## *AFFIDAVIT OF PUBLICATION*

STATE OF UTAH)

ss.

County of Carbon,)

I, Ken Larson, on oath, say that I am the Publisher of the Sun Advocate, a twice-weekly newspaper of general circulation, published at Price, State a true copy of which is hereto attached, was published in the full issue of such newspaper for 4 (Four) consecutive issues, and that the first publication was on the 15th day of January, 2004, and that the last publication of such notice was in the issue of such newspaper dated the 5th day of February, 2004.

Ken G. Larson

Ken G Larson - Publisher

Subscribed and sworn to before me this 5th day of February, 2004.

Linda Thayn

Notary Public My commission expires January 10, 2007 Residing at Price, Utah

Publication fee, $ 599.04

LINDA THAYN
NOTARY PUBLIC • STATE of UTAH
845 EAST MAIN
PRICE, UTAH 84501
COMM. EXPIRES 1-10-2007

# PUBLIC NOTICE

**APPLICATION FOR PHASE I BOND RELEASE**
**STAR POINT MINE**
**PLATEAU MINING CORPORATION**
**PERMIT C/007/006, APPROVED 01/28/92**

Notice is hereby given that Plateau Mining Corporation, P.O. Box 30, 847 Northwest Highway 191, Helper, Utah 84526, a subsidiary of RAG American Coal Company, 999 Corporate Blvd., Linthicum Heights, MD 21090, has filed an application with the Utah Department of Natural Resources, Division of Oil, Gas and Mining pursuant to R645-301-880 for Phase I bond release to Permit C/007/006. This Phase I bond release applies to 95.3 acres, including the Corner Canyon and Mudwater Fan sizes, of disturbed lands where the backfilling and grading, installation of drainage controls, and reseeding requirements have been completed in accordance with approved mining and reclamation plan and pursuant to the Utah Coal Program Regulations.

In accordance with the provision of R645-301-880, of the State of Utah R645 Coal Mining Rules, notice is hereby given that Plateau Mining Corporation is applying for partial release of the performance bond posted for this property. The surety bond posted for the Star Point Mine is $7,796,000.00. Plateau Mining Corporation is seeking release of 60% of the bond, or $4,677,600.00.

The portion of the permit area that is affected is located in Carbon County, Utah as follows:

Township 15 South, Range 7 East, SLB&M

Section 12: Portion of the NE1/4W1/4

Township 15 South, Range 8 East, SLB&M

Section 8: Portion of the SW1/4NW1/4
Section 9: Portion of the SE1/4SE1/4; SW1/4SW1/4
Section 10: Portion of the S1/2 North of County Road 290
Section 15: Portion of the NE1/4NE1/4
Section 16: Portion of the N1/2; SE1/4

The permit area is shown of the Wattis U.S. Geological Survey 7.5 minute map.

The Utah Division of Oil, Gas and Mining will now evaluate the proposal to determine whether it meets all the criteria of the Permanent Program Performance Standards according to the requirements of the Utah Coal Mining Rules.

Written comments, objections and request for information conferences on this proposal may be addressed to:

Utah Coal Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Closing date for submission of such comments, objections and requests for public hearing or information conference on the proposal must be submitted by March 8, 2004.

Published in the Sun Advocate January 15, 22, 29 and February 5, 2004.

# CARBON COUNTY
## PRICE, UTAH 84501

April 7, 2004

Carbon County Board of Commissioners

Re: ***Cyprus Plateau Road***

Dear Commissioners:

Ray Hanson and I have reviewed the road today with Johnny Pappas representing Cyprus Plateau. As of April 7, 2004, the road in general is in good repair and that portion that had washed out a couple years ago has been satisfactorily repaired. Cyprus Plateau requires a letter from the County Attorney as soon as possible stating that the repairs have been inspected and approved.

Sincerely,

Evan Hansen

Evan Hansen, County Engineer

Ray Hanson

Ray Hanson, County Road Supervisor

**PLATEAU MINING CORPORATION**
Willow Creek Mine
P.O. Box 30
Helper, Utah 84526
(435)472-0475
Fax: (435)472-4782

March 30, 2004

Ms. Alice B. Carlton
Forest Supervisor
599 West Price River Drive
Price, Utah 84501

**Re: Notification of Application for Phase I Bond Release, Star Point Mine, Plateau Mining Corporation, C/007/006, Carbon County, Utah**

Dear Ms. Carlton:

Plateau Mining Corporation has completed Phase I of the approved reclamation plan for the Star Point Mine area. This is based on completing the backfilling and grading, installation of drainage controls, and reseeding requirements on 93.5 acres in accordance with the approved reclamation plan.

Pursuant to the provisions of R645-301-880 of the State of Utah R645 Coal Mining Rules, this letter will serve as notification that Plateau Mining Corporation intends to file an application with the Utah Division of Oil, Gas and Mining for partial release of the performance bond posted for this operation.

The surety bond posted for the Star Point Mine is $7,796,000.00. Plateau Mining Corporation is seeking release of 60% of the bond, or $4,678,000.00.

Comments concerning Phase I bond release from the legal or equitable owner of record of the surface areas affected and from the Federal, Utah and local government agencies should be mailed to: Plateau Mining Corporation, Attention: Johnny Pappas, 847 NW Highway 191, Helper, Utah 84526.

If you have any questions or need additional information, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

Env: Star Point Mine-Phase I Bond Release
Chrono: JP040305.LTR

**PLATEAU MINING CORPORATION**
Willow Creek Mine
P.O. Box 30
Helper, Utah 84526
(435)472-0475
Fax: (435)472-4782

March 30, 2004

Mr. Mark Mackiewicz
Bureau of Land Management
125 South 600 West
Price, Utah 84501

**Re: Notification of Application for Phase I Bond Release, Star Point Mine, Plateau Mining Corporation, C/007/006, Carbon County, Utah**

Dear Mr. Mackiewicz:

Plateau Mining Corporation has completed Phase I of the approved reclamation plan for the Star Point Mine area. This is based on completing the backfilling and grading, installation of drainage controls, and reseeding requirements on 95.3 acres in accordance with the approved reclamation plan.

Pursuant to the provisions of R645-301-880 of the State of Utah R645 Coal Mining Rules, this letter will serve as notification that Plateau Mining Corporation intends to file an application with the Utah Division of Oil, Gas and Mining for partial release of the performance bond posted for this operation.

The surety bond posted for the Star Point Mine is $7,796,000.00. Plateau Mining Corporation is seeking release of 60% of the bond, or $4,678,000.00.

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If you have any questions or need additional information, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

Env: Star Point Mine-Phase I Bond Release
Chrono: JP040306.LTR

**PLATEAU MINING CORPORATION**
Willow Creek Mine
P.O. Box 30
Helper, Utah 84526
(435)472-0475
Fax: (435)472-4782

March 30, 2004

Mr. William D. Krompel
Commissioner
120 East Main Street
Price, Utah 84501

**Re: Notification of Application for Phase I Bond Release, Star Point Mine, Plateau Mining Corporation, C/007/006, Carbon County, Utah**

Dear Mr. Krompel:

Plateau Mining Corporation has completed Phase I of the approved reclamation plan for the Star Point Mine area. This is based on completing the backfilling and grading, installation of drainage controls, and reseeding requirements on 93.5 acres in accordance with the approved reclamation plan.

Pursuant to the provisions of R645-301-880 of the State of Utah R645 Coal Mining Rules, this letter will serve as notification that Plateau Mining Corporation intends to file an application with the Utah Division of Oil, Gas and Mining for partial release of the performance bond posted for this operation.

The surety bond posted for the Star Point Mine is $7,796,000.00. Plateau Mining Corporation is seeking release of 60% of the bond, or $4,678,000.00.

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If you have any questions or need additional information, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

Env: Star Point Mine-Phase I Bond Release
Chrono: JP040307.LTR

**PLATEAU MINING CORPORATION**
Willow Creek Mine
P.O. Box 30
Helper, Utah 84526
(435)472-0475
Fax: (435)472-4782

March 30, 2004

Mr. Randy Scott
General Manager
Sunnyside Cogeneration Associates
#1 Power Plant Road
Sunnyside, Utah 84539

**Re: Notification of Application for Phase I Bond Release, Star Point Mine, Plateau Mining Corporation, C/007/006, Carbon County, Utah**

Dear Mr. Scott:

Plateau Mining Corporation has completed Phase I of the approved reclamation plan for the Star Point Mine area. This is based on completing the backfilling and grading, installation of drainage controls, and reseeding requirements on 93.5 acres in accordance with the approved reclamation plan.

Pursuant to the provisions of R645-301-880 of the State of Utah R645 Coal Mining Rules, this letter will serve as notification that Plateau Mining Corporation intends to file an application with the Utah Division of Oil, Gas and Mining for partial release of the performance bond posted for this operation.

The surety bond posted for the Star Point Mine is $7,796,000.00. Plateau Mining Corporation is seeking release of 60% of the bond, or $4,678,000.00.

Comments concerning Phase I bond release from the legal or equitable owner of record of the surface areas affected and from the Federal, Utah and local government agencies should be mailed to: Plateau Mining Corporation, Attention: Johnny Pappas, 847 NW Highway 191, Helper, Utah 84526.

If you have any questions or need additional information, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

Env: Star Point Mine-Phase I Bond Release
Chrono: JP040308.LTR

**PLATEAU MINING CORPORATION**
Willow Creek Mine
P.O. Box 30
Helper, Utah 84526
(435)472-0475
Fax: (435)472-4782

March 30, 2004

Mr. Kevin S. Carter
Director
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102-2818

**Re: Notification of Application for Phase I Bond Release, Star Point Mine, Plateau Mining Corporation, C/007/006, Carbon County, Utah**

Dear Mr. Carter:

Plateau Mining Corporation has completed Phase I of the approved reclamation plan for the Star Point Mine area. This is based on completing the backfilling and grading, installation of drainage controls, and reseeding requirements on 93.5 acres in accordance with the approved reclamation plan.

Pursuant to the provisions of R645-301-880 of the State of Utah R645 Coal Mining Rules, this letter will serve as notification that Plateau Mining Corporation intends to file an application with the Utah Division of Oil, Gas and Mining for partial release of the performance bond posted for this operation.

The surety bond posted for the Star Point Mine is $7,796,000.00. Plateau Mining Corporation is seeking release of 60% of the bond, or $4,678,000.00.

Comments concerning Phase I bond release from the legal or equitable owner of record of the surface areas affected and from the Federal, Utah and local government agencies should be mailed to: Plateau Mining Corporation, Attention: Johnny Pappas, 847 NW Highway 191, Helper, Utah 84526.

If you have any questions or need additional information, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

Env: Star Point Mine-Phase I Bond Release
Chrono: JP040309.LTR

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to improve overall stability. The later report completed in 1987 indicates that stabilities were successfully improved at a critical section. According to the reports presented in the exhibits, all roads evaluated currently have conservative factors of safety greater than 1.3.

**TABLE 534.130a**
**Road Specifications**

| Date of Letter | Content | Factor of Safety |
|---|---|---|
| 1/84 | Evaluation of Upper Mine Road (County Road 290) Stability | 1.0 to 1.6 |
| 7/30/87 | Re-evaluation of Upper Mine Road (County Road 290) Stability | 1.37 |
| 11/15/89 | Stability evaluation of mine roads south of Sediment Pond 2 | 1.31 to 4.05 |

Plan and profile views of all existing roads can be found on Maps 521.121a through 521.121d, and on Maps 534.100a through 534.100e. Road specifications can be found on Table 534.200a, Road Specifications. A revised cross section for Road F is provided in Exhibit 761b, superceding the cross section for the road shown on Map 534.100d.

**Map 534.100a, Road (A) Profile and Cross Sections**
**Map 534.100b, Road (A) Profile and Cross Sections**
**Map 534.100c, Road (B) Profile and Cross Sections**
**Map 534.100d, Road (C), (D), (E), (F), (G) Profile and Cross Sections**
**Map 534.100e, Road (H), (I), (J), (K) Profile and Cross Sections**

**TABLE 534.200a**
**Road Specifications**

| ROAD | SURFACE TYPE | SURFACE WIDTH | LENGTH | MAXIMUM GRADE % | MINIMUM GRADE % | AVERAGE GRADE % |
|---|---|---|---|---|---|---|
| 'A'(1) | Asphalt & Gravel | 24' to 34' | 3.71 miles | 1.5 | 1.6 | 7 |
| 'B'(2) | Asphalt & Gravel | 24' | 1.83 miles | 13.4 | 1 | 9.4 |
| 'C'(1) | Gravel | 20' | 0.55 miles | 4.2 | 0.9 | 2.8 |
| 'D'(1) | Gravel | 20' | 0.18 miles | 13.3 | 0.4 | 5.3 |
| 'E'(2) | Asphalt | 24' | 0.15 miles | 6.5 | 6.5 | 6.5 |
| 'F'(2) | Dirt & Gravel | 12' | 0.08 miles | 4.3 | 0.0 | 2.6 |
| 'G'(3) | Dirt & Gravel | 12' | 0.40 miles | 13.9 | 0 | 4.7 |
| 'H'(2) | Railroad Track | 5' | 0.65 miles | 3.5 | 1 | 2.1 |
| 'I'(2) | Gravel | 12' | 0.37 miles | 18.1 | 18.1 | 18.1 |
| 'J'(4) | Gravel | 15' | 0.71 miles | 0.74 | 0.74 | 0.74 |
| 'K'(2) | Gravel | 12' | 0.18 miles | 5.5 | 5.5 | 5.5 |

(1) County Road 290 – Provides post mining land use for access to Gentry Mountain
(2) Road removed during reclamation
(3) Road transferred to Sunnyside Cogeneration Associates Permit C/007/042 in November 2003
(4) Utah Railway's access to their tracks

Road maintenance is addressed in R645-301-526.100. Reclamation of roads is addressed in R645-301-542.200, and typical reclamation cross sections of the roads are shown on Maps 542.200d through 542.200f. All non-public roads will be reclaimed. County Road No. 290 and the River Gas road, which are both public roads, will not be reclaimed to support the post-mining land uses. County Road No. 290 will remain to provide access to public and private property on Gentry Mountain. A 795 foot section of this road was widened in 1993, Carbon County agreed to the widening project and accepted the widened section after mining ceases. The River Gas road will remain to allow public access to areas north of the permit area and to allow River Gas Corporation access to their Coal Bed methane Facilities. A letter from River Gas Corporation requesting continued access on this road is provided in Exhibit 534.100.

**Map 542.200e**
**Map 542.200f**

**535. thru 535.500. SPOIL.**

Disposal of spoil is discussed in R645-301-528.322.

**536. thru 536.900. COAL MINE WASTE.**

Disposal of coal mine waste is discussed in R645-301-528.322.

**537. thru 537.250. REGRADED SLOPES.**

Regrading of fills is discussed in R645-301-542.200.

**540. RECLAMATION PLAN.**

**541. GENERAL.**

**541.100. COMMITMENT.**

Upon the permanent cessation of coal mining and reclamation operations at the Star Point Mines, CPMC will close, backfill, or otherwise permanently reclaim all affected areas in accordance with the R645 regulations and this reclamation plan.

**541.200. SURFACE COAL MINING AND RECLAMATION ACTIVITIES**

No surface coal mining and reclamation activities have or will be conducted within the permit area.

## 541.300. UNDERGROUND COAL MINING AND RECLAMATION ACTIVITIES.

All surface equipment, structures, or other facilities not required for continued underground mining activities and monitoring, unless approved by the Division as suitable for the post-mining land use or environmental monitoring, will be removed and the affected lands reclaimed following permanent cessation of mining operations.

## 541.400. ENVIRONMENTAL PROTECTION PERFORMANCE STANDARDS.

The plan presented herein is designed to meet the requirements of R645-301 and the environmental protection performance standards of the State Program.

## 542. NARRATIVES, MAPS AND PLANS.

## 542.100. RECLAMATION TIMETABLE.

Reclamation of the Refuse Pile, topsoil borrow, and subsoil stockpile sites referred to within this Plan are superseded with the information presented in Sunnyside Cogeneration Associates' Permit C/007/042.

A detailed timetable for the completion of each major step in the reclamation plan is included as Table 542.100a and Figure 5-1 in Exhibit 233. Table 542.100a projects completion of the reclamation within a 2-year period. However, specifics related to the duration and sequencing of reclamation construction activities will be dependent largely upon contractor preference and equipment. Therefore, selected tasks may shift and the time frame may be extended beyond that indicted in Table 542.100a (up to a total potential duration of 5 years).

## 542.200. PLAN FOR BACKFILLING, SOIL STABILIZATION, COMPACTING, AND GRADING.

The Star Point regrading plan was designed to meet the objectives of balancing cut and fill quantities, maintaining a geotechnically stable site, and minimizing erosion. The primary features of the regrading plan are:

- Regrading of areas to create slopes which will adequately drain while minimizing long-term erosion concerns;
- Backfilling to remove highwalls and cut slopes to the extent possible within the objectives noted above (cut and fill balance, site stability, and erosion control), recognizing the presence of pre-SMCRA slopes where available on-site materials will not allow complete removal of the highwalls and cut slopes;
- Construction of stable channels across regraded areas; and
- Removal of sedimentation ponds and implementation of interim sediment control.

The as-built cut quantity for the Star Point facility is 652,973 cubic yards, with a fill of 442,826 cubic yards (see Table 542.200a). The difference between these two quantities was balanced by placing at the Lion Deck and Refuse Pile. Regrading activities continued until the final surface configuration was achieved as shown on Maps 542.200a through 542.200h. Details regarding topsoil placement and revegetation following regrading are provided in Chapters 200 and 300 of this M&RP, respectively. Any plans presented in this section that are not consistent with information presented in Exhibit 528.322d supercede the information in Exhibit 528.322d.

# TABLE 542.100a
## Reclamation Timetable

| Task | Months From Start of Reclamation[a] | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| **No. 1 and No. 2 Mines and Access Road** | | | | | | | | | | | | | | | | | | | | | | | | |
| Remove Storage/Seal Mine Openings | | | | | | | | | | | | | | | | | | | | | | | | |
| Install Interim Sediment Control | | | | | | | | | | | | | | | | | | | | | | | | |
| Backfill and Compact | | | | | | | | | | | | | | | | | | | | | | | | |
| Construct Reclamation Channels | | | | | | | | | | | | | | | | | | | | | | | | |
| Remove Sedimentation Pond No. 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Place Topsoil | | | | | | | | | | | | | | | | | | | | | | | | |
| Revegetate | | | | | | | | | | | | | | | | | | | | | | | | |
| **Mudwater Canyon Fan, Corner Canyon Fan, and Little Park Canyon Breakout (if installed)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Remove Structures/Seal Mine Openings | | | | | | | | | | | | | | | | | | | | | | | | |
| Install Interim Sediment Control | | | | | | | | | | | | | | | | | | | | | | | | |
| Backfill and Compact | | | | | | | | | | | | | | | | | | | | | | | | |
| Place Topsoil | | | | | | | | | | | | | | | | | | | | | | | | |
| Revegetate | | | | | | | | | | | | | | | | | | | | | | | | |
| **Gentry Mountain Air Shaft** | | | | | | | | | | | | | | | | | | | | | | | | |
| Seal Mine Opening | | | | | | | | | | | | | | | | | | | | | | | | |
| Revegetate as Necessary | | | | | | | | | | | | | | | | | | | | | | | | |

DIV OF OIL GAS & MINING

DIV OF OIL GAS & MINING

## TABLE 542.200a
## AS-BUILT CUT and FILL BALANCE[a]

| Area | Cut Quantity ($yd^3$) | Fill Quantity ($yd^3$) | Difference ($yd^3$) |
|---|---|---|---|
| Lion Deck | 69,202 | 182,734 | +113,532 |
| Pond 1 | 29,906 | 24,075 | -5,831 |
| Pond 2 | 14,656 | 14,415 | -241 |
| Main channel and lower facilities | 419,764 | 96,459 | -323,305[b] |
| Refuse pile [1] | | | |
| No. 1 and 2 Mine roads | 32,801 | 31,557 | -1,244 |
| No. 1 Mine | 54,864 | 57,352 | +2,488 |
| No. 2 Mine | 1,137 | 1,780 | +643 |
| Lion Deck road repair | 2320 | 2320 | 0 |
| Exploration road | 1,566 | 1,566 | 0 |
| Pond 6 [1] | | | |
| Pond 7 | 1,589 | 196 | -1,393 |
| Pond 8 | 3,824 | 3,157 | -667 |
| Subsoil stockpile [1] | | | |
| Refuse pile test plots [1] | | | |
| Topsoil pile north of test plots | 14,117 | 819 | -13,298[c] |
| Unit train loadout area and conveyor | 5,561 | 17,287 | +11,726 |
| Mudwater Canyon fan portal | 1,659 | 2,965 | +1,306 |
| Corner Canyon fan portal | 7.0 | 6,144 | +6,137 |
| Little Park fan portal [d] | | | |
| Total | 652,973 | 442,826 | - 210,147 |

[1] Permitted by Sunnyside Cogeneration Associates (SCA) under Permit C/007/042
[a] Caluclated using Softdesk® Civil/Survey, Version 7.5-7.6
[b] Material to be moved to Lion Deck and Refuse Pile (SCA Agreement)
[c] Material to be used in reclamation of the Main Channel and/or Lion Deck areas
[d] Little Park fan portal was never constructed.

Revised: 03/04

**Demolition.** Prior to significant regrading activities at the Star Point facility, existing buildings, walls, utilities, coal-handling facilities, and other above-ground structures and materials will be removed from the area. To the extent possible, these structures and facilities will be salvaged. Those materials requiring off-site disposal will be placed in a permitted landfill. Final decisions regarding salvage or disposal of structures and equipment will be made just prior to reclamation following an assessment of the salvageability of the structures and equipment. If foundations will not interfere with regrading activities, they will be left in place for on-site burial. Foundations which will be within 4 feet of the reclaimed surface will be broken up to the extent practical prior to backfilling. Other foundations may be left intact.

Non-coal wastes found during demolition or other reclamation activities (including, but not limited to, grease, lubricants, paints, flammable liquids, garbage, abandoned machinery, lumber, and combustible materials generated during previous mining activities) will be placed and stored in a controlled manner at the Star Point facility. This storage area will be determined at the time of reclamation and will be at the discretion of the permittee. Final disposal of the non-coal mine wastes will be at a designated disposal site within the permit area or at a State-approved solid waste disposal facility. Notwithstanding any other provision of the R645 rules, any non-coal mine waste defined as "hazardous" under Section 3001 of the Resource Conservation and Recovery Act ("RCRA")(P.L. 94-580, as amended) and 40 CFR 261 will be handled in accordance with the requirements of Subtitle C of RCRA and any implementing agency.

**Backfilling and Compaction.** The objective of the proposed backfilling, contouring, and grading process is to achieve a stable reclaimed surface which will provide a variety of topographic features enhancing the post-mining land use. Prior to grading, all vegetation, organic matter, and debris will be cleared from areas to receive fill. The cut material from site regrading will be placed as fill and graded to facilitate drainage from the mine site and contributing side areas. All fill placed during recontouring of the site will be compacted to at least 85 percent of maximum Proctor density (ASTM D698). Compaction will be accomplished using repeated passes of rubber-tired equipment, rollers, and other appropriate equipment.

Side hill fills, where the width is too narrow to allow access by compaction equipment, will be initially constructed by end dumping, but only to a width necessary to allow equipment access. After this is achieved, the fill will be placed in lifts and compacted to at least 85 percent of maximum Proctor density.

Fill lifts will be placed with a thickness when compacted of no more than 12 inches. Care will be taken to ensure that fill materials are not frozen during placement or compaction. Any areas that are damaged by freezing will be reconditioned, reshaped, and recompacted to at least 85 percent of maximum Proctor density.

Previous (pre-SMCRA) mining in the area has resulted in the exposure of coal seams and the formation of cut slopes incident to mining activities. An indication of the extent of the pre-SMCRA disturbance is provided in Exhibit 542.200a, which contains copies of stereographic aerial photographs dated September 17, 1975 (pre-SMCRA), November 21, 1976 (pre-SMCRA), and May 8, 1984 (post-SMCRA). To the extent feasible, using available materials, coal outcrops which were previously exposed by pre-SMCRA operations will be covered with at least 4 feet of soil during reclamation. Furthermore, pre-SMCRA cut slopes will be covered to the extent practical given the available material. The extent to which slopes will be covered is indicated on Maps 542.200a through 542.200i. Cut slopes will remain where complete backfilling would result in slopes whose steepness would be unstable or where the backfill would impinge upon roads which are to be retained as part of post-reclamation land use.

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the mulch), the erosion rate is estimated to vary from 3.8 to 36.3 tons per acre per year (a 53 percent reduction compared to pre-mining conditions). Hence, reclamation of the area will reduce soil loss below that estimated to have occurred prior to disturbance, even with the concurrent removal of the sedimentation ponds during reclamation.

If reclamation work is not completed before seasonal conditions require a halt to reclamation work, those areas which have been regraded but which have not been topsoiled and reseeded will be deep gouged and left in a roughened state until reclamation activities resume.

## 542.300. FINAL SURFACE CONFIGURATION MAPS AND CROSS SECTIONS.

Final surface configuration maps and cross sections for the Star Point site are provided on Maps 542.200a through 542.200h and Drawing 5-2 through 5-4. County Road 290, which accesses the lands west of the surface facilities will remain following reclamation (see Section 542.600). No other facilities related to the coal mining operations will remain in the permit area following reclamation.

## 542.400. REMOVAL OF TEMPORARY STRUCTURES.

All surface structures associated with the mining operation will be removed as outlined in Section 542.200. A description ensuring that all structures and the sedimentation pond have been removed will be provided to the Division before seeking bond release or abandoning the permit area.

## 542.500. REMOVAL OF SEDIMENTATION PONDS.

Information regarding removal of the sedimentation ponds associated with the Star Point Mines is provided in Section 542.200. The timetable for removal of these ponds is indicted in Table 542.100a.

## 542.600. ROADS.

All roads not to be retained for an approved post-mining land use will be reclaimed after they are no longer needed for mining and reclamation operations. County Road 290 is a public road used to access Gentry Mountain and Carbon County's communication and relay facilities. In order to achieve post-mining land use, this road will be retained after final reclamation. Reclamation of mining areas adjacent to these roads will be performed in a manner which protects the long-term post-mining land uses of the roads and the area. Table 534.200a identifies the status of each road pursuant to its post mining long term use.

Roads will be reclaimed by pulling fill back up from the downslope and placing it in the cuts. The replaced fill material will be shaped to conform to the adjacent terrain and to meet natural drainage patterns. Following rough grading, topsoil will be applied to the regraded surfaces and the reclaimed roads will be mulched, deep gouged, and revegetated in accordance with Section 542.200 of this M&RP.

Natural drainages will be re-established across the reclaimed roads as indicated in Section 760. Culverts which are required for an approved post-mining land use (i.e., those which exist along County Road 290) will be retained; all others will be removed. Water bars and cross drains may be constructed across reclaimed roads to minimize erosion where necessary. The entrances to reclaimed roads will be blocked by barriers of native rock or earthen berms to prevent vehicular access.

As indicated in Exhibit 553.130b, a section of the lower portion of the Lion Deck access road experienced a stability failure in May 1994. Although this section of road was repaired, additional repair work is anticipated during reclamation to provide a long-term, stable surface for County Road 290. This repair

work will consist of the removal of approximately 12,600 cubic yards of material, backfilling this material in adjacent areas to assist in achieving the post-reclamation topography, and importing approximately 12,600 cubic yards of material from the alternate borrow area (identified in Section 233 of this M&RP) to reconstruct the road. The fill used to reconstruct the road will be placed with a thickness when compacted of no more than 8 inches. All fill placed during reconstruction of the road will be compacted to at least 92 percent of maximum Proctor density (ASTM D698). Compaction will be accomplished using repeated passes of rollers and other appropriate equipment.

## 542.700. FINAL ABANDONMENT OF MINE OPENINGS AND DISPOSAL AREAS.

**Abandonment of Openings.** All mine openings will be sealed at least 25 feet inside the mine opening. Prior to installation of the seal, all loose material will be removed from the roof, floor, and rib of the mine within 3 feet of the seal area. The seal will then be constructed using solid concrete blocks (average minimum compressive strength of 1,800 psi) with nominal dimensions of 6 inches high, 8 inches wide, and 16 inches long. Mortar will consist of one part cement, three parts sand, and no more than 7 gallons of water per sack of cement.

The seal will be recessed at least 16 inches deep into each rib and 12 inches deep into the floor. No recess will be made into the roof. In the bottom course, each block will be laid with its long axis parallel to the rib. The long axis in succeedingly higher courses will be perpendicular to the long axis of the blocks in the preceding course. An interlaced pilaster will be constructed in the center.

The seals will have a thickness of approximately 16 inches. Following seal construction, the entries will be backfilled from the seal to the outside surface with soil that is sloped at the surface to match the final slope at the entry. The soil will then be raked and revegetated with the approved seed mixture (see Section 300).

Alternatively, a cast-in-place MSHA approved seal will be installed with a minimum thickness of 3 feet and with a minimum compressive strength of 200 psi.

**Disposal of Excess Spoil.** If excess spoil is generated in the permit area, this material will be disposed of in the refuse pile prior to final reclamation of that pile. Material which is added to the refuse pile during reclamation will be placed in accordance with the procedures outlined in Section 528.322 of this M&RP.

**Disposal of Coal Mine Waste.** All reference to the refuse pile mentioned within this section is superseded with the information provded by Sunnyside Cogeneration Associates' Permit C/007/042. All coal mine waste generated at the Star Point Mines during reclamation will be disposed of at the refuse pile in accordance with the procedures outlined in Section 528.322 of this M&RP. The refuse pile will be reclaimed following completion of mining, placement of spoil and coal-mine waste generated during reclamation, and completion of the sampling program discussed in R645-301-528.322. During reclamation, the pile will be reshaped as necessary to achieve the approximate shape indicated on Map 542.200c, and then ripped or scarified to insure a stable contact between the refuse and the cover material. Subsequent to placement of the cover material, the surface will be gouged or pocked so as to produce a roughened surface to help control runoff and enhance local vegetative growth. Gouging or pocking of the surface material will be conducted in a manner so as to minimize penetration of the refuse material.

Test plots were established in 1982 on the east end of the refuse pile to evaluate various topsoil and subsoil depths for final reclamation of the refuse pile. To date, data indicate that as little as 10 inches of soil or subsoil will be adequate for final reclamation. However, since the data obtained from the test plots


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| | Prime Reference |
|---|---|
| Map 761a, As- Built Reclamation Watersheds and Diversions | Page 700- 187 |
| Map 761b, As-Built Reclamation Watersheds and Diversions | Page 700- 187 |
| Map 761c, As-Built Reclamation Watersheds and Diversions | Page 700- 187 |
| Map 761d, As-Built Reclamation Channel Cross-Sections | Page 700- 187 |

## LIST OF EXHIBITS

| | |
|---|---|
| Exhibit 722.100a, Field and Laboratory Water Quality Data from Representative Springs Obtained During the 1986 Inventory of Springs | Page 700- 14 |
| Exhibit 722.100b, USGS Stream Data | Page 700- 32 |
| Exhibit 724.100a, Water Quality Data Summary | Page 700- 38 |
| Exhibit 724.200a, Field and Laboratory Methods for the Analysis of Water Quality Samples | Page 700- 48 |
| Exhibit 728a, Spring Flow Hydrographs | Page 700- 55 |
| Exhibit 728b, In-mine Well Completion Details, and Approval and Condition for Abandonment of Gentry Ridge Wells | Page 700- 60 |
| Exhibit 728c, Aquifer Evaluations | Page 700- 67 |
| Exhibit 728d, Special Water Quality Analyses | Page 700- 72 |
| Exhibit 728e, Dispersion Calculations | Page 700- 84 |
| Exhibit 728f, Spring and Ground Water Comparisons | Page 700- 89 |
| Exhibit 728g, Hydrologic Reports Pertaining to the Abandonment of Equipment Underground | Page 700- 82 |
| Exhibit 728h, Evaluation of Hydrologic Monitoring at the Star Point Mine | Page 700- 107 |
| Exhibit 731.110a, Hydrologic Response to Land Subsidence Cause by Underground Coal Mining, Miller Creek Drainage, Carbon County, Utah | Page 700- 96 |
| Exhibit 731.122a, Water Rights Mitigation Plan | Page 700- 100 |
| Exhibit 732.300a, Diversion Ditch and Culvert Peak Flow Calculations | Page 700- 122 |
| Exhibit 732.300b, Hydrologic Calculation Update | Page 700- 122 |
| Exhibit 732.300c, Unit Train Hydrology | Page 700- 122 |
| Exhibit 733.210a, Sedimentation Pond Approval, Documentation and Certification | Page 700- 123 |
| Exhibit 742a, Pond 5 Hydrologic Calculations | Page 700- 147 |
| Exhibit 742b, Ditch No. 14 Hydraulic Calculations | Page 700- 148 |

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**R645-301-700 (HYDROLOGY)**


| | Prime Reference |
|---|---|
| Exhibit 742.221a, Treatment of Underflow from Thickener Tank using Settling Ponds | Page 700- 151 |
| Exhibit 742.221b, Thickener Underflow Design Detail Maps | Page 700- 152 |
| Exhibit 742.221c, Sediment Pond Water Quality Data | Page 700- 153 |
| Exhibit 742.221d, NPDES Permit | Page 700- 142 |
| Exhibit 742.221e, Pond Calculations | Page 700- 153 |
| Exhibit 742.221f, Pond No. 2 Outlet Modification | Page 700- 160 |
| Exhibit 742.221g, Culvert Capacity Calculations | Page 700- 166 |
| Exhibit 742.221h, Pond Inlet and Outlet Design Calculations | Page 700- 166 |
| Exhibit 742.312a, Riprap Calculations | Page 700- 172 |
| Exhibit 761a, Ditch and Channel Design Calculations | Page 700- 187 |
| Exhibit 761b, River Gas Road Culvert and Ditch Designs | Page 700- 188 |
| Exhibit 761c, As-Built Hydrology Calculations and Construction | Page 700- 187 |

**Channel Reclamation - General.** All sedimentation ponds and Treatment Facility No. 1 located in conjunction with the Star Point operation are temporary in nature and have been designed according to applicable regulations. These facilities will be removed or filled upon completion of the coal mining operation. As required by Federal and State regulations, such areas disturbed by temporary pond and channel diversion construction will be restored to match surrounding conditions, and the area will be stabilized with an effective vegetative cover as soon as possible after removal. This cover will be composed of native and other plants which are adaptable to the site and provide soil stability.

Stream channel reclamation design has been undertaken as required in the mining regulations. Upon reclamation, existing roadways (except those discussed in Section 542.600) and the existing surface-water conveyance facilities will be removed and the area regraded to the extent technically practical to pre-mining conditions, including revegetation of disturbed areas as specified in the reclamation plan. The plan includes the removal of most of the culverts and temporary diversion facilities associated with mining activities and the restoration of surface contours. As-built conditions showing the culverts and channels constructed upon reclamation of the site are presented on Maps 761a through 761d. Culverts to be retained are associated with the roads that will be retained consistent with the post-mining land use.

It should be noted that the extent of the channels and culverts shown on Maps 761a through 761c are for illustrative purposes. The actual extent will be determined in the field, ensuring that channels are constructed across all reclaimed cut and fill slopes and that culverts extend beneath the retained county road. In the area of the Lion Deck, all channels on the uphill side of the county road will cross the reclaimed fill prior to discharging into the reclamation culverts. It is anticipated that the reclamation culverts will extend primarily beneath the road surface. Final extent of reclamation channels and culverts will be determined in the field.

**Reclamation Channel Design.** Reclamation channel designs were based on the assumption that existing surface disturbances such as roadways (except as described in Section 542.600) and diversions (except those associated with the retained road) will be removed upon final reclamation and that surface runoff will follow natural flow paths approximating those which existed prior to mining. With flow paths defined, anticipated peak surface runoff rates were calculated using the curve-number methodology of the U.S. Soil Conservation Service (1972). Upstream and downstream cross-sections were observed in the field for those channels requiring reclamation and channel design has been completed to match natural conditions to the extent possible.

Reclaimed channel design calculations for the mine permit area are shown in Exhibit 761a. Diversions with a drainage area of less than 1 square mile were designed to safely convey the peak flow resulting from the 10-year, 6-hour precipitation event (in accordance with R645-301-742.333). The "main" reclamation channel (SPRD-31), with a drainage area of greater than 1 square mile, is classified as intermittent due to its watershed size (R645-100-200) and was, therefore, designed to convey the peak flow resulting from the 100-year, 6-hour precipitation event. Watershed boundaries for the drainage areas associated with each reclamation diversion are indicated on Maps 761a through 761c or in Exhibit 761a if those watershed boundaries extend beyond the borders of the maps.

Exhibit 761a presents designs and Exhibit 761c presents the as-built construction for the following three categories of reclamation channels:

- Standard broad-swale design
- Standard riprap-channel design

Channels which fit into each of the above categories are identified in Exhibit 761a and Exhibit 761c. The standard broad-swale design will generally be installed high in the watershed on steep reclaimed slopes where drainage areas and design discharges are limited. This channel will consist of a broad swale in which an erosion-control mat has been installed (Tensar TM-3000 or equivalent) and then seeded with the appropriate seed mix. The mat will provide immediate erosion protection, which will ultimately be enhanced by the vegetation.

The standard riprap-channel design will generally be installed lower in the watersheds where design discharges are greater. The standard design consists of riprap with a median diameter of 6 inches installed over a sand filter blanket, with a bottom width of 4 feet, a depth of 1 foot, and side slopes of 2H:1V. The filter blanket will consist of the standard Utah Department of Transportation ("UDOT") 1-inch mix.

Site-specific channel designs are generally in lower reaches of the watersheds where design flows are higher. These channels have been designed with riprap underlain by one or two filter blankets (depending upon the median diameter of the riprap), or with erosion-control mat, depending on the location. Where on filter blanket is designed, it will consist of the UDOT 1-inch mix. Where two filter blankets are designed, they will consist of a $d_{50}$ = 1-inch material overlying the UDOT 1-inch mix. Channel dimensions and median riprap diameters vary between the site-specific designs.

Tables 761a and 761b summarizes the design of the reclamation channels. Location and as-built cross-section of the channels constructed during reclamation are shown on Maps 761a through 761d and the as-built calculations demonstrating compliance with the design parameters are presented in Exhibit 761c. Note Channels SPRD-32, -34, -39, -41, -42, -43 and a segment of SPRD-40 are associated with Sunnyside Cogeneration Associates' Permit C/007/042 and no longer permitted by PMC under C/007/006 or shown on Map 761c.

Maps 761a and 761c show portions of four reclamation channels (SPRD-25a, -25b, -26, and -26a) constructed across the old (pre-SMCRA) tram grade that will not be reclaimed under this plan (compare with Maps 542.200a and 542.200c). Runoff from above this abandoned grade has on occasion flowed down this grade in the past, causing localized erosion of the grade and diversion of flows into facility areas. In order to prevent this from occurring following reclamation, the channels will be extended across the grade at the indicated locations. Each of these channels will consist of the standard broad-swale design (just as the lower portions are designed) and will be constructed as noted above. The only regrading of the tram area will occur where the channels cross the grade, with no additional reclamation of the tram grade being anticipated. The reclamation design for the Lion's Deck and Pond 001 areas have been refined necessitating a new channel design. The modified channel design for these areas can be found in an Addendum to Exhibit 761a.

**Reclamation Culvert Design.** Several existing culverts associated with County Road 290 will be retained following reclamation. The retention of these culverts is necessary for long-term maintenance of the condition of the road.

Operational culvert 46B will be replaced by SPRC-44 to allow reclamation of the access road to Pond 001. Details of the design can be found in the Addendum to Exhibit 761a.

## 762. ROAD RECLAMATION.

All roads located on the permit property not to be retained for an approved post-mining land use will be reclaimed immediately after they are no longer needed for coal mining and reclamation operations.

Design calculations for culverts and ditches associated with the River Gas road are presented in Exhibit 761b. Since this road will not be reclaimed, these structures will be retained following reclamation. Sediment contributions from the road will be minimized by proper road maintenance and by surfacing the road with gravel road-base material.

# Exhibit 761c

# As-built Hydrology Calculations

The purpose of these calculations is to demonstrate that the constructed reclamation channels can handle the peak flow generated by the 10-yr 6-hr Design storm event. All channels have been verified assuming a 10-yr 6-hr storm event except the main channel (SPRD-31) which has been designed for the 100-yr 6-hr storm event.

To minimize confusion and ease review watersheds and channels have been labeled in the same manner as found in the design calculations in Exhibit 761a and the Addendum to Exhibit 761a. Any deviation from this has been identified in the following tables and calculations.

Where watershed areas changed very little or the as-built channel configuration resulted in a smaller watershed area, draining to the channel, the peak flows determined in Exhibit 761a and the Addendum to Exhibit 761a were used. If the as-built watershed was larger than the design watershed the peak flow was recalculated. In many cases the design watershed was larger than the as-built watershed and the larger design peak flow was used to be conservative. For example the as-built watershed RWS-31 is much smaller than the design watershed since SCA took control of the refuse pile. However, the design peak flow from Exhibit 761a has been used to be conservative

The Curve Number summary on pages 2 to 4 identifies the watersheds that have been recalculated.

Data for all of the watersheds have been summarized in the adjoining tables. (See pages 5 and 6)

The same methodology described on pages 1 & 4 of Exhibit 761a have been used for these calculations.

Watershed locations can be seen on Maps 761a, 761b, and 761c

REGISTERED PROFESSIONAL ENGINEER
10-28-03
No. 189797
LAYNE D. JENSEN
Layne D. Jensen
STATE OF UTAH

# STAR POINT MINE AS-BUILT RECLAMATION
## CURVE NUMBER SUMMARY

| | Watershed No. | Total Area (ac) | Undisturbed | | Reclaimed | | Weighted CN |
|---|---|---|---|---|---|---|---|
| | | | Area (ac) | CN | Area (ac) | CN | |
| * | RWS-1 | 9.1 | 7.7 | 75 | 1.4 | 80 | 76 |
| * | RWS-2 | 4.4 | 4.0 | 65 | 0.4 | 80 | 66 |
| * | RWS-3 | 2.7 | 2.5 | 65 | 0.2 | 80 | 66 |
| * | RWS-4 | 8.8 | 8.3 | 65 | 0.5 | 80 | 66 |
| * | RWS-5 | 2.6 | 2.2 | 65 | 0.4 | 80 | 67 |
| * | RWS-6 | 7.1 | 6.5 | 65 | 0.6 | 80 | 66 |
| * | RWS-7 | 11.4 | 11.2 | 70 | 0.2 | 80 | 70 |
| | RWS-8 | 13.87 | 12.95 | 70 | 0.92 | 85 | 71 |
| | RWS-9 | 2.36 | 2.15 | 68 | 0.21 | 80 | 69 |
| | RWS-10 | 6.23 | 2.89 | 67 | 3.34 | 80 | 74 |
| | RWS-11 | 1.96 | 1.32 | 67 | 0.64 | 80 | 71 |
| | RWS-12 | 14.86 | 10.65 | 70 | 4.21 | 80 | 73 |
| * | RWS-14 | 7.7 | 6.3 | 75 | 1.4 | 80 | 76 |
| | RWS-15 | 5.51 | 5.26 | 75 | 0.25 | 90 | 76 |
| * | RWS-16 | 7.5 | 6.2 | 75 | 1.3 | 80 | 76 |
| * | RWS-21 | 14.0 | 9.3 | 75 | 4.7 | 81 | 77 |
| * | RWS-22 | 29.0 | 23.7 | 70 | 5.3 | 81 | 72 |
| * | RWS-24 | 191.3 | 155.8 | 70 | 35.5 | 81 | 72 |
| | RWS-25a | 3.74 | 3.64 | 80 | 0.1 | 80 | 80 |
| | RWS-25b | 4.80 | 4.70 | 80 | 0.1 | 80 | 80 |
| * | RWS-26 | 10.2 | 10.1 | 80 | 0.1 | 80 | 80 |
| | RWS-27 | 0.41 | 0.40 | 80 | 0.01 | 80 | 80 |

- RWS-13 Not used due to channel configuration change in the field.
- RWS-17-20 and RWS-23 Replaced in the Addendum to Exhibit 76la by RWS-44-53

* Information copied from Exhibit 76la

STAR POINT MINE AS-BUILT RECLAMATION
CURVE NUMBER SUMMARY (cont.)

| | Watershed No. | Total Area (ac) | Undisturbed | | Reclaimed | | Weighted CN |
|---|---|---|---|---|---|---|---|
| | | | Area (ac) | CN | Area (ac) | CN | |
| | | | | | | | |
| | RWS-28 | 8.65 | 8.40 | 80 | 0.25 | 80 | 80 |
| | RWS-29a | 19.34 | 16.74 | 80 | 2.60 | 96 | 82 |
| | RWS-29b | 13.62 | 13.17 | 80 | 0.45 | 80 | 80 |
| * | RWS-30 | 9.1 | 8.6 | 80 | 0.5 | 80 | 80 |
| * | RWS-31 | 772.3 | 652.6 | 75 | 119.7 | 81 | 76 |
| * | RWS-33 | 14.6 | 11.7 | 80 | 2.9 | 83 | 81 |
| | RWS-35 | 19.35 | 18.66 | 90 | 0.69 | 80 | 90 |
| | RWS-35a | 1.02 | 0.83 | 90 | 0.19 | 80 | 88 |
| * | RWS-36 | 3.1 | 2.6 | 90 | 0.5 | 80 | 88 |
| | RWS-40 | 2.86 | 2.42 | 90 | 0.44 | 80 | 88 |
| * | RWS-44 | 24.24 | 24.02 | 65 | 0.22 | 80 | 66 |
| * | RWS-45 | 9.65 | 7.47 | 70 | 2.18 | 80 | 73 |
| * | RWS-46 | 20.67 | 18.20 | 65 | 2.47 | 82 | 67 |
| * | RWS-47 | 15.00 | 13.58 | 65 | 1.42 | 82 | 67 |
| * | RWS-48 | 11.40 | 9.40 | 65 | 2.00 | 83 | 69 |
| * | RWS-49 | 10.76 | 9.50 | 65 | 1.26 | 83 | 68 |
| * | RWS-50 | 23.78 | 22.68 | 70 | 1.10 | 82 | 71 |
| * | RWS-51 | 10.72 | 7.59 | 70 | 3.13 | 84 | 74 |
| | RWS-52 | 1.71 | 0.45 | 80 | 1.26 | 80 | 80 |
| | RWS-53 | 4.27 | 2.12 | 80 | 2.15 | 80 | 80 |
| | | | | | | | |

- RWS-32, 34, 39, 41, 42 and 43 Are now all part of the SCA permit area
- RWS-37 and 38 Were not needed since channels were not constructed in these areas

* Information copied from Exhibit 76la and the Addendum to Exhibit 76la.

STAR POINT MINE AS-BUILT RECLAMATION
CURVE NUMBER SUMMARY (cont.)

| | Watershed No. | Total Area (ac) | Undisturbed | | Reclaimed | | Weighted CN |
|---|---|---|---|---|---|---|---|
| | | | Area (ac) | CN | Area (ac) | CN | |
| + | RWS-54 | 4.59 | 4.49 | 80 | 0.1 | 80 | 80 |
| + | RWS-55 | 5.65 | 5.55 | 80 | 0.1 | 80 | 80 |
| + | RWS-56 | 0.65 | 0.55 | 80 | 0.1 | 80 | 80 |
| + | RWS-57 | 2.30 | 2.10 | 80 | 0.2 | 80 | 80 |
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+ These watersheds are associated with 4 new channels that were not included in the reclamation design.

| Watershed Area a | Drainage Area (ac) | Curve Number | S (in) | Y (%) | I (ft) | L (hr) | Time of Conc. (hr) | Peak Flow (cfs) |
|---|---|---|---|---|---|---|---|---|
| RWS-1 | 9.1 | 76 | 3.158 | 68.6 | 1160 | 0.049 | 0.081 | 0.86 |
| RWS-2 | 4.4 | 66 | 5.152 | 63.7 | 980 | 0.058 | 0.097 | 0.06 |
| RWS-3 | 2.7 | 66 | 5.152 | 76.5 | 820 | 0.046 | 0.077 | 0.03 |
| RWS-4 | 8.8 | 66 | 5.152 | 75.1 | 1020 | 0.055 | 0.092 | 0.11 |
| RWS-5 | 2.6 | 67 | 4.925 | 79.5 | 980 | 0.051 | 0.085 | 0.04 |
| RWS-6 | 7.1 | 66 | 5.152 | 80.8 | 1020 | 0.053 | 0.089 | 0.09 |
| RWS-7 | 11.4 | 70 | 4.286 | 68.9 | 1100 | 0.055 | 0.092 | 0.25 |
| RWS-8 | 13.87 | 71 | 4.085 | 63.6 | 1820 | 0.084 | 0.140 | 0.35 |
| RWS-9 | 2.36 | 69 | 4.493 | 54.8 | 885 | 0.053 | 0.089 | 0.05 |
| RWS-10 | 6.23 | 74 | 3.514 | 54.6 | 1305 | 0.064 | 0.106 | 0.28 |
| RWS-11 | 1.96 | 71 | 4.085 | 62.8 | 842 | 0.045 | 0.076 | 0.05 |
| RWS-12 | 14.86 | 73 | 3.699 | 62.1 | 1680 | 0.075 | 0.125 | 0.53 |
| RWS-14 | 7.7 | 76 | 3.158 | 57.8 | 1180 | 0.054 | 0.090 | 0.7 |
| RWS-15 | 5.51 | 76 | 3.158 | 65.9 | 1150 | 0.049 | 0.082 | 0.51 |
| RWS-16 | 7.5 | 76 | 3.158 | 53.3 | 1020 | 0.050 | 0.083 | 0.71 |
| RWS-21 | 14 | 77 | 2.987 | 6.6 | 2720 | 0.302 | 0.504 | 0.81 |
| RWS-22 | 29 | 72 | 3.889 | 41.2 | 2560 | 0.133 | 0.222 | 0.85 |
| RWS-24 | 191.3 | 72 | 3.889 | 46.5 | 5040 | 0.215 | 0.359 | 5.35 |
| RWS-25a | 3.74 | 80 | 2.500 | 67.9 | 940 | 0.037 | 0.061 | 0.78 |
| RWS-25b | 4.8 | 80 | 2.500 | 65.7 | 985 | 0.039 | 0.065 | 0.99 |
| RWS-26 | 10.2 | 80 | 2.500 | 57.6 | 1280 | 0.051 | 0.085 | 1.99 |
| RWS-27 | 0.41 | 80 | 2.500 | 55.7 | 240 | 0.014 | 0.023 | 0.09 |
| RWS-28 | 8.65 | 80 | 2.500 | 52 | 1670 | 0.066 | 0.111 | 1.62 |
| RWS-29a | 19.34 | 82 | 2.195 | 55.1 | 3960 | 0.121 | 0.202 | 4.72 |
| RWS-29b | 13.62 | 80 | 2.500 | 60.6 | 1855 | 0.067 | 0.112 | 2.54 |

| Watershed Area a | Drainage Area (ac) | Curve Number | S (in) | Y (%) | l (ft) | L (hr) | Time of Conc. (hr) | Peak Flow (cfs) |
|---|---|---|---|---|---|---|---|---|
| RWS-30 | 9 | 80 | 2.500 | 48.4 | 1680 | 0.069 | 0.116 | 1.67 |
| RWS-31 | 772.3 | 76 | 3.158 | 55.4 | 10500 | 0.316 | 0.528 | 145.73 |
| RWS-33 | 14.6 | 81 | 2.346 | 21.5 | 2400 | 0.134 | 0.223 | 2.6 |
| RWS-35 | 19.35 | 90 | 1.111 | 75.1 | 1870 | 0.042 | 0.071 | 7.8 |
| RWS-35a | 1.02 | 88 | 1.364 | 46.6 | 625 | 0.024 | 0.041 | 0.52 |
| RWS-36 | 3.1 | 88 | 1.364 | 59.2 | 800 | 0.026 | 0.044 | 1.57 |
| RWS-40 | 2.86 | 88 | 1.364 | 56.6 | 925 | 0.030 | 0.050 | 1.44 |
| RWS-44 | 24.24 | 66 | 5.152 | 67 | 2200 | 0.108 | 0.181 | 0.3 |
| RWS-45 | 9.65 | 73 | 3.699 | 49.5 | 600 | 0.037 | 0.062 | 0.35 |
| RWS-46 | 20.67 | 67 | 4.925 | 75.5 | 1800 | 0.085 | 0.141 | 0.3 |
| RWS-47 | 15 | 67 | 4.925 | 67.4 | 1700 | 0.086 | 0.143 | 0.22 |
| RWS-48 | 11.4 | 69 | 4.493 | 80.5 | 1600 | 0.071 | 0.118 | 0.22 |
| RWS-49 | 10.76 | 68 | 4.706 | 75.1 | 1540 | 0.073 | 0.122 | 0.18 |
| RWS-50 | 23.76 | 71 | 4.085 | 64.5 | 2000 | 0.089 | 0.149 | 0.61 |
| RWS-51 | 10.72 | 74 | 3.514 | 59.1 | 720 | 0.038 | 0.063 | 0.58 |
| RWS-52 | 1.71 | 80 | 2.500 | 68.9 | 505 | 0.022 | 0.037 | 0.37 |
| RWS-53 | 4.27 | 80 | 2.500 | 56.8 | 575 | 0.027 | 0.045 | 0.92 |
| RWS-54 | 4.59 | 80 | 2.500 | 54.5 | 1480 | 0.059 | 0.098 | 0.88 |
| RWS-55 | 5.65 | 80 | 2.500 | 47.7 | 1470 | 0.063 | 0.105 | 1.07 |
| RWS-56 | 0.65 | 80 | 2.500 | 48.4 | 610 | 0.031 | 0.051 | 0.14 |
| RWS-57 | 2.3 | 80 | 2.500 | 44 | 1210 | 0.056 | 0.093 | 0.45 |

**Notes**

S = 1000/CN - 10

Y = average watershed slope = (length of contour lines)(contour interval)/(watershed area)

l = hydraulic length

L = watershed lag =( l^0.8(S+1)^0.7) / (1900(Y)^0.5)

Time of Concentration + 1.67L

Peak Flow is based on a 10-yr 6-hr storm event except for RWS-31 which is a 100-yr 6-hr storm event

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-8

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 13.87 acres |
| Depth = 1.40 inches | CN = 71.00 |
| Duration = 6.0 hrs | Time conc.= 0.14 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.073 inches
Initial abstr: 0.817 inches
Peak flow: 0.35 cfs ( 0.025 iph )
at time: 3.528 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-9

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 2.36 acres |
| Depth = 1.40 inches | CN = 69.00 |
| Duration = 6.0 hrs | Time conc.= 0.09 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.050 inches
Initial abstr: 0.899 inches
Peak flow: 0.05 cfs ( 0.019 iph )
at time: 5.518 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-10

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 6.23 acres |
| Depth = 1.40 inches | CN = 74.00 |
| Duration = 6.0 hrs | Time conc.= 0.11 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.115 inches
Initial abstr: 0.703 inches
Peak flow: 0.28 cfs ( 0.044 iph )
at time: 2.558 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-11

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 1.96 acres |
| Depth = 1.40 inches | CN = 71.00 |
| Duration = 6.0 hrs | Time conc.= 0.08 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.073 inches
Initial abstr: 0.817 inches
Peak flow: 0.05 cfs ( 0.026 iph )
at time: 3.516 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-12

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 14.86 acres |
| Depth = 1.40 inches | CN = 73.00 |
| Duration = 6.0 hrs | Time conc.= 0.13 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.100 inches
Initial abstr: 0.740 inches
Peak flow: 0.53 cfs ( 0.035 iph )
at time: 3.517 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-15

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 5.51 acres |
| Depth = 1.40 inches | CN = 76.00 |
| Duration = 6.0 hrs | Time conc.= 0.08 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.150 inches
Initial abstr: 0.632 inches
Peak flow: 0.51 cfs ( 0.093 iph )
at time: 2.526 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-25a

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 3.74 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.06 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.78 cfs ( 0.206 iph )
at time: 2.513 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-25b

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 4.80 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.07 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.99 cfs ( 0.204 iph )
at time: 2.513 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-27

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 0.41 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.02 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.09 cfs ( 0.223 iph )
at time: 2.502 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-28

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 8.65 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.11 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 1.62 cfs ( 0.186 iph )
at time: 2.531 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-29a

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 19.34 acres |
| Depth = 1.40 inches | CN = 82.00 |
| Duration = 6.0 hrs | Time conc.= 0.12 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.293 inches
Initial abstr: 0.439 inches
Peak flow: 4.72 cfs ( 0.242 iph )
at time: 2.533 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-29b

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 13.62 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.11 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 2.54 cfs ( 0.185 iph )
at time: 2.539 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-35

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 13.35 acres |
| Depth = 1.40 inches | CN = 90.00 |
| Duration = 6.0 hrs | Time conc.= 0.07 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.606 inches
Initial abstr: 0.222 inches
Peak flow: 7.80 cfs ( 0.580 iph )
at time: 2.509 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-35

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 1.02 acres |
| Depth = 1.40 inches | CN = 88.00 |
| Duration = 6.0 hrs | Time conc.= 0.04 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.510 inches
Initial abstr: 0.273 inches
Peak flow: 0.52 cfs ( 0.502 iph )
at time: 2.504 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-40

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 2.86 acres |
| Depth = 1.40 inches | CN = 88.00 |
| Duration = 6.0 hrs | Time conc.= 0.05 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.510 inches
Initial abstr: 0.273 inches
Peak flow: 1.44 cfs ( 0.499 iph )
at time: 2.507 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-52

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 1.71 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.04 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.37 cfs ( 0.217 iph )
at time: 2.506 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-53

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 4.27 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.05 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.92 cfs ( 0.213 iph )
at time: 2.508 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-54

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 4.59 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.10 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.88 cfs ( 0.190 iph )
at time: 2.522 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-55

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 5.65 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.11 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 1.07 cfs ( 0.188 iph )
at time: 2.534 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-56

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 0.65 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.05 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.14 cfs ( 0.210 iph )
at time: 2.509 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
RWS-57

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 2.30 acres |
| Depth = 1.40 inches | CN = 80.00 |
| Duration = 6.0 hrs | Time conc.= 0.09 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.238 inches
Initial abstr: 0.500 inches
Peak flow: 0.45 cfs ( 0.192 iph )
at time: 2.530 hrs

---

# Channel Verification

The purpose of this section is to verify that the as-built channels can handle the 10-yr 6-hr storm event. Channels were modified during construction as a result of field conditions. These calculations demonstrate that the channels are still adequate

To facilitate construction a standard channel using pyramat (an erosion control mat) was specified for most channels. Since a standard design was used for construction of most channels a single calculation assuming the minimum cross-section for this standard channel will verify the adequacy of the standard channel. Riprap channels or non-standard pyramat channels will be verified individually.

A summary of the channels as measured in August 2003 can be found in the table on pages 34 through 38

The same methodology and assumptions used in the design in Exhibit 76la and the Addendum to Exhibit 76la have been used for these calculations.

Channel profiles can be found on attached figures 1 through 39 with the profile for main channel SPRD-31 on Map 542.200F

Channel cross-sections can be found on Map 761d

Standard Pyramat channel verification.

The original design specified Tensar TM-3000 Erosion Control Mat. At the time of construction this mat was no longer available. SI Industries Pyramat was substituted. The Pyramat has the same or better performance as the Tensar TM-3000. See the end of this section for detailed information on pyramat.

The minimum cross-section (minimum capacity) measured in the field is:

| | | | |
|---|---|---|---|
| Bottom width | = | 2.0' | (SPRD-17b, 19b + 25a) |
| Average Side slopes | = | 1.03:1 | (SPRD-17c) |
| Depth | = | 0.67' | (SPRD-17c) |
| max slope | = | 68.0% | (SPRD-17c) |
| min. slope | = | 7.9% | (SPRD-5) |
| Peak flow | = | 1.7 cfs. | |

These measurements represent a worst case. The majority of Pyramat channel has a bottom width of 2.5-3', side slopes flatter than 1.75:1 and depth over 0.8'. Thus actual capacity will be much greater than this calculation demonstrates.

These worst case calculations assume a non-vegetated state ($n=0.025$) and maximum slope for checking velocity and a well vegetated ($n=0.047$) and minimum slope for checking adequate depth.

Calculation sheets can be found on pages 39 and 40

The following Pyramat channels are within the above criteria:

| | | | |
|---|---|---|---|
| SPRD-1 | SPRD-14 | SPRD-20a | SPRD-44 |
| SPRD-1a | SPRD-14a | SPRD-21 | SPRD-45 |
| SPRD-2 | SPRD-15 | SPRD-25a | SPRD-46 |
| SPRD-3 | SPRD-16 | SPRD-25b | SPRD-47 |
| SPRD-4a | SPRD-17a | SPRD-26 | SPRD-48 |
| SPRD-4b | SPRD-17b | SPRD-27 | SPRD-49 |
| SPRD-5 | SPRD-17c * | SPRD-28 | |
| SPRD-6 | SPRD-18a | SPRD-30 | |
| SPRD-7 | SPRD-18b | SPRD-35a | |
| SPRD-9 | SPRD-19a | SPRD-36a | |
| SPRD-11 | SPRD-19b | SPRD-40 | |

The following Pyramat channels will be verified independently:

SPRD-10, SPRD-20b, SPRD-29b, and SPRD-35

Calculation sheets for these channels can be found on pages 41 through 48

* It would have been preferable to have a riprap channel for SPRD-17c. However, the slope was so steep that a riprap channel would have been unstable. The slope exceeded the angle of repose for the filter material and likely exceeded the angle of repose for the riprap.

All Riprap channels will be verified individually.

The Mannings n will be determined using the following equation, which takes into account the slope and riprap size:

$$n = 0.0456\,(D_{50} \times Slope)^{0.159}$$

$D_{50}$ = Riprap median diameter (in)
Slope = Slope (ft/ft)

Abt, S.R., Khattak, M.S., Nelson, J.D., Ruff, J.E, Shaikh, A., Wittler, R.J., Lee, D.W. and Hinkle, N.E. 1987 Development of Riprap Design Criteria by riprap testing in flumes: Phase 1. U.S. Nuclear Regulatory Commission. Washington D.C.

Calculation sheets for verification of riprap channels can be found on pages 49 through 66

Swales crossing the country road along the Lion's Deck area and the road ditch in the Lion's Deck area are verified in the calculation sheets found on pages 67 through 80

# STAR POINT MINE RECLAMATION
# AS-BUILT CHANNEL DESIGN FLOWS

| Diversion Ditch | Contributing Watersheds | Design Flow (cfs) |
|---|---|---|
| SPRD-1 | RWS-1 | 0.86 |
| SPRD-1a | RWS-1 | 0.86 |
| SPRD-2 | RWS-2 | 0.06 |
| SPRD-3 | RWS-3 | 0.03 |
| SPRD-4a | 40% RWS-4 | 0.04 |
| SPRD-4b | RWS-4 | 0.11 |
| SPRD-5 | RWS-5 | 0.04 |
| SPRD-6 | RWS-6 | 0.09 |
| SPRD-7 | RWS-7 | 0.25 |
| SPRD-8 | RWS-1 + 8 | 1.21 |
| SPRD-9 | RWS-2, 3 and 9 | 0.14 |
| SPRD-10 | RWS-2,3,4,5,9, and 10 | 0.57 |
| SPRD-11 | RWS-6 and 11 | 0.14 |
| SPRD-12 | RWS-6, 7, 11 and 12 | 0.92 |
| SPRD-14+14a | RWS-14 | 0.7 |
| SPRD-15 | RWS-15 | 0.51 |
| SPRD-16 | RWS-15 and 16 | 1.22 |
| SPRD-17a | RWS-50 | 0.61 |
| SPRD-17b | RWS-49 | 0.18 |
| SPRD-17c | RWS-49, 50, and 52 | 1.16 |
| SPRD-18a | RWS-48 | 0.22 |
| SPRD-18b | RWS-48 | 0.22 |
| SPRD-19a | RWS-47 | 0.22 |

Note: When only part of a watershed contributes runoff to a channel or culvert the runoff will be determined by multiplying the total flow by the percentage of the watershed area flowing to the ditch or culvert. In some cases the total watershed runoff may be used.

STAR POINT MINE RECLAMATION
AS-BUILT CHANNEL DESIGN FLOWS

| Diversion Ditch | Contributing Watersheds | Design Flow (cfs) |
|---|---|---|
| SPRD-19b | RWS-47 | 0.22 |
| SPRD-19c | RWS-47 | 0.22 |
| SPRD-20a | 60% RWS-46 | 0.18 |
| SPRD-20b | RWS-46 | 0.30 |
| SPRD-21 | RWS-21 | 0.81 |
| SPRD-22a | RWS-22 | 0.85 |
| SPRD-24 | RWS-24 | 5.35 |
| SPRD-25a | RWS-25a | 0.78 |
| SPRD-25b | RWS-25b | 0.99 |
| SPRD-26 | 70% RWS-26 | 1.40 |
| SPRD-26a | 60% RWS-26 | 1.20 |
| SPRD-27 | RWS-27 | 0.09 |
| SPRD-28 | RWS-28 | 1.62 |
| SPRD-29a | RWS-29a | 4.72 |
| SPRD-29b | RWS-29b | 2.54 |
| SPRD-30 | RWS-30 | 1.67 |
| SPRD-31 | RWS-31 which includes all upstream watersheds | 145.73 100-yr 6-hr |
| SPRD-33 | RWS-33 | 2.60 |
| SPRD-35 | RWS-35 | 7.8 |
| SPRD-35a | RWS-35a | 0.52 |
| SPRD-36a | RWS-36 | 1.57 |
| SPRD-40 | RWS-40 | 1.44 |
| SPRD-44 | RWS-44 | 0.3 |

Note: When only part of a watershed contributes runoff to a channel or culvert the runoff will be determined by multiplying the total flow by the percentage of the watershed area flowing to the ditch or culvert. In some cases the total watershed runoff may be used.

# STAR POINT MINE RECLAMATION
# AS-BUILT CHANNEL DESIGN FLOWS

| Diversion Ditch | Contributing Watersheds | Design Flow (cfs) |
|---|---|---|
| SPRD-45 | RWS-45 | 0.35 |
| SPRD-23 | RWS-48, 49, 50, 52, + 53 | 2.30 |
| SPRD-46 | RWS-54 | 0.88 |
| SPRD-47 + 47a | RWS-55 | 1.07 |
| SPRD-48 | RWS-56 | 0.14 |
| SPRD-49 | RWS-57 | 0.45 |
| Swale-17a | RWS-50 | 0.61 |
| Swale-17b | RWS-49 | 0.18 |
| Swale-18a | RWS-48 | 0.22 |
| Swale-19a+b | RWS-47 | 0.22 |
| Swale-20a | RWS-46 | 0.30 |
| Lion's Deck Road Ditch | RWS-51 | 0.58 |
| | | |
| SPRC-22 | RWS-22 | 0.85 |
| SPRC-44 | RWS-45* and 44 | 0.65 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Note: When only part of a watershed contributes runoff to a channel or culvert the runoff will be determined by multiplying the total flow by the percentage of the watershed area flowing to the ditch or culvert. In some cases the total watershed runoff may be used.

* RWS-45 peak flow is based on the watershed on Exhibit 761a in the addendum to Exhibit 761a which shows a much larger watershed.

**STAR POINT MINE AS-BUILT RECLAMATION CHANNEL SUMMARY**
**10-YEAR 6-HOUR STORM EVENT**
**(PAGE 1 of 5)**

| Reclamation Channel | Peak Flow (cfs) | Bottom Width (ft) | Side Slopes (H:V) | Channel Depth (ft) | Min. Bottom Slope (%) | Max. Bottom Slope (%) | Erosion Control Riprap $D_{50}$ (in) or Pyramat | Status |
|---|---|---|---|---|---|---|---|---|
| SPRD-1 | 0.86 | 2.5 | 1.71:1 | 1.17 | 20.4 | 36.4 | Pyramat | OK |
| SPRD-1a | 0.86 | 5.0 | 2.14:1 | 1.17 | 22.1 | 46.8 | Pyramat | OK |
| SPRD-2 | 0.06 | 3.0 | 2:1 | 1.0 | 17.8 | 50.0 | Pyramat | OK |
| SPRD-3 | 0.03 | 2.5 | 2.67:1 | 0.75 | 19.6 | 59.7 | Pyramat | OK |
| SPRD-4a | 0.04 | 3.5 | 2.33:1 | 0.75 | 24.2 | 51.9 | Pyramat | OK |
| SPRD-4b | 0.11 | 3.0 | 2.5:1 | 0.75 | 19.2 | 52.9 | Pyramat | OK |
| SPRD-5 | 0.04 | 3.0 | 2.81:1 | 0.67 | 7.9 | 64.7 | Pyramat | OK |
| SPRD-6 | 0.09 | 3.0 | 2.84:1 | 0.79 | 15.2 | 43.0 | Pyramat | OK |
| SPRD-7 | 0.25 | 2.5 | 2.70:1 | 0.83 | 15.1 | 35.1 | Pyramat | OK |
| SPRD-8 | 1.21 | 5.5 | 1.69:1 | 1.33 | 10.8 | 64.5 | 9 | OK |
| SPRD-9 | 0.14 | 3.0 | 2.4:1 | 0.83 | 25.9 | 42.6 | Pyramat | OK |
| SPRD-10* | 0.57 | 2.5 | 1.78:1 | 1.13 | 20.0 | 40.2 | 9 | OK |
| SPRD-10* | 0.57 | 7.0 | 2.72:1 | 0.92 | 17.1 | 43.6 | Pyramat | OK |
| SPRD-11 | 0.14 | 2.2 | 1.98:1 | 1.08 | 30.4 | 64.5 | Pyramat | OK |
| SPRD-12 | 0.92 | 3.5 | 2.54:1 | 1.08 | 22.5 | 44.1 | 9 | OK |

Notes: The ditches described above represent the section of ditch with the **least** capacity to handle runoff. It does not indicate the ditch configuration everywhere.

* The upper portion of SPRD-10 is a riprap channel with the lower portion being a Pyramat channel. See As-built Map 761b for the location of the transition point



Revised: October, 2003

**STAR POINT MINE AS-BUILT RECLAMATION CHANNEL SUMMARY**
**10-YEAR 6-HOUR STORM EVENT**
**(PAGE 2 of 5)**

| Reclamation Channel | Peak Flow (cfs) | Bottom Width (ft) | Side Slopes (H:V) | Channel Depth (ft) | Min. Bottom Slope (%) | Max. Bottom Slope (%) | Erosion Control Riprap $D_{50}$ (in) or Pyramat | Status |
|---|---|---|---|---|---|---|---|---|
| SPRD-13 | Not built, see note on the last page of this table for explanation | | | | | | | |
| SPRD-14 | 0.70 | 2.5 | 1.71:1 | 1.17 | 14.3 | 34.5 | Pyramat | OK |
| SPRD-14a | 0.70 | 3.0 | 1.91:1 | 0.92 | 21.0 | 30.5 | Pyramat | OK |
| SPRD-15 | 0.51 | 3.0 | 1.75:1 | 1.0 | 19.6 | 65.0 | Pyramat | OK |
| SPRD-16 | 1.22 | 3.5 | 1.91:1 | 0.92 | 21.9 | 53.8 | Pyramat | OK |
| SPRD-17a | 0.61 | 3.0 | 1.75:1 | 1.0 | 19.2 | 58.1 | Pyramat | OK |
| SPRD-17b | 0.18 | 2.0 | 2.53:1 | 0.79 | 24.9 | 51.0 | Pyramat | OK |
| SPRD-17c | 1.16 | 3.0 | 1.03:1 | 0.67 | 38.7 | 68.0 | Pyramat | OK |
| SPRD-18a | 0.22 | 3.0 | 2.1:1 | 0.83 | 30.3 | 65.6 | Pyramat | OK |
| SPRD-18b | 0.22 | 3.0 | 1.64:1 | 0.67 | 32.7 | 44.4 | Pyramat | OK |
| SPRD-19a | 0.22 | 3.0 | 1.71:1 | 1.17 | 28.3 | 65.5 | Pyramat | OK |
| SPRD-19b | 0.22 | 2.0 | 2.03:1 | 1.0 | 27.7 | 52.9 | Pyramat | OK |
| SPRD-19c | 0.22 | 2.5 | 2.1:1 | 0.83 | 21.2 | 54.1 | Pyramat | OK |
| SPRD-20a | 0.18 | 3.5 | 2.5:1 | 0.5 | 27.0 | 51.1 | Pyramat | OK |
| SPRD-20b | 0.3 | 2.5 | 1.5:1 | 1.0 | 2.6 | 13.1 | Pyramat | OK |
| SPRD-21 | 0.81 | 3.5 | 1.75:1 | 0.67 | 8.5 | 24.4 | Pyramat | OK |

Notes: The ditches described above represent the section of ditch with the **least** capacity to handle runoff. It does not indicate the ditch configuration everywhere.



Revised: October, 2003

**STAR POINT MINE AS-BUILT RECLAMATION CHANNEL SUMMARY**
**10-YEAR 6-HOUR STORM EVENT**
**(PAGE 3 of 5)**

| Reclamation Channel | Peak Flow (cfs) | Bottom Width (ft) | Side Slopes (H:V) | Channel Depth (ft) | Min. Bottom Slope (%) | Max. Bottom Slope (%) | Erosion Control Riprap $D_{50}$ (in) or Pyramat | Status |
|---|---|---|---|---|---|---|---|---|
| SPRD-22a | 0.85 | 3.5 | 2.17:1 | 1.5 | 6.4 | 22.4 | 6 | OK |
| SPRD-23 | 2.30 | 3.0 | 1.67:1 | 1.5 | 28.5 | 54.1 | 6 | OK |
| SPRD-24 | 5.35 | 4.5 | 1.86:1 | 1.21 | 11.4 | 31.4 | 6 | OK |
| SPRD-25a | 0.78 | 2.0 | 1.71:1 | 1.17 | 21.4 | 61.0 | Pyramat | OK |
| SPRD-25b | 0.99 | 2.3 | 1.72:1 | 0.92 | 13.5 | 36.2 | Pyramat | OK |
| SPRD-26 | 1.40 | 3.0 | 1.64:1 | 0.67 | 10.3 | 49.2 | Pyramat | OK |
| SPRD-26a | 1.20 | 2.67 | 1.82:1 | 0.92 | 14.7 | 37.2 | Pyramat | OK |
| SPRD-27 | 0.09 | 3.5 | 1.15:1 | 1.08 | 11.8 | 36.5 | Pyramat | OK |
| SPRD-28 | 1.62 | 2.5 | 1.5:1 | 1.17 | 8.3 | 26.1 | Pyramat | OK |
| SPRD-29a | 4.72 | 3.5 | 3:1 | 1.0 | 12.9 | 46.9 | 9 | OK |
| SPRD-29b | 2.54 | 3.0 | 1.29:1 | 1.17 | 12.1 | 44.3 | Pyramat | OK |
| SPRD-30 | 1.67 | 3.0 | 1.5:1 | 1.0 | 18.6 | 45.7 | Pyramat | OK |
| SPRD-31 | 145.73@ | 12 | 2.27:1 | 3.42 | 2.9 | 14.1 | 12 | OK |
| SPRD-33 | 2.60 | 4.5 | 1.58:1 | 3.0 | 2.9 | 12.6 | 6 | OK |
| SPRD-35 | 7.80 | 2.5 | 2.7:1 | 0.83 | 6.4 | 21.2 | Pyramat | OK |

Notes: The ditches described above represent the section of ditch with the **least** capacity to handle runoff. It does not indicate the ditch configuration everywhere.

Reclamation channels SPRD-32, 34, 39, 41, 42, and 43 are in the Refuse Pile and Sub-soil Stockpile areas and are now part of the SCA permit

@ Peak flow for a 100-year 6-hour storm event since watershed is over 1 square mile



Revised: October, 2003

**STAR POINT MINE AS-BUILT RECLAMATION CHANNEL SUMMARY**
**10-YEAR 6-HOUR STORM EVENT**
**(PAGE 4 of 5)**

| Reclamation Channel | Peak Flow (cfs) | Bottom Width (ft) | Side Slopes (H:V) | Channel Depth (ft) | Min. Bottom Slope (%) | Max. Bottom Slope (%) | Erosion Control Riprap $D_{50}$ (in) or Pyramat | Status |
|---|---|---|---|---|---|---|---|---|
| SPRD-35a | 0.52 | 2.5 | 2.7:1 | 0.83 | 20.6 | 25.0 | Pyramat | OK |
| SPRD-36a | 1.57 | 3.0 | 2.18:1 | 0.92 | 9.1 | 30.8 | Pyramat | OK |
| SPRD-36b | Not built, see note on the last page of this table for explanation | | | | | | | |
| SPRD-37 | Not built, see note on the last page of this table for explanation | | | | | | | |
| SPRD-38 | Not built, see note on the last page of this table for explanation | | | | | | | |
| SPRD-40 | 1.44 | 2.5 | 1.25:1 | 0.92 | 15.9 | 37.5 | Pyramat | OK |
| SPRD-44 | 0.3 | 3.0 | 1.64:1 | 0.92 | 10.6 | 36.1 | Pyramat | OK |
| SPRD-45 | 0.35 | 2.5 | 1.5:1 | 1.0 | 8.3 | 31.9 | Pyramat | OK |
| Swale-17a | 0.61 | 6 | 13:1 and 32:1 | >0.5 | 1.0 | 5.0 | Sewer Rock | OK |
| Swale-17b | 0.18 | 6 | 24:1 and 19:1 | >0.5 | 1.0 | 5.0 | Sewer Rock | OK |
| Swale-18a | 0.22 | 8 | 24:1 and 19:1 | >0.5 | 1.0 | 5.0 | Sewer Rock | OK |
| Swale-19a | 0.22 | 10 | 16:1 and 24:1 | >0.5 | 1.0 | 5.0 | Sewer Rock | OK |
| Swale-19b | 0.22 | 8 | 13:1 and 32:1 | >0.5 | 1.0 | 5.0 | Sewer Rock | OK |
| Swale-20a | 0.30 | 10 | 32:1 and 24:1 | >0.5 | 1.0 | 5.0 | Sewer Rock | OK |
| Road Ditch | 0.58 | 0 | 1:1 and 4.5:1 | 0.67 | 1.0 | 4.3 | Roadbase | OK |

Notes: The ditches described above represent the section of ditch with the **least** capacity to handle runoff. It does not indicate the ditch configuration everywhere.

Reclamation channels SPRD-32, 34, 39, 41, 42, and 43 are in the Refuse Pile and Sub-soil Stockpile area and are now part of the SCA permit

SPRD-13 was not built because it was a section of channel after SPRD-10 and SPRD-12 combined in the design. These two channels never combined, hence SPRD-13 was not needed.



Revised: October, 2003

**STAR POINT MINE AS-BUILT RECLAMATION CHANNEL SUMMARY**
**10-YEAR 6-HOUR STORM EVENT**
**(PAGE 5 of 5)**

| Reclamation Channel | Peak Flow (cfs) | Bottom Width (ft) | Side Slopes (H:V) | Channel Depth (ft) | Min. Bottom Slope (%) | Max. Bottom Slope (%) | Erosion Control Riprap $D_{50}$ (in) or Pyramat | Status |
|---|---|---|---|---|---|---|---|---|
| SPRD-46 | 0.88 | 2.5 | 2.05:1 | 0.92 | 18.9 | 44.1 | Pyramat | OK |
| SPRD-47 &47a | 1.07 | 2.5 | 2.33:1 | 0.75 | 19.0 | 40.65 | Pyramat | OK |
| SPRD-48 | 0.14 | 2.5 | 1.58:1 | 1.00 | 24.5 | 43.6 | Pyramat | OK |
| SPRD-49 | 0.45 | 2.5 | 2.63:1 | 0.67 | 15.7 | 47.4 | Pyramat | OK |
| | | | | | | | | |

Notes: The ditches described above represent the section of ditch with the **least** capacity to handle runoff. It does not indicate the ditch configuration everywhere.

SPRD-36a was not constructed due to minimal drainage area. During construction it was decided that this channel should be moved to handle a larger drainage area. Hence, SPRD-35a was built instead of SPRD-36b.

SPRD-37 was not built due to an observation that due to a very low slope in the area no channel existed to tie reclamation channel SPRD-37 into. The railroad tracks have created a nearly flat area that caused runoff to spread out and drop its sediment load. Hence it was observed that the channel would fill with sediment within a short time due to the high sediment load of the runoff in this area. It was decided that there was no benefit in building a channel to convey the runoff an extra 300 feet and then letting the runoff spread out. Thus SPRD-37 was not built. The reclamation in this area was configured to promote spreading at the bottom of all side channels.

Four channels were designed to cut through the tramway. The four channels were built (SPRD-25a, 25b, 26, and 26a). However the location of these channels were changed during construction to be in areas where the channels would be most beneficial. Thus SPRD-38 was not built where shown on the design maps.

The short channels adjacent to the main channel such as SPRD-22b did not need to be built due to the width of the main channel. The main channel was simply widened slightly to allow runoff from the undisturbed drainage to flow directly into the main channel.

Channels SPRD-46, 47, 48, and 49 are new channels not include in the reclamation design.

# Pyromat Channel Min. Slope, Min. X-Section
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine As-builts |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.047 | Assuming well vegetated |
| Slope | 0.079000 ft/ft | |
| Left Side Slope | 1.03 H : V | |
| Right Side Slope | 1.03 H : V | |
| Bottom Width | 2.00 ft | |
| Discharge | 1.70 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.25 ft | < 0.67 |
| Flow Area | 0.6 ft² | |
| Wetted Perimeter | 2.70 ft | |
| Top Width | 2.50 ft | |
| Critical Depth | 0.27 ft | |
| Critical Slope | 0.057801 ft/ft | |
| Velocity | 3.08 ft/s | |
| Velocity Head | 0.15 ft | |
| Specific Energy | 0.39 ft | |
| Froude Number | 1.16 | |
| Flow Type | Supercritical | |

Freeboard = 0.42' = 5"

# Pyromat Channel Max. Slope, Min. X-Section
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine As-builts |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.025 | Assuming no vegetation |
| Slope | 0.680000 ft/ft | |
| Left Side Slope | 1.03 H : V | |
| Right Side Slope | 1.03 H : V | |
| Bottom Width | 2.00 ft | |
| Discharge | 1.70 cfs | |

| Results | |
|---|---|
| Depth | 0.09 ft |
| Flow Area | 0.2 ft² |
| Wetted Perimeter | 2.25 ft |
| Top Width | 2.18 ft |
| Critical Depth | 0.27 ft |
| Critical Slope | 0.016354 ft/ft |
| Velocity | 9.23 ft/s → non-vegetated maximum velocity |
| Velocity Head | 1.32 ft |
| Specific Energy | 1.41 ft |
| Froude Number | 5.60 |
| Flow Type | Supercritical |

short term (½ hr) = 20 ft/s

long term (50 hrs) = 10 ft/s

See pages 91 and 93

# SPRD-10 Min, Slope, Vegetated, Pyramat
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.047 | vegetated |
| Slope | 0.171000 | ft/ft |
| Left Side Slope | 2.72 | H : V |
| Right Side Slope | 2.72 | H : V |
| Bottom Width | 7.00 | ft |
| Discharge | 0.57 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.05 | ft < 0.92 |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 7.27 | ft |
| Top Width | 7.26 | ft |
| Critical Depth | 0.06 | ft |
| Critical Slope | 0.083803 | ft/ft |
| Velocity | 1.69 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 0.09 | ft |
| Froude Number | 1.38 | |
| Flow Type | Supercritical | |

freeboard = 0.87

# SPRD-10 Max, Slope, Unvegetated, Pyramat
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.025 | unvegetated |
| Slope | 0.436000 | ft/ft |
| Left Side Slope | 2.72 | H : V |
| Right Side Slope | 2.72 | H : V |
| Bottom Width | 7.00 | ft |
| Discharge | 0.57 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.02 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 7.14 | ft |
| Top Width | 7.13 | ft |
| Critical Depth | 0.06 | ft |
| Critical Slope | 0.023705 | ft/ft |
| Velocity | 3.29 | ft/s < 10 fps |
| Velocity Head | 0.17 | ft |
| Specific Energy | 0.19 | ft |
| Froude Number | 3.72 | |
| Flow Type | Supercritical | |

# SPRD-20b Min Slope, Vegetated Pyramat
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.047 | vegetated |
| Slope | 0.026000 | ft/ft |
| Left Side Slope | 1.50 | H : V |
| Right Side Slope | 1.50 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 0.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.10 ft | < 1.0' |
| Flow Area | 0.3 ft² | |
| Wetted Perimeter | 2.88 ft | |
| Top Width | 2.81 ft | |
| Critical Depth | 0.08 ft | |
| Critical Slope | 0.079031 ft/ft | |
| Velocity | 1.08 ft/s | |
| Velocity Head | 0.02 ft | |
| Specific Energy | 0.12 ft | |
| Froude Number | 0.60 | |
| Flow Type | Subcritical | |

freeboard = 0.9'


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# SPRD-20b Max Slope, Unvegetated Pyramat
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.025 | unvegetated |
| Slope | 0.131000 | ft/ft |
| Left Side Slope | 1.50 | H : V |
| Right Side Slope | 1.50 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 0.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.04 | ft |
| Flow Area | 0.1 | ft² |
| Wetted Perimeter | 2.66 | ft |
| Top Width | 2.63 | ft |
| Critical Depth | 0.08 | ft |
| Critical Slope | 0.022360 | ft/ft |
| Velocity | 2.63 | ft/s << 10 fps |
| Velocity Head | 0.11 | ft |
| Specific Energy | 0.15 | ft |
| Froude Number | 2.23 | |
| Flow Type | Supercritical | |


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# SPRD-29b Min Slope, Vegetated Pyramat
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | |
|---|---|
| Mannings Coefficient | 0.047 Vegetated |
| Slope | 0.121000 ft/ft |
| Left Side Slope | 1.29 H : V |
| Right Side Slope | 1.29 H : V |
| Bottom Width | 3.00 ft |
| Discharge | 2.54 cfs |

| Results | |
|---|---|
| Depth | 0.21 ft < 1.17 |
| Flow Area | 0.7 ft² |
| Wetted Perimeter | 3.70 ft |
| Top Width | 3.55 ft |
| Critical Depth | 0.27 ft |
| Critical Slope | 0.054918 ft/ft |
| Velocity | 3.63 ft/s |
| Velocity Head | 0.20 ft |
| Specific Energy | 0.42 ft |
| Froude Number | 1.44 |
| Flow Type | Supercritical |

freeboard = .96'

# SPRD-29b Max Slope, Unvegetated Pyramat
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.025 | unvegetated |
| Slope | 0.443000 | ft/ft |
| Left Side Slope | 1.29 | H : V |
| Right Side Slope | 1.29 | H : V |
| Bottom Width | 3.00 | ft |
| Discharge | 2.54 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.10 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 3.32 | ft |
| Top Width | 3.26 | ft |
| Critical Depth | 0.27 | ft |
| Critical Slope | 0.015538 | ft/ft |
| Velocity | 8.16 | ft/s < 10 fps |
| Velocity Head | 1.03 | ft |
| Specific Energy | 1.13 | ft |
| Froude Number | 4.65 | |
| Flow Type | Supercritical | |

# SPRD-35 Min. Slope, Vegetated Pyramat
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.047 | Vegetated |
| Slope | 0.064000 | ft/ft |
| Left Side Slope | 2.70 | H : V |
| Right Side Slope | 2.70 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 7.80 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.50 | ft < |
| Flow Area | 1.9 | ft² |
| Wetted Perimeter | 5.39 | ft |
| Top Width | 5.21 | ft |
| Critical Depth | 0.55 | ft |
| Critical Slope | 0.045831 | ft/ft |
| Velocity | 4.04 | ft/s |
| Velocity Head | 0.25 | ft |
| Specific Energy | 0.75 | ft |
| Froude Number | 1.17 | |
| Flow Type | Supercritical | |

# SPRD-35 Max. Slope, Unvegetated Pyramat
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.025 | unvegetated |
| Slope | 0.212000 | ft/ft |
| Left Side Slope | 2.70 | H : V |
| Right Side Slope | 2.70 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 7.80 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.26 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 3.98 | ft |
| Top Width | 3.88 | ft |
| Critical Depth | 0.55 | ft |
| Critical Slope | 0.012967 | ft/ft |
| Velocity | 9.54 | ft/s < 10 fps ok |
| Velocity Head | 1.41 | ft |
| Specific Energy | 1.67 | ft |
| Froude Number | 3.66 | |
| Flow Type | Supercritical | |

# SPRD-8 Min. Slope
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.045 | $D_{50} = 9''$ |
| Slope | 0.108000 ft/ft | |
| Left Side Slope | 1.69 H : V | |
| Right Side Slope | 1.69 H : V | |
| Bottom Width | 5.50 ft | |
| Discharge | 1.21 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.10 ft | < 1.37' freeboard = 1.23' |
| Flow Area | 0.5 ft² | |
| Wetted Perimeter | 5.88 ft | |
| Top Width | 5.83 ft | |
| Critical Depth | 0.11 ft | |
| Critical Slope | 0.063652 ft/ft | |
| Velocity | 2.21 ft/s | |
| Velocity Head | 0.08 ft | |
| Specific Energy | 0.17 ft | |
| Froude Number | 1.27 | |
| Flow Type | Supercritical | |

# SPRD-8 Max. Slope
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.060 | $n = 0.0456 (0.645 \times 9)^{0.159} = 0.06$ |
| Slope | 0.645000 ft/ft | $D_{50} = 9''$ |
| Left Side Slope | 1.69 H : V | |
| Right Side Slope | 1.69 H : V | |
| Bottom Width | 5.50 ft | |
| Discharge | 1.21 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.07 ft | |
| Flow Area | 0.4 ft² | |
| Wetted Perimeter | 5.76 ft | |
| Top Width | 5.73 ft | |
| Critical Depth | 0.11 ft | |
| Critical Slope | 0.112289 ft/ft | |
| Velocity | 3.21 ft/s | < 9 fps |
| Velocity Head | 0.16 ft | |
| Specific Energy | 0.23 ft | |
| Froude Number | 2.21 | |
| Flow Type | Supercritical | |

# SPRD-10 Min. Slope
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.050 | $D_{50}$ = 9" |
| Slope | 0.200000 ft/ft | |
| Left Side Slope | 1.78 H : V | |
| Right Side Slope | 1.78 H : V | |
| Bottom Width | 2.50 ft | |
| Discharge | 0.57 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.09 ft | < 1.13' freeboard = 1.04' |
| Flow Area | 0.2 ft² | |
| Wetted Perimeter | 2.85 ft | |
| Top Width | 2.81 ft | |
| Critical Depth | 0.11 ft | |
| Critical Slope | 0.079377 ft/ft | |
| Velocity | 2.48 ft/s | < 9 fps ok |
| Velocity Head | 0.10 ft | |
| Specific Energy | 0.18 ft | |
| Froude Number | 1.52 | |
| Flow Type | Supercritical | |


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# SPRD-10 Max. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.056 | $D_{50} = 9''$ |
| Slope | 0.402000 ft/ft | |
| Left Side Slope | 1.78 H : V | |
| Right Side Slope | 1.78 H : V | |
| Bottom Width | 2.50 ft | |
| Discharge | 0.57 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.08 ft | |
| Flow Area | 0.2 ft² | |
| Wetted Perimeter | 2.81 ft | |
| Top Width | 2.77 ft | |
| Critical Depth | 0.11 ft | |
| Critical Slope | 0.098816 ft/ft | |
| Velocity | 2.88 ft/s | < 9 fps OK |
| Velocity Head | 0.13 ft | |
| Specific Energy | 0.20 ft | |
| Froude Number | 1.90 | |
| Flow Type | Supercritical | |

# SPRD-12 Min. Slope
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.051 | $D_{50}$ = 9" |
| Slope | 0.225000 ft/ft | |
| Left Side Slope | 2.54 H : V | |
| Right Side Slope | 2.54 H : V | |
| Bottom Width | 3.50 ft | |
| Discharge | 0.92 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.09 ft | < 1.08' freeboard = 0.99' ok |
| Flow Area | 0.3 ft² | |
| Wetted Perimeter | 4.00 ft | |
| Top Width | 3.97 ft | |
| Critical Depth | 0.13 ft | |
| Critical Slope | 0.079033 ft/ft | |
| Velocity | 2.69 ft/s | |
| Velocity Head | 0.11 ft | |
| Specific Energy | 0.20 ft | |
| Froude Number | 1.61 | |
| Flow Type | Supercritical | |

# SPRD-12 Max. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.057 | $D_{50} = 9''$ |
| Slope | 0.441000 ft/ft | |
| Left Side Slope | 2.54 H : V | |
| Right Side Slope | 2.54 H : V | |
| Bottom Width | 3.50 ft | |
| Discharge | 0.92 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.08 ft | |
| Flow Area | 0.3 ft² | |
| Wetted Perimeter | 3.94 ft | |
| Top Width | 3.91 ft | |
| Critical Depth | 0.13 ft | |
| Critical Slope | 0.098032 ft/ft | |
| Velocity | 3.10 ft/s | < 9 fps ok |
| Velocity Head | 0.15 ft | |
| Specific Energy | 0.23 ft | |
| Froude Number | 1.98 | |
| Flow Type | Supercritical | |

# SPRD-22a Min. Slope
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.039 | $D_{50}$ = 6" |
| Slope | 0.064000 ft/ft | |
| Left Side Slope | 2.17 H : V | |
| Right Side Slope | 2.17 H : V | |
| Bottom Width | 3.50 ft | |
| Discharge | 0.85 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.11 ft | < 1.5' freeboard = 0.139' ok |
| Flow Area | 0.4 ft² | |
| Wetted Perimeter | 4.02 ft | |
| Top Width | 3.97 ft | |
| Critical Depth | 0.12 ft | |
| Critical Slope | 0.047556 ft/ft | |
| Velocity | 2.08 ft/s | |
| Velocity Head | 0.07 ft | |
| Specific Energy | 0.18 ft | |
| Froude Number | 1.14 | |
| Flow Type | Supercritical | |

# SPRD-22a Max. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.048 | $D_{50}$ = 6" |
| Slope | 0.224000 ft/ft | |
| Left Side Slope | 2.17 H : V | |
| Right Side Slope | 2.17 H : V | |
| Bottom Width | 3.50 ft | |
| Discharge | 0.85 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.08 ft | |
| Flow Area | 0.3 ft² | |
| Wetted Perimeter | 3.90 ft | |
| Top Width | 3.87 ft | |
| Critical Depth | 0.12 ft | |
| Critical Slope | 0.070351 ft/ft | |
| Velocity | 2.73 ft/s | < 7.5 fps ok |
| Velocity Head | 0.12 ft | |
| Specific Energy | 0.20 ft | |
| Froude Number | 1.69 | |
| Flow Type | Supercritical | |

# SPRD-24 Min. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.043 | $D_{50} = 6''$ |
| Slope | 0.114000 ft/ft | |
| Left Side Slope | 1.86 H : V | |
| Right Side Slope | 1.86 H : V | |
| Bottom Width | 4.50 ft | |
| Discharge | 5.35 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.25 ft | < 1.21' freeboard = 0.96' ok |
| Flow Area | 1.2 ft² | |
| Wetted Perimeter | 5.56 ft | |
| Top Width | 5.43 ft | |
| Critical Depth | 0.34 ft | |
| Critical Slope | 0.041658 ft/ft | |
| Velocity | 4.31 ft/s | |
| Velocity Head | 0.29 ft | |
| Specific Energy | 0.54 ft | |
| Froude Number | 1.59 | |
| Flow Type | Supercritical | |

# SPRD-23 Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | |
|---|---|
| Mannings Coefficient | 0.055 $D_{50} = 6''$ |
| Slope | 0.541000 ft/ft |
| Left Side Slope | 1.67 H : V |
| Right Side Slope | 1.67 H : V |
| Bottom Width | 3.00 ft |
| Discharge | 2.30 cfs |

| Results | |
|---|---|
| Depth | 0.14 ft |
| Flow Area | 0.5 ft² |
| Wetted Perimeter | 3.55 ft |
| Top Width | 3.47 ft |
| Critical Depth | 0.25 ft |
| Critical Slope | 0.076158 ft/ft |
| Velocity | 5.05 ft/s < 7.5 fps ok |
| Velocity Head | 0.40 ft |
| Specific Energy | 0.54 ft |
| Froude Number | 2.46 |
| Flow Type | Supercritical |


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# SPRD-23 Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.050 | $D_{50}$ = 6" |
| Slope | 0.285000 ft/ft | |
| Left Side Slope | 1.67 H : V | |
| Right Side Slope | 1.67 H : V | |
| Bottom Width | 3.00 ft | |
| Discharge | 2.30 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.16 ft | < 1.5' |
| Flow Area | 0.5 ft² | |
| Wetted Perimeter | 3.62 ft | |
| Top Width | 3.53 ft | |
| Critical Depth | 0.25 ft | |
| Critical Slope | 0.062088 ft/ft | |
| Velocity | 4.40 ft/s | |
| Velocity Head | 0.30 ft | |
| Specific Energy | 0.46 ft | |
| Froude Number | 2.01 | |
| Flow Type | Supercritical | |

freeboard = 1.34'

# SPRD-24 Max. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.050 | $D_{50} = 6''$ |
| Slope | 0.314000 ft/ft | |
| Left Side Slope | 1.86 H : V | |
| Right Side Slope | 1.86 H : V | |
| Bottom Width | 4.50 ft | |
| Discharge | 5.35 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.20 ft | |
| Flow Area | 1.0 ft² | |
| Wetted Perimeter | 5.36 ft | |
| Top Width | 5.26 ft | |
| Critical Depth | 0.34 ft | |
| Critical Slope | 0.057497 ft/ft | |
| Velocity | 5.38 ft/s | < 7.5 fps ok |
| Velocity Head | 0.45 ft | |
| Specific Energy | 0.65 ft | |
| Froude Number | 2.18 | |
| Flow Type | Supercritical | |

# SPRD-29a Min. Slope
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.047 | $D_{50} = 9''$ |
| Slope | 0.129000 ft/ft | |
| Left Side Slope | 3.00 H : V | |
| Right Side Slope | 3.00 H : V | |
| Bottom Width | 3.50 ft | |
| Discharge | 4.72 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.26 ft | < 1.0' freeboard = 0.74' ok |
| Flow Area | 1.1 ft² | |
| Wetted Perimeter | 5.17 ft | |
| Top Width | 5.09 ft | |
| Critical Depth | 0.35 ft | |
| Critical Slope | 0.049801 ft/ft | |
| Velocity | 4.16 ft/s | |
| Velocity Head | 0.27 ft | |
| Specific Energy | 0.53 ft | |
| Froude Number | 1.55 | |
| Flow Type | Supercritical | |

# SPRD-29a Max. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.057 | $D_{50} = 9''$ |
| Slope | 0.469000 ft/ft | |
| Left Side Slope | 3.00 H : V | |
| Right Side Slope | 3.00 H : V | |
| Bottom Width | 3.50 ft | |
| Discharge | 4.72 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.20 ft | |
| Flow Area | 0.8 ft² | |
| Wetted Perimeter | 4.80 ft | |
| Top Width | 4.73 ft | |
| Critical Depth | 0.35 ft | |
| Critical Slope | 0.074192 ft/ft | |
| Velocity | 5.60 ft/s | < 9 fps ok |
| Velocity Head | 0.49 ft | |
| Specific Energy | 0.69 ft | |
| Froude Number | 2.34 | |
| Flow Type | Supercritical | |


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# SPRD-31 Min. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.039 | $D_{50}$ = 12" |
| Slope | 0.029000 | ft/ft |
| Left Side Slope | 2.27 | H : V |
| Right Side Slope | 2.27 | H : V |
| Bottom Width | 12.00 | ft |
| Discharge | 145.73 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.38 | ft < 3.42' |
| Flow Area | 20.8 | ft² |
| Wetted Perimeter | 18.82 | ft |
| Top Width | 18.24 | ft |
| Critical Depth | 1.50 | ft |
| Critical Slope | 0.021174 | ft/ft |
| Velocity | 7.01 | ft/s |
| Velocity Head | 0.76 | ft |
| Specific Energy | 2.14 | ft |
| Froude Number | 1.16 | |
| Flow Type | Supercritical | |

freeboard = 2.04'


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# SPRD-31 Max. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.050 | $D_{50}$ = 12" |
| Slope | 0.141000 ft/ft | |
| Left Side Slope | 2.27 H : V | |
| Right Side Slope | 2.27 H : V | |
| Bottom Width | 12.00 ft | |
| Discharge | 145.73 cfs | |

| Results | | |
|---|---|---|
| Depth | 1.01 ft | |
| Flow Area | 14.4 ft² | |
| Wetted Perimeter | 17.01 ft | |
| Top Width | 16.59 ft | |
| Critical Depth | 1.50 ft | |
| Critical Slope | 0.034962 ft/ft | |
| Velocity | 10.09 ft/s | < 10.45 fps ok |
| Velocity Head | 1.58 ft | |
| Specific Energy | 2.59 ft | |
| Froude Number | 1.91 | |
| Flow Type | Supercritical | |

# SPRD-33 Min. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.035 | $D_{50} = 6''$ |
| Slope | 0.029000 ft/ft | |
| Left Side Slope | 1.58 H : V | |
| Right Side Slope | 1.58 H : V | |
| Bottom Width | 4.50 ft | |
| Discharge | 2.60 cfs | |

| Results | | |
|---|---|---|
| Depth | 0.22 ft | < 3.0' freeboard = 2.78' |
| Flow Area | 1.0 ft² | |
| Wetted Perimeter | 5.31 ft | |
| Top Width | 5.18 ft | |
| Critical Depth | 0.21 ft | |
| Critical Slope | 0.030667 ft/ft | |
| Velocity | 2.48 ft/s | |
| Velocity Head | 0.10 ft | |
| Specific Energy | 0.31 ft | |
| Froude Number | 0.97 | |
| Flow Type | Subcritical | |

# SPRD-33 Max. Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.044 | $D_{50} = 6''$ |
| Slope | 0.126000 | ft/ft |
| Left Side Slope | 1.58 | H : V |
| Right Side Slope | 1.58 | H : V |
| Bottom Width | 4.50 | ft |
| Discharge | 2.60 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.16 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 5.10 | ft |
| Top Width | 5.01 | ft |
| Critical Depth | 0.21 | ft |
| Critical Slope | 0.048977 | ft/ft |
| Velocity | 3.41 | ft/s < 7 fps ∴ OK |
| Velocity Head | 0.18 | ft |
| Specific Energy | 0.34 | ft |
| Froude Number | 1.54 | |
| Flow Type | Supercritical | |

# Swale 17a Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 13.00 | H : V |
| Right Side Slope | 32.00 | H : V |
| Bottom Width | 6.00 | ft |
| Discharge | 0.61 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.09 | ft < 0.5" freeboard = 0.41' |
| Flow Area | 0.7 | ft² |
| Wetted Perimeter | 10.03 | ft |
| Top Width | 10.02 | ft |
| Critical Depth | 0.06 | ft |
| Critical Slope | 0.034949 | ft/ft |
| Velocity | 0.85 | ft/s |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.10 | ft |
| Froude Number | 0.56 | |
| Flow Type | Subcritical | |

# Swale 17a Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.050000 | ft/ft |
| Left Side Slope | 13.00 | H : V |
| Right Side Slope | 32.00 | H : V |
| Bottom Width | 6.00 | ft |
| Discharge | 0.61 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.06 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 8.57 | ft |
| Top Width | 8.56 | ft |
| Critical Depth | 0.06 | ft |
| Critical Slope | 0.034949 | ft/ft |
| Velocity | 1.47 | ft/s < 5 for ok |
| Velocity Head | 0.03 | ft |
| Specific Energy | 0.09 | ft |
| Froude Number | 1.18 | |
| Flow Type | Supercritical | |

# Swale 17b Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 24.00 | H : V |
| Right Side Slope | 19.00 | H : V |
| Bottom Width | 6.00 | ft |
| Discharge | 0.18 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.04 | ft < 0.5' freeboard = 0.46' ok |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 7.94 | ft |
| Top Width | 7.93 | ft |
| Critical Depth | 0.03 | ft |
| Critical Slope | 0.043870 | ft/ft |
| Velocity | 0.57 | ft/s |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.05 | ft |
| Froude Number | 0.51 | |
| Flow Type | Subcritical | |

# Swale 17b Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.050000 | ft/ft |
| Left Side Slope | 24.00 | H : V |
| Right Side Slope | 19.00 | H : V |
| Bottom Width | 6.00 | ft |
| Discharge | 0.18 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.03 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 7.21 | ft |
| Top Width | 7.21 | ft |
| Critical Depth | 0.03 | ft |
| Critical Slope | 0.043870 | ft/ft |
| Velocity | 0.97 | ft/s < 5 fps ok |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.04 | ft |
| Froude Number | 1.06 | |
| Flow Type | Supercritical | |

# Swale 18a Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 24.00 | H : V |
| Right Side Slope | 19.00 | H : V |
| Bottom Width | 8.00 | ft |
| Discharge | 0.22 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.04 | ft < 0.5' freeboard = 0.46' ok |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 9.86 | ft |
| Top Width | 9.86 | ft |
| Critical Depth | 0.03 | ft |
| Critical Slope | 0.044223 | ft/ft |
| Velocity | 0.57 | ft/s |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.05 | ft |
| Froude Number | 0.51 | |
| Flow Type | Subcritical | |

# Swale 18a Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | |
|---|---|
| Mannings Coefficient | 0.030 |
| Slope | 0.050000 ft/ft |
| Left Side Slope | 24.00 H : V |
| Right Side Slope | 19.00 H : V |
| Bottom Width | 8.00 ft |
| Discharge | 0.22 cfs |

| Results | |
|---|---|
| Depth | 0.03 ft |
| Flow Area | 0.2 ft² |
| Wetted Perimeter | 9.16 ft |
| Top Width | 9.16 ft |
| Critical Depth | 0.03 ft |
| Critical Slope | 0.044223 ft/ft |
| Velocity | 0.95 ft/s < 5.0 fps ok |
| Velocity Head | 0.01 ft |
| Specific Energy | 0.04 ft |
| Froude Number | 1.06 |
| Flow Type | Supercritical |


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# Swale 19a Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 16.00 | H : V |
| Right Side Slope | 24.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 0.22 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.04 | ft < 0.5' freeboard = 0.46' ok |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 11.53 | ft |
| Top Width | 11.53 | ft |
| Critical Depth | 0.02 | ft |
| Critical Slope | 0.045988 | ft/ft |
| Velocity | 0.54 | ft/s |
| Velocity Head | 4.46e-3 | ft |
| Specific Energy | 0.04 | ft |
| Froude Number | 0.50 | |
| Flow Type | Subcritical | |

# Swale 19a Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.050000 | ft/ft |
| Left Side Slope | 16.00 | H : V |
| Right Side Slope | 24.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 0.22 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.02 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 10.95 | ft |
| Top Width | 10.95 | ft |
| Critical Depth | 0.02 | ft |
| Critical Slope | 0.045990 | ft/ft |
| Velocity | 0.89 | ft/s < 5 fps ok |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.04 | ft |
| Froude Number | 1.04 | |
| Flow Type | Supercritical | |

# Swale 19b Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 13.00 | H : V |
| Right Side Slope | 32.00 | H : V |
| Bottom Width | 8.00 | ft |
| Discharge | 0.22 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.04 ft | < 0.5' freeboard = 0.46' ok |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 9.94 | ft |
| Top Width | 9.94 | ft |
| Critical Depth | 0.03 | ft |
| Critical Slope | 0.044282 | ft/ft |
| Velocity | 0.57 | ft/s |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.05 | ft |
| Froude Number | 0.51 | |
| Flow Type | Subcritical | |

# Swale 19b Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.050000 | ft/ft |
| Left Side Slope | 13.00 | H : V |
| Right Side Slope | 32.00 | H : V |
| Bottom Width | 8.00 | ft |
| Discharge | 0.22 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.03 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 9.21 | ft |
| Top Width | 9.21 | ft |
| Critical Depth | 0.03 | ft |
| Critical Slope | 0.044282 | ft/ft |
| Velocity | 0.95 | ft/s < 5 fps ok |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.04 | ft |
| Froude Number | 1.06 | |
| Flow Type | Supercritical | |

# Swale 20a Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 32.00 | H : V |
| Right Side Slope | 24.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 0.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.05 | ft < 0.5' freeboard = 0.45' ok |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 12.54 | ft |
| Top Width | 12.54 | ft |
| Critical Depth | 0.03 | ft |
| Critical Slope | 0.043512 | ft/ft |
| Velocity | 0.59 | ft/s |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.05 | ft |
| Froude Number | 0.51 | |
| Flow Type | Subcritical | |

# Swale 20a Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.050000 | ft/ft |
| Left Side Slope | 32.00 | H : V |
| Right Side Slope | 24.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 0.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.03 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 11.59 | ft |
| Top Width | 11.59 | ft |
| Critical Depth | 0.03 | ft |
| Critical Slope | 0.043500 | ft/ft |
| Velocity | 0.98 | ft/s < 5 fps ok |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.04 | ft |
| Froude Number | 1.07 | |
| Flow Type | Supercritical | |

# Road Ditch Minimum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 1.00 | H : V |
| Right Side Slope | 4.50 | H : V |
| Bottom Width | 0.00 | ft |
| Discharge | 0.58 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.37 | ft < 0.67 |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 2.24 | ft |
| Top Width | 2.05 | ft |
| Critical Depth | 0.31 | ft |
| Critical Slope | 0.027628 | ft/ft |
| Velocity | 1.52 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 0.41 | ft |
| Froude Number | 0.62 | |
| Flow Type | Subcritical | |

freeboard = 0.3'
The road also slopes towards the ditch adding an additional 6" of depth. Thus there is plenty of freeboard. See Channel X-section sheet.


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# Road Ditch Maximum Slope
# Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | |
|---|---|
| Mannings Coefficient | 0.030 |
| Slope | 0.043000 ft/ft |
| Left Side Slope | 1.00 H : V |
| Right Side Slope | 4.50 H : V |
| Bottom Width | 0.00 ft |
| Discharge | 0.58 cfs |

| Results | |
|---|---|
| Depth | 0.28 ft |
| Flow Area | 0.2 ft² |
| Wetted Perimeter | 1.71 ft |
| Top Width | 1.56 ft |
| Critical Depth | 0.31 ft |
| Critical Slope | 0.027628 ft/ft |
| Velocity | 2.63 ft/s < 5.0 fps ∴ ok |
| Velocity Head | 0.11 ft |
| Specific Energy | 0.39 ft |
| Froude Number | 1.23 |
| Flow Type | Supercritical |

# Culvert Verification

There are two culverts under the county road installed during reclamation SPRC-22 and SPRC-44

## SPRC-22

$Q_{10-6}$ = 0.85 cfs
Diameter = 24"
mitred inlet.
HW/D = 2.0
Inlet capacity = 22 cfs page 84

Barrel Capacity = 12.25 cfs. See page 82

12.25 cfs >> 0.85 cfs ∴ ok

## SPRC-44

$Q_{10-6}$ = 0.65 cfs
Diameter = 24"
mitred inlet
HW/D = 1.5

Inlet capacity = 18 cfs page 84

Barrel Capacity = 17.3 cfs. See page 83

17.3 cfs >> 0.65 cfs ∴ ok

# SPRC-22 FULL FLOW CAPACITY
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Full Flow Capacity |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.024 | |
| Slope | 0.010000 | ft/ft |
| Diameter | 24 | in |

| Results | | |
|---|---|---|
| Depth | 2.00 | ft |
| Discharge | 12.25 | cfs >> 0.85 ∴ ok |
| Flow Area | 3.1 | ft² |
| Wetted Perimeter | 6.28 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 1.26 | ft |
| Percent Full | 100.0 | % |
| Critical Slope | 0.019219 | ft/ft |
| Velocity | 3.90 | ft/s |
| Velocity Head | 0.24 | ft |
| Specific Energy | 2.24 | ft |
| Froude Number | 0.00 | |
| Maximum Discharge | 13.18 | cfs |
| Discharge Full | 12.25 | cfs |
| Slope Full | 0.010000 | ft/ft |
| Flow Type | N/A | |

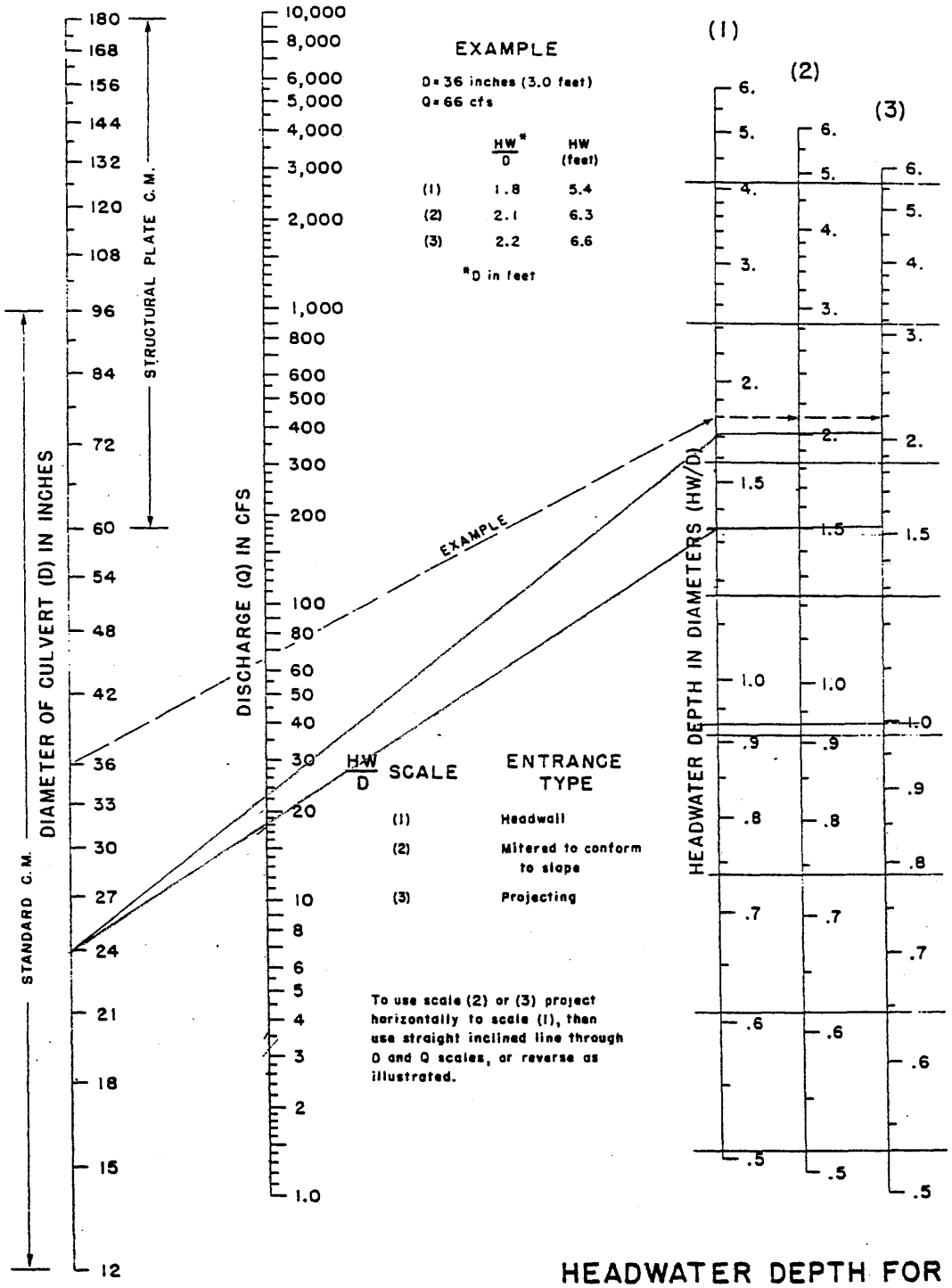
# SPRC-44 FULL FLOW CAPACITY
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | Star Point Mine Reclamation |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Full Flow Capacity |

| Input Data | |
|---|---|
| Mannings Coefficient | 0.024 |
| Slope | 0.020000 ft/ft |
| Diameter | 24 in |

| Results | |
|---|---|
| Depth | 2.00 ft |
| Discharge | 17.33 cfs >7 0.65 cfs ok |
| Flow Area | 3.1 ft² |
| Wetted Perimeter | 6.28 ft |
| Top Width | 0.00 ft |
| Critical Depth | 1.50 ft |
| Percent Full | 100.0 % |
| Critical Slope | 0.024032 ft/ft |
| Velocity | 5.52 ft/s |
| Velocity Head | 0.47 ft |
| Specific Energy | 2.47 ft |
| Froude Number | 0.00 |
| Maximum Discharge | 18.64 cfs |
| Discharge Full | 17.33 cfs |
| Slope Full | 0.020000 ft/ft |
| Flow Type | N/A |

# CHART 5

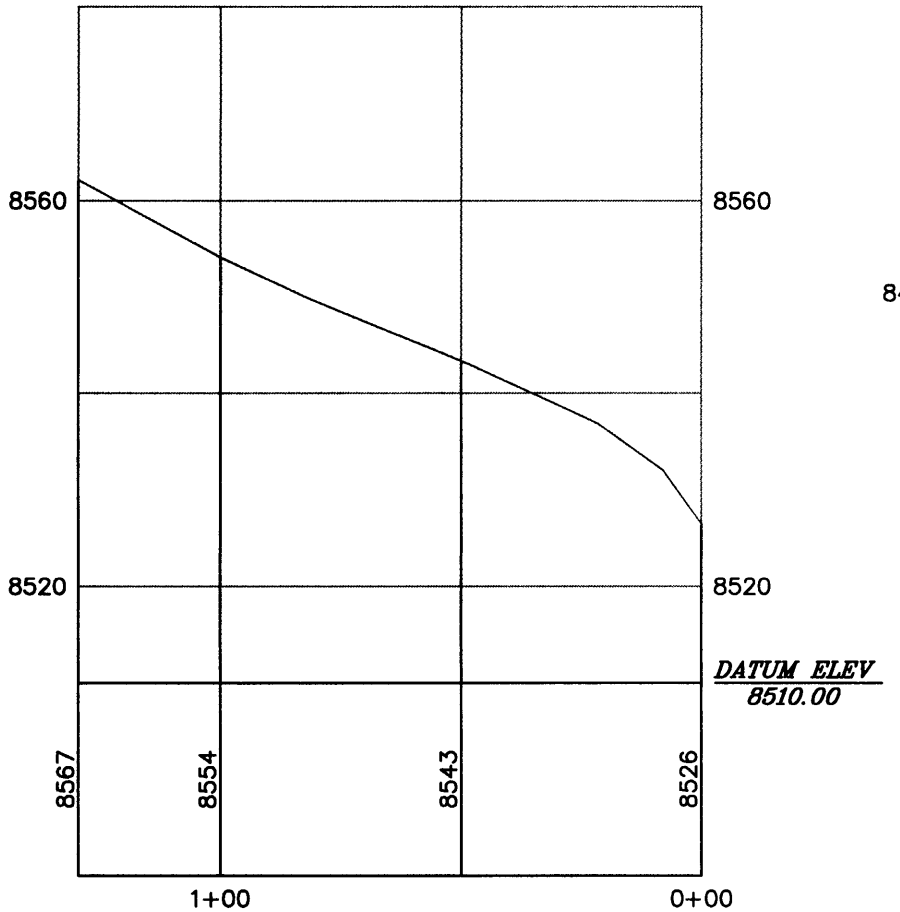



## HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

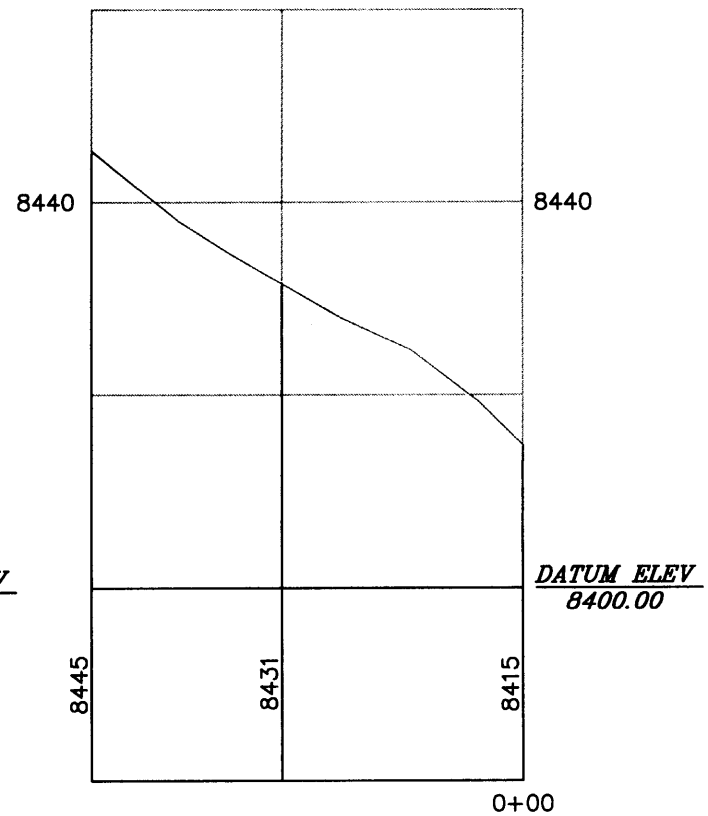


Ref (U.S. Dept. of Transportation, 1977)




PROFILE SPRD-1

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-1a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 1. AS-BUILT RECLAMATION CHANNEL PROFILES

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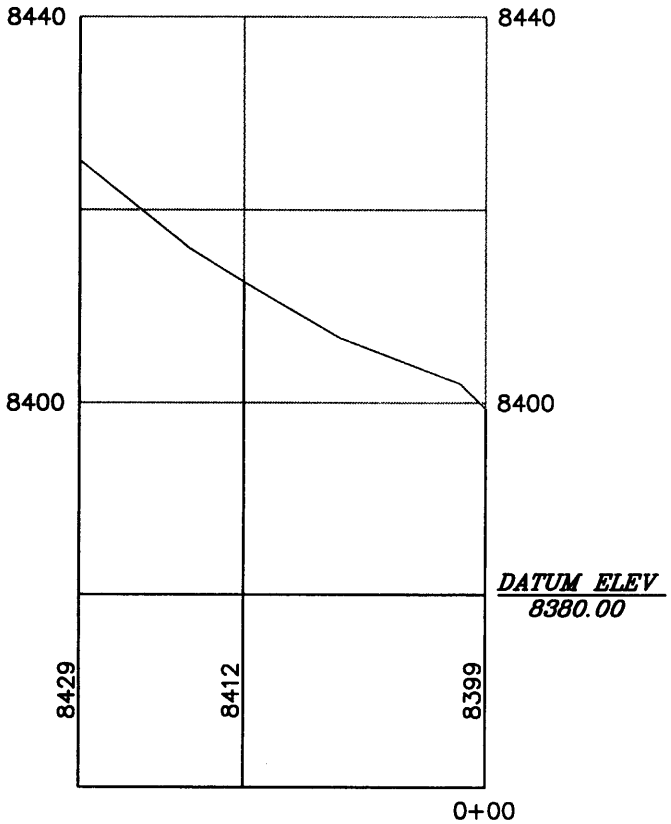
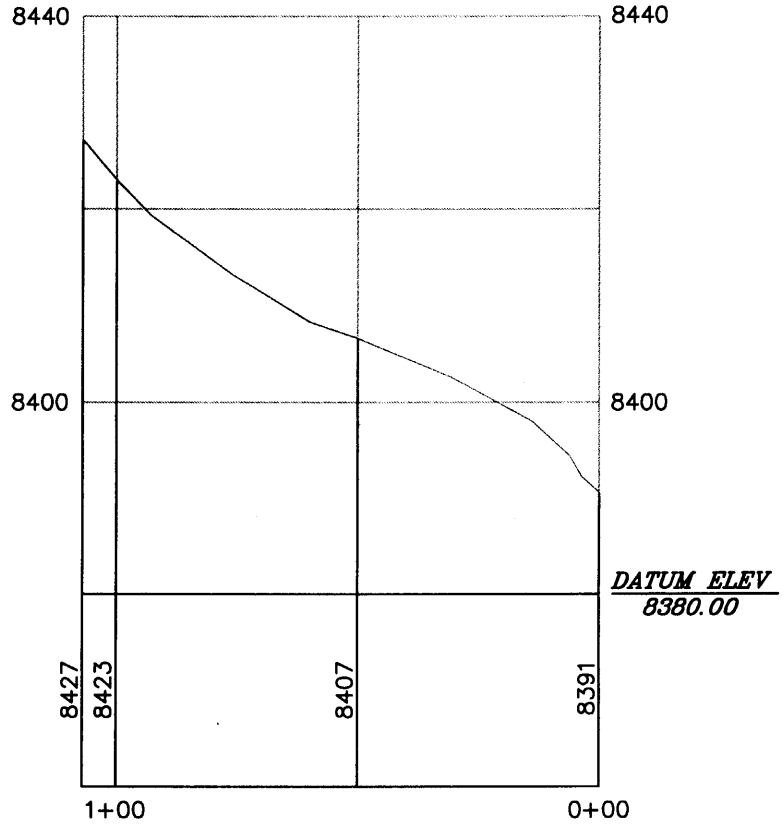



PROFILE SPRD-2

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-3

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 2. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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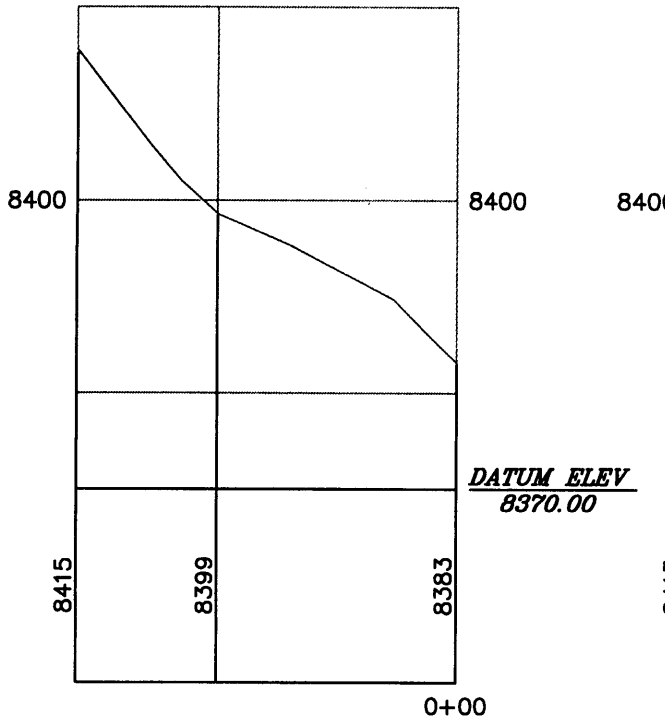
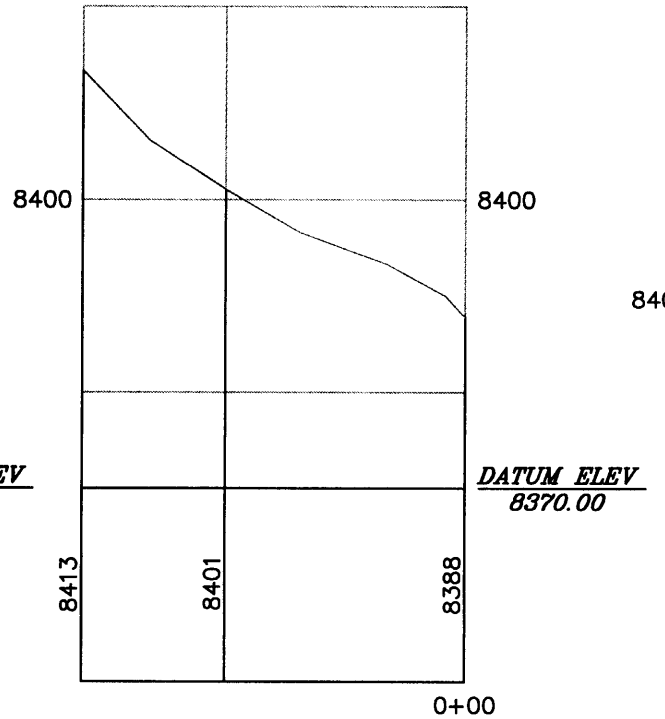


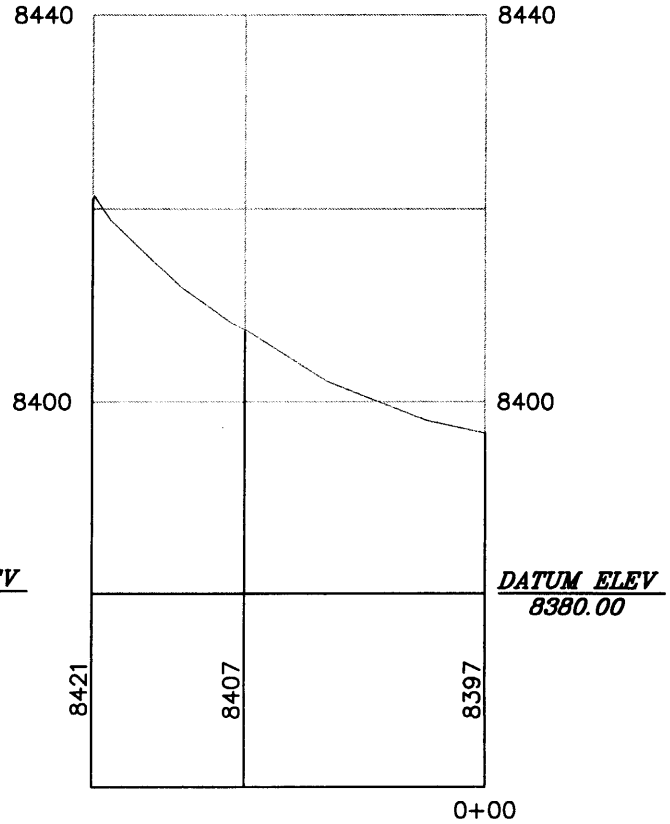

PROFILE SPRD-4a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-4b

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-5

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 3. AS-BUILT RECLAMATION CHANNEL PROFILES

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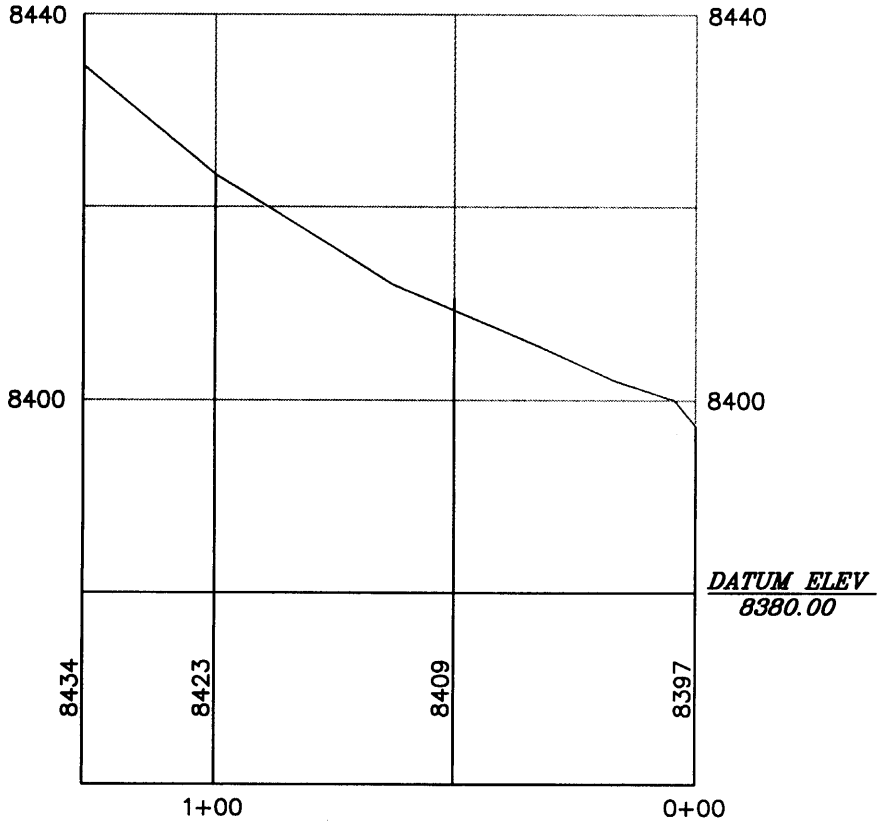
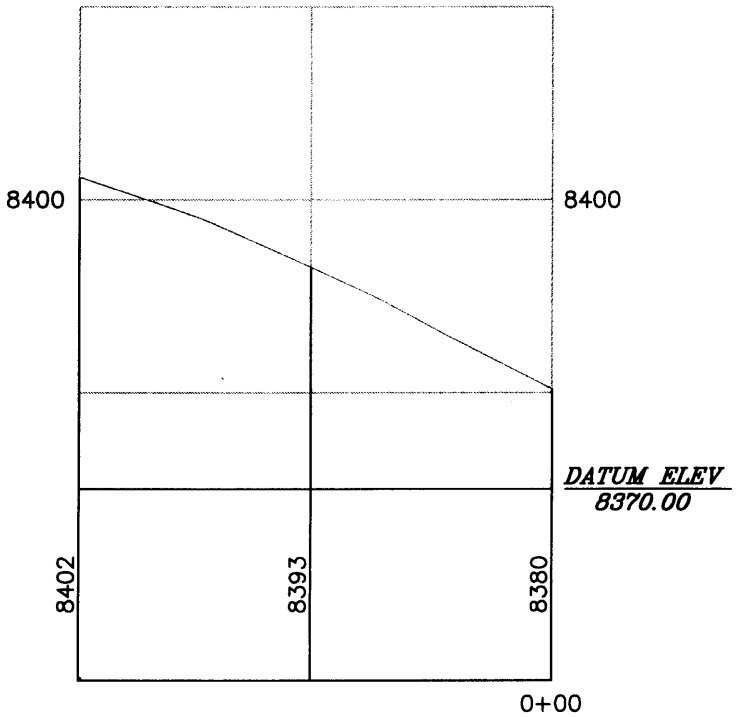



PROFILE SPRD-6

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-7

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 4. AS-BUILT RECLAMATION CHANNEL PROFILES

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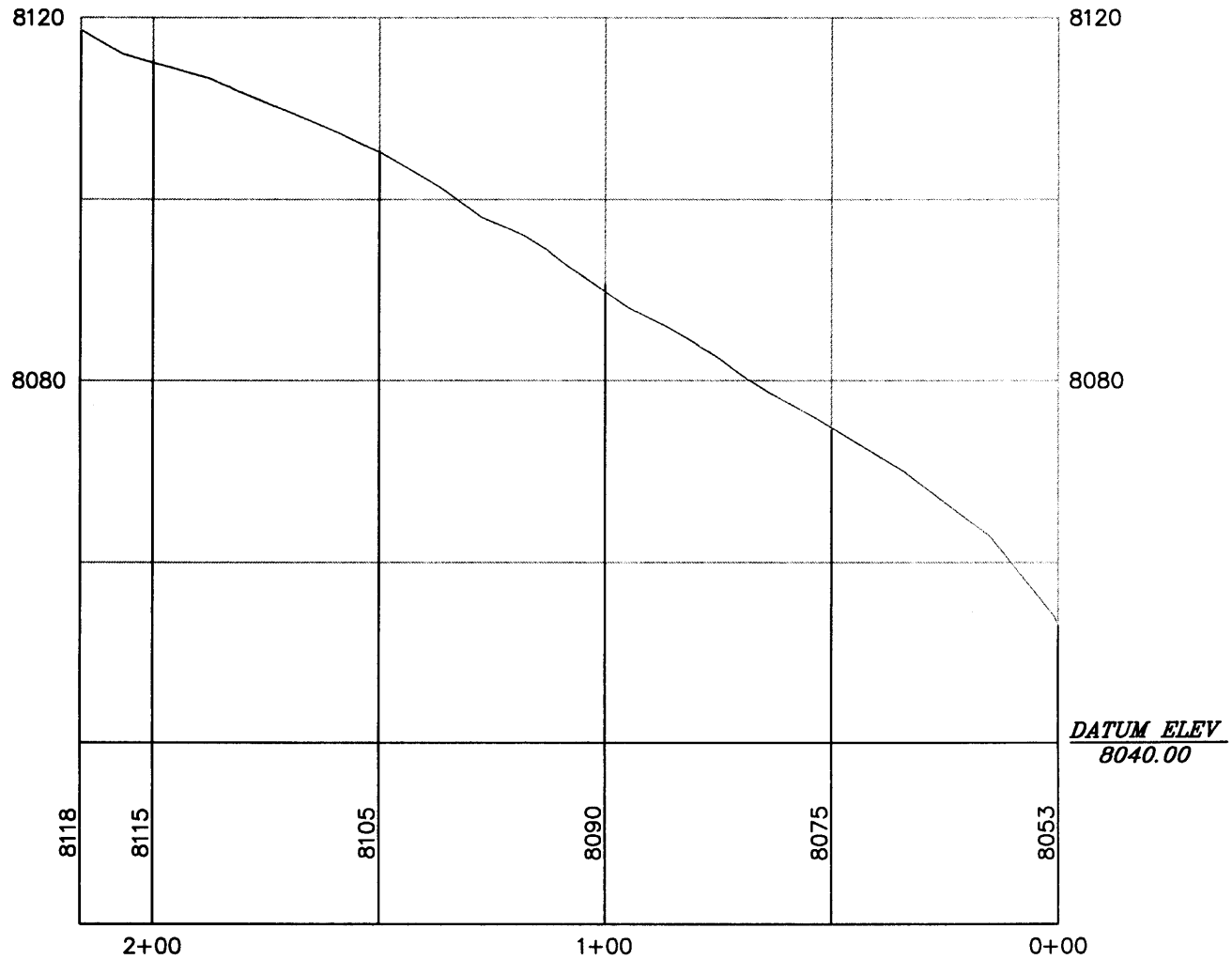


PROFILE SPRD-8

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 5. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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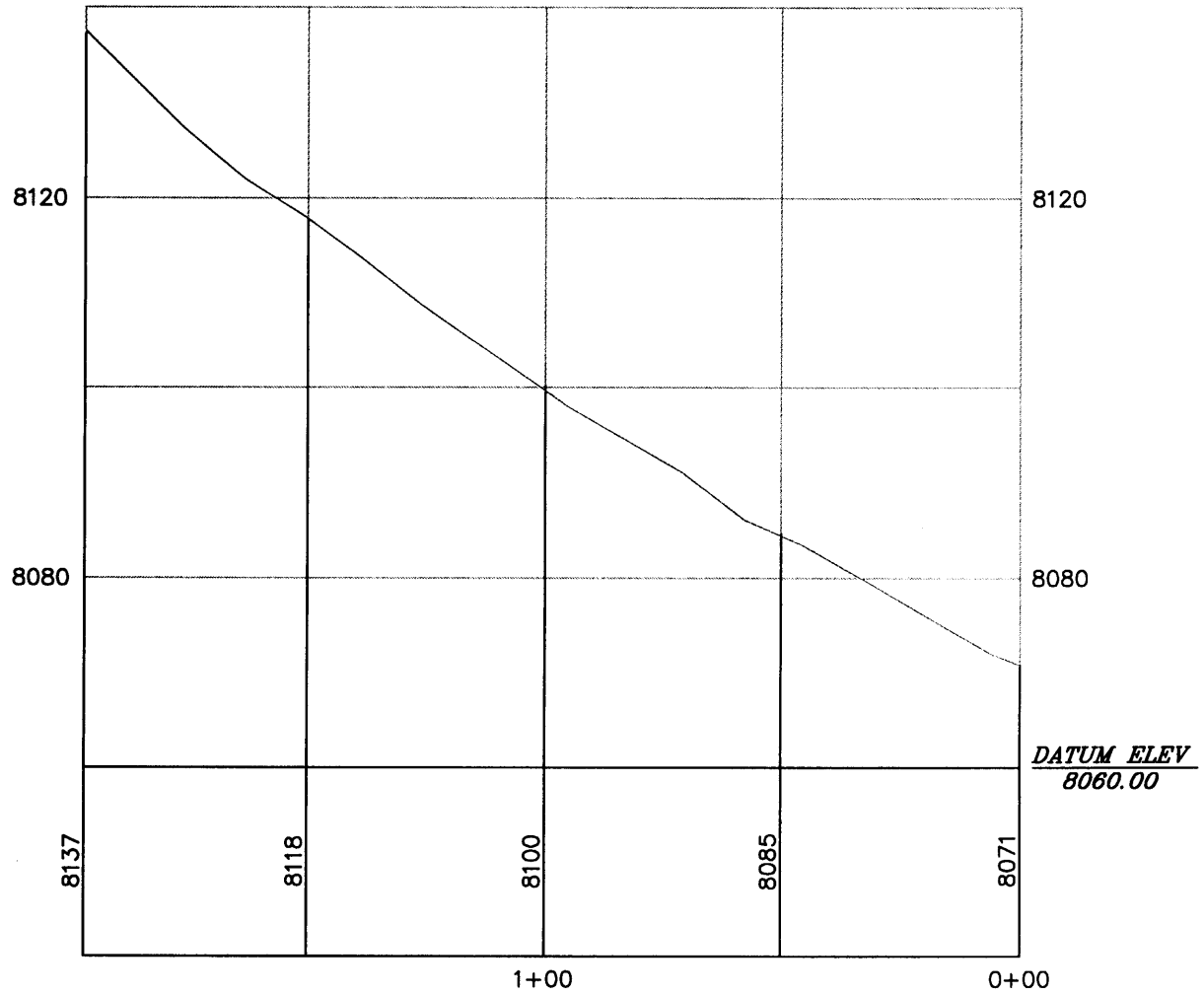


PROFILE SPRD-9

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 6. AS-BUILT RECLAMATION CHANNEL PROFILES

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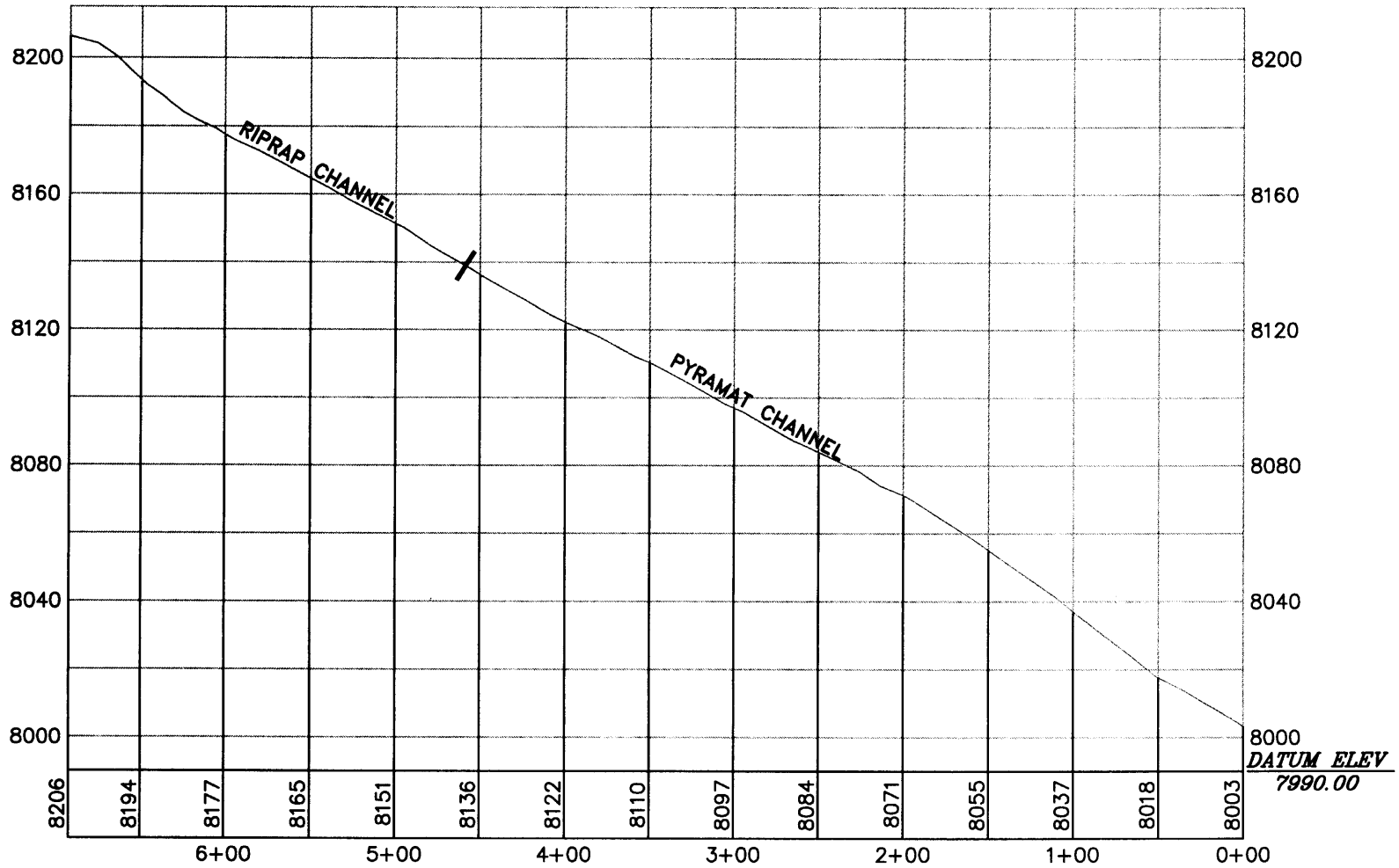


PROFILE SPRD-10

HORIZONTAL SCALE: 1=100'
VERTICAL SCALE: 1=50'

FIGURE 7. AS-BUILT RECLAMATION CHANNEL PROFILES

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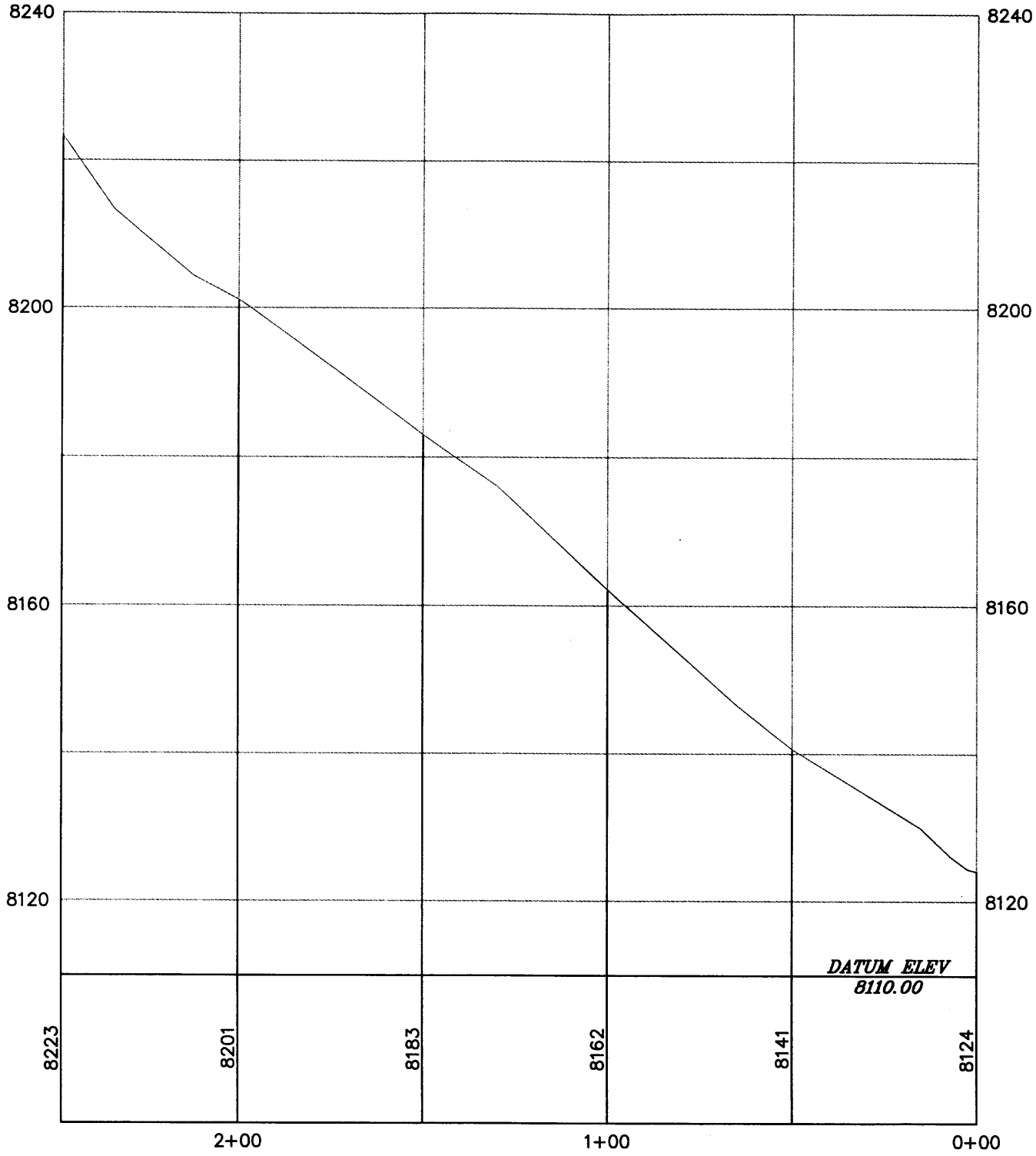
G:\UC779\07\DWG\PRO-2.DWG\10-09-03

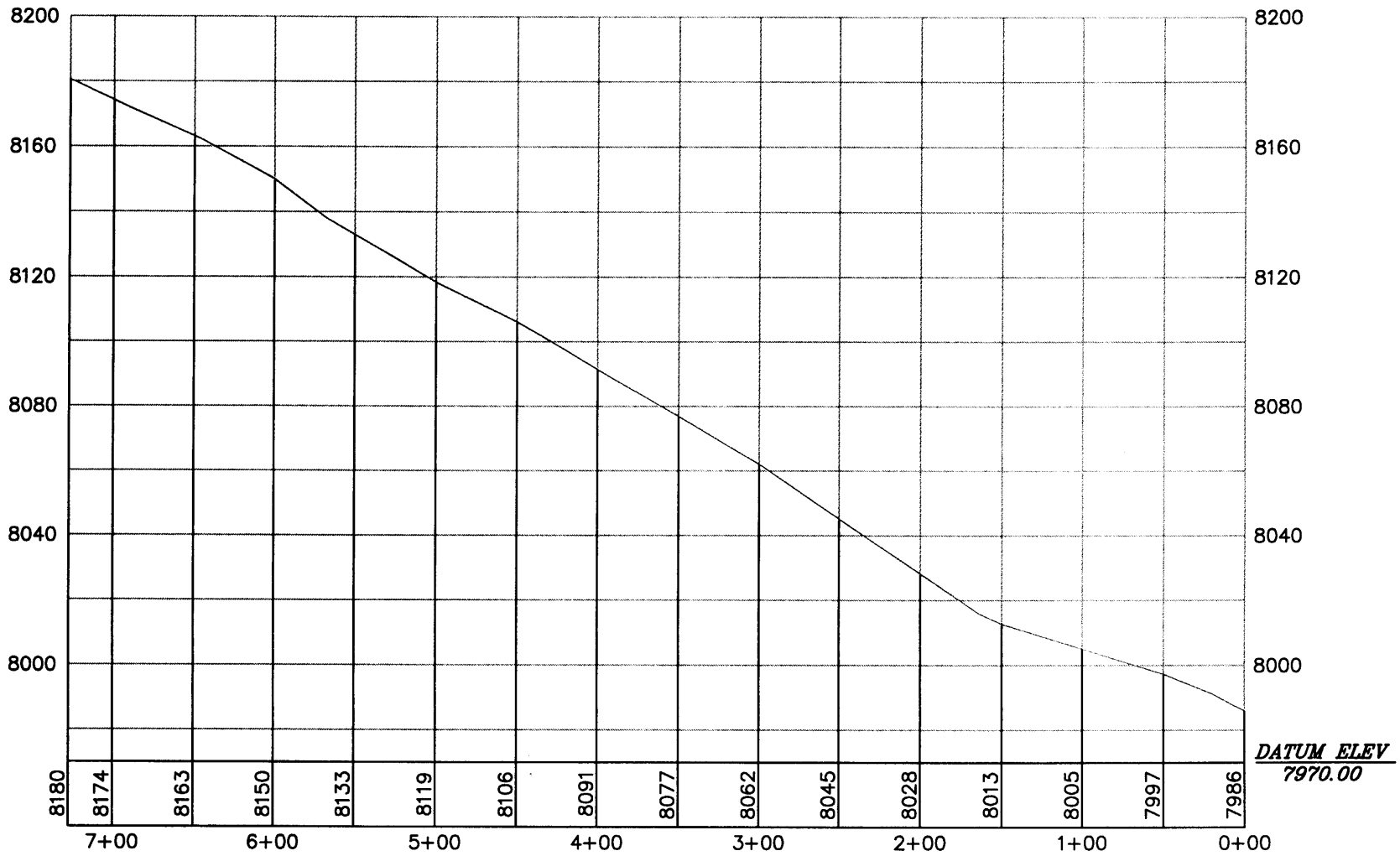



PROFILE SPRD-11

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 8. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax




PROFILE SPRD-12

HORIZONTAL SCALE: 1=100'
VERTICAL SCALE: 1=50'

FIGURE 9. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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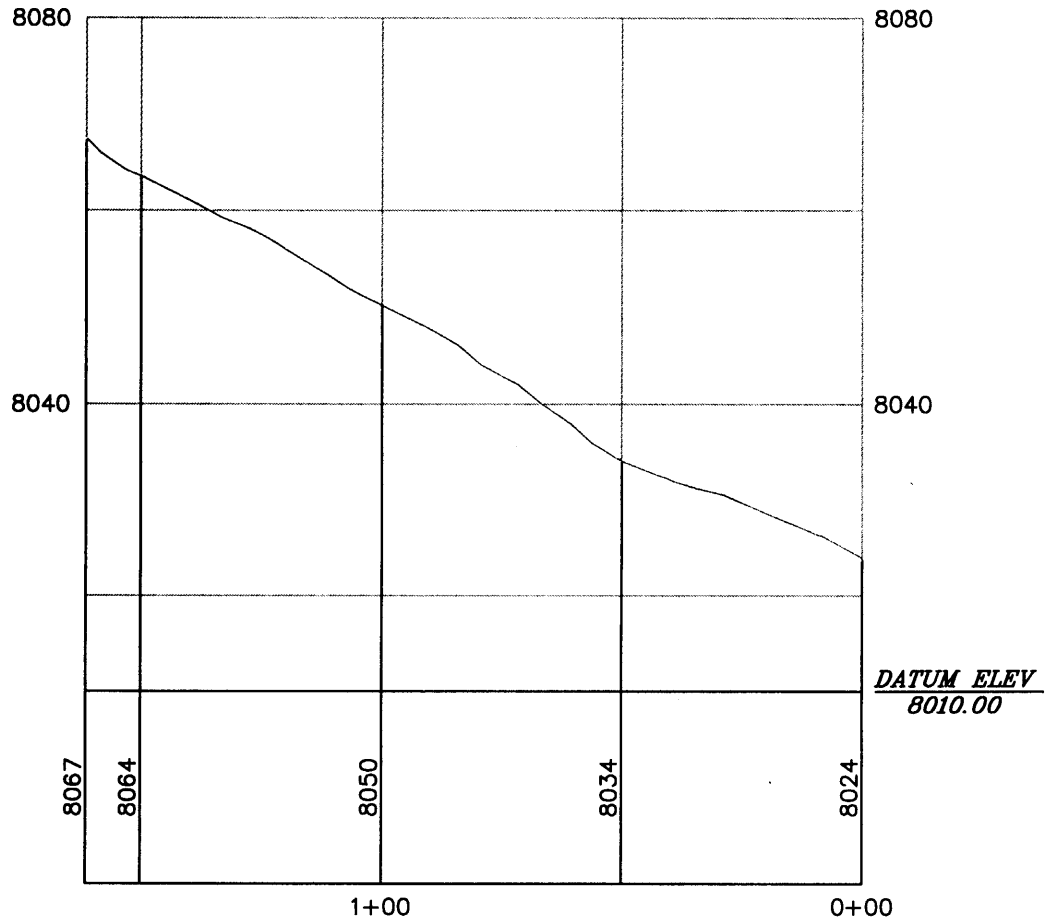


PROFILE SPRD-14

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 10. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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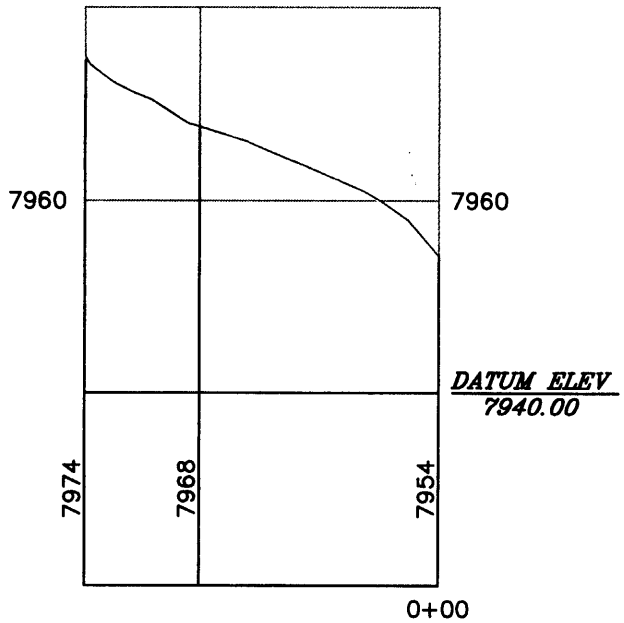
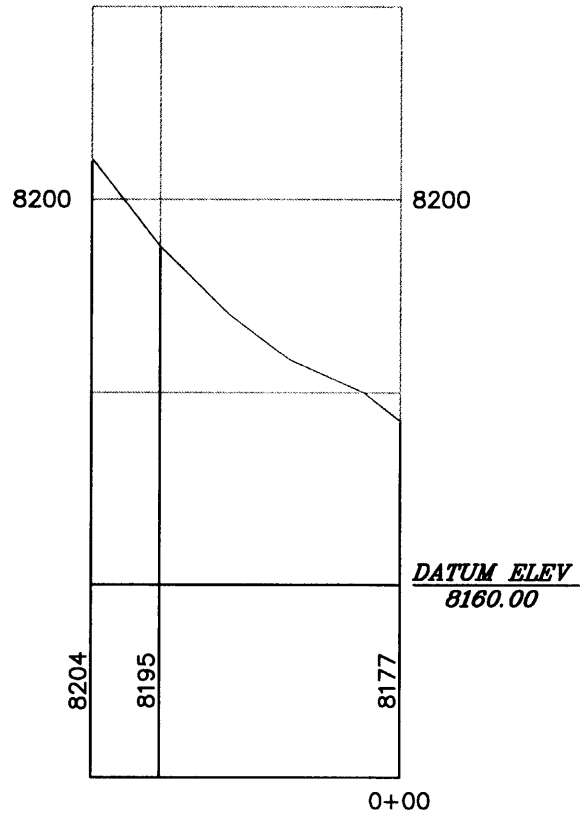


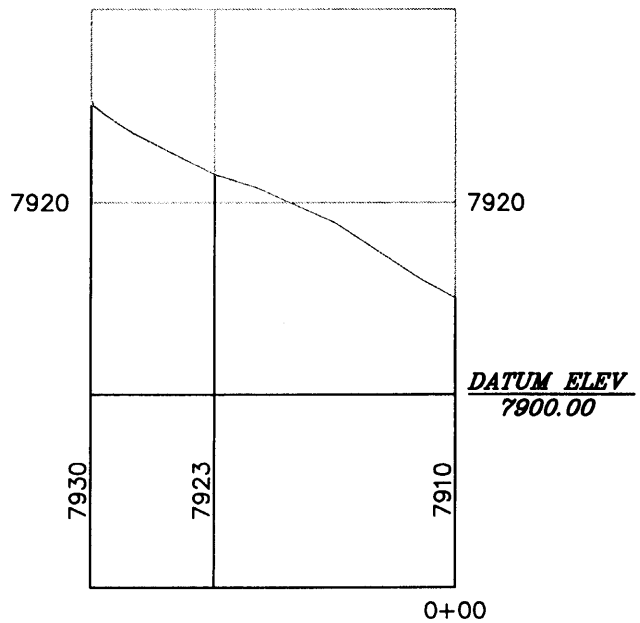

PROFILE SPRD-14a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-15

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-16

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 11. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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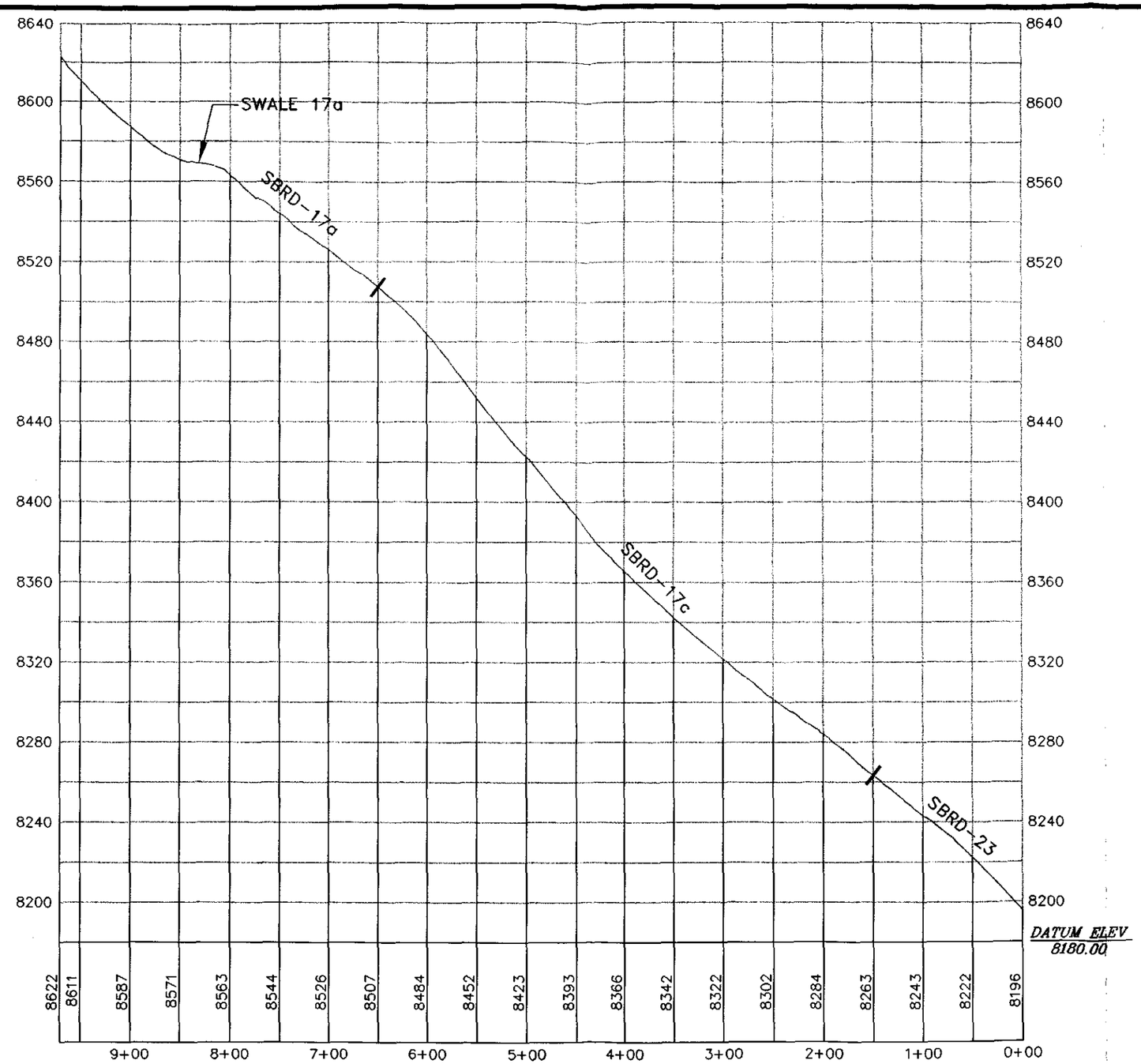
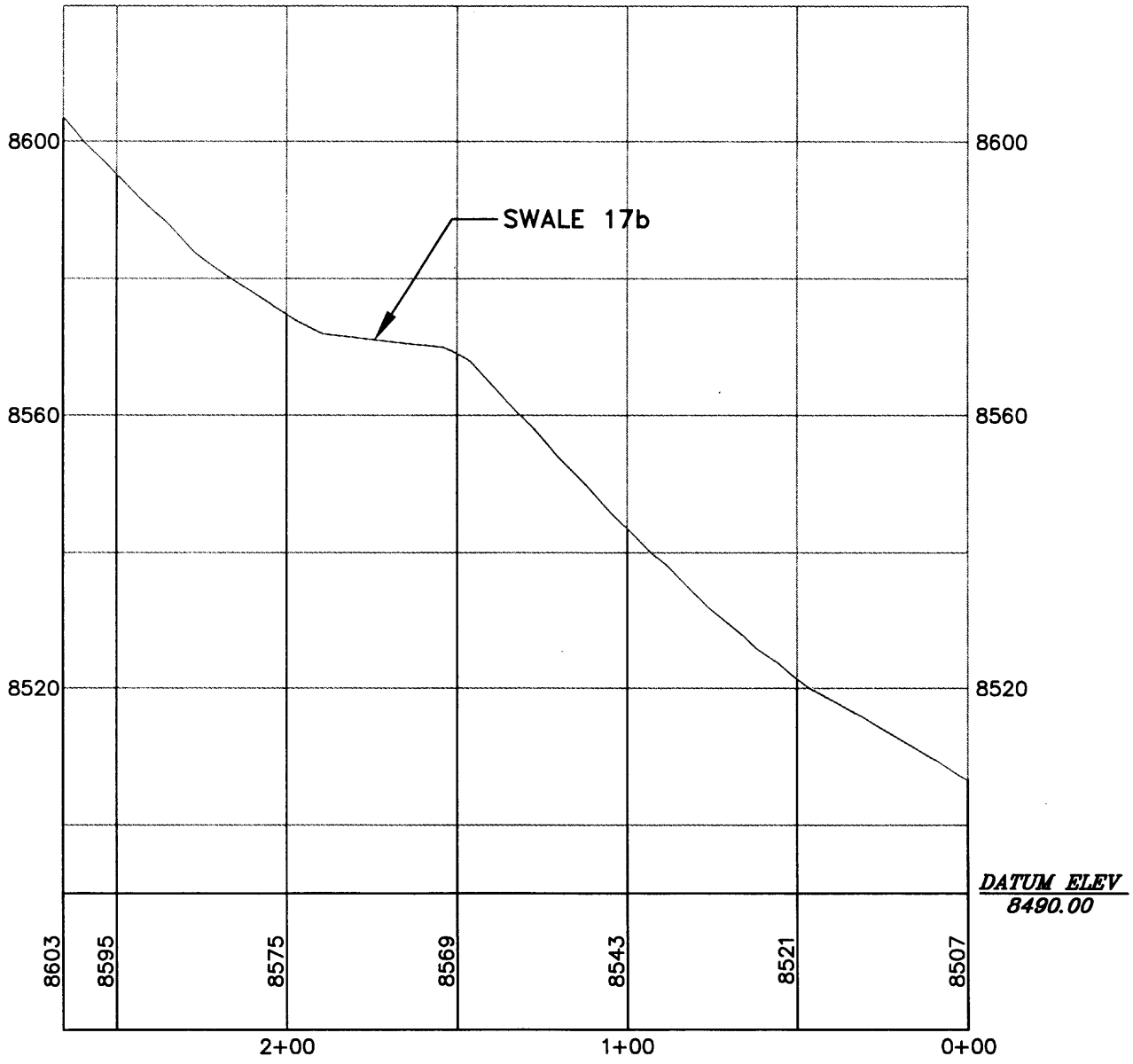



PROFILE SPRD-23,17c and 17a

HORIZONTAL SCALE: 1=120'
VERTICAL SCALE: 1=60'

FIGURE 12. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

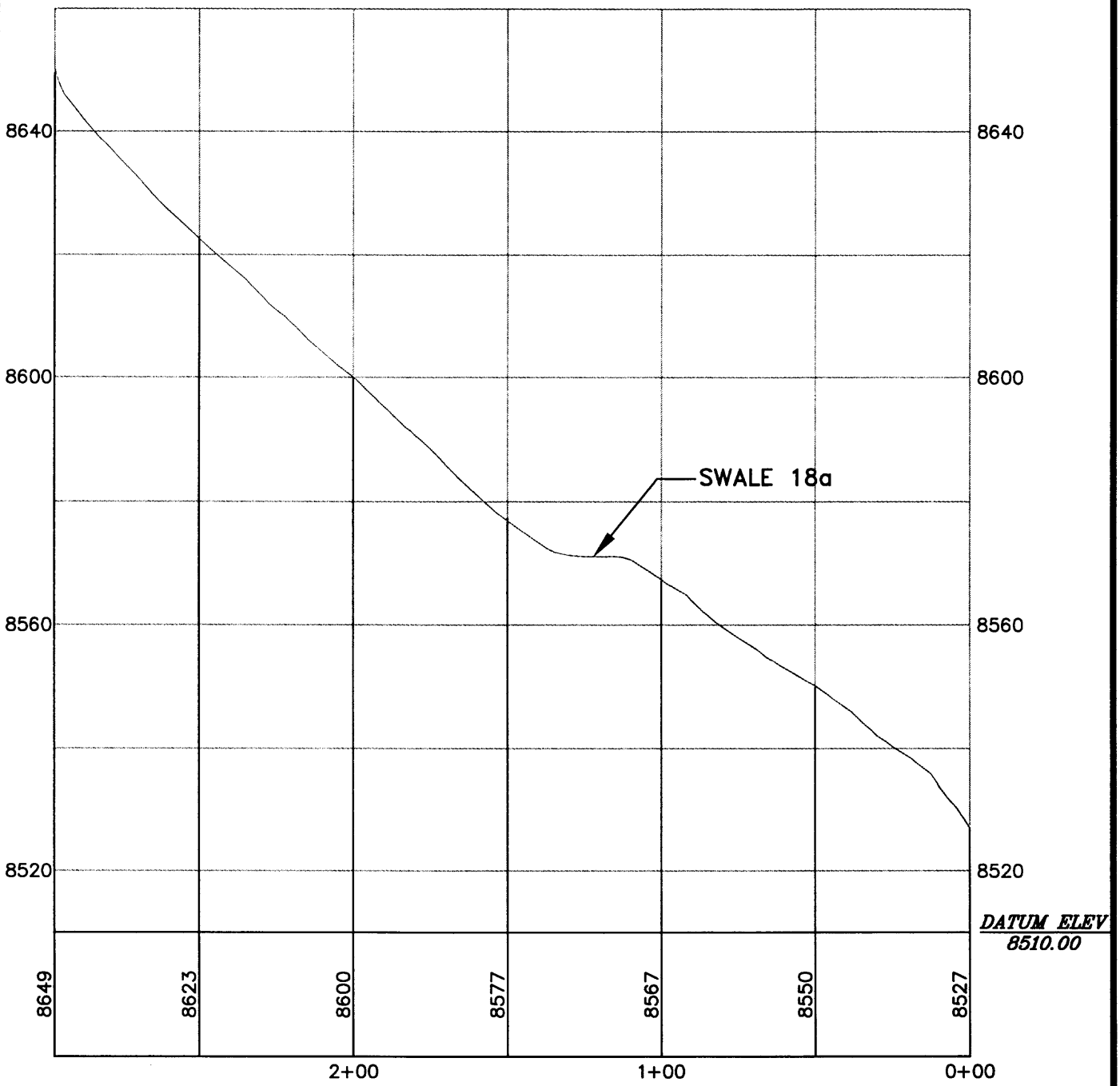



PROFILE SPRD-17b

HORIZONTAL SCALE: 1=50'
VERTICAL SCALE: 1=25'

FIGURE 13. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

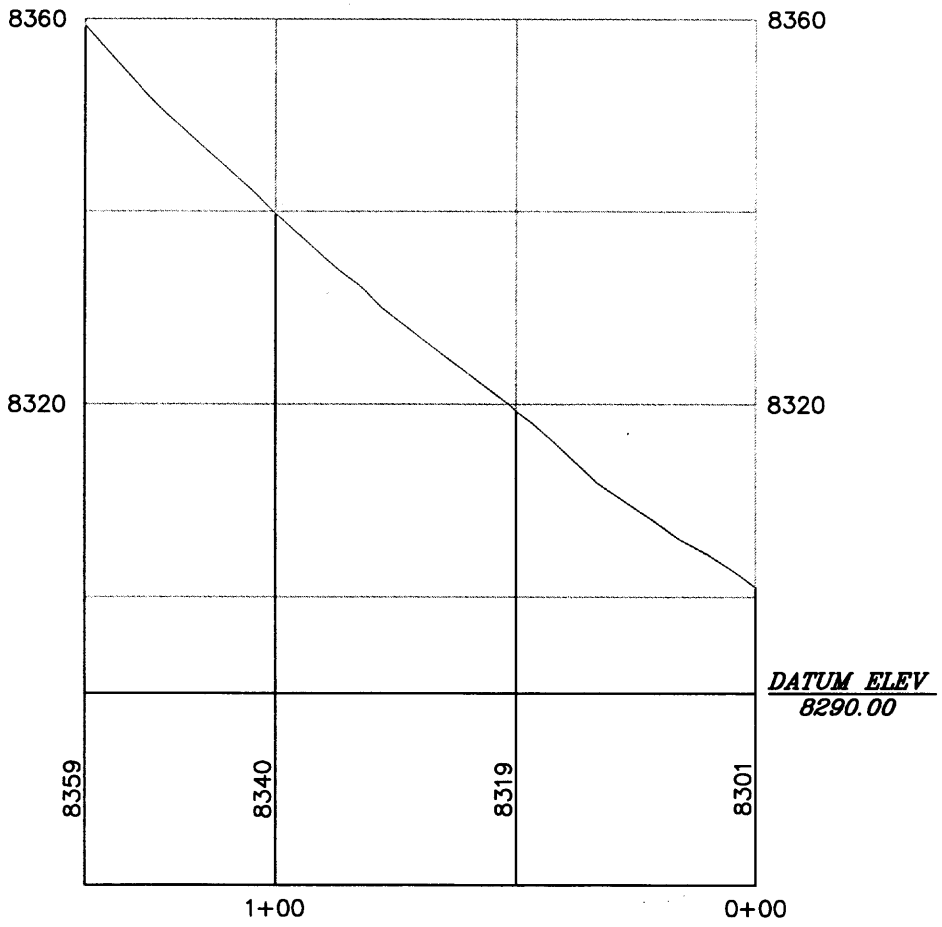



PROFILE SPRD-18a

HORIZONTAL SCALE: 1=50'
VERTICAL SCALE: 1=25'

FIGURE 14. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

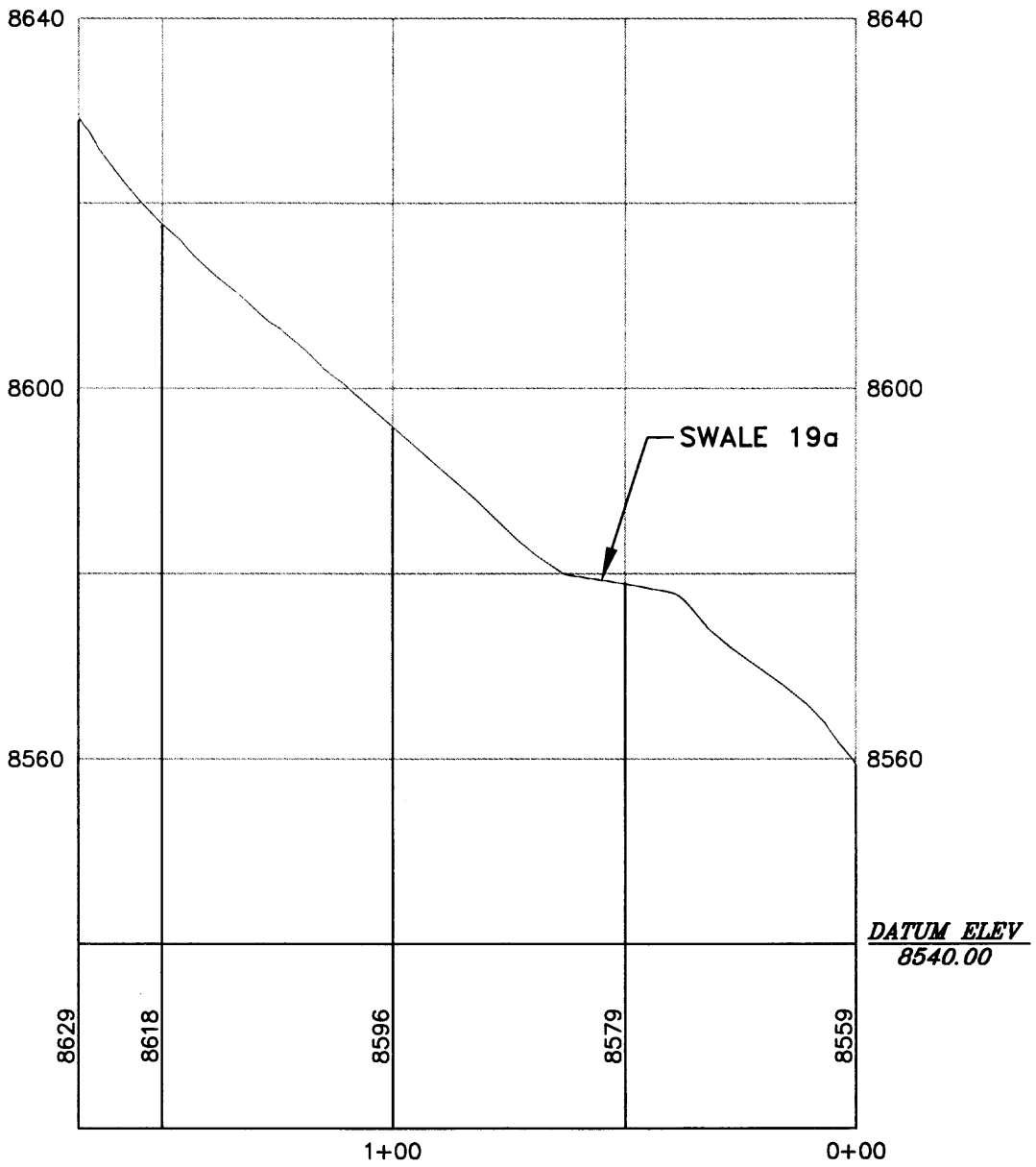



PROFILE SPRD-18b

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 15. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

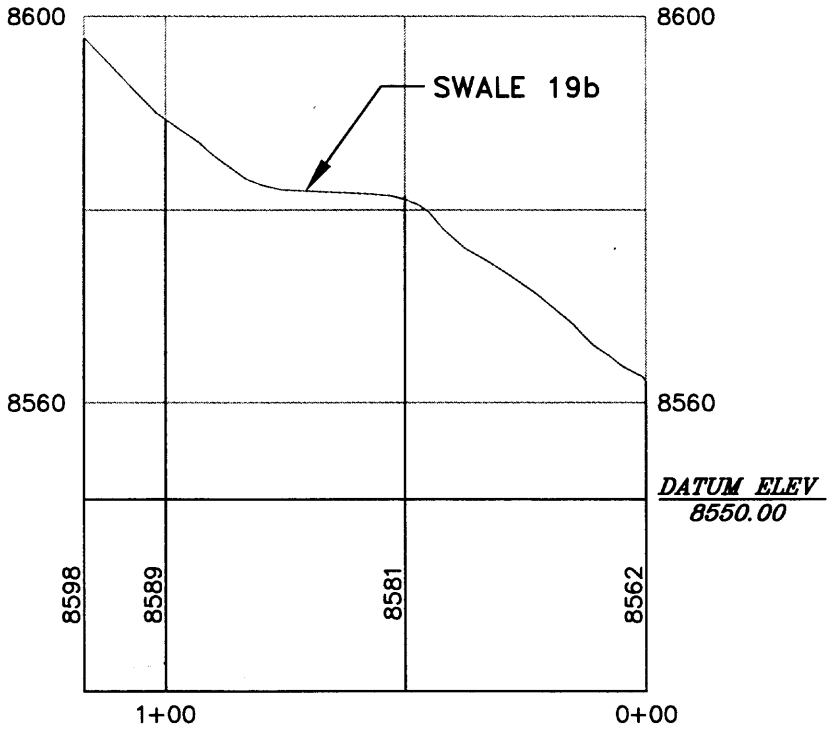



PROFILE SPRD-19a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 16. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax



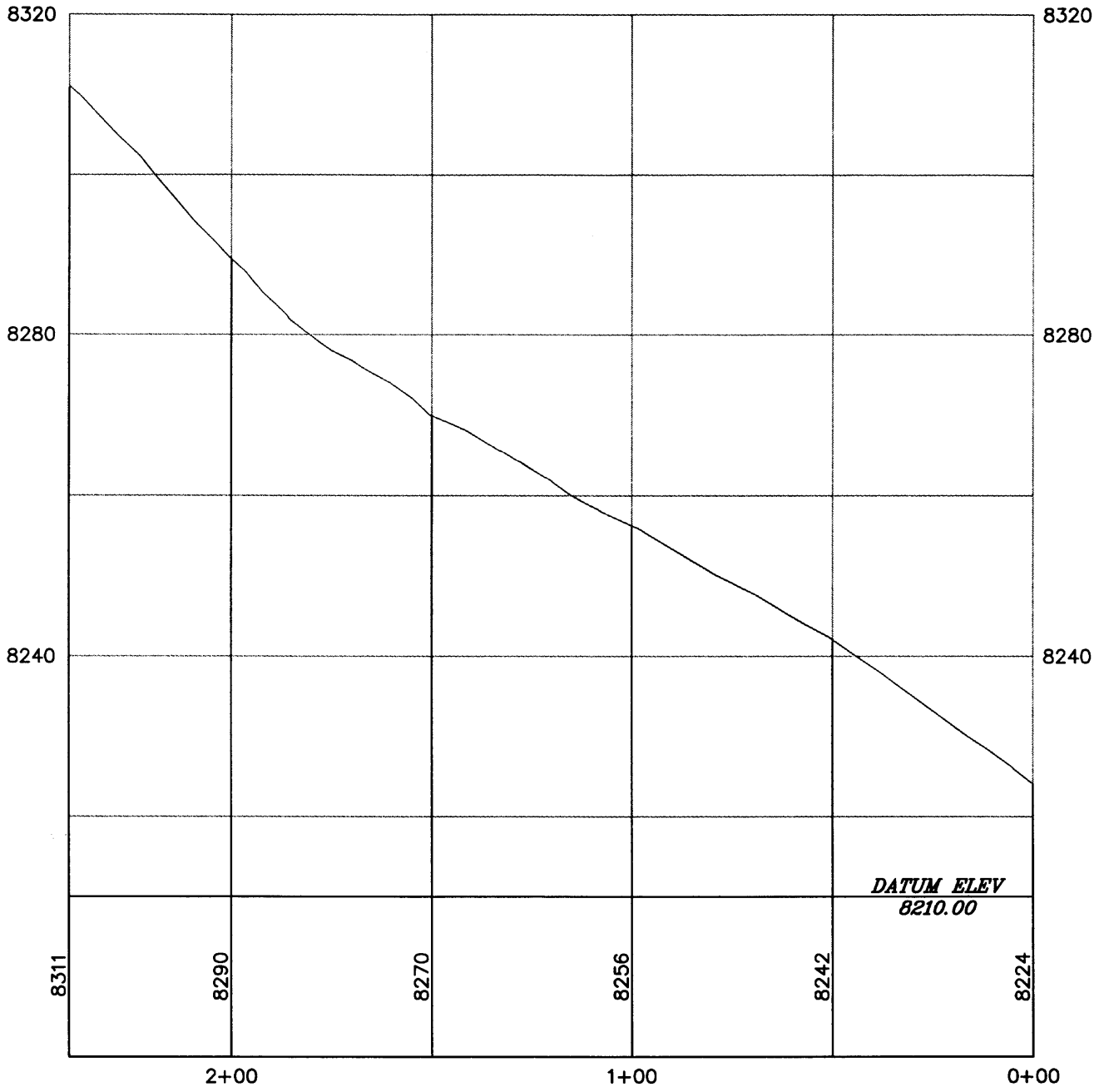

PROFILE SPRD-19b

HORIZONTAL SCALE: 1=40'

VERTICAL SCALE: 1=20'

FIGURE 17. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

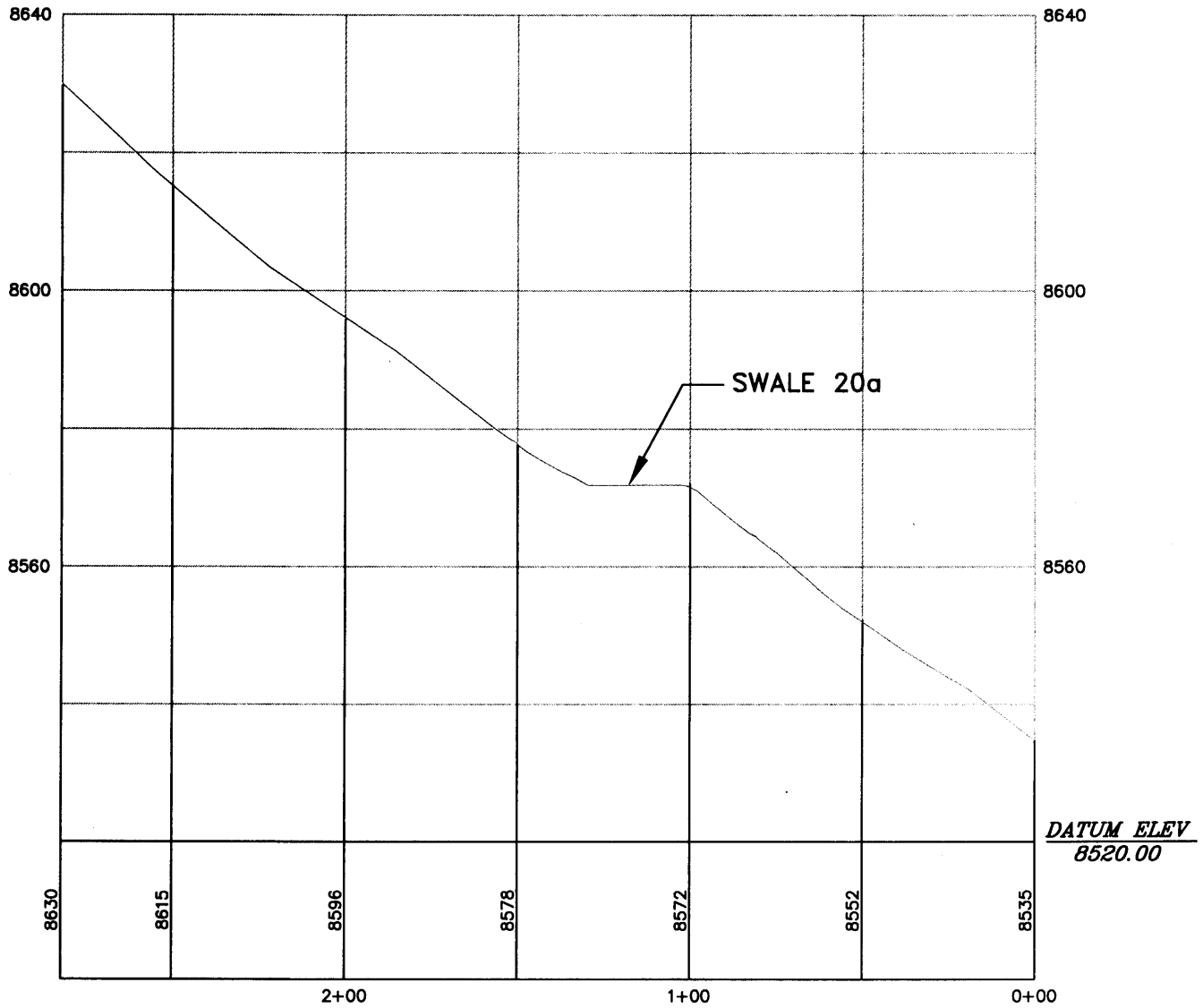



PROFILE SPRD-19c

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 18. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax




PROFILE SPRD-20a

HORIZONTAL SCALE: 1=50'
VERTICAL SCALE: 1=25'

FIGURE 19. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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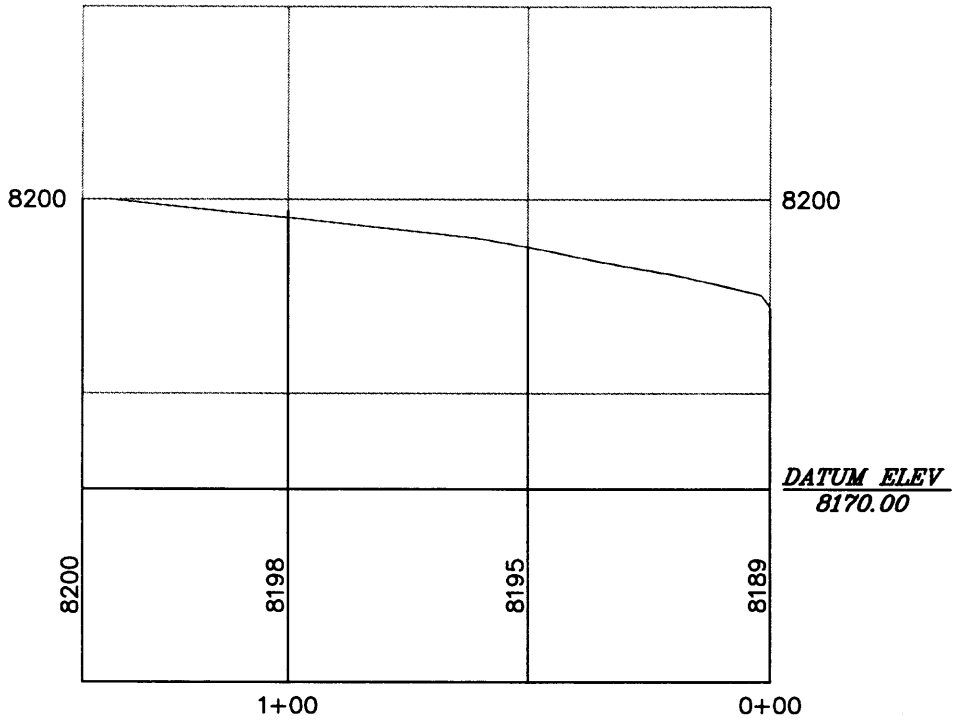
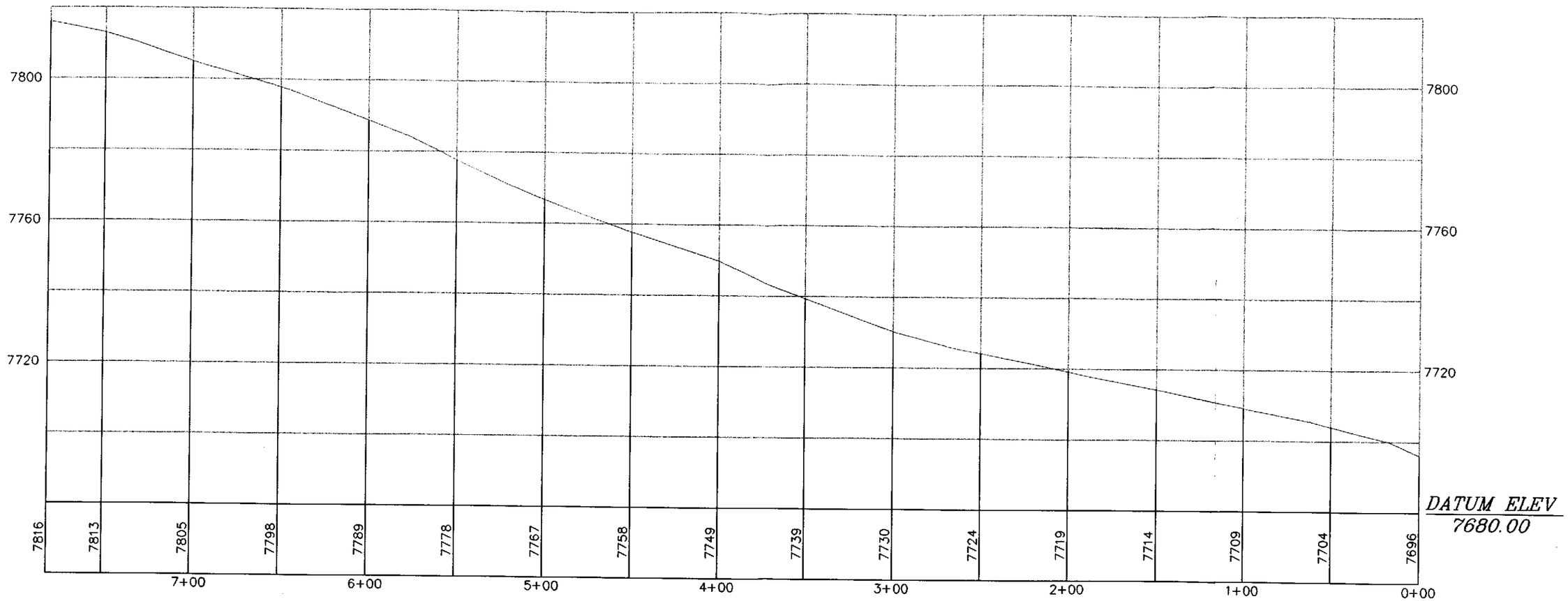



PROFILE SPRD-20b

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 20. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

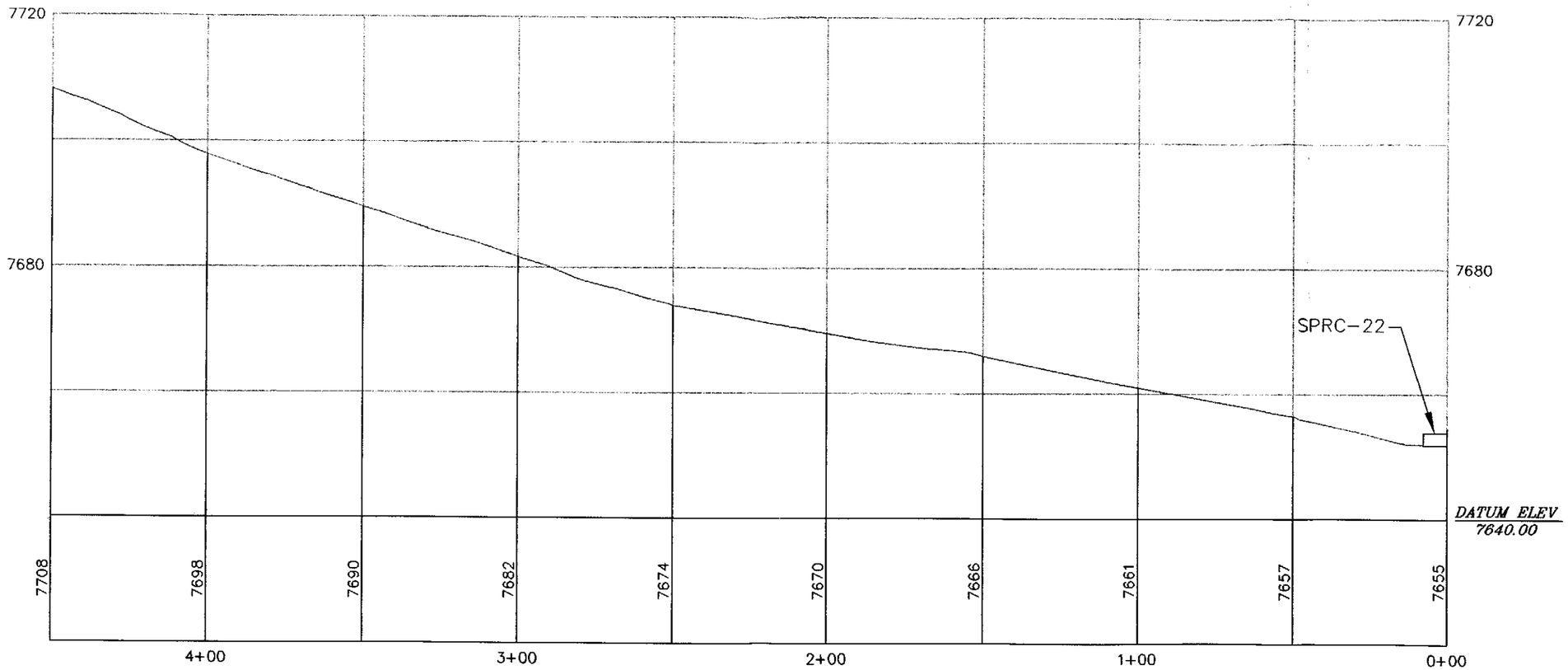



PROFILE SPRD-21

HORIZONTAL SCALE: 1=60'
VERTICAL SCALE: 1=30'

FIGURE 21. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

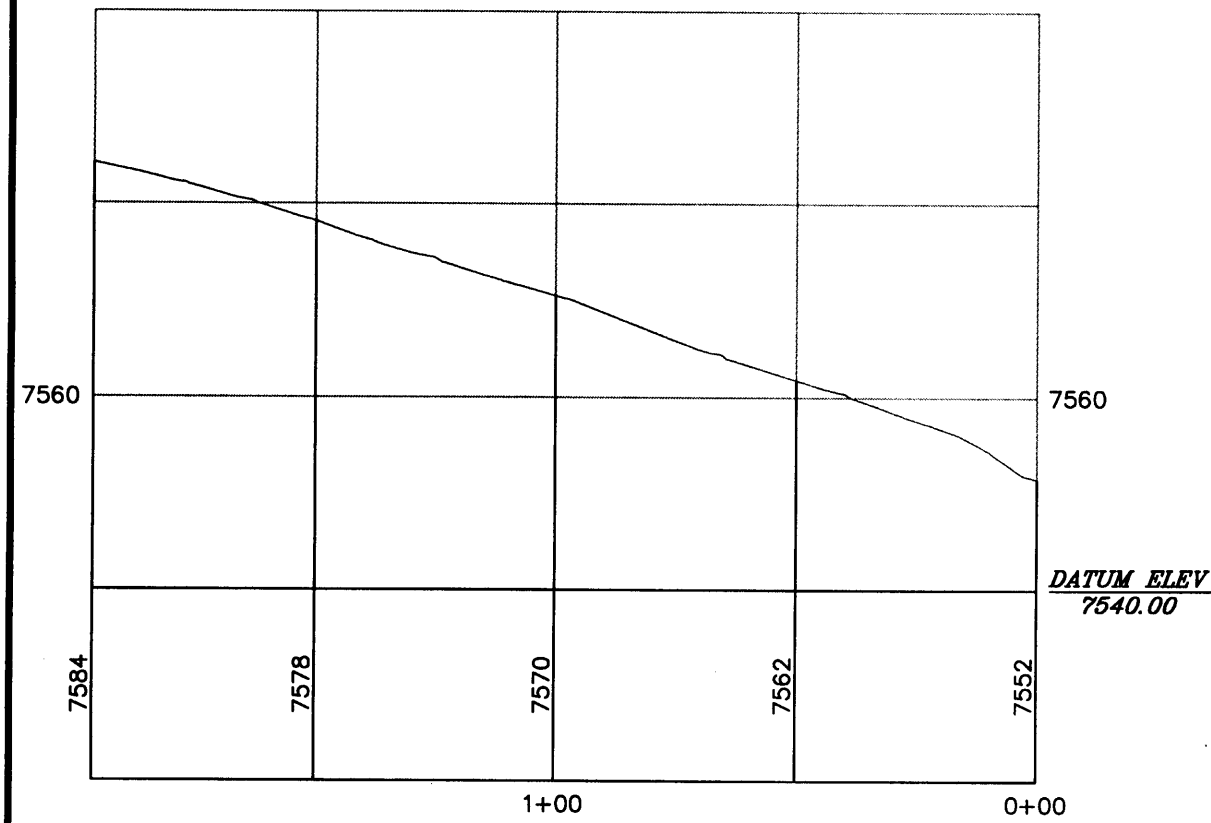



PROFILE SPRD-22a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

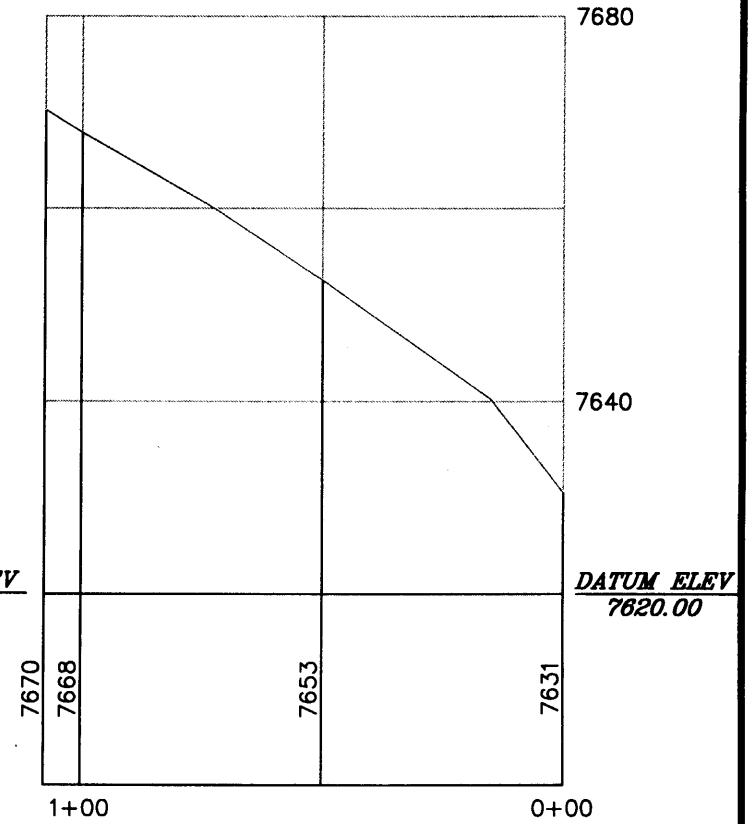
FIGURE 22. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax




PROFILE SPRD-24

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-25a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 23. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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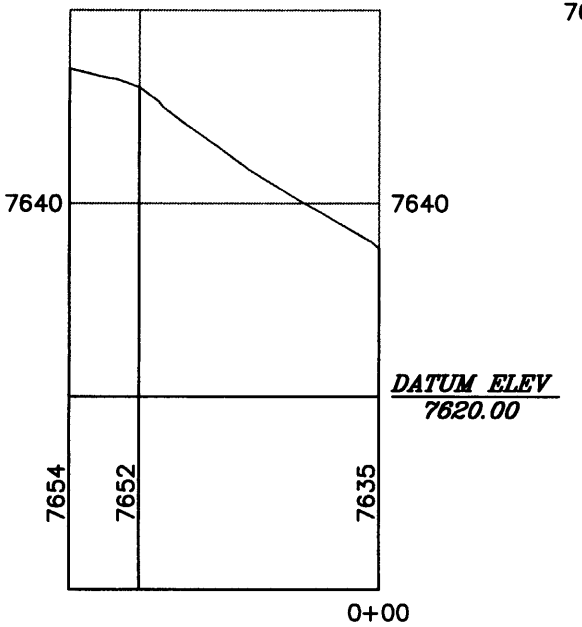
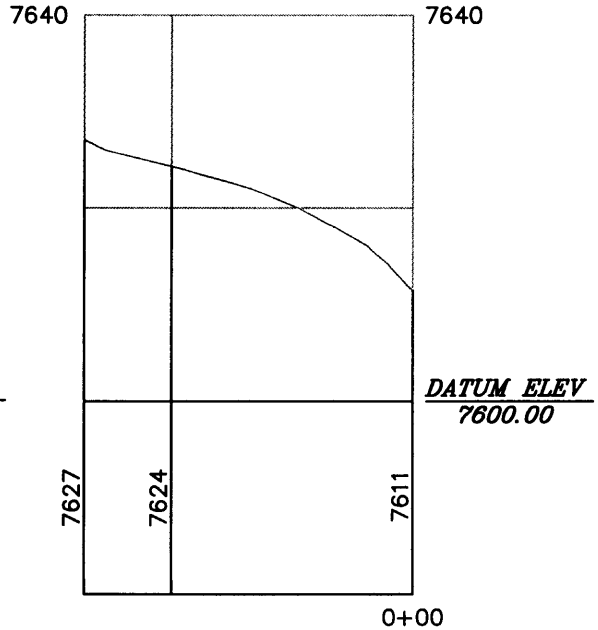


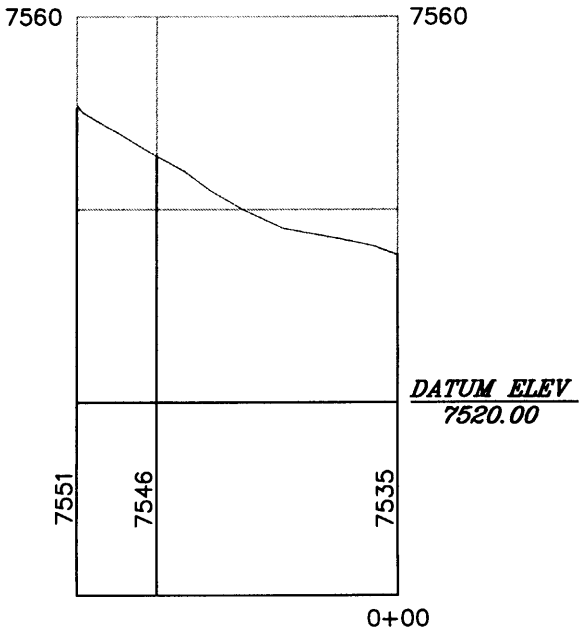

PROFILE SPRD-25b

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-26

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SBRD-26

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 24. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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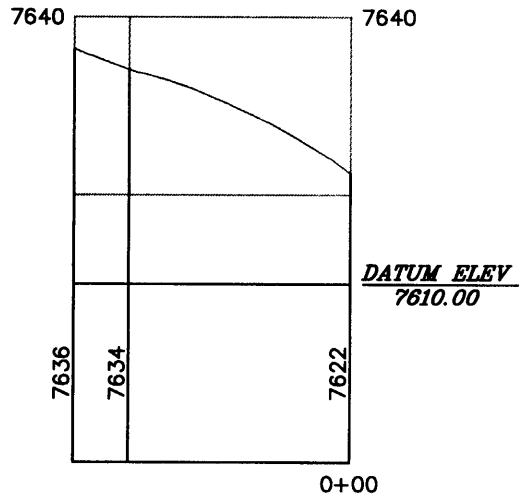
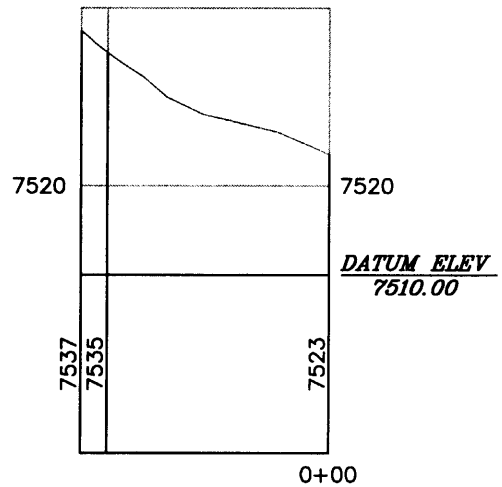



PROFILE SPRD-26a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SBRD-27

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 25. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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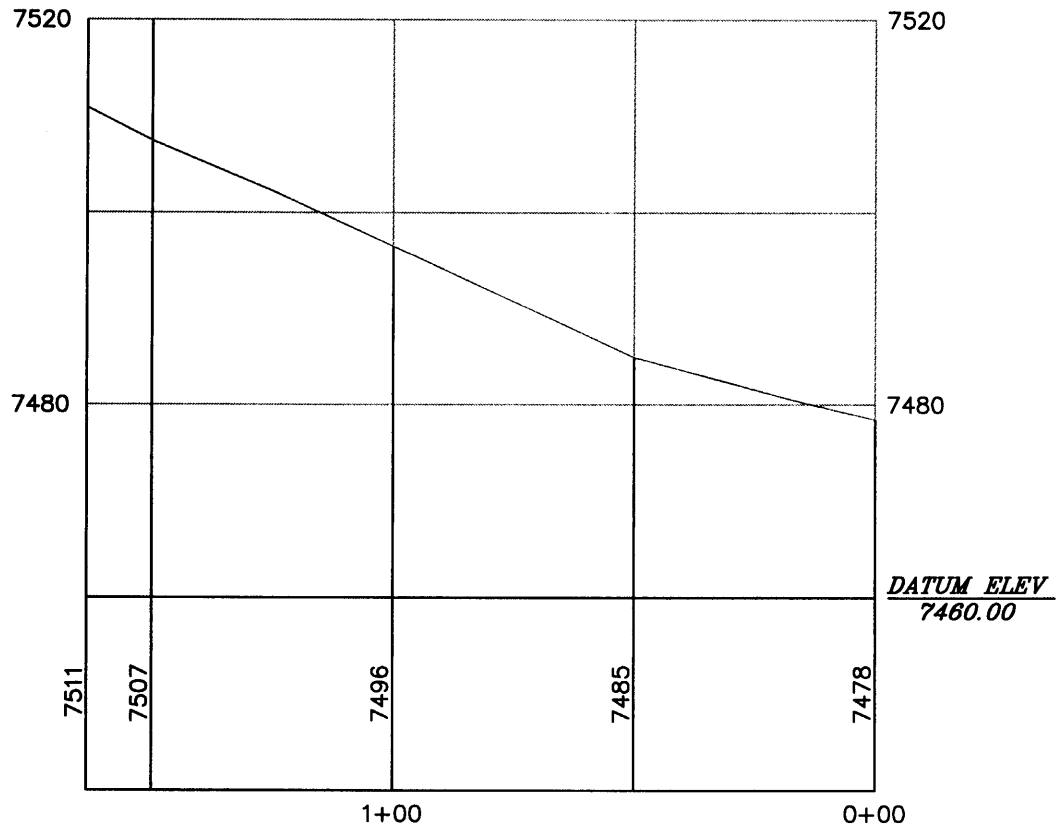


PROFILE SBRD-28

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 26. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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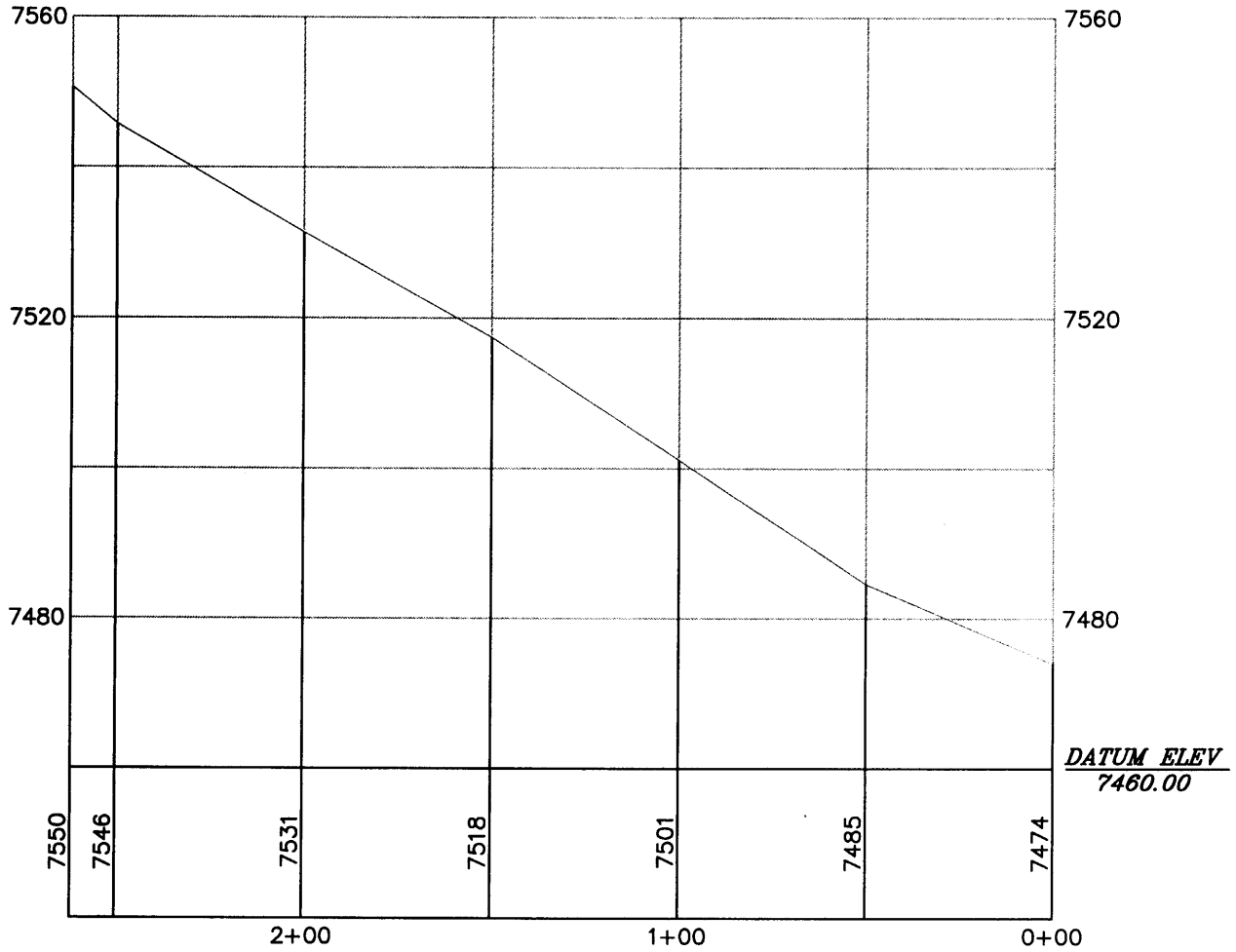


PROFILE SBRD-29a

HORIZONTAL SCALE: 1=50'
VERTICAL SCALE: 1=25'

FIGURE 27. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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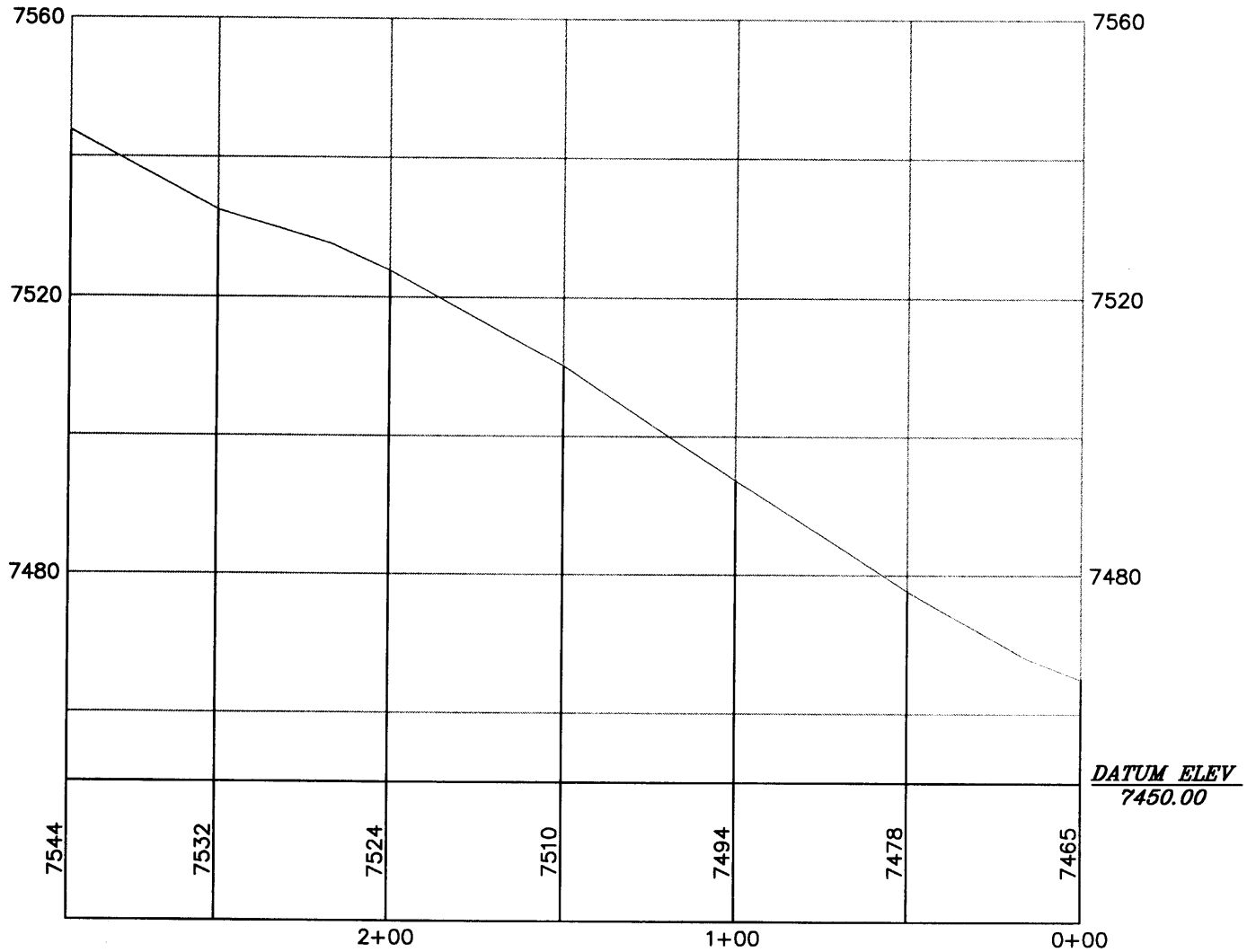


PROFILE SBRD-29b

HORIZONTAL SCALE: 1=50'
VERTICAL SCALE: 1=25'

FIGURE 28. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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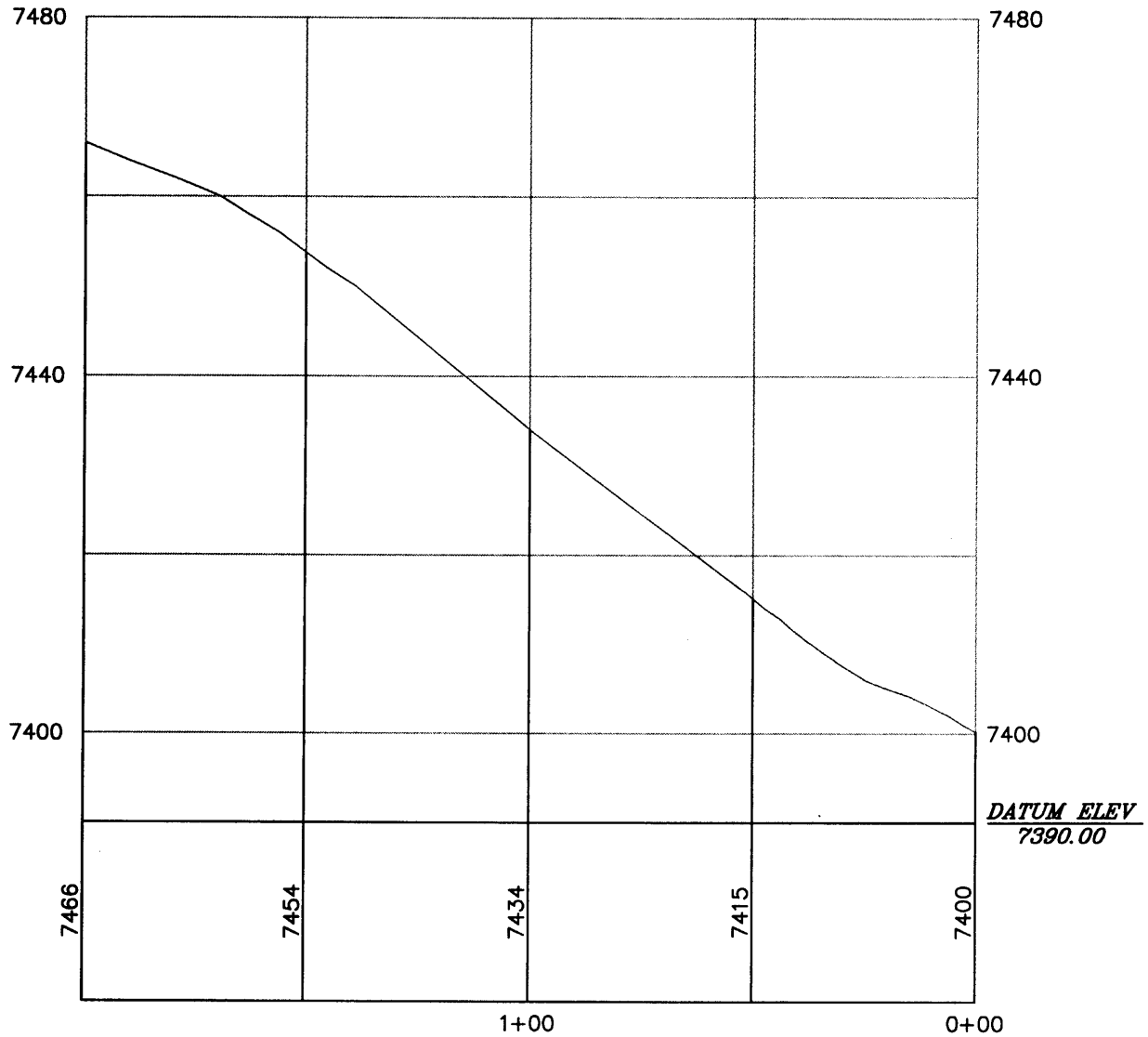


PROFILE SPRD-30

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 29. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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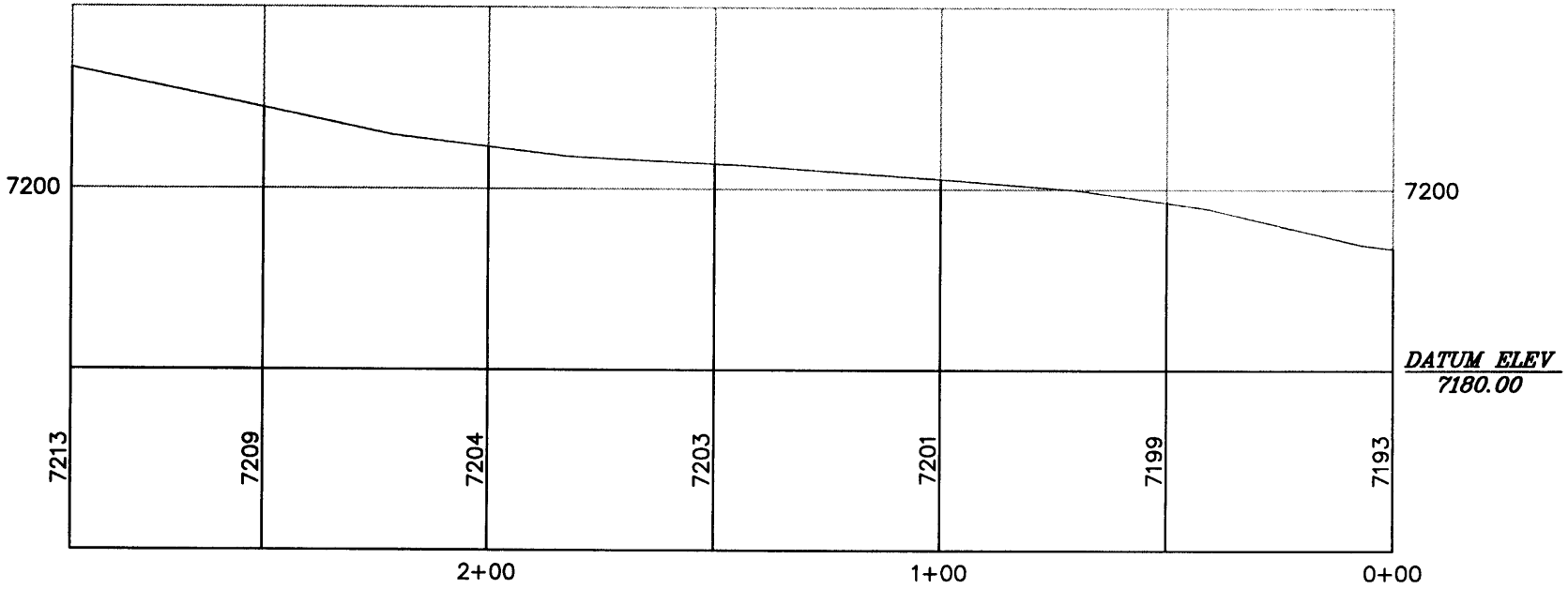


PROFILE SPRD-33

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 30. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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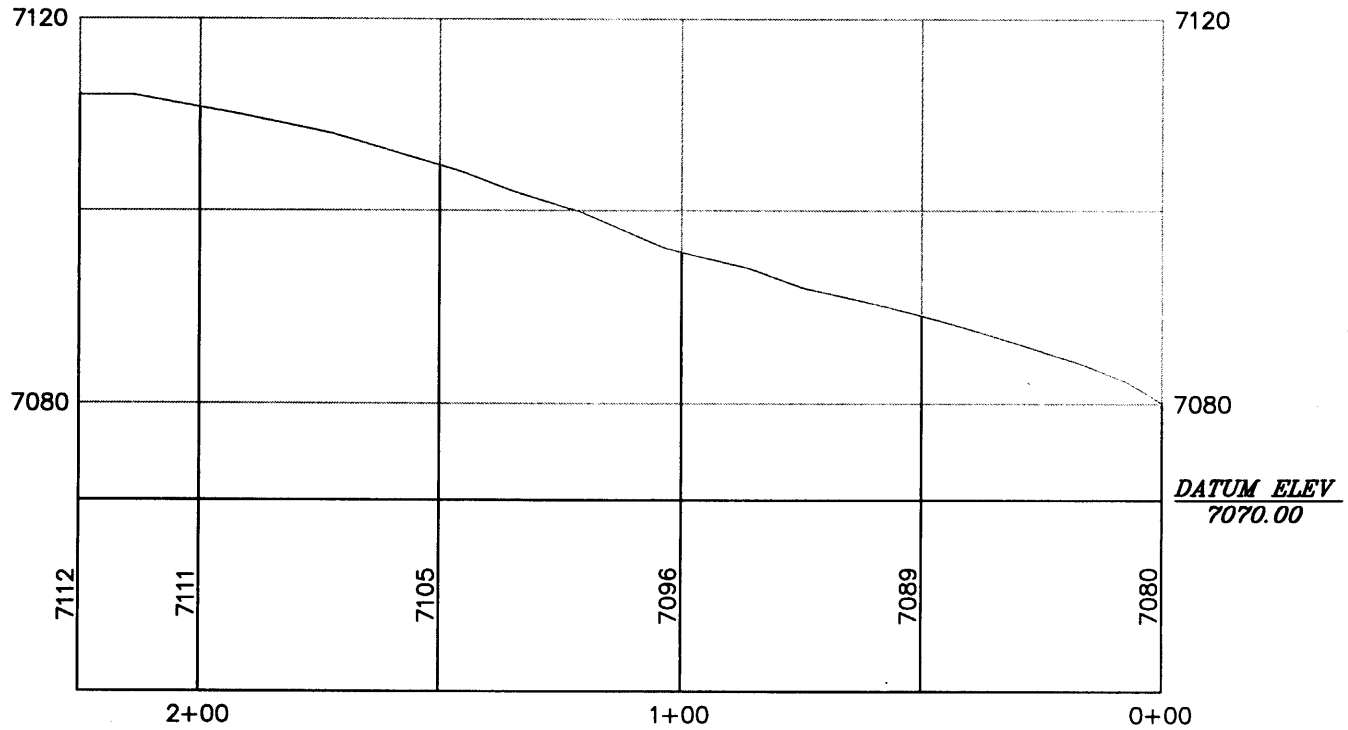


PROFILE SPRD-35

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 31. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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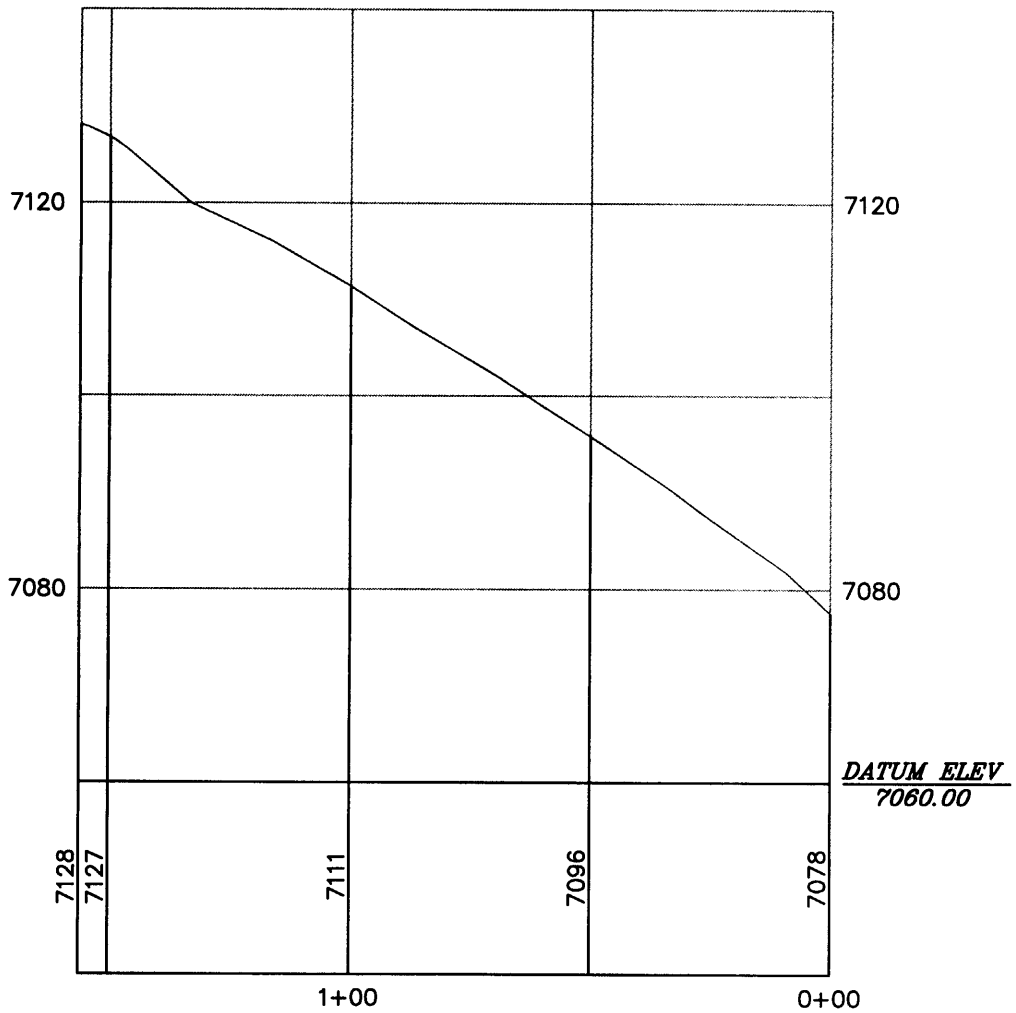
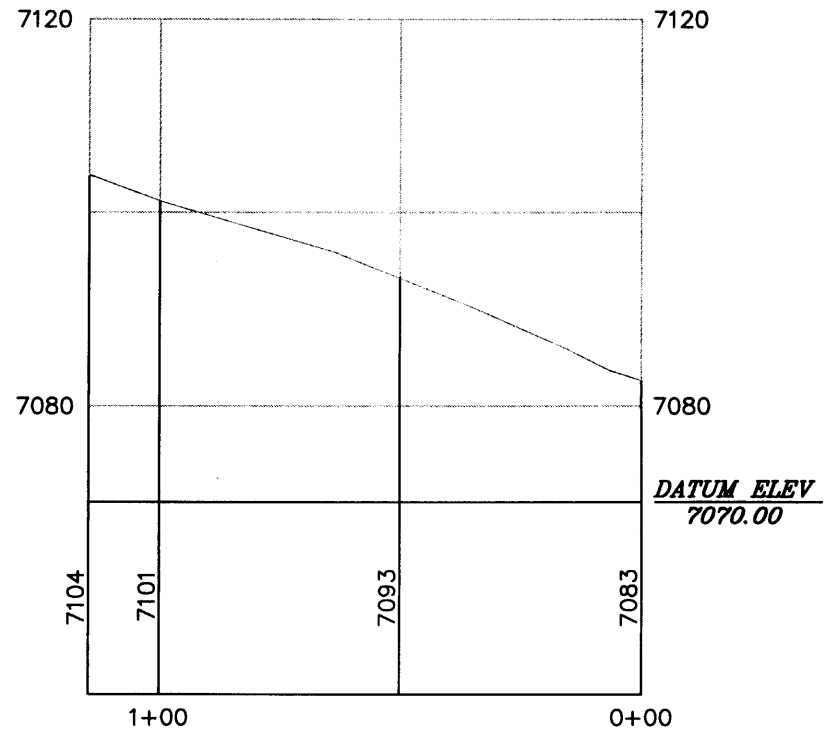



PROFILE SPRD-35a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'



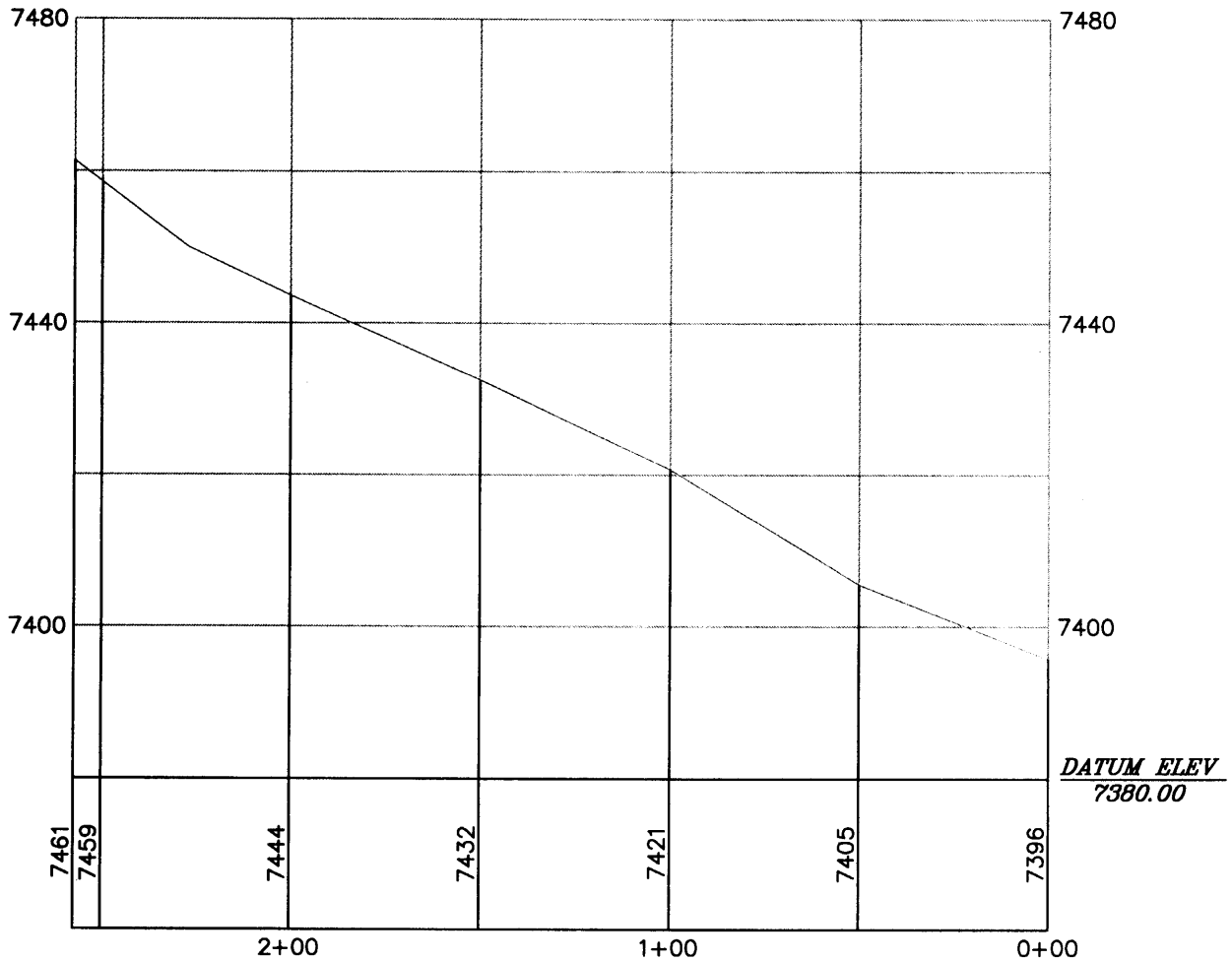

PROFILE SPRD-36a

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 32. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

G:\UC779\07\DWG\PRO-1.DWG\10-08-03




PROFILE SPRD-40

HORIZONTAL SCALE: 1=50'
VERTICAL SCALE: 1=25'

FIGURE 33. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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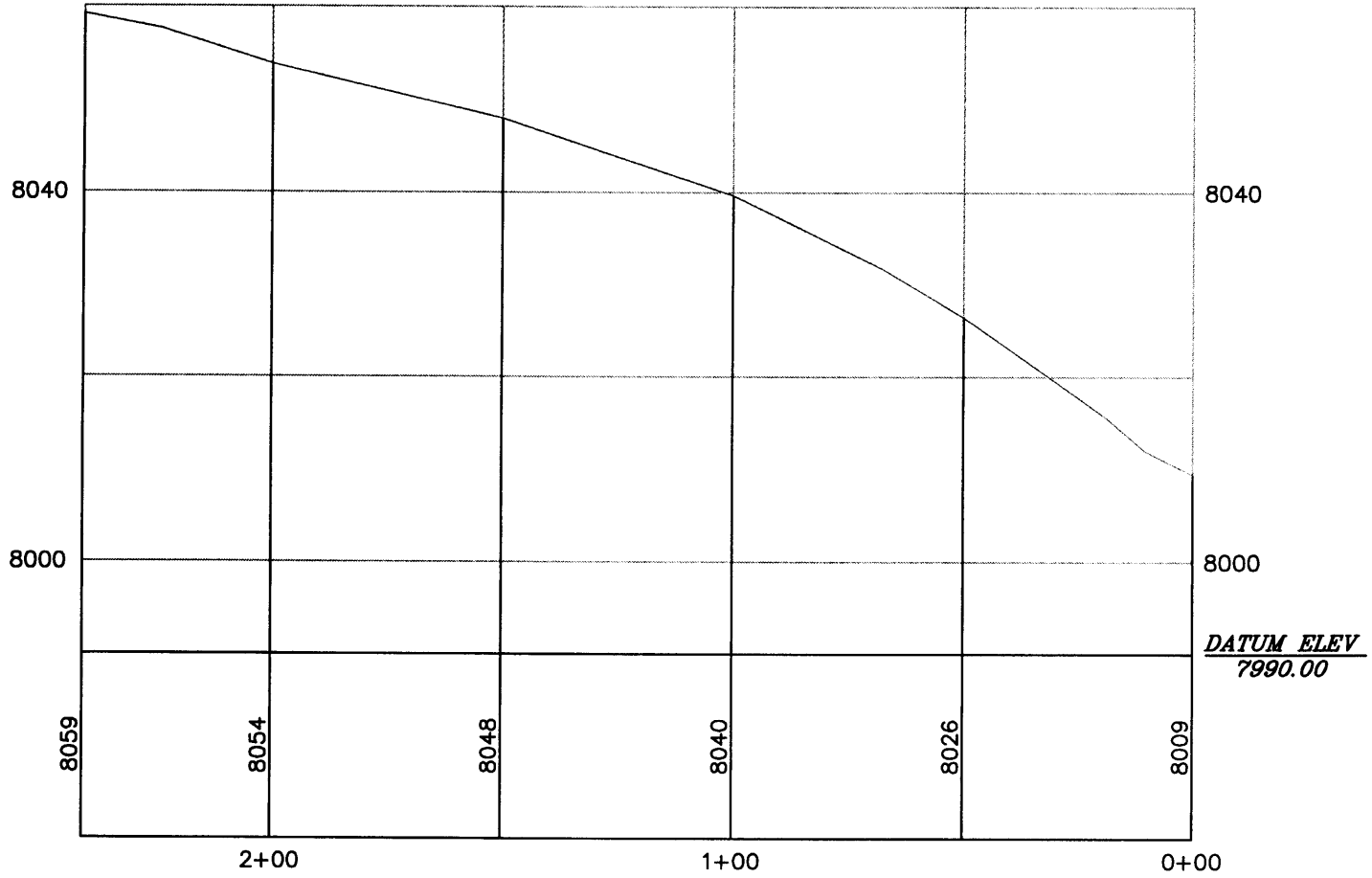


PROFILE SPRD-44

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 34. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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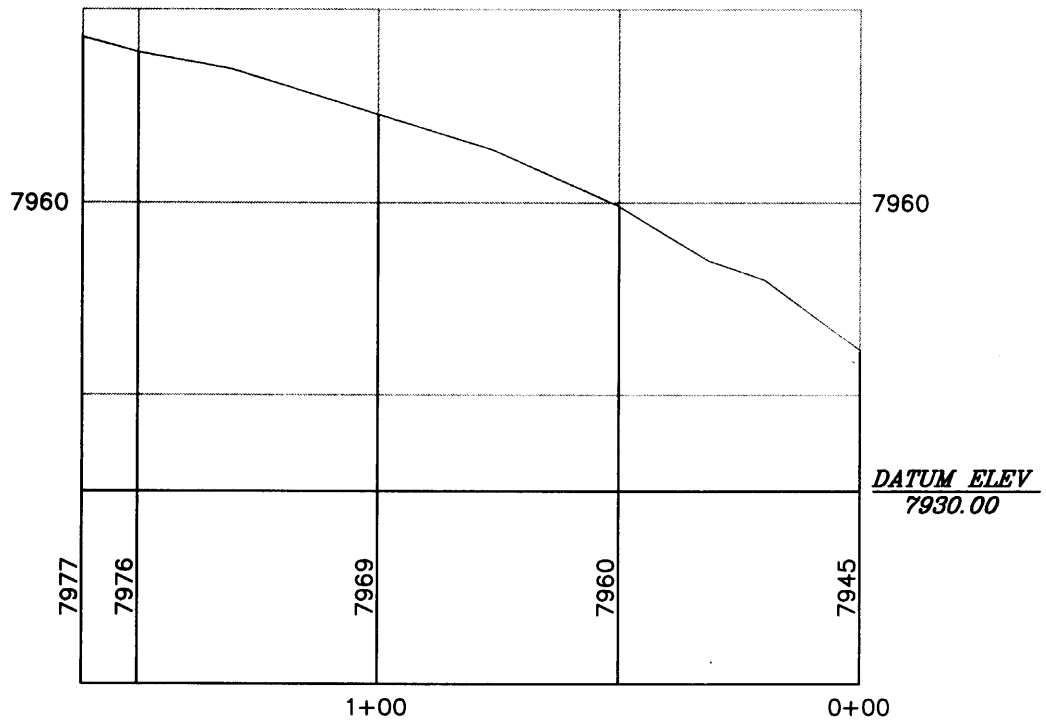


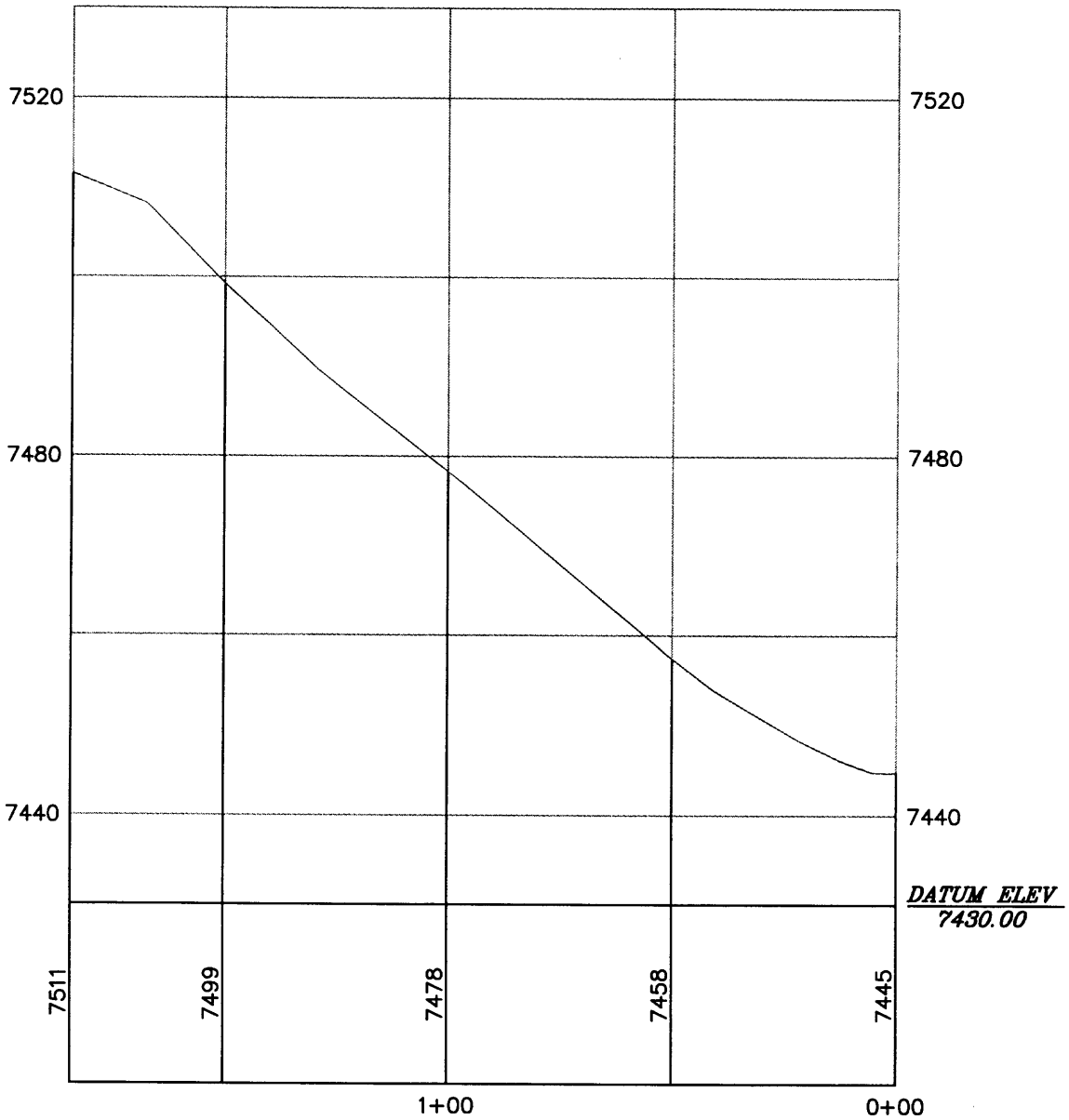

PROFILE SPRD-45

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 35. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

G:\UC779\07\DWG\PRO-5.DWG\10-08-03

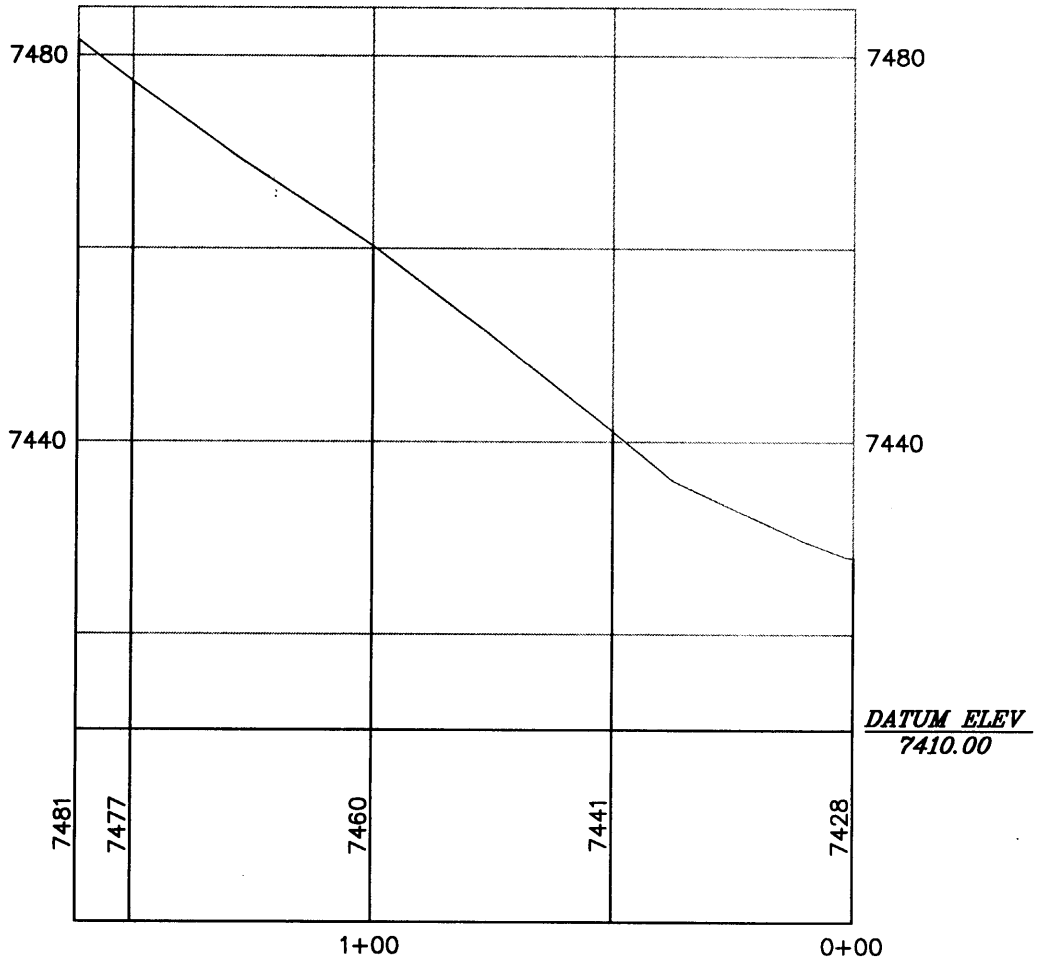



PROFILE SPRD-46

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

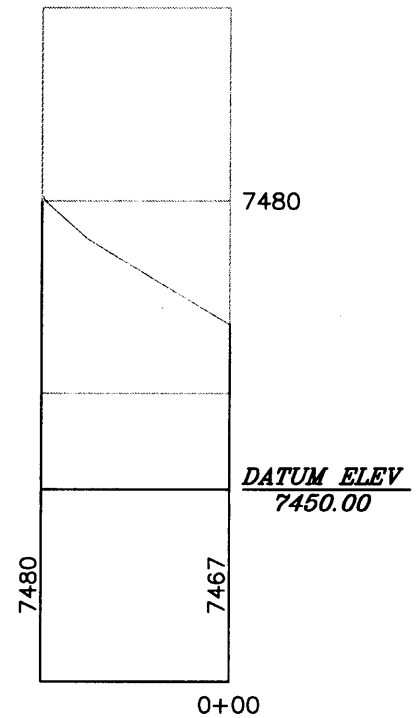
FIGURE 36. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax




PROFILE SPRD-47

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'




PROFILE SPRD-47A

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 37. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

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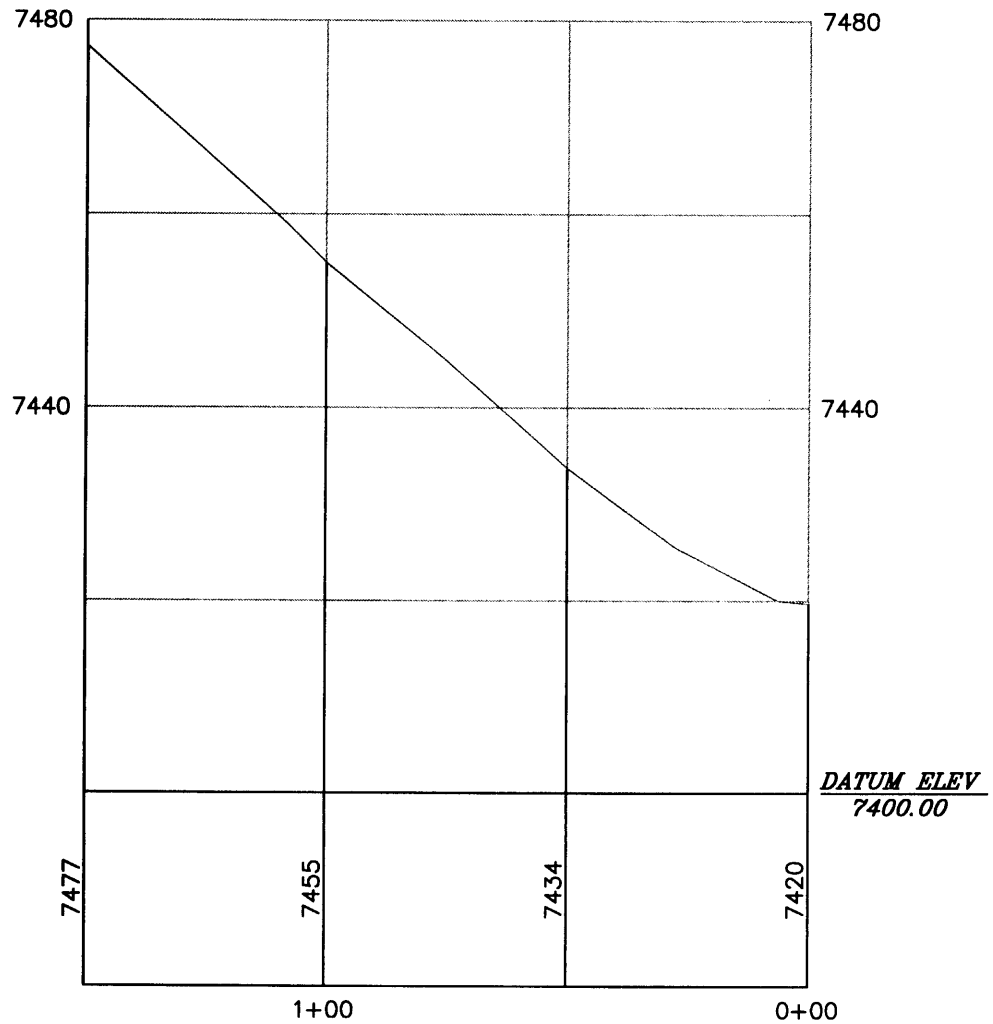


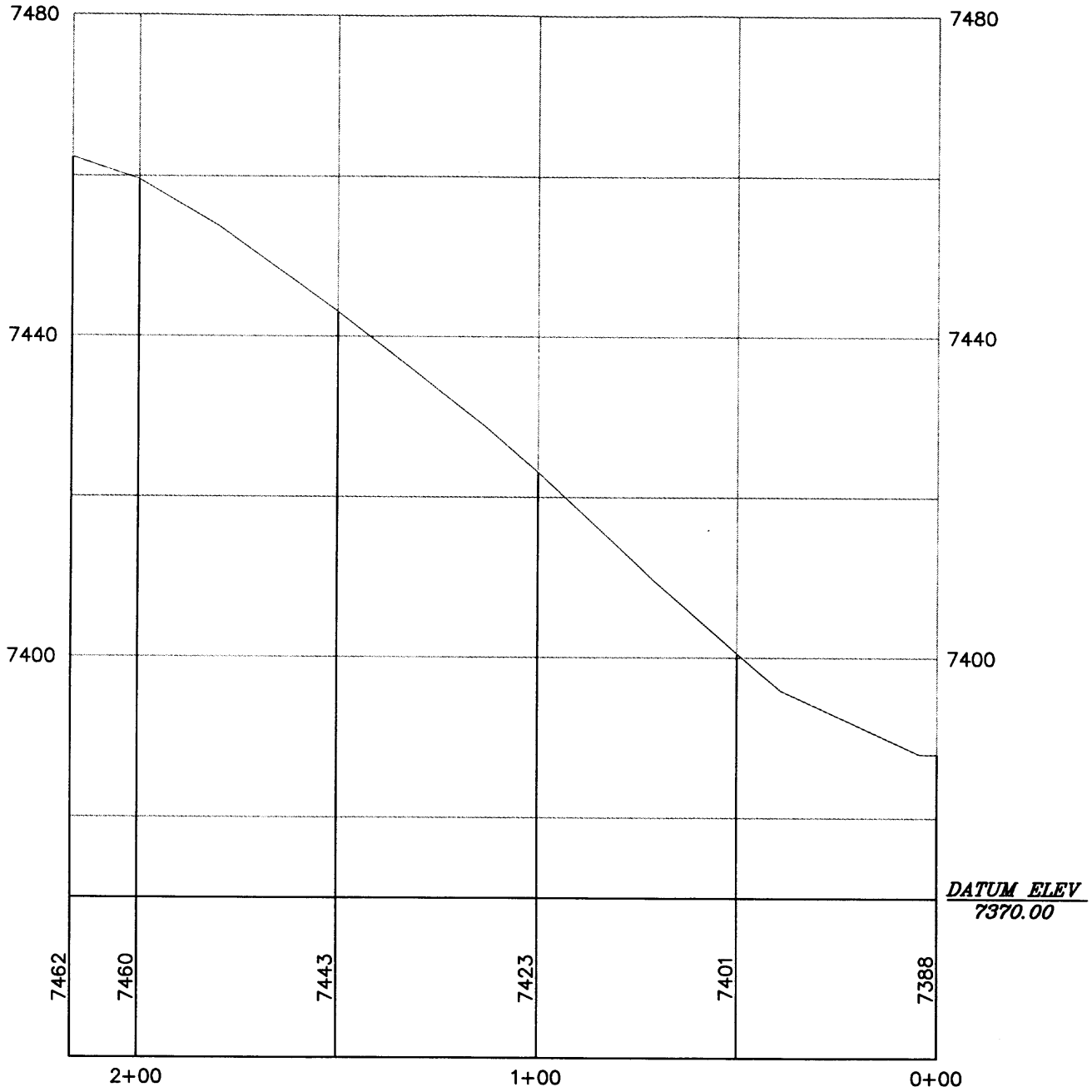

PROFILE SPRD-48

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 38. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

G:\UC779\07\DWG\PRO-5.DWG\10-08-03




PROFILE SPRD-49

HORIZONTAL SCALE: 1=40'
VERTICAL SCALE: 1=20'

FIGURE 39. AS-BUILT RECLAMATION CHANNEL PROFILES

EarthFax

# STAR POINT MINE
# PHASE I BOND RELEASE
# PERMIT C/007/006

## INTRODUCTION

The Star Point Mine is located on Gentry Mountain approximately 23 miles southwest of Price, Utah on the east side of the Wasatch Plateau Coal Field. The Star Point Mine permit area is 8820.86 acres of which 93.77 acres (Maps 542.200a, 542.200b, 542.200c, 542.200g and 542.200h) are within the disturbed (bonded) area boundary. A performance bond in the amount of $7,796,000 is held to ensure that reclamation is accomplished. The Permit expires on January 27, 2007.

Mining operations began in 1916 when the Wattis Brothers and Mr. Browning bought 160 acres from the United States and developed the property for coal production. The Lion Coal Company operated Wattis No. 1 and 2 mines until the end of 1963. There were no coal mining activities from 1964 through 1967. Plateau Mining, Ltd. Operated the Star Point No. 1 mine in the Hiawatha Coal Seam, which was not mined by Lion Coal Company, and the Star Point No. 2 Mine in the Wattis Coal Seam, previously known as the Wattis No. 1 Mine, from 1967 through the fall of 1971. United Nuclear Corporation acquired the Star Point Mines in the fall of 1971. Modernization of the coal mine started when the Lion Deck portal area was expanded in October 1977. United Nuclear Corporation operated the mine until July 1980. Plateau Mining Corporation (PMC) operated the Star Point Mine until February 2000. The current permittee is Plateau Mining Corporation, a subsidiary of RAG American Coal Holding, Inc., changed from Cyprus Plateau Mining Corporation in 1999. Historically, the Star Point No. 2 Mine developed coal resources in the Hiawatha, Third, and Wattis seams by the room and pillar, and longwall mining methods with an annual production of 1 to 3 million tons.

Following the permanent cessation of operations in the spring of 2000, PMC began reclamation activities. Reclamation in 2000 dealt with: the demolition of the overland conveyor system and preparation plant; the removal of equipment and machinery from underground; the demolition, backfilling and grading, and reseeding of the Corner Canyon (0.44 acres) and Mudwater Canyon (1.10 acres) Fan sites; and the sealing of the portals at the Lion Deck. As a footnote to the backfilling and grading activities at the remote fan sites, PMC earned a 2001 Earth Day Award for outstanding results following applications of innovative environmental technology for backfilling remote locations from within the mine (outside-in).

Reclamation activities continued in 2001 with further demolition, backfilling and grading, and reseeding activities on approximately 45.0 acres, which include the following: 1) No. 1 Mine Area encompassing 35.0 acres; and 2) Unit Train Loadout and Silo area encompassing 10.0 acres.

During 2002, demolition, backfilling and grading, and revegetation operations were performed on approximately 47.0 acres. The reclaimed acres are as follows: 1) 24.5 acres associated with the Lions Deck and Pond 1 Areas; and 2) 22.5 acres associated with the Overland Conveyor and Main Channel Areas.

In 2003, reclamation related activities were completed with the abandonment of water monitoring wells, boreholes, and minor backfilling and/or fencing of subsidence cracks. During this year, PMC demonstrated that subsidence has substantially ceased and through the permit amendment process received approval from DOGM to discontinue further subsidence monitoring.

The Star Point Refuse pile and associated topsoil stockpile areas were removed from Permit C/007/006 in November 2003, and permitted by Sunnyside Cogeneration Associates under a new Permit C/007/042 for use as a fuel source for their power generating facility.

All demolition, backfilling and grading, and revegetation activities have been completed at the Star Point Mine.

## RECLAMATION PRACTICES

## BACKFILLING AND GRADING

The coal regulatory program requires that mined lands be returned to Approximate Original Contour (AOC) to provide for the restoration of the affected area to a condition which is at least, fully capable of supporting the pre-mining land use. A finding that AOC has been achieved means that; the permittee has demonstrated a basis for approval of the designs presented in the Mining and Reclamation Plan, the Division has evaluated and documented its approval of the designs in a Technical Analysis and, that upon implementation and completion of the backfilling and grading and other techniques required to achieve AOC, all performance standards required by reclamation are achieved. The requirements for AOC cannot be found in any one portion of the regulations, but are a compilation of performance standards which pertain to backfilling and grading, revegetation, land use, and protection of the hydrologic resources.

Prior to backfilling and grading the disturbed area, with the exception of the remote fan sites, the entire area was flown in 2001 in order to generate a pre-reclamation topography. Following the reclamation work completed in 2002, the entire site was flown again in the summer of 2003 in order to generate the as-built topography.

Maps 542.200a, 542.200b, and 542.200c reflect this new as-built topography which meets the requirements for AOC. Considering the reclamation challenges pre-SMCRA and steep-slope mine sites present, the permittee overcame the challenges and believes it met or exceeded expectations. In addition to supporting the postmining land use of wildlife habitat and grazing,

PMC also performed reclamation to support the industrial land use for oil and gas exploration, development and conveyance. The industrial postmining land use was achieved and Phase III bond release for the area was approved in December 2003.

The topography within the disturbed area is at 2-foot contours and reclamation cross-sections presented on Maps 542.200d1, 542.200d2, 542.200d3, 542.200e1, 542.200e2, 542.200f, 542.200g, and 542.200h depict the operational, approved, and as-built topography with Map 761d presenting the as-built channel cross-sections.

**Lion Deck**

Since the mine is an underground mine, little if any spoil was generated; therefore, spoil material was not available for backfilling of the pre-SMCRA highwall and other cutslopes at the Lion Deck, so PMC utilized coal processing waste as the backfilling media. Approximately 113,532 cubic yards of coal waste was hauled from the main channel area and placed on the Lion Deck. Following the placement and grading of the coal waste, approximately 54,502 cubic yards of the side-cast material, making up a portion of the made-lands, was mined in benches and used to cover the coal waste with a thickness of 4-feet. In addition to the 54,502 cubic yards used to cover the coal waste, an additional 14,700 cubic yards was used to fill the stope hole for a total cut of 69,202 cubic yards.

Table 542.200a (Exhibit A), and in Section 500, of the mining and reclamation plan reflects the as-built cut and fill balance. The areas that received coal waste and the areas where the growth media was removed are shown on Maps 542.200a, 542.200b, 542.00a1, 542.200a2, and 542.200a3.

Complete elimination of the pre-SMCRA highwall was not possible due to the Gentry Mountain Road (County Road 290). For long term stability purposes the county road had to be constructed on a stable surface (cut versus fill). Therefore, the road was relocated off of the side-cast fill slope and moved inward towards the highwall; thereby, reducing the amount of highwall and cutslopes that can backfilled and achieve the 1.3 static safety factor.

The only way to place fill material higher on the highwall is to increase the slope angle or move the road to a less stable surface. Slope stability information is presented in Section 542.200 of the mining and reclamation plan. To avoid shallow surface failures and minimize erosion the slope angle should average 2H:1V. Since the slope will be concave, the upper section of the backfill could be increased to 1.8H:1V.

When looking at the as-built reclamation cross-section E-E', there remains 3-5 feet more of a pre-SMCRA highwall than anticipated at the Lion Deck. The approved reclamation plan showed approximately 50 feet of the pre-SMCRA highwall being eliminated, but during the backfilling and grading activities, 45- 47 feet of the pre-SMCRA highwall was eliminated. Complete elimination of the pre-SMCRA highwall is due to County Road 290 that traverses across the

Lion Deck and in-front of this highwall. To allow unrestricted access by the pubic and private property owners to Gentry Mountain, County Road 290 had to be reconstructed to facilitate the postmining land use.

The Division's letter dated March 19, 2004 (Exhibit A), further clarifies issues regarding highwall remnant retention.

All portals on the Lion Deck were sealed in accordance with the approved plan. The attached (Exhibit B) final closure Map titled "Star Point No. 2 Mine Lion Wattis Seam" was submitted to MSHA in 2001. This map shows the Lion Deck portals sealed in December 2000. Final Closure Maps were submitted to MSHA in January 2001 with a complete set sent to DOGM on February 9, 2001 (Exhibit B).

A letter from MSHA to OSM (Exhibit B), dated January 26, 2001, discusses the final mine maps and request to enter the maps into the Mine Map Repository.

## Unit Train Loadout Area

The unit train loadout area once facilitated a 200-foot tall by 90-foot wide 10,000-ton concrete silo and associated conveyors and transfer structures. The concrete silo was razed by Ms. Ruth Anderson (Salt Lake Seismic Services) through the use of explosives in accordance with an approved blasting plan. Prior to razing of the silo, a trench was dug immediately adjacent to the silo for it to fall in to and the area be reclaimed back to a pad for Utah Railway. The silo was razed in September 2001.

Following the razing of the silo backfilling and grading activities commenced on the area supporting the conveyor and transfer structures. The re-contoured area is shown on Map 542.200c.

The main reason for the difference between the approved reclamation design and the as-built reclamation is the limitations caused by only having 10' contours when the reclamation plan was developed. The 10' contours did not define the channel alignments correctly and the cutslopes were not well defined. As a result, the approved reclamation design showed some undisturbed areas being disturbed as part of reclamation and some disturbed areas not being reclaimed at all.

During reclamation construction, cutslopes were covered to the extent possible without cutting into or covering undisturbed areas. Cross-section H-3 to H-3' is very different from the approved plan because the cutslope was covered over 10' higher than the approved design shows. To accomplish this, the shape of the area was modified from the design. The reclaimed area slopes towards channel SPRD-35 more than shown on the approved plan. The cross-section parallels the slope on the actual reclaimed surface while it ran nearly perpendicular to the slope on the approved reclamation plan. Thus, it appears that less of the cutslope was reclaimed when in actuality more of the cutslope was covered and just the shape of the reclaimed surface was changed.

The approved design and actual reclamation in the vicinity of cross-section I-3 to I-3' is different because the reclamation design has part of the undisturbed drainage being filled-in to move the channel to the east.

As mentioned above, undisturbed areas were left alone as much as possible during reclamation. Thus, the cross-sections of the reclamation design and actual reclamation surface are different.

In the approved reclamation plan SPRD-36B was to be constructed on an extremely small watershed while no channel was to be built on an adjacent larger watershed. During construction, it was determined that a constructed channel would be far more beneficial on the larger watershed. Thus, SPRD-36b in the approved reclamation plan was moved and referred to as SPRD-35a on the as-built maps.

Channel SPRD-37 in the approved reclamation plan was not built because it was unnecessary and would not provide a benefit. Due to the Mancos Shale in this drainage the sediment load in the runoff is very high. The nearly flat slope of the proposed SPRD-37 would result in the constructed channel filling in with sediment not long after being built.

After filling, the channel with sediment the runoff would then find its own course. Knowing this it was determined that it would be more natural to place large rocks at the bottom of the three tributary drainages to dissipate energy and then spread the runoff over the reclaimed area. This would allow nature to find its own course and provide extra water to the reclaimed area to promote vegetation growth. Since the runoff will be depositing sediment as it slows down, the path taken by the runoff will be constantly changing. Whether a channel was built or not this would eventually occur. Therefore, it was decided to let nature have its way from the beginning instead of waiting a few years for nature to fill in the channel.

## No. 1 Mine Road Area

The material used as backfill and topsoil for this pre-SMCRA area came from the side-cast material used during the road and made-land construction and from the embankment of sediment pond 3. A soil investigation of the material was performed in 1997 and is further discussed in Section 240 of the mining and reclamation plan.

This area is shown on Maps 542.200a, 542.200b and 542.200c. Portal sealing of the No.1 Mine reclamation area is presented on the Maps titled "Star Point No. 1 Mine" and "Star Point No. 2 Mine Wattis Seam" in Exhibit B.

## Lower Facilities and Main Channel Area

Within this area (Map 542.200c), the pre-SMCRA coal waste that once filled the main channel was removed and either used as backfill material on the Lion Deck or placed on the refuse pile. Approximately 113,532 cubic yards was hauled and placed on the Lion Deck and approximately 209,773 cubic yards was placed on the refuse pile.

In the area where the preparation plant once stood, the Permittee reclaimed the land to facilitate the industrial postmining land use for oil and gas exploration and development. The industrial land use was achieved by Phillips/Conoco and the affected area received Phase III bond release in December 2003. This area is shown on Map 542.200c.

With respect to the refuse pile and substitute topsoil stockpile, it was acquired by Sunnyside Cogeneration Associates and is now permitted under C/007/042, effective November 2003. The coal processing waste stored in the refuse pile is used as a fuel source for the power generating facility located in East Carbon, Utah. The areas under permit C/007/042 are shown on Map 542.200c.

The Star Point Mine Permit discusses the bifurcation of the refuse pile from Permit C/007/006 to Permit C/007/042 and the industrial postmining land use for Phillips/Conoco. All warranty deeds, surface use, purchase, and lease agreements are presented in the Star Point mining and reclamation plan.

**Corner Canyon and Mudwater Canyon Fan Sites**

The reclamation work at the Corner Canyon (Map 542.200h) and Mudwater Canyon (Map 542.200g) fan portals and associated ventilation portals was very challenging and required the use of an innovative picket fence technique for which the Permittee received an Earth Day Award in 2001. The reclamation was done from the outside working back into the mine (outside-in versus inside-out). Like a gopher trying to backfill its hole as it goes back into its hole.

There are no roads to the site and all equipment had to be transported through the mine. To accomplish the difficult task of backfilling steep highwalls and cuts, PMC utilized an innovative method of constructing a log "picket fence" supported by cables. Using small conveyors and equipment, soil was piled behind the log fence. When the cables were released, the fence and soil fell, covering the disturbed area. The final results were slopes that closely match the surrounding area.

Some of the pre-SMCRA highwall remnants remain due to the lack of available spoil and other backfilling material. As stated above, there are no roads into this area which limited the type of equipment that could be used. The backfilling and grading was done with mine-scoops, a D-3 dozer, and a small conveyor belt and hopper.

At the Corner Canyon site, cut material was stored in the return following the construction of the site. During the backfilling and grading, this material was removed from the mine and placed against the highwalls and cutslopes. During the construction of the site, approximately 200 cubic yards of topsoil was salvaged and hauled through the mine and placed at the topsoil stockpile across from the refuse pile. When it came time to redistribute this soil material it had to be hauled up to the Lion Deck portal and then hauled through the mine in scoops to Corner Canyon and redistributed.

At the pre-SMCRA Mudwater Canyon site, most of the backfill and growth media had to come from the pad area (made-land). The material available for backfilling purposes was limited

because much of the fill material was lost during construction. This is the main reason why remnants of the highwalls remain. PMC did however, utilize some clean underground development waste stored in the mine for use as backfill to augment the available fill material to eliminate as much of the highwall as possible.

The Division's letter dated March 19, 2004 (Exhibit A), further clarifies issues regarding highwall remnant retention.

Portal sealing of the Corner Canyon and Mudwater Canyon portals are presented on the Maps titled "Star Point No. 2 Mine 2nd West Mains Wattis Seam" and "Star Point No. 2 Mine Main West Middle Seam", respectively, in Exhibit B.

**Roads**

The only road that remained to support the postmining land uses is County Road 290 (Gentry Mountain Road). The roads that once supported the mining operation have been reclaimed, transferred to Sunnyside Cogeneration Associates, or retained to support the postmining land uses. This is shown on the Table 534.200a (Exhibit A) and discussed in Section 542.600 of the mining and reclamation plan.

The section of the oiled (asphalted) county road that required some minor rehabilitation work was inspected by the County Engineer and his approval of the work in presented in Exhibit A.

## TOPSOIL/GROWTH MEDIA RESOURCES

Due to the majority of the surface disturbance being pre-SMCRA, topsoil resources were not salvaged for redistribution during reclamation. With the lack of topsoil resources, suitable growth media was identified and used for reclamation purposes. Much of the growth media was generated from the side-cast material placed during the construction of access roads, building pads, pond embankments, parking lots, and other made lands.

The actual placement of the growth media/topsoil resources occurred concurrently with the backfilling and grading activities. Soil resources are distributed onto the graded areas as soon as possible and prepared for reseeding. Once the appropriate depth of soil cover is applied, approximately 2 tons per acre on certified noxious weed free hay is spread and mixed into the soil resource. After the seed is distributed, an additional 1.5 tons per acre of certified noxious weed free straw is spread over the area and then tacked together with approximately 500 pounds per acre of tackifier and hydrolmulch.

During the incorporation of the hay into the soil, deep gouges (approximately 18"to 24"deep) are created by the track-hoe equipment for the purpose of, but not limited too: controlling sediment

and erosion, harvesting precipitation, entrapment of seed, and creating micro-climates that will enhance the opportunity for revegetation success.

The only nutrients added to the soil resources are the organic material associated with the hay and straw. No fertilizers were used during reclamation. It has been PMC's experience that fertilizer is not necessary and only encourages the growth of annual weeds that compete against the native species for nutrients and water.

It should be noted however, that no further roughening of the fill material, other than that already created by the dozers and track-hoes, and that performed during the deep gouging process, was performed prior to the placement of growth media. The deep gouging technique typically provides for the roughening of the fill and soil interface.

More information regarding the soil resources can be found in Section 200 of the Star Point Mine Permit.

## REVEGETATION

Once the backfilling and grading activities were completed for each respective area, the soils were prepared for seeding by incorporating 2 tons/acre of certified noxious weed free hay into the soil and the establishing of deep gouges for sediment treatment and water harvesting purposes. Shortly after the soil was prepared, seeding was performed and approximately 1.5 tons/acre of certified noxious weed free straw was scattered over the reseeded areas, followed by approximately 500 pounds/acre of hydromulch and tackifier. The main purpose of the hydromulch and tackifier is to bind the straw together whereby a semblance of a mat is created to keep the straw in place and provide further erosion control.

More information regarding biology and vegetation can be found in Section 300 of the Star Point Mine Permit. Copies of the seed mixes used and seedlings transplanted are provided in the 2000, 2001, and 2002 annual reports when the reclamation reseeding was performed.

## HYDROLOGY

Reclamation channels were constructed to meet or exceed the minimum design criteria set forth in Utah's R645 Coal rules. The design and as-built of the reclamation channels is presented in Appendix 761c in Section 700 of the Star Point Mine Permit. Information presented in Appendix 761c demonstrates that the constructed reclamation channels can handle the peak flow generated by the 10-year, 6-hour design storm and for the 100-year, 6-hour design storm for the main channel (SPRD-31).

As-built reclamation watersheds and diversions are presented on Maps 761a, 761b, and 761c. As-built reclamation channel cross-sections are presented on Map 761d.

## BOND RELEASE

Plateau Mining Corporation (PMC) is requesting a 60% reduction in its bond in accordance with R645-301-880.310. At the completion of Phase I, after the operator completes the backfilling and regarding (which may include the replacement of topsoil) and drainage control of a bonded area in accordance with the approved reclamation plan, 60 percent of the bond can be released.

Therefore, PMC is requesting a 60% reduction to its $7,796,000 bond. The reduction by $4,678,000 (rounded to nearest $1,000) will leave a $3,118,000 bond.

Based on the provided as-built topography and drainage control, PMC has adequately demonstrated that it has met or exceeded the approved backfilling and grading plan. This can be easily confirmed when observing Maps 521.200d1, 542.200d2, 542.200d3, 542.200e1, 542.200e2, 542.200f, 542.200g, and 542.200h. The cross-sections depict the approved design topography and the as-built topography for ease of comparison.

Furthermore, all topsoil and/or other substitute growth media has been placed, prepared, and seeded. The reclamation of the Star Point Mine achieved the approved plan and facilitates the permitted multiple land uses.

# EXHIBIT A

TABLES AND CORRESPONDENCE

## TABLE 542.200a
## AS-BUILT CUT and FILL BALANCE[a]

| Area | Cut Quantity ($yd^3$) | Fill Quantity ($yd^3$) | Difference ($yd^3$) |
|---|---|---|---|
| Lion Deck | 69,202 | 182,734 | +113,532 |
| Pond 1 | 29,906 | 24,075 | -5,831 |
| Pond 2 | 14,656 | 14,415 | -241 |
| Main channel and lower facilities | 419,764 | 96,459 | -323,305[b] |
| Refuse pile [1] | | | |
| No. 1 and 2 Mine roads | 32,801 | 31,557 | -1,244 |
| No. 1 Mine | 54,864 | 57,352 | +2,488 |
| No. 2 Mine | 1,137 | 1,780 | +643 |
| Lion Deck road repair | 2320 | 2320 | 0 |
| Exploration road | 1,566 | 1,566 | 0 |
| Pond 6 [1] | | | |
| Pond 7 | 1,589 | 196 | -1,393 |
| Pond 8 | 3,824 | 3,157 | -667 |
| Subsoil stockpile [1] | | | |
| Refuse pile test plots [1] | | | |
| Topsoil pile north of test plots | 14,117 | 819 | -13,298[c] |
| Unit train loadout area and conveyor | 5,561 | 17,287 | +11,726 |
| Mudwater Canyon fan portal | 1,659 | 2,965 | +1,306 |
| Corner Canyon fan portal | 7.0 | 6,144 | +6,137 |
| Little Park fan portal [d] | | | |
| Total | 652,973 | 442,826 | - 210,147 |

[1] Permitted by Sunnyside Cogeneration Associates (SCA) under Permit C/007/042
[a] Caluclated using Softdesk® Civil/Survey, Version 7.5-7.6
[b] Material to be moved to Lion Deck and Refuse Pile (SCA Agreement)
[c] Material to be used in reclamation of the Main Channel and/or Lion Deck areas
[d] Little Park fan portal was never constructed.

Revised: 04/04

**TABLE 534.200a**
**Road Specifications**

| ROAD | SURFACE TYPE | SURFACE WIDTH | LENGTH | MAXIMUM GRADE % | MINIMUM GRADE % | AVERAGE GRADE % |
|---|---|---|---|---|---|---|
| 'A'[1] | Asphalt & Gravel | 24' to 34' | 3.71 miles | 1.5 | 1.6 | 7 |
| 'B'[2] | Asphalt & Gravel | 24' | 1.83 miles | 13.4 | 1 | 9.4 |
| 'C'[1] | Gravel | 20' | 0.55 miles | 4.2 | 0.9 | 2.8 |
| 'D'[1] | Gravel | 20' | 0.18 miles | 13.3 | 0.4 | 5.3 |
| 'E'[2] | Asphalt | 24' | 0.15 miles | 6.5 | 6.5 | 6.5 |
| 'F'[2] | Dirt & Gravel | 12' | 0.08 miles | 4.3 | 0.0 | 2.6 |
| 'G'[3] | Dirt & Gravel | 12' | 0.40 miles | 13.9 | 0 | 4.7 |
| 'H'[2] | Railroad Track | 5' | 0.65 miles | 3.5 | 1 | 2.1 |
| 'I'[2] | Gravel | 12' | 0.37 miles | 18.1 | 18.1 | 18.1 |
| 'J'[4] | Gravel | 15' | 0.71 miles | 0.74 | 0.74 | 0.74 |
| 'K'[2] | Gravel | 12' | 0.18 miles | 5.5 | 5.5 | 5.5 |

[1] County Road 290 – Provides post mining land use for access to Gentry Mountain
[2] Road removed during reclamation
[3] Road transferred to Sunnyside Cogeneration Associates Permit C/007/042 in November 2003
[4] Utah Railway's access to their tracks

State of Utah

Department of
Natural Resources

Division of
Oil, Gas & Mining

ROBERT L. MORGAN
*Executive Director*

LOWELL P. BRAXTON
*Division Director*

OLENE S. WALKER
*Governor*

GAYLE F. McKEACHNIE
*Lieutenant Governor*

March 19, 2004

Johnny Pappas, Sr. Environmental Engineer
Plateau Mining Corporation
P.O. Box 30
Helper, Utah 84526-0030

Re: The Division's Findings on Highwall Retention at the Lion Deck, Corner Canyon and Mudwater Canyon Portal Areas, Plateau Mining Corporation, Star Point Mine, C/007/006, Task ID #1768, Outgoing File

Dear Mr. Pappas:

In a conversation that you had with Wayne Western on February 26, 2004, you requested that the Division provide you with the findings that the Division made on highwall remnants that will be retained at the Star Point Mine. The following information should address your concerns.

**Highwall Remnant Retention at the Lion Deck Area:**

On February 14, 2002, Plateau Mining Corporation submitted a revised reclamation plan for the Lion Deck area because of the availability of improved topographic maps and changes to the reclamation plan for the conveyor belt access road. The revised reclamation plan for the Lion Deck area called for concave slopes to replace the approved straight postmining slopes. The concave design allowed for increased slope heights without decreased stability.

The higher postmining slopes eliminated or reduced the highwalls scheduled to remain after reclamation. However, some highwall remnants would remain.

R645-301-553.650 required the Division to make specific findings in writings before approval of highwall remnant retention. The Division stated the findings in Technical Analysis AM02B-2, dated July 22, 2002 and a summary of the finds is as follows:

When the Division evaluated the reclamation plan, they found that the regulations conflicted because:

- R645-301-553.120, Eliminate all highwalls with the exception of pre-SMCRA highwalls at sites where lack of reasonably available fill prevents total reclamation. Volume calculations for the Star Point Mine showed that there is enough fill material for total highwall elimination.

- R645-301-553.130, Postmining slopes will not exceed the angle of repose and the slopes must have a safety factor of 1.3 or greater. In order to achieve a safety factor of 1.3 some of the slopes used to reclaim highwalls would have to extent on to County Road 290. The reclaimed slopes would block the road.

- R645-301-553.150, The reclaimed site must support the approved postmining land use that included keeping County Road 290 open. Therefore, the toe of the reclaimed slopes cannot extent onto the right of way for County Road 290.

The highwalls were constructed pre-SMCRA so that the limitations of eliminating the highwall remnants and keeping County Road 290 open existed at the time of the initial permit. County Road 290 is in a steep canyon with many cliffs so moving the road is not possible. The only options the Division had during the initial permit process was to deny the permit or require road closure at reclamation.

When the Division first permitted the Star Point Mine, they examined those issues. Closing County Road 290 was not possible because neither the Division nor the applicant had the authority to close the road and the county insisted that the road to remain open. Because the postmining slopes would be next to County Road 290, the main concern was public safety. Therefore, the Division required the Permittee to construct slopes that had a safety factor of 1.3.

The revised reclamation plan called for more highwall elimination or reduction due to higher postmining slopes. The concave design allowed increased slope heights without decreased stability. Because of those advantages over the existing plan, the Division approved the amendment.

**Minimum Safety Factor for Highwall Remnants at the Lion Deck Portal Area:**

The slope stability calculations for the Lion Deck area are in Exhibit 553.130a of the mining and reclamation plan. In those calculations, PMC demonstrated that the reclaimed slopes would have a safety factor of 1.3.

The slope stability calculations do not cover all the reclaimed highwall slopes. R645-301-553.530 allows alternative methods for determining slope stability for highwall remnants. In the Technical Analysis dated July 22, 2002, the Division approved PMC to backfill slopes to a 2H: 1V grade with the upper sections of the slopes being at 1.8H: 1V. The Division has found slopes with that design are stable.

Both PMC and the Division assumed the highwall remnant designs stable because the remnants are similar to the stable natural cliffs and bedrock outcrops in the area. Therefore, the Division concluded that allowing highwall remnants to remain is not a hazard to the public or the environment.

**Why Not All of Available Fill Material Was Used to Eliminate More of the Highwall Remnants at the Lion Deck Portal Area:**

R645-301-553.600, All highwalls must be eliminated with the exception of pre-SMCRA highwalls at site where there is not enough fill to complete reclamation. There is abundant fill material at the site. As mentioned earlier, the regulatory requirement to eliminate highwalls whenever there is available fill material conflicts with leaving County Road 290 open and the stability requirements.

**Why the Highwall Remnants Will Not be a Danger to the Public or the Environment at the Lion Deck Portal Area:**

The highwall remnants will not be a danger to the public or the environment because:

- The reclaimed slopes have a safety factor of 1.3.
- The highwall remnants are in solid bedrock and are a safe.
- PMC used roughening techniques such as pocking to minimize erosion until vegetation is established.
- PMC seeded the slopes so that vegetation would stabilize the soils.

**Why Some As-Built Slopes Expose More of the Highwalls than Anticipated:**

PMC must address this issue. Mr. Pappas did state to Mr. Western on February 26, 2004 that a mistake was made but the effects were minimal.

**Highwall Retention at Mudwater Canyon and Corner Canyon:**

PMC received the annual Earth Day award in 2001 for the innovative technique they used to reclaim the pre-SMCRA portals at Mudwater Canyon and Corner Canyon. The miners at both sites constructed the portals as breakouts. The only access for mechanized equipment is through the mine. Therefore, type and size of equipment that can reach a site is limited.

The traditional way to reclaim a remote breakout is to use small earthmoving equipment to reclaim the area around the portal, remove move the equipment and then push fill out the portal. That technique prevented reclamation of the highwalls because the miners could not place material above the portals.

PMC used innovative techniques to reclaim Mudwater Canyon and Corner Canyon. PMC constructed a log fence above each portal, placed backfill material

behind the log fences and then collapsed the log fences. The backfill material slide down and covered the highwalls ten to fifteen feet above the portals. PMC did not eliminate all the highwalls but the highwall remnants that remained were smaller than at comparable sites.

The factors that prevented the elimination of highwalls at Mudwater Canyon and Corner Canyon are as follows:

- The portals are on slopes that are at or near the angle of repose. Such slopes have safety factors of 1.0, and R645-301-553.100 requires that reclaimed slopes have a safety factor of 1.3. Eliminating the highwalls would require restoring the site to the original configuration. At the original configuration, the slopes would not meet the safety factor requirements.

- The limitations PMC faced transporting equipment through the mine. While no regulation allows for highwall retention due to equipment limitation the Division recognizes those limitations when they evaluated the reclamation plan for pre-SMCRA sites.

- Much of the fill material at the sites was lost during construction. Therefore, the amount of available fill was limited.

- PMC seeded the sites so that vegetation would stabilize the soils. During annual inspections of the sites, the Division found that the vegetation was adequate to prevent erosion. The Division considers those sites environmentally stable.

Since the sites are in remote locations therefore, only a small number of people will visit the area. While the highwalls are a potential hazard, they are similar to natural cliffs in the areas. The Division does not consider the highwalls to be a significant public hazard.

I hope that you find this information helpful. If you have any questions, please call me at (801) 538-5268 or Wayne Western at (801) 538-5263.

Sincerely,

Pamela Grubaugh-Littig
Permit Supervisor

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# CARBON COUNTY
## PRICE, UTAH 84501

April 7, 2004

Carbon County Board of Commissioners

Re: ***Cyprus Plateau Road***

Dear Commissioners:

Ray Hanson and I have reviewed the road today with Johnny Pappas representing Cyprus Plateau. As of April 7, 2004, the road in general is in good repair and that portion that had washed out a couple years ago has been satisfactorily repaired. Cyprus Plateau requires a letter from the County Attorney as soon as possible stating that the repairs have been inspected and approved.

Sincerely,

Evan Hansen

Evan Hansen, County Engineer

Ray Hanson

Ray Hanson, County Road Supervisor

# **EXHIBIT B**

CORRESPONDENCE AND MSHA CLOSURE MAPS

Willow Creek Mine
847 NW Hwy 191
Helper, Utah 84526
(435) 472-0475
Fax: (435) 472-4780

# PLATEAU MINING CORPORATION

An affiliate of RAG

February 9, 2001

Mr. Daron R. Haddock
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

**Re:** **Star Point Mine MSHA Final Closure Maps, Plateau Mining Corporation, Star Point Mine, C/007/006, Carbon County, Utah**

Dear Mr. Haddock:

Plateau Mining Corporation (PMC) is submitting a courtesy copy of the aforemention as submitted to MSHA. If the Division has any questions, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

Enclosures

File: Star Point Mine - MSHA Final Closure
Chrono: JP010204.ltr

John Kuzar
MSHA

**RE:** Plateau Mining Corporation: Star Point No. 2 Mine, MSHA ID # 42-00171 and Star Point No. 1 Mine, MSHA ID # 42-00170 Final Mine Closure Maps

Dear Mr. Kuzar:

Enclosed are the final mine closure maps for the Star Point #2 Mine and the Star Point #1 Mine. The grid system on the Star Point #2 maps are State Plane coordinates and a coordinate grid conversion to State Plane coordinates is included on the Star Point #1 map.

The enclosed maps are as follows:

**Star Point No. 2 Mine**

Lion, Wattis Seam
Third Main South, Wattis Seam
2ND West Mains, Wattis Seam
South Mains, Wattis Seam
Third North Mains, Wattis Seam
Third North Mains, Wattis Seam Map 2
Wattis Seam (For Mine Workings Reference East of the Lion Portal)
Mudwater, Middle Seam
2ND North Mains, Middle Seam
Main West, Middle Seam
SL031286, Hiawatha Seam

**Star Point No. 1 Mine**

Star Point No. 1 Mine

MSHA

| UNDERGROUND MINE FILE |
|---|
| DATE FWD. 1-26-01 |
| INITIALS BB |

Diane Bent

| Surname | Date |
|---|---|
| Hansen | 1-25-01 |
| Hughes | 1/25 |
| Watts | 1/25/01 |
| | |
| | |

Coal Mine Safety and Health
District 9

JAN 26 2001

Greig Robertson
U. S. Dept. of Interior
Office of Surface Mining
Mine Map Repository
3 Parkway Center
Greentree, PA 15220

RE: Star Point No. 2 Mine
Mine ID. No. 42-00171
Star Point No. 1 Mine
Mine ID. No. 42-00170

Dear Mr. Robertson:

Enclosed is a copy of the final mine maps for the subject mines. These mines are owned by Plateau Mining Corporation, are located near Helper, Utah, and are currently sealed.

Please enter the maps into the Mine Map Repository. Enclosed for your information are copies of the Legal Identity Reports for the Star Point No. 1 and No. 2 Mines. Please return the mine closure maps, bearing the microfilm catalog numbers assigned by the Office of Surface Mining (OSM). The approximate longitude and latitude for the mine location is as follows:

Longitude: 111 degrees W, Latitude: 39.5 degrees N

If there are any questions concerning these requests, please contact Sid Hansen at 303-231-5463.

Sincerely,

**/s/ John A. Kuzar**

John A. Kuzar
District Manager

Enclosure

bcc: EC Plan File
VG - Chron 1193022
[redacted]
file: vent\sih\4200171\finalmap.wpd