by the regulatory authority.

If required and compatible with postmining land use, cut and fill terraces will be used where flatter slopes cannot otherwise be attained. The terraces will meet the following requirements:

1. The width of individual terrace benches will not exceed 20 feet unless approved by the regulatory authority.
2. The vertical distance between terraces will be sufficient to prevent excessive erosion and to provide long-term stability.
3. Terrace outslopes will not exceed 50 percent unless they can be shown to have a minimum static safety factor of 1.5 and provide adequate erosion control.
4. Culverts and underground rock drains will be used on terraces where approved by the regulatory authority.
5. Small depressions will be constructed if necessary to minimize erosion, conserve soil moisture or promote vegetation.

Waste materials, including mineral matter, debris, or abandoned equipment will not be allowed to remain on final graded slopes. Woody materials will not be buried in backfilled areas unless placed in such a way as to not deteriorate the stable conditions of the backfilled area. Concrete foundations will be broken up and disposed of in abandoned mine openings. Water and sewer lines will, in most cases, be left in place and covered with backfill material. Unlined or unprotected drainage channels will not be constructed on fill materials unless approved by the regulatory authority.

All exposed coal seams remaining after mining and all acid-forming, toxic-forming and combustible materials will be covered with a minimum of 4 feet of the best available non-toxic and non-combustible material. If necessary, acid-forming or toxic-forming material will be treated to neutralize toxicity. These materials will not be buried or stored in close proximity to a drainage course.

Backfilled material will be selectively hauled and compacted where necessary to prevent leaking of acid-forming and toxic-forming materials into surface or ground waters and wherever necessary to ensure the stability of backfilled materials. Compaction will be attained by spreading backfill material in thin lifts and continually rerouting earth moving equipment over the lifts.

Final grading and placement of topsoil will be done along the contour unless such grading or placement is hazardous to equipment operators, in which case grading will be done in a direction other than along the contour. Grading will be conducted in a manner which minimizes erosion and provides a surface for replacement of topsoil which will minimize slippage. In the event that rills or gullies deeper than 9 inches form in areas that have been regraded and topsoiled, they will be filled, graded and stabilized and the area reseeded.

Maps and cross sections showing anticipated final surface configuations and other details for individual sites are given in Exhibits at the end of Chaper III.

TABLE III-10 (Revised June, 1983)

COST ESTIMATE FOR RECLAMATION

MIDDLE FORK MINING OPERATIONS

Total Acres = 24

| DESCRIPTION | EQUIPMENT* | QUANTITY | UNIT | UNIT PRICE | EQUIPMENT QUANTITY | EQUIPMENT UNIT PRICE | MAN HOURS QUANTITY | MAN HOURS UNIT PRICE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Mobalization | Flatbed tractor | | | | 60 Hrs. | 95.00 | | | $ 5,700 |
| Remove Structures | Laborer | | | | | | 480 Hrs. | 25.00 | |
| | Flatbed Tractor | | | | 160 Hrs. | 95.00 | | | |
| | Crane | | | | 80 Hrs. | 60.00 | | | $ 32,000 |
| Regrading | D-9 Dozer | 107,000 | Yards | 0.40/Yd. | | | | | |
| | 225 Backhoe | | | | 80 Hrs. | 80.00 | | | $ 49,200 |
| Place Topsoil | 14G Patrol w/Ripper | | | | 40 Hrs. | 70.00 | | | |
| | 966 Loader | | | | 40 Hrs. | 80.00 | | | $ 6,000 |
| Seeding & Planting | Hydroseeder | 6 | Acres | 2,000/Acre | (Cost Includes Materials) | | | | |
| | Range Drill | 18 | Acres | 1,200/Acre | (Cost Includes Materials) | | | | $ 33,600 |
| Supervision | 3/4 Ton Pickup | 160 | Hrs. | 32.00/Hr. | | | | | $ 5,120 |
| Postmining Monitoring & Maint. | 20% | | | | | | | | $ 26,324 |
| Miscellaneous Expenses | 20% | | | | | | | | $ 31,589 |

*Equipment Costs Include Operator's Wages

TOTAL COST $189,533

Assumptions:

a) These cost are essentially based on USF's completely halting mining operations, reclamation commencing and 1983 dollars.

b) Surface facilities will be salvaged and removed. Foundations will be broken up & disposed of in abandoned mine openings prior to sealing.

c) No removal of buried water or sewer lines.

d) Roadways to mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed, they will remain for access.

e) No disposal of toxic wastes is necessary.

f) Mine yards and other facilities constructed prior to the Act have not stockpiled topsoil. The best available material on or near the sites will be used for reclamation.

g) No hydraulic mine seal is necessary.

h) The costs are based on engineering judgement and past experience.

$\frac{\$189,533}{24} = \$7,897/\text{Acre}$

TABLE III-11 (Revised June, 1983)
COST ESTIMATE FOR RECLAMATION
NORTH FORK MINING OPERATIONS

Total Acres = 2

| DESCRIPTION | EQUIPMENT* | QUANTITY | UNIT | UNIT PRICE | EQUIPMENT QUANTITY | EQUIPMENT UNIT PRICE | MAN HOURS QUANTITY | MAN HOURS UNIT PRICE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Mobalization | Flatbed tractor | | | | 16 | Hrs. 95.00 | | | $ 1,520 |
| Remove Structures | | | | NONE | | | | | |
| Regrading | D-9 Dozer | 2,857 | Yards | 0.35/Yd. | | | | | $ 1,000 |
| Place Topsoil | 14-G Patrol w/Ripper<br>End Dump Truck | | | | 16<br>32 | Hrs. 70.00<br>Hrs. 55.00 | | | $ 2,880 |
| Seeding & Planging | Hydroseeder | 2 | Acres | 2000.00/Acre | (Cost Includes Materials) | | | | $ 4,000 |
| Supervision | 3/4 Ton Pickup | 16 | Hrs. | 32.00/Hr. | | | | | $ 512 |
| Postmining Monitoring & Maint. | | 160 | Hrs. | 32.00/Hr. | | | | | $ 5,120 |
| Miscellaneous Expenses | 20% | | | | | | | | $ 3,006 |

*Equipment Costs Include Operator's Wages

TOTAL COST $ 18,038

Assumptions:

a) These cost are essentially based on USF's completely halting mining operations, reclamation commencing and 1983 dollars.

b) Surface facilities will be salvaged and removed. Foundations will be broken up & disposed of in abandoned mine openings prior to sealing.

c) No removal of buried water or sewer lines.

d) Roadways to mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed, they will remain for access.

e) No disposal of toxic wastes is necessary.

f) Mine yards and other facilities constructed prior to the Act have not stockpiled topsoil. The best available material on or near the sites will be used for reclamation.

g) No hydraulic mine seal is necessary.

h) The costs are based on engineering.

$$\frac{\$18,038}{2 \text{ Acres}} = \$9,010/\text{Acres}$$

TABLE III-12 (Revised June, 1983)
COST ESTIMATE FOR RECLAMATION
SOUTH FORK MINING OPERATIONS

Total Acres = 14

| DESCRIPTION | EQUIPMENT* | QUANTITY | UNIT | UNIT PRICE | EQUIPMENT QUANTITY | EQUIPMENT UNIT PRICE | MAN HOURS QUANTITY | MAN HOURS UNIT PRICE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Mobalization | Flatbed Tractor | | | | 60 Hrs. | 95.00 | | | $ 5,700 |
| Remove Structures | Laborers | | | | | | 240 Hrs. | 25.00 | |
| | Flatbed Tractor | | | | 120 Hrs. | 95.00 | | | |
| | Crane | | | | 40 Hrs. | 60.00 | | | $ 19,800 |
| Regrading | D-9 Dozer | 80,000 | Yards | 0.35/Yd. | | | | | |
| | 225 Backhoe | | | | 60 Hrs. | 80.00 | | | $ 32,800 |
| Place Topsoil | 14-G Patrol w/Ripper | | | | 40 Hrs. | 70.00 | | | |
| | 966 Loader | | | | 40 Hrs. | 80.00 | | | $ 6,000 |
| Seeding & Planting | Hydroseeder | 10 | Acres | 2,000/Acre | (Cost Includes Materials) | | | | |
| | Range Drill | 4 | Acres | 1,200/Acre | (Cost Includes Materials) | | | | $ 24,800 |
| Supervision | 3/4 Ton Pickup | 120 | Hrs. | 32.00/Hr. | | | | | $ 3,840 |
| Postmining Monitoring & Maint. | | | | | | | 400 Hrs. | 32.00 | $ 12,800 |
| Miscellaneous Expenses | 20% | | | | | | | | $ 21,148 |

*Equipment Costs Include Operator's Wages

TOTAL COST $126,888

Assumptions:

a) These cost are essentially based on USF's completely halting mining operations, reclamation commencing and 1983 dollars.

b) Surface facilities will be salvaged and removed. Foundations will be broken up & disposed of in abandoned mine openings prior to sealing.

c) No removal of buried water sewer lines.

d) Roadways to mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed, they will remain for access.

e) No disposal of toxic wastes is necessary.

f) Mine yards and other facilities constructed prior to the Act have not stockpiled topsoil. The best available material on or near the sites will be used for reclamation.

g) No hydraulic mine seal is necessary.

h) The costs are based on engineering judgement and past experience.

$$\frac{\$126,888}{14 \text{ Acres}} = \$9,063/\text{Acre}$$

TABLE III-13 (Revised June, 1983
COST ESTIMATE FOR RECLAMATION
HIAWATHA PROCESSING PLANT AND LOADOUT FACILITY

Total Acres = 220

| DESCRIPTION | EQUIPMENT* | QUANTITY | UNIT | UNIT PRICE | EQUIPMENT QUANTITY | EQUIPMENT UNIT PRICE | MAN HOURS QUANTITY | MAN HOURS UNIT PRICE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Mobalization | Flatbed Tractor | | | | 80 | Hrs. 95.00 | | | $ 7,600 |
| Remove Structures | Laborers<br>Flatbed Tractor<br>Crane | | | | 320<br>160 | Hrs. 95.00<br>Hrs. 60.00 | 960 | Hrs. 25.00 | $ 64,000 |
| Regrading | D-9 Dozer<br>651 Scraper | 1,034,000 | Yards | .30/Yd. | 480 | Hrs. 125.00 | | | $370,200 |
| Place Topsoil | 14-G Patrol<br>651 Scraper | 150,000 | Yards | .30/Yd. | 240 | Hrs. 70.00 | | | $ 61,800 |
| Seeding & Planting | Hydroseeder<br>Range Drill | 40<br>180 | Acres<br>Acres | 2,000/Acre<br>1,200/Acre | | | | | $296,000 |
| Supervision | 3/4 Ton Pickup | 480 | Hrs. | 32.00/Hr. | | | | | $ 15,360 |
| Postmining Monitoring & Maint. | | | | | | | 800 | Hrs. 32.00 | $ 25,600 |
| Miscellaneous Expenses | 20% | | | | | | | | $168,112 |

*Equipment Costs Include Operators Wages

TOTAL PRICE $1,008,672

Assumptions:

a) These cost are essentially based on USF's completely halting mining operations, reclamation commencing and 1983 dollars.

b) Surface facilities will be salvaged and removed. Foundations will be broken up & disposed of in abandoned mine openings prior to sealing.

c) No removal of buried water or sewer lines.

d) Roadways to mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed, they will remain for access.

e) No disposal of toxic wastes is necessary.

f) Mine yards and other facilities constructed prior to the Act have not stockpiled topsoil. The best available material on or near the sites will be used for reclamation.

g) No hydraulic mine seal is necessary.

h) The costs are based on engineering.

$\frac{\$1,008,672}{220 \text{ Acres}} = \$4,585/\text{Acres}$

TABLE III-14 (Revised June, 1983)
COST ESTIMATE FOR RECLAMATION
MOHRLAND AREA MINING OPERATIONS

Total Acres = 55

| DESCRIPTION | EQUIPMENT | QUANTITY | UNIT | UNIT PRICE | EQUIPMENT QUANTITY | EQUIPMENT UNIT PRICE | MAN HOURS QUANTITY | MAN HOURS UNIT PRICE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Mobalization | Flatbed Tractor | | | | 60 | Hrs. 95.00 | | | $ 5,700 |
| Remove Structures | Laborers | | | | | | 720 | Hrs. 25.00 | |
| | Flatbed Tractor | | | | 240 | Hrs. 95.00 | | | |
| | Crane | | | | 120 | Hrs. 60.00 | | | $ 48,000 |
| Regrading | D-9 Dozer | | | | 320 | Hrs. 125.00 | | | |
| | 225 Backhoe | | | | 160 | Hrs. 80.00 | | | $ 52,800 |
| Place Topsoil | End Dump Truck | | | | 160 | Hrs. 55.00 | | | |
| | 14-G Patrol w/Ripper | | | | 200 | Hrs. 70.00 | | | |
| | 966 Loader | | | | 80 | Hrs. 80.00 | | | $ 29,200 |
| Seeding & Planting | Hydroseeder | 35 | Acres | 2,000/Acre | | | | | |
| | Range Drill | 20 | Acres | 1,200/Acre | | | | | $ 94,000 |
| Supervision | 3/4 Ton Pickup | 320 | Hrs. | 32.00/Hr. | | | | | $ 10,240 |
| Postmining Monitoring & Maint. | | | | | | | 800 | Hrs. 32.00 | $ 25,600 |
| Miscellaneous Expense | | | | | | | | | $ 53,108 |
| | | | | | | TOTAL PRICE | | | $318,648 |

Assumptions:

a) These cost are essentially based on USF's completely halting mining operations, reclamation commencing and 1983 dollars.

b) Surface facilities will be salvaged and removed. Foundations will be broken up & disposed of in abandoned mine openings prior to sealing.

c) No removal of buried water or sewer lines.

d) Roadways to mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed, they will remain for access.

e) No disposal of toxic wastes is necessary.

f) Mine yards and other facilities constructed prior to the Act have not stockpiled topsoil. The best available material on or near the sites will be used for relcamation.

g) No hydraulic mine seal is necessary.

h) The costs are based on engineering.

$\frac{\$318,648}{55 \text{ Acres}} = \$5,794/\text{Acre}$

# REVEGETATION PLAN FOR THE KING VI MINE

PR-69-1

Prepared by

John A. Rice

BIO/WEST, Inc.
P. O. Box 3226
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Prepared for

U. S. Fuel Company
136 East South Temple
Salt Lake City, Utah 84111

U. S. Fuel Purchase Order No. H-16597

June 16, 1982

June 18, 1982

Stipulation 7-81-2

## Revegetation Plan

The goal of this revegetation plan is to establish a permanent, effective and diverse vegetative cover, capable of self-regeneration and plant succession, for use as rangeland and wildlife habitat. A prompt vegetative cover will be established which, through time, will allow vegetative cover, woody plant density and productivity to recover to levels equal to the cover, density and productivity of reference areas. U.S. Fuel Company proposes an Interim Revegetation Plan to test individual species and a variety of steep slope revegetation methods. The Interim Revegetation Plan will provide information which will help determine the success and survivability of each species planted and whether or not introduced species can aid in establishing a diverse, effective and permanent cover compatible with postmining land use. A variety of steep slope revegetation methods will be tested during the interim to evaluate their effectiveness in soil stabilization and vegetative establishment.

### Interim Revegetation Plan

Interim Revegetation efforts will begin soon after site preparation during the fall of 1982. The areas to be revegetated during the interim are listed in Table 1. These areas were formed during construction

Table 1. Disturbed area (acres) in each vegetation type to be revegetated during the interim at the King VI Mine.

| Vegetation Type | Location | | | | | |
|---|---|---|---|---|---|---|
| | Stacker Conveyor | Sediment Pond | Coal Pile | Truck Turnout | Conveyor | Total |
| Riparian | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.10 |
| Pinyon-Juniper | 0.00 | 0.00 | 0.15 | 0.40 | 0.20 | 0.75 |
| Sagebrush | 0.25 | 0.20 | 0.10 | 0.00 | 0.00 | 0.55 |
| Total | 0.25 | 0.30 | 0.25 | 0.40 | 0.20 | 1.40 |

by clearing vegetation, cut-and-fill or excavation. The soils of these areas are a mixture of topsoil and subsoil (see Topsoil Plan) with slopes up to 90%. In addition to steep slopes, compaction of soils presents a problem to revegetation in the areas under the stacker conveyor and between the truck turnout and haul roads. A variety of steep slope revegetation methods and ripping to a depth of 14-16 inches during seedbed preparation will be used to alleviate these problems. The soil stabilization methods proposed consist of a variety of combinations of chemical tackifier, nylon netting and mulch. Each combination to be tested includes hydraulic application of seed (Attachment 1, 22 lbs pure live seed/acre), fertilizer (as per recommendations based on the results of soil tests) and chemical tackifier (140 lbs/acre). This application will be followed by one of these treatments:

1. Nylon netting oversprayed with wood fiber mulch (2000 lbs/acre) and chemical tackifier (120 lbs/acre).
2. Hydraulic application of straw mulch (1000 lbs/acre) with chemical tackifier (120 lbs/acre), overlaid with nylon netting, oversprayed with wood fiber mulch (1000 lbs/acre) and chemical tackifier (60 lbs/acre).
3. Hydraulic application of straw mulch (2000 lbs/acre) with chemical tackifier (120 lbs/acre), overlaid with nylon netting.
4. Hydraulic application of wood fiber mulch (2000 lbs/acre) with chemical tackifier (120 lbs/acre).

Treatments 1 and 2 will be tested on the steeper slopes of the conveyor, coal pile and truck turnout areas. Treatments 3 and 4 will be

tested on the less steep slopes of the truck turnout area, under the stacker conveyor, and on the sediment pond outslopes. Specific location of study plots will be determined in consultation with Utah Division of Oil, Gas and Mining (UDOGM).

Interim revegetation will be monitored annually during the first five years, semi-annually during the second five years, and every third year thereafter until final reclamation. Monitoring will be conducted during the peak production period (late July to early August) when plant cover is near maximum and individual species are recognizable. Percent plant, litter, rock, and bare ground cover will be ocularly estimated using a 0.5 $m^2$ rectangular quadrat. In addition, percent plant cover will be estimated for each individual species. The sample size for each treatment area will be adequate at 90% confidence with 10% precision using the following formula:

$$n = \frac{s^2 t^2}{D^2}$$

where, $n$ = minimum sample size

$t$ = t distribution for a given level of confidence

$S^2$ = the variance estimate from preliminary sampling

$D$ = level of accuracy desired for the estimate of the mean.

## Final Revegetation Plan

Final Revegetation efforts will begin following the close of operations in the King VI Mine area, dismantling of the conveyor system and soon after backfilling and final grading. The areas to be revegetated during Final Revegetation are listed in Table 2.

Backfilling and final grading will eliminate the steeper slopes of the conveyor, coal pile, truck turnout and sediment pond areas. Following final grading and topsoiling, slopes are expected to be less than 50% in these areas.

Final revegetation will be accomplished in two phases. Phase 1, initial seeding of distrubed areas, and Phase 2, augmentation of Phase 1 with additional seedings (during the fall season) or transplantings (during the spring season). Phase 1 will be accomplished soon after seedbed preparation during the fall season. Phase 2 will be initiated based upon the results of monitoring for two growing seasons.

### Phase 1

The present plan for slopes from 25 to 50% is to hydroseed (Attachment 2, 22 lbs/acre of pure live seed) with fertilizer (as per recommendations based on the results of soil tests) and chemical tackifier (140 lbs/acre); overspray with straw mulch (2,000 lbs/acre) and chemical tackifier (120 lbs/acre); and overlay nylon netting. Data collected during Interim Revegetation would provide a basis for potential modifications to this plan. Slopes less than 25% will be

Table 2. Disturbed area (acres) in each vegetation type to be revegetated during final reclamation at the King VI Mine.

| Vegetation Type | Location | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Stacker Conveyor | Sediment Pond | Coal Pile | Truck Turnout | Conveyor | Haul Road | Diversion Ditch | Total |
| Riparian | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 |
| Pinyon-Juniper | 0.00 | 0.00 | 0.50 | 1.25 | 0.20 | 4.00 | 0.03 | 5.98 |
| Sagebrush | 0.25 | 0.40 | 0.30 | 0.00 | 0.00 | 6.50 | 0.00 | 7.45 |
| Total | 0.25 | 0.50 | 0.80 | 1.25 | 0.20 | 10.50 | 0.03 | 13.53 |

topsoiled; ripped to a depth of 14-16 inches to loosen the packed soil and to promote better root and moisture penetration; disked to prepare the seedbed; fertilized as per recommendations based on the results of soil tests; harrowed to incorporate the fertilizer; seeded using a rangeland drill; and mulched with straw (2,000 lbs/acre) mechanically crimped into the soil to control erosion, promote germination, and increase moisture retention of the soil.

Phase 2

Herbaceous species often germinate and become established more rapidly than woody species, thus outcompeting woody species for water and essential nutrients when they are seeded simultaneously. Therefore, U.S. Fuel Company proposes to monitor the success of Phase 1 for two growing seasons and, thereafter, take corrective actions as necessary to ensure revegetation success. The principal corrective actions anticipated are additional seeding (herbaceous and woody species) and transplanting (woody species). Areas where Phase 1 was unsuccessful in vegetative establishment will be examined to determine which additional treatments (applications of seed, fertilizer, mulch or other soil stabilizers) are needed to ensure vegetative establishment. Shrubs and trees will be transplanted as necessary to meet revegetation standards of success for woody plant density and community diversity (Attachment 2).

Monitoring and Standards for Success

Final revegetation will be monitored annually during the first 5 years and semi-annually during the remainder of the responsibility period (except annually for the last two years). Reference areas will also be monitored annually during the last two years of the responsibility period. Monitoring will be conducted during the peak production period (late July to early August) when plant cover is near maximum and individual species are recognizable. Parameters to be monitored include cover, production and woody plant density. Cover and production will be measured in 0.5 $m^2$ quadrats located randomly in permanently located areas in the disturbed communities. At least one permanent location will be established in each distrubed area to be revegetated, listed in Table 2. Total cover and cover by species will be ocularly estimated in each quadrat. Production will be estimated by clipping current annual growth of species in each quadrat. Woody plant density will be estimated using randomly located 1 x 2 m quadrats. The sample size (number of quadrats) for each parameter in each area to be sampled will be considered adequate at 80% confidence with 10% precision (formula given in Interim Revegetation Plan). The 80% confidence level is used because the area distrubed was shrubland.

The Reference Areas Method will be used for revegetation standards. The cover, production, and woody plant density of the revegetated area will be considered equal if they are at least 90% of the cover, production and woody plant density of the reference area with 80% statistical confidence (shrublands). Student's t-tests will be performed to test

these hypotheses. Similarity in species composition between revegetated and reference areas will be demonstrated using a similarity index such as Jaccard's Community Coefficient or Sorenson's Index of Similarity.

ATTACHMENT 1

Seed Mix For Interim Revegetation

The following seed mix was developed to provide a variety of predominantly native species to be tested for their ability to survive and be successful in stabilizing the soil and establishing a diverse, effective and permanent vegetative cover. The seed mix is composed of grasses (bunchgrasses and sod formers), forbs, and shrubs, adapted to the soils and climate of the King VI Mine.

| Scientific and Common Name | % by Weight of Pure Live Seed |
|---|---|
| NATIVE GRASSES | |
| Agropyron riparium<br>Streambank wheatgrass | 7 |
| Agropyron smithii<br>Western wheatgrass | 7 |
| Agropyron trachycaulum<br>Slender wheatgrass | 7 |
| Elymus cinereus<br>Basin wildrye | 7 |
| Poa pratensis<br>Kentucky bluegrass | 2 |
| INTRODUCTED GRASSES | |
| Agropyron intermedium<br>Intermediate wheatgrass | 7 |
| Elymus junceus<br>Russian wildrye | 7 |
| NATIVE FORBS | |
| Eriogonum umbellatum<br>Sulfur flower | 7 |
| Hedysarum boreale<br>Northern sweetvetch | 7 |
| Artemisia ludoviciana<br>Louisiana sagebrush | 2 |
| INTRODUCED FORBS | |
| Medicago sativa<br>Alfalfa | 7 |
| Melilotus officinalis<br>Yellow sweetclover | 7 |

| Scientific and Common Name | % by Weight of Pure Live Seed |
|---|---|
| NATIVE SHRUBS | |
| Artemisia tridentata wyominyensis<br>Big sagebrush | 2 |
| Cercocarpus montanus<br>True mountain-mahogany | 7 |
| Chrysothamnus nauseosus albicaulis<br>Rubber rabbitbrush | 7 |
| Ephedra viridis<br>Green ephedra | 10 |

In addition to the above seed mixture, U.S. Fuel Company requests approval from UDOGM to include 10 lbs of rye and 10 lbs of barley to serve as a nurse crop.

Information from field tests will help determine whether or not the use of the introduced species can be justified for final reclamation. The introduced species were selected for their ease of establishment, erosion control and compatibility with post-mining land use.

ATTACHMENT 2

## Seed Mix for Final Reclamation

The following seed mix was developed to provide a variety of native species which should be successful in stabilizing the soil and establishing a diverse, effective and permanent vegetative cover. The seed mix is composed of grasses (bunchgrasses and sod formers), forbs, shrubs, and trees adapted to the soils and climate of the King VI Mine. The seed mix may be modified (upon approval by UDOGM) based upon the results of Interim Revegetation field tests.

| Scientific and Common Name | % by Weight of Pure Live Seed |
|---|---|
| GRASSES | |
| Agropyron riparium<br>Streambank wheatgrass | 7 |
| Agropyron smithii<br>Western wheatgrass | 7 |
| Agropyron trachycaulum<br>Slender wheatgrass | 7 |
| Elymus cinereus<br>Basin wildrye | 7 |
| Poa pratensis<br>Kentucky bluegrass | 2 |
| FORBS | |
| Eriogonum umbellatum<br>Sulfur flower | 7 |
| Hedysarum boreale<br>Northern sweetvetch | 7 |
| Artemisia ludoviciana<br>Louisiana sagebrush | 2 |
| SHRUBS | |
| Artemisia tridentata wyominyensis<br>Big sagebrush | 2 |
| Cercocarpus montanus<br>True mountain-mahogany | 7 |
| Chrysothamnus nauseosus albicaulis<br>Rubber rabbitbrush | 7 |
| Ephedra viridis<br>Green ephedra | 10 |
| TREES | |
| Pinus ponderosa<br>Ponderosa pine | 14 |
| Pseudotsuga menziesii<br>Douglas fir | 14 |
| Total | 100 |

This seed mix will be augmented by transplanting (as seedlings, tubelings or container-grown stock) the following species not listed in the seed mix:

Pinyon-Juniper and Sagebrush Areas

Shrubs

Cercocarpus ledifolius
Curlleaf mountain mahogany

Juniperus communis
Common juniper

Mahonia repens
Creeping Oregon grape

Trees

Juniperus scopulorum
Rocky Mountain juniper

Pinus edulus
Pinyon pine

Riparian Areas

Shrubs

Amelanchier alnifolia
Serviceberry

Juniperus communis
Common juniper

Rhus trilobata
Oakbrush sumack

Rosa woodsii
Woods rose

Trees

Acer glabrum
Rocky Mountain maple

Juniperus scopulorum
Rocky Mountain juniper

Populus tremuloides
Quaking aspen

Prunus virginiana
Chokecherry

These species were selected based on their occurrence in the various vegetation types at the King VI Mine and for their contribution as wildlife habitat. Transplanted plants will be "grouped" so as to maximize benefit to wildlife.

BIO/WEST, Inc.
P.O. Box 3226
Logan, Utah 84321
(801) 752-4202

November 16, 1982

Mr. Charles J. Jahne
Sharon Steel Corporation
19th Floor, University Club Bldg.
136 East South Temple
Salt Lake City, UT 84111

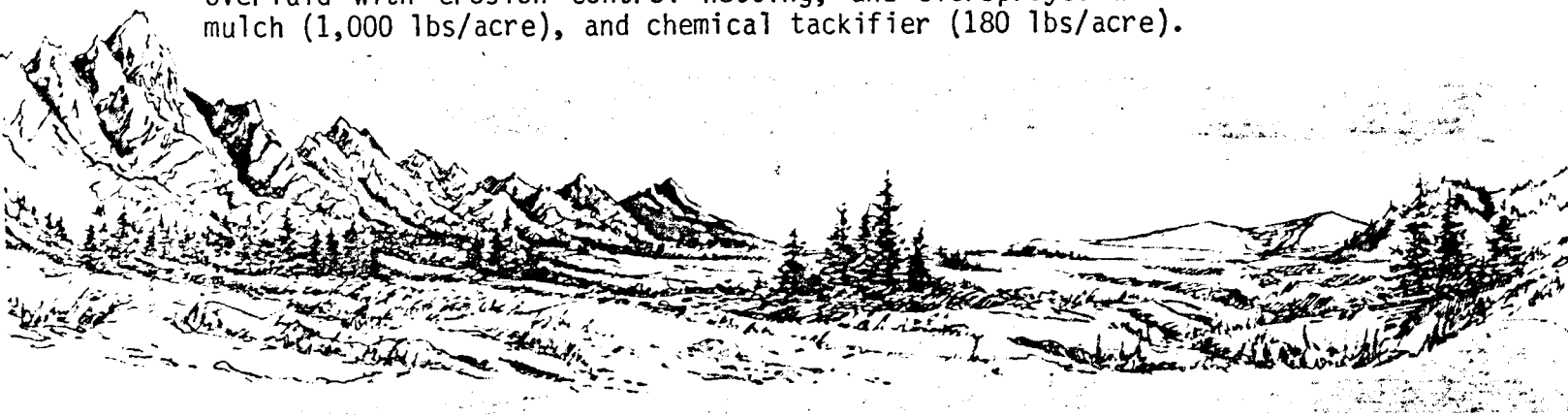
Dear Mr. Jahne:

Interim revegetation efforts at the King VI Mine were completed on Wednesday, November 3, 1982. The newly-created topsoil stockpile and each of the areas listed in the Interim Revegetation Plan were: seeded at the rate of 42 lbs pure live seed per acre of the mix (including the nurse crop) outlined in the Interim Revegetation Plan; fertilized at the rate of 50 lbs/acre of nitrogen, 100 lbs/acre of phosphate, and 50 lbs/acre of potash; and tackified at the rate of 140 lbs/acre of chemical tackifier. The seed, fertilizer, and tackifier were hydraulically applied by B&R Reclamation Specialists (B&R) on Saturday, October 30, 1982.

Approximately one-half of the area along the conveyor, at the sediment pond and truck turnout, and of the outslopes of the sediment pond was overlaid with erosion control netting and oversprayed with wood fiber mulch (2,000 lbs/acre) and chemical tackifier (120 lbs/acre). The remainder of these areas was mulched with straw (hand applied at 1,000 lbs/acre), overlaid with erosion control netting, and oversprayed with wood fiber mulch (1,000 lbs/acre) and chemical tackifier (180 lbs/acre).

The top of the bank of the sediment pond and the newly-created topsoil stockpile were oversprayed with wood fiber mulch (2,000 lbs/acre) and chemical tackifier (120 lbs/acre).

The compacted areas at the truck turnout and near the stacker conveyor were "ripped" (by B&R) to a depth of about 16 inches on Saturday shortly before hydraulic application of the seed, fertilizer, and tackifier (detailed above). These areas were oversprayed with wood fiber mulch (2,000 lbs/acre) and chemical tackifier (120 lbs/acre). A small area near the stacker conveyor which had been disturbed, but not compacted, was mulched with straw (hand applied at 1,000 lbs/acre), overlaid with erosion control netting, and oversprayed with wood fiber mulch (1,000 lbs/acre), and chemical tackifier (180 lbs/acre).



The burlap covering the original topsoil stockpile was removed before hydraulic application of the seed, fertilizer and tackifier (detailed above). The stockpile was mulched with straw (hand applied at 2,000 lbs/acre) and overlaid with erosion control netting.

The wood fiber mulch and chemical tackifier were hydraulically applied by B&R on Wednesday, November 3, 1982.

Ms. Jean Semborski asked me to comment on your use of burlap. Burlap, as you used it, was a very effective means of controlling erosion and stabilizing the topsoil stockpile; however, it was a hindrance to plant growth and survival. I was surprised at the cover and density of the grasses under the burlap. As expected, though, most of the plants were in low vigor, judged by their color (pale green and yellow) and the fineness of their leaves. The low vigor was undoubtedly caused by the burlap covering which prevented sunlight from reaching the leaves. Without sunlight, the plants were forced to use carbohydrate reserves to maintain growth, rather than building up reserves as they normally would during the growing season. This winter, the leaves will die back to the crown of each plant and the plants will have to rely on carbohydrate reserves to stay alive. Since most of the plants have little or no reserves, they will die. It is my opinion that, although the burlap was effective at short-term erosion control, it as defeating the long-term erosion control and stabilizing effect of plant establishment and survival.

As I indicated in our telephone conversation yesterday, I will be out of town for the Thanksgiving holidays. If you have any questions or need any additional information, you can contact our secretary, Nancy, who will relay the message to me. Have a happy holiday.

Sincerely,

John Rice

John Rice
Vegetation/Soils Section Manager

JR/nh

cc: Jean Semborski, U.S. Fuel Company

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## 3.1 Scope

United States Fuel Company has different areas of current operation and has scheduled redevelopment of others. Because of the complexity of these plans, five separate areas of operation and reclamation will be discussed in this chapter. The five permit areas (disturbed surface) included under one mine plan area are referenced as follows:

U. S. Fuel Company General Permit Areas

1. Middle Fork of Miller Creek Surface Facilities
2. North (Right) Fork of Miller Creek Ventilation Shaft
3. Hiawatha Processing Plant and Waste Disposal Sites
4. South (Left) Fork of Miller Creek Surface Facilities
5. Mohrland Area, Cedar Creek Canyon Surface Facilities

As described in detail in Chapter V Historical and Cultural Resources, the United States Fuel Company was organized in 1915 and commenced operation in 1916 when it took over the properties of the Consolidated Fuel Company, Castle Valley Coal Company, and the Black Hawk Coal Company, whose mines all existed on the current mine plan area. Development of different areas has taken place by U. S. Fuels Company up until the present time. Seven significant mines have been developed since the beginning of mining in this area. Coal extraction has been entirely by the room and pillar mining method. Mining has continued uninterrupted for a period of over 70 years with a total production of over 56 million tons. To clarify the previous, current and future coal mining operations on the mine plan area, Table III-1 is presented on the following page.

Table III-1

Mines Identification

| Mine Location | Mine Name | Coal Seams Mined | Status |
|---|---|---|---|
| West of Hiawatha | Old Blackhawk Mine King No. 1 | Hiawatha Seam | Abandoned |
| Cedar Creek Canyon | Mohrland Mine King No. 2 | Hiawatha Seam | Abandoned |
| South Fork of Miller Creek | King No. 3 | Hiawatha Seam | Abandoned |
| Middle Fork of Miller Creek | King No. 4 | A & B Seam | Operating |
| Middle Fork of Miller Creek | King No. 5 | B Seam | Operating |
| Middle Fork of Miller Creek | Hiawatha No. 1 | Hiawatha Seam | Abandoned |
| Middle Fork of Miller Creek | Hiawatha No. 2 South Entries | Hiawatha Seam | Abandoned |
| Middle Fork of Miller Creek | King No. 5 | A Seam | Proposed Development |
| South Fork of Miller Creek | King No. 6 | Hiawatha Seam | Proposed Re-Development |
| Cedar Creek Canyon Mohrland Mine Area | King No. 7 | Hiawatha Seam | Proposed Re-Development |
| Cedar Creek Canyon Mohrland Mine Area | King No. 8 | Upper Seam | Proposed Re-Development |

Surface areas of mines scheduled for redevelopment have been disturbed, to some extent, from previous mining. This compliance permit application represents the current and forecasted underground coal mining operations of U. S. Fuel Company.

## 3.2 Surface Facilities/Construction Plans

Middle Fork of Miller Creek. The King No. 4 and 5 underground coal mines share the same surface facility located in the Middle Fork canyon of the Miller Creek drainage. A new ventilation portal for King 4 exists in the North (Right) Fork. These two mines are currently U. S. Fuel Company's operating mines. The King No. 4 and 5 mines were opened in 1974 and 1978 respectively. Surface facilities used in support of mining operations are located on private land owned by the U. S. Fuel Company.

The Middle Fork mine yard comprises approximately 12 acres and includes part of the plant site of the old Hiawatha No. 1 and 2 mines which were abandoned in 1928. Surface openings to the old Hiawatha No. 1 mine have been sealed off or blocked off with iron gates, locked and posted with warning signs. Openings to the Hiawatha No. 2 mine are sealed off with reinforced concrete bulkheads which serve as dams to store water for culinary and mining purposes. A pipe extending through the bulkhead in the old manway portal is connected with two 40 horsepower centrifugal pumps which deliver water to a 40,000 gallon water tank located above the bathhouse. Water impounded behind the bulkheads is monitored by a pressure gage in the pump room. Surface openings to the Hiawatha No. 1, as well as King No. 4 and 5 mines are in a down dip direction, thus precluding the gravity discharge of mine water in this area. Other hydrologic conditions and abandoned mine works contribute to the prevention of mine water discharge. These are discussed in Chapter VII, Hydrology.

The existing surface facility structures and mine yard layout with buildings are shown on Exhibits III-1A and 1B. Table III-2 summarizes existing and proposed for the Middle Fork mine yard facilities. All structures are maintained in a safe stable operating condition.

Table III-2

Summary of Surface Facilities

Middle Fork Mine Yard

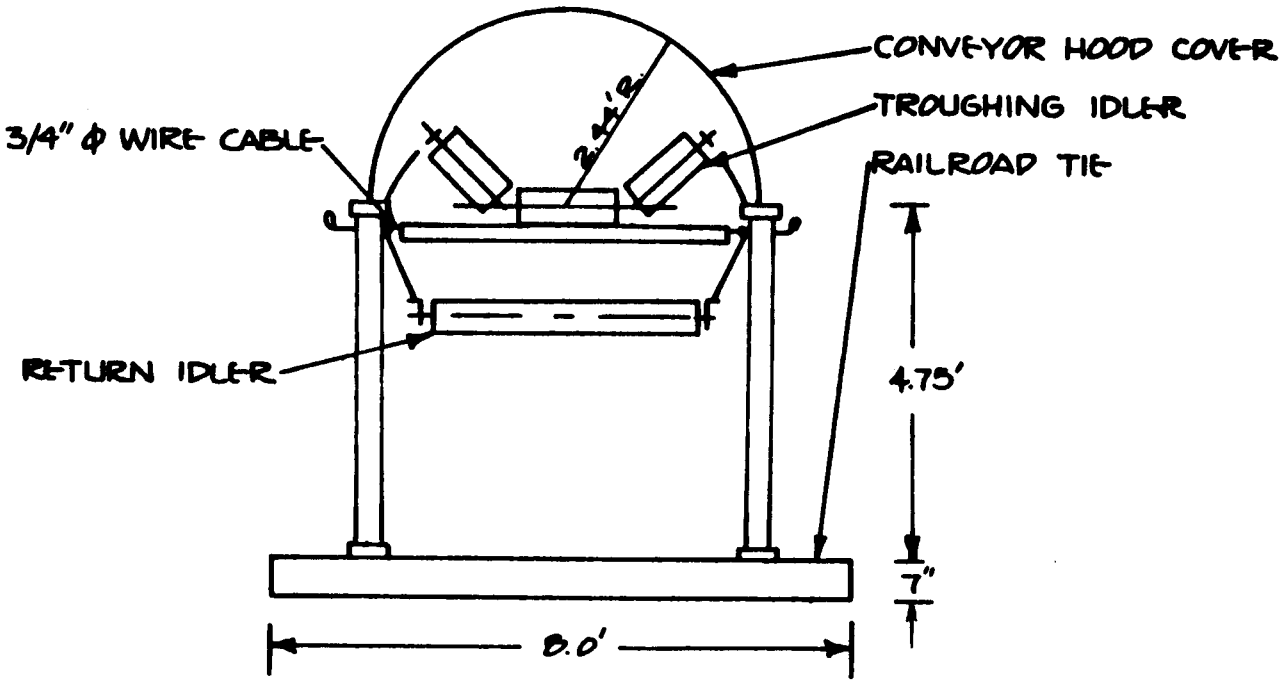
King No. 4 and 5

| Facility | Date Constructed | Size |
|---|---|---|
| **Mine Yard and Storage Areas** | | |
| Parking Lot | 1974 | 1.1 Acre |
| Equipment and Supply Storage | 1974 | 1.0 Acre |
| Coal Stockpile - 13,000 Ton | 1974 | 0.5 Acre |
| Sediment Pond | 1980 | 3.0 Acres |
| Structures and Open Access Areas | 1974 | |
| **Buildings and Structures** | | |
| Main Changehouse and Warehouse | 1974 | 12,000 Sq. Ft. |
| Small Changehouses (Trailers) | 1976 | 1,450 Sq. Ft. |
| Yard Conveyor Structures | 1978 | 830 Linear Ft. |
| King 4 Fan Housing | 1974 | 840 Sq. Ft. |
| King 5 Fan Housing | 1978 | 746 Sq. Ft. |
| King 5 Warehouse and Equipment Building | 1978 | 800 Sq. Ft. |
| Main Substation | 1974 | 2,480 Sq. Ft. |
| King 5 Substation | 1978 | 725 Sq. Ft. |
| Water Tank | 1974 | 24 Ft. Dia. - 40,000 Gal. |
| King 4 Switch Building | 1975 | 378 Sq. Ft. |
| King 5 Switch Building | 1978 | 225 Sq. Ft. |
| King 4 Storage Shed | 1976 | 256 Sq. Ft. |
| Bulk Rockdust Bin | 1975 | 11 Ft. Dia. - 100 Ton |
| Belt Drive Switch Building | 1974 | 300 Sq. Ft. |
| King 4 Portals | 1974 | 4 Openings |
| King 5 Portals | 1978 | 3 Openings |
| Hiawatha Mine Portals (Inactive) | 1909 | Openings |
| Truck Loading Facility | 1975 | 600 Ton/Hr. |
| **Utilities** | | |
| Main Power Line | 1974 | 12 KV. 3 Miles |
| Water Lines | 1974 | 2,500 Linear Ft. |
| Sewer Lines | 1974 | 2,685 Linear Ft. |
| Drain Field | 1974 | 0.4 Acre |
| **Haulage Facilities** | | |
| Haul Road | 1974 | 30 Ft. x 3 Miles |
| Yard Track | 1974 | 42 Gage |
| 42 In. Conveyor System (Proposed) | - | 42 In. x 2.9 Miles |
| **North Fork Ventilation Portal** | | |
| Yard Area | 1980 | 1.0 Acre |
| Jeep Road | 1920 | 3 Miles |

Adverse effects to the existing hydrologic balance are controlled by retaining sediment within disturbed areas or directing runoff into a sedimentation pond located at the eastern end of the mine yard. Surface runoff from undisturbed areas is channeled away from disturbed areas by way of interconnecting culverts beneath the mine yard. The calculations and design of the Middle Fork sedimentation pond can be found in Chapter VII-1 Appendices and Exhibit VII-9, respectively. The sedimentation pond and underground reservoir in the Hiawatha No. 2 mine are the only impoundments that exist in the Middle Fork area.

The access corridor from the town of Hiawatha to the Middle Fork mine yard is owned by U. S. Fuel Company. This corridor contains the coal haulage road, powerline, and proposed overland conveyor system. Coal handling facilities in the Middle Fork yard consist of a 750 foot overload conveyor structure extending from the King No. 4 and 5 haulage portals to a stacking tower, a 13,000 ton storage pile, and a vibrating feeder type truck loading facility. From the loading facility at Middle Fork mine, coal is transported by 25 ton bottom dump trucks over a 3 mile haulroad to the processing plant. The haulroad is 24 feet wide, paved with 4 inches of plant mix bituminous material. The haulroad has 3 foot shoulders on each side, giving the road a total width of 30 feet. Drainage structures for the road adequately pass runoff from the upper watersheds into Miller Creek. The location of culverts are shown on Exhibits III-1A and 1B.

A new 3 mile overland conveyor system is proposed to be constructed alongside the haulroad from the truck loading facility to the processing plant. The proposed conveyor will be fully covered. A typical section of the proposed wire rope conveyor for Middle Fork mines is shown on Plate III-1.




| | | | | |
|---|---|---|---|---|
| SCALE N.T.S. | DATE | UNITED STATES FUEL CO. HIAWATHA, UTAH | TYPICAL SECTION OF WIRE ROPE CONVEYOR | NO. PLATE III-1 |
| DR'N: CARLA F. | 1-29-81 | | | |
| CKD: | AP'VD | | | |

The approximate disturbed area at this time for the Middle Fork mine facilities and storage areas is 12 acres. No additional disturbed acres for Middle Fork mine is anticipated. The existing haulroad has approximately 15 acres of disturbed area. The construction of the proposed overland conveyor is estimated to disturb 12 additional acres, bringing the access corridor to a total of 27 disturbed acres.

North Fork Ventilation Portal. A plan for the construction of this facility is included in the appendix of this chapter. A portal was constructed in the North Fork drainage to provide the King No. 4 mine with intake ventilation. Originally, the plan called for return ventilation warranting the construction of a fan and powerline. Exhibit III-2 shows the disturbed area, approximately one acre, for the portal facility. A three mile jeep road form Hiawatha to the ventilation portal is the only access.

South (Left) Fork Mine Yard. The South Fork mine yard was constructed in 1947 to facilitate the old King 3 mine. For almost 38 years, from 1948 to 1975, there were mining sections operating in the King 3 mine (old works of the proposed King 6 mine). The mine yard occupies approximately 8 acres of fee land. Work is currently underway to upgrade the existing, and construct new facilities for the proposed King 6 mine. Table III-3 gives a summary of the existing and proposed surface facilities for South Fork mine yard.

Coal will be loaded underground on a proposed 42 inch wire conveyor; that is anticipated to be much the same overland conveyor system as planned for Middle Fork mine and shown on Plate III-1. The coal will then be conveyed from the mine mouth, approximately 2,400 feet down the South Fork canyon, to a coal stockpile. Trucks will be loaded and transport the coal 3 miles to the processing plant at Hiawatha. The surface facilities for South Fork are located on Exhibits III-4A and III-4B.

Table III-3

Summary of Surface Facilities

South Fork Mine Yard

King No. 6

| Facility | Date Construction | Size |
|---|---|---|
| Mine Yard and Storage Areas | | |
| Parking Lot | 1981 | 0.5 AC |
| Equipment and Supply Storage | 1981 | 1.0 AC |
| Upper Sediment Pond | 1979 | 1.0 AC |
| Truck Loadout Sediment Pond | Proposed | Approx. 1.0 AC |
| Buildings and Structures | | |
| Change House | Approx. 1948 | Approx. 6,400 Sq. Ft. |
| Shop Building | Approx. 1948 | Approx. 3,600 Sq. Ft. |
| Fan Housing | Approx. 1948 | Approx. 800 Sq. Ft. |
| Water Tank | | 40,000 Gal. |
| Main Substation | Approx. 1948 | Approx. 500 Sq. Ft. |
| King 6 Portals | 1981 | 3 Openings |
| Storage Shed | 1979 | Approx. 1,100 Sq. Ft. |
| Truck Loading Facility | Proposed | Approx. 1.0 AC |
| Utilities | | |
| Main Power Line | 1981 | Approx. 2,500 L.F. |
| Water Lines | 1981 | Approx. 3,000 L.F. |
| Sewer Lines | 1981 | |
| Drain Field | 1981 | |
| Haulage Facilities | | |
| Upgrade Paved Haulroad | 1981 | 30 Ft. x 2.5 Miles |
| 42 In. Conveyor System | Proposed | 2,000 L.F. |

Water is supplied to South Fork facilities from a pipe extending through the intake air portal pumped to a 40,000 gallon tank located up the canyon from the changehouse. Remaining water is piped down the canyon to a 130,000 gallon concrete in-ground tank. This water is used at Hiawatha for municipal and industrial uses. A summary of U. S. Fuels water rights is included in Chapter VII, Hydrology. A sewage line runs from the changehouse to a septic tank located in the mine yard; further down the canyon, it runs to a drain field shown on Exhibit III-4A.

Impact on the existing hydrologic balance will be controlled by retaining runoff in sedimentation ponds. Runoff from the mine yard will be channeled to the existing sedimentation at the eastern end of the mine yard. Surface runoff from undisturbed areas is diverted away from disturbed areas. The volume of water retained is the surface runoff only since no water will be discharged form the King No. 6 mine. A sedimentation pond has been designed for runoff from the proposed truck loading facility.

The disturbed area for the South Fork facility yard, including the sedimentation pond, is approximately 8 acres. The access corridor, which includes the haulroad and proposed conveyor system, totals approximately 13 acres of disturbed area. The truck loading facility and remaining sedimentation pond amount to 3 disturbed acres. The total disturbed area for South Fork mine King No. 6, at the present, includes 16 acres with a proposed 8 additional acres.

Hiawatha Processing Plant and Waste Disposal Sites. The processing plant at Hiawatha is located immediately north of the town and is on U. S. Fuel Company fee land. Although U. S. Fuel Company owns the complete town of Hiawatha in fee, including buildings, the permit area only includes mine related boundaries. Table III-4 gives a list of

## Table III-4

## List of Major Capital Equipment
## Hiawatha Coal Preparation Plant Facilities

### Buildings and Structures

400 Ton/Hr. Coal Preparation Plant (Washing, Drying, Sizing)
480 Ton/Hr. Truck Unloading Facility
100 Ton/Hr. Fine Coal Recovery System
12,000 KV Main Electrical Substation
Machine Shop
Carpenter Shop
Resin Recovery Plant

### Yard Areas

Railroad Yards
Five Slurry Impoundments with Refuse Embankments
15,000 Ton Coal Stockpile Area

### Mobile Equipment

3 - 15 Ton Haul Trucks
2 - 20 Ton Caterpiller D330 Haul Trucks
2 - Terex 72-61 Front End Loaders
1 - Caterpiller 988-B Front End Loader
1 - D6 Caterpiller Dozer
1 - 14E Caterpiller Road Grader
1 - P&H 18 Ton Crane
1 - Mack Truck and Lowboy

major capital equipment associated with the processing plant facilities. The plant was built in 1938. It has a capacity to wash, size, and thermal dry 400 tons of coal per hour. Slurry discharge from the plant is channeled through a resin recovery process where resin is extracted by froth flotation. From the resin plant, slurry is discharged into impoundments where it is stored, allowed to dry and eventually reclaimed for shipment to coal markets. Some coal fines are being sold from the slurry, but the impoundments will increase in size. Slurry pond embankments are constructed of refuse material derived from the coal washing process. This refuse material can sometimes amount to as much as 20 to 30 percent of the mine run coal. Plans are being considered for installation of a new processing plant adjacent to the existing one. Also proposed are plans for the construction of a unit train loading facility which will be installed north of the processing plant shown on Exhibit III-3.

Water for domestic and industrial use at Hiawatha is presently supplied by two water systems. The main supply consists of an 8 inch diameter (minimum) water line extending from the Mohrland mine portal along the Utah Railroad right-of-way to four water tanks near the old King-1 tramway. These tanks have a total capacity of 245,000 gallons and are interconnected at a manifold box. Inflow to these tanks varies between 500 and 1,200 gallons per minute, depending on seasonal influences. From the manifold box, a line extends to the coal preparation plant and another line connects with a chlorinator building and a 40,000 gallon holding tank (town tank). The standby system, the South Fork system, consists of a 6 inch line from the King 3 mine drain tunnel through a 125,000 gallon concrete tank to the upper part of town.

The present sanitary sewer system in Hiawatha is old. It consists of a collection system with a few manholes and a septic tank - evaporation lagoon disposal system. No mining operation liquid wastes are discharged into the sanitary sewer system. Surface runoff from the town is diverted through channels and culverts away from mining operations. The runoff is eventually deposited in watershed drainages. Surface runoff from the slurry ponds, refuse stockpiles, and processing operation is retained in sedimentation ponds.

Coal is currently being truck hauled from the Middle Fork mine operations, processed at Hiawatha and loaded on rail cars on Utah Railroads spur. Proposed plans will reduce the amount of processing area used at Hiawatha. The total disturbed area for Hiawatha, approximately 220 acres, includes the proposed conveyor, loadout and preparation facility that will be constructed on previously disturbed area.

Mohrland Area Surface Facilities. The old Mohrland mine (King 2) is located on the north side of Cedar Creek Canyon at an elevation of 7,750 feet. The surface area was disturbed in the early part of this century to facilitate the King No. 2 mine in the Hiawatha seam. Structures still standing include portals, a fan building, an old hoist building and a mine water discharge facility. This yard area, which covers 2 acres of fee land, has not been used in connection with mining since it was abandoned in 1949.

A roadway exists from the old King 2 mine to the Mohrland railroad yard. This facility is located at the southern end of the Utah Railway track system near the old Mohrland townsite. A coal processing plant existed at the Mohrland railroad yard which was supplied by tramway from the King 2 mine approximately 1.5 miles up the canyon. The processing plant and related structures were dismantled in the early 1940's.

This site comprises 4 acres of fee land, including the railroad track right-of-way which is owned by the Utah Railway Company and the remainder owned by U. S. Fuel Company. Utah Power and Light Company is currently leasing and operating a coal loading system at Mohrland railroad yard. U. S. Fuel Company has proposed to use this site in the future for a coal stockpiling and loading facility to serve the King 7 and 8 mines.

Redevelopment of yard areas and surface facilities are planned for construction in Cedar Creek Canyon. The construction of surface facilities at the old King No. 2 mine, along with the Mohrland railroad loadout, are planned for the 1980's. Due to the steep and narrow nature of the canyon, a series of small yards with interconnecting roads are planned to be constructed on old Mohrland townsites. Following is a list of surface facilities to be built in this area:

New mine portals
Access roads
Supply and equipment storage yards
Topsoil stockpile areas
Changehouse
Office buildings
Shop and warehouse buildings
Parking lots
Electrical substations and power lines
Water and sewage facilities
Runoff and sediment control structures
Overland conveyor system
Unit train loadout facility

Several alternatives exist for development of coal mining in the Hiawatha and upper seams in Cedar Creek Canyon. These alternatives have been examined in detail, as shown on Exhibits III-5A and 5B. They range from entering the old King 2 mine works and extracting the remaining coal from the Hiawatha seam to developing new portal facilities on the south side of Cedar Creek, in both the Hiawatha and upper seams.

The water supply for Hiawatha flows from mine discharge at the old Mohrland mine. At the time the King 7 or King 8 mines are developed, water will be stored and used for these facilities. The sewer system

will be similar to the other mines surface facilities; septic tank with a drain field. All surface runoff will be retained in sedimentation ponds. Sedimentation ponds have been calculated and designed for all the development alternatives.

A roadway for the Cedar Creek Canyon has been designed and is located in Chapter XIII. The road is basically for access to the mining operations, although, in the initial development, coal may be hauled over the road. This roadway will be paved with crushed mix rock and bituminous surfacing. Eventually, a overland conveyor system is proposed for conveying coal from the mine mouth to the unit train loadout.

No development has taken place in Cedar Creek Canyon at this time. Utah Power and Light has an agreement with Consolidation Coal Company to allow them to load coal at the railroad loadout. That is the only mining related activity in the Mohrland area. The total area proposed to be disturbed is approximately 67 acres. This estimate includes two alternative portal developments, all roadways and ponds, facility yards, proposed railroad loadout and overland conveyor.

## 3.3 Operation Plans

King 4 Mine. The King 4 mine is located in sections 13, 24 and 25, T.15S., R.7E.; and sections 18, 19 and 30, T.15S., R.8E., SLBM. It is bounded by the Bear Canyon fault on the west, property boundaries on the north, coal seam outcrops on the east and mined-out workings of the King 1 mine on the south. Portals are located in the Middle Fork canyon of Miller Creek, 3 miles northwest of Hiawatha. The mine was opened in 1974 when haulage and ventilation entries were driven outward from the northern extension of the King 1 mine to the B seam outcrop in Middle Fork. Once portals were established, the King 1 mine which had been mined out in earlier years, was sealed off and abandoned to the south. A set of entries which connect with South Fork were left open and maintained for access and ventilation.

The mine area includes approximately 3,000 acres, of which 2,250 acres contain fee coal owned by U. S. Fuel Company. 720 acres are held under Federal Consolidated lease Nos. U-026583 and U-058261; and 30 acres are under Federal lease No. SL-069985. Production varies between 600,000 and 800,000 tons per year depending on many factors from local mining conditions to labor and market influences. Table III-5 has a summary of mining methods and estimated productivities for all of U. S. Fuel Company's proposed and operating mines. At the present time, mining is being done almost entirely in the B seam. One section is operating in the A seam near where the A and B seams converge forming a single bed. Exhibit III-6A shows the projected mine plan by year for the King 4 A seam. However, extensive development of the A and Hiawatha seams will be delayed pending extraction of the overlying B seam.

Development of the B seam in the King 4 mine is generally in an up-dip direction toward the northern boundary of the property.

Table III-5

Mining Methods and Estimated Productivity

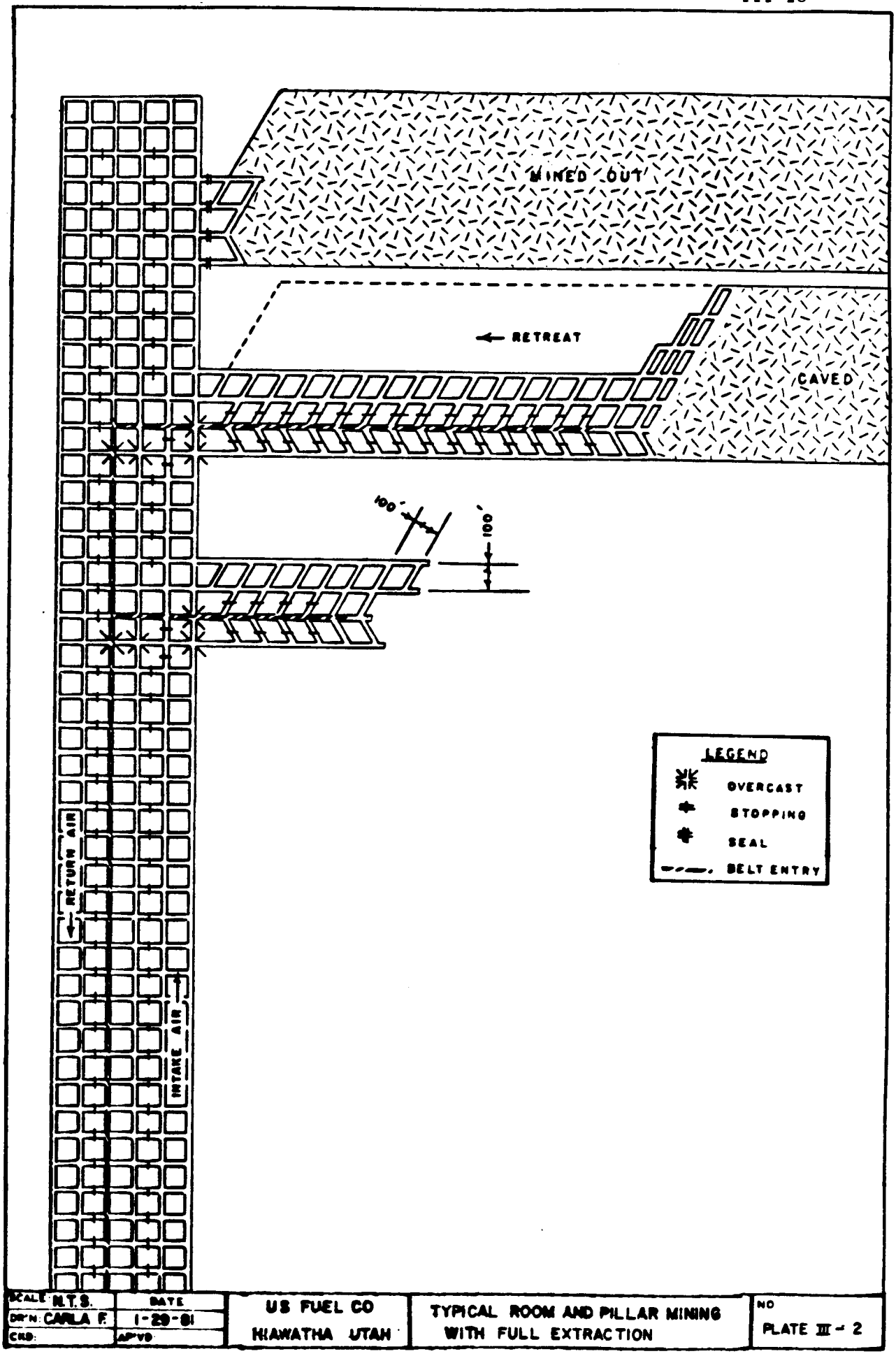
| Mine | Seam | Mining Methods | Production Date | Estimated Productivity |
|---|---|---|---|---|
| King 4 | B | Continuous Miner Room and Pillar | Operating | 700,000 Tons/Year |
| King 4 | A | Continuous Miner Room and Pillar | Operating | 200,000 Tons/Year |
| King 5 | B | Continuous Miner Room and Pillar | Operating | 250,000 Tons/Year |
| King 5 | A | Longwall and Room and Pillar | 2000 | 450,000 Tons/Year |
| King 6 | Hiawatha | Continuous Miner Room and Pillar | 1981 | 384,000 Tons/Year |
| King 6 | A | Continuous Miner Room and Pillar | 1983 | 225,000 Tons/Year |
| King 7 | Hiawatha | Continuous Miner Room and Pillar | 1984 | 1,200,000 Tons/Year |
| King 8 | Upper | Longwall and Room and Pillar | 1986 | 900,000 Tons/Year |

4,309

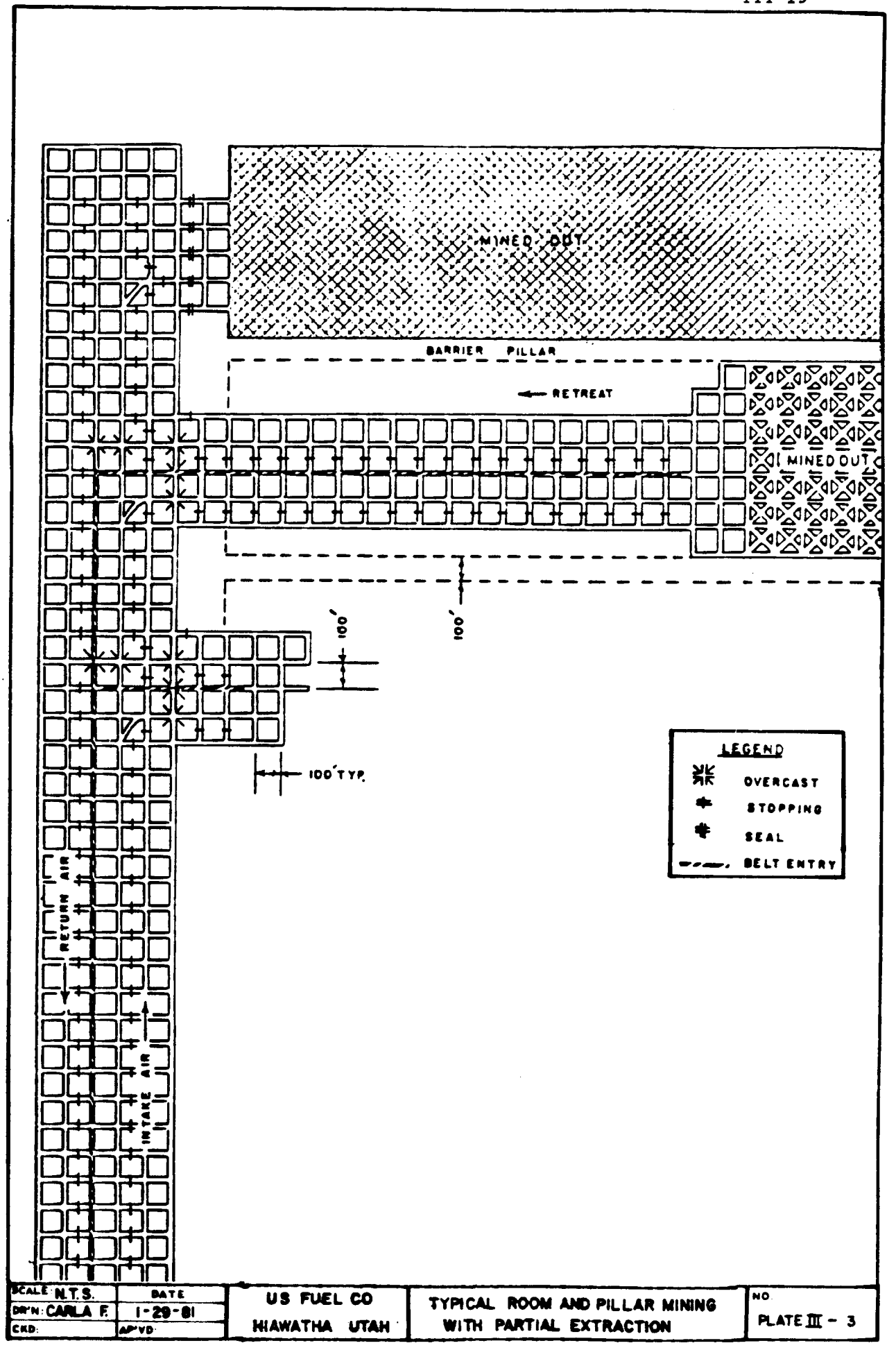
The mine is laid out to accomodate four continuous miner sections operating on a two shift per day basis with a third (midnight) shift reserved for maintenance and catch-up operations. Exhibit III-6B shows existing workings and projected development for room and pillar mining in the B seam. Mining consists of driving 5 or 6 entry main development headings, off from which room and pillar panels are later extended. Entries and crosscuts are driven 20 feet wide and generally on 100 foot centers, though 60 and 80 foot centers are occasionally used. Crosscuts are turned either at 60 or 90 degrees to the entries. Crosscuts at 60 degrees allow for better haulage and equipment mobility; whereas, 90 degree crosscuts provide greater roof support.

Room and pillar panels are developed by driving 3 to 5 parallel entries to the boundary of a coal block and extracting pillars in a retreat fashion while picking up two to four additional rooms on either side of the development entries. Both full and partial extraction methods are employed depending on local roof conditions, as shown on Plates III-2 and III-3. With the full extraction method, coal is mined in a step fashion which allows the roof to cave on a controlled break line across the full width of the mined-out panel. Once the break line is established, pressure is relieved from adjacent abutments allowing mining to proceed in a safe sequence. With the partial extraction method, pillars are mined by splitting from several directions while leaving stumps of coal to support the roof. The size of the stumps vary from place to place depending on local roof conditions and judgement of the section foreman.

Each mining section uses one continuous miner served by two shuttle cars. The shuttle cars relay coal from the miner in the face area to a conveyor belt feeder-breaker located 100 to 300 feet back of the face.




| | | | | |
|---|---|---|---|---|
| SCALE: N.T.S. | DATE | US FUEL CO | TYPICAL ROOM AND PILLAR MINING | NO |
| DR'N: CARLA F. | 1-29-81 | HIAWATHA UTAH | WITH FULL EXTRACTION | PLATE III - 2 |
| CKD: | APVD | | | |




| | | | | |
|---|---|---|---|---|
| SCALE N.T.S. | DATE | US FUEL CO | TYPICAL ROOM AND PILLAR MINING | NO. |
| DR'N: CARLA F. | 1-29-81 | HIAWATHA UTAH | WITH PARTIAL EXTRACTION | PLATE III - 3 |
| CKD: | APV'D | | | |

From the feeder-breaker, coal is transported on a series of roof-hung, wire rope supported, belt conveyors to the haulage portal and truck loading facility. Mining progresses in a sequential pattern, generally beginning on the return air side of a development heading and progressing to the intake air side while advancing each entry from 20 to 100 feet. This allows roof bolting and cleanup operations to be carried out in adjacent entries simultaneously with mining.

The present miner inventory consists of three Lee Norse oscillating head miners, one Lee Norse HH-546 Hardhead miner and one Joy 12CM6 miner. Shuttle cars are of the Joy 10SC type. Other equipment used in the miner sections include Galis 320A and Lee Norse TDI-43 roof bolters; Stamler BF-17B and Rosco feeder-breakers; Pemco 750 KVA power centers and Elkhorn AR-95 battery powered scoops. Table III-6 gives a list of the general underground equipment in King's No. 4 and 5.

Mining of the A and Hiawatha seams in the King 4 mine will be greatly influenced by the nature of B seam mining above. Due to the small rock interval between seams, and concentrated stress resulting from overlying mined out workings, longwall mining techniques are being considered. Since detailed plans for mining the A and Hiawatha seams will depend on the final configuration of mining in the B seam, none are presented at this time.

Coal is transported from each mining section to the portal on a series of wire rope supported belt conveyors. All mainline belts and most submain belts are 42 inches wide. A few 36 inch belts are also used. Conveyor segments vary in length from 2,000 to 3,000 feet and are powered by Continental, Long Aridox, and shop fabricated drives ranging from 75 horsepower to duel 150 horsepower. From the haulage portal, coal is combined with that derived from the King 5 mine and

Table III-6

General Underground Equipment

King No. 4 and 5

1 - Lee Norse MC45E Continuous Miner (K4)
1 - Lee Norse 106H Continuous Miner (K4)
1 - Lee Norse HH06 Continuous Miner (K4)
1 - Joy 12CM6 Continuous Miner (K4)
2 - Joy 12CM6 Continuous Miners (K5)
10 - Joy 10SC22 Shuttle Cars (K4)
4 - Joy 10SC22 Shuttle Cars (K5)
2 - Lee Norse Roof Bolters (K4)
2 - Lee Norse Roof Bolters (K5)
1 - Galis Roof Bolter (K4)
2 - Joy Roof Bolters (K4)
1 - Fletcher Roof Bolter (K4)
7 - 750 KVA Section Power Centers (K4)
3 - 750 KVA Section Power Centers (K5)
2 - Joy 11BV Loaders (K4)
6 - Elkhorn Battery Scoops (K4)
3 - Eimco Diesel Scoops (K5)
3 - Rosco Feeder Breakers (K4)
5 - Stamler Feeder Breakers (K4)
2 - Stamler Feeder Breakers (K5)
20,000 Ft. 42 In. Belt Conveyor Systems (K4)
5,000 Ft. 36 In. Belt Conveyor Systems (K4)
8,000 Ft. 42 In. Belt Conveyor Systems (K5)
13 - Trolley Locomotives (K4)
4 - Air Compressors (K4)
2 - Air Compressors (K5)
4 - Railrunner Personnel Carriers (K4)
9 - Mine Jeeps (K4)
2 - Eimco Diesel Mantrips (K5)
4 - Kubota Boss Buggies (K5)

conveyed to a 13,000 ton storage pile in the Middle Fork mine yard. From here it is reclaimed, weighed and hauled to the processing plant in 25 ton, bottom dump trucks. Personnel and supplies are transported underground by a 42 inch gage track network using a variety of General Electric and Jeffrey haulage motors, and Railrunner personnel carriers. Haulage and other equipment are repaired in a well equipped underground shop located near the manway portal.

Roof support procedures are carried out in accordance with plans approved by the Mine Safety and Health Administration. A copy of the MSHA approved roof support plans along with the approved ventilation plans for King 4 are included in the Appendix III-1 of this chapter. A row of timber posts carried 5 feet apart and 5 feet out from one rib is installed in all entries and crosscuts. A variety of specific approved timbering methods are used in pillar sections. Roof bolts are installed on a spot bolting basis where roof conditions indicate a need. Both mechanical and resin bolts of 4, 5, and 6 foot lengths are used. In areas where bolts are needed, they are installed such that they are not more than 5 feet apart in either direction. Where conditions indicate a need, supplementary support such as additional bolts, longer bolts, posts, cribs or crossbars are installed.

The King 4 mine is presently being ventilated by a Jeffrey 350,000 CFM fan that was installed in 1980 to replace the existing Joy La-Del axial flow fan that was located in the Middle Fork mine yard. Air is coursed through the mine by way of intake and return airways separated by well constructed cinder block stoppings. Overcasts and regulators are installed where needed to insure that each section is served by a separate split of air. Face ventilation is achieved by use of line curtains supported by timber posts located 5 feet out from one rib. Coal dust derived

from mining is exhausted away from the face behind the line curtain. No axiliary face ventilating fans are used. Since King 4 is not a gassy mine, methane bleeder entries are not generally employed. All ventilation procedures are covered by M.S.H.A. approved plans.

King 5 Mine. Portals for the King 5 mine are located on the south side of the Middle Fork mine yard adjacent to the King 4 portals. Surface facilities are shared by both mines. The King 5 mine was opened in the spring of 1978. Mine workings are located in sections 29, 30, 31, and 32, T.15S., R.8E., SLBM. An area comprising 900 acres of fee land and 320 acres of federal lease land (SL-025431) could ultimately be mined if economical coal thicknesses (greater than 5.0 feet) persist throughout the reserve block.

Present production is 250,000 tons per year, derived from two sections operating on a one production shift per day basis in the B seam. Exhibit III-7B shows the B seam mine plan projections. The Hiawatha seam, which lies 110 feet below the existing B seam workings, was mined out in earlier years. No adverse effects from these old workings have been encountered to date. Portions of the A seam have also been mined out in this area. Plans for eventually redeveloping the A seam have been designed, Exhibit III-7A, although remaining portions will be difficult to mine since they lie only 20 to 30 feet above the mined out Hiawatha seam.

The King 5 mine has three portal openings, exhaust fan portal, belt haulage portal, and an intake air/manway portal. Once inside the mine, two additional entries are picked up, forming a five main development heading which is being driven due south through the center of the B seam coal reserve block between South and Middle Forks. Room and pillar extraction methods are employed similar to those in King 4 mine, Plates III-2 and 3. Room and pillar panels are extended east and west off the main headings.

The B seam thickness in this area averages about 5.5 feet, requiring the use of low profile mining equipment. Two mining sections employ Joy CM6 continuous miners and Joy 10SC22 shuttle cars. The underground equipment for King 5 is listed in Table III-6.

Coal is hauled by a 42 inch Long Airdox conveyor system powered by 150 hp dual drive unit. Coal is broken and fed onto the conveyor at a controlled rate by Stamler BF-17B belt feeders. The mainline conveyor operates at 570 feet per minute and can handle a maximum of 600 tons per hour. Coal from the King 5 mine is combined with coal from the King 4 mine at a transfer point near the portal where it is conveyed to a 13,000 ton stockpile. Personnel are transported underground by diesel powered Eimco 950 mantrips and Elmac 605 Boss buggies. Equipment and supplies are transported by Eimco diesel powered scoops.

Roof control is the same as in the King 4 mine except that a full bolting plan is followed. The MSHA approved roof control and ventilation plans for King 5 are included in Appendix III-2 of this chapter. Bolts are installed on 5 foot centers in all entries and crosscuts. In the face areas, bolts are installed after every 20 foot advance in any mining place. Both resin and mechanical bolts are installed with Lee Norse TDI-36 and Joy RBD-81 roof bolting machines.

Ventilation is provided by a 6 foot diameter Sturtevant axiflo fan, exhausting 80,000 cubic feet of air per minute at 1.5 inches of water gage. Permanent and temporary stoppings are carried to within 300 feet of the last open crosscut in each section. Face ventilation and dust control are provided by line curtains installed on a row of timber posts 5 feet out from one rib and extended to within 15 feet of the face. Air quality and quantity are monitored by mine personnel on a routine basis. No methane gas has been detected in King 5 mine to date.

King 6 Mine. The King 6 mine will be located in the South Fork canyon which is just south of the present King 4 and 5 mines. To bring this mine on stream in 1981, various portal, conveyor, transportation, and production related work must be done. Two portals existing from the abandoned King 3 mine will be reopened and two additional portals will be constructed. Mine workings will be located in sections 25, and 36 T.15S., R.7E. and sections 29, 30, 31 and 32 T.15S., R.8E.

The King 6 mine, as envisioned, will handle two continuous miner coal production sections. These sections, when fully on stream, will have a total capacity of 384,000 tons per year in the Hiawatha and A seams. These two sections will operate two shifts per day making a total of four production shifts per day. Production could average 400 tons per unit shift at full production. Portions of both the Hiawatha and A seams have been mined out previously in this area. The mining plans, Exhibits III-8A and 8B, are designed for one miner working in each of the seams. Since the portals enter on the Hiawatha seam, a tunnel up to the A seam is planned after the main entries have been developed.

The mine has four portal openings planned, intake air, belt haulage, manway and materials, and return air. A five main development heading will be driven west in the Hiawatha seam. One miner section will remain in the Hiawatha seam, the second will advance through a tunnel to the A seam above and recover the remaining A seam coal. Exhibits III-8A and 8B project the mine plans for the King 6, Hiawatha and A seams. Room and pillar extraction methods will be employed with panels extending north of the main heading. Table III-7 lists the projected underground equipment.

Table III-7

Projected Underground Equipment

King No. 6

The following mining equipment will be needed to start and sustain production from two mining sections:

Equipment

2 - Continuous Miners

4 - Joy 10SC Shuttle Cars

2 - Stamler Feeder Breakers

1 - Diesel Scoop

2 - Section Power Centers

2 - Roof Bolters

2 - Face Distribution Boxes

2 - Sections Water Pumps

2 - Aux. Face Fans

2 - Conveyor Terminals including Power Centers

5,000 Ft. Conveyor Intermediate

10,000 Ft. Conveyor Belting

10,000 Ft. 15 KV Power Cable

10,000 Ft. 4 In. Water Pipe

1 - Lot Mine Communication Equipment

1 - Lot Fire Protection Equipment

1 - Lot Safety Equipment

4 - Diesel Mantrips

1 - Portable Air Compresser

1 - Bulk Rock Dust Tank

1 - Rubber Tired Rock Duster

3 - Trickle Rock Dusters

3 - Bantam Rock Dusters

Misc. Electrical Cable

Roof control and ventilation plans have been submitted and approved by MSHA for the King 6 mine. A copy of each of the plans is in the Appendix III-4 at the end of this chapter.

King 7 Mine. The King 7 mine will be located in Cedar Creek Canyon. Construction of surface facilities are projected to begin in 1984. Two alternatives for portal locations are being considered at this time. Reopening the old Mohrland mine portals in the Hiawatha seam or developing new portals on the south side of Cedar Creek.

Based on the estimated productivity of 1.2 million tons per year, a mine plan has been developed, Exhibit III-9. King 7 mine plan develops the Hiawatha seam using continuous miners - room and pillar methods. A projected equipment list has been developed in Table III-8.

King 8 Mine. This mine will be developed in the upper seam in the Mohrland area, approximately 330 feet above the Hiawatha seam. Coal will be extracted by way of a vertical raise from the proposed King 7 mine below. The land area to be affected by this mine will be essentially the same as that affected by the King 7 mine, namely that area bounded by the King 1 workings on the north, the coal outcrop on the east and the property boundaries on the south and west. The area comprises 4,500 acres and is shown in Exhibit III-9. Some surface facilities for the King 8 mine can be shared with the King 7 mine. Two sites are being considered for access portals. One is directly above the proposed King 7 portals. The other is farther up Cedar Creek Canyon where the existing road crosses the upper seam outcrop. A projected equipment list is shown on Table III-9.

## Table III-8

## Projected King No. 7 Major Equipment List

5 - Joy 12 CM Miners or Equivalent

10 - Joy 10SC Shuttle Cars or Equivalent

5 - Roofbolters

5 - Scooptrams, with 2 Sets Batteries and Chargers

5 - Belt Feeder Breakers, Cat-Mounted

5 - Rock Dusters, Rubber Tired

5 - Auxiliary Face Fans

5 - Man-carrying Locomotives with 2 Sets Batt., 11 Man Capacity

5 - Foreman, Mechanic, and General Personnel Jeeps

2 - Supply Locomotives, 10 Ton

20 - Supply Cars
4 - Rock Cars, 6 Ton Capacity

1 - Equipment Carrier, 60 Ton Capacity

Table III-9

Projected King No. 8 Major Equipment List

2 - Joy 12CM Miners or Equivalent

4 - Joy 10SC Shuttle Cars

2 - Roof Bolters

2 - Scoop Trams, with 2 Sets Batteries and Chargers

2 - Belt Feeder Breakers, Cat-Mounted

2 - Rock Dusters, Rubber Tired

4 - Auxiliary Face Fans

3 - Man-carrying Locomotives with 2 Sets Batt., 11 Man Capacity

3 - Foreman, Mechanic, and General Personnel Jeeps

2 - Supply Locomotives, 10 Ton

20 - Supply Cars

5 - Rock Cars, 6 Ton Capacity

1 - Equipment Carrier, 60 Ton Capacity

1 - Double-Ended Ranging Shearer

104 - Shield-Type Roof Supports

1 - Hydraulic Power Pack

1 - Face Conveyor

1 - Stage Loader

1 - Entry Conveyor

## 3.4 Environmental Protection

### Land Use

U.S. Fuel Company has been operating coal mines in the Hiawatha area since the early part of the turn of the century. Land-use has remained relatively unchanged in the various topographies on the property over the years and is not expected to change significantly in the future. The land-use picture is still and will remain primarily wildlife habitat and limited grazing. U.S. Fuel Company mining operations are located in the narrow canyons that lead to the top of the Wasatch Plateau, therefore, no cropland or prime farmland is within the mine plan area. Control measures needed to mitigate impacts shall include steps necessary to protect ground and surface waters, soil resources, vegetation, wildlife, and air quality.

### Human Values

A site search conducted by Utah's Division of State History located no known archaeological or cultural sites. Sites have been identified in the area but none are located on the property. In the event any paleontological remains are discovered during the mining operations, U.S. Fuel Company will notify the Division of State History.

### Hydrologic Balance

Groundwater on the U.S. Fuel Company mine plan area flows through faults and old mine workings in a southerly direction along the dip of the formations. Groundwater is believed to exist in perched aquifers above the lowest mined coal seam. The water is collected at the old Mohrland mine portals and piped to Hiawatha. The water is of high quality and is used for municipal and industrial purposes.

Surface water exists in several small perennial streams on the mine plan area. The streams are recharged by rain, snow melt and springs occurring in the alluvium and colluviums of the channels. There is no discharge of water from mine openings, other than the abandoned Mohrland portal. The major contaminates are suspended solids and oil and grease resulting from surface runoff on disturbed areas.

Control measures to mitigate impacts will include: stabilizing disturbed areas, diverting runoff, reseeding of reclaimed areas, regulating channel velocity, and paving roadways. Sedimentation ponds are used to control suspended solids and oil and grease contaminations.

A monitoring plan is detailed in Chapter VII for both ground and surface waters. Springs and streams will be monitored for quantity and quality to detect any effects mining operations may cause. NPDES permits have been obtained for several discharge locations on the mine plan area; their requirements will be complied with and reported to the appropriate government agency. The U.S.G.S. maintains several water monitoring stations on and near the property.

Soil and Vegetative Resources

All of the current and projected mining areas have been disturbed because of mining operations prior to Act 95-87. Topsoil was not removed and stockpiled on any past or present operations. The primary effects on soils are expected to include compaction, loss of organic matter, contamination with coal fines and mixing with the subsoil.

In areas where U.S. Fuel Company has projected redeveloping abandoned surface facilities an effort will be made to salvage topsoil. The surface facilities currently in operation, at the time reclamation takes place, will be removed and revegetated.

Fish and Wildlife Resources

Some mining activities have been deleterious to our wildlife resources, but over the years most affected populations have adjusted to their altered environments. Future operations will alter the wildlife environments still further. The fish and wildlife consultation guidelines that the Division of Oil, Gas, and Mining has suggested using to prepare the permit have been followed by the Division of Wildlife Resources in Chapter X. Measures to mitigate impacts to fish and wildlife will be employed. The areas disturbed will be kept to a minimum. All disturbed sites no longer needed for mining operations will be reclaimed according to approved reclamation standards. Water qualities will be monitored and maintained.

Air Quality

U.S. Fuel Company has a thermal drying unit for the preparation of the coal at Hiawatha. Air quality monitoring in the form of stack emissions will proceed as per the request of Utah's Bureau of Air Quality.

Fugitive dust will have an impact on the air quality. Several sources of fugitive dust are:

1. Middle Fork and South Fork truck loading facilities
2. Access roads
3. Ventilation fan
4. Coal handling facilities
5. Coal slurry and refuse impoundments

The plan for fugitive dust control will include the following measures to control fugitive dust in the above areas:

1. Periodic watering of unpaved roads on a frequency as needed;
2. Frequent blading and shaping of unpaved roads to stabilize the road surface;

3. Paving of roads;
4. Restricting the speed of travel;
5. Substituting of conveyor systems for haul trucks and covering of conveyor systems;
6. Minimizing the area of disturbed land;
7. Prompt revegetation of regraded lands;
8. Use of alternatives for coal handling methods, restriction of dumping procedures, wetting of disturbed materials during handling, and compaction of disturbed areas;
9. Extinguishing any areas of burning or smoldering coal and periodic inspections for coal burning areas whenever the potential for spontaneous combustion is high; and
10. Restricting fugitive dust and spoil and coal transfer and loading points.

Subsidence Control Plan

A cooperative agreement between U.S. Fuel Company and the U.S. Forest Service exists for the monitoring of subsidence. No subsidence features exist as yet because past mining left support pillars. U.S. Fuel Company is currently fully extracting coal and if subsidence occurs it will occur uniformly over the surface. Due to the amount of cover above the mineable seams, subsidence features may not become visible on the surface. Precautions will be taken to insure enough cover is left between the mining operation and the outcrop to protect from subsidence.

Waste Disposal Plans

Fine refuse from the preparation plant is stored in slurry ponds. Some of the fines once dried are sold to available markets. The coarse refuse is used for stabilizing the embankment slopes on the slurry

ponds. Runoff from the embankment slopes is contained in sedimentation ponds. No coal processing waste disposal facility is proposed to return waste to abandoned underground workings. All underground development waste generated by the mining operation is disposed of in mined-out areas underground. U.S. Fuel Company has not produced toxic or acid-forming materials.

Based on the characteristics, handling and disposal of various waste products, the impact on the environment is minimal. The slurry refuse does not go into the hydrologic system. The refuse material is covered with coarse, non-combustible waste and compacted to eliminate ignition.

## 3.5 Reclamation Plan

### Middle Fork

Surface areas related to mining in Middle Fork (King 4 and 5) were disturbed prior to the Surface Mining Control and Reclamation Act, therefore, no topsoil storage or handling areas have been established. The surface structures will be removed and foundations will be backfilled. The compacted topsoil will be scarified before revegetating. Highwalls connected with portals, embankments and benches will be terraced in the form of highwall slope reduction to control erosion.

Abandoned mine portals from Hiawatha No. 2 mine have been closed with gates and posted. One of the Hiawatha No. 2 mine portals is discharging water. This portal has a concrete bulkhead and valve regulating the discharge flow for the town of Hiawatha's water source. The portals for King 4 and 5 will be backfilled and graded to prevent access.

Ponds and diversions will be removed and regraded. Erosion control channels with straw dikes remain at the toe of embankments if necessary for stabilization.

A suitably permanent, diverse and native vegetative cover, as described in Chapter IX, Vegetation Resources, will be established on all affected areas of land, except roadways. Revegetation will be hand spreaded. If revegetation establishes itself without mulching and fertilization, none will be performed. Planting will occur at such times when the greatest moisture conditions exist to eliminate the need for irrigation.

The Middle Fork mine yard will not disturb any additional area through the mine life of King 4 and 5. An overland conveyor system has been proposed for the Middle Fork access corridor. This acreage has been included with the existing haulroad. The mine life for King 4 and 5 has been projected past the year 2000, therefore, an accurate time-table for reclamation is not possible at this time. Once operations are projected to halt within a permit period, reclamation procedures will be planned, monitored and managed by U.S. Fuel Company.

A cost estimate for reclamation of the Middle Fork mining operations in approximate 1980 dollars is presented in Table III-10.

North Fork

The intake ventilation shaft in North Fork was constructed in 1979-80 for the King 4 mine. Trees and large brush were cleared from the site before topsoil was removed. Topsoil was salvaged and stock-piled for reclamation. Topsoil was then redistributed immediately after the completion of surface structures. Following redistribution of topsoil, seeding was placed on the area to protect against erosion. A seeding list recommended in a letter from the Division of Oil, Gas and Mining is included in Appendix III-1. This includes the construction plan agreement with D.O.G.M. and OSM.

South Fork

South Fork mine yard is on previously disturbed areas from the King 3 mine which halted operations in 1975. U.S. Fuel Company is reconditioning the facilities to start operations in King 6 mine in 1981. Previously disturbed areas in South Fork will be reclaimed in the same manner as the Middle Fork mine yard. Some topsoil has been salvaged and stockpiled, mostly from areas not previously disturbed. The yard

Table III-10

Cost Estimate for Reclamation
Middle Fork Mining Operations

| | Disturbed Acres Current | Disturbed Acres Proposed | Grading $6,000/ Acre (000's) | Disking $50/ Acre (000's) | Seeding $300/ Acre (000's) | Total $ Current | Total $ Proposed |
|---|---|---|---|---|---|---|---|
| Portals and Slopes | 5 | | 30 | | 1.5 | 31.5 | |
| Facility and Storage Yards | 7 | | | 0.4 | 2.1 | 2.5 | |
| Ponds and Diversion Structures | 2 | | 12 | | 0.6 | 12.6 | |
| Haulroad | 17 (haulroad will remain for access) | | | | | | |
| Proposed Conveyor | | 10 | | 0.5 | 3 | | 3.5 |
| Total | 24 Acres | | | | | 50.1 | |
| Miscellaneous Expenses @ 20% | | | | | | 10.0 | |
| Engineering Expenses @ 15% | | | | | | 7.5 | |
| Administration @ 5% | | | | | | 2.5 | |
| Grand Total | | | | | | 70.1 | |

Assumptions:

a. These costs are essentially based on USF's completely haulting mining operations, reclamation commencing and 1980 dollars.
b. The salvage value of the steel in the facilities and the salvage value of the electrical system will meet or exceed the cost of removing such facilities.
c. The foundations will remain and in most cases be covered with 2.0 feet of topsoil and revegetated.
d. No removal of water or sewage lines.
e. Roadways to the mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed; they will remain for access.
f. No disposal of toxic wastes is necessary.
g. The mine yards at the portals have not stockpiled topsoil. Recontouring and revegetation of these areas is the only reclamation necessary.
h. 2.0 feet of topsoil will cover regraded slurry piles for revegetation. This topsoil will be obtained from a borrow pit along the flood plain of Miller Creek one mile maximum distance from the slurry piles.
i. No hydraulic mine seal is necessary.
j. No continued monitoring cost following reclamation was calculated.
k. Revegetation will consist of hand seeding only, thus assuming the land classification is rangeland, no trees, shrubs or forbs will be planted.
l. The costs are based on engineering judgment and past experience.
m. Mobilization costs are included in the miscellaneous expenses.

Table III-11

Cost Estimate for Reclamation
North Fork Ventilation Portal

| | | (000's) | | | |
|---|---|---|---|---|---|
| | Disturbed Acres | Grading $6,000/ Acre | Disking $50/ Acre | Seeding $300/ Acre | Total |
| Portal and Bench Area | 2 | 12 | | 0.6 | 12.6 |
| Miscellaneous Expenses @ 20% | | | | | 2.5 |
| Engineering Expenses @ 15% | | | | | 2.0 |
| Administration @ 5% | | | | | 0.6 |
| Grand Total | 2 Acres | | | | 17.7 |

Assumptions:

a. These costs are essentially based on USF's completely haulting mining operations, reclamation commencing, and 1980 dollars.
b. Roadways to the mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed; they will remain for access.
c. No hydraulic mine seal is necessary.
d. No continued monitoring cost following reclamation was calculated.
e. Revegetation will consist of hand seeding only, thus assuming the land classification is rangeland, no trees, shrubs or forbs will be planted.
f. The costs are based on engineering judgment and past experience.
g. Mobilization costs are included in the miscellaneous expenses.

area topsoil has been compacted from past mining and may have lost nutrients. Following mining operations, projected past the year 2000, the surface structures will be dismantled and removed. The mine yard will be disked and foundations covered with backfill material. Portal openings for the King 6 mine will be backfilled to the angle of repose. No hydraulic mine seals will be necessary. The bench areas will be terraced and straw dikes placed at the toes to control erosion. Sedimentation ponds and diversion channels will be regraded and topsoil replaced.

Revegetation will consist of native species selected from the reference areas on the U.S. Fuel Company property. These areas can be found in Chapter IX, Vegetation. Revegetation will be hand broadcasted over the entire disturbed area. If revegetation establishes itself without mulching and fertilization, none will be performed. Planting will occur during periods of greatest moisture conditions.

Hiawatha

The Hiawatha coal processing plant and loadout facility have been in operation since 1939. U.S. Fuel Company intends to dismantle and remove all coal processing, loadout and support facilities. Office buildings will be turned over to the town of Hiawatha. There has been no topsoil or fill material salvaged and stockpiled for reclamation, since operations preceded the Surface Mining Control and Reclamation Act. The majority of disturbed area in Hiawatha is slurry piles, refuse piles (from the preparation plant), and sedimentation ponds. This disturbed area accounts for approximately 150 acres. To reclaim this area U.S. Fuel Company will regrade the slurry and refuse piles and cover them with available topsoil from a borrow pit in the Miller Creek

Table III-12

Cost Estimate for Reclamation
South Fork Mining Operation

| | Disturbed Acres | | (000's) Grading $6,000/ Acre | Disking $50/ Acre | Seeding $300/ Acre | Total $ | |
|---|---|---|---|---|---|---|---|
| | Current | Proposed | | | | Current | Proposed |
| Portals and Slopes | 2 | | 12 | | 0.6 | 12.6 | |
| Facility and Storage Yards | 5 | | | 0.3 | 1.5 | 1.8 | |
| Ponds and Diversion Structures | 2 | | 12 | | 0.6 | 12.6 | |
| Haulroad | 11 (haulroad will remain for access) | | | | | | |
| Proposed Truck Loading Facility | | 2 | | 0.1 | 0.6 | | 0.7 |
| Proposed Conveyor | | 3 | | 0.2 | 0.9 | | 1.1 |
| Total | 14 Acres | | | | | 28.8 | |
| Engineering Expenses @ 15% | | | | | | 4.3 | |
| Administration @ 5% | | | | | | 1.4 | |
| Miscellaneous Expenses @ 20% | | | | | | 5.8 | |
| Grand Total | | | | | | 40.3 | |

Assumptions:

a. These costs are essentially based on USF's completely haulting mining operations, reclamation commencing, and 1980 dollars.
b. The salvage value of the steel in the facilities and the salvage value of the electrical system will meet or exceed the cost of removing such facilities.
c. The foundations will remain and in most cases be covered with 2.0 feet of topsoil and revegetated.
d. No removal of water or sewage lines.
e. Roadways to the mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed; they will remain for access.
f. No disposal of toxic wastes is necessary.
g. The mine yards at the portals have not stockpiled topsoil. Recontouring and revegetation of these areas is the only reclamation necessary.
h. 2.0 feet of topsoil will cover regraded slurry piles for revegetation. This topsoil will be obtained from a borrow pit along the flood plain of Miller Creek one mile maximum distance from the slurry piles.
i. No hydraulic mine seal is necessary.
j. No continued monitoring cost following reclamation was calculated.
k. Revegetation will consist of hand seeding only, thus assuming the land classification is rangeland, no trees, shrubs or forbs will be planted.
l. The costs are based on engineering judgment and past experience.
m. Mobilization costs are included in the miscellaneous expenses.

Table III-13

Cost Estimate for Reclamation
Hiawatha Processing Plant and Loadout Facility

| | Disturbed Acres | (000's) Grading $6,000/ Acre | Disking $50/ Acre | Seeding $300/ Acre | Total $ |
|---|---|---|---|---|---|
| Slurry, Refuse Piles and Ponds | 164 | 984 | | 49.0 | 1,033.0 |
| Proposed Conveyor and Loadout | 18 | | 0.9 | 5.4 | 6.3 |
| Preparation Plant, Storage Yard and Support Facilities | 38 | | 1.9 | 11.4 | 13.3 |
| Miscellaneous Expenses @ 20% | | | | | 210.5 |
| Engineering Expenses @ 15% | | | | | 157.9 |
| Administration @ 5% | | | | | 52.9 |
| Grand Total | 220 Acres | | | | 1,473.9 |

Assumptions:

a. These costs are essentially based on USF's completely haulting mining operations, reclamation commencing, and 1980 dollars.
b. The salvage value of the steel in the facilities and the salvage value of the electrical system will meet or exceed the cost of removing such facilities.
c. The foundations will remain and in most cases be covered with 2.0 feet of topsoil and revegetated.
d. No removal of water or sewage lines.
e. Roadways to the mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed.
f. No disposal of toxic wastes is necessary.
g. 2.0 feet of topsoil will cover regraded slurry piles for revegetation. This topsoil will be obtained from a borrow pit along the flood plain of Miller Creek one mile maximum distance from the slurry piles.
h. No continued monitoring cost following reclamation was calculated.
i. Revegetation will consist of hand seeding only, thus assuming the land classification is rangeland, no trees, shrubs or forbs will be planted.
j. The costs are based on engineering judgment and past experience.
k. Mobilization costs are included in the miscellaneous expenses.

flood plain. Because of the volume of slurry and refuse piles, regrading will not be approximate original contours. The embankment slopes will be reduced to control erosion. Structure foundations will be covered with available backfill material.

Sedimentation ponds and diversion structures will be removed and backfilled. Topsoil has been salvaged in the cases of the sedimentation ponds. Once they are regraded topsoil will be redistributed.

Revegetation will be native species selected from reference areas on the property. Seeding will be hand broadcasted over the entire disturbed area. Planting will occur during periods of greatest moisture conditions.

A proposed plan to replace the existing processing plant and loadout facility is currently under consideration. The proposed facility would be located adjacent to the old processing plant and a unit train loadout constructed. These new systems would not affect as much area. The land remaining after disassembling the old facilities and not planned for future development would be reclaimed at the time of final abandonment of the area. The Hiawatha existing or proposed facility will remain in operation as long as coal is mined from the property. There are mining operations projected on the U.S. Fuel Company property to continue well past the year 2000. To project a reclamation timetable at this point, accounting for the life of the existing and projected operations and surface facilities, would be of little value. A more realistic view of reclamation would be to estimate the cost and timetable for reclaiming the property as if operations were to halt immediately. Table III-13 estimates the cost in 1980 dollars for reclaiming the Hiawatha coal processing plant and loadout facility.

Mohrland Area

The Mohrland area mine facilities are planned for construction in Cedar Creek Canyon about 1984. The King 7 and 8 underground mining operations have been planned so that their surface facilities will be located on previously disturbed areas left from the old Mohrland mine, King 1. Some new areas will be disturbed for portals as soon as a portal alternative has been selected. Foundations from both the mine operations and the community that existed for the mine still exist. These areas have been abandoned for approximately 30 years so that some vegetation has returned to the sites.

Topsoil will be removed and stockpiled from areas to be disturbed for revegetation purposes. The stockpiles will be seeded and erosion control channels and berms constructed.

Structures constructed for the King 7 and 8 mines will be disassembled and removed. Besides the access roadway that leads to the top of the Wasatch Plateau, all other roadways in Cedar Creek Canyon constructed for mining operations will be regraded and revegetated. Sedimentation structures will be regraded, topsoil replaced and seeded.

A suitable, permanent, diverse, and native vegetative cover, as described in Chapter IX, Vegetative Resources, will be established on all affected areas of land. Seeding will be hand broadcasted. If revegetation establishes itself without mulching and fertilization, more will be performed. Planting will occur at such times when the greatest moisture conditions exist to eliminate the need for irrigation.

Once operations are projected to halt within a permit period, reclamation procedures will be planned, monitored and managed by U.S. Fuel Company. A cost estimate for reclamation of the Mohrland mining operations in approximate 1980 dollars is presented in Table III-14.

## Table III-14

## Cost Estimate for Reclamation
## Mohrland Area Mine Yard

Note: Proposed redevelopment for 1984.

| | Proposed Redevelop-ment Acres | (000's) Grading $6,000/ Acre | Disking $50/ Acre | Seeding $300/ Acre | Total $ |
|---|---|---|---|---|---|
| Portals and Slopes | | | | | |
| Alternative 1A | 9 | | | | |
| Alternative 1B | 4* | 66 | | 3.3 | 69.3 |
| Alternative 2A | 5 | | | | |
| Alternative 2B | 4 | | | | |
| Facility and Storage Yards | 16 | | 0.8 | 4.8 | 5.6 |
| Ponds and Diversion Structures | 4 | 24 | | 1.2 | 25.2 |
| Roadways | 18** | 48 | | 2.4 | 50.4 |
| Railroad Loadout | 8 | | 0.4 | 2.4 | 2.8 |
| Conveyor | 8 | | 0.4 | 2.4 | 2.8 |
| Total | 55 Acres | | | | 156.1 |
| Engineering Expenses @ 15% | | | | | 23.4 |
| Administration @ 5% | | | | | 7.8 |
| Miscellaneous Expenses @ 20% | | | | | 31.2 |
| Grand Total | | | | | 218.5 |

* 11 acres average.
** 10 acres to remain.

Table III-14 (Continued)

Assumptions:

a. These costs are essentially based on USF's completely halting mining operations, reclamation commencing and 1980 dollars.
b. The salvage value of the steel in the facilities and the salvage value of the electrical system will meet or exceed the cost of removing such facilities.
c. The foundations will remain and in most cases be covered with 2.0 feet of topsoil and revegetated.
d. No removal of water or sewage lines.
e. Roadways to the mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed; will remain for access (approximately 10 acres).
f. No disposal of toxic wastes is necessary.
g. The mine yards at the portals have not stockpiled topsoil. Recontouring and revegetation of these areas is the only reclamation necessary.
h. 2.0 feet of topsoil will cover regraded slurry piles for revegetation. This topsoil will be obtained from a borrow pit along the flood plain of Miller Creek one mile maximum distance from the slurry piles.
i. No hydraulic mine seal is necessary.
j. No continued monitoring cost following reclamation was calculated.
k. Revegetation will consist of hand seeding only, thus assuming the land classification is rangeland, no trees, shrubs or forbs will be planted.
l. The costs are based on engineering judgment and past experience.
m. Mobilization costs are included in the miscellaneous expenses.

Performance Bond Liability (for areas disturbed 1981)

These costs are based on reclamation of the following areas in 1980 dollars:

| | Disturbed Acres | Total $(000's) |
|---|---|---|
| Middle Fork Mining Operations | | |
| Portals and Slopes | 5 | 31.5 |
| Facility and Storage Yards | 7 | 2.5 |
| Ponds and Diversions | 2 | 12.6 |
| North Fork Ventilation Portal | | |
| Portal and Bench Area | 2 | 12.6 |
| South Fork Mining Operations | | |
| Portals and Slopes | 2 | 12.6 |
| Facility and Storage Yards | 5 | 1.8 |
| Ponds and Diversions | 2 | 12.6 |
| Hiawatha Processing Plant and Loadout | | |
| Slurry, Refuse Piles and Ponds | 182 | 1,039.3 |
| Preparation Plant, Storage Yards and Support Facilities | 38 | 13.3 |
| Miscellaneous Expenses @ 20% | | 227.8 |
| Engineering Expenses @ 15% | | 170.8 |
| Administration @ 5% | | 56.9 |
| Grand Total | 245 Acres | 1,594.3 |

Assumptions:

a. These costs are essentially based on USF's completely halting mining operations, reclamation commencing and 1980 dollars.
b. The salvage value of the steel in the facilities and the salvage value of the electrical system will meet or exceed the cost of removing such facilities.
c. The foundations will remain and in most cases be covered with 2.0 feet of topsoil and revegetated.
d. No removal of water or sewage lines.
e. Roadways to the mine portals and USF's office buildings at Hiawatha will not be removed or reclaimed; they will remain for access.
f. No disposal of toxic wastes is necessary.
g. The mine yards at the portals have not stockpiled topsoil. Recontouring and revegetation of these areas is the only reclamation necessary.
h. Two feet of topsoil will cover regraded slurry piles for revegetation. This topsoil will be obtained from a borrow pit along the flood plain of Miller Creek one mile maximum distance from the slurry piles.

i. No hydraulic mine seal is necessary.
j. No continued monitoring cost following reclamation was calculated.
k. Revegetation will consist of hand seeding only, thus assuming the land classification is rangeland, no trees, shrubs or forbs will be planted.
l. The costs are based on engineering judgment and past experience.
m. Mobilization costs are included in the miscellaneous expenses.

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## 7.1 Groundwater Hydrology

Geology is the principal factor controlling the occurrence and availability of groundwater. Unconsolidated deposits of Quaternary age are the most permeable water-bearing formations in parts of this region; sandstone strata of Jurassic, Cretaceous, and Tertiary age contain the most extensive bedrock aquifers (Price and Arnow, 1974).

The region is not very complex structurally, but hydrologically it is divided into units by structural elements such as the Book Cliffs, the San Rafael Swell, and the Wasatch Plateau. These units are modified by numerous subsidiary folds, faults, and intrusions; and in the upper formations by deeply cut drainage systems. The deep drainage system in some areas drains the exposed bedrock. The upper water-bearing beds are discontinuous and partially void of water near cliff faces (Final EIS, 1979). The upper formations of the Wasatch Plateau as shown on Plate VI-1 have been reported as the water-bearing formations. Field investigations have shown that most of the springs and seeps outcrop in the Price River, Star Point, and Castlegate Sandstone formations. The Flagstaff limestone and North Horn formation are conglomerates composed of limestone yielding water to wells for municipal use at Price, Utah. Price and Waddell note that wells in consolidated rocks underlying most of this region generally yield less than 50 gallons per minute. Quaternary alluvial deposits are the most permeable deposits in the area. They can be expected to yield from 10 to 100 gallons per minute to wells in the vicinity of perennial streams.

The lower valley area of the drainage is underlain with a formation called the Mancos shale. The shales have very low permeability, the little water that originates from this formation has little value due

to its bicarbonate sodium and sulfate content. The Ferron Sandstone formation in the southern part of the Wasatch Plateau has yielded potable water to the Emery municipal well and water to underground mine workings.

Water-table conditions commonly prevail in shallow alluvium along larger streams, and in relatively flat-lying sedimentary rocks. The deeply cut drainages that are common to the Wasatch Plateau and the Hiawatha area in particular are recharged into the larger streams by the water-table found in the canyon's alluvium. Quaternary alluvial deposits can be expected to yield from 10 to 100 gallons per minute to wells in the vicinity of perennial streams. The groundwater is recharged principally in the higher plateaus which receive the most precipitation and produce most of the runoff. Springs, stream courses, and patches of phreatophytes discharge the groundwater into the creeks. The direction of movement of water through the bedrock formations has not been determined accurately for the regional area, although a few local areas have been examined.

The groundwater is recharged primarily by direct infiltration of precipitation (probably much less than 5% of the annual precipitation) in the upper elevations of the plateaus and by infiltration from perennial streams that flow into the Mancos shale lowlands. Although the surficial material may be relatively less permeable than the underlying saturated beds, considerable amounts of water infiltrate to the saturated beds because of the large areas through which the infiltration occurs. Groundwater recharge also takes place to a limited extent by infiltration in outcrops (exposures at the land surface) of some of the more permeable and stratigraphically lower formations. The areas of outcrops are small, and thus limit the amount of recharge (Final EIS, 1979).

Depths to ground-water range from less than 50 ft. to more than 1,000 ft. Ground-water levels are generally less than 50 ft. beneath the land surface along alluvial plains of the larger perennial streams (Green, Price and San Rafael Rivers) and 500 ft. to more than 1,000 ft. beneath the land surface on higher plateaus (Price and Waddell, 1973). Local perched ground-water bodies are only a few feet below the land surface in much of the region. The high elevation aquifers can best be described as perched aquifers, these are generally the springs that recharge the perennial streams.

Groundwater is encountered from time to time in the course of underground mining, possibly existing in perched aquifers. Usually, it occurs in the form of drippers or small steady trickles from the roof and floor. These generally tend to decrease and dry up as development advances. Large water flows have been encountered in the past, mainly due to contact with the Bear Canyon Fault, which is a major water-bearing structure. Old mine workings have contacted the fault at several points and this probably accounts for most of the mine water presently being discharged from the old Mohrland portal. Since the dip of the beds in this area is toward the southwest, all water encountered in mining tends to flow to the most southerly opening, the old Mohrland portal. The direction of the subsurface water flow is demonstrated by potentiometric surface of the perched aquifers, indicated by both the spring elevations and the dip of the formations in the southerly direction. A western development heading, which is still accessible in the King 4 mine, contacted the Bear Canyon fault and exposed a water flow averaging approximately 100 gallons per minute. This water is presently being used for fire protection and dust suppression in the King 4 mine. A

minor north trending fault zone recently exposed in a section of the King 4 mine contains numerous small water trickles where it was followed for a distance of over 600 ft. The combined flow from these trickles amounts to less than 10 gallons per minute.

Mine workings in an east section of the King 4 mine intersected the lower portion of drill hole 13 which was drilled 950 ft. vertically from the surface on Gentry Mountain. A small trickle of water amounting to less than 1 gallon per minute is flowing from this hole. Numerous small diameter explority holes have been drilled from underground workings throughout the area. Most of these holes are now inaccessible and drill records show little or no data relating to ground water. Of the underground drill holes driven since 1970, only two encountered appreciable water zones. Drill hole 72-8, approximately 1,500 ft. east of the Bear Canyon fault, was drilled vertically up for a distance of 93 ft. It is producing a water flow of 3 gallons per minute. Drill hole 77-1, approximately 1,000 ft. east of the Bear Canyon fault, was drilled vertically down for a distance of 118 ft. It is said to have produced a very small artesian flow, but is no longer accessible for observation. These drill holes are shown on Exhibit VII-1, the General Hydrology map.

Ground water quality in this area is generally good. Table VII-1 gives U.S. Fuel Company's quantity and quality data for 10 springs in and near the mine plan area. The locations of these springs are shown on Exhibit VII-1. They were selected as hydrologic monitoring points because of their representative location with respect to mine workings and because they each had flow during the drought year of 1977. Some springs have been developed with troughs and small impoundments to facilitate livestock and wildlife watering.

In addition to the ground water conditions at the mine and monitoring points observed and detailed by Robert Eccli, Mine Engineer for U.S. Fuel Company, additional springs are located on Exhibit VII-1. These sources of water quantity and quality as shown on Table VII-1 are studies from U.S. Geological Survey Open-File Reports. These analyses are listed in the table to show a comparison of the quantity and quality data for the sample sites shown on Exhibit VII-1.

Mine water, besides that used in King 4 for fire prevention and dust suppression, flows southerly away from active mining and is presently discharged by gravity flow at the old Mohrland portal. A quantity of this water enters a 12 in. metal pipe and is diverted to a water tank on Miller Creek for culinary and industrial purposes at Hiawatha. The remainder of mine water flows into Cedar Creek. This mine water discharge is covered by NPDES Permit No. UT-0023094. Monitoring this discharge will closely reflect the character of water encountered during mining operations. Table VII-1 shows the quantity and quality of the water discharged through the old Mohrland mine workings. No other mine water discharge or dewatering is expected to take place through mining by U.S. Fuel Company.

Presented in Table VII-2 is a Summary of Underground Water Rights in U.S. Fuel Company's control as of this report.

Table VII-2

Summary of Underground Water Rights

| Underground Water Claims | Amount of Water CFS | GPM | Water Use |
|---|---|---|---|
| Certification No. 4147 (pending change application Nos. A-6961 and A-6963) | 0.058 | 26 | Mining and industrial |
| Cert. No. 4148 | 0.446 | 200 | Municipal, mining, industrial and irrigation |
| Cert. No. A-1129 | 0.015 | | Mining and culinary |
| Cert. No. 7237 | 0.334 | 150 | Domestic and stock watering |
| Cert. No. 6065 (pending change application Nos. A-6961 and A-6963) | 0.942 | 423 | Mining, industrial and municipal |
| Springs | | | |
| Cert. No. 2155 (6 springs) | 0.3868 | 174 | Domestic and culinary |
| Cert. No. 2156 (3 springs) | 0.0877 | 39 | Domestic and culinary |

The coal seams being mined are in the Blackhawk formation which is overlain by the predominant water-bearing formations. These formations including the Blackhawk formation are already highly broken by joints, fractures and heavily mined out areas which are very porous, readily accepting recharge. Depending on the coal extraction method employed, subsidence, in cases, could result in additional fractures through the strata above the Star Point Sandstone formation. No mining is proposed to be done below the Hiawatha coal seam which lies immediately on top of the Star Point Sandstone formation. Subsidence, which may result in fractures through the Blackhawk formation into the Castlegate and Price River formations, could reduce the occurrence of springs and seeps, or reduce yields from them. Loss of water from local perched aquifers within the interbedded sandstone layers of the Blackhawk formation itself is very likely. Discharge from the old Mohrland portal (King No. 2 portal) is not expected to be disrupted. Pillars remain in the

old works reducing the likelihood of subsidence. The effects of past mining on water sources are not known, except that significant flows have resulted from contact with major fractures such as the Bear Canyon fault. Parts of the King 1 mine were mined out from 10 to 30 years ago by room and pillar methods, yet numerous springs overlying this mine are still flowing. Whether they have diminished as a result of mining is not known.

Diminution of the existing surface and ground water sources could possibly affect some livestock and wildlife watering sites at higher elevations. Water presently being used for municipal, industrial, and irrigation purposes should not be diminished to any great extent since water diverted into the ground would most likely return to mine openings, springs and streams near the Star Point sandstone which is well above municipal, industrial and irrigation points of use. Water quality should not be significantly affected by mining as evidenced by the high quality of mine water presently being discharged.

A groundwater hydrologic monitoring plan is presently being implemented. Springs and mine water discharge are currently being monitored for quantity and quality as indicated by Table VII-1. Also, a subsidence monitoring program is being carried out in cooperation with the U.S. Forest Service to assess the effects of subsidence on forest land.

The map included with this plan (Exhibit VII-1) shows the location of 10 numbered springs which we propose to measure and analyze once in the spring and once in the fall. These springs were selected because of their representative location with respect to mine workings and because they each had some flow during the drought year of 1977. Flow measurements will be made with V-notch weirs on open springs and by the time-volume

method where springs discharge from installed pipes. Water samples will be analyzed according to Table VII-3 below:

Table VII-3

Routine Sampling Analytical Schedule

Flow Rate
pH
Air and Water Temperature
Acidity (Surface and Mine Water Only)
Specific Conductance
Total Suspended Solids (Surface and Mine Water Only)
Total Dissolved Solids
Total Manganese (Surface and Mine Water Only)
Total Iron
Dissolved Iron
Nitrate (as N)
Sulfate
Chloride
Oil and Grease (Surface and Mine Water Only)

Mine water discharge from the old Mohrland portal (King No. 2) is covered by E.P.A. Permit No. UT-0023094, dated October 17, 1977. Monitoring requirements under this permit are listed below in Table VII-4. In addition to the E.P.A. requirements, the parameters of specific conductance, total manganese, and dissolved iron will be analyzed monthly.

Table VII-4

E.P.A. Monitoring Requirements For Mohrland Mine Water Discharge

| Effluent Characteristic | Monitoring Frequency |
|---|---|
| Flow | Monthly |
| Total Suspended Solids | Monthly |
| Total Dissolved Solids | Monthly |
| Total Iron | Monthly |
| Alkalinity-Acidity | Monthly |
| pH | Monthly |
| Oil and Grease | Monthly |
| $BOD_5$ | Quarterly |
| Total Coliforms/100 ML | Quarterly |
| Fecal Coliforms/100 ML | Quarterly |

## 7.2 Surface Water Hydrology

The eastern part of the Wasatch Plateau is part of the Colorado River Basin and is drained by small streams tributary to the Price, San Rafael, and Fremont Rivers, branches of the Green and Colorado Rivers. The west slope of the plateau, a smaller part of the total area, is drained by tributaries of the Sevier River, which flows into Sevier Lake, one of the numerous sinks of the Great Basin. The crest of the plateau is thus part of the divide between the Colorado River and the Great Basin (Spieker, 1931).

The Price River is the largest stream in the plateau and drains about 500 square miles in the northeastern part, rising in the general vicinity of Soldier Summit and Pleasant Valley, and flowing eastward through a narrow canyon in the east front of the plateau, across the northern part of Castle Valley, and north of the Beckwith Plateau to its confluence with the Green River, about 14 miles north of the town of Green River. The Price River is normally a moderate-sized stream, having a mean flow of about 200 second-ft. at Helper, where it emerges from its canyon in the plateau. In the early summer the flow usually reaches a maximum of 800 to 1,200 second-ft., but it varies from year to year, having an extreme recorded maximum of more than 8,000 second-ft. (Spieker, 1931). These conditions are due to the fact that the tributaries of Price River are snowfed, therefore, seasonal fluctuation of flow rates is great. Stream flows are greatest during late spring and early summer, decreasing to a minimum flow in early autumn through mid-winter.

Huntington Canyon is the next large stream south of the Price River. These two waterways are the immediate recipients of surface and groundwater discharge from the U.S. Fuel Company property. Huntington Creek rises on the well-watered plateau surface, flows through a narrow,

deep canyon toward the desert, and joins Cottonwood and Ferrow Creeks to form the San Rafael River which eventually drains into the Green River. Its mean flow, measured near the mouth of Huntington Canyon, is normally about 100 second-ft., its maximum about 600, and its minimum about 30. It drains an area in the plateau of about 160 square miles. The Left Fork of Huntington Creek has been impounded at two places, and the reservoirs are used to equalize the seasonal flow of water for irrigation of Castle Valley in the vicinity of Huntington and Cleveland. The main course of Huntington Creek in the plateau is about 30 miles long (Spieker, 1931).

There are several small drainages discharging surface water from U.S. Fuel Company's property. Miller Creek in the northern part of the property (Exhibit VII-1) is part of the Price River drainage system. Its main tributaries include North Fork (Right Fork on U.S.G.S. maps), Middle Fork and South Fork (Left Fork on U.S.G.S. maps). The main artery of Miller Creek is a perennial stream and the tributaries, except Left Fork of North Fork of Miller Creek, are intermittent. Miller Creek flows just north of the town of Hiawatha into the bottom lands. Miller Creek is used for municipal, industrial and irrigation purposes.

Cedar Creek, with its Left and Right Fork tributaries, is part of the San Rafael River system. Cedar Creek is a perennial stream. The remaining streams draining surface water from the U.S. Fuel Company property are small and in the southern part of the property, thus they are all part of the San Rafael River drainage system. Ben Johnson, Chris Ottison Canyon and the Left and Right Forks of Fish Creek are ephemeral. Bear Creek Canyon and McCadden Hollow are intermittent. Gentry Hollow Creek is tributary to Tie Fork and Huntington Creek which are also part of the San Rafael River system.

The mine plan areas are located in both Cedar and Miller Creek Canyons. U.S. Fuel Company holds numerous water rights to surface water in these two canyons as shown on Table VII-5. A diversion dam in the left fork of the north fork of Miller Creek (Cert. 5294), as shown on Exhibit VII-1, is being used to divert water to an underground storage reservoir in the old Hiawatha No. 2 mine. Water from this reservoir is pumped to a tank in the Middle Fork mine yard where it is used for culinary and mining purposes at the King 4 and 5 mines. Water leaving the mine plan area via Miller and Cedar Creeks is used for irrigation and stock watering purposes at the Millerton and Cedar Creek Ranches, both of which are owned by U.S. Fuel Company.

Table VII-5

Summary of Surface Water Rights

| Water Right | Amount of Water CFS | GPM | Water Use |
|---|---|---|---|
| Miller Creek | | | |
| Certification No. 5294 | 3.300 | 1,481 | Municipal and industrial |
| Cert. No. 2159 | 0.700 | 314 | Irrigation at Millerton Ranch |
| Cert. No. 2347 | 0.240 | 108 | Irrigation at Millerton Ranch |
| Cert. No. A-169 | 0.106 | 48 | Irrigation at Millerton Ranch |
| Cedar Creek | | | |
| Cert. No. 2159 (pending change application Nos. A-6962 and A-6964) | 1.500 | 673 | Irrigation and domestic |
| Cert. No. 107-B | 2.500 | 1,122 | Irrigation at Cedar Creek Ranch |

Note: Deeds to predecessors of U.S. Fuel Company conveyed described lands and all the waters of Cedar Creek. Similar deeds conveyed other lands and all the waters of Miller Creek.

Surface water quantity and quality have been sampled for the stations located on Exhibit VII-1. Table VII-6 lists these stations and analyses. The principal limitation found in the water quality is the total suspended solids criteria. With the advent of sedimentation ponds to capture runoff from disturbed areas, these point source discharges should meet the suspended solids effluent limitation guidelines.

Sedimentation Pond Design Methods

Rainfall and runoff relationships have been determined for critical areas where surface effects of underground mining are expected. Because of different periods of development, several engineering staffs have been involved in the individual sediment pond designs. A report compiled by Vaughn Hansen Associates and supplemented by Rollins, Brown and Gunnell, Incorporated, is incorporated in the appendix of this chapter; and represents the sedimentation pond designs for the following areas:

Hiawatha Mine Yard
Slurry Ponds 3 and 4
Slurry Pond 5-South
Slurry Pond 5-North
Hiawatha Refuse Pile
Upper Coal Storage Yard
Middle Fork Yard
South Fork Yard
Lower Mohrland Yard*
Upper Mohrland Yard - Upper*
Upper Mohrland Yard - Lower*
Upper Mohrland Yard - Combined*

* Revised to accommodate new mine plans.

The sedimentation ponds described above can be located on the surface facilities (Exhibits III-1 to VII-4). The methods of design along with the calculations are located in the appendix of this chapter under the title of the engineering staff that designed the structure. The plan views and cross sections of previously listed sedimentation ponds are shown on Exhibits VII-2 through VII-10.

The sedimentation pond design for Cedar Creek Canyon, King 7 and 8 mine development have been revised in order to accommodate new plans in the surface facilities. The method and calculations were performed by John T. Boyd Company and are presented in the appendix of this chapter. Also, Exhibits VII-14 through VII-18 are the plan view and cross sections for the ponds. Alternative sites have been indicated for the mine development of King 7 and 8, leading to the design of sedimentation ponds that may or may not be selected for construction.

A final sedimentation pond design by U.S. Fuel Company engineering staff is incorporated in the appendix. This sedimentation pond, located on Exhibit III-11, represents a proposed pond for the runoff control from the proposed 42 in. overland conveyor belt at King 6 mine.

Deterioration of surface water from runoff will be minimized using the best engineering alternatives available. Surface water from undisturbed areas will be diverted away from mining operations. Disturbed surface area will be minimized whenever possible. All runoff from disturbed areas under the definition of Utah's Division of Oil, Gas, and Mining will pass through a sedimentation structure.

A hydrologic balance with existing conditions will be maintained. A comprehensive analysis consisting of items in Table VII-7 will be run on samples from each monitoring point to define their initial character. Additional routine sampling and analysis for items listed in Table VII-3 will be determined for each point at intervals specified for individual sites. Monitored data will be organized, tabulated and submitted to the regulatory authority on a quarterly basis. The surface water monitoring stations shown on Exhibit VII-1 are described below:

ST-1 Right Fork of North Fork of Miller Creek. This perennial tributary to Miller Creek will be monitored with a V-notch weir or small Cipolletti weir installed just above the junction with Left Fork. This station will be monitored for flow and analyzed according to Table VII-3 on a monthly basis for a baseline period. Once the system has been defined, sampling will be reduced to a quarterly basis. This site is generally not accessible during winter months.

ST-2 Left Fork of North Fork of Miller Creek. Two stations will be monitored on this perennial tributary. One above the Hiawatha No. 2 mine diversion point (2 A), and one between the diversion point and the junction with Right Fork (2 B). Water will be monitored on a monthly basis for a baseline period then reduced to quarterly monitoring once the system has been defined. Volume measurements will be by V-notch or Cipolletti weirs. Monitoring will be limited to accessible months.

ST-3 Middle Fork of Miller Creek. This tributary is intermittent. A recording station consisting of a suitably sized weir will be installed near the confluence with the North Fork of Miller Creek. Flow measurements will be taken bimonthly. Water samples will be analyzed twice yearly.

ST-4 South Fork of Miller Creek. This tributary is intermittent. A weir will be installed near the confluence with Miller Creek and monitored similarly to Middle Fork.

ST-5 Miller Creek. This significant perennial stream will be monitored with a 3 ft. Cipolletti weir at a point below the confluence of South Fork. Water will be monitored monthly for a baseline period then reduced to quarterly upon approval of the regulatory authority.

ST-6 Cedar Creek. This is a significant perennial stream. It will be monitored at a point below the old Mohrland mine portal. Volume measurements will be by a suitably sized weir. Monitoring will be done on a monthly basis until sufficient baseline data is gathered to justify reduced monitoring.

ST-7 Gentry Hollow Creek. A recording station for the perennial stream will be installed just above the junction with Wild Cattle Hollow. Due to the remote location of this point, we propose monitoring on a semi-annual basis.

## Table VII-7

### Initial Comprehensive Analytical Schedule

Flow Rate
pH
Air and Water Temperature
Specific Conductance
Acidity (as $CACO_3$)
Total Suspended Solids (Surface Water Only)
Total Dissolved Solids
Total Organic Carbon
Calcium
Manganese
Magnesium
Sodium
Potassium
Total Iron
Dissolved Iron
Iron
Carbonate
Fluoride
Bicarbonate
Chloride
Sulfate
Nitrate Plus Nitrite (as N)
Kjeldahl N
Dissolved Phosphorus
Silica
Trace Elements
- Arsenic
- Cadmium
- Zinc
- Selenium

Radioactivity
- Gross Alpha
- Gross Beta

Oil and Grease

## 7.3 Alluvial Valley Floor Determination

As shown on Exhibit V-1, the General Geology map, alluviums exist on the U.S. Fuel Company property in the uplands of Cedar and Miller Creeks. The unconsolidated stream laid deposits created by these creeks are not very extensive due to the nature of the steep, narrow canyons. The creeks are used for irrigation at the floor of the escarpments.

The mining operation's surface facilities are located on benches in the alluviums. The existing and proposed operations will not interrupt, discontinue, or preclude farming on an alluvial valley floor because the bottom lands are undeveloped range land mostly used for grazing. The mining operations are not expected to materially damage the quantity or quality of water in surface and underground water systems that supply water to the bottom lands. The water analysis given in Tables VII-1 and VII-6 for surface and underground water shows no significant changes in water quantity or quality in areas where U.S. Fuel Company mines are currently operating.

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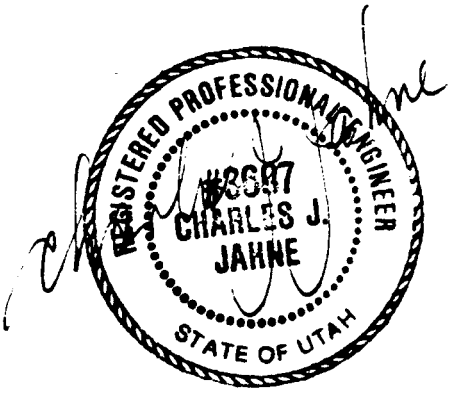
Kent, K.M., A Method For Estimating Volume and Rate of Runoff in Small Watersheds, USDA Soil Conservation Service. SCS-TP-149, 1973.

# HYDROLOGIC INFORMATION

# KING VI MINE AREA

# UNITED STATES FUEL COMPANY

Submitted: December 5, 1980



# HYDROLOGIC INFORMATION - KING VI MINE AREA

GENERAL DISCUSSION:

United States Fuel Company plans to open a new portal at the King Mine location west of Hiawatha, Utah. This portal is to be known as the King VI Mine. The portal is accessible by way of the Miller Creek South Fork Canyon road. Coal mining has been done in the same area in the past, but the property was evacuated in 1973. The South Fork Canyon road fell into disuse during the ensuing years and the road surface has suffered from decay, soil upheaval and general disintegration. The overall plan for the King VI Mine calls for re-paving and improving the South Fork Canyon road, a 42" wide overland conveyor belt some 2100 feet long, a 5,600 ton capacity conical storage pile with reclaiming system and a truck load-out terminal adjacent to the storage pile. This arrangement, of the conveyor belt, the storage pile and the truck load-out, appears on accompanying drawings EST 43-79-G1, G2 and G3.

Hydrologic considerations which have to be addressed as a result of this planned expansion include; capture and storage of run-off water from the disturbed area which will hold the storage pile and truck load-out, capture and control of the run-off water from the undisturbed mountainside and separation of the run-off from the disturbed and undisturbed areas.

Since the new roadway surface that would drain into the new run-off control ditch contributes less than one percent to the overall captured water total, it has been included in the "AREA DRAINED" columns noted in Tables 2 and 3. The area drained was computed by first developing "$\ell$", the hydraulic length, of the mountainside starting at the ridge line and extending to the center of the road. This result was then multiplied by the distance between "W" bearings lines. Previous hydrologic reports submitted by United States Fuel Company and prepared by Vaughan Hansen Associates (August, 1978) and Rollins, Brown and Gunnell, Inc.

(May, 1979) assumed precipitation (P) and curve number (CN) data to be correct. That same data has been assumed correct in this report. Estimated precipitation depths for various return periods and duration are compiled in Table 1 and the curve numbers are noted in Tables 2 and 3.

Table 1

Estimated precipitation depths for various return periods and durations at Hiawatha, Utah (from Richardson, 1971).

| | | DURATION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yrs | 5 Min | 10 Min | 15 Min | 30 Min | 1 Hr | 2 Hr | 3 Hr | 6 Hr | 12 Hr | 24 Hr |
| RETURN PERIOD | 1 | .03 | .04 | .05 | .07 | .09 | .24 | .39 | .76 | 1.09 | 1.43 |
| | 2 | .07 | .10 | .13 | .18 | .23 | .40 | .55 | .95 | 1.30 | 1.67 |
| | 5 | .13 | .20 | .25 | .35 | .44 | .62 | .79 | 1.22 | 1.60 | 2.00 |
| | 10 | .16 | .25 | .31 | .43 | .55 | .75 | .93 | 1.40 | 1.82 | 2.25 |
| | 25 | .23 | .35 | .44 | .62 | .78 | .99 | 1.19 | 1.69 | 2.14 | 2.60 |
| | 50 | .26 | .40 | .50 | .70 | .88 | 1.11 | 1.33 | 1.89 | 2.38 | 2.90 |
| | 100 | .31 | .48 | .60 | .84 | 1.06 | 1.30 | 1.54 | 2.12 | 2.64 | 3.18 |

Two design criteria were decided upon at the start of this study. The first was to include no new culverts under the re-paved South Fork Canyon road, and the second was to use the existing 36" diameter culverts to divert run-off water from the north to the south side of the road. To do this, a stream velocity of five feet per second was assumed in determining the various cross sectional areas of the run-off control ditch. An investigation was made relative to using rip-rap in the run-off control ditch, but it was determined that the

amount of excavation would not change enough to make it worthwhile.

THE OVERLAND CONVEYOR:

A 42" wide, covered, overland belt conveyor, extending from the mine portal to the coal storage pile will be installed for coal transportation. It is the intent of this conveyor that there should be no use of large coal trucks on the steeper portion of the South Fork Canyon road. Attempting to haul heavy loads down a ten percent grade in icy, snowy winter conditions has been considered as an unsafe operation. The conveyor will be covered for its full length and will be serviced and maintained on a daily basis. Spillages occurring along the belt line will be handled as emergencies and will be cleaned up as quickly as possible. From the terrain and the local vegetation, it would appear that clean up will be performed with shovels, wheelbarrows and trucks located on the road.

THE SEDIMENTATION POND:

An excavated sedimentation pond has been chosen rather than one that resides atop the existing terrain. Many shapes were investigated in order to meet volume and surface area requirements, but the steepness of the canyon on the south side of the road necessitated extensive dike fill across the creek and providing a culvert to allow stream passage. The excavated sedimentation pond lends itself to backfilling and re-foresting once there is no further use for it.

The pond will be constructed with the excavation slopes as shown. Where dirt fill is required, it will be placed with a minimum of four inches of topsoil on the crest and down hill slopes and the cover will be reseeded with a variety of native grasses, forbs and shrubs in the autumn. The seeds will be hand broadcast without fertilizer as has been done successfully at the Hiawatha site in the past. A listing of native grasses, forbs and shrubs has been

delivered by the office of Surface Mining to United States Fuel Company and that list will be the basis for the revegetation work performed. Once the use of the sedimentation pond is ended, the stored dirt will be placed in the pond opening, reseeded and shrubbed with the native grasses, forbs and shrubs used to cover the fill dirt while the pond was in use.

WATER DRAINAGE AND SEDIMENT DISPOSAL:

The sedimentation pond has a 24-hour detention capacity and a 0.286 acre feet sediment capacity. Water that has been gathered in the pond can be drained off thru a six inch diameter pipe which is equipped with a gate valve complete with a valve extension. Access to the valve wheel is by way of a wooden platform extending from one side of the pond. The bottom of the pipe is four feet,six inches above the sedimentation storage volume. In this location, the pipe will become the measuring device for determining the time to remove the accumulated sediment.

Once the sediment has accumulated to the bottom of the six inch pipe, it will be hauled to an existing slurry pond located at the Hiawatha, Utah site. All existing sedimentation ponds at the Hiawatha site are emptied of sediment in this fashion. Each has its own discharge monitoring system and water drainage arrangement. Each of these systems and arrangements is included in NPDES discharge permit UT-0023094 and it is one of the intentions of this report that this new sedimentation pond be added to the coverage provided in the above permit.

TABLE 2

UNDISTURBED DRAINAGE AREA DATA

| BEARING | AREA DRAINED Sq.Ft. | Sq.Mi. | CN | $S_1$ | $\ell$ | $\gamma$ | $S_2$ |
|---|---|---|---|---|---|---|---|
| W-11,000 - W-10,500 | 1,078,000 | 0.038 | 70 | 4.28 | 2156 | 53.68 | 0.10 |
| W-10,500 - W-10,000 | 1,052.000 | 0.037 | 70 | 4.28 | 2105 | 50.42 | 0.10 |
| W-10,000 - W- 9,500 | 747,000 | 0.026 | 70 | 4.28 | 1494 | 74.16 | 0.064 |
| W- 9,500 - W- 9,000 | 946,000 | 0.034 | 70 | 4.28 | 1892 | 48.82 | 0.07 |
| W- 9,000 - W- 8,000 | 1,810,000 | 0.065 | 70 | 4.28 | 1810 | 53.0 | 0.07 |
| W- 8,000 - W- 7,000 | 1,592,000 | 0.057 | 70 | 4.28 | 1592 | 54.14 | 0.085 |
| W- 7,000 - W- 6,000 | 1,515,000 | 0.054 | 70 | 4.28 | 1515 | 49.11 | 0.075 |
| W- 6,000 - W- 5,000 | 1,474,000 | 0.053 | 70 | 4.28 | 1474 | 37.53 | 0.085 |
| W- 5,000 - W- 4,000 | 610,000 | 0.022 | 70 | 4.28 | 610 | 43.39 | 0.075 |
| W- 4,000 - W- 3,500 | 225,000 | 0.008 | 70 | 4.28 | 451 | 63.94 | 0.055 |
| W- 3,500 - W- 2,700 | 190,900 | 0.006 | 70 | 4.28 | 238 | 65.00 | 0.094 |

TABLE 3

DISTRUBED DRAINAGE AREA DATA

| BEARING | AREA DRAINED Sq.Ft. | Sq.Mi. | CN | $S_1$ | $\ell$ | $\gamma$ |
|---|---|---|---|---|---|---|
| W-10,000 - W- 9,500 | 125,000 | 0.004 | 90 | 1.11 | 250 | 24.39 |

TABLE 4

UNDISTRUBED DRAINAGE AREA RUN-OFF DATA

| BEARING | P | Q | L | $T_p$ | $q_p$ | v | DITCH AREA |
|---|---|---|---|---|---|---|---|
| W-11,000 - W-10,500 | 2.25 | 0.342 | 0.107 | 0.125 | 50.32 | 5 | 10.06 |
| W-10,500 - W-10,000 | 2.25 | 0.342 | 0.108 | 0.126 | 48.60 | 5 | 19.78 |
| W-10,000 - W- 9,500 | 2.25 | 0.342 | 0.067 | 0.070 | 61.48 | 5 | 12.3 |
| W- 9,500 - W- 9,000 | 2.25 | 0.342 | 0.100 | 0.117 | 48.10 | 5 | 21.92 |
| W- 9,000 - W- 8,850 | 2.25 | 0.342 | 0.093 | 0.109 | 14.80 | 5 | 24.87 |
| W- 8,850 - W- 8,000 | 2.25 | 0.342 | 0.093 | 0.109 | 83.89 | 5 | 16.78 |
| W- 8,000 - W- 7,000 | 2.25 | 0.342 | 0.083 | 0.097 | 97.26 | 5 | 36.23 |
| W- 7,000 - W- 6,000 | 2.25 | 0.342 | 0.084 | 0.098 | 91.20 | 5 | 18.24 |
| W- 6,000 - W- 5,500 | 2.25 | 0.342 | 0.094 | 0.109 | 131.44 | 5 | 26.29 |
| W- 5,500 - W- 5,000 | 2.25 | 0.342 | 0.094 | 0.109 | 40.24 | 5 | 8.05 |
| W- 5,000 - W- 4,000 | 2.25 | 0.342 | 0.043 | 0.050 | 72.83 | 5 | 14.36 |
| W- 4,000 - W- 3,500 | 2.25 | 0.342 | 0.027 | 0.031 | 42.71 | 5 | 23.12 |
| W- 3,500 - W- 2,700 | 2.25 | 0.342 | 0.017 | 0.019 | 52.27 | 5 | 19.00 |

TABLE 5

DISTURBED DRAINAGE AREA RUN-OFF DATA

| BEARING | P | Q | L | $T_p$ | $q_p$ | Sedimentation Pond R.O. Vol. | Sed.Vol. | Spillway Flow |
|---|---|---|---|---|---|---|---|---|
| W-10,000 - W- 9,500 | 2.25 | 1.31 | 0.009 | 0.01 | 149.19 | 0.313 A.F. | 0.286 A.F. | 24,122 GPD |

SAMPLE CALCULATIONS:

1. Formulas Used:

| | |
|---|---|
| $S_1 = (1000 \div CN) - 10$ | Inches |
| $Q = (P - 0.2S_1)^2 \div (P + 0.8S_1)$ | Inches |
| $L = [(\ell)^{0.8} \times (S_1+1)^{0.7}] \div 1,900\sqrt{s}$ | Hours |
| $T_p = 1.17 \times L$ | Hours |
| $A = \ell \times$ Bearing Distances | Square Feet |
| $A_H = A \div 43,560 \times 6\ 40$ | Square Miles |
| $qp = 484 \times A_H \times Q \div T_p$ | Cubic Feet/Seconds |
| $A_D = 8R^2$ | Square Feet |
| $qp = 40R^2$ | Cubic Feet/Seconds |
| R.O. Volume = A x Q ÷ 12 x 43560 | Acre Feet |
| Sed. Storage Volume = 0.1 A ÷ 43560 | Acre Feet |

2. Calculations For Bearing W 8,000-W 7,000 - Tables 2 & 4:

| | |
|---|---|
| $S_1 = (1000 \div 70) - 10 = 4.28$ | Inches |
| $Q = (2.25-0.2 \times 4.28)^2 \div (2.25 + 0.8 \times 4.28) = 0.342$ | Inches |
| $L = [(1592)^{0.8} (4.28+1)^{0.7}] \div 1900\sqrt{54.14} = 0.083$ | Hours |
| $T_p = 1.17 \times 0.083 = 0.097$ | Hours |
| $A = 1592 \times 1000 = 1,592,000$ | Square Feet |
| $A_H = 1,592,000 \div 43,560 \times 640 = 0.057$ | Square Miles |
| $qp = 484 \times 0.057 \times 0.342 \div 0.097 = 97.26$ | Cubic Feet/Second |

Note: Total flow in ditch at these bearings = 97.26 + 83.89 Cubic Feet/Second

| | |
|---|---|
| $R = (181.15 \div 40)^{0.5} = 2.13$ | Feet |
| $A_D = 8 \times 2.13^2 = 36.23$ | Square Feet |

SAMPLE CALCULATIONS (Continued):

4. Calculations For Bearing W 10,000 - W 9,500 - Tables 3 & 5:

$S_1 = (1000 \div 90) - 10 = 1.11$ Inches

$Q = (2.25\text{-}0.2 \times 1.11)^2 \div (2.25 + 0.8 \times 1.11) = 1.31$ Inches

$L = [(250)^{0.8} (1.11+1)^{0.7}] \div 1900 \sqrt{24.39} = 0.014$ Hours

$T_P = 1.17 \times 0.014 = 0.017$ Hours

$A = 250 \times 500 = 125{,}000$ Square Feet

$A_H = 125{,}000 \div 43560 \times 640 = 0.004$ Square Miles

$qp = 484 \times 0.004 \times 1.31 \div 0.017 = 149.19$ Cubic Feet/Second

Sedimentation Pond Volume: (24 Hour Detention)

$V$ Run-Off $= (125{,}000 \div 43560) \times (1.31 \div 12) = 0.313$ Acre Feet

$V$ Sediment Storage $= 0.1 \times 125{,}000 \div 43560 = 0.286$ Acre Feet

Total Pond Volume (Acre Feet) = .599

Sedimentation Pond Surface Area:

$A_S = [125{,}000 \times (1.31 \div 12) \times 7.47] \div 50 = 2039$ Square Feet

Sediment Storage:

$V_{sed.} = 0.286 \times 43{,}560 = 12{,}460$ Cubic Feet

$12{,}460 \times 0.6 = 7476$ Cubic Feet

$V_{below\ 6"\ Pipe} = 116 \times 10 \times 4.5 = 5{,}220$ Cubic Feet

$+ 116 \times 4.5 \times 4.5 = 2{,}349$

$+ 10 \times 4.5 \times 4.5 = 202$

$+ 20 \times 4.5 \times 4.5 = 405$

$8{,}176$ Cubic Feet

SAMPLE CALCULATIONS (Continued):

Sediment Storage:

$V_{\text{above 6" Pipe}} = 0.599 \times 43{,}560 - 8176 - 17{,}916$ Cubic Feet

Storage $= 17{,}916 \times 7.47 = 133{,}836$ Gallons

Avg. Flow Rate $= 1{,}025$ GPM

Est. Time to Drain Pond: $133{,}836 \div 1{,}025 = 2$ Hours, 11 Minutes

# Methods and Calculations for Sedimentation Control Structures In Cedar Creek Canyon, Mohrland Area For United States Fuel Company

By

John T. Boyd Company
Mining and Geological Engineers
November 1980

DAVID J. MORRIS, PROFESSIONAL ENGINEER, UTAH CERTIFICATE NO. 4714, BEING DULY SWORN, CERTIFIES THAT JOHN T. BOYD COMPANY WAS EMPLOYED TO PREPARE THE CONSTRUCTION DRAWINGS AND SPECIFICATIONS FOR THE PROPOSED SEDIMENTATION PONDS AT CEDAR CREEK CANYON, MOHRLAND AREA, EMERY COUNTY, UTAH AND THAT THESE DRAWINGS AND SPECIFICATIONS ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND ARE SUBMITTED FOR APPROVAL.

David J. Morris
David J. Morris, Vice President

SUBSCRIBED AND SWORN TO BEFORE ME THIS 11th DAY OF [illegible] 1981.

City + Co of Denver
State of Colo

Dorothy L. Templeton
Notary Public

My Comm Expires Aug 11, 1982

Method

The following description represents the method of design for the sedimentation ponds No. 1 and 5 (Exhibits VII-14 to 18) in Cedar Creek Canyon for King No. 7 and No. 8 underground mine development. The calculations are based on runoff from disturbed areas only, since all runoff from undisturbed areas will be diverted. From past experience no water will be discharged from the mines for treatemnt.

The runoff volume resulting from a particular rainfall depth was determined using the runoff curve number technique, as defined by the U.S. Soil Conservation Service (1972). According to the curve number methodology, the algebraic and hydrologic relations between storm rainfall, soil moisture storage, and runoff can be expressed by the equations:

$$Q = \frac{(P - 0.25)^2}{P + 0.85} \qquad (1)$$

and

$$S = \frac{1{,}000}{CN} - 10 \qquad (2)$$

Where Q is the direct runoff volume, in inches, S is a watershed storage factor, in inches, defined as the maximum possible difference between P and Q; and CN is a dimensionless expression of S referred to as the curve number. Curve number values were chosen using information supplied by the U.S. Soil Conservation Service (1972), conversations with SCS personnel in Price, Utah and personal hydrologic judgment from field observations. Values of P were obtained for selected durations and return periods as required from the National Oceanic and Atmospheric Administration, Precipitation - Frequency Atlas of the Western United States, Volume VI - Utah, 1973.

Estimates of the peak discharge to be expected from various precipitation events were made using the dimensionless hydrograph method illustrated in Figure VII-1, which was developed by the U.S. Soil Conservation Service

(1972). In this figure, D is the duration of excess rainfall; $t_c$ is the time of concentration, $t_p$ is the time of peak; $t_r$ is the time of recession; $t_b$ is the time of base, with all time units in hours; and $q_p$ is the peak discharge, in cubic feet per second. Five separate hydrograph families have been developed by the U.S. Soil Conservation Service (1972), with the selection of the family of curves to be used based on the curve number and rainfall depth as given in Figure VII-2. According to the dimensionless hydrograph method, one discharge and two time constants are determined from empirical equations and storm distributions. The constants are multiplied by increments of discharge and time from the dimensionless hydrograph to obtain the plotting points of the synthetic hydrograph. Hydrographs from various heterogeneous upstream areas contributing to the same structure (sedimentation pond or culvert) were determined separately for this investigation and added to obtain a composite hydrograph and peak discharge. Because individual hydrographs were not routed through conveyance structures or the proposed pond (see Figure VII-3), the synthetic peak is considered to be a conservative estimate.

Figure VII-1

Dimensionless curvilinear unit hydrograph and equivalent triangular hydrograph (from U.S. Soil Conservation Service, 1972).

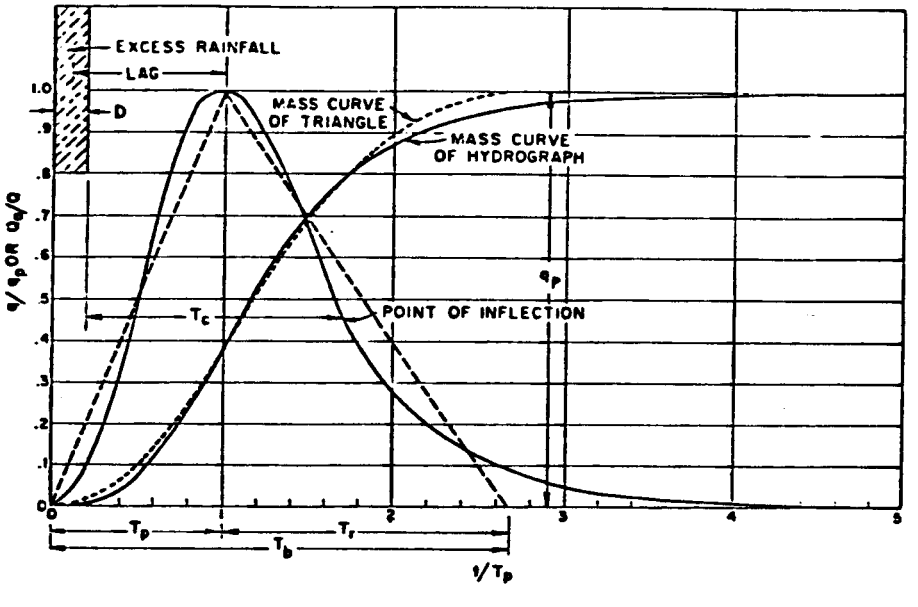


Figure VII-2

Chart for selecting a hydrograph family for a given rainfall and runoff curve number (from U.S. Soil Conservation Service, 1972).

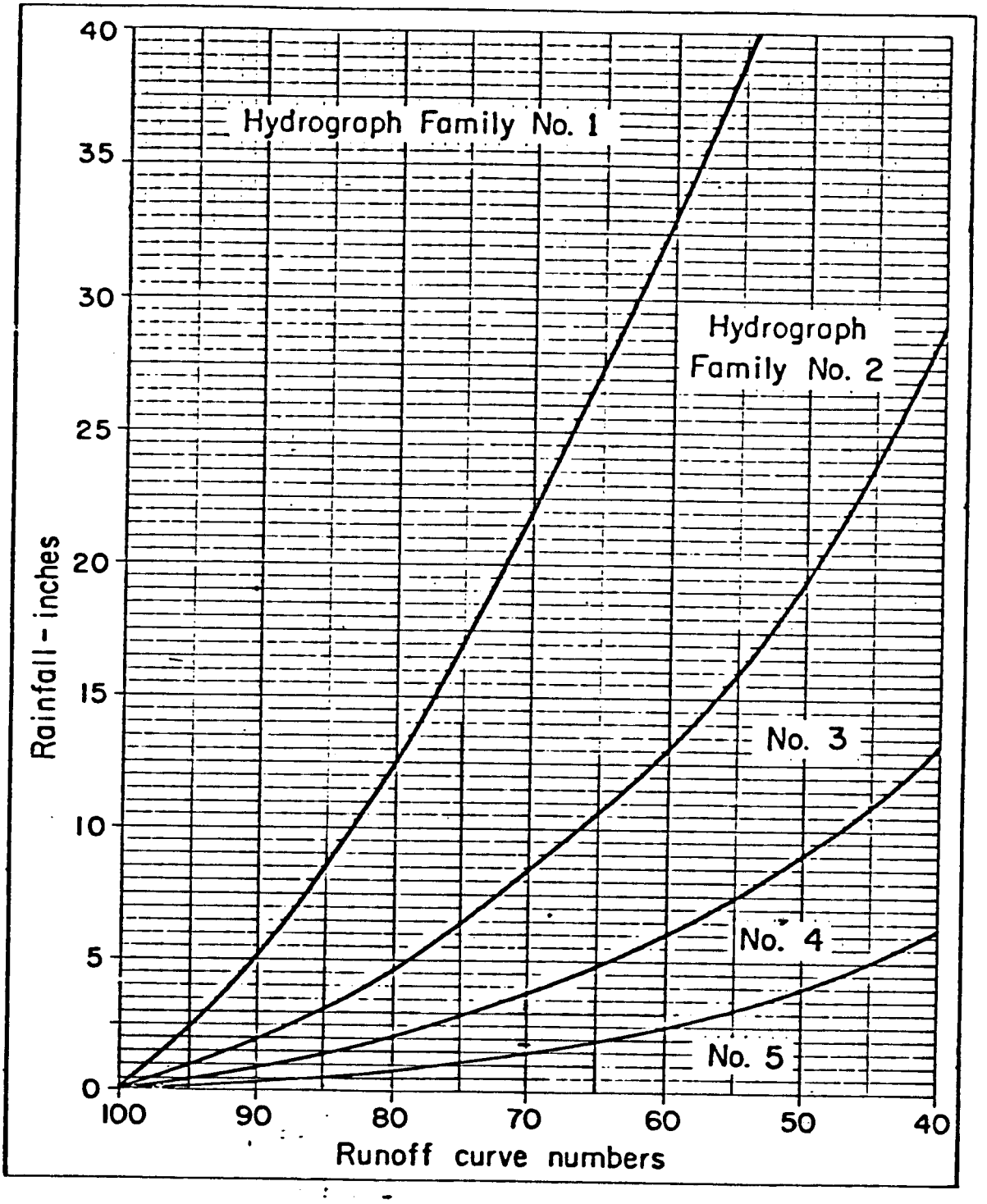
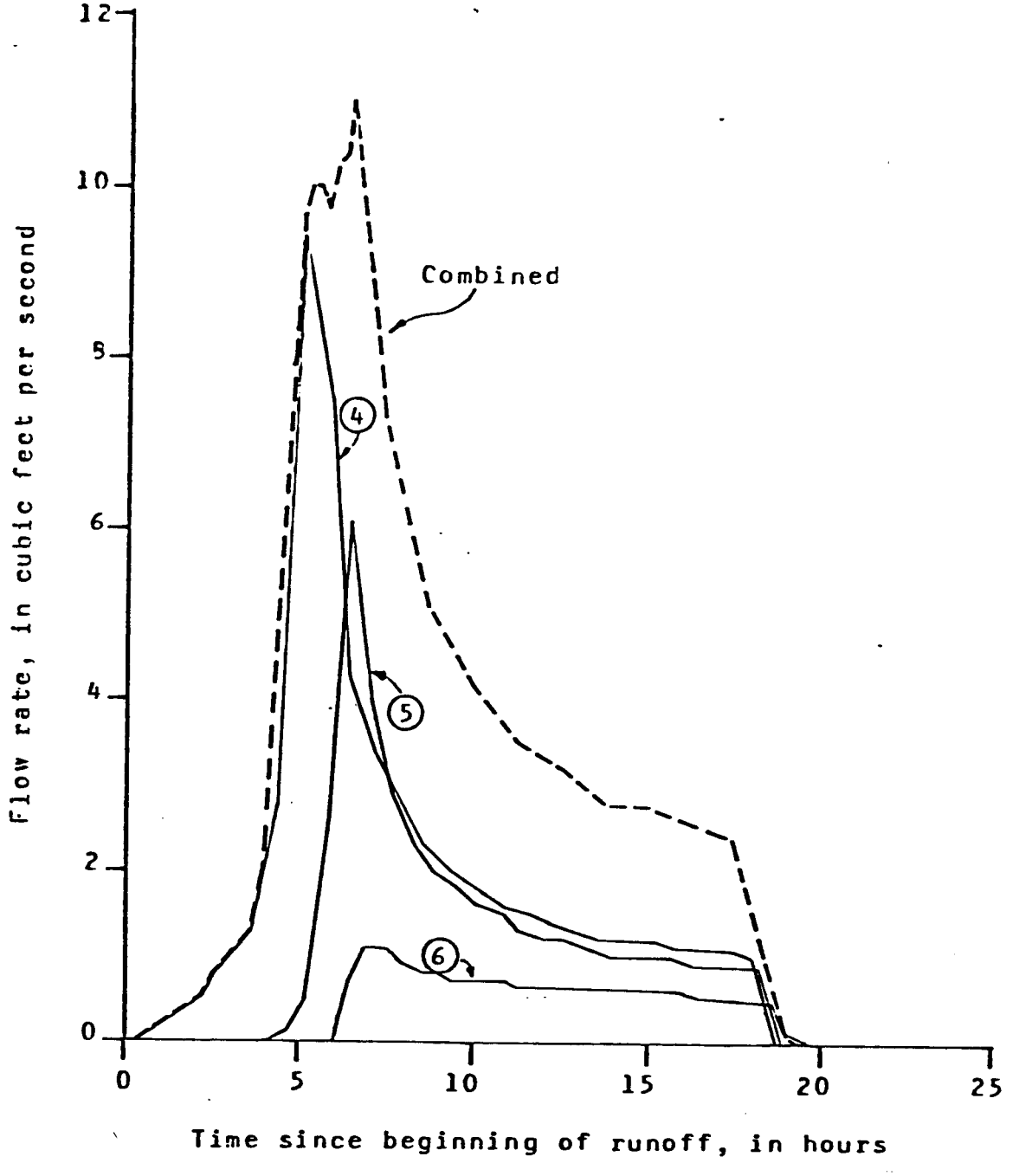


Figure VII-3

Sample individual and composite hydrographs of a complex watershed.



The discharge constant used in the dimensionless hydrograph method is determined according to the equation:

$$q_{pi} = \frac{484\ A\ Q}{t_p} \qquad (3)$$

Where q is the peak discharge constant, in cubic feet per second; A is the drainage area, in square miles; Q is the runoff volume, in inches (as determined by equation 1); $t_p$ is the time elapsed from the beginning of runoff to the hydrograph peak, in hours; and 484 is a constant. $t_p$ is assumed to be a function of watershed lag, which is determined according to the equation:

$$L = \frac{(l^{0.8})\ (s + 1)^{0.7}}{1900\ Y^{0.5}} \qquad (4)$$

Where L is the watershed lag, in hours; l is the hydraulic length, or the length of the mainstram to the farthest divide, in feet; S is as previously defined; and Y is the average watershed slope, in percent. Values of Y were obtained by measuring the lengths (in feet) of selected contour lines within the drainage boundary, multiplying by the selected contour interval (in feet), dividing by the drainage area (in square feet), and multiplying by 100. The hydraulic length was taken from an appropriate topographic map while S was determined from equation 2 once the runoff curve number had been estimated.

According to the U.S. Soil Conservation Service (1972), the watershed lag is equal to 0.6 $t_c$ and the time to peak is equal to 0.7 $t_c$. Combining these two expressions it can be seen that:

$$t_p = 1.17L \text{ and } t_c = 1.67L \qquad (5)$$

where both variables are as previously defined.

The two time constants utilized in the dimensionless hydrograph method are $t_p$ (derived according to equation 5) and $t_o$ or D, the duration of excess rainfall. This latter value was determined using the theoretical Type II storm distribution shown on Figure VII-4 for 24-hour storms and

the design distribution shown in Figure VII-5 for 6-hour storms. According to the curve number method, sufficient precipitation must fall to satisfy initial watershed abstractions before runoff will begin. This depth of rainfall is taken as 0.2S (U.S Soil Conservation Service, 1972), where S is as previously defined. Dividing 0.2S by the total storm depth results in a ratio which can be found on the ordinate of either Figure VII-4 or 5, depending upon the storm duration. The corresponding time on the abscissa of the appropriate figure is the theoretical time from the beginning of rainfall to the beginning of runoff. Subtracting this value from the storm duration results in $t_o$.

Following the determination of a given peak discharge, design sizes for culverts used for ephemeral runoff diversions and conveyance were determined using methods derived by the U.S. Bureau of Public Roads as presented by the U.S. Soil Conservation Service (1972) and illustrated in Figure VII-6. Inlet control was assumed in all cases.

Figure VII-4

24-hour rainfall distributions (from Kent, 1973).

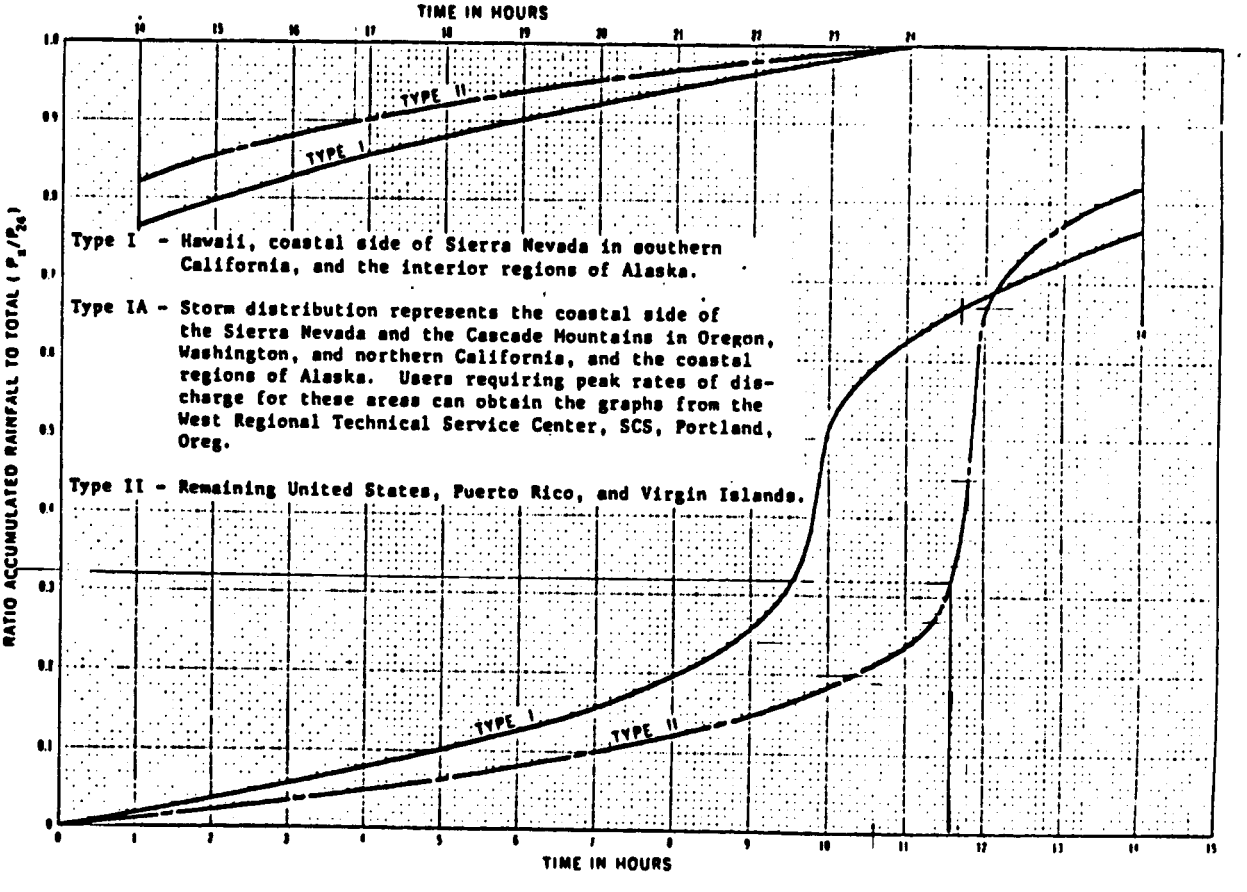


Figure VII-5

6-hour design rainfall distribution (from U.S. Soil Conservation Service, 1972).

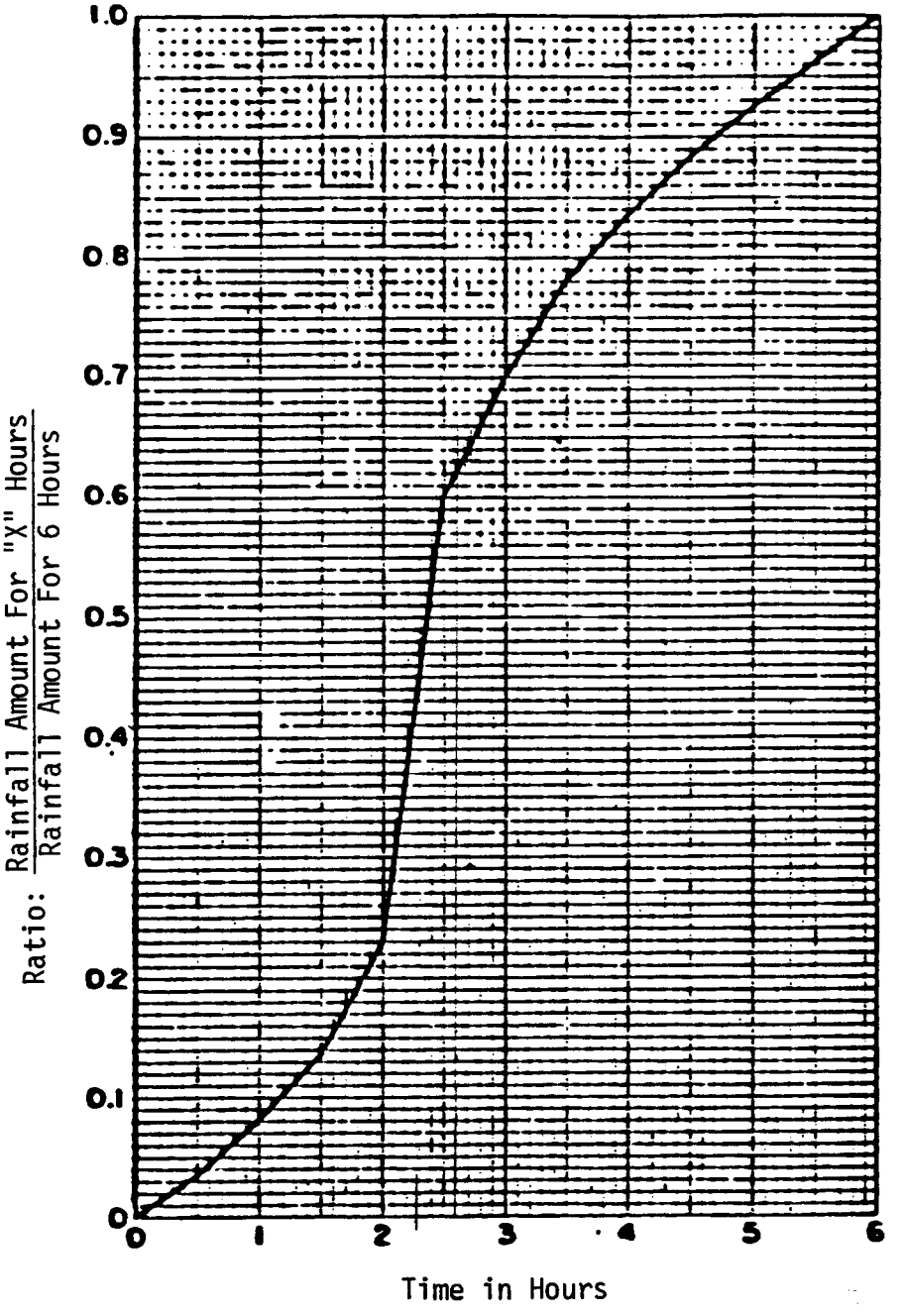
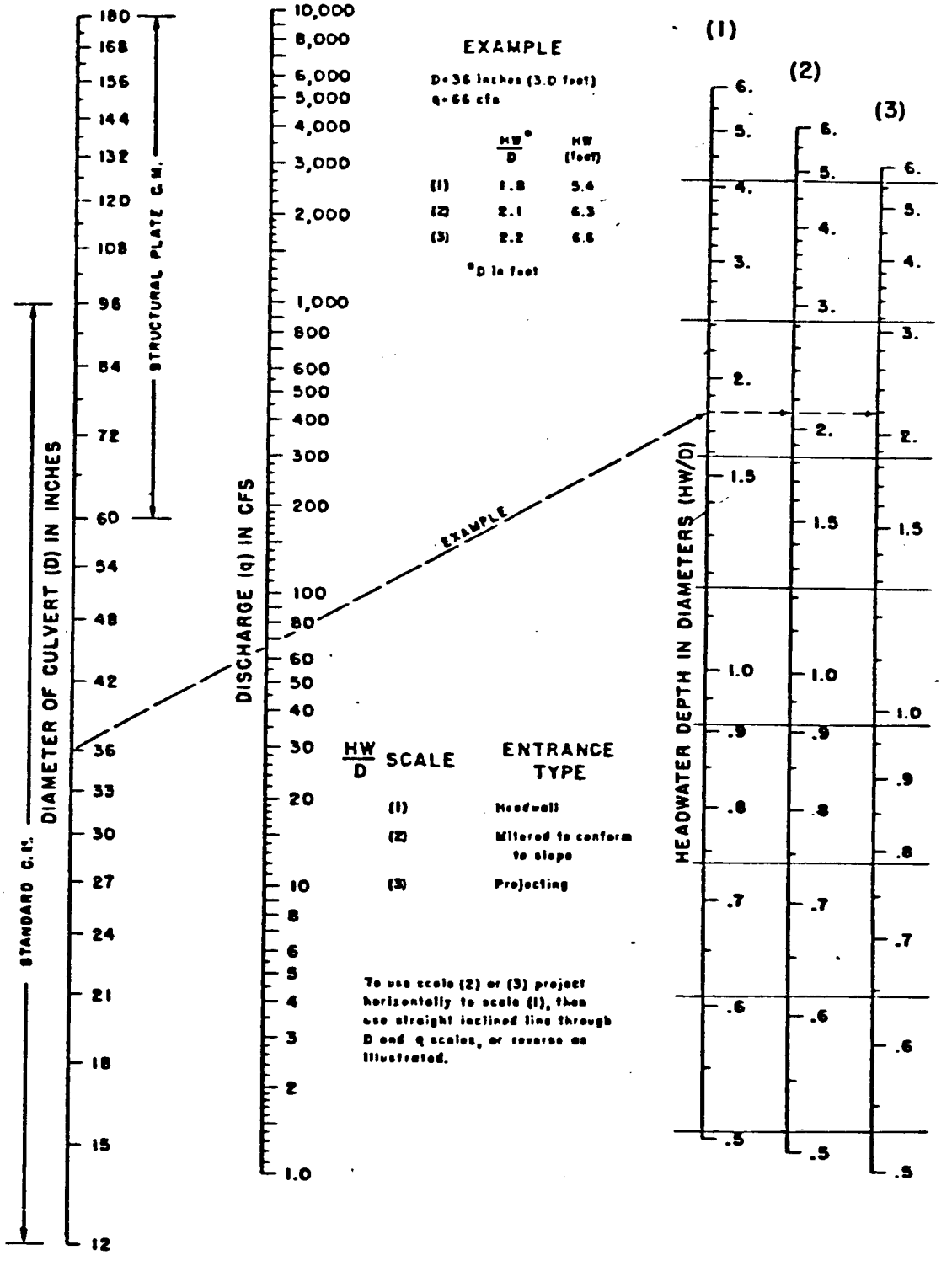


Figure VII-6

Headwater depth for corrugated metal pipe culverts with inlet control (U.S. Soil Conservation Service, 1972).



Sedimentation Ponds - General

Five sedimentation ponds have been designed for the Cedar Creek Canyon, Mohrland underground mines. Not all of the sedimentation ponds are expected to be constructed. Alternative portal sites were selected at this time, when final sites are determined some sedimentation ponds will not be constructed.

The sedimentation ponds were designed according to Utah's Division of Oil, Gas, and Mining, Permanent Program, Surface Effects of Underground Coal Mining Activities Regulations. Each sediment pond is designed to store the runoff from a 10-year, 24-hour precipitation event. In addition to the runoff storage volume retained, each pond was designed to store 0.1 acre foot of volume for each acre of disturbed area within the upstream drainage area. This additional volume, in all probability, could be reduced using standard engineering methods such as the Universal Soil Loss Equation, gully erosion rates, etc.; thus, reducing the required pond design capacity. The methods require a soils investigation of the proposed disturbed areas that, at the time the ponds were designed, was not available. The pond capacities were kept to a minimum by segregating the disturbed area's runoff from the undisturbed area's diversion channels. All structures have been designed using Utah's regulations design criteria.

It was necessary to design the sediment ponds construction within 100 feet of a perennial stream, therefore, a variance is needed to allow the pond to be located within a regulated buffer zone. The variance is requested on the following grounds:

1. The existing terrain limits suitable locations for the ponds without disturbing large areas and incurring unnecessarily large expenses.
2. The main stream channel of Cedar Creek will not be affected by the ponds locations.

3. The flood plain portion of the channel upon which the ponds will be built will be restored to its approximate original contour after the pond is removed.

4. The ponds will not degrade the quality of water in Cedar Creek since all construction precautions will be implemented to stabilize the embankments.

## CALCULATIONS

Definitions:

Runoff Volume = SCS Runoff Curve Number Technique

A = Watershed area (disturbed)
l = Hydraulic length of watershed
h = Elevation difference
CN = Curve number, based on hydrologic soil conditions ('c') recommended by SCS
P = Storm precipitation 10 yr., 24 hr.event
S = Potential maximum retention
Q = Direct runoff volume

Peak Discharge = SCS Dimensionless Hydrograph Method

L = Watershed lay
$t_p$ = Elapsed time from beginning of runoff to the hydrograph peak
$q_{pi}$ = Peak discharge
$t_c$ = Time of concentration
$t_o$ or D = Duration of excess rainfall

Required Design Capacity For Runoff = Hewlett-Packard program

State and federal regulations require that in addition to the runoff volume from a 10 yr., 24 hr. precipitation event be detained in a pond, that 0.1 ac. ft. for each disturbed acre be detained as well.

Inlet Culvert Design

M = Pipe roughness coefficient
D = Pipe diameter, ft.
S = Slope of pipe

Principal Outlet Design = Mynear and Haan (1977)

q = Discharge
a = Cross sectional area of pipe
h = Total head
$K_e$ = Coefficient for entrance loss
$K_b$ = Coefficient for bend loss
$K_p$ = Coefficient for pipe friction
L = Length of pipe

Emergency Spillway Design

R = Hydraulic radius
S = Slope
M = Mannings roughness coefficient
V = Velocity

Sedimentation Pond - Mohrland Area
Railroad Loadout Facility

## Sedimentation Pond No. 1

### Runoff Volume:

A = 8.26 acres = 0.0129 sq. mi.
l = 1,440 ft.
h = 50 ft.
CN = 80
P = 10 yr., 24 hr. storm frequency = 2.0 in.
S = 2.5 in.
Q = 0.56 in.

### Peak Discharge:

L = 0.110 hrs.
$T_p$ = 0.129 hrs.
$Q_{pi}$ = 27.10 cfs
$t_c$ = 0.184 hrs.
$t_o$ or D = 13.3 hrs.

### Required Design Capacity:

The 24 hr. detention time will require 0.384 ac. ft. of runoff storage capacity. The spillway must discharge water at a rate of 0.130 cfs.

### Pond Sediment Storage Requirements:

| | | |
|---|---|---|
| Settling volume: | 10 yr., 24 hr. storm | = 0.384 ac. ft. |
| Sediment volume: | 0.1 ac. ft. x disturbed | = 0.826 ac. ft. |
| Total sediment storage volume | | = 1.210 ac. ft. |

### Pond Design:

Pond capacity requirements:

1.210 ac. ft. = 52,708 cf
include 1.0 ft. freeboard

Pond capacity is approximately 53,404 cf

### Inlet Culvert Design:

Required capacity $q_{pi}$ = 27.10 cfs

Mannings equivalent for pipe flow:

$$q_{pi} = \frac{0.463}{m} D^{8/3} S^{1/2}$$

M = 0.015
D = ?
S = 1.0% = 0.01 ft./ft.

$$27.10 = \frac{0.463}{0.015} D^{8/3} (.0.01)^{1/2}$$

D = 2.25 ft. - use a 27 in. CM pipe flowing full, install headwall.

Principal Outlet Design:

$$q = a\sqrt{\frac{2gh}{1 + K_c + K_b + K_p l}}$$

The required capacity for 24 hr. detention time = 0.130 cfs

$q$ = 0.130 cfs
$a$ = ?
$g$ = 32.2 sq. fps
$H$ = 1.0 ft.
$K_e$ = 1.0
$K_b$ = 0
$K_p$ = 0.105
$L^p$ = 90 ft.

$$0.130 = a\sqrt{\frac{2(32.2)(1.0)}{1 + 1 + 1.105(90)}}$$

a = 0.06 sq. ft.
r = 0.89 in.

Use a 2 in. PVC pipe with a value to restrict flow and a antivortex device.

Emergency Spillway Design

Runoff Volume:

$A$ = 0.0129 sq. mi. = 8.26 ac.
$l$ = 1,440 ft.
$h$ = 50 ft.
CN = 80
$P$ = 25 yr., 24 hr. storm frequency = 2.6 in.
$S$ = 2.5
$Q$ = 0.96 in.

Peak Discharge:

$L$ = 0.110 hrs.
$t_p$ = 0.129 hrs.
$t_c$ = 0.184 hrs.
$D$ = 13.8 hrs.
$q_{pi}$ = 46.46 cfs

The emergency spillway must discharge water at a rate of 46.46 cfs

$$V = \frac{1.49}{m} S^{1/2} R^{2/3}$$

$R$ = 0.67 ft.
$S$ = 0.70% = 0.07 ft./ft.
$M$ = 0.035
$V$ = 2.72 fps
$Q$ = VA = 2.72 (18) = 49.02 cfs which is sufficient

SEDIMENT POND NO. 1
STAGE - STORAGE CHART

| Elevation (Ft.) | Area | | Volume (Ac. Ft.) | |
|---|---|---|---|---|
| | Sq. Ft. | Acres | Incremental | Cumulative |
| 7,086.0 | 4,429 | 0.102 | - | - |
| 7,086.5 | 4,579 | 0.105 | 0.052 | 0.052 |
| 7,087.0 | 4,867 | 0.112 | 0.112 | 0.164 |
| 7,088.0 | 5,259 | 0.121 | 0.121 | 0.285 |
| 7,089.0 | 5,794 | 0.133 | 0.133 | 0.418 |
| 7,090.0 | 6,067 | 0.139 | 0.139 | 0.557 |
| 7,091.0 | 6,519 | 0.150 | 0.150 | 0.707 |
| 7,092.0 | 7,003 | 0.161 | 0.161 | 0.868* |
| 7,093.0 | 7,519 | 0.173 | 0.173 | 1.041 |
| 7,094.0 | 8,067 | 0.185 | 0.185 | 1.226 |
| 7,095.0 | 1.0 ft. freeboard depth | | | |

* 60% clean-out of sediment @ $\approx$ 5.5 ft. depth.

Sedimentation Pond - Mohrland Area
Lower Surface Facilities

## Sedimentation Pond No. 2

### Runoff Volume:

A = 13.90 ac. = 0.01279 sq. mi.
l = 950 ft.
h = 37 ft.
CN = 80
P = 10 yr. 24 hr. event = 2.0 in.
S = .56 in.
Q = 0.56 in.

### Peak Discharge:

L = 0.102 hrs.
$T_p$ = 0.119 hrs.
$Q_{pi}$ = 27.10 cfs
$t_c$ = 0.17 hrs.
$t_o$ or D = 13.4 hrs.

### Required Design Capacity For Runoff:

The 24 hr. detention time will require 0.646 ac. ft. of runoff storage capacity. The spillway must discharge water at a rate of 0.219 cfs.

### Pond Sediment Storage Requirements:

Sediment volume: 0.1 x 13.9 ac. = 1.39 ac. ft.
Total required sediment storage capacity = 2.036 ac. ft.
60% clean-out of sediment @ 5.6 ft. depth

### Pond Design:

Pond capacity requirements:

2.036 ac. ft. = 88,688 cf
include 1.0 ft. freeboard

Pond capacity is 94,976 cf without the 1 ft. freeboard

### Inlet Culvert Design:

Required capacity $q_{pi}$ = 49.42 cfs

$$q_{pi} = \frac{0.463}{m} D^{8/3} S^{1/2}$$

M = 0.015
S = 12% .12 ft./ft.

$$39.42 = \frac{0.463}{0.015} D^{8/3} (.12)^{1/2}$$

D = 1.78 ft. - Use 24 in. CM pipe, install a rock rip-rap concrete headwall at the inlet

Principal Outlet Design:

$$q = a\sqrt{\frac{2gh}{1 + K_e + K_b + K_pL}}$$

q = discharge = .219 cfs
a = ?
g = 32.2 ft./ sq. sec.
H = 1.0 ft.
$K_e$ = 1.0
$K_b$ = 0
$K_p$ = .105
L = 65 ft.

$$.219 = a\sqrt{\frac{2(32.2)(1.0)}{1 + 1 + .105(65)}}$$

a = 0.081 sq. ft. = pi $r^2$
r = 0.091 ft. = 1.09 in.

Use a 2 in. pvc pipe with a antivortex and a valve.

Emergency Spillway Design:

Runoff Volume:

A = .0217 sq. mi. = 13.9 ac.
l = 950 ft.
h = 37 ft.
CN = 80
P = 25 yr., 24 hr. frequency = 2.6 in.
S = 2.5
Q = .96 in.

Peak Discharge:

L = .102 hrs.
$t_p$ = .119 hrs.
$t_c$ = .17 hrs.
D = 13.8 hrs.
$q_{pi}$ = 84.73 cfs

Required Design Capacity:

$$v = \frac{1.49}{m} S^{1/2} R^{2/3}$$

R = hydraulic radius = $\frac{\text{Area of Flow}}{\text{Wetted Perimeter}}$ = .80

S = 0.9% = 0.009 ft./ft.
M = .035
V = 3.48 fps
Q = VA = 3.48(25) = 87.0 cfs which is sufficient

SEDIMENT POND NO. 2
STAGE - STORAGE CHART

| Elevation (Ft.) | Area | | Volume (Ac. Ft.) | |
|---|---|---|---|---|
| | Sq. Ft. | Acres | Incremental | Cumulative |
| 7,020.0 | 84,00 | 0.193 | - | - |
| 7,021.0 | 8,786 | 0.202 | 0.198 | 0.198 |
| 7,022.0 | 9,204 | 0.211 | 0.206 | 0.404 |
| 7,023.0 | 9,654 | 0.222 | 0.217 | 0.621 |
| 7,024.0 | 10,136 | 0.233 | 0.228 | 0.849 |
| 7,025.0 | 10,650 | 0.244 | 0.238 | 1.087 |
| 7,026.0 | 11,196 | 0.257 | 0.251 | 1.338* |
| 7,027.0 | 11,774 | 0.270 | 0.264 | 1.602 |
| 7,028.0 | 12,384 | 0.284 | 0.277 | 1.879 |
| 7,029.0 | 13,026 | 0.299 | 0.292 | 2.171 |

* 60% clean-out at 5.6 ft. depth.

Excavated Sediment Pond Design - Mohrland Area
Portals for Alternative 1A and 2A

## Sedimentation Pond No. 3

### Runoff Volume:

A (Disturbed) = 13.88 ac. = 0.022 sq. mi.
A (total) = 18.37 ac. = 0.029 sq. mi.
L = 2,500 ft.
h = 550 ft.
P = 10 yr., 24 hr. event = 2.50 in.
CN = 80
S = 2.50
Q = 0.89 in.

### Peak Discharge:

L = 0.09 hrs.
$t_p$ = 0.11 hrs.
$q_{pi}$ = 113.6 cfs
$t_c$ = 0.15 hrs.
$t_o$ or D = 13.6 hrs.

### Required Design Capacity for Runoff:

The 24 hr. detention time will require 1.357 ac. ft. of runoff storage capacity. The spillway must discharge at a rate of 0.459 cfs.

### Pond Sediment Storage Requirements:

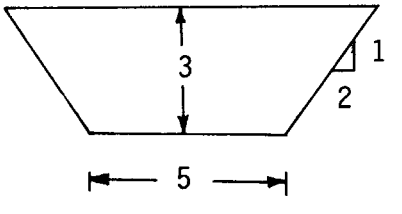
| | | | |
|---|---|---|---|
| Sediment volume | 0.1 x 13.88 | = | 1.388 ac. ft. |
| Total required storage capacity | | = | 2.745 ac. ft. |

### Inlet Channel Design:

$$V = \frac{1.49}{m} S^{1/2} R^{2/3}$$

R = 0.63 ft.
S = 1.0% = 0.01 ft./ft.
M = 0.035
V = 4.05 fps
A = VA = (4.05)(33) = 134 cfs which is sufficient

* Note: Two inlets are designed for this pond, not necessary to use a ditch of this dimension.




d = 3.0 ft.
a = 33.0 sq. ft.
P = 35.4 ft.

Principal Outlet Design:

$$q = a\sqrt{\frac{2gh}{1 + Kc + Kb + K_pL}}$$

$q$ = 0.459 cfs
$a$ = cross sectional area of pipe
$g$ = 32.2 ft./sq. sec.
$H$ = total head = 1.0 ft.
$K_e$ = 1.0
$K_b$ = 0
$K_p$ = 0.015
$L$ = 150 ft.

$$.459 = a\sqrt{\frac{2(32.2)\ 1.0}{1 + 1 + 0.105(150)}}$$

$a$ = 0.24 sq. ft. = pi $r^2$
$r$ = 0.16 ft. = 1.88 in.

Use a 2 in pvc pipe with a value to restrict the flow to 0.459 cfs.

Emergency Spillway Design:

Runoff Volume:

$A$ = 18.37 ac. = 0.029 sq. mi.
$l$ = 2,500 ft.
$h$ = 550 ft.
$P$ = 25 yr., 24 hr. event = 2.9 in.
$CN$ = 80
$S$ = 2.5
$Q$ = 1.18 in.

Peak Discharge:

$L$ = 0.091 hrs.
$t_p$ = 0.106 hrs.
$t_c$ = 0.152 hrs.
$t_o$ or $D$ = 14.4
$q_{pi}$ = 156.25 cfs

Required Design Capacity:

$$v = \frac{1.49}{m} S^{1/2} R^{2/3}$$

$$R = \frac{\text{Area of Flow}}{\text{Wetted Perimeter}} = 1.01$$

$S$ = 1.0% = 0.01 ft./ft.
$M$ = 0.035
$V$ = 4.29 fps
$Q$ = VA = (4.29)(42.0) = 180.0 cfs, which is sufficient.

SEDIMENT POND NO. 3
STAGE - STORAGE CHART

| Elevation (Ft.) | Area | | Volume (Ac. Ft.) | |
|---|---|---|---|---|
| | Sq. Ft. | Acres | Incremental | Cumulative |
| 7,578.00 | 7,394 | 0.170 | - | - |
| 7,579.25 | 7,950 | 0.182 | 0.228 | 0.228 |
| 7,580.50 | 9,031 | 0.207 | 0.259 | 0.487 |
| 7,581.75 | 10,134 | 0.233 | 0.291 | 0.778 |
| 7,583.00 | 11,269 | 0.259 | 0.323 | 1.101 |
| 7,584.25 | 12,444 | 0.286 | 0.357 | 1.458 |
| 7,585.50 | 13,706 | 0.315 | 0.393 | 1.851* |
| 7,586.75 | 14,969 | 0.344 | 0.430 | 2.281 |
| 7,588.00 | 16,300 | 0.374 | 0.468 | 2.749 |

* 60% clean-out elevation depth = 6.50 ft.

Sedimentation Pond Design - Mohrland Area
Hiawatha Seam
Reopening Existing Works Alternative No. 1B
North Side of Cedar Creek

## Sedimentation Pond No. 4

### Runoff Volume:

A = 2.45 ac. = 0.0038 sq. mi.
l = 900 ft.
h = 80 ft.
CN = 80
P = 10 yr., 24 hr. event = 2.5 in.
S = 2.5
Q = .89 in.

### Peak Discharge:

L = 0.075 hrs.
$t_p$ = 0.088 hrs.
$q_{pi}$ = 18.60 cfs
$t_c$ = 0.125 hrs.
$t_o$ or D = Type II Storm = 13.4 hrs.

### Required Design Capacity For Runoff:

The 24 hr. detention time will require 0.181 ac. ft. of runoff storage capacity. The spillway must discharge water at a rate of 0.061 cfs.

### Pond Sediment Storage Requirements:

| | | | |
|---|---|---|---|
| Settling volume | 10 yr., 24 hr. storm | = | 0.181 ac. ft. |
| Sediment volume | 0.1 ac. ft. x disturb. | = | 0.245 ac. ft. |
| Total sediment storage volume | | = | 0.426 ac. ft. |

### Pond Design:

Pond capacity requirements:

0.426 ac. ft. = 18,557 cf
Include 1 ft. of freeboard

Pond capacity is approximately 20,000 cf

### Inlet Culvert Design:

Required capacity $q_{pi}$ = 18.60 cfs

Mannings equivalent for pipe flow:

$$q_{pi} = \frac{0.463}{m} D^{8/3} S^{1/2}$$

M = 0.015
D = ?
S = 50% = 0.005 ft./ft.

$$18.60 = \frac{0.463}{0.015} D^{8/3} (0.005)^{1/2}$$

Principal Outlet Design:

$$q = a\sqrt{\frac{2gh}{1 + K_e + K_b + K_pL}}$$

q = 0.061 cfs
a = ?
g = 32.2 ft./ sq. sec.
H = 1.0 ft.
$K_e$ = 1.0
$K_b$ = 0
$K_p$ = 0.105
L = 70 ft.

Note: A 2 in. pipe with these conditions has a flow (q) capacity = 2.02 cfs.

a = 0.023 sq. ft. = pi $r^2$
r = 0.05 ft. = 0.6 in.

Use a 2 in. pvc pipe with an antivortex device and a valve to restrict the flow to 0.061 cfs will be used.

Emergency Spillway Design:

Runoff Volume:

A = 2.45 ac. = 0.0038 sq. mi.
l = 900 ft.
h = 80 ft.
CN = 80
P = 25 yr., 24 hr. frequency = 2.9 in.
S = 2.5
Q = 1.18 in.

Peak Discharge:

L = o.065 hrs.
tp = 0.076 hrs.
tc = 0.109 hrs.
D = 13.8 hrs.
$q_{pi}$ = 28.56 cfs

Required Design Capacity:

The emergency spillway must discharge water at a rate of 28.56 cfs.

$$v = \frac{1.49}{m} S^{1/2} R^{2/3}$$

R = 0.53 ft.
S = 1.00% = 0.01 ft./ft.
M = .035
V = 2.78 fps
Q = VA = (2.78)(12.0) = 33.39 cfs which is sufficient

SEDIMENT POND NO. 4
STAGE - STORAGE CHART

| Elevation (Ft.) | Area | | Volume (Ac. Ft.) | |
|---|---|---|---|---|
| | Sq. Ft. | Acres | Incremental | Cumulative |
| 7,629.0 | - | - | - | - |
| 7,630.0 | 396 | 0.009 | 0.004 | 0.004 |
| 7,631.0 | 824 | 0.019 | 0.104 | 0.018 |
| 7,632.0 | 1,284 | 0.029 | 0.024 | 0.042 |
| 7,633.0 | 1,776 | 0.041 | 0.035 | 0.077 |
| 7,634.0 | 2,300 | 0.053 | 0.094 | 0.171 |
| 7,635.0 | 2,856 | 0.066 | 0.060 | 0.231* |
| 7,636.0 | 3,444 | 0.079 | 0.072 | 0.303 |
| 7,637.0 | 4,064 | 0.093 | 0.086 | 0.389 |
| 7,638.0 | 4,716 | 0.108 | 0.100 | 0.489 |
| 7,639.0 | 1.0 ft. freeboard | | | |

* 60% clean-out at 5.6 ft. depth.

Sedimentation Pond Design - Mohrland Area
Upper Seam
Alternative Portal No. 2B

## Sedimentation Pond No. 5

### Runoff Volume:

A = 3.01 ac. = 0.0047 sq. mi.
l = 600 ft.
h = 150 ft.
CN = 80
P = 10 yr., 24 hr. event = 2.5 in.
S = 2.5
Q = 0.89 in.

### Peak Discharge:

L = 0.042 hrs.
$t_p$ = 0.0494 hrs.
$q_{pi}$ = 40.98 cfs
$t_c$ = 0.0705 hrs.
$t_o$ or D = 13.4 hrs.
CN = 80, S = 2.5, 0.2S = 0.5
D or $t_o$ = 0.5/2.25 = 0.22 to Type II Storm = 10.6 hrs.
24 hrs = 13.4 hrs.

### Required Design Capacity For Runoff:

The 24 hr. detention time will require 0.223 ac. ft. of runoff storage capacity. The spillway must discharge water at a rate of 0.075 cfs.

### Pond Sediment Storage Requirements:

| | | | |
|---|---|---|---|
| Sediment volume | = 0.1 x 3.01 ac. | = | 0.301 ac. ft. |
| Total required sediment storage capacity | | = | 0.524 ac. ft. |
| 60% clean-out of sediment @ 5.6 ft. depth | | | |

### Pond Design:

Pond capacity requirements:

0.524 ac. ft. = 22,825 cf
Include 1 ft. of freeboard

Pond capacity is approximately 22,869 cf with 0.94 ft. of freeboard.

### Inlet Culvert Design:

Required capacity $q_{pi}$ = 40.98 cfs

Mannings equivalent for pipe flow:

$$q_{pi} = \frac{0.463}{m} D^{8/3} S^{1/2}$$

M = 0.015
S = 50% = 0.005 ft./ft.

$$18.60 = \frac{0.463}{0.015} \; D^{8/3} \; (.005)^{1/2}$$

D = 3.00 ft. - Use 36 in. CM pipe slowing full, install a rock rip-rap or concrete headwall at the inlet.

Principal Outlet Design:

$$q = a \sqrt{\frac{2gh}{1 + K_e + K_b + K_p L}}$$

The required capacity for a 24 hr. detention time was found to be 0.075 cfs, thus:

q = 0.075 cfs
a = ?
g = 32.2 ft./sq. sec.
H = 1.0 ft.
$K_e$ = 1.0
$K_b$ = 0
$K_p$ = 0.105
L = 90 ft.

$$.0075 = a \sqrt{\frac{2(32.2)(1.00)}{1 + 1.0 + 0.105(90)}}$$

a = 0.032 sq. ft. = pi $r^2$
r = 0.06 ft. = 0.6 in.

Use a 2 in. pvc pipe with an antivortex device as shown in the typical drawings and a valve to restrict the flow to 0.075 cfs will be used.

Emergency Spillway Design:

Runoff Volume:

A = 3.01 ac. = 0.0047 sq. mi.
l = 600 ft.
h = 150 ft.
CN = 80
P = 25 yr., 24 hr. frequency = 2.9 in.
S = 2.5
Q = 1.18 in.

Peak Discharge:

L = 0.042 hrs.
$t_p$ = 0.049 hrs.
$t_c$ = .071 hrs.
D = 13.8 hrs.
$q_{pi}$ = 54.78cfs

Required Design Capacity:

The emergency spillway must discharge water at a rate of 54.78 cfs.

Mannings equivalent for open channel flow:

$$v = \frac{1.49}{m} S^{1/2} R^{2/3}$$

$$R = \frac{\text{Area of Flow}}{\text{Wetted Parameter}} = 0.80$$

S = 0.5% = 0.05 ft.ft.
M = .035
V = 2.59 fps
Q = VA = 2.59(25) = 64.75 cfs which is sufficient

SEDIMENT POND NO. 5
STAGE - STORAGE CHART

| Elevation (Ft.) | Area | | Volume (Ac. Ft.) | |
|---|---|---|---|---|
| | Sq. Ft. | Acres | Incremental | Cumulative |
| 8,015.0 | 1,800 | 0.041 | - | - |
| 8,015.5 | 1,894 | 0.043 | 0.021 | 0.021 |
| 8,016.0 | 2,176 | 0.050 | 0.023 | 0.044 |
| 8,017.0 | 2,224 | 0.051 | 0.051 | 0.095 |
| 8,018.0 | 2,484 | 0.057 | 0.054 | 0.146 |
| 8,019.0 | 2,776 | 0.064 | 0.060 | 0.206 |
| 8,020.0 | 3,100 | 0.071 | 0.067 | 0.273 |
| 8,021.0 | 3,456 | 0.079 | 0.075 | 0.348* |
| 8,022.0 | 3,44 | 0.088 | 0.084 | 0.432 |
| 8,023.0 | 4,264 | 0.100 | 0.093 | 0.525 |
| 8,024.0 | 1.0 ft freeboard | | | |

* 60% clean-out at 5.6 ft. depth.

Undisturbed Area Channel Diversion Designs
Cedar Creek Canyon - Mohrland Area

(See Exhibits III-5A and 5B for
Watershed Diversion Locations)

Watershed Diversion No. 1

A = 12.40 ac. = 0.0194 sq. mi.
l = 1,800 ft.
h = 920 ft.
CN = 80
P = 10 yr., 24 hr. precipitation event = 2.5 in.
S = 2.50 in.
Q = 0.89 in.
L = 0.071 hrs.
$t_p$ = 0.083 hrs.
$q_{pi}$ - 100.68 cfs

Mannings Equation for Open Channel Flow

$V = {}^{1.49}/_{m}\, S^{1/2}\, R^{2/3}$
R = 1.04
S = 1.0% = 0.01 ft./ft.
M = 0.035
V = 3.09 fps
Q = VA = 109.26 cfs which is sufficient

Existing ground 50% slope

d = 5.0 ft.
a = 25 sq.ft.
P = 24.24 ft.

Watershed Diversion No. 2

A = 27.55 ac. = 0.043 sq. mi.
l = 2,000 ft.
h = 1,000 ft.
CN = 80
P = 10 yr., 24 hr. precipitation event = 2.5 in.
S = 2.50 in.
Q = 0.89 in.
L = 0.078 hrs.
$t_p$ = 0.091 hrs.
$q_{pi}$ - 203.55 cfs

Mannings Equation for Open Channel Flow

R = 1.35
S = 1.0% = 0.01 ft./ft.
M = 0.035
V = 5.21
Q = VA = 219.92 cfs which is sufficient

Existing ground 50% slope

d = 6.5 ft.
a = 42.3 sq. ft.
P = 31.2 ft.

Watershed Diversion No. 3

A = 20.66 ac. = 0.032 sq. mi.
l = 3,000 ft.
h = 1,080 ft.
CN = 80
P = 10 yr., 24 hr. frequency storm = 2.5 in.
S = 2.50 in.
Q = 0.89 in.
L = 0.128 hrs.
$t_p$ = 0.149 hrs.
$q_{pi}$ = 92.51 cfs

Mannings Equation for Open Channel Flow

R = 1.04
S = 1.0% = 0.01 ft./ft.
M = 0.035
V = 3.09
Q = VA = 109.26 cfs which is sufficient

Existing ground 36% slope

d = 5.0 ft.
a = 25 sq. ft.
P = 24.14 ft.

Watershed Diversion No. 4

A = 72.31 ac. = 0.113 sq. mi.
l = 2,100 ft.
h = 780 ft.
CN = 80
P = 10 yr., 24 hr. frequency storm = 2.0 in.
S = 2.50 in
Q = 0.56 in.
L = 0.095 hrs.
$t_p$ = 0.111 hrs.
$q_{pi}$ = 275.92 cfs

Mannings Equation for Open Channel Flow

R = 1.45
S = 1.0% = 0.01
M = 0.035
V = 5.46
Q = VA = 267.54 cfs which is sufficient

Existing ground 37% slope

d = 7.0 ft.
a = 49 sq. ft.
P = 33.8 ft.

# PROGRAM DESCRIPTION I



Program Title: Flood Routing - Triangular Hydrograph Assumptions

Contributor's Name: Ralph R. Sacrison

Address: Kaiser Steel Corporation Box 1107

City: Raton State/Country: N M Zip Code: 87740

Program Description, Equations, Variables: This program assists in the design of run-off storage structures and/or sedimentation ponds. The user must know the minimum data for this program:

A - Watershed area(acres).
L - Hydraulic length of the watershed(distance between the most remote location and the watershed outlet, ft.).
H - Elevation difference along the hydraulic length(ft.).
V - Volume of runoff over the watershed(in.).
$qp_i$ - Peak runoff flow($ft^3/s$).

Optional input data include:

$t_c$ - Time of concentration(amount of time runoff requires in flowing along the hydraulic length, hrs.).

CN - The Soil Conservation Service Runoff Curve Number.

The first card in the program computes the time to peak($t_p$) for the inflow hydrograph. The second card completes inflow calculations and

Necessary Accessories: NONE.

Operating Limits and Warnings: This method of flood routing should not be considered for watersheds of greater than 10 sq.mi..

Reference(s):
1. National Engineering Handbook, Section 4, 'Hydrology,' Chap. 15, USDA, SCS, 1972.
2. Hydrology and Sedimentology of Surface Mined Lands, C.T.Haan, B.J. Barfield, University of Kentucky, Lexington, KY, 1978.
3. Engineering Field Manual for Conservation Practices, Chap. 2 (rev. 10/73 for New Mexico). USDA, SCS.

## PROGRAM DESCRIPTION I

### Flood Routing - Triangular Hydrograph Assumptions

determines the outflow hydrograph. The detention time and storage requirements are computed. As a final option, the outlow base time(tbo) may be altered and a new outflow rate ($qp_o$) computed.

CARD I

The first card computes the time to peak runoff($t_p$) for a given rainfall event and watershed geometry.

$$t_p = t_L + D/2 \qquad (1)$$

where $t_L$ is the lag time and D is the time duration of the rainfall excess(1,2). The lag time is commonly estimated by one of the following approaches:

SCS Empirical Method

$$t_L = 0.6\ t_c \qquad (2)$$

SCS Curve Number Method

$$t_L = \frac{L^{0.8}(S+1)^{0.7}}{1900(Y)^{\frac{1}{2}}} \qquad (3)$$

where S =(1000/CN)-10 and Y is the slope in percent.

The $t_c$ may be found from a number of methods(1,2,3). If the value is not available, the program employs an empirical method based upon studies from plowed and fallow fields(2):

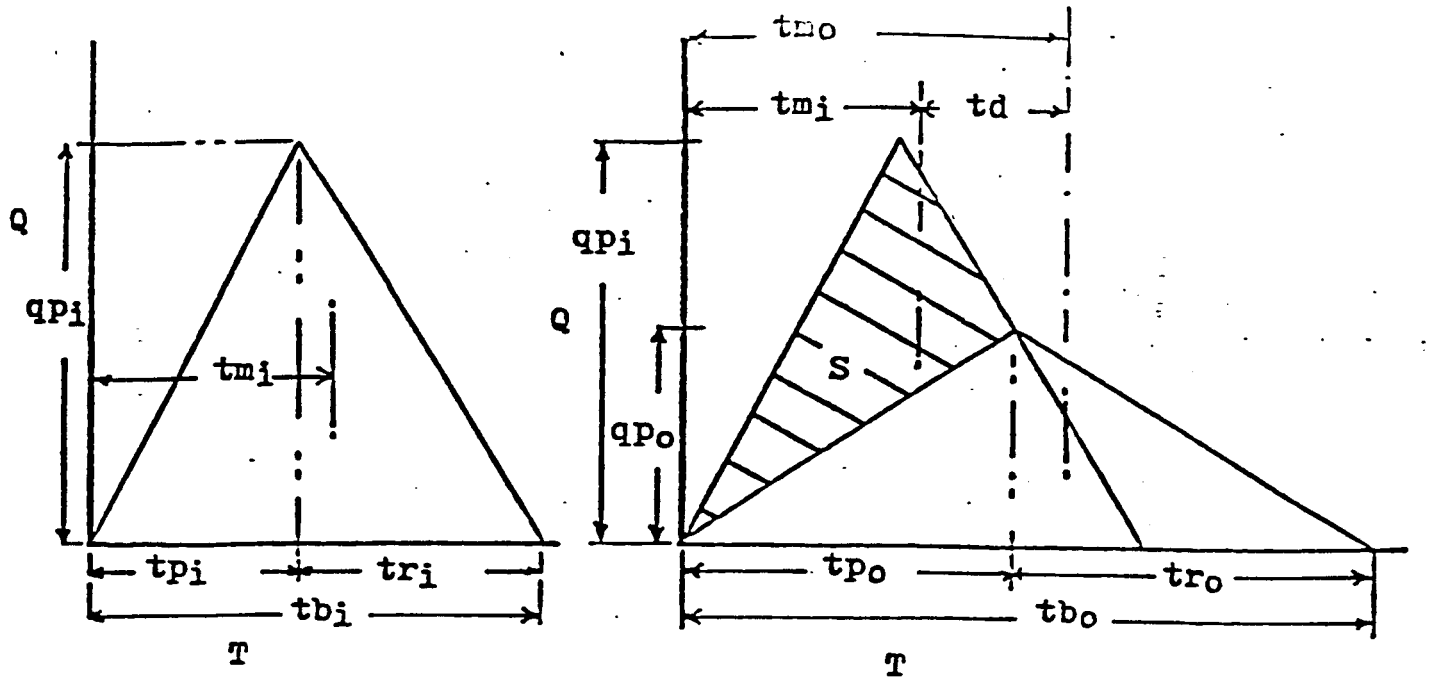
$$t_c = \frac{0.0078\ L^{.77}(L/H)^{.385}}{60} \qquad (4)$$

Equation 1 requires an assumption on the magnitude of the rainfall excess, D. The ratio $t_p$:D ranges from 3 to 5, with 4 a common value.

CARD II

The second card performs the actual flood routing. Figure 1 illustrates the hydrographs. The equations employed are labelled. The units and quantities are described below. The subscript i denotes inflow, o denotes outflow.

$tb_i, tb_o$ - hydrograph time base(hr.).
$qp_i, qp_o$ - peak flow(in/hr).
$tm_i, tm_o$ - time to centroid(hr.).




Q - in/hr
T - hr

(a) $tb = 2V/qp$

(b) $tm = \frac{qp(tp)}{6V}\left[\frac{2tp^2}{tb} + \frac{tr}{tp}(tr + 3tp)\right]$

(c) $Q^* = (tb_i - tr_i\ qp_o/qp_i)qp_o/V$

(d) $f(Q^*) = 1/3\left[\frac{Q^{*3}}{2} - Q^{*2} + Q^* + 2\right]$

(e) $qp_o = f(Q^*)\ V/(td + tm_i)$

(f) $tp_o = tb_i - tr_i\ qp_o/qp_i$

(g) $S = tb_i(qp_i - qp_o)/2$

FIGURE 1

Idealized inflow and inflow/outflow hydrographs(from 2.)

In equations (a) and (b), the like subscripts will solve for the appropriate base and centroid times.

Equations (c),(d), and (e) are solved recursively to produce a value for $qp_o$. In the algorithm presented, the difference between $qp_o(i)$ and $qp_o(i-1)$ is decreased to a tolerance level. The initial value taken is $qp_i$. This approach is chosen to minimize coding.

# PROGRAM DESCRIPTION I

## Flood Routing - Triangular Hydrograph Assumptions

$tp_i, tp_o$ - time to peak flow(hr.).
$tr_i, tr_o$ - time to recede(hr.).
$Q^*$ - the value relating $qp_o$ to the inflow hydrograph.
$f(Q^*)$ - the function of $Q^*$, a cubic shown in eqn(d).
S - the storage volume required for the given hydrographs(in.).

The inflow hydrograph is constructed using the values entered for peak flow($qp_i$), area(A), and direct runoff(V). The time-to-peak($tp_i$) value calculated on CARD I is used to determine the centroid time($tm_i$).

A main concern of sediment pond design is the detention time achieved in the pond. This is defined as:

$$td = tm_o - tm_i$$

A desired detention time is entered, and employed to arrive at the necessary peak outflow rate($qp_o$). The $qp_o$, found from the iterative procedure shown in FIG. 1, allows the computation of the peak outflow time($tp_o$). This, in turn, allows the calculation of the rest of the outflow hydrograph points; $tb_o, tr_o$, and $tm_o$. The outflow centroid time can then be used to provide a check on the desired detention time*.

Another approach in the design of sediment control ponds is to employ a set outflow base(or release) time. Thus, the program allows the calculation of a peak outflow rate(and entire outflow hydrograph) using a desired release time, $tb_o$.

---

* This actual detention time provides an indirect check on the calculation of $qp_o$. Equation (e) computes $qp_o$, which is accepted when a tolerance is reached between $qp_o(i)$ and $qp_o(i-1)$. When accepted, $tp_o$, hence $tm_o$, is calculated. Thus, a discrepancy in desired vs. actual detention times can be related directly to the accuracy of the routine selecting $qp_o$.
In the existing program, a tolerance of 0.0001 is thought sufficient in the selection of $qp_o$.

# PROGRAM DESCRIPTION II



**Sample Problem (Sketch if Desired)**

Determine the inflow/outflow hydrographs for a 58.10 acre watershed having a 3000 ft hydraulic length and a 225 ft vertical drop. Chapter 2 of the Engineering Field Manual for Conservation Practices gives a tc of 0.170 hr, a $qp_i$ of 91.77 $ft^3/s$, and a direct runoff volume V of 1.35 in.

The necessary storage(S) and peak outflow($qp_o$) are sought for both a 24-hr detention time and a 96-hr release.

**Conclusion:**

The 24-hr detention time will require 6.380 ac-ft of capacity. The spillway must discharge water at the rate of 2.195 $ft^3/s$.

Designing to the 96-hr release requires 6.419 ac-ft of water storage. The spillway must discharge at the rate of 1.648 $ft^3/s$.

**SOLUTION:**

| Input | Function | Display | Comments |
|---|---|---|---|
| (CARD I) | | | |
| 0.17 | B | 0.170,SPC,0.102 | tc,tL |
| 4 | E | 4.000,0.117 | tp,D,tpi |
| RD II) | | | |
| 91.77 | ENTER | | |
| 58.1 | ENTER | | |
| 1.35 | A | 91.770,58.100,<br>1.350,SPC,1.566,<br>1.724,1.607,0.608 | qpi,A,V,qpi(in/hr),tbi,tri,<br>tmi |
| | | | |
| 24 | B | 24.000,SPC,16.000<br>0.048,0.682,SPC,<br>0.037,2.195,1.685,<br>72.062,70.377,<br>24.557,23.948,<br>1.318,6.380 | td,i,Q*,f(Q*),qpo,qpo($ft^3/s$)<br>tpo,tbo,tro,tmo,td,S(in),<br>S(ac-ft) |
| | | | |
| 96 | E | 96.000,0.028,<br>1.648,1.695,<br>96.000,94.305,<br>32.545,31.937,<br>1.326,6.419 | td,qpo,qpo($ft^3/s$),tpo,tbo,<br>tro,tmo,td,S(in),S(ac-ft) |

Sample Problem (Sketch If Desired)

- The concentration time used in the preceeding example has been questioned and you are asked to recompute the hydrographs using only the gross physical aspects of the watershed. The runoff volume and peak inflow will remain the same.

Conclusion:

On the basis of the results of the CARD I calculations, you determine there will no material change in the outflow rates nor the storage requirements.

SOLUTION:

| Input | Function | Display | Comments |
|---|---|---|---|
| (CARD I) | | | |
| 225 | ENTER | | |
| 3000 | A | 3000.00, 225.000, | L, H, tc, $t_L$ |
| | | 0.168, SPC, 0.101 | |
| 4 | E | 4.000, 0.115 | tp:D, tpi |

# USER INSTRUCTIONS



| EP | INSTRUCTIONS | INPUT | FUNCTION | SIZE: (HP-41C) DISPLAY |
|---|---|---|---|---|
| 1 | LOAD CARD I(side 1) | | | |
| 2 | Select the desired option and | | | |
| | enter the necessary values: | | | |
| | Solve for $tc = .0078L^{.77}\frac{L}{H}^{.385}$ | H | ENTER | |
| | | L | A | L, H, tc, $t_L$ |
| | OR: enter the time of concentration. | tc | B | tc, $t_L$ |
| | OR: enter the SCS Curve Number, | CN | ENTER | |
| | elevation difference and | H | ENTER | |
| | hydraulic length. | L | C | CN, H, L, $t_L$ |
| 3 | Enter the tp:D ratio | tp:D | E | tp:D, $tp_i$ |
| | LOAD CARD II(both sides) | | | |
| 5 | Enter peak inflow, $qpi(ft^3/s)$, | $qp_i$ | ENTER | |
| | drainage area, A(ac); and runoff volume, V(in). (All subsequent | A | ENTER | |
| | flow in (in/hr), volume in (in), time in (hr) unless otherwise noted) | V | A | $qp_i$, A, V, SPC, $qpi, tb_i, tr_i, tm_i$, SPC |
| 6 | Enter desired detention time | td | B | td, SPC, i, Q*, f(Q*), SPC, $qp_o$, $qp_o(ft^3/s)$ $tp_o$, $tb_o$, $tr_o$, $tm_o$, td, S, S(ac-ft) |
| 7 | Enter desired outflow base time | $tb_o$ | E | $tb_o$, $qp_o$, $qpo(ft^3/s)$, $tp_o$, $tb_o$, $tr_o$, $tm_o$, td, S, S(ac-ft) |
| | Return to step 1 for any new values or to correct errors. | | | |
| | NOTE: Steps 6 and 7 must be performed in that order. | | | |

# PROGRAM LISTING



☐ 67 ☒ 97 ☐ 41C

(CARD I)

| STEP/ LINE | KEY ENTRY | KEY CODE (67/97 only) | COMMENTS |
|---|---|---|---|
| 01 | *LBLA | 21 11 | Compute $t_c$ from eqn. (4). |
| 02 | STO3 | 35 03 | |
| 03 | PRTX | -14 | |
| 04 | X ↔ Y | -41 | |
| 05 | PRTX | -14 | |
| 06 | STO2 | 35 02 | |
| 07 | % | -24 | |
| 08 | . | -62 | |
| 09 | 3 | 03 | |
| 10 | 8 | 08 | |
| 11 | 5 | 05 | |
| 12 | Y↑X | 31 | |
| 13 | RCL3 | 36 06 | |
| 14 | . | -62 | |
| 15 | 7 | 07 | |
| 16 | 7 | 07 | |
| 17 | Y↑X | 31 | |
| 18 | . | -62 | |
| 19 | 0 | 00 | |
| 20 | 0 | 00 | |
| 21 | 7 | 07 | |
| 22 | 8 | 08 | |
| 23 | * | -35 | |
| 24 | * | -35 | |
| 25 | 6 | 06 | |
| 26 | 0 | 00 | |
| 27 | % | -24 | |
| 28 | *LBLB | 21 12 | Compute $t_L$ from eqn. (2). |
| 29 | DSP3 | -63 03 | |
| 30 | PRTX | -14 | |
| 31 | . | -62 | |
| 32 | 6 | 06 | |
| 33 | * | -35 | |
| 34 | GTOD | 22 14 | |
| 35 | *LBLC | 21 13 | Compute $t_I$ from eqn. (3). |
| 36 | STO3 | 35 03 | |
| 37 | R↓ | -31 | |
| 38 | STO2 | 35 02 | |
| 39 | R↓ | -31 | |
| 40 | STO1 | 35 01 | |
| 41 | PRTX | -14 | |
| 42 | 1/X | 52 | |
| 43 | 1 | 01 | |
| 44 | 0 | 00 | |
| 45 | 0 | 00 | |
| 46 | 0 | 00 | |
| 47 | * | -35 | |
| 48 | 9 | 09 | |
| 49 | - | -45 | |
| 50 | . | -62 | |
| 51 | 7 | 07 | |
| 52 | Y↑X | 31 | |
| 53 | RCL3 | 36 03 | |
| 54 | . | -62 | |
| 55 | 8 | 08 | |
| 56 | Y↑X | 31 | |
| 57 | * | -35 | |
| 58 | RCL2 | 36 02 | |
| 59 | PRTX | -14 | |
| 60 | RCL3 | 36 03 | |
| 61 | PRTX | -14 | |
| 62 | % | -24 | |
| 63 | 1 | 01 | |
| 64 | 0 | 00 | |
| 65 | 0 | 00 | |
| 66 | * | -35 | |
| 67 | . | -62 | |
| 68 | 5 | 05 | |
| 69 | Y↑X | 31 | |
| 70 | 1 | 01 | |
| 71 | 9 | 09 | |
| 72 | 0 | 00 | |
| 73 | 0 | 00 | |
| 74 | * | -35 | |
| 75 | 1/X | 52 | |
| 76 | * | -35 | |
| 77 | *LBLD | 21 14 | Print $t_L$ |
| 78 | DSP3 | -63 03 | |
| 79 | SPC | 16-11 | |
| 80 | PRTX | -14 | |
| 81 | STO0 | 35 00 | |
| 82 | R/S | 51 | |
| 83 | *LBLE | 21 15 | Compute tp (inflow) and store in $R_1$. Clear all other registers for use by CARD II. |
| 84 | PRTX | -14 | |
| 85 | 2 | 02 | |
| 86 | * | -35 | |
| 87 | 1/X | 52 | |
| 88 | 1 | 01 | |
| 89 | X↔Y | -41 | |
| 90 | - | -45 | |
| 91 | 1/X | 52 | |
| 92 | RCL0 | 36 00 | |
| 93 | * | -35 | |
| 94 | PRTX | -14 | |
| 95 | SPC | 16-11 | |
| 96 | CLRG | 16-53 | |
| 97 | STO1 | 35 01 | |
| 98 | R/S | 51 | |
| 00 | | | |

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# PROGRAM LISTING



☐ 67 ☒ 97 ☐ 41C (CARD II)

| STEP/ LINE | KEY ENTRY | KEY CODE (67/97 only) | COMMENTS |
|---|---|---|---|
| | *LBLA | 21 11 | Initialize; con |
| 02 | CF0 | 16 22 00 | vert $qp_i$ to |
| 03 | STOA | 35 11 | in/hr. |
| 04 | R↓ | -31 | |
| 05 | STOB | 35 12 | |
| 06 | R↓ | -31 | |
| 07 | PRTX | -14 | |
| 08 | RCLB | 36 12 | |
| 09 | PRTX | -14 | |
| 10 | / | -24 | |
| 11 | 4 | 04 | 12(in/ft) * |
| 12 | 3 | 03 | 3600 (s/hr) |
| 13 | 2 | 02 | |
| 14 | 0 | 00 | |
| 15 | 0 | 00 | |
| 16 | * | -35 | |
| 17 | 4 | 04 | 43560($ft^2$/ac.) |
| 18 | 3 | 03 | |
| 19 | 5 | 05 | |
| 20 | 6 | 06 | |
| 21 | 0 | 00 | |
| 22 | / | -24 | |
| 23 | STO6 | 35 06 | $qp_i$(in/hr) |
| 24 | RCLA | 36 11 | |
| 25 | PRTX | -14 | |
| | SPC | 16-11 | |
| 27 | R↓ | -31 | |
| 28 | PRTX | -14 | |
| 29 | SF2 | 16 21 02 | |
| 30 | GSB1 | 23 01 | |
| 31 | GSB2 | 23 02 | |
| 32 | SPC | 16-11 | |
| 33 | R/S | 51 | |
| 34 | *LBLB | 21 12 | Enter $t_d$. |
| 35 | STO2 | 35 02 | (desired time) |
| 36 | PRTX | -14 | |
| 37 | RCL6 | 36 06 | Use $qp_i$ as |
| 38 | STO9 | 35 09 | initial $qp_o$. |
| 39 | *LBLC | 21 13 | |
| 40 | GSB3 | 23 03 | |
| 41 | ABS | 16 31 | |
| 42 | 1 | 01 | |
| 43 | EEX | -23 | |
| 44 | 4 | 04 | If .0001 |
| 45 | CHS | -22 | DIFF, accept |
| 46 | X>Y? | 16-34 | $qp_o$. |
| 47 | GTOD | 22 14 | |
| 48 | RCLE | 36 15 | |
| 49 | CHS | -22 | |
| 50 | 2 | 02 | |

| STEP/ LINE | KEY ENTRY | KEY CODE (67/97 only) | COMMENTS |
|---|---|---|---|
| 51 | / | -24 | |
| 52 | ST+9 | 35-55 09 | Recompute $qp_o$. |
| 53 | GTOC | 22 13 | |
| 54 | *LBLD | 21 14 | |
| 55 | SPC | 16-11 | |
| 56 | RCLI | 36 46 | i |
| 57 | PRTX | -14 | |
| 58 | RCLC | 36 13 | Q* |
| 59 | PRTX | -14 | |
| 60 | RCLD | 36 14 | f(Q*) |
| 61 | PRTX | -14 | |
| 62 | SPC | 16-11 | |
| 63 | *LBLd | 21 16 14 | |
| 64 | RCL9 | 36 09 | $qp_o$(in/hr) |
| 65 | PRTX | -14 | |
| 66 | 4 | 04 | |
| 67 | 3 | 03 | |
| 68 | 5 | 05 | |
| 69 | 6 | 06 | |
| 70 | 0 | 00 | |
| 71 | * | -35 | |
| 72 | RCLB | 36 12 | |
| 73 | * | -35 | |
| 74 | 4 | 04 | |
| 75 | 3 | 03 | |
| 76 | 2 | 02 | |
| 77 | 0 | 00 | |
| 78 | 0 | 00 | |
| 79 | / | -24 | |
| 80 | PRTX | -14 | $qp_o$($ft^3$/s) |
| 81 | RCL9 | 36 09 | |
| 82 | RCL6 | 36 06 | Eqn. (f) |
| 83 | / | -24 | |
| 84 | RCL8 | 36 08 | $tr_i$ |
| 85 | * | -35 | |
| 86 | CHS | -22 | |
| 87 | RCL7 | 36 07 | $tb_i$ |
| 88 | STO0 | 35 00 | |
| 89 | + | -55 | |
| 90 | STO1 | 35 01 | $tp_o$ |
| 91 | PRTX | -14 | |
| 92 | RCL6 | 36 06 | |
| 93 | RCL9 | 36 09 | |
| 94 | X ⇔ Y | -41 | |
| 95 | STO9 | 35 09 | |
| 96 | ↓R | -31 | |
| 97 | STO6 | 35 06 | |
| 98 | GSB1 | 23 01 | |
| 99 | RCL3 | 36 03 | $tm_i$ |
| 00 | F0? | 16 23 00 | |

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☐ 67 ☑ 97 ☐ 41C

(CARD II) con.

| STEP/LINE | KEY ENTRY | KEY CODE (67/97 only) | COMMENTS |
|---|---|---|---|
| 01 | RCL5 | 36 05 | |
| 102 | STO5 | 35 05 | |
| 103 | GSB2 | 23 02 | |
| 104 | RCL5 | 36 05 | $tm_i$ |
| 105 | - | -45 | |
| 106 | PRTX | -14 | actual $t_d$. |
| 107 | RCL9 | 36 09 | $qp_i$ |
| 108 | RCL6 | 36 06 | $qp_o$ |
| 109 | - | -45 | |
| 110 | 2 | 02 | Eqn. (g). |
| 111 | % | -24 | |
| 112 | RCL0 | 36 00 | $tb_i$ |
| 113 | * | -35 | |
| 114 | PRTX | -14 | S(in) |
| 115 | 1 | 01 | |
| 116 | 2 | 02 | |
| 117 | % | -24 | |
| 118 | RCLB | 36 12 | A(ac.) |
| 119 | * | -35 | |
| 120 | PRTX | -14 | S(ac-ft) |
| 121 | SPC | 16-11 | |
| 122 | R/S | 51 | |
| 123 | *LBL1 | 21 01 | Sub. 1. |
| 124 | 1/X | 52 | Compute $tb_i$, tr. |
| 125 | RCLA | 36 11 | Eqn. (a). |
| 126 | * | -35 | |
| 127 | 2 | 02 | |
| 128 | * | -35 | |
| 129 | PRTX | -14 | |
| 130 | STO7 | 35 07 | tb |
| 131 | RCL1 | 36 01 | tp |
| 132 | - | -45 | |
| 133 | PRTX | -14 | tr |
| 134 | STO8 | 35 08 | |
| 135 | F2? | 16 23 02 | First time thru |
| 136 | STO4 | 35 04 | store $tr_i$ in |
| 137 | RTN | 24 | R4. |
| 138 | *LBL2 | 21 02 | Sub. 2. |
| 139 | RCL1 | 36 01 | Compute tm, |
| 140 | 3 | 03 | eqn. (b). |
| 141 | * | -35 | |
| 142 | RCL8 | 36 08 | tr |
| 143 | + | -55 | |
| 144 | RCL8 | 36 08 | |
| 145 | * | -35 | |
| 146 | RCL1 | 36 01 | |
| 147 | % | -24 | |
| 148 | RCL1 | 36 01 | |
| 149 | $X^2$ | 53 | |
| 150 | 2 | 02 | |

| STEP/LINE | KEY ENTRY | KEY CODE (67/97 only) | COMMENTS |
|---|---|---|---|
| 151 | * | -35 | |
| 152 | RCL7 | 36 07 | tb |
| 153 | % | -24 | |
| 154 | + | -55 | |
| 155 | RCL1 | 36 01 | tp |
| 156 | * | -35 | |
| 157 | RCL6 | 36 06 | qp |
| 158 | * | -35 | |
| 159 | RCLA | 36 11 | V(in) |
| 160 | % | -24 | |
| 161 | 6 | 06 | |
| 162 | % | -24 | |
| 163 | PRTX | -14 | |
| 164 | STO3 | 35 03 | tm |
| 165 | RTN | 24 | |
| 166 | *LBL3 | 21 03 | Sub. 3. |
| 167 | RCL8 | 36 08 | Compute eqn. |
| 168 | * | -35 | (c)&(d). |
| 169 | RCL6 | 36 06 | $qp_i$ |
| 170 | % | -24 | |
| 171 | CHS | -22 | |
| 172 | RCL7 | 36 07 | $tb_i$ |
| 173 | + | -55 | |
| 174 | RCL9 | 36 09 | $qp_o$ |
| 175 | * | -35 | |
| 176 | RCLA | 36 11 | V |
| 177 | % | -24 | |
| 178 | STOC | 35 13 | Q* |
| 179 | 3 | 03 | |
| 180 | Y^X | 31 | $(Y \wedge X)$ or $X \leq Y$? |
| 181 | .2 | 02 | |
| 182 | % | -24 | |
| 183 | RCLC | 36 13 | |
| 184 | $X^2$ | 53 | |
| 185 | - | -45 | |
| 186 | RCLC | 36 13 | |
| 187 | + | -55 | |
| 188 | 2 | 02 | |
| 189 | + | -55 | |
| 190 | 3 | 03 | |
| 191 | % | -24 | |
| 192 | STOD | 35 14 | f(Q*) |
| 193 | RCLA | 36 11 | V |
| 194 | * | -35 | |
| 195 | RCL2 | 36 02 | td |
| 196 | RCL3 | 36 03 | $tm_i$ |
| 197 | + | -55 | |
| 198 | % | -24 | |
| 199 | CHS | -22 | |
| 200 | RCL9 | 36 09 | $qp_o(i)$ |

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☐ 67 ☑ 97 ☐ 41C (CARD II) con.

| STEP/ LINE | KEY ENTRY | KEY CODE (67/97 only) | COMMENTS |
|---|---|---|---|
| 01 | + | -55 | DIFF=$qp_o(i)$ - |
| 202 | STOE | 35 15 | $qp_o(i-1)$ |
| 203 | ISZI | 16 26 46 | ← RTN |
| 204 | *LBLE | 21 15 | Revise $qp_o$ to |
| 205 | RCL9 | 36 09 | fit desired |
| 206 | STO6 | 35 06 | $tb_o$. |
| 207 | X≷Y | -41 | exchange X and Y |
| 208 | PRTX | -14 | |
| 209 | SF0 | 16 21 00 | |
| 210 | 1/X | 52 | |
| 211 | RCLA | 36 11 | V |
| 212 | * | -35 | |
| 213 | 2 | 02 | Eqn. (a). |
| 214 | * | -35 | |
| 215 | STO9 | 35 09 | $qp_o$ |
| 216 | RCL0 | 36 00 | |
| 217 | STO7 | 35 07 | $tb_i$ |
| 218 | RCL4 | 36 04 | $tr_i$ |
| 219 | STO8 | 35 08 | |
| 220 | GTOd | 22 16 14 | |
| 221 | R/S | 51 | |
| 30 | | | |
| 40 | | | |
| 50 | | | |
| 51 | | | |
| 60 | | | |
| 70 | | | |
| 80 | | | |
| 90 | | | |
| 00 | | | |

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# REGISTERS, STATUS, FLAGS, ASSIGNMENTS

## DATA REGISTERS

| | | | |
|---|---|---|---|
| 0 | $tb_i$ | | |
| 1 | $tp_i, tp_o$ | | |
| 2 | td(desired) | | |
| 3 | $tm_i, tm_o$ | | |
| 4 | $tr_i$ | | |
| 5 | $tm_i, tm_o$ | | |
| 6 | $qp_i, qp_o$ | | |
| 7 | $tb_i, tb_o$ | | |
| 8 | $tr_i, tr_o$ | | |
| 9 | $qp_i, qp_o$ | | |
| | | | |
| A | V(in.) | | |
| B | A(ac.) | | |
| C | Q* | | |
| D | f(Q*) | | |
| E | DIFF | | |
| I | i | | |

## STATUS

SIZE _____ TOT. REG. _____ USER MODE

ENG _____ FIX 3 SCI _____ ON ____ OFF ____

DEG X RAD ____ GRAD _____

## FLAGS

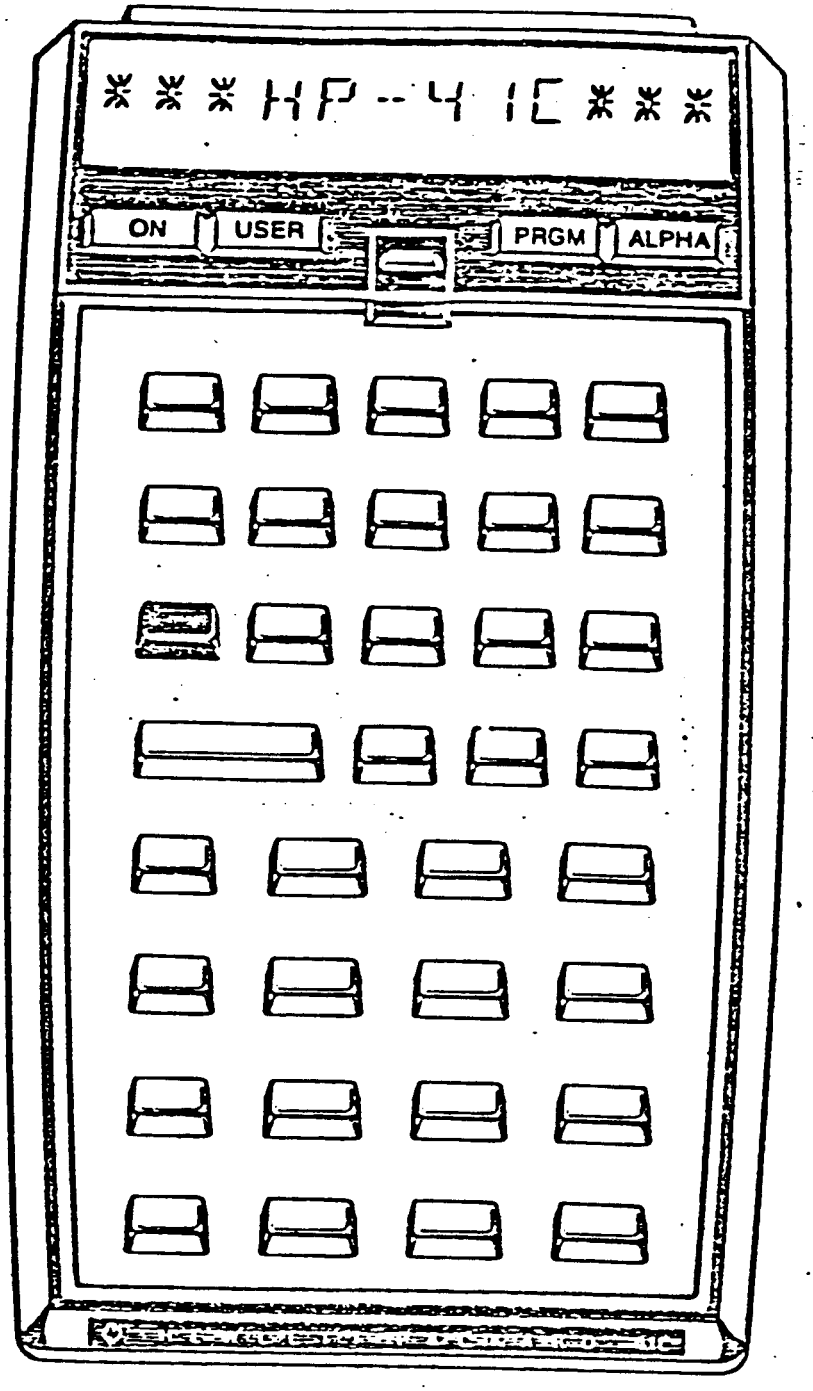
| # | INIT S/C | SET INDICATES | CLEAR INDICATES |
|---|---|---|---|
| 0 | C | | 1st time thru LBLd, save $tm_i$. |
| | | 2nd time thru LBLd, recall $tm_i$. | |
| 2 | S | 1st time thru SUBRTN 1, save $tr_i$. | |
| | | | 2nd time thru, do not save $tr_o$. |

## ASSIGNMENTS

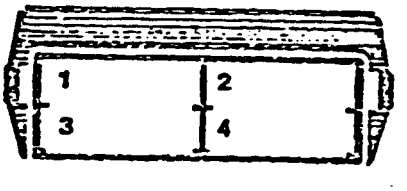
| FUNCTION | KEY | FUNCTION | KEY |
|---|---|---|---|
| | | | |

# CARD LABELING

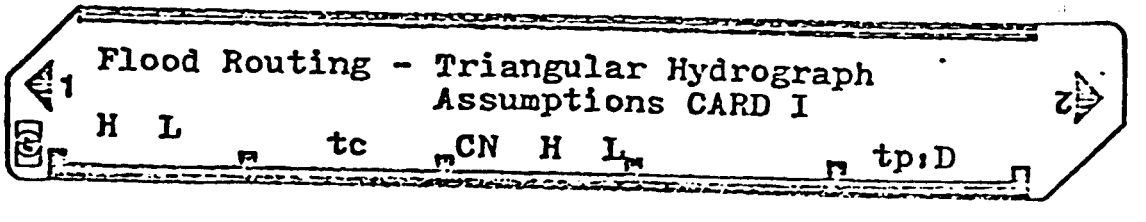
KEYBOARD




SYSTEM CONFIGURATION

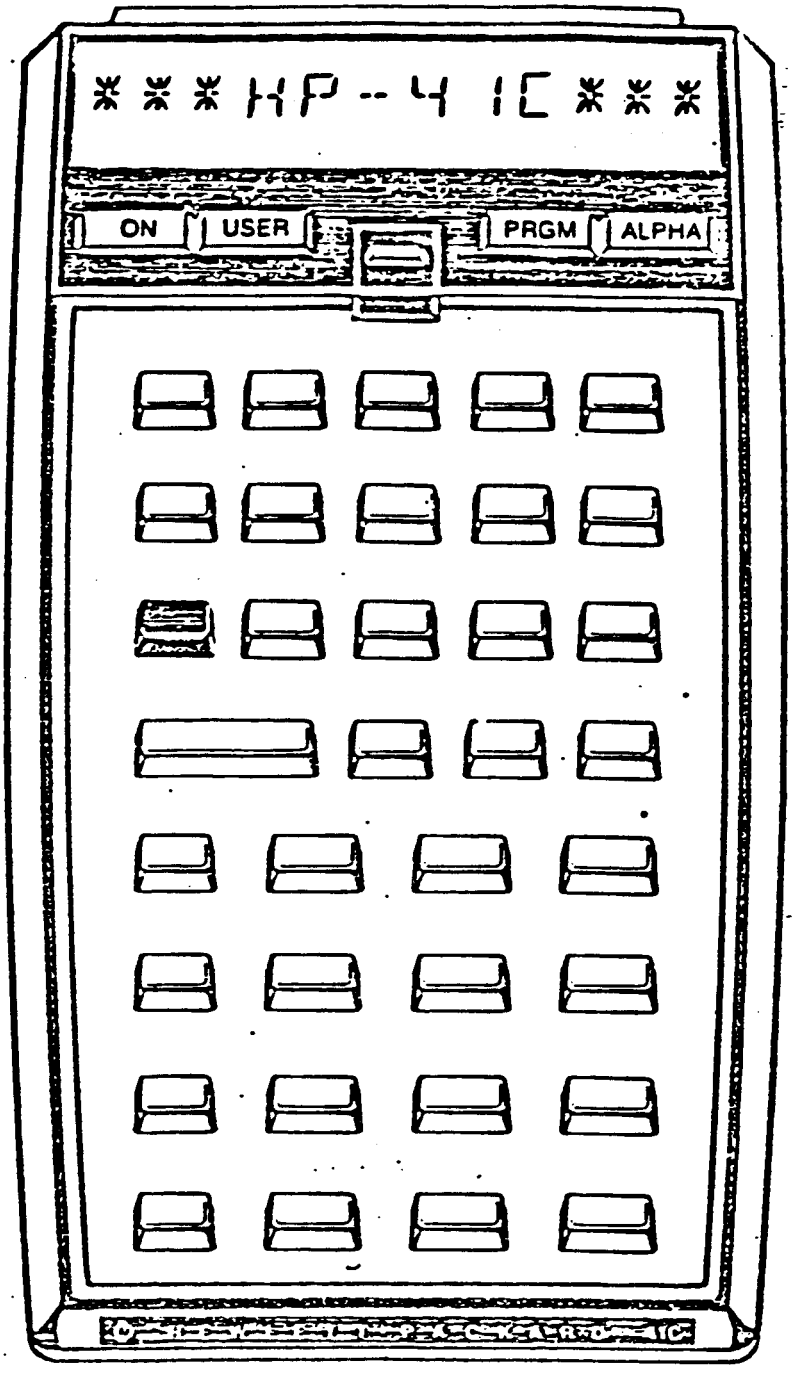



CARD

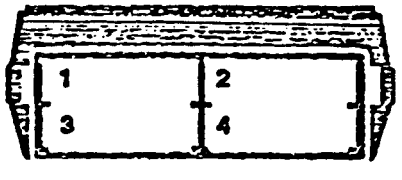


# KEYBOARD CARD LABELING

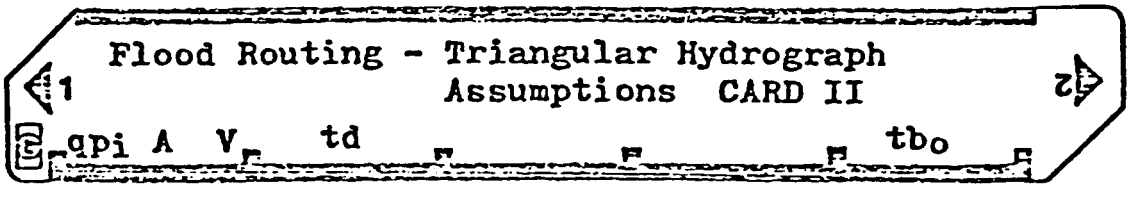
KEYBOARD




SYSTEM CONFIGURATION




CARD



UMC 783.15 GROUND WATER INFORMATION (ACR RESPONSE)

The ground water system for the Wasatch Plateau is quite complicated due to faulting, joints and the dip of the formations. Very little is known about the relationship of these multiple geologic features on the hydrologic regime. Data is lacking and inconclusive with respect to the small portion that is recorded. In some cases data may be difficult to obtain or may not even relate to the area of interest.

"Directions and rates of ground water movement from the recharge to the discharge areas are controlled largely by geologic structures and variations in rock permeability. Because of faults and the dip of the rock strata, some ground water passes from one surface drainage basin to another. Considering the locations of faults, the gentle dip of rock strata, and overall rock permeability it is generally believed that most of the ground water that originates in a given drainage basin is also discharged somewhere within that basin. However, on a local level, the springs in Tie Fork Canyon and Bear Canyon which are tributary to Huntington Creek appear to be fault related and could be fed by sources that would otherwise be tributary to the Price river."[1]

It is believed that most water enters the rocks above the coal seam principally from the higher plateaus where the most snow and rain falls. This water has the potential of eventually finding its way to the coal seams.[1]

At the King 4 mine portal, water has been observed draining from the coal-roof interface of a rider seam above the B seam during years of high spring runoff.

1. United States Department of the Interior, BLM, "Uinta-Southwest Utah Coal Region, Round II Draft EIS.

During surface drilling programs conducted in 1976 and 1977, water was encountered in most of the 11 drill holes drilled at the elevation of about the base of the Flagstaff Limestone-top of the North Horn Formation. This particular horizon is usually a peril in surface drilling programs and was in this case also. The holes lost circulation at this level (about 300 feet below the drill collar) and no measurements of ground water flow or records of depth or quality were made.

No holes have been drilled since the eleven that were drilled prior to the Surface Mining and Reclamation Act. No data is available for depths to ground water encountered by the drill holes.

No significant amount of information concerning depths to ground water encountered by mine workings has been collected but some observations have been made. Ground water (or in-mine water was also encountered when mine workings advanced against the Bear Canyon fault. The fault was intercepted by westward mining of the B seam at an elevation of about 8180 feet. A description of this location is provided in Ch. VI, page three along with information relating to the north-south trending fault in the middle of the mine property.

No prominent water bearing joint or fracture systems have been observed in the coal seams or overlying roof rock. Seepage occurs in the mine workings to a certain extent. This indicates that water does percolate down through the strata to some unknown degree.[1] Joints and fractures within the coal and roof allow some water contained in the rock above to drain into the open works. A sandstone roof would be the most permeable type of roof lending to moist conditions until the supply of water is exhausted, while shale and mudstone don't allow the percolation of water as easily. Joint and fracture

patterns are most commonly observed in sympathetic orientation usually directly responding to extraneous elements imposed upon the coal seam (e.g. faults, horizontal off-set, channelization).

The cleat orientation for the Gentry Mountain region appears to be N73°W and from N 25°E to N 25°W.

Jointing, where it can be observed, is approximately east-west and in some places inclined from 60°- 70° to the south. This feature or its orientation has not been found to have any particular significance in relation to water infiltration of mine works.

Discharge from the Mohrland portal occurs at 7700 feet. Due to the dip of the beds in the mine property, this portal controls the discharge of water occuring in the old works north of this point. A large portion probably comes from workings adjacent to the Bear Canyon fault.

To answer the question of whether water can percolate through the entire geologic section with a definite yes or no would require a substantial amount of drilling and monitoring at a very high cost.

Underground, the wet conditions and water flow are confined basically to fault zones and sandstone channels affecting the coal seam.

A more extensive account of drill holes and what water they encountered is presented on page four of Ch. VII.

In the case of drill hole #13, which was drilled down 950 feet from the surface, it produced only about one gallon per minute from its overall height to where it was observed intercepting the B seam.

Several old drill holes (drilled from the Hiawatha seam up to the B seam quite some time ago) have been observed. None appeared to to producing

water. The mine doesn't appear to have significant perched water between or above the seams being mined. Only drill hole #72-8, drilled approximately 1500 feet east of the Bear Canyon fault, produced water (about three gallons per minute). This hole, drilled vertically, was 93 feet high and is shown on the General Surface and Subsurface Water Hydrology Map, Exhibit VII. More details are provided in Ch. VII, page four.

Due to the interbedding of sandstone and shale, a large percentage of penetrating surface water probably is intercepted by the more impermeable shale beds. Several of our monitored springs occur in the lower portion of the North Horn Formation just above the Price River Formation and are probably a result of the impermeability of the lower beds.

No information is available on aquifers in the Hiawatha or Mohrland areas. We are not aware of any aquifers above that mentioned in the literature i.e. the Ferron Sandstone.

Wells drilled into the Mancos Shale would prove rather poor due to the lack of permeability in the shale and the high amount of dissolved solids. The Ferron Sandstone member is the most extensive aquifer near to the surface that could be used as a water supply. This formation lies about 2000 feet below the town of Hiawatha but has never been tested. The town of Emery, about 40 miles to the south obtains water from the lower portion of the Ferron Sandstone at a rate of 150 to 250 gallons per minute with 790 mg/l dissolved solids.[2]

2. "Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal Fields Area, Utah" Geological Survey Water Supply Paper 2068, United States BLM and United States Environmental Protection Agency.

Precise knowledge of ground water depths and aquifers in the Miller and Cedar creek drainage areas is quite limited as no wells or borings have been drilled into the alluvial fill in the vicinity of the mine property. The majority of the available information and data relating to ground water has been reported already in Ch. VII, page 3.

No description of the depth to the water table is available. It is questionable whether a reliable water table in the Quaternary valley fill exists. No wells have been dug in town or the surrounding areas which could provide documentation of alluvial ground water. Pieziometric maps of ground water levels do not exist nor is there available data.

Seepage, at the elevation of the streams, contributes to small, tributary streams from localized seeps along the channel banks. Water appears to percolate down through permeable layers and alluvium until it intercepts the level of the stream flow. Seeps can be observed at various points along the canyons down from the top of the plateau to the alluvium and weathered Mancos Shale below.

Permeability of the alluvial gravels is considered quite good. Because of this, water may also percolate form the stream bed into the surrounding materials. Based on wells in other areas similar to the Hiawatha setting, a yield of from 10 to 100 gallons per minute could be expected in the vicinity of a perennial stream.

In areas disassociated with direct seepage from perennial streams and based on principal geologic units in the area, a six inch diameter well drilled up to 1000 feet deep in the vicinity of Hiawatha should only produce one to five gallons per minute.[1]

The effects of planned subsidence and unexpected subsidence on ground water occurence, discharge and quality are discussed under UMC 817.17 Alternate Water Supply.

Post mining disposition of the 12" pipeline to the town of Hiawatha is addressed under UMC 784.14 Protection of the Hydrologic Balance and the subject of post mining utilization is refered to in Ch. III-30 A.

UMC 783.16 SURFACE WATER ( ACR RESPONSE)

To minimize disturbance to the hydrologic cycle, sediment ponds on the property have been designed and placed such that all disturbed area drainage will flow into and be contained in them. The ponds are designed with spillways and oil skimmers in order to treat and control the water in the event of discharge from the ponds. To date no correctly designed and constructed pond has discharged.

Sediment ponds were also constructed to contain the sediment and runoff from the outslopes of the slurry ponds. Sediment and runoff derived from the tipple yard is either contained in the yard or makes its way to one of the surrounding slurry ponds.

More details concerning pond dimensions and features can be found in Ch. III, Exhibits 1-5b under their respective areas, also in Ch. VII Ex. 2-18.

Ground water is not monitored in the mine plan area.

Surface water is monitored before and after the disturbed areas, from springs on the Plateau and along streams on or issuing from the permit area. A complete account of locations and monitored characteristics is presented in Ch. VII, pages 7 - 12.

Undisturbed surface drainage from tributary canyons above both South Fork and Middle Fork mine yards is conveyed below the disturbed area and sediment ponds and is released from the bypass culverts.

Temporary impoundments of water presently supply the town and mines. One impoundment consists of an underground reservoir created when the Hiawatha #2 mine was sealed. (See Ch. III, page 3). The second is located at Mohrland where the sealed King #2 mine has impounded water which is currently being utilized for the town and wash plant water source.

The Mohrland mine portal discharge point discharges from 600 to 800 gallons of water per minute from a discharge box fed by the flooded mine workings. Water can be regulated at this box to flow into a twelve inch pipeline or discharge into Cedar Creek. The pipeline supplies four holding tanks located in Hiawatha that feed supply lines for the town and wash plant. Additional descriptive information can be found in Ch. III on page 11 and Ch. VII pages 5 and 8.

A point of diversion exists in the left fork of the North Fork of Miller Creek. This enables the mine to divert water from the creek to an underground storage reservoir in the old Hiawatha #2 mine. Capacity in the reservoir is estimated to be 100 million gallons.

Water impounds against reinforced concrete bulkheads which are located below the Middle Fork yard. A water gauge monitored here determines the amount of water to be diverted into this reservoir. Water is pumped from this reservoir to the water tank above the Middle Fork bath house. This arrangement is discussed in Ch. III on page 3 and in Ch. VII on page 11 also.

Postmining rehabilitation of sediment ponds, diversions, impoundments and treatment facilities are discussed in Ch. III on pages 35-42. Refer also to the maps and cross-sections of regrading plans located in the back of Ch. III.

Ponds and diversions will be removed and regraded. Topsoil will be repalced if it was removed prior to surface disturbance. Reclamation work will then be carried out on the areas. Treatment facilities will be discontinued and dismantled unless they are needed for facilities still

in use (e.g. treatment of the town's water supply). The recontoured slopes and benches will utilize straw bales where necessary to control erosion.

Impoundments created by sealed mine portals are discussed, with respect to their post mining use, in Ch. III-30A

Stream water monitoring station ST3-A, ST3-B and ST6-A are not intended to be a formal part of our Hydrologic Monitoring plan. Stations ST-3, ST-4 and ST-6 have been established as permanent monitoring points to assess the effects of mining operations on water quantity and quality in South Fork, Middle Fork and Cedar Creek Canyons. The additional stations listed above were recommended by the Division for our own information. Stations ST3-A and ST3-B are located immediately above and below the King 4 and King 5 mine yards in Middle Fork. Stations ST4-A and ST4-B are located above and below the King 6 surface facilities in South Fork. Station ST6-A is located above the Mohrland portal in Cedar Creek Canyon. Stream flows at these stations are monitored for chemical parameters only. No volume measurements are taken. Data from these stations are listed in table VII-6 included with this submittal.

UMC 785.19 ALLUVIAL VALLEY FLOORS (ACR RESPONSE)

The stream valleys of Miller and Cedar creeks were examined within a two mile radius of the permit boundary for possible consideration as potential alluvial valley floors. Additional information as requested in the Apparent Completeness Review is given below:

Gravel terraces and stream flood plains have been mapped on a two mile radius of the permit boundary and presented on Exhibit VI-1. Three separate bench gravel surfaces exist on the eastern front of the Wasatch plateau. These gravels are not distinguished by any special patterns but can be identified by their elevation in relation to lower remnant surfaces. The highest surface exists in small isolated areas near the cliffs. The second surface covers a much greater area and forms long narrow benches sloping eastward from the cliffs. The lowest surface is the broadest remnant and has been trenched by the existing streams. Bench cappings consist of gravel and boulders derived from sandstone and limestone of the plateau. Cappings range in the thickness from five feet in some areas to over 100 feet near the cliffs where they contain the coarsest material. The stream terraces or valley floors exist at a considerably lower elevation than the surrounding benches. The valley floors consist of narrow belts of recent alluvium comprised of coarse gravel and overlain by fine sand and silt. In most locations the streams have cut deeply into the valley floors creating narrow channels with nearly vertical walls. These channels, which comprise the active flood plain, are from 15 to over 30 feet deep and provide good exposures for examining the nature of the material forming the valley floors. They also provide good exposures to observe evidence of ground water or subirrigation.

The Soil Conservation Service has classified soils and described plant communities existing on the valley floors of Cedar and Miller Creeks. Soils along Cedar Creek are classified as Glenberg Very Fine Sandy Loam. Along Miller Creek they are classified as Haverson Fine Sandy Loam. See Tables VII-8 and VII-9. Vegetation on the valley floors is predominantly big sagebrush with very few grasses or forbes. Narrowleaf cottonwood trees, willows, meadow grasses and rushes exist but are confined to the very narrow

active flood plain trench and stream banks incised below the valley floors.

A field investigation of both valley floors was done within the permit area and for a distance of two miles beyond the permit boundary. No evidence of stream diversion structures were found within the areas examined. Some evidence of past agriculturial activity occurs near an old abandoned farm site just outside the permit boundary on Miller Creek. Stone ruins and old fence posts can be seen. A small pond located on the flood plain near and at about the same elevation as the stream, had been maintained in the past. Since this pond contains water throughout the year with no apparent overland inflow, the presence of ground water is indicated. An old structure and abandoned machinery suggest that water may have been pumped from this pond to terraces above. Outlines of what may have been small cultivated fields or livestock enclosures can be seen on upper terraces at this site. No other indications of significant managed agricultural activity was observed along either stream. Outside the permit area, livestock are managed by BLM policies. These lands are, and for the most part, always were open and undeveloped range land. Cultivated lands exist along both streams at Millerton and Cedar Creek Ranches (both over four miles from the permit area) where valley floors widen out to areas large enough to justify irrigation structures. Stream diversions and irrigation ditches exist at both ranches. Conventional irrigation is used, subirrigation or flood irrigation is not.

It is doubtful that the valley floors, within a two mile radius of the permit boundary, are broad enough or have slopes suitable to justify development for flood irrigation. Usable surfaces suitable for agricultural purposes are limited by the narrow confines of higher benches. Also, the stream channels tend to meander alternately against the steep sides of the higher benches, terminating the lateral extent of usable surfaces and restricting the development of irrigation ditches. The flood plains are certainly too narrow and rocky to be cultivated. Stream diversion structures would be expensive and difficult to maintain due to the depth of the stream channels below the valley floors.

Seeps and damp zones can be seen on the near vertical walls of the flood plains at several locations. These seeps range in height from one to four feet above the stream channels. No other evidence of possible subirrigation were observed.

GLC GLENBERG VERY FINE SANDY LOAM, 3 TO 6 PERCENT SLOPES

This Glenberg soil is very deep and well drained. It occurs on nearly level and gently sloping valley floors and terraces at elevations of 5,500 to 6,900 feet. This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 10 to 12 inches. Mean annual air temperature is 47° to 49° F, mean annual soil temperature is 49° to 51° F, and the average freeze-free season is 115 to 140 days. This soil occurs in the vicinity of Hiawatha and in small areas near East Carbon City, Horse Canyon and Cedar Mountain. Slopes are 3 to 6 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly big sagebrush, blue grama, bullgrass, greasewood, fourwing saltbush and globlemallow.

Included in mapping are small areas of Haverson loam, 3 to 8 percent slopes; and Haverson loam, 1 to 3 percent slopes.

In a representative profile the surface layer is pale brown very fine sandy loam about 4 inches thick. The underlying layers are pale brown and brown very fine sandy loam and loam to a depth of 60 inches or more.

Permeability is moderate. Available water capacity is about 7.0 to 10.0 inches to a depth of 60 inches. The water supplying capacity is about 6 to 7 inches. Organic matter content in the surface layer is very low. Effective rooting depth is 60 inches or more. Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-34.

This soil is used for rangeland, wildlife habitat and recreation.

The potential plant community is about 50 percent perennial grasses, 15 percent forbs, and 35 percent shrubs. Important plants are Indian ricegrass, galleta, blue grama, salina wildrye, needleandthread, globemallow, aster, pale eveningprimrose, locoweed, shadscale, fourwing saltbush, winterfat, big sagebrush, black sagebrush and yellowbrush.

Practices for maintaining or improving vegetation include a planned system of grazing, grazing for proper percent of plant use, and good water distribution.

Seeding may be advisable if the plant community shows much departure from potential. Seeding success may be attained during years of average or above average precipitation. For seeding success a good, clean firm seedbed is necessary. Control of undesirable weeds and shrubs can be obtained by plowing with a large double disk, by burning, or by spraying with chemicals. Plants suitable for seeding are Siberian wheatgrass, crested wheatgrass, Russian wildrye, prostrate summercyprus and potential native plants for which seeds or nursery stock are available.

This soil is in Capability Subclass VIe, nonirrigated; Semidesert Loam (Sagebrush) D34 ecological site.

Taxonomic classification is coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents.

A representative pedon of Glenberg very fine sandy loam, 3 to 7 percent slopes was described 2 miles southeast of Hiawatha; 600 feet north and 2,600 feet west of the SE corner of Section 1, T. 16 S. R. 8 E. (Photo No. & Coord, 2-83, J-5).

A1--0 to 4 inches; pale brown (10YR 6/3) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak medium granular structure; soft, very friable, slightly sticky, nonplastic; common very fine and medium roots; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6) abrupt smooth boundary.

C1--4 to 10 inches; pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky, nonplastic; common very fine, fine and medium roots; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt wavy boundary.

A1b--10 to 14 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine, fine and medium roots; few fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt wavy boundary.

C2--14 to 46 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) when moist; massive; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common fine pores; (this horizon contains a 1 inch thick organic layer) strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.9); clear smooth boundary.

C3--46 to 60 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) when moist; weak medium subangular blocky structure; hard, firm, slightly sticky, slightly plastic; common very fine and fine roots; many fine pores; strongly calcareous, carbonates are in veins; strongly alkaline (pH 9.0).

The A horizon has hue of 10YR and 2.5Y value of 5 or 6 dry and chroma of 2 or 3. It is typically very fine sandy loam but may include fine sandy loam and loamy fine sand. The A horizon is slightly to strongly calcareous and moderately to strongly alkaline. It is 2 to 4 inches thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 or 6 dry and chroma of 2 to 4. It is typically loam but ranges to very fine and fine sandy loam. The C horizon is mainly massive but may include weak and moderate subangular blocky structure. It is slightly to strongly calcareous and is moderately to strongly alkaline.

Table VII-8 Continued..

(1)

# SOIL INTERPRETATIONS RECORD

MLRA(S) 34 | STATE UTAH | RECORD NO. | AUTHOR(S) HKS | DATE 11/78 | KIND OF UNIT SERIES | REVISED | UNIT NAME GLC GLENBERG | UNIT MODIFIER

CLASSIFICATION AND BRIEF SOIL DESCRIPTION

## ESTIMATED SOIL PROPERTIES

| PROP | DEPTH (IN) | USDA TEXTURE | UNIFIED | AASHO | FRACT > 3 IN (PCT) | PERCENT OF MATERIAL LESS THAN 3 IN PASSING SIEVE: 4 | 10 | 40 | 200 | LIQUID LIMIT | PLASTICITY INDEX |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | VFSL | CL- | A - 4 | 0 | 100 | 100 | 85-95 | 50-65 | 20-25 | 5-10 |
| | 4-60 | VFSL, L, FSL | SM-SC, CL-ML | A - 4 | 0 | 100 | 100 | 70-95 | 45-70 | 20-30 | 5-10 |

| PROP | DEPTH (IN) | CLAY (PCT OF <2MM) | MOIST BULK DENSITY (G/CM³) | PERMEABILITY (IN/HR) | AVAILABLE WATER CAPACITY (IN/IN) | SOIL REACTION (PH) | SALINITY (MMHOS/CM) | SHRINK-SWELL POTENTIAL | EROSION FACTORS K | EROSION FACTORS T | WIND EROD. GROUP | ORGANIC MATTER (PCT.) | CORROSIVITY STEEL | CORROSIVITY CONCRETE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAME DEPTH AS ABOVE | 13-14 | 1.3-1.45 | 0.6-2.0 | 0.15-0.17 | 7.9-9.0 | <2 | LOW | .43 | 5 | 3 | 1-3 | HIGH | MODERATE |
| | | 10-17 | 1.3-1.45 | 0.6-2.0 | 0.12-0.17 | 7.9-9.0 | <2 | LOW | .43 | | | | | |

| PROP | FLOODING FREQUENCY | FLOODING DURATION | FLOODING MONTHS | HIGH WATER TABLE DEPTH (FT) | HIGH WATER TABLE KIND | HIGH WATER TABLE MONTHS | CEMENTED PAN DEPTH (IN) | CEMENTED PAN HARDNESS | BEDROCK DEPTH (IN) | BEDROCK HARDNESS | SUBSIDENCE INITIAL (IN) | SUBSIDENCE TOTAL (IN) | HYD GRP | POTENTIAL FROST ACTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NONE | | | >6.0 | | | -- | | >60 | | -- | | B | MODERATE |

## SANITARY FACILITIES

| FOOTNOTES | | |
|---|---|---|
| SEPTIC TANK ABSORPTION FIELDS | MODERATE - PERCS SLOWLY | |
| SEWAGE LAGOONS | SEVERE - SEEPAGE, SLOPE | |
| SANITARY LANDFILL (TRENCH) | SLIGHT | |
| SANITARY LANDFILL (AREA) | SLIGHT | |
| DAILY COVER FOR LANDFILL | GOOD | |

## BUILDING SITE DEVELOPMENT

| FOOTNOTES | | |
|---|---|---|
| SHALLOW EXCAVATIONS | SLIGHT | |
| DWELLINGS WITHOUT BASEMENTS | SLIGHT | |
| DWELLINGS WITH BASEMENTS | SLIGHT | |
| SMALL COMMERCIAL BUILDINGS | 3-4%: SLIGHT<br>5: MODERATE - SLOPE | |
| LOCAL ROADS AND STREETS | MODERATE - LOW STRENGTH, FROST ACTION | |
| LAWNS, LANDSCAPING, AND GOLF FAIRWAYS | SLIGHT | |

## REGIONAL INTERPRETATIONS

| FOOTNOTES | | |
|---|---|---|
| REGION | | |

## CONSTRUCTION MATERIAL

| FOOTNOTES | | |
|---|---|---|
| ROADFILL | FAIR - LOW STRENGTH | |
| SAND | IMPROBABLE SOURCE - EXCESS FINES | |
| GRAVEL | IMPROBABLE SOURCE - EXCESS FINES | |
| TOPSOIL | GOOD | |

## WATER MANAGEMENT

| FOOTNOTES | | |
|---|---|---|
| POND RESERVOIR AREA | SEVERE - SEEPAGE | |
| EMBANKMENTS DIKES AND LEVEES | SEVERE - PIPING | |
| EXCAVATED PONDS AQUIFER FED | NO WATER | |
| DRAINAGE | DEEP TO WATER | |
| IRRIGATION | SOIL BLOWING, SLOPE, ERODES EASILY | |
| TERRACES AND DIVERSIONS | ERODES EASILY, SOIL BLOWING | |
| GRASSED WATERWAYS | ERODES EASILY | |

(2)

UNIT NAME GLENBERG — RECREATIONAL DEVELOPMENT
UNIT MODIFIER

| | FOOTNOTE |
|---|---|
| CAMP AREAS | MODERATE - DUSTY |
| PICNIC AREAS | MODERATE - DUSTY |
| PLAYGROUNDS | MODERATE - SLOPE, DUSTY |
| PATHS AND TRAILS | SEVERE - ERODES EASILY |

CAPABILITY AND YIELDS PER ACRE OF CROP AND PASTURE (HIGH LEVEL MANAGEMENT)

| CLASS DETERMINING PHASE | CAPABILITY | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N-IRR | IRR | N-IRR | IRR | N-IRR | IRR | N-IRR | IRR | N-IRR | IRR | N-IRR | IRR | N-IRR | IRR | N-IRR | IRR |
| ALL | 6E | | | | | | | | | | | | | | | |

WOODLAND SUITABILITY

| CLASS DETERMINING PHASE | ORD SYM | MANAGEMENT PROBLEMS: EROSION HAZARD | EQUIP LIMIT | SEEDLING MORT'Y. | WINDTH HAZARD | PLANT COMPET. | POTENTIAL PRODUCTIVITY: COMMON TREES | SITE INDEX | TREES TO PLANT |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NONE | | |

WINDBREAKS

| CLASS-DETERMINING PHASE | SPECIES | HT | SPECIES | HT | SPECIES | HT | SPECIES | HT |
|---|---|---|---|---|---|---|---|---|
| | NONE | | | | | | | |

WILDLIFE HABITAT SUITABILITY

| CLASS DETERMINING PHASE | POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED | GRASS & LEGUME | WILD HERB | HARDWD TREES | CONIFER PLANTS | SHRUBS | WETLAND PLANTS | SHALLOW WATER | POTENTIAL AS HABITAT FOR: OPENLAND WILDLIFE | WOODLAND WILDLIFE | WETLAND WILDLIFE | RANGELAND WILDLIFE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALL | POOR | POOR | FAIR | -- | POOR | FAIR | POOR | V. POOR | POOR | FAIR | V. POOR | FAIR |

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

| COMMON PLANT NAME | PLANT SYMBOL (NLSPN) | PERCENT | PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE |
|---|---|---|---|
| INDIAN RICEGRASS | ORHY | 20 | |
| GALLETA | HIJA | 10 | |
| BLUE GRAMA | BOGR2 | 5 | |
| SALINA WILDRYE | ELSA | 5 | |
| OTHER PERENNIAL GRASSES | PPGG | 10 | |
| GLOBEMALLOW | SPHAE | 6 | |
| LOCOWEED | ASTRA | 1 | |
| ASTER | ASTER | 1 | |
| PALE EVENINGPRIMROSE | OEPA | 1 | |
| OTHER FORBS | AAFF | 6 | |
| BIG SAGEBRUSH | ARTR2 | 15 | |
| SHADSCALE | ATCO | 7 | |
| FOURWING SALTBUSH | ATCA2 | 5 | |
| WINTERFAT | EULAS | 3 | |
| OTHER SHRUBS | SSSS | 5 | |
| POTENTIAL PRODUCTION (LBS./AC. DRY WT.) FAVORABLE YEARS | | 1,000 | SEMIDESERT LOAM (BIG SAGEBRUSH) 034 |
| NORMAL YEARS | | 750 | |
| UNFAVORABLE YEARS | | 450 | |

FOOTNOTES

HBC HAVERSON FINE SANDY LOAM, HIGH RAINFALL, 1 TO 5 PERCENT SLOPES

This Haverson soil is very deep and well drained. It occurs on alluvial fans and drainage ways at elevations of 6,300 to 6,850 feet. This soil formed in mixed, calcareous alluvium derived mainly from sandstone and shale.

The average annual precipitation is 12 to 14 inches. Mean annual air temperature is 47° to 49° F, mean annual soil temperature is 49° to 51° F, and the average freeze-free season is 100 to 120 days. This soil occurs on Cedar Mountains, in Clark Valley, West of Price and near Wellington and Wattis. Slopes are 1 to 5 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly big sagebrush, black sagebrush, greasewood, blue grama, Indian ricegrass and needleandthread.

Included in mapping are small areas of Glenberg fine sandy loam, high rainfall, 1 to 3 percent slopes; and Haverson fine sandy loam, high rainfall, 5 to 15 percent slopes, eroded.

In a representative profile the surface layer is brown fine sandy loam about 6 inches thick. The underlying layer is pale brown loam and silt loam 30 inches thick. The next layer is pale brown fine sandy loam to depth of 60 inches or more.

Permeability is moderately slow. Available water capacity is about 7.5 to 11 inches to a depth of 60 inches. Water supplying capacity is about 6.5 to 8 inches. Organic matter content in the surface layer is low. Effective rooting depth is greater than 60 inches. Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-27.

This soil is used for rangeland, wildlife habitat and recreation.

The potential plant community is about 60 percent grass, 10 percent forbs and 30 percent shrubs. Important plants are native bluegrasses, western wheatgrass, needleandthread, prairie junegrass, bluebunch wheatgrass, bottlebrush squirreltail, salina wildrye, blue grama, scarlet globemallow, aster, meadow milkvetch, peavine, big sagebrush, Wyoming sagebrush, black sagebrush, yellowbrush and winterfat.

Practices for maintaining or improving vegetation include a planned grazing system, grazing for the proper percent of plant use, adequate fencing, and good water, distribution. Adequate brush control can be obtained by aerial spraying, plowing, chaining, railing, or burning.

Seeding is advisable if severe deterioration of potential plants has occurred. Plants suitable for seeding, in addition to potential native species include Siberian wheatgrass, crested wheatgrass, Russian wildrye, intermediate wheatgrass, Tegmar wheatgrass, pubescent wheatgrass, small burnet and prostrate summercyprus.

This soil is in Capability Subclass VIe, nonirrigated; Upland Loam D34, E47 ecological site.

Taxonomic classification is fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents.

A representative pedon of Haverson fine sandy loam 5 to 15 percent slopes, as described in mapping unit HBD2 about 1,400 feet east and 2,100 feet north of the SW corner of Section 21, T. 13 S., R. 9 E., 3 miles west of Helper (Photo No. & Coord. 3-95-A, C-12) is used to represent this soil.

A1--0 to 6 inches; brown (10YR 5/3) fine sandy loam, grayish brown (10YR 5/2) moderate coarse subangular blocky structure; slightly hard, friable, slightly hard, slightly plastic; common very fine and few fine roots; common very fine and fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1--6 to 16 inches; pale brown (10YR 6/3) loam, grayish brown 10YR 5/2 when moist; moderate coarse subangular blocky structure; hard, friable; slightly sticky, slightly plastic; few very fine roots; many very fine, few fine and medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear wavy boundary.

C2--16 to 24 inches; pale brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) when moist; moderate medium subangular blocky structure; hard, friable, sticky, plastic; few very fine roots; common very fine, few fine and medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C3--24 to 36 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky, slightly plastic; few very fine and fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

C4--36 to 45 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive; very hard, firm, slightly sticky, slightly plastic; common very fine pores; cicada casts present; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

C5--45 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive; very hard, firm, slightly sticky, slightly plastic; common very fine pores; cicada casts present; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0).

Range in characteristics has not been determined for this soil.

(1)

# SOIL INTERPRETATIONS RECORD

MLRA(S) 34, 47 | KIND OF UNIT: SERIES | UNIT NAME: HSG, MEDIUM, NEVERSON, HIGH RAINFALL
STATE: UTAH | RECORD NO. | AUTHOR(S): HKS | DATE: 11-78 | REVISED | UNIT MODIFIER:
CLASSIFICATION AND BRIEF SOIL DESCRIPTION

ESTIMATED SOIL PROPERTIES

| PROP | FOOTNOTE DEPTH (IN) | USDA TEXTURE | UNIFIED | AASHO | FRACT. > 3 IN (PCT.) | PERCENT OF MATERIAL LESS THAN 3 IN. PASSING SIEVE: 4 | 10 | 40 | 200 | LIQUID LIMIT | PLASTICITY INDEX |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0-6 | FSL | SM-SC, CL-ML | A-4 | 0 | 100 | 100 | 70-85 | 40-55 | 20-30 | 5-10 |
| | 6-60 | SR-FSL-CL | CL-ML, CL, ML | A-4, A-6 | 0 | 100 | 100 | 75-100 | 50-75 | 25-35 | 5-15 |

| PROP | DEPTH (IN) | CLAY (PCT OF <2MM) | MOIST BULK DENSITY (G/CM³) | PERMEABILITY (IN/HR) | AVAILABLE WATER CAPACITY (IN/IN) | SOIL REACTION (PH) | SALINITY (MMHOS/CM) | SHRINK-SWELL POTENTIAL | EROSION FACTORS: K | T | WIND ERODIBILITY GROUP | ORGANIC MATTER (PCT) | CORROSIVITY: STEEL | CONCRETE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAME DEPTH AS ABOVE | 14-17 | 1.3-1.45 | 2.0-6.0 | 0.13-0.15 | 7.9-9.0 | <2 | LOW | .32 | 5 | 3 | 1-2 | HIGH | MODERATE |
| | | 19-30 | 1.3-1.45 | 0.2-2.0 | 0.13-0.18 | 8.5-9.0 | <2 | MODERATE | .32 | | | | | |

| PROP | FLOODING: FREQUENCY | DURATION | MONTHS | HIGH WATER TABLE: DEPTH (FT) | KIND | MONTHS | CEMENTED PAN: DEPTH (IN) | HARDNESS | BEDROCK: DEPTH (IN) | HARDNESS | SUBSIDENCE: INITIAL (IN) | TOTAL (IN) | HYD GRP | POTENTIAL FROST ACTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NONE | | | >6.0 | | | - | | >60 | | - | | B | MODERATE |

## SANITARY FACILITIES

| | FOOTNOTES | |
|---|---|---|
| SEPTIC TANK ABSORPTION FIELDS | | SEVERE - PERCS SLOWLY |
| SEWAGE LAGOONS | | 1-2%: MODERATE - SEEPAGE<br>2-7%: MODERATE - SEEPAGE, SLOPE<br>7-15%: SEVERE - SLOPE |
| SANITARY LANDFILL (TRENCH) | | 1-8%: SLIGHT<br>8-15%: MODERATE - SLOPE |
| SANITARY LANDFILL (AREA) | | 1-8%: SLIGHT<br>8-15%: MODERATE - SLOPE |
| DAILY COVER FOR LANDFILL | | 1-8%: GOOD<br>8-15%: FAIR - SLOPE |

## BUILDING SITE DEVELOPMENT

| | FOOTNOTES | |
|---|---|---|
| SHALLOW EXCAVATIONS | | 1-8%: SLIGHT<br>8-15%: MODERATE - SLOPE |
| DWELLINGS WITHOUT BASEMENTS | | 1-8%: MODERATE - SHRINK-SWELL<br>8-15%: MODERATE - SHRINK-SWELL, SLOPE |
| DWELLINGS WITH BASEMENTS | | 1-8%: MODERATE - SHRINK-SWELL<br>8-15%: MODERATE - SLOPE, SHRINK-SWELL |
| SMALL COMMERCIAL BUILDINGS | | 1-4%: MODERATE - SHRINK-SWELL<br>4-8%: MODERATE - SHRINK-SWELL, SLOPE<br>8-15%: SEVERE - SLOPE |
| LOCAL ROADS AND STREETS | | SEVERE - LOW STRENGTH |
| LAWNS, LANDSCAPING, AND GOLF FAIRWAYS | | 1-8%: SLIGHT<br>8-15%: MODERATE - SLOPE |

## REGIONAL INTERPRETATIONS

| | FOOTNOTES: | |
|---|---|---|
| | | |

## CONSTRUCTION MATERIAL

| KEYING ONLY | FOOTNOTES | |
|---|---|---|
| FILL | ROADFILL | POOR - LOW STRENGTH |
| SAND | SAND | IMPROBABLE SOURCE - EXCESS FINES |
| GRAVEL | GRAVEL | IMPROBABLE SOURCE - EXCESS FINES |
| SOIL | TOPSOIL | 1-8%: FAIR - TOO CLAYEY<br>8-15%: FAIR - TOO CLAYEY, SLOPE |

## WATER MANAGEMENT

| | FOOTNOTES | |
|---|---|---|
| PONDRS | POND RESERVOIR AREA | 1-3%: MODERATE - SEEPAGE<br>3-8%: MODERATE - SEEPAGE, SLOPE<br>8-15%: SEVERE - SLOPE |
| DIKES | EMBANKMENTS DIKES AND LEVEES | SEVERE - PIPING |
| PONDAQ | EXCAVATED PONDS AQUIFER FED | NO WATER |
| DRAIN | DRAINAGE | DEEP TO WATER |
| IRRIG | IRRIGATION | 1-3%: SOIL BLOWING<br>3-15%: SOIL BLOWING, SLOPE |
| TERRAC | TERRACES AND DIVERSIONS | 1-8%: SOIL BLOWING<br>8-15%: SLOPE, SOIL BLOWING |
| WATERW | GRASSED WATERWAYS | 1-8%: FAVORABLE<br>8-15%: SLOPE |

Table VII-9 Continued..

(2)

UNIT NAME HAVERSON — RECREATIONAL DEVELOPMENT

UNIT MODIFIER HIGH RAIN FALL

CAMP AREAS — FOOTNOTE: 1-8%: SLIGHT; 8-15%: MODERATE - SLOPE

PICNIC AREAS — FOOTNOTE: 1-8%: SLIGHT; 8-15%: MODERATE - SLOPE

PLAYGROUNDS — FOOTNOTE: 1-2%: SLIGHT; 2-6%: MODERATE - SLOPE; 8-15%: SEVERE - SLOPE

PATHS AND TRAILS — FOOTNOTE: SLIGHT

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE FOR HIGH LEVEL MANAGEMENT

| CLASS DETERMINING PHASE | CAPABILITY | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NIRR | NIR | WIRR | WIR | NIRR | MR | WIRR | WIR | NIRR | MR | WIRR | IRR | NIRR | IR | WIRR | IRR |
| ALL | 6E | | | | | | | | | | | | | | | |

WOODLAND SUITABILITY

| CLASS DETERMINING PHASE | ORD SYM | MANAGEMENT PROBLEM: EROSION HAZARD | EQUIP LIMIT | SEEDLING MORT'Y. | WINDTH. HAZARD | PLANT COMPET. | POTENTIAL PRODUCTIVITY: COMMON TREES | SITE INDEX | TREES TO PLANT |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NONE | | |

WINDBREAKS

| CLASS DETERMINING PHASE | SPECIES | HT | SPECIES | HT | SPECIES | HT | SPECIES | HT |
|---|---|---|---|---|---|---|---|---|
| | NONE | | | | | | | |

WILDLIFE HABITAT SUITABILITY

| CLASS DETERMINING PHASE | POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED | GRASS & LEGUME | WILD HERB | HARDWD TREES | CONIFER PLANTS | SHRUBS | WETLAND PLANTS | SHALLOW WATER | POTENTIAL AS HABITAT FOR: OPENLAND WILDLIFE | WOODLAND WILDLIFE | WETLAND WILDLIFE | RANGELAND WILDLIFE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALL | POOR | POOR | FAIR | - | POOR | FAIR | V. POOR | V. POOR | POOR | FAIR | V. POOR | FAIR |

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

| COMMON PLANT NAME | PLANT SYMBOL (NLSPM) | PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: PERCENT |
|---|---|---|
| BLUE GRAMA | BOGR2 | 5 |
| WESTERN WHEATGRASS | AGSM | 5 |
| NEEDLEANDTHREAD | STCO4 | 10 |
| BLUEGRASS | POA(++) | 15 |
| SALINA WILDRYE | ELSA | 5 |
| OTHER PERENNIAL GRASSES | PPGG | 20 |
| SCARLET GLOBEMALLOW | SPCO | 2 |
| MEADOW MILKVETCH | ASDI5 | 1 |
| ASTER | ASTER | 1 |
| OTHER PERENNIAL FORBS | PPFF | 6 |
| SAGEBRUSH | ARTEM | 15 |
| WINTERFAT | EULA5 | 2 |
| FOURWING SALTBUSH | ATCA2 | 2 |
| RABBITBRUSH | CHRYS9 | 1 |
| OTHER SHRUBS | SSSS | 8 |
| POTENTIAL PRODUCTION (LBS./AC. DRY WT.) FAVORABLE YEARS | | 1,400 |
| NORMAL YEARS | | 1,075 |
| UNFAVORABLE YEARS | | 700 |

UPLAND LOAM D&S, E47

FOOTNOTES

SYM

UMC 783.17 ALTERNATIVE WATER SUPPLY INFORMATION

Underground mining operations could affect surface and ground water sources. Depending on coal extraction methods used, subsidence could more or less result in fractures through the strata above the Star Point sandstone formation. Fractures resulting from subsidence, as well as natural fractures encountered in mining could contribute to changes in existing water patterns. Springs, seeps, and stream flows could possibly be affected, and changes in drainage patterns could result. Since no mining is proposed to be done below the Hiawatha coal seam which lies immediately on top of the Star Point sandstone, strata below that elevation should not be affected.

The effects of past mining on water sources is not known, except that significant flows have resulted from contact with major fractures such as, the Bear Canyon fault. Large areas of the King 1 and King 2 mines were mined out from 10 to 50 years ago by room and pillar methods, yet numerous springs and seeps overlying these mines are still flowing. Whether or not they have diminished as a result of mining is not known.

Since the dip of beds in the mine plan area is toward the south west and since all existing mine workings are more or less interconnected, all water encountered in mining tends to flow to the most southerly mine opening which at this time is the old Mohrland Portal (King 2 portal) in Cedar Creek Canyon.

Dinimuation of existing surface and ground water sources could possibly affect some livestock and wildlife watering sites at higher elevations. Water presently being used for municipal, domestic, industrial, and irrigation purposes should not be dimished to any great extent since water diverted into the ground would most likely return to mine openings,

springs, and streams near the Star Point sandstone which is well above municipal, domestic, industrial and irrigation points of use. Water quality should not be significantly affected by mining as evidenced by the consistant high quality of mine water presently being discharged.

A hydrologic monitoring plan has been implemented since 1977. Springs, streams and discharges are being monitored at specific intervals to assess the effects of mining operations on water quality and quantity. Also, a subsidence monitoring program, which includes serial photography, is being carried out in cooperation with the Forest Service to assess the effects of mining on forest land.

In the event that an alternative water supply is needed, mine water from the Mohrland Portal in Cedar Creek Canyon is proposed as a reliable, good quality source. This source should not diminish or be contaminated by mining operations. It is presently being used for municipal, domestic and industrial purposes at Hiawatha and for irrigation at ranches along Cedar Creek and Miller Creek.

TABLE VII-6 (Continued)

| Location | Date Sampled or Received | pH Standard Units | Specific Conductance umhos/cm | Acidity As CaCO3 mg/l. | Total Suspended Solids mg/l. | Total Dissolved Solids mg/l. | Total Manganese mg/l. | Total Iron As Fe mg/l. | Dissolved Iron As Fe mg/l. | Chloride mg/l. | Sulfate mg/l. | Nitrate Plus Nitrate (As N) mg/l. | Oil Grease mg/l. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SF-3A Middle Fork of Miller Creek (Above the disturbed area) | 8/82 | 8.00 | 990 | 1.00 | 18.0 | 646 | 0.003 | 0.015 | 0.010 | 12.40 | 156 | 0.16 | 0.6 |
| | 7/82 | 8.10 | 420 | < 0.01 | 7.0 | 254 | 0.001 | 0.010 | - | 2.00 | 15 | 0.05 | 1.6 |
| | 6/82 | 8.10 | 430 | < 0.01 | 2.0 | 312 | 0.007 | 0.130 | 0.060 | 17.90 | 21 | < 0.01 | 0.6 |
| | 5/82 | 8.10 | 520 | < 0.01 | 58.0 | 340 | 0.040 | 0.780 | 0.270 | 10.60 | 43 | 0.30 | 4.4 |
| | 12/81 | - | - | - | - No Flow - | | - | - | - | - | - | - | - |
| | 11/81 | - | - | - | - No Flow - | | - | - | - | - | - | - | - |
| | 10/81 | - | - | - | - No Flow - | | - | - | - | - | - | - | - |
| Average | | 8.10 | | 0.26 | 21.3 | 383 | 0.013 | 0.234 | 0.110 | | | | |
| SF-3B Middle Fork of Miller Creek (Below the disturbed area) | 3/83 | 7.70 | 390 | < 1.00 | 19.5 | 220 | 0.050 | 0.930 | 0.700 | 27.50 | 120 | 0.09 | < 0.5 |
| | 8/82 | 8.40 | 790 | < 0.01 | 8.0 | 518 | 0.085 | 0.350 | 0.210 | 11.20 | 177 | 0.36 | 1.0 |
| | 7/82 | 7.70 | 2200 | 8.00 | 12.0 | 1756 | 0.120 | 0.330 | - | 13.33 | 309 | 0.10 | 1.6 |
| | 6/82 | 8.00 | 620 | < 0.01 | 26.0 | 404 | 0.015 | 0.290 | 0.130 | 10.10 | 54 | 0.04 | < 0.1 |
| | 5/82 | 7.90 | 1190 | < 0.01 | 355.0 | 775 | 0.215 | 10.000 | 1.350 | 19.60 | 96 | 0.37 | 0.2 |
| | 12/81 | - | - | - | - No Flow - | | - | - | - | | - | - | - |
| | 11/81 | - | - | - | - No Flow - | | - | - | - | | - | - | - |
| | 10/81 | - | - | - | - No Flow - | | - | - | - | | - | - | - |
| Average | | 7.94 | | 1.81 | 84.1 | 735 | 0.097 | 2.380 | 0.600 | | | | |
| SF-4A South Fork of Miller Creek (Above the disturbed area) | 9/82 | 8.40 | 800 | < 0.01 | 2.0 | 520 | 0.050 | 0.210 | - | 14.10 | 78 | < 0.01 | < 0.1 |
| | 8/82 | 8.30 | 805 | < 0.01 | 7.0 | 563 | 0.010 | 0.080 | 0.010 | 4.20 | 171 | 0.37 | 0.4 |
| | 7/82 | 8.00 | 700 | 3.00 | 10.0 | 411 | 0.002 | 0.010 | - | 1.00 | 106 | 0.06 | 0.4 |
| | 6/82 | 8.00 | 550 | < 0.01 | 21.0 | 360 | 0.015 | 0.230 | 0.120 | 20.10 | 36 | 0.18 | < 0.1 |
| | 5/82 | 8.00 | 570 | < 0.01 | 405.0 | 375 | 0.170 | 4.100 | 1.460 | 5.10 | 84 | 0.35 | 1.4 |
| | 12/81 | 7.70 | 1100 | 10.00 | 1.0 | 750 | 0.012 | 0.220 | 0.060 | 5.00 | 255 | 0.23 | < 1.0 |
| | 11/81 | 7.50 | 1000 | 22.00 | 28.0 | 680 | 0.015 | 0.230 | 0.070 | 4.70 | 202 | 0.24 | 0.2 |
| | 10/81 | 8.10 | 1050 | < 0.01 | 31.0 | 695 | 0.010 | 0.210 | 0.070 | 4.30 | 228 | 0.33 | 4.2 |
| Average | | 8.00 | | 4.38 | 63.1 | 544 | 0.036 | 0.660 | 0.360 | | | | |
| SF-4B South Fork of Miller Creek (Below the disturbed area) | 9/82 | 8.40 | 770 | < 0.01 | 19.0 | 503 | 0.008 | 0.160 | - | 19.00 | 126 | 0.05 | < 0.1 |
| | 8/82 | 8.50 | 690 | < 0.01 | 15.0 | 435 | 0.012 | 0.210 | 0.070 | 5.70 | 153 | < 0.01 | < 0.1 |
| | 7/82 | 8.20 | 640 | < 0.01 | 1.0 | 376 | 0.001 | 0.030 | - | 3.20 | 43 | 0.07 | 2.2 |
| | 6/82 | 8.00 | 570 | < 0.01 | 70.0 | 374 | 0.025 | 0.080 | 0.020 | 31.90 | 72 | 0.09 | 0.4 |
| | 5/82 | 8.00 | 1150 | < 0.01 | 749.0 | 385 | 0.255 | 9.530 | 1.540 | 9.30 | 69 | 0.53 | 9.2 |
| | 12/81 | - | - | - | - No Flow - | | - | - | - | - | - | - | - |
| | 11/81 | - | - | - | - No Flow - | | - | - | - | - | - | - | - |
| | 10/81 | - | - | - | - No Flow - | | - | - | - | - | - | - | - |
| Average | | 8.20 | | < 0.01 | 170.5 | 425 | 0.060 | 1.930 | 0.620 | | | | |
| SF-6A Cedar Creek (Above Mohrland) | 3/83 | 7.80 | 950 | < 1.00 | 235.0 | 578 | 0.100 | 0.290 | 0.090 | 7.00 | 320 | < 0.01 | 1.5 |
| | 2/83 | 7.40 | 1050 | < 1.00 | 48.5 | 730 | 0.120 | 0.490 | 0.410 | 6.92 | 390 | < 0.01 | < 0.5 |
| | 11/82 | - | 820 | 4.00 | 25.0 | 535 | 0.020 | 0.740 | 0.410 | 5.80 | 177 | 0.27 | 0.6 |
| | 10/82 | 8.00 | 820 | < 1.00 | 230.0 | 535 | 0.070 | 3.100 | 0.720 | 0.30 | - | 0.08 | < 0.1 |
| | 9/82 | 8.10 | 75 | < 0.01 | 20.0 | 325 | 0.015 | 0.105 | 0.060 | 2.30 | 114 | 0.07 | 0.4 |
| | 8/82 | 8.20 | 570 | < 0.01 | 82.0 | 375 | 0.008 | 0.133 | 0.100 | 7.90 | 19 | 0.31 | < 0.1 |
| | 7/82 | 8.20 | 550 | < 0.01 | 324.0 | 360 | 0.155 | 6.410 | 0.730 | 6.50 | 32 | 0.08 | 0.1 |
| | 6/82 | 7.80 | 540 | 2.50 | 16.0 | 355 | 0.005 | 0.130 | 0.090 | 1.90 | 42 | 0.05 | 0.4 |
| | 5/82 | 8.00 | 460 | < 0.01 | 162.0 | 305 | 0.090 | 2.250 | 0.450 | 5.20 | 80 | 0.12 | 3.6 |
| | 4/82 | 7.80 | 1000 | 2.00 | 36.0 | 650 | 0.040 | 0.160 | 0.210 | 4.70 | 295 | 0.08 | < 1.0 |
| | 11/81 | 7.60 | 740 | 8.00 | 78.0 | 500 | 0.022 | 0.220 | 0.100 | 4.10 | 174 | 0.03 | 1.6 |
| | 10/81 | 7.40 | 840 | 2.00 | 200.0 | 550 | 0.020 | 0.225 | 0.100 | 4.50 | 168 | 1.90 | 3.6 |
| Average | | 7.84 | | 1.30 | 125.5 | 500 | 0.055 | 1.232 | 0.290 | | | | |