CHAPTER III

RECLAMATION PLAN

Chapter III RECLAMATION PLAN

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3.1 Introduction

The Horse Canyon mine facilities will be maintained in a stable fashion according to the descriptions found in Chapter II. After an undetermined period of time Kaiser may decide to restore the property to an active status. If this were to occur, Kaiser would submit an operating plan according to UMC 784.11 and .12 and a revised reclamation plan for the proposed operations. If the decision is to permanently close the operations, Kaiser will notify the Division of Oil, Gas and Mining of the decision and commence final reclamation of the disturbed area according to UMC 784.13 and 817.132.

The methods and schedule for the reclamation of the present facilities are described in this chapter.

3.2 Proposed Post Mining Land Use

The planned post-mining land use will be for wildlife habitat. The use of the land, following reclamation, for any non-industrial or commercial purpose more intensive than for wildlife habitat, is not justified. Sufficient land for significant cropland development does not exist; nor is there sufficient water for irrigation. The soils in the area will not support a sustainable forage for both wildlife use and livestock grazing.

The reclamation plan, as described in Chapter III is designed to achieve the post mining land use. Further discussion of post-mining land use is presented in Section 10.3.2.

3.3 General Reclamation Objectives

The reclamation activities proposed in this chapter are intended to comply with the general requirements of UMC 784.13 and meet the following specific objectives:

1) demolition and cleanup of the site to prepare the site for regrading and revegetation,
2) regrading of the present fills, pads, highwalls, roads, and other disturbances to achieve a stable, post mining contour which will be similar to the surrounding area, free draining and conducive to revegetation,
3) restoration of the natural drainage pattern through the disturbed area to the extent practicable while maintaining appropriate sediment controls and drainage under the public road,
4) covering areas of refuse and pavement with topsoil to allow revegetation of these surfaces,
5) reseeding the regraded surfaces with a species mix designed to re-establish the surrounding native vegetation on the reclaimed areas and provide for wildlife habitat, and
6) monitor and maintain the reclaimed property until the reclamation success standards are achieved and the bond is released.

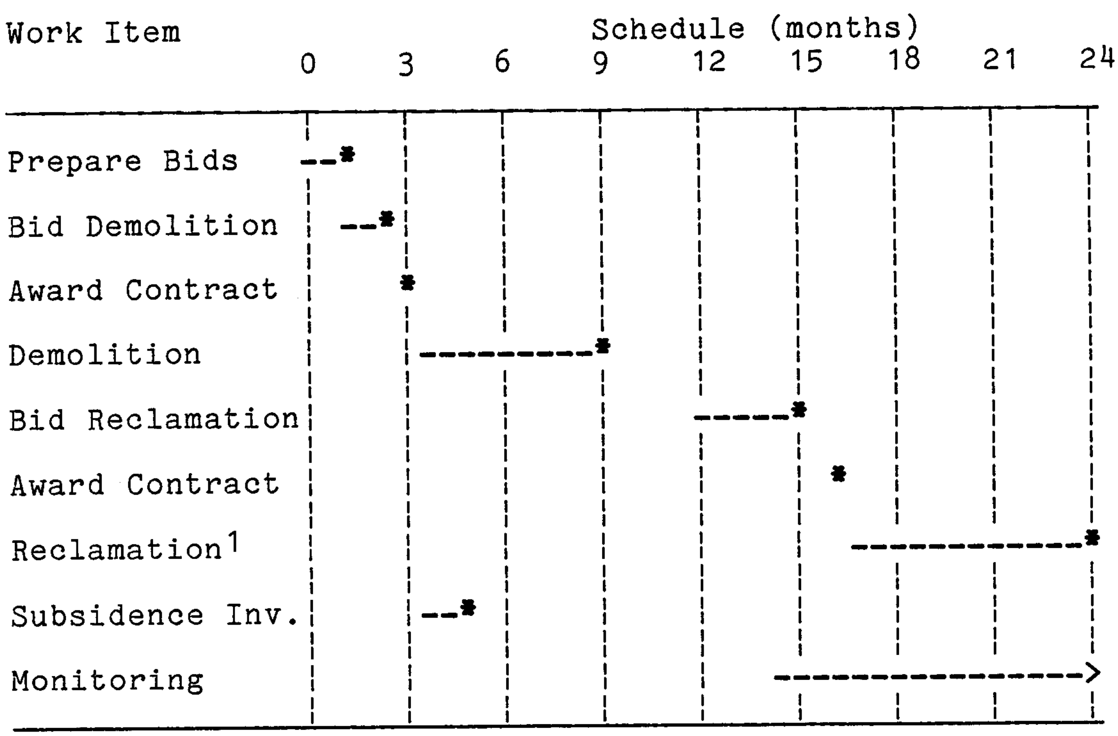
3.4 Areas to be Reclaimed

There are 63.6 acres of disturbance within the permit area of which 62.8 acres will be reclaimed. The area of disturbance to be reclaimed is shown on Plates IV-1 A-F.

One area which will not be reclaimed are the two portals on the north side of Lila Canyon, 1.7 miles south-southeast of the facilities area (Plate II-2). This portal site comprises 0.8 acres of the total disturbance. Access to the site is a difficult two hour hike on foot, climbing from the mouth of the canyon up the side wall to the breakout. From the south rim of the canyon above the site and from the canyon bottom the portal site is not visible to the casual viewer. All materials from mining activities have been pulled inside the mine opening before it was sealed. The portal seal was checked in 1989 and is secure. Much of the small area of disturbance is rock outcrop, similar to the surrounding terrain. During the 1989 visit no water impoundments existed at the site and the small talus slope had a good growth of native species already established. Because of the remoteness of the site, lack on access and small size of the disturbance, Kaiser is proposing to do no further reclamation in this area.

3.5 Schedule and Timing

When the decision is made to permanently cease operations, Kaiser will notify the Division of Oil, Gas and Mining and commence implementation of the various portions of this reclamation plan as indicated below.



* Completion Date

1 Reclamation includes portal backfilling, regrading, hydrology construction, topsoiling, and revegetation.

3.6 Removal of Structures and Site Cleanup

All surface facilities with the exception of the Lila Canyon Portals will be demolished and the debris disposed of in the landfill or in the highwall backfills. The justification for leaving the Lila Canyon portals is found in Section 3.7.1.

3.7 Backfilling and Grading

This section discusses the backfilling and regrading that will be done during the reclamation period. Backfilling and regrading will involve closure of the portals, regrading surface areas, backfilling against highwalls and regrading some roads. The objective of these activities is to restore the site to topographic configurations and geomorphic conditions similar to the surrounding area. In general, all final slopes will be constructed to a grade of 2h:1v. Details of the backfilling and regrading are discussed in this section and in Section 4.3.2.

3.7.1 Portal Closures

All portals have already been closed with a solid block masonry wall which is suitable for permanent reclamation. All portals with the exception of the Lila Canyon east and west portals will be backfilled and revegetated during reclamation. Figure 4.6.2-1 shows a typical portal section which has been sealed and backfilled.

The Lila Canyon portals have been sealed with permanent masonry walls immediately back from the opening. The exterior fan facilities have already been removed and the small pad which remains has been cleared of any mining equipment. Because of the remoteness and inaccessibility of the portals it is proposed that no further backfilling or reclamation take place at this location. There is no means of access to the portals other than foot travel, thus it would be impossible to regrade the small pad which remains.

3.7.2 Excess Spoil and Underground Development Waste

Excess spoil and underground development waste has been used to construct some of the facility area fills and also has been disposed of in the Hillside and Road Junction Refuse Piles. The Hillside Refuse Pile and the outer slopes of the Road Junction Refuse Pile are prelaw structures and hence will not be reclaimed. Plates VII-1 A,B and II-1 A,B show the location of areas which have refuse exposed on the surface. Refuse in the facility fills will be left in place or used in highwall backfills to achieve the post reclamation contour configuration. Removal and regrading of refuse fills along the ephemeral stream channel is described in Section 4.3.

3.7.3 Roads

All mine roads are dirt-surfaced Class II roads and will be reclaimed accordingly, as described in Section 4.4.2. The public road which crosses the Horse Canyon surface facilities area will be left in use following site reclamation, however, the bridge will be removed unless title is transferred to a public entity.

The mine roads will either be eliminated during regrading, as discussed in section 4.4.2, or used as the site of runoff control facilities as discussed in Chapter VI. The remaining mine roads will be stabilized with water bars, ripped, scarified, have all bridges and culverts removed, and be closed to vehicular traffic by the installation of earth berms.

Other transportation facilities including conveyors, the trestle, and railroad tracks within the disturbed areas will be removed during the demolition phase, as discussed in Section 3.6 and 4.7, and the disturbed areas will be reclaimed.

3.8 Drainage Control

This section presents the plan to be implemented during reclamation in order to control the drainage from the site. The drainage control includes a discussion of the drainage plan, and a discussion of the measures to be taken to control sediment.

3.8.1 Drainage Plan

As required under UMC 784.14 of the State Program, protection of the hydrologic balance will be accomplished during both maintenance and reclamation of the Horse Canyon minesite. During maintenance, six of the existing sediment ponds will be enlarged to assure adequate detention of disturbed area runoff and new emergency spillways will constructed to improve the passage of runoff from high flow events. The two other existing ponds are adequately sized, but will have improved emergency spillways constructed. A series of berms, diversion ditches, and culverts will be installed or upgraded to convey runoff to the ponds, or to divert undisturbed area runoff away from the minesite. A description of this drainage plan, as well as a description of the means used for the protection of water quality and water rights, is contained in Chapters II and VI of this application.

During reclamation, the drainage plan for the Horse Canyon area will be modified to meet requirements imposed by regrading and to meet the specific goals and regulations of reclamation. It will consist of a network of three road ditches and nine berms which will convey runoff from the 10 year - 24 hour rainfall event to various silt-fence locations for filtering before it enters the Horse Canyon drainage. These silt fences will function to protect water quality during reclamation, and will take the place of the eight sediment ponds used during the maintenance period. Removal of the sediment ponds at the beginning of reclamation will allow for faster recovery of the vegetation and for less disturbance of the site once initial reseeding takes place. Where possible, undisturbed-area runoff will be diverted away from the disturbed area through existing diversions. Existing culverts will be removed, except where they cross the public road which traverses the permit area, and a channel will be reestablished at those locations. An additional channel will be constructed across the backfilled slope at the old Woodard Portal location. Water quality will be protected by moving and rip rapping exposures of refuse which currently impinge upon Horse Canyon Creek at the mine pad area, and by hay-baling the top of the Road Junction Refuse Pile. Plates VI-4 A-F show locations and typical cross sections of the drainage plan features. Section 6.5.2 in this report describes the Reclamation Plan hydrology and designs in detail.

3.8.2 Sediment Control

During the maintenance period, sediment production and water quality will be controlled with eight sediment ponds and several silt fences, as described in Chapters 2 and 6.6.1. Upon reclamation, all eight sediment ponds on the mine site will be taken out of use. Five will be eliminated during the regrading and topsoiling activities and the remaining three will be breached. The breached ponds will have a silt fence installed at the location of the emergency spillway and will serve as small detention basins throughout the reclamation period. Various other silt fences will also be installed around the site to prevent offsite contributions of sediment. Berms and road ditches will convey runoff to these silt fences, and existing clear water diversions will minimize the amount of water which must be passed through them. Locations and diagrams of these silt fences, diversions, and breaches are shown on Plates VI-4 A-F, and a detailed description of them is found in section 6.6.2.

3.9 Topsoil Handling

Mining operations began at the Horse Canyon Mine prior to implementation of topsoil salvage requirements. Therefore, borrowed soil materials will be required in selected locations in order to achieve successful reclamation on areas affected by the mining operations. All discussions of topsoil handling during final reclamation will be discussed in terms of the use 'topsoil' although it is recognized that this material is not technically identical to topsoil. A complete discussion of the materials used for topsoil is found in Section 7.4.2.

3.9.1 Areas to Receive Topsoil

Within the Horse Canyon permit area, the areas that will receive an application of topsoil include the following:

1) Road Junction Refuse Pile top - 1 foot
2) Landfill - 2 feet
3) Facilities and Tipple areas - 1 foot

Areas that will receive topsoil include areas such as those occupied by concrete rubble, pavement, refuse, or any other unsuitable plant growth medium. Paved areas will be ripped to a minimum depth of 18 inches, and covered with a minimum of 1 foot of topsoil. Refuse exposed in the present fills will generally be moved and buried as fill material against the highwalls; however, where refuse materials remains on the regraded surface, 1 foot of topsoil will be utilized to cover the refuse. Any other areas located at the time of final reclamation that are occupied by unsuitable plant growth medium will be treated as necessary and covered with 1 foot of topsoil.

Some disturbed areas on the mine area will not receive topsoil. Such areas include those that are not surfaced with refuse, pavement, concrete rubble, or other unsuitable plant growth material. For example, heavily compacted pads which have 'clean' soil materials underlying them will not be topsoiled. These in-place soils will be sampled and tested for the parameters listed in Section 7.2.3, ripped, amended and prepared for reseeding and planting according to the methods described in Sections 7.5 and 7.6.

3.9.2 Topsoil Removal

Because no topsoil material was salvaged prior to mining operations, borrow materials will need to be substituted for topsoil in order to establish vegetative growth on disturbed areas. Approximately 27,540 YD3 of topsoil will be needed to evenly cover the area delineated on Plates IV-1 A-F. This topsoil will be obtained from one borrow area located at the mouth of Horse Canyon to the south of the Road Junction Refuse

Pile (Plate II-1 A). The soil that will be utilized is the best available on the Kaiser Coal property without disturbing the channel of Horse Canyon Creek (Plate VII-1 A). Due to the bouldery and stony nature of the soils in the borrow area (Section 7.2.4) up to 20% of the total volume borrowed may have to be discarded in the borrow area. For this reason, the borrow area has been designed to provide 33,048 BCY of material from an area of approximately five acres excavated five feet deep.

Specific activities that will involve the borrow area include: 1) preparation of the borrow area by removing existing vegetation, 2) removing adequate amounts of material for reclamation purposes and, 3) regrading and revegetating the borrow area. A sufficient amount of topsoil will be left in the bottom of the borrow area for reclamation and this area will be permanently revegetated according to the procedures discussed in Section 8.4.2.

The topsoil stripping depths will be confirmed by qualified personnel in the field prior to actual disturbance. Salvageable topsoil will be removed from the area by front-end loaders and trucks, scrapers, dozers, or other standard equipment. The topsoil will then be immediately redistributed as described in Sections 3.9.4.

3.9.3 Topsoil Storage

No topsoil is available for reclamation at the Horse Canyon Mine, and consequently none will be stored or utilized during final reclamation. The one exception is the topsoil stored near the Road Junction Refuse Pile. This stockpile contains approximately 30 BCY and will be utilized as topsoil during final reclamation of the refuse pile.

3.9.4 Topsoil Redistribution

The recontoured surfaces of disturbed areas that will receive topsoil will be prepared by ripping to a minimum depth of 18 inches. Ripping will alleviate compaction caused by equipment and will also provide a roughened surface for bonding with the topsoil or revegetating directly into the regraded surfaces. Ripping is particularly important in the steeper sloped portions of the topsoiled areas where bonding of the topsoil to the regraded slope is necessary to reduce topsoil slippage.

After appropriate surface preparation is completed, topsoil will be applied. The material will be placed and spread by dozers, front-end loaders, trucks, scrapers, and graders where appropriate. The soil materials will be applied as evenly as is practicable, and worked on the contour whenever possible. A minimum amount of heavy equipment activity will be allowed during handling operations to prevent compaction. Topsoil will be placed at the depths discussed in Section 3.9.1.

Prior to seeding, the topsoil and other regraded surfaces will receive a light disking, or be otherwise scarified along the contour if a crust has developed since final grading or other soil preparation activities. Otherwise, no special soil preparation will be necessary.

In some areas, such as on steep slopes, it may be necessary to create a roughened surface to prevent water erosion. Water erosion will be controlled by using a shallow chisel plow on level contour, using a lister or rangeland pitter, or by other appropriate means depending upon soil conditions. The purpose is to leave an uneven, erosion-resistant surface that will aid water infiltration and enhance germination and establishment of seeded species.

3.9.5 Amendments

It is expected that the applied topsoil will require fertilizer amendments at the time of final reclamation. Because the majority of the disturbed area will be covered with topsoil taken from one location, soil samples will be obtained from the borrow area according to the procedures outlined in Section 7.2, and in accordance with DOGM Topsoil and Reclamation Guidelines.

In-place soil materials that will be reclaimed without additional topsoil will be sampled concurrently or immediately following the redistribution of topsoil. Samples will be taken as a continuous sample within the top 12 inches of material. One composite sample taken from three locations or holes will be collected from each reclamation area. The total number of samples taken at each site will depend upon the soil conditions at the time.

Analyses will be conducted according to methods prescribed in Section 7.6, and by DOGM Topsoil Guidelines. The operator will work with DOGM to ensure that the redistributed soils are analyzed according to DOGM Guidelines and that the tests are performed by an approved laboratory. The results of the soil testing will be used to establish recommendations for fertilizer or other soil amendments. In general, soil amendments will be applied during the fall or spring as concurrent with reseeding operations as possible to maximize plant response.

All of the soils in the project area, as well as the borrow soils, appear to be adequate for reclamation purposes and should respond well to fertilizer application.

3.10 Revegetation

The objective of the post mining revegetation program at the Horse Canyon Mine are to restore the surface disturbed area to a land use capability similar to that which existed prior to mining. The initial objectives are to stabilize the soils, and to restore the disturbed area to approximate original hydrologic conditions. Ultimately, the disturbed areas will be returned to their pre-mining use with watersheds in their approximate premining character. In general, the long term appearance and usefulness of the reclaimed permit area will be similar to that encountered prior to mining and also that found in the adjacent areas that remain undisturbed by mining and related activities.

3.10.1 Seeding and Planting

All seeding will be done during the fall in order to maximize revegetation success. It should be noted, however, that seeding may occur during other seasons if needed to control erosion or soil degradation.

The seed mix, application rate, and seeding techniques are based on reclamation experience in the area, as well as on consideration of local environmental conditions of soil, slopes, elevation, and precipitation. Use of this seed mix will result in a rapidly established and effective vegetation cover capable of minimizing erosion and meeting the goals of the reclamation program. The seed mix proposed for use in final reclamation, shown in Table 8.4.2.1-1, is designed to re-establish a Pinyon-Juniper Woodland vegetative type, and will be planted throughout the disturbed area. This proposed seed mix contains species well adapted to the area, and will produce a diverse, and effective vegetation cover capable of self-regeneration. This seed mix will be used according to the procedures described in Section 8.4.2.

Seed availability will determine the ultimate seed mixture and variety of seed used. If a variety of seed is not available, the Division will be notified, and additional seed of one of the seeds listed or another species or variety will be substituted so that the final PLS per acre is equivalent to the proposed mix.

During final reclamation, the seed mixture will be placed by either a drill seeder or by broadcast seeding, depending upon the slope. On steep slopes where equipment cannot be safely operated, the seed will be broadcast or hydroseeded. If the seed is broadcast, the amount of seed will be increased as indicated in Table 8.4.2.1-1, and tackifier may be used to further ensure soil contact on steep slopes.

The final reclamation plan is designed to provide successful reclamation when compared with the current condition of the

Pinyon-Juniper Woodland reference area. The required live shrub stem density can be achieved from the shrub seed currently in the seed mix.

3.10.2 Mulching and Soil Stabilization

Following seeding, native pasture hay or alfalfa will be applied at a rate of 2 tons per acre. The mulch will be spread in such a way as to provide a uniform distribution of mulch over the revegetated area. Where conditions allow safe equipment operation, the mulch will be mechanically crimped using standard methods. Where necessary, other methods of soil stabilization, such as tackifier, may be used.

3.10.3 Vegetation Success Determination

Monitoring of success of permanent revegetation efforts will be performed according to the following schedule:

1) First year following seeding - reconnaissance survey and qualitative evaluation of revegetation.
2) Second year - qualitative as well as quantitative sampling of cover, frequency and woody plant density.
3) Third year - qualitative and quantitative sampling of cover, frequency and woody plant density.
4) Fourth year - qualitative evaluation only

5) Fifth year - all parameters listed during the third year.

6) Sixth year - qualitative evaluation only.

7) Seventh year - qualitative evaluation only.

8) Eighth year - qualitative evaluation only.

9) Ninth year - all parameters listed during the third year plus production sampling.

10) Tenth year - all parameters listed during the third year.

During the ninth and tenth years, revegetated areas as well as the Pinyon-Juniper Woodland reference area will be sampled for all parameters listed in order to test reclamation success. In the tenth year following revegetation, application for bond release will be made.

According to the DOGM guidelines, a reference area is an area similar to the plant community that will be disturbed with respect to vegetation (cover, density, composition), soils, aspect, climate, and elevation. The reference area will be maintained and used as the standard for comparisons with the reclaimed area. The Pinyon-Juniper Woodland Reference Area has been established and approved by the DOGM for use as the post-mining standard for the Horse Canyon Mine. The reference area will be used according to DOGM guidelines to determine reclamation success.

Post-reclamation sampling procedures will be similar to those used during the vegetation baseline survey as described in Section 8.2.2. This will be done in order to limit sampling variability, and to enhance data comparability. Additionally, vegetation productivity will be sampled using randomly placed quadrants within the reference and reclaimed areas. Exclosures will be used only if grazing occurs in these areas. However, the site is remote from livestock water and should not experience any grazing. Clipping will be by lifeform, and will comply with the DOGM guidelines. Cover and density data will be collected by species. Sampling on both the reclaimed and reference areas will be to statistically adequate levels using a two-tailed t-test, according to DOGM Vegetation Guidelines. An 80 percent confidence level with a 10 percent change in the mean will be used because the vegetation type is a woodland.

After adequate samples have been collected for the vegetation parameters (cover, productivity, and woody plant density) the parameters will be compared between the reference area and the corresponding reclaimed sites. Because the post-mining land use is wildlife, the revegetation will be considered successful when ground cover of a reclaimed site is 70 percent of the ground cover in the reference area, within a 90 percent statistical confidence. The stem densities on the reclaimed areas must be within 90 percent of the densities on the reference areas with an 80 percent statistical confidence in order to be considered successful.

3.10.4 Irrigation

Irrigation should not be required in order to establish successful vegetative growth for final reclamation. All areas will be mulched to increase germination and to improve soil moisture. Furthermore, successful reclamation has been achieved at the nearby Sunnyside Mines without the use of supplemental irrigation.

3.11 Monitoring and Maintenance

This section addresses the concerns of the monitoring efforts that will take place during the reclamation period. This will consist of water, vegetation, subsidence and erosion monitoring activities.

3.11.1 Water

Monthly inspection of runoff and sediment control structures will be conducted. Evidence of berm or ditch overtopping, bypass, or erosion will be noted and any needed repairs or upgrading will take place at the time of inspection or shortly after, depending on the scope of work required. Inspection of silt fences will include making sure that no bypass can take place, examining fabric for integrity, and noting the remaining capacity for sediment detention. Again, any needed maintenance will occur in a timely manner.

In addition, a water quality monitoring program will continue throughout the bonding period. The three sites in Horse Canyon Creek, two above and one below the disturbed area, that are currently monitored semi-annually will be monitored semi-annually throughout reclamation. One monitoring session will take place in early spring, to attempt to catch the snowmelt runoff, and the other will take place during early fall in an attempt to catch a thunderstorm event. A list of parameters to be measured is found below in Table 3.11.1-1. In addition, single-stage sediment samplers will be installed below two silt fences in order to ascertain that discharge is meeting effluent limitations regarding total suspended sediment (TSS). A single stage sampler will also be installed above the disturbed area at one of the semi-annual sites to provide background information on TSS. These samplers will be checked during the monthly maintenance inspections and any samples will be analyzed for TSS. Quarterly monitoring reports will be submitted to the Division.

Table 3.11.1-1. Reclamation Water Quality Parameters

Total Settleable Solids
Total Suspended Solids
Total Dissolved Solids

Acidity
Bicarbonate
Calcium
Carbonate
Chloride
Hardness
Iron
Magnesium
Total Magnesium
Oil and Grease
Potassium
Sodium
Sulfate

Cation/Anion Balance

3.11.2 Vegetation

The reseeded areas will be protected from livestock grazing.

However, the site is remote from livestock water and should not experience any grazing. Protection from wildlife is generally impractical.

The establishment of weeds will be minimized by ensuring that all seed purchased is labeled in accordance with the Federal Seed Act, Section 201. This law limits or restricts the presence of certain noxious plant species.

Mulching helps control weed emergence and native hay will be selected to minimize introduction of weed seed. Revegetation experience has shown that after a couple of years, most weeds are naturally eliminated from the reclamation stands. If weeds should become a problem, mowing may be utilized where terrain permits, or in extreme cases, herbicides may be used.

Any necessary insect or rodent control will be guided by the U.S. Fish and Wildlife Service, The Utah State Cooperative Extension Service, and the Animal, Plant, Health Inspection Service.

3.11.3 Subsidence

As described in Section 5.4, a one time, walking survey of the area over the existing Geneva Mine workings will be conducted. The objective of this survey will be to identify, describe and map any obvious indications of subsidence. These observations will include: tension or compression features in the surficial soils and rock, indications of excessive slope instability, disturbances to vegetation and wildlife, and indications of negative impacts on surficial water such as dried springs or terminated stream channels. However, since the areas mined since 1977 are small and are surrounded by and/or adjacent to large areas of older mining activity, the existence of any subsidence cracks above these areas may not be attributable to post-1977 activity. Should the survey reveal evidence of subsidence, the evidence will be documented and its potential origin and impact evaluated. This report will be made available to the Division of Oil, Gas and Mining.

3.11.4 Erosion

When rills or gullies deeper than 9 inches develop in areas that have been regraded and/or topsoiled, they will be filled, graded or otherwise stabilized. The affected area will then be reseeded or replanted according to the methods of Section 3.10.1. If rills or gullies less than 9 inches deep develop, they will be stabilized and reseeded if they are disruptive to post mining land use, or may result in additional erosion and sedimentation.

CHAPTER IV

ENGINEERING DESIGNS

VOLUME 1

Chapter IV ENGINEERING DESIGNS

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4.1 Use of Explosives

Storage, handling and use of explosives will be in compliance with State and Federal rules and regulations. The powder magazine and detonator caps magazine are located in Horse Canyon above the facility area (No. 32 and 33, Plate II-1 B and Appendix II-1).

Explosives will be used as needed in the maintenance of the surface facilities and in reclamation. Concrete foundations and walls or rocks may be cleared with explosives. Blasting operations will be supervised and conducted by persons who have been trained, examined and certified as provided by 30 CFR and applicable regulations of the State Industrial Commission.

4.2 Underground Development Waste

Underground development waste has been disposed of since the development of the mine in 1943. The primary disposal site of the waste rock is the Road Junction Refuse Pile. Some development waste rock was used for road base fill material in the construction of the public access road along Horse Canyon and for fill material in the construction of the pads for the mine facilities.

4.2.1 Road Junction Refuse Pile

The Road Junction Refuse Pile was started in 1943 as a side hill fill configured disposal site for underground development waste including the diluted waste rock picked from the run-of-mine coal. The waste pile is located south of the mine facilities, adjacent to Utah State Highway 124 (Plate IV-1 A). The waste pile covers approximately six acres and varies in depth between two and twenty feet.

The outer slopes of the Road Junction Refuse Pile are outside of the area of post-law mining disturbance and therefore will not be reclaimed. The top of the pile will be maintained during the maintenance period, and will be reclaimed as discussed in Sections 4.3.2 and 3.9.4.

There is no record of a geotechnical site investigation prior to the initial disposal of waste rock in 1943. Refuse has been placed in layers and compacted to insure stability. The pile is situated on an alluvial deposit with a slope of eight percent. Because of this grade, no rocktoe buttresses or keyway cuts for stability are required. There is no rock chimney core. The surface of the refuse pile has been graded and contoured to prevent excessive seepage and entrapment of water within the pile. Drainage from above the pile is diverted away from the pile by the State Highway 124.

The materials comprising the base of the pile are unconsolidated alluvial sand, gravel and boulders. There are no records indicating the presence of a rock drainage blanket at the base of the pile, and none are observed. Inspection of the site in 1983 revealed no seeps, springs or groundwater flow (U.S. Steel, 1983). Furthermore, inspection of the site in March, 1987 by JBR revealed no seeps or springs at the base of the pile.

The refuse pile is located outside of the area of underground operations and therefore is not subject to the effects of subsidence from present or future operations.

Stability of the refuse pile has been analyzed by U.S. Steel (1983). This analysis included three sections of the refuse pile where the side slopes are between 1.5h:1v and 1.8h:1v. These analyses demonstrate a static factor of safety for all sections to be greater than 1.5. A copy of these analyses are included in Appendix IV-1.

The refuse pile will be inspected on a quarterly basis by a qualified, registered engineer of other qualified person (MSHA Certified Impoundment Inspector) for slopes, seepage, and other visible factors which could indicate potential failure. The results of the inspections will be recorded and maintained at the Sunnyside Mine office. If any inspection discloses that a potential hazard exists, the Division and MSHA will be informed of the findings and of the emergency procedures formulated for public protection and remedial action.

Additional refuse material placed on the refuse pile from other sources within the permit area will be spread out and compacted in a 24-inch horizontal layer with a dozer. The outer slope of the refuse pile will not be effected by any future activities. Layering of the pile and compaction has been designed to achieve structural stability and to prevent fires.

The Junction Refuse Pile will be sampled and a physio-chemical analysis performed at three sites on the pile to characterize the acid and/or toxic-forming potential of the material. At each site, samples will be taken using a hand auger at intervals of: 0 to 6 inches, 6 to 12 inches, 12 to 24 inches and 36 to 48 inches. In addition, a composite will be taken comprising material from all intervals for a total of five samples per site. All samples will analyzed for parameters listed in the Division Soil Guidelines, Table 6.

4.2.2 Waste Rock Fills

During the development of the mine in 1943, underground development waste was used for fill material in the construction of the pads for the mine facilities and for road base material for the public road providing access along Horse Canyon. The exact extent of the waste rock is unknown, however exposures have been identified adjacent to Horse Canyon Creek for approximately 1,400 feet (Plates VI-5 A-F). The depth of the waste rock varies between six and twenty feet where exposed along the stream bank.

There is no record of a geotechnical site investigation prior to the placement of the waste rock. The material appears to have been placed in layers and compacted to insure stability. The waste rock is situated on alluvial deposits with grades less than one percent. Because of this grade, it is assumed that no rocktoe buttresses or keyway cuts were installed for stability and that no rock chimney cores are present. The surfaces of the waste rock contain public roads, mine facilities, sediment ponds and other sediment control structures.

The materials comprising the base of the waste rock deposits are unconsolidated alluvial sand, gravel and boulders. There are no records indicating the presence of a rock drainage blanket at the base of the fills, and none are observed. A survey of the site in October, 1985 by JBR revealed no seeps, springs or groundwater flow. Furthermore, inspection of the site in March, 1987 by JBR revealed no seeps or springs at the base of the fills.

The waste rock fills are located outside of the area of underground operations and therefore are not subject to the effects of subsidence from present or future operations.

The present side slopes of the waste rock fills varies between 2h:1v and near vertical. Based on the stability analysis conducted by U.S. Steel (1983) on the Road Junction Refuse Pile (Appendix IV-1) it is assumed that the slopes with grades less than 1.5h:1v have a static factor of safety greater than 1.5.

During the maintenance period, some of the exposed sections of the waste rock fills will be stabilized with riprap. The locations and specific treatments for these sections are discussed in detail in Section 6.6.1 and shown on Plates VI-3 C, D, and E. There will not be any regrading of these fill slopes during maintenance because such activities would eliminate the public road and existing sediment control structures.

For final reclamation the side slopes of the waste rock fills will be pulled back from the stream and regraded to 2h:1v. Details of this regrading are discussed in Section 4.3.2.

4.3 Regrading

The areas affected by surface operations will be graded, backfilled, or where steep slopes exist, cut to generally provide for uniform drainage of runoff. Selective material handling will be employed to minimize contamination of clean fill soils with refuse.

4.3.1 Maintenance Plan

Regrading will be necessary during the maintenance period for a portion of the public access road adjacent to Horse Canyon Creek. This regrading is to control runoff and will involve raising the elevation of the road two feet, for a section approximately two hundred feet in length. The material for this regrading will be obtained from nearby slopes containing clean fill. The volume of material utilized will be 296 cubic yards. The location of this section of the road is shown on Plate VI-3 E.

Regrading will also take place on a small portion of the landfill which requires additional material to adequately cover debris presently protruding from the surface. This will require pushing soil and clean fill from adjacent areas over the area to be covered.

4.3.2 Reclamation Plan

Refuse material in fills facing or exposed by the Horse Canyon Creek stream channel will be pulled back horizontally 6 feet from the stream channel and the new slope reduced to a 2h:1v configuration. The toe of the regraded slope will be protected with riprap as discussed in Section 6.6.2. The refuse material removed from the fills will be transported to, backfilled and compacted at the base of an adjacent highwall. Where refuse is not exposed along the stream, the banks will be reduced to a 2h:1v configuration. During reclamation only those portions with refuse exposed along the bank will be pulled back and riprapped. For the purposes of the bond estimate, all facility area fill slopes were assumed to be contaminated with refuse material. Based on this assumption, approximately 2,000 feet of stream bank will be pulled back and riprapped. However, when regrading occurs, it is possible that areas currently covered with a thin veneer of refuse and mapped as such may turn out to be largely clean earth fill.

Clean fill from highwall reduction will be used to cover the refuse. Where fill is not available, borrow soils will be used to cover the exposed refuse material to a depth of one foot. Plates II-1 A-F show the post mine contours and the areas expected to be covered with topsoil. The cross-sections of highwalls with existing and final configurations are shown on

Plates II-2 A-E.

Slope stability has been analyzed for the final configuration of a typical highwall backfill and for a typical section of the mine facilities area. The analysis are found in Appendix IV-2 and demonstrate the following static factors of safety: typical highwall, F.S greater than 1.3; typical mine facility, F.S. greater than 1.5.

The post law portions of the Road Junction Refuse Pile and the solid waste landfill with be covered with 1 foot and 2 feet of topsoil respectively.

A cut and fill balance for backfilling and regrading is found in the bonding estimate. An excess of fill (20,800 cubic yards) is available for use if needed for new disturbances.

4.4 Roads and Other Transportation Facilities

In addition to roads, transportation facilities in the disturbed area include the following:

1) old railroad trestle which connects portals on opposite sides of the creek channel (No. 7, Appendix II-1);

2) the 54-inch belt conveyor which connects the Rock Tunnel Portal to the Transfer House and Crusher (No. 36, Appendix II-1);

3) the Belt Conveyor which is enclosed in a gallery and connects the Transfer House to the Tipple (No. 35, Appendix II-1);

4) the Carbon County Railroad tracks which are shown on all topographic maps in this document; and

5) the railroad bridge for the Carbon County Railroad.

4.4.1 Maintenance Plan

Most of the roads and transportation facilities will be allowed to remain as they are now throughout the maintenance period. Specific actions for insuring stability of one road are discussed below in this section. Measures for improving public safety at the site, including the enclosure of accessible parts of the conveyor are discussed in Section 2.7.6.

The principal road in the Horse Canyon area is the road passing through the property that provides access to upper Horse Canyon and the top of the Book Cliffs to the south of Horse Canyon. This road is under the management of the U.S. Bureau of Land Management. The other roads within the Horse Canyon disturbed area are dirt-surfaced and are considered Class II roads because they are used for more than six (6) months of the year and are not used for coal transportation (U.S. Steel, 1981). Road grade information and cross sections for the Class II roads are provided in Appendix IV-3. The locations of these sections are indicated on Plates II-1 A, B.

Interim reclamation work, including installation of water bars and hydroseeding and hydromulching was done in 1986 on the following form Class II roads:

1) the former access road from the main Horse Canyon public road to the water tanks (No. 8 and No. 28, Appendix II-1 in the small area exemption in upper Horse Canyon;

2) the former access road from the ford across Horse Canyon Creek located 300 feet northeast of the trestle to the North Fan Portal (No. 3, Appendix II-1); and

3) the former access road from the PCB storage shed (No. 42, Appendix II-1) to the South Fan Portal (No. 58, Appendix II-1).

This interim work has been done in cooperation with and the approval of the Division of Oil, Gas and Mining.

The other Class II roads in the disturbed area will not be altered other than for the establishment of drainage controls necessary to implement the hydrologic designs during the maintenance period. These designs are described in Chapter VI. As the road cross sections in Appendix IV-3 show, the roads are currently bermed on the outslope side and sloped to the interior for drainage control.

The main access road through the property will have selected improvements made upon it during the maintenance period. The road bed from the trestle (No. 7, Appendix II-1) to a point 200 feet east of the trestle will be raised a total of two feet. This will be done to eliminate the ponding of water and resultant berm breaching that is prevalent in this segment of the road. In addition, the road is very close to Horse Canyon Creek in a number of locations. In a number of such places the road outslope toe has been eroded and the outslope has been oversteepened. The outslope toes in these areas will be riprapped for stabilization as is discussed in Section 6.5.1.

The other transportation facilities at the site will not be mechanically maintained or operated in any manner during the maintenance period. The presence of these facilities will have no impact on fish or wildlife, water or air quality or related environmental values during the maintenance period.

4.4.2 Reclamation Plan

The public road which crosses the Horse Canyon surface facilities area will be rerouted as shown on Plates IV-1 A-F and VI-4D-E during site reclamation. Cross sections are in Appendix IV-3. The other roads will be either removed or stabilized during regrading, as discussed in section 4.3, or used as the site of runoff control facilities as discussed in Chapter VI.

A schedule for the public road relocation and appropriate approvals to meet the requirements of UMC 761.12(d) will be submitted to the Division of Oil, Gas and Mining in advance of any construction activities.

Other transportation facilities including conveyors, the trestle, and railroad tracks within the disturbed areas will be removed during the demolition phase, as discussed in Section 4.7.

The following measures will be taken for the purposes of reclamation of the mine roads during reclamation:

1) the roads not removed during regrading will be closed to vehicular traffic by the installation of berms;

2) natural drainage patterns will be restored as discussed in Chapter 6;

3) all bridges and culverts will be removed, this includes the public access road bridge across Horse Canyon Creek, unless title to this bridge is transferred to a public entity;

4) roadbeds not removed as a part of the regrading plan will be ripped and scarified;

5) fill slopes and cut slopes will be regraded as discussed in Section 4.3;

6) water bars and berms will be constructed to prevent erosion as described in Chapter VI;

7) although no road surfacing materials have been used on any of the roads, the asphalt surfaces will be ripped prior to topsoiling, as detailed in Section 7.5.

4.5 Support Facilities

The facilities as described in Section 2.1 and listed in Appendix II-1 have been designed, constructed, and located to provide adequate service to the mining operation and to prevent or control erosion and siltation, water pollution, and damage to public or private property. Damage to the environment will be prevented by implementing the plans found in Chapters VI through X.

Is this true?

4.6 Portal Seals

There are twelve mine openings within the Horse Canyon permit area that are temporarily sealed. The seals used are suitable for temporary closure or permanent reclamation. These portals are specifically located on Plate II-1A,B.

There are two drill holes in the permit area (Plate II-1B). They will be permanently plugged and capped during reclamation. One is an eight-inch, cased drill hole that, during mining operations was used to supply a pressurized source of water to the mine. The drill hole is connected to the mine water system on the surface by a six-inch steel pipe line and isolated with gate valves. Temporary sealing of the drill hole during the maintenance period will be achieved by closing the surface valve.

There is also a drill hole near the South Fan which was installed for the hoist power cable. This drill hole is temporarily sealed and will be plugged during final reclamation at the time of the demolition of the South Fan building.

4.6.1 Maintenance Plan

The portals and the drill hole will remain sealed during the period of time that the mine is inactive. The seals will be repaired on an as-needed basis if they are damaged by geomorphic process or by vandals.

4.6.2 Reclamation Plan

Slope or drift openings required to be sealed shall be sealed with solid, substantial, noncombustible material such as concrete blocks, bricks, or tile and shall be completely filled with noncombustible material for a distance of at least 25 feet into such openings in accordance with CFR 75.1711-2. Figure 4.6.2-1 shows a typical portal reclaimed after sealing and backfilling.

Most mine openings are framed with a concrete structure to maintain the portal integrity. These structures will be demolished and covered in place by backfill. A complete description of the backfilling plan is found in Section 4.3.2.

The plugging and management of drill holes will adhere to the procedures stipulated by the United States Geological Survey as detailed in Appendix IV-4.

TYPICAL CROSS SECTION OF MINE PORTAL SEALS

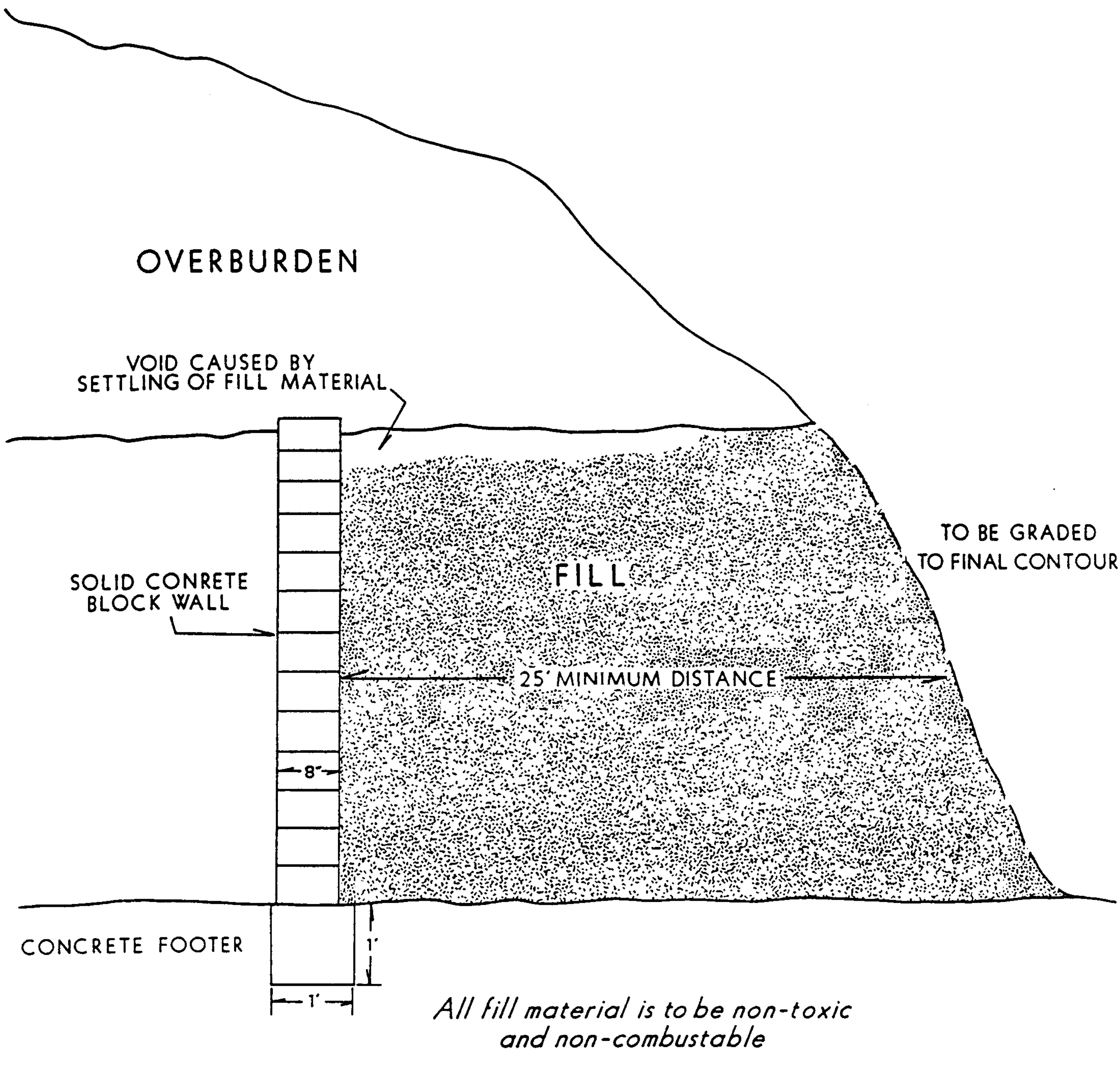


Figure 4.6.2-1 Typical Final Reclamation Portal Seal

4.7 Reclamation Cost Estimate

The cost estimate of reclamation includes demolition and disposal of structures, backfilling of portals and highwalls, distribution of topsoil, establishment of sedimentation controls, revegetation, fencing, monitoring of sediment control and revegetation, maintenance of sediment controls, and a reclamation schedule. Details of the cost estimate are found in Appendix IV-5. Total bonding estimate for the permit is $1,517,346.

4.8 References

U.S. Steel, 1981. Mining and Reclamation Plan for the Geneva Mine. Submitted to DOGM.

U.S. Steel, 1983. Response to Determination of Completeness Review. Submitted to DOGM.

List of Appendices

Appendix IV-1

Stability Analysis of the Road Junction Refuse Pile

STABILITY ANALYSIS ROAD JUNCTION REFUSE PILE

Underground development waste from Geneva Mine is disposed of at the Road Junction Refuse Pile. The refuse pile is limited in areal extent (approximately 300 ft. long by 300 ft. wide) and is generally less than 20 feet in height above the ground surface. U. S. Steel Mining Co. conducted a stability analysis on the side slopes of the pile as follows:

GENERAL

The Rotational Equilibrium Analysis of Multilayered Embankment (REAME) program, developed by the University of Kentucky, was used to perform the safety factor calculations. A circular failure surface is assumed under a rotating mass. The mass is divided into slices and the sum of moments tending to cause and resist failure are determined. The safety factor is the ratio of these two sums. REAME can calculate the safety factor using either the normal method or the simplified Bishop method. All calculations were completed using the simplified Bishop method.

No springs or seeps have been observed on the side slopes of the refuse pile or in the adjacent areas. Therefore, the ground water table was assumed to be below any failure surface.

῾ne following angles of internal friction were located in reference materials:

	Friction Angle	Density
*Common earth, moist	25 - 45 degrees	
*Gravel, sand and clay	20 - 35 degrees	
+Sand, dry	35 degrees	90-110
+Earth, common loam	35 degrees	73
+Gravel, run of bank	38 degrees	90-100
+Shale, crushed	39 degrees	90

*Caterpillar Performance Handbook
+BF Goodrich Engineering Handbook

To be conservative, the natural ground (soil 1) was assumed to have the following material properties:

Friction Angle	30 degrees
Density	90 lbs/cf
Cohesion	0.0 lbs/sf

Samples of coarse refuse have been sampled at Somerset Mine and the Wellington Coal Cleaning Plant (refer to Technical Revision No. 1). The results of these samples are reproduced below:

	Somerset Mine	Hole 1 Wellington	Hole 2 Wellington
Friction Angle	35.5 deg.	34.7 deg.	32.8 deg.
Density lb/cf	84.8 deg.	93.7 deg.	84 deg.
Cohesion lb/sf	0.0 deg.	144 deg.	288 deg.

The following properties were assumed for the stability calculations:

Friction Angle	35 degrees
Density	85 lbs/cf
Cohesion	144 lbs/sf

RESULTS

Case 1

Case 1 is the west slope of section A-A' shown on Drawing C3-1208. An enlarged cross-section is attached which shows the potential failure surface where the minimum safety factor was calculated. The following table lists some of the failure surfaces evaluated and their associated safety factors:

Coordinates of Center Hor.	Vert.	Radius of Failure Surface	No. Failure Surfaces at Center	Minimum Safety Factor
64.667	28.000	21.690	11	1.890
72.000	32.000	26.090	11	2.126
54.083	29.750	23.563	7	2.260
61.417*	33.750	27.778	11	1.799
		28.525	-	1.809
		26.286	-	1.831
68.750	37.750	31.146	11	1.928
58.167	39.500	33.869	11	1.799
65.500	43.500	36.286	11	1.852
51.667	51.000	44.195	11	2.134
59.000	55.000	48.453	11	1.830

*Minimum Safety Factor

Case 2

Case 2 is the west slope of section B-B' shown on Drawing C3-1208. An enlarged cross-section is attached which shows the potential failure surface where the minimum safety factor was calculated. The following table lists some of the failure surfaces evaluated and their associated safety factors:

Coordinates of Center Hor.	Vert.	Radius of Failure Surface	No. of Failure Surfaces at Center	Minimum Safety Factor
42.000	34.667	16.789	11	1.884
49.000	39.333	21.813	11	1.946
44.333*	46.333	28.458	11	1.768
		26.484		2.005
		29.446		1.777
51.333	51.000	33.356	11	1.888
39.667	53.333	35.245	11	1.809
46.667	58.000	39.784	11	1.790
35.000	60.333	43.019	11	1.955
42.000	65.000	47.417	11	1.782

*Minimum

Case 3

Case 3 is the east slope of section A-A' shown on Drawing C3-1208. An enlarged cross section is attached which shows the potential failure surface where the minimum safety factor was calkculated. The following table lists some of the failure surfaces evaluated nd their associated safety factors:

Coordinates of Center Hor.	Vert.	Radius of Failure Surface	No. of Failure Surfaces at Center	Minimum Safety Factor
73.333	36.667	22.513	11	4.529
80.000	40.000	24.164	11	4.225
69.833	43.667	30.418	11	4.334
76.500	47.000	32.004	11	4.122
66.333	50.667	37.553	11	4.286
73.000*	54.000	39.504	11	4.095

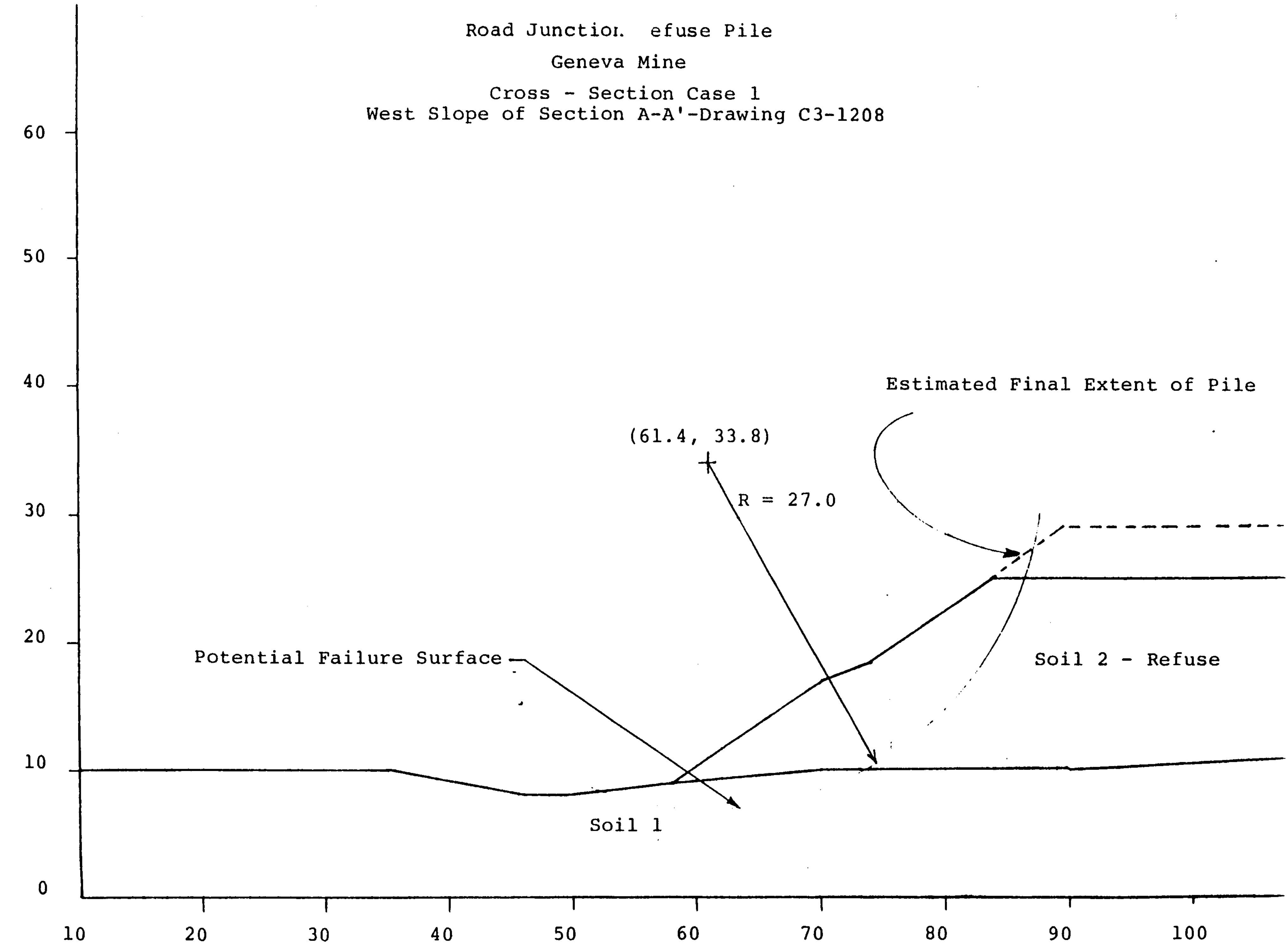
*Minimum

All of the above calculations are based on the dimensions of the final refuse pile shown on the cross sections. The minimum safety factors for the existing pile are shown below:

Case	Coordinates of Center Hor.	Vert.	Radius of Failure Surface	Minimum Safety Factor
1	61.417	33.750	27.032	1.837
2	44.333	46.333	28.485	1.789
3	73.000	54.000	39.504	4.095

Conclusion

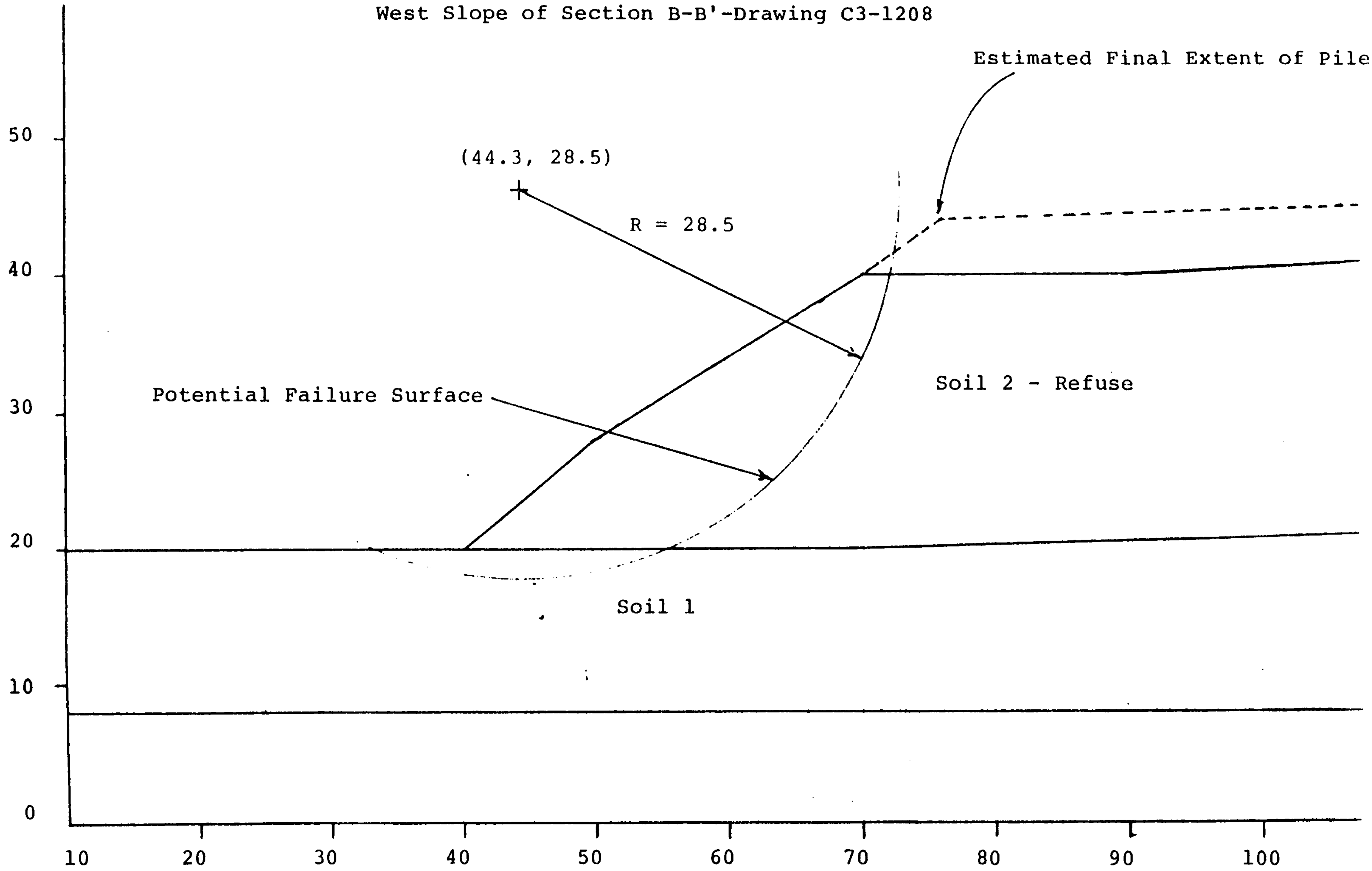
The three slopes evaluated have minimum safety factors in excess of 1.5.


Road Junctioı efuse Pile
Geneva Mine
Cross - Section Case 1
West Slope of Section A-A'-Drawing C3-1208
Estimated Final Extent of Pile
(61.4, 33.8)
R = 27.0
Potential Failure Surface
Soil 2 - Refuse
Soil 1
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100

Road Junction Refuse Pile

Geneva Mine

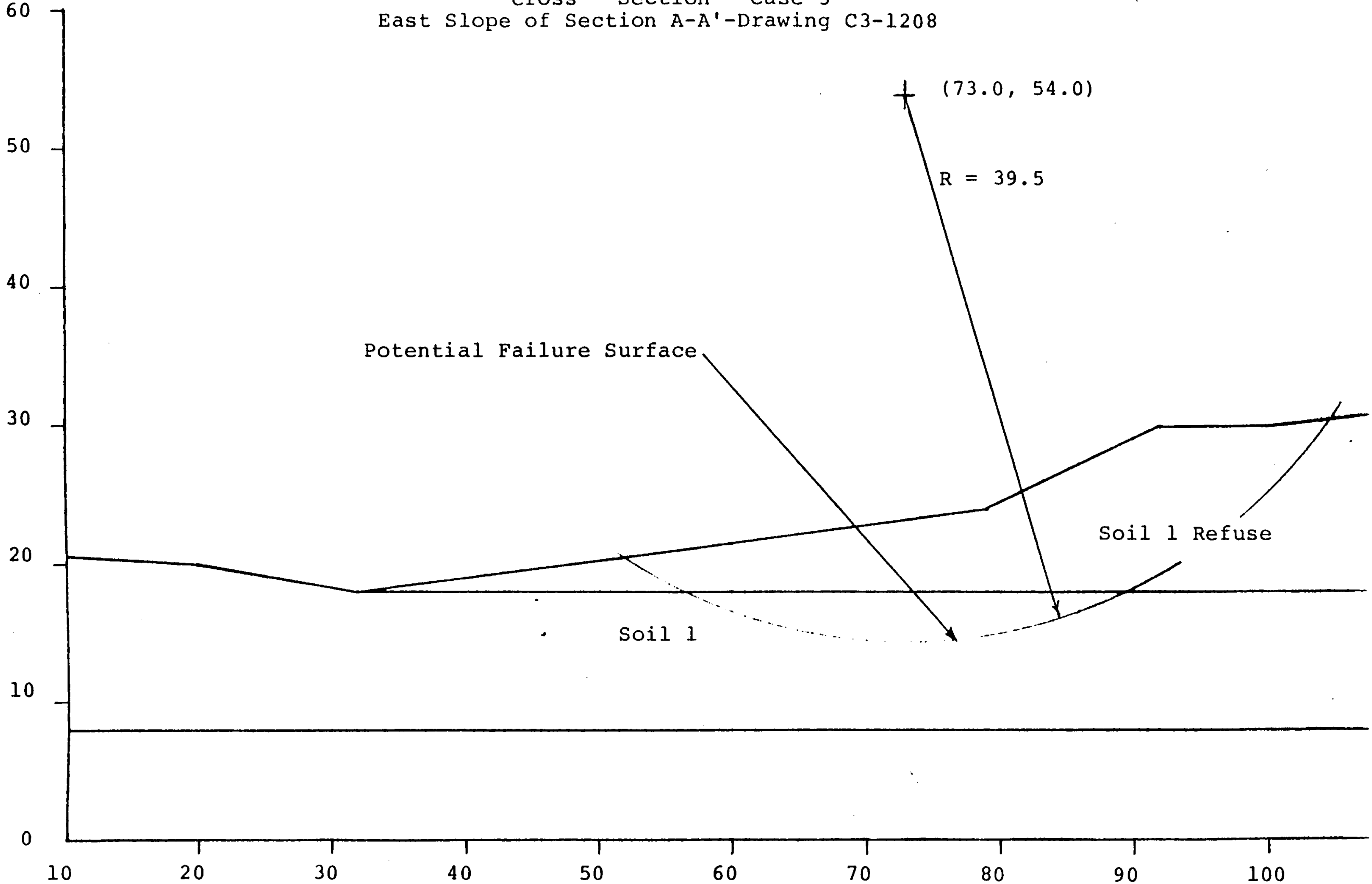
Cross - Section Case 2
West Slope of Section B-B'-Drawing C3-1208

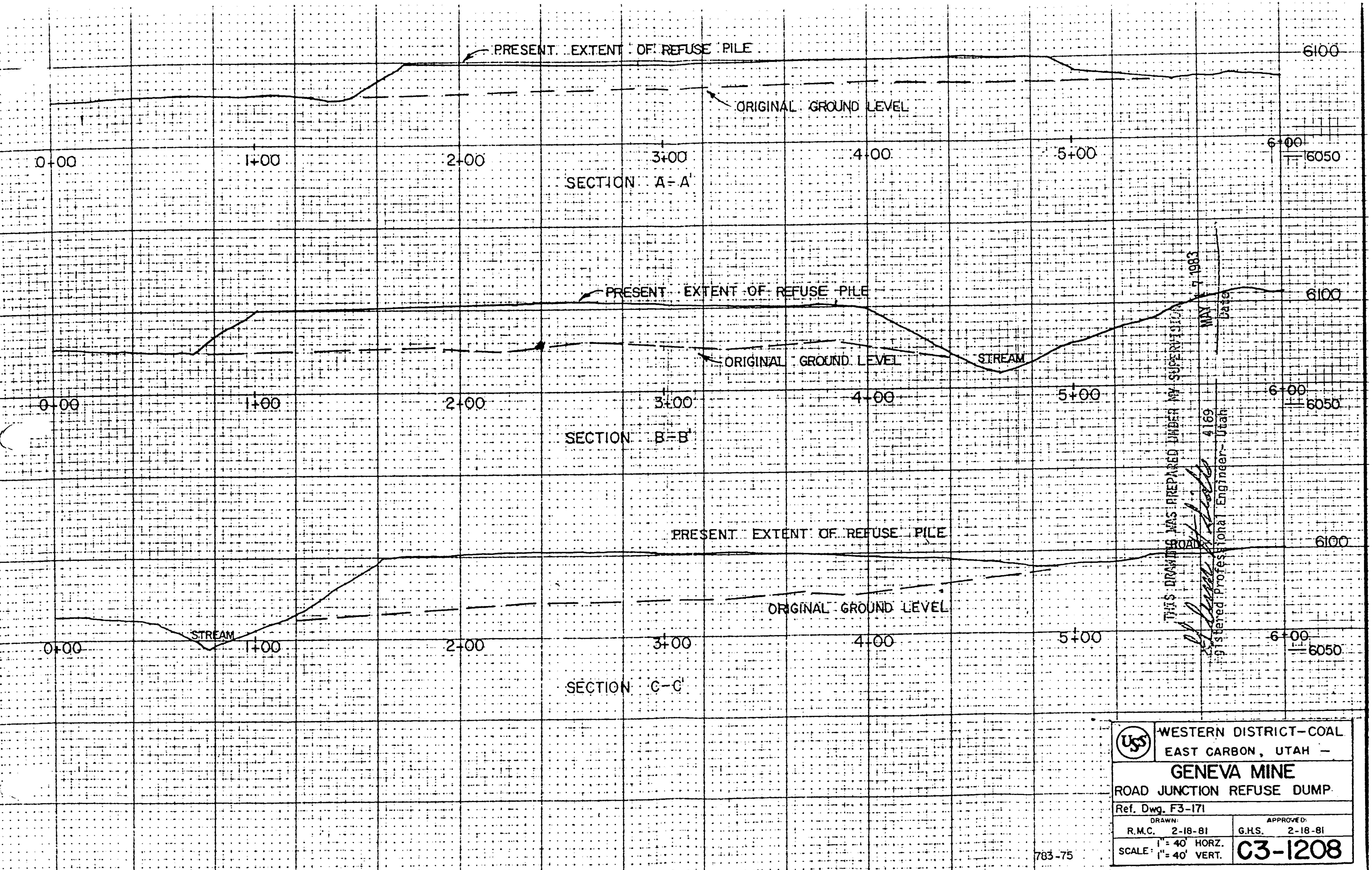


Road Junction Refuse Pile

Geneva Mine

Cross - Section - Case 3
East Slope of Section A-A'-Drawing C3-1208




PRESENT EXTENT OF REFUSE PILE
ORIGINAL GROUND LEVEL
6100
6050
0+00
1+00
2+00
3+00
4+00
5+00
6+00
SECTION A-A'
PRESENT EXTENT OF REFUSE PILE
ORIGINAL GROUND LEVEL
STREAM
6100
6050
0+00
1+00
2+00
3+00
4+00
5+00
6+00
SECTION B-B'
PRESENT EXTENT OF REFUSE PILE
ORIGINAL GROUND LEVEL
STREAM
ROAD
6100
6050
0+00
1+00
2+00
3+00
4+00
5+00
6+00
SECTION C-C'
THIS DRAWING WAS PREPARED UNDER MY SUPERVISION
MAY 17 1983
Date
4169
Registered Professional Engineer - Utah
USS
WESTERN DISTRICT-COAL
EAST CARBON, UTAH
GENEVA MINE
ROAD JUNCTION REFUSE DUMP
Ref. Dwg. F3-171
DRAWN: R.M.C. 2-18-81
APPROVED: G.H.S. 2-18-81
SCALE: 1" = 40' HORZ. 1" = 40' VERT.
C3-1208
783-75

Appendix IV-2

Stability Analysis of Final Reclamation Configuration

Introduction

This appendix presents the results of slope stability analysis for the post-reclamation configuration of the highwall backfills and the mine facilities regraded slopes at the Horse Canyon Mine, Emery County, Utah.

This stability analysis of the highwall backfills regraded sections of the mine facilities is based on the post-reclamation configuration. The details of the backfilling and regrading are discussed in Sections 3.7.3 and 4.3.2 of this document. The purpose of this report is to demonstrate a static factor of safety of at least 1.3 for the highwalls and 1.5 for the regraded slopes in the mine facilities area. The principal components of this project were:

1) Preparation of typical highwall backfill cross sections.
2) Preparation of typical regraded slopes cross section.
3) Compilation of material properties.
4) Evaluation of slope stability.

In this appendix we summarize the methodology used to evaluate the slope stability and present the results of our analysis. Computer printouts from the stability analysis are presented at the end of the appendix.

Methodology

The slope stability has been evaluated using the simplified Janbu method of slices (Janbu and others, 1956). A computer program has been used to generate potential failure surfaces and calculate the factor of safety for each surface (Geoslope, 1985). One hundred potential failure surfaces have been considered for each highwall backfill and for each regraded slope. Included in computer printouts at the end of the report are descriptions of the surfaces with the ten lowest factors of safety for each analysis. Appendix IV-2 Figures 1 and 2 show the typical highwall backfill, and the typical regraded slope in cross section, and the potential failure surface with the lowest factor of safety.

Only static conditions were considered in the stability analysis.

Geometry

Typical cross sections for the highwall backfill and regraded slopes in the facilities area have been prepared and were utilized for this study. Because the height of the highwall backfills will vary, the highest backfill was used for the stability analysis; this height is 60 feet. By demonstrating a factor of safety for this backfill to be greater than 1.3, it can be assumed that lower highwall backfills will also have a factor of safety greater than 1.3. To simplify the analysis, the geometry of the final backfill has been assumed to approximate a right triangle; having a height of 55 feet and a base of 110 feet. Similarly, the geometry of the regraded slopes were approximated by a right triangle having a height of 20 feet and a base of 40 feet. The 20 foot height represents the highest slope that will be regraded and thus will have the lowest factor of safety. The final slope configuration for both the highwall backfills and the regraded slopes will be 2h:1v.

Material Properties, Highwall Backfill

The stability of the highwall backfills is dependent upon parameters such as geometry, locations of piezometric surfaces, and strengths of the materials. In as much as the materials comprising the backfills will be coarse grained with only minor amounts of fines, we assumed the materials will be in drained conditions. Therefore, we have assumed one piezometric surface to exist at the contact of the fill material and the naturally occurring ground.

The base for the backfills is assumed to be competent materials. A similar assumption has been made for the bedrock at the back of the backfills. The fill material for the backfills will be excavated from the existing pads, or will consist of demolition debris. If demolition debris is used for backfill material, it will be placed in the back of the fill and covered with a minimum of 4 feet of fill material. This will insure that the demolition debris will not effect the stability of the fill. The fill material is coarse grained sand and gravel with minor amounts of fines corresponding to a GW or GP (depending on grading) in the Unified Soil Classification System (USCS). We have used data from available references to assign the material properties necessary to perform the stability analysis.

The dry density of the material has been assigned a value of 110 pcf. This represents the average of the values for dry sand and for gravel according to Spangler and Handy (1973). Furthermore, 110 pcf is the dry density for GP as reported by both USBR (1977), and E. D'Appolonia (1976). We have chosen to use the value for GP rather than for GW because it is the lower of the two values and thus yields the lower factor of safety. In this manner, we have used the 'worst case scenario'.

The angle of internal friction has been assigned a value of 34 degrees for this study. This represents the average of the values listed in the literature assuming the material is similar to 'dry sand' from Spangler and Handy (1973); 'GP' from USBR (1977); 'granular soils' from E. D'Appolonia (1976); and 'sub-rounded sand' from Brunsden and Prior (1984). The value selected is considered to be conservatively low as the values reported in the literature range up to 40 degrees.

Because the material is assumed to be coarse-grained, the cohesion is equal to 0 psi.

Material Properties, Regraded Slopes

The material comprising the slopes that will be regraded in the mine facilities area is a mixture of underground development waste rock and naturally occurring alluvial materials. The material properties have been assumed to be similar to the properties of the material comprising the Road Junction Refuse Pile. This material has a dry density of 85 pcf, an internal friction angle of 35 degrees and cohesion equal to 144 psi. The waste rock is situated on naturally occurring alluvial materials which have the following properties: dry density of 90 pcf, internal friction angle of 30 degrees and cohesion equal to 0 psi. A complete discussion of the material properties for the refuse pile and underlying alluvium is found in Appendix IV-1 of this document.

Results

Stability analysis reveal factors of safety of 1.353 for the highwall backfill and 1.906 for the regraded slopes in the mine facilities area. These factors of safety are for the potential failure surface with the lowest factor of safety. These failure surfaces are shown in Appendix IV-2 Figures 1 and 2.

Conclusions

Based on the available data and assumptions made, we conclude the highwall backfills will have a factor of safety of at least 1.3 and the regraded slopes will have a factor of safety of at least 1.5.

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Janbu, N., Bjerrum, L., and Kjaernsli, B., 1956, Soil Mechanics Applied to Some Engineering Problems, Norwegian Geotechnical Institute, Publ. No. 16.

Spangler, M. G., and Handy, R. L., 1973, Soil Engineering, Intext Educational Publishers, New York, 748 pp.

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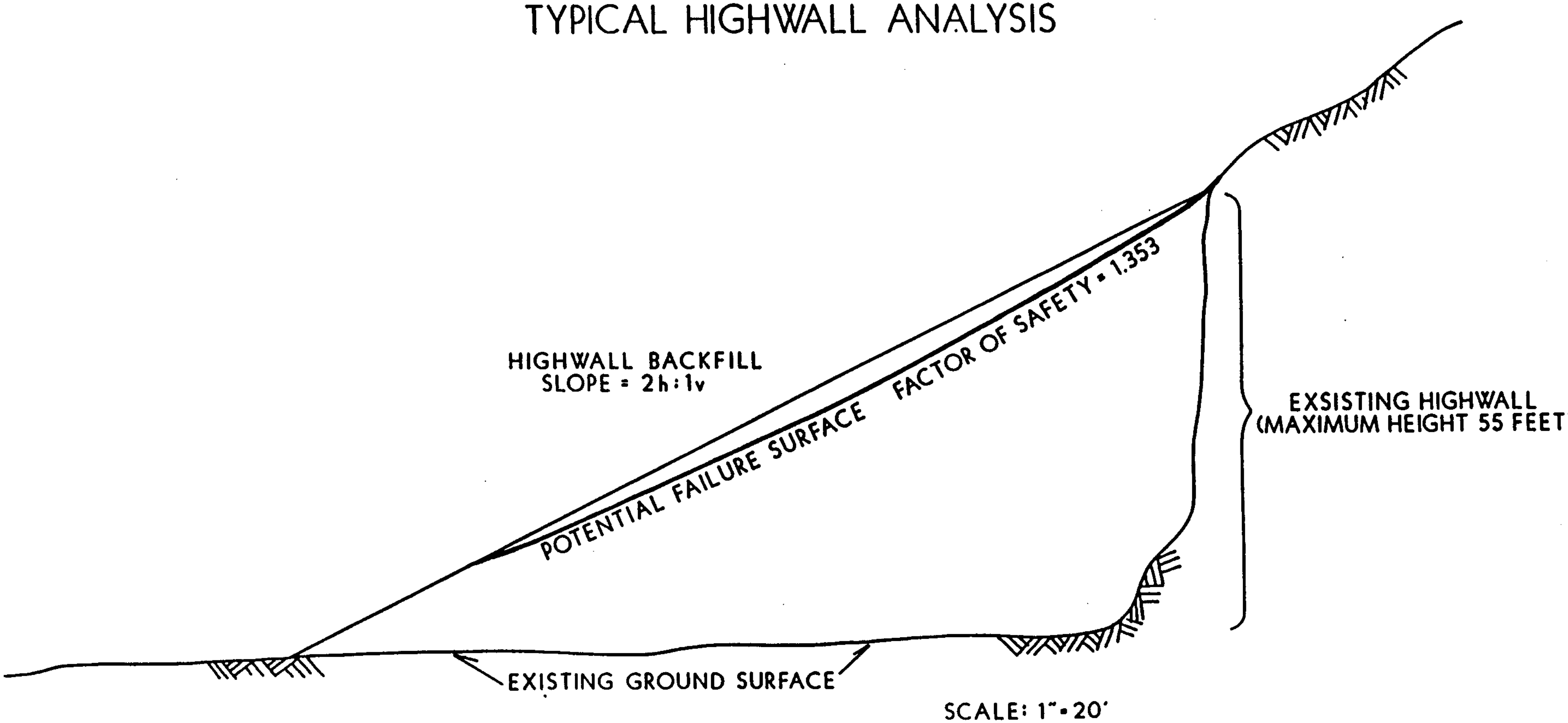
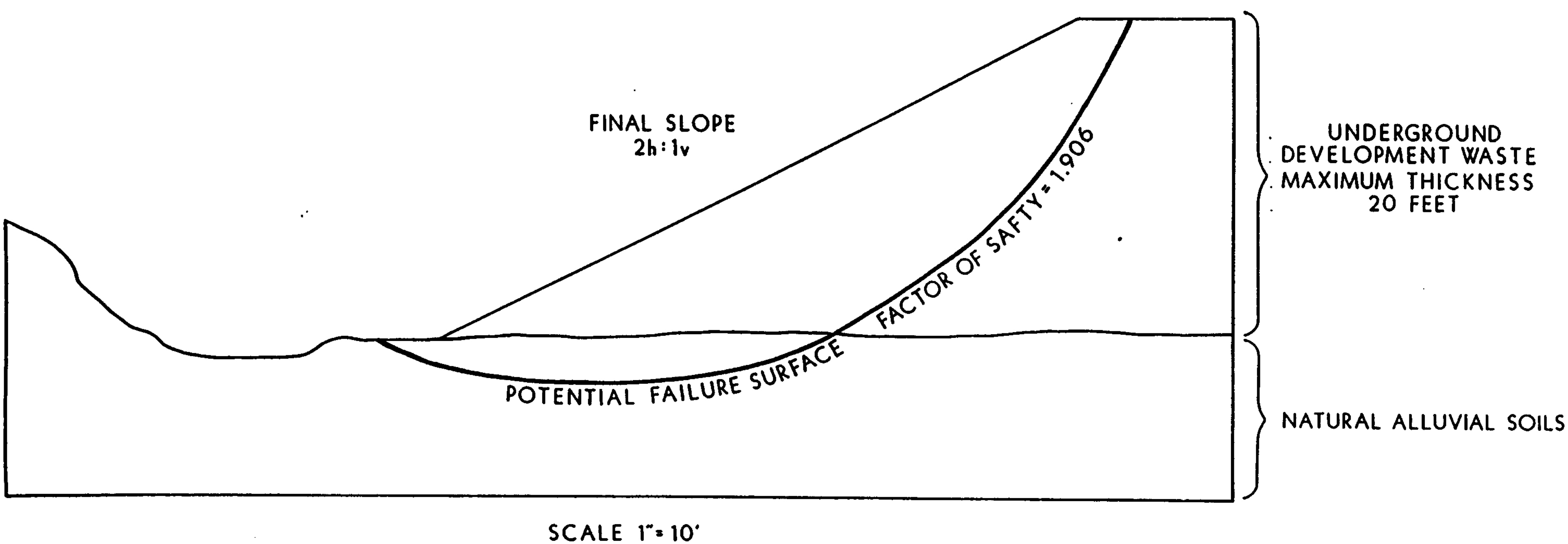
SLOPE STABILITY ANALYSIS
TYPICAL HIGHWALL ANALYSIS



Appendix IV-2
Figure 1

SLOPE STABILITY ANALYSIS
TYPICAL MINE FACILITIES CROSS SECTION



Appendix IV-2

Figure 2

GEOSLOPE
Version 3.1

Supplied by GEOCOMP Corp.
342 Sudbury Rd., Concord, MA. 01742
(617) 369-8304

GEOSLOPE V3.1 is based on the program, STABL3, developed at Purdue University under sponsorship of the Federal Highway Administration.

GEOCOMP Corp. has modified the program to run on various microcomputers and plotting devices.

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JBR CONSULTANTS GROUP
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--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION TYPICAL HIGHWALL BACKFILL

BOUNDARY COORDINATES

2 TOP BOUNDARIES
4 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	10.00	15.00	10.00	1
2	15.00	10.00	70.00	37.50	1
3	15.00	10.00	60.00	10.00	1
4	60.00	10.00	70.00	20.00	1

ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.
1	110.0	110.0	.0	34.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	.00
2	70.00	.00

SEARCHING ROUTINE WILL BE LIMITED TO AN AREA DEFINED BY 3 BOUNDARIES OF WHICH THE FIRST 3 BOUNDARIES WILL DEFLECT SURFACES UPWARD

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT
1	.00	10.00	.00	.00
2	.00	.00	70.00	.00
3	70.00	.00	70.00	37.50

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED ALONG THE GROUND SURFACE BETWEEN X = 15.00
AND X = 30.00

EACH SURFACE TERMINATES BETWEEN X = 60.00
AND X = 70.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION T WHICH A SURFACE EXTENDS IS Y = .00

2.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

* * SAFETY FACTORS ARE CALCULATED BY THE MODIFIED JANBU METHOD * *

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 1 SPECIFIED BY 25 COORDINATE POINTS

SAFETY FACTOR = 1.353

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	26.67	15.83	21.13
2	28.53	16.55	21.60
3	30.39	17.29	22.08
4	32.25	18.04	22.56
5	34.09	18.81	23.04
6	35.93	19.59	23.51
7	37.77	20.39	23.99
8	39.59	21.20	24.47
9	41.41	22.03	24.95
10	43.23	22.88	25.43
11	45.03	23.73	25.90
12	46.83	24.61	26.38
13	48.62	25.50	26.86
14	50.41	26.40	27.34
15	52.19	27.32	27.81
16	53.95	28.25	28.29
17	55.72	29.20	28.77
18	57.47	30.16	29.25
19	59.21	31.14	29.72
20	60.95	32.13	30.20
21	62.68	33.14	30.68
22	64.40	34.16	31.16
23	66.11	35.19	31.63
24	67.81	36.24	32.11
25	69.11	37.06	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	27.60	1.87	21.74	.00	.00	19.54	9.74
2	29.46	1.86	63.11	.00	.00	56.69	28.26
3	31.32	1.85	100.42	.00	.00	90.15	44.93
4	33.17	1.85	133.70	.00	.00	119.94	59.78
5	35.01	1.84	162.97	.00	.00	146.12	72.83
6	36.85	1.83	188.26	.00	.00	168.72	84.09
7	38.68	1.83	209.62	.00	.00	187.79	93.59
8	40.50	1.82	227.07	.00	.00	203.35	101.35
9	42.32	1.81	240.64	.00	.00	215.46	107.38
10	44.13	1.81	250.39	.00	.00	224.14	111.71
11	45.93	1.80	256.35	.00	.00	229.45	114.35
12	47.73	1.79	258.57	.00	.00	231.42	115.34
13	49.52	1.78	257.08	.00	.00	230.09	114.67
14	51.30	1.78	251.93	.00	.00	225.50	112.39
15	53.07	1.77	243.18	.00	.00	217.70	108.50

17	56.59	1.75	215.04	.00	.00	192.62	96.00
18	58.34	1.75	195.77	.00	.00	175.42	87.43
19	60.08	1.74	173.10	.00	.00	155.17	77.33
20	61.82	1.73	147.08	.00	.00	131.91	65.74
21	63.54	1.72	117.78	.00	.00	105.69	52.68
22	65.26	1.71	85.25	.00	.00	76.55	38.15
23	66.96	1.70	49.56	.00	.00	44.54	22.20
24	68.46	1.30	11.86	.00	.00	10.66	5.31

1

FAILURE SURFACE # 2 SPECIFIED BY 29 COORDINATE POINTS

SAFETY FACTOR = 1.354

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	18.33	11.67	20.45
2	20.21	12.37	20.92
3	22.08	13.08	21.39
4	23.94	13.81	21.85
5	25.79	14.55	22.32
6	27.64	15.31	22.79
7	29.49	16.09	23.26
8	31.33	16.88	23.73
9	33.16	17.68	24.20
10	34.98	18.50	24.66
11	36.80	19.34	25.13
12	38.61	20.19	25.60
13	40.41	21.05	26.07
14	42.21	21.93	26.54
15	44.00	22.82	27.01
16	45.78	23.73	27.47
17	47.56	24.65	27.94
18	49.32	25.59	28.41
19	51.08	26.54	28.88
20	52.83	27.51	29.35
21	54.58	28.49	29.82
22	56.31	29.48	30.28
23	58.04	30.49	30.75
24	59.76	31.51	31.22
25	61.47	32.55	31.69
26	63.17	33.60	32.16
27	64.86	34.67	32.63
28	66.55	35.74	33.09
29	66.74	35.87	

1

FAILURE SURFACE # 3 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.357

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	21.67	13.33	18.50
2	23.56	13.97	19.15
3	25.45	14.62	19.81
4	27.33	15.30	20.46
5	29.21	16.00	21.11
6	31.07	16.72	21.76

8	34.78	18.23	23.06
9	36.62	19.01	23.71
10	38.45	19.81	24.37
11	40.27	20.64	25.02
12	42.09	21.48	25.67
13	43.89	22.35	26.32
14	45.68	23.24	26.97
15	47.46	24.14	27.62
16	49.24	25.07	28.27
17	51.00	26.02	28.93
18	52.75	26.99	29.58
19	54.49	27.97	30.23
20	56.22	28.98	30.88
21	57.93	30.01	31.53
22	59.64	31.05	32.18
23	61.33	32.12	32.83
24	63.01	33.20	33.49
25	64.68	34.31	34.14
26	66.33	35.43	34.79
27	67.56	36.28	

1

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Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 4 SPECIFIED BY 20 COORDINATE POINTS

SAFETY FACTOR = 1.358

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	30.00	17.50	18.19
2	31.90	18.12	19.16
3	33.79	18.78	20.13
4	35.67	19.47	21.09
5	37.53	20.19	22.06
6	39.39	20.94	23.03
7	41.23	21.72	24.00
8	43.05	22.54	24.97
9	44.87	23.38	25.94
10	46.67	24.26	26.91
11	48.45	25.16	27.88
12	50.22	26.10	28.85
13	51.97	27.06	29.82
14	53.70	28.05	30.79
15	55.42	29.08	31.75
16	57.12	30.13	32.72
17	58.81	31.21	33.69
18	60.47	32.32	34.66
19	62.12	33.46	35.63
20	62.57	33.78	

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 5 SPECIFIED BY 20 COORDINATE POINTS

SAFETY FACTOR = 1.360

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	30.00	17.50	17.31
2	31.91	18.10	18.39
3	33.81	18.73	19.47

5	37.57	20.10	21.63
6	39.43	20.83	22.71
7	41.27	21.60	23.79
8	43.10	22.41	24.87
9	44.91	23.25	25.95
10	46.71	24.13	27.03
11	48.49	25.04	28.10
12	50.26	25.98	29.18
13	52.01	26.95	30.26
14	53.73	27.96	31.34
15	55.44	29.00	32.42
16	57.13	30.07	33.50
17	58.80	31.18	34.58
18	60.44	32.31	35.66
19	62.07	33.48	36.74
20	62.29	33.65	

1

FAILURE SURFACE # 6 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.360

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	20.00	12.50	17.01
2	21.91	13.09	17.78
3	23.82	13.70	18.55
4	25.71	14.33	19.33
5	27.60	14.99	20.10
6	29.48	15.68	20.87
7	31.35	16.39	21.64
8	33.21	17.13	22.41
9	35.06	17.89	23.18
10	36.89	18.68	23.96
11	38.72	19.49	24.73
12	40.54	20.33	25.50
13	42.34	21.19	26.27
14	44.14	22.08	27.04
15	45.92	22.99	27.82
16	47.69	23.92	28.59
17	49.44	24.88	29.36
18	51.19	25.86	30.13
19	52.92	26.86	30.90
20	54.63	27.89	31.68
21	56.33	28.94	32.45
22	58.02	30.01	33.22
23	59.70	31.11	33.99
24	61.35	32.23	34.76
25	63.00	33.37	35.53
26	64.62	34.53	36.31
27	65.83	35.42	

1

FAILURE SURFACE # 7 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.361

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)

2	23.58	13.91	17.57
3	25.49	14.51	18.34
4	27.39	15.14	19.11
5	29.28	15.80	19.89
6	31.16	16.48	20.66
7	33.03	17.19	21.44
8	34.89	17.92	22.21
9	36.74	18.67	22.99
10	38.58	19.45	23.76
11	40.41	20.26	24.54
12	42.23	21.09	25.31
13	44.04	21.94	26.09
14	45.84	22.82	26.86
15	47.62	23.73	27.64
16	49.39	24.66	28.41
17	51.15	25.61	29.18
18	52.90	26.58	29.96
19	54.63	27.58	30.73
20	56.35	28.60	31.51
21	58.06	29.65	32.28
22	59.75	30.72	33.06
23	61.42	31.81	33.83
24	63.08	32.92	34.61
25	64.73	34.06	35.38
26	66.36	35.22	36.16
27	67.98	36.40	36.93
28	68.34	36.67	

1

FAILURE SURFACE # 8 SPECIFIED BY 21 COORDINATE POINTS

SAFETY FACTOR = 1.375

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	28.33	16.67	11.79
2	30.29	17.08	13.36
3	32.24	17.54	14.93
4	34.17	18.05	16.49
5	36.09	18.62	18.06
6	37.99	19.24	19.62
7	39.87	19.91	21.19
8	41.74	20.64	22.76
9	43.58	21.41	24.32
10	45.40	22.23	25.89
11	47.20	23.11	27.45
12	48.98	24.03	29.02
13	50.73	25.00	30.59
14	52.45	26.02	32.15
15	54.14	27.08	33.72
16	55.81	28.19	35.28
17	57.44	29.35	36.85
18	59.04	30.54	38.42
19	60.61	31.79	39.98
20	62.14	33.07	41.55
21	63.43	34.21	

1

FAILURE SURFACE # 9 SPECIFIED BY 28 COORDINATE POINTS

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	23.33	14.17	11.41
2	25.29	14.56	12.61
3	27.25	15.00	13.80
4	29.19	15.48	15.00
5	31.12	15.99	16.20
6	33.04	16.55	17.39
7	34.95	17.15	18.59
8	36.85	17.79	19.78
9	38.73	18.46	20.98
10	40.59	19.18	22.18
11	42.45	19.94	23.37
12	44.28	20.73	24.57
13	46.10	21.56	25.76
14	47.90	22.43	26.96
15	49.69	23.34	28.16
16	51.45	24.28	29.35
17	53.19	25.26	30.55
18	54.91	26.28	31.74
19	56.62	27.33	32.94
20	58.29	28.42	34.13
21	59.95	29.54	35.33
22	61.58	30.70	36.53
23	63.19	31.89	37.72
24	64.77	33.11	38.92
25	66.33	34.37	40.11
26	67.86	35.65	41.31
27	69.36	36.97	42.51
28	69.85	37.42	

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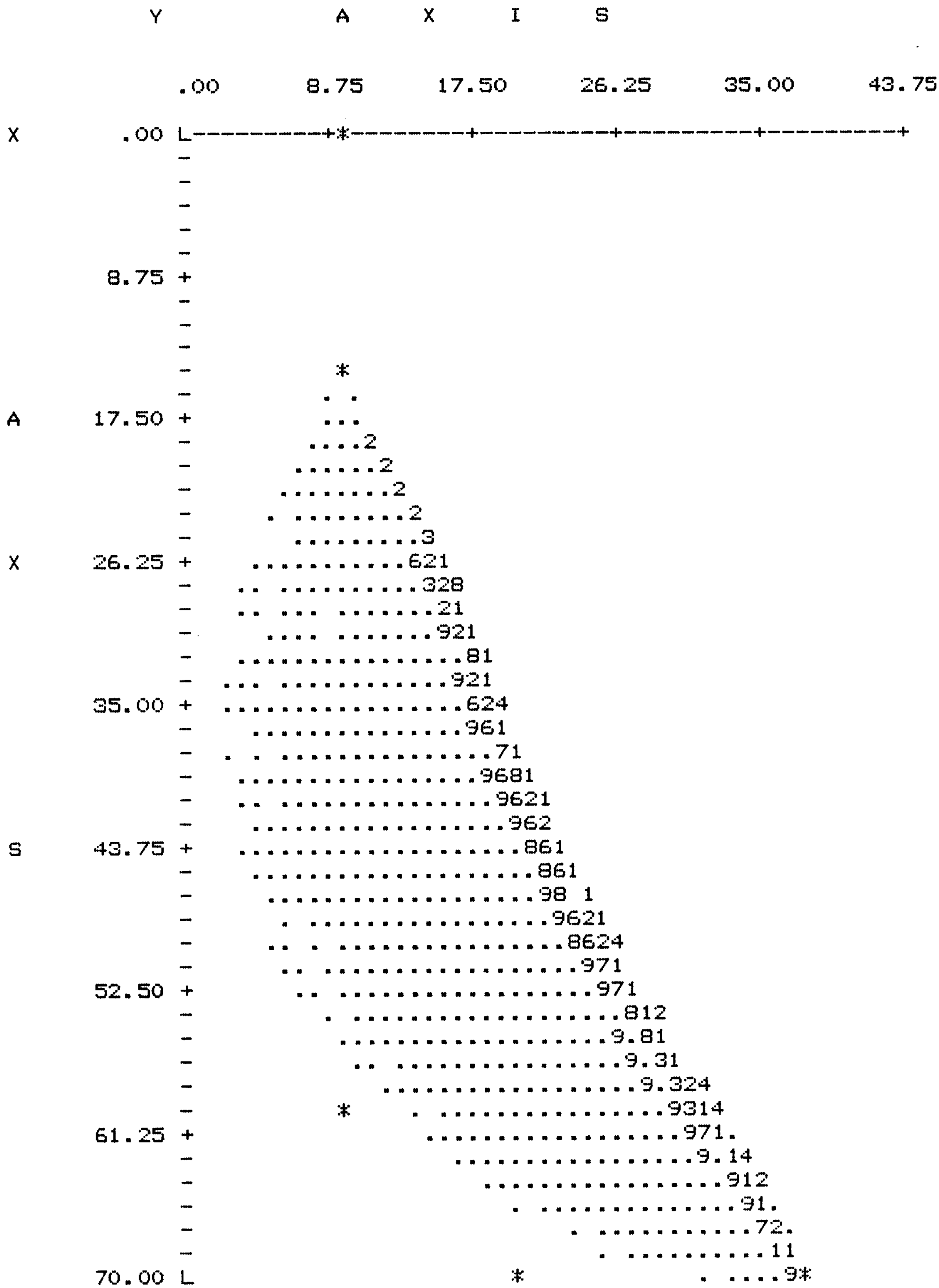
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE #10 SPECIFIED BY 21 COORDINATE POINTS

SAFETY FACTOR = 1.379

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	30.00	17.50	10.82
2	31.96	17.88	12.56
3	33.92	18.31	14.29
4	35.86	18.80	16.03
5	37.78	19.36	17.76
6	39.68	19.97	19.50
7	41.57	20.63	21.24
8	43.43	21.36	22.97
9	45.27	22.14	24.71
10	47.09	22.98	26.45
11	48.88	23.87	28.18
12	50.64	24.81	29.92
13	52.38	25.81	31.65
14	54.08	26.86	33.39
15	55.75	27.96	35.13
16	57.39	29.11	36.86
17	58.99	30.31	38.60
18	60.55	31.56	40.33
19	62.07	32.85	42.07
20	63.56	34.19	43.81
21	63.75	34.37	

Salt Lake City, UT (S/N 5076)



GEOSLOPE
Version 3.1

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JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION TYPICAL CROSS SECTION OF MINE FACILITIES AREA

BOUNDARY COORDINATES

5 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT	SOIL TYPE BELOW BND
1	.00	10.00	8.00	8.00	1
2	8.00	8.00	14.00	10.00	1
3	14.00	10.00	20.00	10.00	1
4	20.00	10.00	60.00	30.00	2
5	60.00	30.00	90.00	30.00	2
6	20.00	10.00	90.00	10.00	1

ISOTROPIC SOIL PARAMETERS

SOIL TYPE NO.	TOTAL UNIT WT.	SATURATED UNIT WT.	COHESION INTERCEPT	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT	PIEZOMETRIC SURFACE NO.
1	90.0	90.0	.0	30.0	.00	.0	1
2	85.0	85.0	144.0	35.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER	Y-WATER
1	.00	.00
2	90.00	.00

SEARCHING ROUTINE WILL BE LIMITED TO AN AREA DEFINED BY 3 BOUNDARIES
OF WHICH THE FIRST 3 BOUNDARIES WILL DEFLECT SURFACES UPWARD

BOUNDARY NO.	X-LEFT	Y-LEFT	X-RIGHT	Y-RIGHT
1	.00	10.00	.00	.00
2	.00	.00	90.00	.00
3	90.00	.00	90.00	30.00

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = 10.00
AND X = 25.00

EACH SURFACE TERMINATES BETWEEN X = 50.00
AND X = 70.00

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00

2.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

* * SAFETY FACTORS ARE CALCULATED BY THE MODIFIED JANBU METHOD * *

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 1 SPECIFIED BY 31 COORDINATE POINTS

SAFETY FACTOR = 1.906

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	15.00	10.00	-20.82
2	16.87	9.29	-17.74
3	18.77	8.68	-14.66
4	20.71	8.17	-11.58
5	22.67	7.77	-8.49
6	24.65	7.48	-5.41
7	26.64	7.29	-2.33
8	28.64	7.21	.75
9	30.64	7.23	3.83
10	32.63	7.37	6.92
11	34.62	7.61	10.00
12	36.59	7.95	13.08
13	38.54	8.41	16.16
14	40.46	8.96	19.24
15	42.34	9.62	22.33
16	44.19	10.38	25.41
17	46.00	11.24	28.49
18	47.76	12.20	31.57
19	49.46	13.24	34.65
20	51.11	14.38	37.74
21	52.69	15.60	40.82
22	54.20	16.91	43.90
23	55.64	18.30	46.98
24	57.01	19.76	50.06
25	58.29	21.29	53.15
26	59.49	22.89	56.23
27	60.60	24.56	59.31
28	61.62	26.28	62.39
29	62.55	28.05	65.47
30	63.38	29.87	68.56
31	63.43	30.00	

SLICE NO.	X	DX	DW	DQ	DU	DN	DSr
1	15.94	1.87	59.81	.00	.00	72.31	21.90
2	17.82	1.90	174.12	.00	.00	202.43	61.31
3	19.39	1.23	163.27	.00	.00	183.28	55.51
4	20.35	.71	121.43	.00	.00	136.32	41.29
5	21.69	1.96	498.14	.00	.00	542.11	164.19
6	23.66	1.98	730.43	.00	.00	773.52	234.28
7	25.64	1.99	946.55	.00	.00	[illegible]	[illegible]

8	27.64	2.00	1143.69	.00	.00	1158.92	351.00
9	29.64	2.00	1319.40	.00	.00	1314.29	398.06
10	31.63	2.00	1471.62	.00	.00	1445.58	437.82
11	33.62	1.99	1598.69	.00	.00	1553.35	470.46
12	35.60	1.97	1699.37	.00	.00	1638.12	496.14
13	37.56	1.95	1772.88	.00	.00	1700.45	515.01
14	39.50	1.92	1818.86	.00	.00	1740.90	527.27
15	41.40	1.89	1837.43	.00	.00	1760.08	533.07
16	42.80	.92	904.86	.00	.00	869.98	263.49
17	43.73	.93	925.16	.00	.00	841.87	384.77
18	45.10	1.81	1802.28	.00	.00	1637.76	677.12
19	46.88	1.76	1751.41	.00	.00	1593.14	660.73
20	48.61	1.70	1678.21	.00	.00	1531.27	638.01
21	50.29	1.65	1584.69	.00	.00	1453.06	609.28
22	51.90	1.58	1473.24	.00	.00	1359.50	574.91
23	53.45	1.51	1346.53	.00	.00	1251.66	535.30
24	54.92	1.44	1207.53	.00	.00	1130.75	490.89
25	56.33	1.36	1059.44	.00	.00	998.09	442.16
26	57.65	1.28	905.66	.00	.00	855.16	389.66
27	58.89	1.20	749.73	.00	.00	703.63	334.00
28	59.75	.51	284.85	.00	.00	264.15	172.57
29	60.30	.60	302.70	.00	.00	272.24	175.54
30	61.11	1.02	397.75	.00	.00	324.14	194.60
31	62.09	.93	223.59	.00	.00	113.71	117.31
32	62.97	.83	73.54	.00	.00	-85.29	44.21
33	63.41	.05	.29	.00	.00	-13.71	70.50

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 2 SPECIFIED BY 31 COORDINATE POINTS

SAFETY FACTOR = 1.911

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	16.67	10.00	-27.63
2	18.44	9.07	-24.09
3	20.26	8.26	-20.56
4	22.14	7.55	-17.02
5	24.05	6.97	-13.48
6	25.99	6.50	-9.94
7	27.96	6.16	-6.40
8	29.95	5.93	-2.86
9	31.95	5.83	.68
10	33.95	5.86	4.22
11	35.94	6.01	7.76
12	37.93	6.28	11.30
13	39.89	6.67	14.84
14	41.82	7.18	18.38
15	43.72	7.81	21.92
16	45.57	8.56	25.46
17	47.38	9.42	28.99
18	49.13	10.39	32.53
19	50.82	11.46	36.07
20	52.43	12.64	39.61
21	53.97	13.91	43.15
22	55.43	15.28	46.69
23	56.80	16.74	50.23
24	58.08	18.27	53.77
25	59.27	19.89	57.31
26	60.35	21.57	60.85
27	61.32	23.32	64.39
28	62.18	25.12	67.93

30	63.57	28.87	75.01
31	63.87	30.00	

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 3 SPECIFIED BY 34 COORDINATE POINTS

SAFETY FACTOR = 1.913

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	11.67	9.22	-23.78
2	13.50	8.42	-20.92
3	15.37	7.70	-18.06
4	17.27	7.08	-15.19
5	19.20	6.56	-12.33
6	21.15	6.13	-9.46
7	23.12	5.80	-6.60
8	25.11	5.57	-3.73
9	27.11	5.44	-.87
10	29.11	5.41	1.99
11	31.10	5.48	4.86
12	33.10	5.65	7.72
13	35.08	5.92	10.59
14	37.05	6.29	13.45
15	38.99	6.75	16.32
16	40.91	7.31	19.18
17	42.80	7.97	22.05
18	44.65	8.72	24.91
19	46.47	9.56	27.77
20	48.24	10.50	30.64
21	49.96	11.52	33.50
22	51.62	12.62	36.37
23	53.24	13.81	39.23
24	54.78	15.07	42.10
25	56.27	16.41	44.96
26	57.68	17.82	47.82
27	59.03	19.31	50.69
28	60.29	20.85	53.55
29	61.48	22.46	56.42
30	62.59	24.13	59.28
31	63.61	25.85	62.15
32	64.54	27.62	65.01
33	65.39	29.43	67.88
34	65.62	30.00	

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 4 SPECIFIED BY 29 COORDINATE POINTS

SAFETY FACTOR = 1.914

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	18.33	10.00	-26.07
2	20.13	9.12	-22.31
3	21.98	8.36	-18.55
4	23.88	7.73	-14.79
5	25.81	7.22	-11.03
6	27.77	6.83	-7.27
7	29.76	6.58	-3.51
8	31.75	[illegible]	[illegible]

9	33.75	6.47	4.01
10	35.75	6.61	7.77
11	37.73	6.88	11.54
12	39.69	7.28	15.30
13	41.62	7.80	19.06
14	43.51	8.46	22.82
15	45.35	9.23	26.58
16	47.14	10.13	30.34
17	48.87	11.14	34.10
18	50.52	12.26	37.86
19	52.10	13.49	41.62
20	53.60	14.81	45.38
21	55.00	16.24	49.14
22	56.31	17.75	52.90
23	57.52	19.35	56.66
24	58.62	21.02	60.42
25	59.60	22.76	64.18
26	60.48	24.56	67.94
27	61.23	26.41	71.70
28	61.85	28.31	75.46
29	62.29	30.00	

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 5 SPECIFIED BY 32 COORDINATE POINTS

SAFETY FACTOR = 1.936

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	11.67	9.22	-28.68
2	13.42	8.26	-25.18
3	15.23	7.41	-21.68
4	17.09	6.67	-18.18
5	18.99	6.05	-14.69
6	20.93	5.54	-11.19
7	22.89	5.15	-7.69
8	24.87	4.89	-4.19
9	26.86	4.74	-.70
10	28.86	4.72	2.80
11	30.86	4.81	6.30
12	32.85	5.03	9.79
13	34.82	5.37	13.29
14	36.77	5.83	16.79
15	38.68	6.41	20.29
16	40.56	7.10	23.78
17	42.39	7.91	27.28
18	44.16	8.83	30.78
19	45.88	9.85	34.28
20	47.54	10.98	37.77
21	49.12	12.20	41.27
22	50.62	13.52	44.77
23	52.04	14.93	48.27
24	53.37	16.42	51.76
25	54.61	17.99	55.26
26	55.75	19.64	58.76
27	56.79	21.35	62.25
28	57.72	23.12	65.75
29	58.54	24.94	69.25
30	59.25	26.81	72.75
31	59.84	28.72	76.24
32	60.15	30.00	

1

JBR CONSULTANTS GROUP

FAILURE SURFACE # 6 SPECIFIED BY 27 COORDINATE POINTS

SAFETY FACTOR = 1.946

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	16.67	10.00	-25.25
2	18.48	9.15	-21.24
3	20.34	8.42	-17.22
4	22.25	7.83	-13.21
5	24.20	7.37	-9.20
6	26.17	7.05	-5.19
7	28.16	6.87	-1.18
8	30.16	6.83	2.84
9	32.16	6.93	6.85
10	34.15	7.17	10.86
11	36.11	7.55	14.87
12	38.04	8.06	18.89
13	39.94	8.71	22.90
14	41.78	9.48	26.91
15	43.56	10.39	30.92
16	45.28	11.42	34.93
17	46.92	12.56	38.95
18	48.47	13.82	42.96
19	49.94	15.18	46.97
20	51.30	16.64	50.98
21	52.56	18.20	54.99
22	53.71	19.84	59.01
23	54.74	21.55	63.02
24	55.64	23.33	67.03
25	56.43	25.18	71.04
26	57.07	27.07	75.06
27	57.53	28.76	

1

FAILURE SURFACE # 7 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.948

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	16.67	10.00	-17.85
2	18.57	9.39	-14.56
3	20.51	8.88	-11.27
4	22.47	8.49	-7.98
5	24.45	8.22	-4.69
6	26.44	8.05	-1.40
7	28.44	8.00	1.89
8	30.44	8.07	5.18
9	32.43	8.25	8.47
10	34.41	8.55	11.76
11	36.37	8.95	15.05
12	38.30	9.47	18.34
13	40.20	10.10	21.63
14	42.06	10.84	24.92
15	43.87	11.68	28.21
16	45.63	12.63	31.50
17	47.34	13.67	34.79
18	48.98	14.81	38.08

20	52.06	17.37	44.66
21	53.48	18.78	47.95
22	54.82	20.26	51.24
23	56.07	21.82	54.53
24	57.23	23.45	57.82
25	58.30	25.14	61.11
26	59.26	26.89	64.40
27	60.13	28.70	67.69
28	60.66	30.00	

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 8 SPECIFIED BY 28 COORDINATE POINTS

SAFETY FACTOR = 1.948

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	18.33	10.00	-16.08
2	20.26	9.45	-12.90
3	22.21	9.00	-9.73
4	24.18	8.66	-6.55
5	26.16	8.43	-3.37
6	28.16	8.32	-.20
7	30.16	8.31	2.98
8	32.16	8.41	6.15
9	34.15	8.63	9.33
10	36.12	8.95	12.50
11	38.07	9.38	15.68
12	40.00	9.92	18.85
13	41.89	10.57	22.03
14	43.74	11.32	25.21
15	45.55	12.17	28.38
16	47.31	13.12	31.56
17	49.02	14.17	34.73
18	50.66	15.31	37.91
19	52.24	16.54	41.08
20	53.75	17.85	44.26
21	55.18	19.25	47.43
22	56.53	20.72	50.61
23	57.80	22.27	53.78
24	58.98	23.88	56.96
25	60.07	25.56	60.14
26	61.07	27.29	63.31
27	61.97	29.08	66.49
28	62.37	30.00	

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE # 9 SPECIFIED BY 34 COORDINATE POINTS

SAFETY FACTOR = 1.952

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	13.33	9.78	-22.07
2	15.19	9.03	-19.38
3	17.07	8.36	-16.68
4	18.99	7.79	-13.98
5	20.93	7.31	-11.28
6	22.89	6.91	-8.58

8	26.86	6.41	-3.18
9	28.86	6.30	-.49
10	30.86	6.28	2.21
11	32.85	6.36	4.91
12	34.85	6.53	7.61
13	36.83	6.80	10.31
14	38.80	7.15	13.01
15	40.75	7.60	15.71
16	42.67	8.15	18.41
17	44.57	8.78	21.10
18	46.43	9.50	23.80
19	48.26	10.30	26.50
20	50.05	11.20	29.20
21	51.80	12.17	31.90
22	53.50	13.23	34.60
23	55.14	14.37	37.30
24	56.74	15.58	39.99
25	58.27	16.86	42.69
26	59.74	18.22	45.39
27	61.14	19.64	48.09
28	62.48	21.13	50.79
29	63.74	22.68	53.49
30	64.93	24.29	56.19
31	66.05	25.95	58.88
32	67.08	27.66	61.58
33	68.03	29.42	64.28
34	68.31	30.00	

1

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

FAILURE SURFACE #10 SPECIFIED BY 27 COORDINATE POINTS

AFETY FACTOR = 1.954

POINT NO.	X-SURF	Y-SURF	ALPHA (DEG)
1	16.67	10.00	-22.96
2	18.51	9.22	-19.06
3	20.40	8.57	-15.16
4	22.33	8.04	-11.25
5	24.29	7.65	-7.35
6	26.27	7.40	-3.45
7	28.27	7.28	.46
8	30.27	7.29	4.36
9	32.27	7.45	8.27
10	34.24	7.73	12.17
11	36.20	8.15	16.07
12	38.12	8.71	19.98
13	40.00	9.39	23.88
14	41.83	10.20	27.78
15	43.60	11.13	31.69
16	45.30	12.18	35.59
17	46.93	13.35	39.49
18	48.47	14.62	43.40
19	49.92	15.99	47.30
20	51.28	17.46	51.20
21	52.53	19.02	55.11
22	53.68	20.66	59.01
23	54.71	22.38	62.91
24	55.62	24.16	66.82
25	56.41	26.00	70.72
26	57.07	27.88	74.63
27	57.27	28.64	

JBR CONSULTANTS GROUP
Salt Lake City, UT (S/N 5076)

```
          Y            A     X     I     S

               .00      11.25     22.50     33.75     45.00     56.25

X        .00 L--------*+---------+---------+---------+---------+
             -
             -
             -
             -      *
             -       .
       11.25 +     ..3
             -    ..3.*
             -   ...391
             -  ...3912
             -  ..53914
             - ...3914*
A      22.50 +....3917..
             -...53218...
             -...5317.....
             -...5217.....
             ....5217......
             .....241.......
X      33.75 ....52417......
             .....2467.......
             .....5217........
             -.....2167.......
             -.....23187.......
             -......2417.......
       45.00 + ......2167.......
             - ......23117.......
             -  ......24517.......
             -  .......2451760.......
             -   .......2351560.......
             -    .......234157660.....
S      56.25 +     ........221515.66060
             -      ........923.1855..06
             -       ........9.221.185.5*
             -         .......9.932218184
             -          .........9..32321
             -             ........99..33
       67.50 +                ........999
             -                   ........
             -
             -
             -
             -
       78.75 +
             -
             -
             -
             -
             -
       90.00 L         *                 *
```

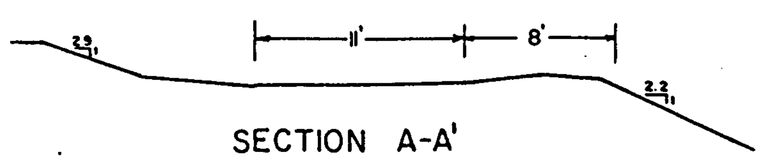
Appendix IV-3

Road Grade and Cross Sections for Class II Roads

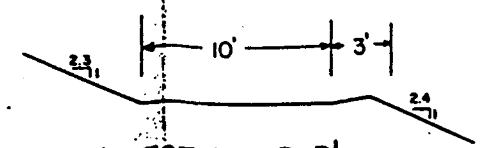
U.S. Steel Mining Company, Inc.

GENEVA COAL MINE
ROAD CROSS-SECTIONS

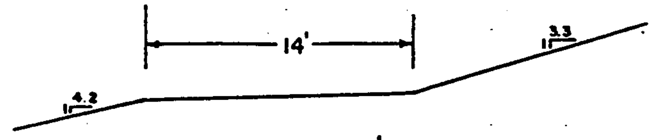
C3-1282
Sheet 1 of 3



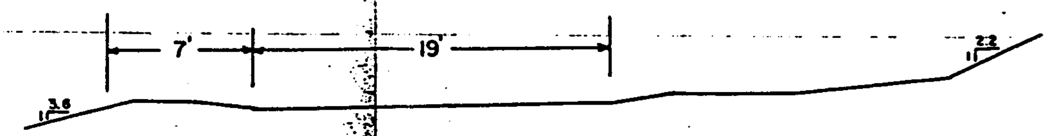
SECTION A-A'
GRADE: 10.4%



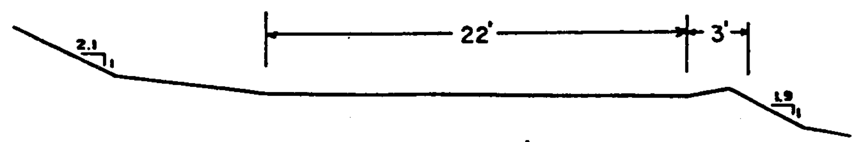
SECTION D-D'
GRADE: 14.4%



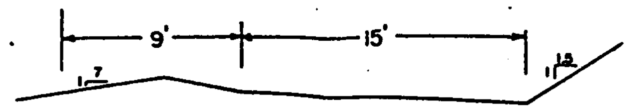
SECTION B-B'
GRADE: 0.5%



SECTION E-E'
GRADE: 6.6%



SECTION C-C'
GRADE: 9.5%



SECTION F-F'
GRADE: 10.4%

THIS DRAWING WAS PREPARED UNDER MY SUPERVISION

Carl W. Winters 05118 — REGISTERED PROFESSIONAL ENGINEER - UTAH
5-13-83 — DATE

Scale: 1" = 10' (v. & h.)

Reference drawing: E3-3334

ENG'G DEPARTMENT — WESTERN DISTRICT
APPROVED GHS 5-4-83
CHECKED VRW 5-3-83
APPROVED FOR SAFETY
DRAWN CWW -83
TRACED

REVISIONS

784-60

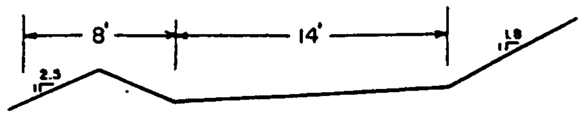
U.S. Steel Mining Company, Inc.

GENEVA COAL MINE
ROAD CROSS-SECTIONS

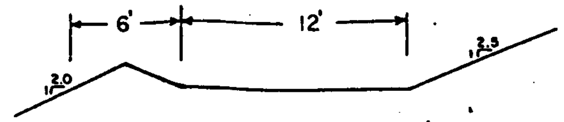
C3-1282
Sheet 2 of 3

ENGINEERING DEPARTMENT
WESTERN DISTRICT

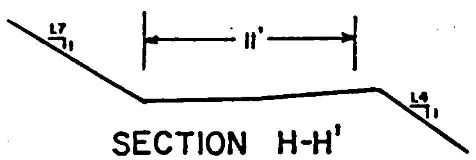
APPROVED: G.H.S. 5-4-83
CHECKED: V.R.W. 5-3-83
APPROVED FOR SAFETY:
DRAWN: C.W.W. 5-3-83
TRACED:



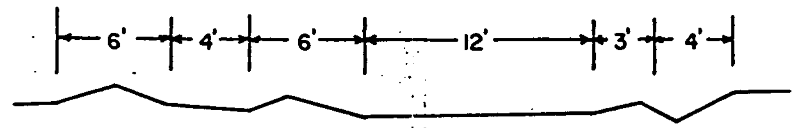
SECTION G-G'
GRADE: 10.7%



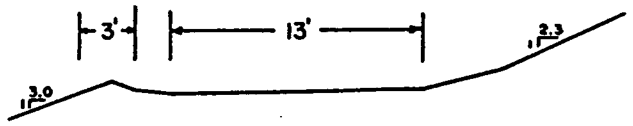
SECTION J-J'
GRADE: 13.4%



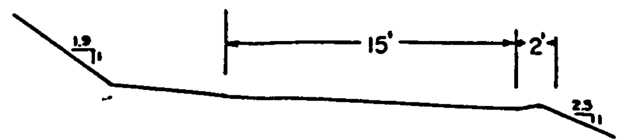
SECTION H-H'
GRADE: 4.8%



SECTION K-K'
GRADE: 9.0%



SECTION I-I'
GRADE: 12.8%



SECTION L-L'
GRADE: 9.0%

THIS DRAWING WAS PREPARED UNDER MY SUPERVISION

Carl W. Winters 05118 — REGISTERED PROFESSIONAL ENGINEER - UTAH
5-13-83 — DATE

Scale: 1" = 10' (v.& h.)

Reference drawings: E3-3334, F3-171

REVISIONS

784-60 i

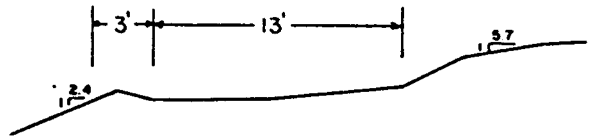
(USS) U.S. Steel Mining Company, Inc.

GENEVA COAL MINE

ROAD CROSS-SECTIONS

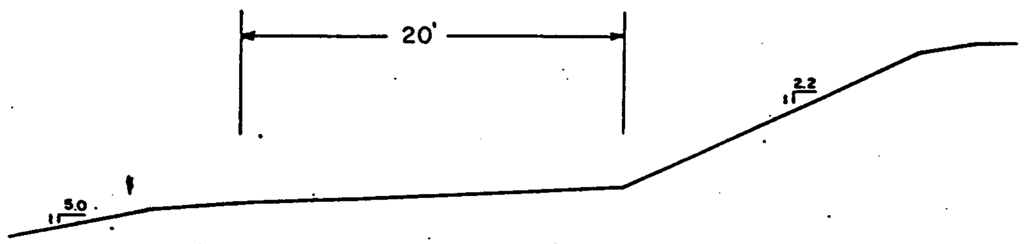
C3-1282

Sheet 3 of 3



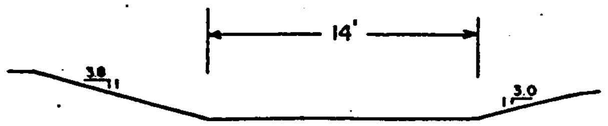
SECTION M-M'

GRADE: 8.6 %



SECTION N-N'

GRADE: 8.0 %



SECTION O-O'

GRADE: 7.0%

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Carl W. Winters 05118 — REGISTERED PROFESSIONAL ENGINEER - UTAH

5-13-83 — DATE

Scale: 1" = 10' (v. & h.)

Reference drawing F3-171

REVISIONS

784-60 ii

EN... RING DEPART... WESTERN DISTRICT

APPROVED G.H.S. 5-4-83

CHECKED V.R.W. 5-3-83

APPROVED FOR SAFETY

DRAWN C.W.W. -3-83

TRACED

Appendix IV-4

USGS Stipulations Covering Surface Drilling Programs

Table III-4

USGS STIPULATIONS
COVERING
SURFACE DRILLING PROGRAMS

1. Archeological, historical and endangered species clearances are required prior to the approval of any operation.

2. Any operation will immediately cease upon the discovery of any significant archeological or historical site. The Area Mining Supervisor shall be immediately notified of any such find.

3. When artesian flows or water horizons with possible development potential are encountered, the Area Mining Supervisor and the surface management agency shall be notified immediately so that a determination can be made concerning their development potential. Where possible, clean water samples shall be collected by the operator for analysis by the USGS.

4. Drill holes shall be cemented with proper slurry from the bottom to the collar. The lessee shall be responsible for the proper plugging of each hole unless a written request to keep the hole open is made by the Area Mining Supervisor. If drill hole cannot be fully cemented, possibly due to sloughing or fractures, the Area Mining Supervisor must be notified, and his instructions for subsequent plugging followed.

5. The slurry shall be made using 5.2 - 5.5 gallons of water per bag of cement. The drill stem shall be lowered to the bottom of the hole and sufficient slurry pumped through the stem to fill 200 feet of the hole. The drill stem will then be raised 200 feet and the process repeated. The drill hole shall be completely plugged using this method.

6. The Area Mining Supervisor shall be notified as to the time when the first hole is to be plugged so that a representative of his office can arrange to observe the procedure if circumstances permit. Subsequent observations of other holes being plugged will be arranged as deemed necessary.

7. The hole location is to be marked by placing an approved marker such as a capped pipe, steel fencepost, or metal plate in the concrete plug. Such markers are to show hole number, year drilled, lessee name, and as feasible, the section, township, and range in which hole is located. Top of concrete plug, if located in cultivated field, must be set below normal plow depth (10 to 12 inches).

8. Mud pits must be backfilled and leveled. Liquids or mud in the pits must be pumped out and removed from the premises or allowed to dry before they are backfilled.

9. Drill sites must be cleaned and all material, including drill cuttings, foreign to the natural setting must be buried or removed. Trash will be removed from the area. Revegetation of disturbed area will generally be required. If excavation is required in preparing a drill site, topsoil will be stockpiled separately. Before the drill site is permanently abandoned, the location will be regraded to a natural contour and the topsoil redistributed. Type, method, and scheduling of revegetation will be specified by the surface management agency through the Area Mining Supervisor.

10. The Area Mining Supervisor shall be notified as to the anticipated completion date of the program.

11. A monthly report shall be submitted to the Area Mining Supervisor within 10 days after the end of the month. It will include:

    (1) The holes completed during the month and the total depth of each hole.
    (2) The date each hole was completed.
    (3) The date each hole was plugged.
    (4) The type of drilling plug or core.

12. The following reports shall be submitted to the Area Mining Supervisor in duplicate after the completion of the program:

    (1) Hydrologic logs using the attached form.
    (2) Geophysical and lithologic logs and all geologic interpretations of each log.
    (3) Coal analysis.
    (4) Total acreage of surface disturbed per hole, including acreage disturbed by access roads.

Note: All information submitted must contain the lease number. All logs must contain the surface elevation of drill hole and the location of the drill site. The sites will be located using coordinates and or measured distances from the nearest section line.

Appendix IV-5

Reclamation Cost Estimate

Introduction

The cost estimate of reclamation includes demolition and disposal of structures, backfilling of portals and highwalls, distribution of topsoil, establishment of sedimentation controls, revegetation, fencing, monitoring of sediment control and revegetation, maintenance of sediment controls, and a reclamation schedule.

Demolition and Disposal of Structures

A list of buildings and/or structures volumes is found in Appendix IV-5 Table 1. Identification numbers used in this table correspond to the listing and location of facilities on Plate II-1 A, B. The volumes, when available, were taken from the bonding estimate in the original Geneva Mine permit application submitted by the United States Steel Corporation. The remainder of the information was generated by measuring the plan area for buildings on a 1" = 50' map and estimating height of the walls and roofs from field observations. Total building volume including the foundation was broken down into the volume of brick, concrete, steel and wood for each structure.

Concrete and brick rubble produced from the demolition will be disposed of in the highwall reduction fills. Wood debris produced in demolition will be disposed of in the industrial waste pile. Steel debris will be disposed of as scrap (no salvage value is assumed for the purpose of the bond). Disposal costs for brick, concrete, steel and wood debris is included in the demolition cost[1].

Unit costs by volume used in the demolition and disposal of structures section of the bond are as follows:

Steel[2]	$\$0.16/ft^3$
Concrete[3]	$\$0.22/ft^3$
Brick[4]	$\$0.17/ft^3$
Wood[5]	$\$0.17/ft^3$

Costs of the demolition are as follows:

Steel -	$850,308\ ft^3 * \$0.16/ft^3 =$	$136,049
Concrete -	$752,095\ ft^3 * \$0.22/ft^3 =$	$165,460
Brick -	$603,321\ ft^3 * \$0.17/ft^3 =$	$102,565
Wood -	$245,712\ ft^3 * \$0.17/ft^3 =$	$41,771
Total Building Demolition Costs -		**$445,845**

Backfilling Portals and Highwalls

A list of portals, cross-sectional areas, and distance from the surface to the seal is located in Appendix IV-5 Table 2. Identification numbers used in this table correspond to the listing and location of facilities on Plate II-1 A, B. The information in this table was derived from field measurements with the exception of the data for the Woodard portal which was estimated because bad roof conditions prevented entering the portal.

The portals will be backfilled using mobil sectional conveyors. Two laborers will be needed to operate and retreat the conveyors from a entry as it is filled. A 1.5 yd^3 front end loader will supply fill to the conveyor hopper. Work weeks and days are assumed to be 5 days and 8 hours respectively. Setup, transport and tear down of the conveyor system between portals is assumed to be 2 hours.

Unit costs by volume of fill, weekly rental rate and hourly labor rate are as follows:

Loader[6]	$1.00/$yd^3$
Conveyor[7]	$400/week
Labor[8]	$23.85/hour

Costs of the backfilling are as follows:

2,155 yd^3 * 2550 lb/yd^3 / 2000 lb/t =	2,748 tons
2,748 t / 63 t/hr =	43.6 hrs
10 portals * 2 hrs =	20 hrs
20 hrs + 43.6 hrs =	63.6 hrs
63.6 hrs / 8 hrs/day =	8.0 days
8.0 days / 5 days/wk =	1.6 wks

Two weeks rental rate are assumed to be used for the conveyor system (2 sections).

Conveyor	-	2 wks * $400 * 2 sect. =	$1,600
Labor	-	65.6 hrs * $23.85/hr * 2 =	$3,129
Loader	-	2,155 yd^3 * $1.00/$yd^3$ =	$2,155
Total Portal Backfilling Costs -			**$6,884**

A list of cut and fill balances for regrading is found in Appendix IV-5 Table 3. The cross-sections which are identified in this table are shown on Plates IV-2 B-E and located on Plates IV-1 A-F. Cross-sections were located to show details of important features in the present and post mine topography and to provide a base for the cut and fill balance calculation. The area of influence on the balance sheet is half the average distance between the adjacent cross-sections. Cut and fill volumes were calculated by multiplying the sectional area by the area of influence. Sections E-E', EE-EE' and DD-DD' were located to intersect the center of isolated highwall cuts. The associated areas of influence indicate a distance on either side of the section line that bracket the cut. A list of the volume of brick and concrete demolition rubble is found in Appendix IV-5 Table 4.

The following is a summary of the complete mass balance for all materials expressed in bank cubic yards:

Regrading	
Fills	-50,222 yd^3
Cuts	+40,083 yd^3
Portals	
Backfilling	- 2,155 yd^3
Borrow Soil	+27,540 yd^3
Demolition Rubble	
Brick and Concrete	+ 9,256 yd^3
Soil Loss	
Filling 40% Voids In Demolition Rubble	- 3,702 yd^3
Net Balance	+20,800 yd^3

The excess material is equivalent to approximately 2.3 inches of material spread over the disturbed area. For all practically the positive imbalance can be ignored for the purposes of the reclamation plan.

Regrading, removal of refuse from the wash bank, and slope reduction will be conducted with 400 HP dozers with rippers. All area to be cut including the borrow site will be assumed to be ripped prior to dozing. The refuse material from the fill fronting the south side of the wash will be pushed to the adjacent highwall fills for burial. Clean fill where available within 300 feet will be used to cover the refuse. Where pushes are longer than 300 feet borrow material will be used to cover the exposed refuse material to a depth of one foot. Plates II-1 A-F shows the post mine contours and the areas expected to be covered with borrow soils.

Unit costs by volume used in the regrading and calculations are as follows:

400 HP Dozer	Ripping[9]	\$1.27/yd3
	Pushing[10]	\$0.91/yd3

Costs of backfill highwalls and regrading using a combined ripping and dozing cost of \$2.18/yd3 are as follows:

40,083 yd3 * \$2.18/yd3 = \$87,381

The majority of the borrow soil will be removed from a site 1.5 road miles south west of the facilities area. A second site for topsoil is at the Road Junction Refuse Pile 0.5 miles from the borrow site where topsoil is stockpiled. A 400 HP dozer will be used to rip and push the borrow soils into loading piles for a front end loader to work in. Twenty percent of the material will be oversized rocks which will be pushed to the sides of the borrow area. Maximum dozer push distance will not exceed 300 feet. Five cubic yard front end loaders will load the soil into 12 cubic yard trucks for transportation to the fill sites. The trucks will spot loads when dumping to minimize the push needed to spread the material into a uniform one foot thick layer.

Unit costs by volume of fill are as follows:

400 HP dozer	
Ripping[9]	\$1.27/yd3
Pushing[10]	\$0.91/yd3
200 HP dozer	
Pushing[11]	
Loader[12]	\$0.90/yd3
Truck	
1 mile[13]	\$1.93/yd3
3 miles[14]	\$2.79/yd3

Costs of borrow soil handling are as follows:

Ripping -	33,048 yd3 * \$1.27 =	\$41,971
Pushing -	33,048 yd3 * \$0.91 =	\$30,074
Loading -	27,540 yd3 * \$0.90 =	\$24,786
Haul -	2,775 yd3 * \$1.93 =	\$5,356
Haul -	24,765 yd3 * \$2.79 =	\$69,094
Spread -	27,540 yd3 * \$0.60 =	\$16,524
Total Regrading Costs -		**\$275,186**

Sedimentation Control

Sedimentation control after reclamation during the 10 year responsibility period will utilize a majority of the sediment control structures proposed for and constructed during the maintenance period. As outlined in Section 6.6.2 and shown on Plates VI-4 A-F the sediment ponds will be regraded or in the case of 4, 5, 6 and 7 the outer embankment will be breached. The cost of all regrading with the exception of the pond breaches is covered in the backfilling section. Berms and silt fences will be used for all sediment control. Appendix IV-5 Table 5 gives a breakdown of all sediment control construction during reclamation. All berms and silt fences used during maintenance are assumed to be rebuilt during reclamation. Daily output for silt fence installation is assumed to be 100 feet per man day. Rip Rap will be machine placed.

Unit costs for sedimentation control are as follow:

200 HP dozer[10]	$0.91/yd^3$
Labor[8]	$23.85/hour
Silt Fence[15]	$0.50/yd^2$
Tee Posts[16]	$1.97 each
Field Fence[17]	$61.95/330' roll
Riprap[18]	$46.00/yd^2$

Costs of berms, ditches, silt fences and riprap are calculated using the total volume, length and area respectively from Appendix IV-5 Table 5 as follows:

Berms -	2474 yd^3 * $0.91/$yd^3$ =	$2,251
Ditches -	492 yd^3 * $0.91/$yd^3$ =	$448
Fabric -	393 ft * 2.5 ft. / 9 ft^2/yd^2 * $0.50/$yd^2$ =	$55
Tee Posts -	393 ft / 4 ft/post * $1.97 each =	$194
Field Fence -	use total roll cost because silt fence length is less than one roll length	$62
Labor -	393 ft / 100 ft./man day * 8 hr/ man day * $23.85 =	$750
Riprap -	4933yd^2 * $46.00/$yd^2$ =	$226,918

Total Sedimentation Control - **$230,678**

Revegetation

All disturbed areas will be revegetated to a Pinyon-Juniper Woodland vegetation type. All areas that will not receive borrow soils will be ripped to a depth of 18 inches. Prior to seeding, the disturbed area will be disked to break up surface soil crusting. Soils will be tested at a rate of one composite sample per acre (from 3 holes) to determine the chemical amendments needed to finish seed bed preparation. Soil sampling labor output is assumed to be 4 composite samples per hour. Seed and fertilizer will be broadcast by hydroseeding at the rates found in Table 8.4.2.1-1. The perimeter of the disturbed areas will be fenced with four strand stock fence with posts on 16 foot centers.

Unit costs for revegetaton are as follows:

400 HP Dozer	
Ripping[9]	$\$1.27/yd^3$
Disking[19]	$\$0.01/yd^2$
Soil Test[20]	$45.00/sample
Labor[8]	$23.85/hour
Hydroseeding[21]	$22/acre
Fertilizer[22]	$39/acre
Seed Cost[23]	$680.20
Hydromulching[24]	$1,250/acre
Fencing[25]	$1.60/ft

Costs of the revegetation are as follows:

Ripping -	47.05 ac * 2 ft * 43,560 ft^2/ac / 27 ft^3/yd^3 * $\$1.27/yd^3$ =	$192,805
Disking -	62.83 ac * 43560 ft^2/ac * $\$0.01/ft^2$ =	$27,369
Soil Test -	63 samples * $45.00/sample =	$2,835
Sample Labor -	63 samples / 4 samples/hr * $23.85/hr =	$376
Hydroseed -	62.83 ac * $22/acre =	$1382
Fertilizer -	62.83 ac * $39.00/acre =	$2,446
Seed -	62.83 * $680.20/acre =	$42,716
Hydromulch -	62.83 * $1,250/acre =	$78,537
Fencing -	22,000 ft * $1.60/ft =	$35,200
Total Revegetation -		$384,109

Monitoring

Vegetation, soil stability, and hydrologic controls will be monitored on a periodic basis. Cost expressed in this section are for the total ten year responsibility period. Vegetation will be monitored as indicated in Section 8.4. Soil stability will be monitored for rills and gully formation twice a year. Hydrologic controls will be monitored four times a year. Labor for reports for the soil stability and hydrologic control monitoring is included in the field time.

Unit costs for monitoring are as follows:

Monitoring Labor - $30.00/hr

Costs of the monitoring are as follows:

Vegetation		
Field -	63 days * 8 hr/day * $30.00/hr =	$15,120
Reports -	108 days * 8 hr/day * $30.00/hr =	$25,920
Soil -	20 days * 8 hr/day * $30.00/hr =	$4,800
Hydrologic -	40 days * 8 hr/day * $30.00/hr =	$9,600
Total Monitoring -		**$55,440**

Maintenance

Maintenance costs during the 10 year responsibility period are conservative assumptions based on field experience with revegetation, sediment control and soil stability. Revegetation is assumed to fail on 25 percent of the disturbed area. All costs associated with the first planting will be incurred a second time. All sediment controls (ditches and berms) are assumed to be completely replaced once during the responsibility period. Rills and gullies are assumed to form during the first year only on 10 percent of the disturbed area. The rills and gullies will be regraded (1 foot depth) and the affected area revegetated.

Unit cost for the maintenance are as listed in the hydrologic controls, regrading and revegetation sections of this appendix.

Costs of the maintenance are as follows:

Revegetation -	25% * $384,109 =	$96,027
Sediment Control		
Ditches -	100% * $448 =	$448
Berms _	100% * $2251 =	$2,251
Rills and Gullies		
Regrading -	10% * 62.8 *43560 * 1 ft / 27 * $0.91 =	$9,219
Revegetation	10% * $363,670 =	$36,367
Total Maintenance -		**$144,312**

1. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.2-040-0010, 2.2-040-0050, 2.2-040-0080 and 2.2-040-0700. BUILDING DEMOLITION Large urban projects, including disposal.

2. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.2-040-0010. BUILDING DEMOLITION Large urban projects, including disposal, steel. Daily Output = 21,500 ft^3. Total Including O@P = $0.16/$ft^3$.

3. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.2-040-0050. BUILDING DEMOLITION Large urban projects, including disposal,

concrete. Daily Output = 15,300 ft3. Total Including O@P = $0.22/ft3.

4. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.2-040-0080. BUILDING DEMOLITION Large urban projects, including disposal, masonry. Daily Output = 20,100 ft3. Total Including O@P = $0.17/ft3.

5. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.2-040-0700. BUILDING DEMOLITION Large urban projects, including disposal, wood. Daily Output = 14,800 ft3. Total Including O@P = $0.17/ft3.

6. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-160-1550. EXCAVATING BULK Common earth piled. Daily Output = 640 yd3. Total Including O@P = $1.00/yd3.

7. Clearfield Conveyor Sales. Carrol Peterson. May 6, 1987. Personal Communication. 16 inch wide D31 conveyor. 63 tons per hour with 159 lbs/ft3 material. Rental rate $400 per week.

8. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. Page ix. CREWS. Crew A-2. 2 building labors. Total Including O@P = $23.85/hr.

9. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-370-2600. RIPPING very hard, 400 HP dozer, ideal conditions. Daily Output = 1,300 yd3. Total including O&P = $1.27.

10. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-370-3450. RIPPING Dozing ripped material. 410 HP dozer, 300' haul. Daily Output = 1,800 yd3. Total including O&P = $0.91.

11. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-370-3000. RIPPING dozing ripped material. 200 HP dozer, 100' haul. Daily Output = 1,800 yd3. Total including O&P = $0.60.

12. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-160-1650. EXCAVATING, BULK Common earth piled. Wheel mounted, 5 C.Y. cap.. Daily Output = 1,480 yd3. Total including O&P = $0.90.

13. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-300-0330. HAULING earth 12 C.Y. dump truck 1 mile round trip. Daily Output = 260 yd3. Total including O&P = $1.93.

14. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-300-0450. HAULING earth 12 C.Y. dump truck 3 mile round trip. Daily Output = 180 yd^3. Total including O&P = $2.79.

15. American Excelsior, Salt Lake City. May 8, 1987. Personal Communication. Dupont Typar 3301 (silt fence). $0.50/$yd^2$.

16. Acme Fence Company, Salt Lake City. May 8, 1987. Personal Communication. Tee Post. $1.97 each.

17. Acme Fence Company, Salt Lake City. May 8, 1987. Personal Communication. Field Fence. $61.95/330' roll.

18. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.3-360-0200. RIP-RAP Machine placed slope protection. Daily Output = 53 yd^2. Total Including O&P = $46/$yd^2$.

19. Robert Snow Means Co., Inc.. 1987. Means Site Work Cost Data. Sixth Annual Edition. 2.8-240-6000. LAWN BED PREPARATION Tilling topsoil, 20 HP tractor w/6" disk, 2" deep. Daily Output = 50,000 yd^2. Total including O&P = $0.01/$yd^2$.

20. Bookcliffs Laboratory. Steamboat Springs, Colorado. Personal Communication. Soil Tests, Utah Guidelines. $45.00 per sample.

21. B & R Reclamation. Price, Utah. Mel Coonrod. Personal Communication. May 12, 1987. Hydroseeding. $22/acre.

22. Intermountain Farmers Supply. Price, Utah. Personal Communication. 200 lbs./acre, $12.50/100 lbs or $25.00/acre.

23. Maple Leaf Seed. Ephraim, Utah. Loyd Stevens. Personal Communication. Seed Costs, Broadcast Rates. $375.53 per acre.

24. B & R Reclamation. Price, Utah. Mel Coonrod. Personal Communication. May 12, 1987. Hydromulching, 100 lbs. tac and 2 tons mulch per acre. $1,250/acre.

25. Mountain States Fence Company. Salt Lake City, Utah. Terry Waite. Personal Communication. May 12, 1987. Four Strand Stock Fence, 6 Foot Tee Posts On 16 Foot Centers. $1.60/ft.

26. Kaiser Coal Corporation. Sunnyside, Utah. Tree seed for pinyon pine and Utah Juniper. $7.00/lb

Appendix IV-5 Table 1 Building Volume Summary

	STRUCTURE OR BUILDING	BRICK CU. FT.	CONCRETE CU. FT.	STEEL CU. FT.	WOOD CU. FT.
1.	IGNITRON	5250	262	0	1050
3.	FAN HOUSE NO. 1	0	23254	883	0
4.	POWDER STORAGE	1400	0	0	280
5.	GASOLINE STORAGE	2520	0	0	504
6.	STORAGE	0	0	0	18000
7.	TRESTLE	0	0	0	52800
8.	REDWOOD TANK	0	113	0	920
9.	TRUCK GARAGE	0	0	0	16250
10.	STORAGE	0	60	0	2700
11.	SEWAGE PLANT	512	3534	0	128
12.	SEWAGE P. RESERVOIR	0	3142	0	0
13.	SEWAGE P. PUMPHOUSE	1500	150	0	300
14.	OIL H. PLANT	0	0	446	0
15.	OIL PLANT TANK	0	0	3142	0
16.	FAN HOUSE NO. 2	0	24488	2545	0
18.	METER HOUSE	560	35	0	210
19.	METER AND ARMATURE S.	17500	1050	0	7000
20.	HEATING PLANT	43808	20138	620	13500
21.	BATH HOUSE	154510	4300	0	36400
22.	MANTRIP L. STATION	0	0	0	18000
23.	MINE OFFICE	38500	1925	0	11550
24.	GARAGE BUILDING	24000	1200	0	7200
25.	WAREHOUSE	154493	113616	0	40000
26.	COMPRESSOR HOUSE	0	0	4032	0
27.	MACHINE SHOP	139875	52742	111280	0
28.	WATER TANK	0	961	53496	0
30.	OIL HOUSE	7293	640	0	2400
31.	CARBONIZATION LAB.	2500	250	0	1000
32.	POWDER MAGAZINE	0	9000	0	0
33.	CAP MAGAZINE	0	1800	0	0
34.	TRANSFER HOUSE	0	2805	49000	0
35.	BELT GALLARY	0	3072	273600	0
37.	TIPPLE	0	402480	199573	0
38.	SCALE HOUSE	7500	375	0	2250
39.	CAR LOADING STA.	0	0	24000	0
40.	RESERVOIR	0	78720	0	0
41.	GALLERY BRIDGE	0	0	0	2400
42.	PCB STORAGE SHED	0	385	0	10010
43.	PUMP HOUSE	0	0	0	800
44.	HOSE HOUSE H.S.A.	800	50	0	30
45.	HOSE HOUSE T.A.	800	50	0	30
46.	CAR REPAIR SHOP	0	1498	67711	0
47.	PUMP BUILDING	0	0	4700	0
48.	OPEN AIR SHED	0	0	49280	0
52.	CARLSON PORTAL (E.)	0	0	1200	0
64.	RAILROAD BRIDGE	0	0	4800	0
	TOTAL	603321	752095	850308	245712

Appendix IV-5 Table 2 Portal Depth, Area and Volume

	PORTAL	DEPTH TO SEAL FT.	AREA SQ. FT.	VOLUME CU. YD.
49.	NORTH FAN	59	93	203
50.	WOODARD (E)			
	RIGHT BRANCH	60	39.00	87
	LEFT BRANCH	35	25.00	32
51.	WOODARD (W)	47	60.30	105
52.	CARLSON (E)			
	CULVERT	30	33.18	37
	COAL	32	108.00	128
53.	CARLSON (W)			
	CULVERT	42	50.26	78
	COAL	12	49.00	22
54.	MAIN INTAKE (S)	60	192.33	427
55.	MANWAY	60	85.75	191
56.	ROCK TUNNEL	108	98.00	392
57.	MAIN INTAKE (N)	39	93.00	134
58.	SOUTH FAN	90	95.50	318
59.	LILA CANYON			
	EAST	N/A	N/A	N/A
	WEST	N/A	N/A	N/A
	TOTAL VOLUME			2155

Appendix IV-5 Table 3 Cut and Fill Balance

Facilities Area

SECTION	AREA OF INFLUENCE	CUT AREA	FILL AREA	CUT VOLUME	FILL VOLUME
A-A'	125	100	1	463	5
B-B'	151	230	177	1286	990
C-C'	141	123	486	642	2538
D-D'	145	289	423	1552	2272
F-F'	175	251	0	1627	0
G-G'	183	74	424	502	2874
H-H'	318	10	51	118	601
J-J'	305	163	0	1841	0
K-K'	160	290	663	1719	3929
L-L'	198	340	429	2493	3146
M-M'	206	258	177	1968	1350
N-N'	178	748	136	4931	897
O-O'	200	235	270	1741	2000
P-P'	190	109	194	767	1365
Q-Q'	55	2222	0	4526	0
E-E'	50	1875	0	3472	0
EE-EE'	150	675	850	3750	4722
DD-DD'	140	445	292	2307	1514
			SUBTOTAL	23463	28202

Tipple Area

SECTION	AREA OF INFLUENCE	CUT AREA	FILL AREA	CUT VOLUME	FILL VOLUME
R-R'	135	778	1484	3890	7420
S-S'	225	481	558	4008	4650
T-T'	240	0	185	0	1644
U-U'	320	0	178	0	2110
V-V'	145	0	0	0	0
W-W'	260	806	595	7761	5730
X-X'	180	144	70	960	467
			SUBTOTAL	16620	22020
			TOTAL	40083	50222

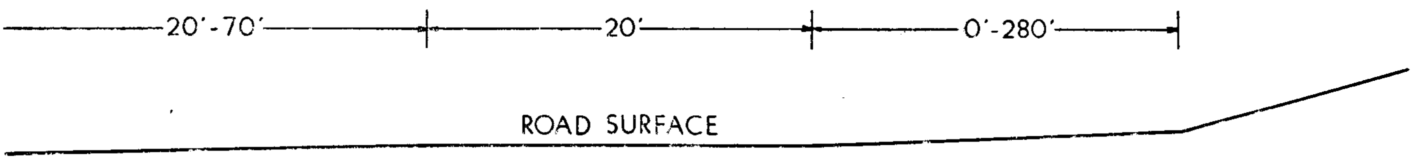
Appendix IV-5 Table 4 Demolition Debris Volumes

STRUCTURE OR BUILDING	INPLACE VOLUME BRICK CU. FT.	CONCRETE CU. FT.	WOOD CU. FT	DEMOLITION VOLUME B&C CU. YD.	WOOD CU. YD.
1. IGNITRON	333	262	81	43	3
3. FAN HOUSE NO. 1	0	1433	0	133	0
4. POWDER STORAGE	120	0	22	7	1
5. GASOLINE STORAGE	180	0	39	10	2
6. STORAGE	0	0	1385	0	59
7. TRESTLE	0	0	4062	0	173
8. REDWOOD TANK	0	113	71	10	3
9. TRUCK GARAGE	0	0	1250	0	53
10. STORAGE	0	0	208	0	9
11. SEWAGE PLANT	106	443	10	47	0
12. SEWAGE P. RESERVOIR	0	112	0	10	0
13. SEWAGE P. PUMPHOUSE	575	150	23	46	1
14. OIL H. PLANT	0	0	0	0	0
15. OIL PLANT TANK	0	0	0	0	0
16. FAN HOUSE NO. 2	0	6660	0	617	0
18. METER HOUSE	90	70	16	11	1
19. METER AND ARMATURE S	680	1050	538	135	23
20. HEATING PLANT	816	3794	1038	397	44
21. BATH HOUSE	2447	4300	2800	534	119
22. MANTRIP L. STATION	0	0	1385	0	59
23. MINE OFFICE	939	1925	888	230	38
24. GARAGE BUILDING	775	1200	554	154	24
25. WAREHOUSE	1665	13170	3077	1312	131
26. COMPRESSOR HOUSE	0	0	0	0	0
27. MACHINE SHOP	1752	8424	0	877	0
28. WATER TANK	0	961	0	89	0
30. OIL HOUSE	426	640	185	83	8
31. CARBONIZATION LAB.	343	250	77	42	3
32. POWDER MAGAZINE	0	1632	0	151	0
33. CAP MAGAZINE	0	415	0	38	0
34. TRANSFER HOUSE	0	2805	0	260	0
35. BELT GALLARY	0	3072	0	284	0
37. TIPPLE	0	29700	0	2750	0
38. SCALE HOUSE	213	375	173	47	7
39. CAR LOADING STA.	0	0	0	0	0
40. RESERVOIR	0	8025	0	743	0
41. GALLERY BRIDGE	0	0	185	0	8
42. PCB STORAGE SHED	0	385	770	36	33
43. PUMP HOUSE	0	0	62	0	3
44. HOSE HOUSE H.S.A.	106	50	2	11	0
45. HOSE HOUSE T.A.	106	50	2	11	0
46. CAR REPAIR SHOP	0	1498	0	139	0
47. PUMP BUILDING	0	0	0	0	0
48. OPEN AIR SHED	0	0	0	0	0
52. CARLSON PORTAL (E.)	0	0	0	0	0
64. RAILROAD BRIDGE	0	0	0	0	0
TOTAL	11672	92964	18901	9256	805

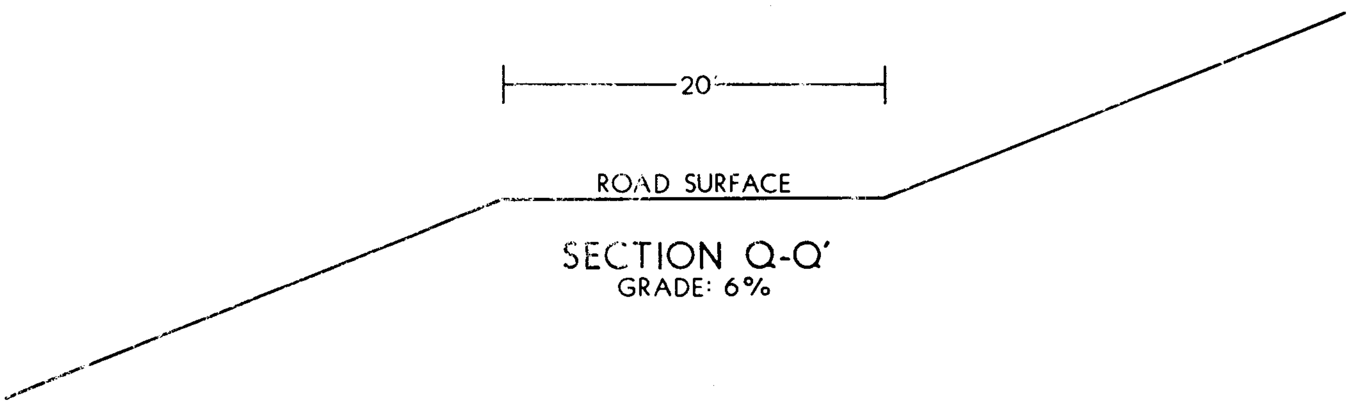
Appendix IV-5 Table 5 Sedimentation Control

LOCATION	LENGTH OF SILT FENCE	LENGTH OF BERM	VOLUME OF BERM CU YD	LENGTH OF DITCH	VOLUME OF DITCH CU YD	LENGTH OF RIP RAP	WIDTH OF RIP RAP	AREA OF RIP RAP
1.	3	300	89	0	0	0	0	0
2.	3	300	89	0	0	0	0	0
3.	0	0	0	0	0	0	0	0
4.	20	0	0	1000	214	0	0	0
5.	10	1200	356	0	0	0	0	0
6.	6	200	59	0	0	0	0	0
7.	0	0	0	0	0	100	24	2400
8.	3	150	44	0	0	0	0	0
9.	10	300	89	0	0	0	0	0
10.	0	0	0	0	0	150	24	3600
11.	55	1700	504	0	0	0	0	0
12.	0	0	0	0	0	500	24	12000
13.	100	0	0	0	0	0	0	0
14.	25	500	148	0	0	0	0	0
15.	5	0	0	0	0	0	0	0
16.	0	0	0	0	0	0	0	0
17.	20	700	207	800	171	0	0	0
18.	0	0	0	0	0	100	24	2400
19.	20	300	89	500	107	0	0	0
20.	10	1600	474	0	0	0	0	0
21.	0	0	0	0	0	2000	12	24000
22.	0	0	0	0	0	0	0	0
23.	3	0	0	0	0	0	0	0
24.	0	600	178	0	0	0	0	0
25.	0	500	148	0	0	0	0	0
26.	100	0	0	0	0	0	0	0
27.	0	0	0	0	0	0	0	0
TOTAL	393		2474		492			44400

NOTE: SECTIONAL AREA OF THE BERM AND DITCH ARE 8 AND 5.8 SQ FT RESPECTIVELY.



SECTION P-P'
GRADE: 3.7%



SECTION Q-Q'
GRADE: 6%

PREPARED BY CONSULTANTS GROUP	
DATE DRAWN 2/22/88	**RELOCATED BLM ROAD** **CROSS SECTIONS**
DATE REVISED	
COMPILED BY R.A.P.	
DRAWN BY C.L.P.	
APPROVED BY	
CONTOUR INTERVAL	
SHEET NO.	PREPARED FOR *KAISER COAL CORPORATION* COLORADO SPRINGS, COLORADO
FILE NO.	