

Table 1
Volumes and Soil Balance

Table 1 - ERL Landfill Capacity and Remaining Soil Requirements		
Gross Airspace	15,911,666	CY
Remaining Airspace	8,700,571	CY
Total Area	132.4	Acre
Module 1	61.2	Acre
Module 2	36.1	Acre
Module 3	35.1	Acre
General Fill Soil Required to Bring Subgrade Up	35,535	CY
Protective Cover Soil over Liner Needed	94,577	CY
AFC FC Soil Required	746,610	CY
Synthetic FC Soil Required	320,858	CY
Soil for Tack On Berms	58,317	CY
Intermediate Cover Soil Required	213,372	CY
Remaining Waste Capacity	7,830,514	CY
Total Waste Capacity	14,320,499	CY
Remaining Daily Cover Required (10% of Remaining Airspace)	870,057	CY
Total Soil Requirements		
Using AFC	2,018,468	CY
Using Synthtetic Final Cover	1,592,716	CY
Available Soil from future Excavation	1,251,935	CY
Soil Deficit using AFC	-766,533	CY
Soil Deficit using Synthetic FC	-340,781	CY

Figure 1
Site Location Map

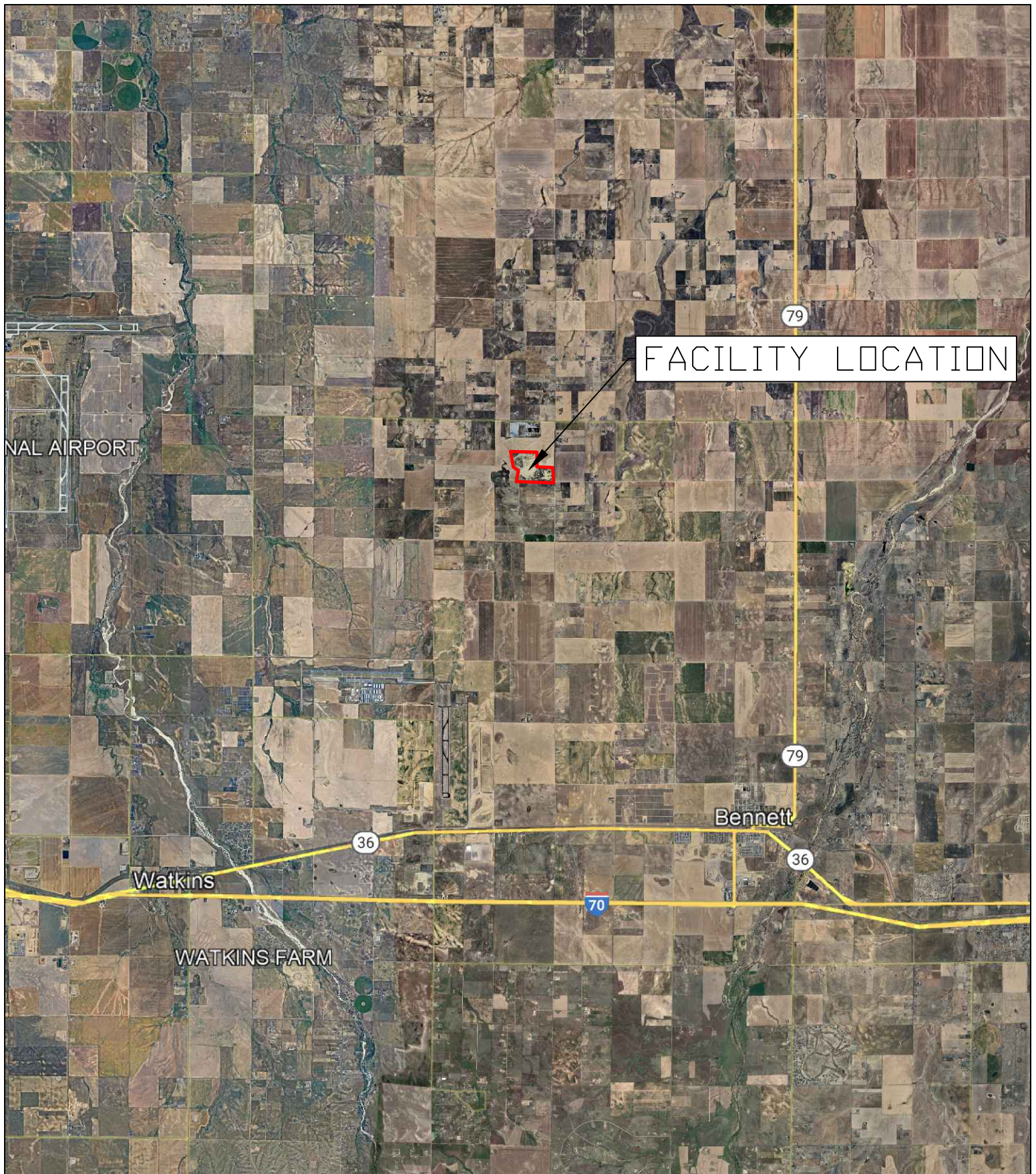


FIGURE
1 OF 2

ERL FACILITY LOCATION

ERL EXPANSION EDOP

ADAMS COUNTY

DATE: 12/4/2024

DRAWN BY: RDS



0 KM

6 KM

AEC AMERICAN
ENVIRONMENTAL
CONSULTING, LLC.

8191 Southpark Lane, Suite 107, Littleton, CO 80120
phone 303-948-7733 fax 303-948-7739

Figure 2
Commercial Hauler Route

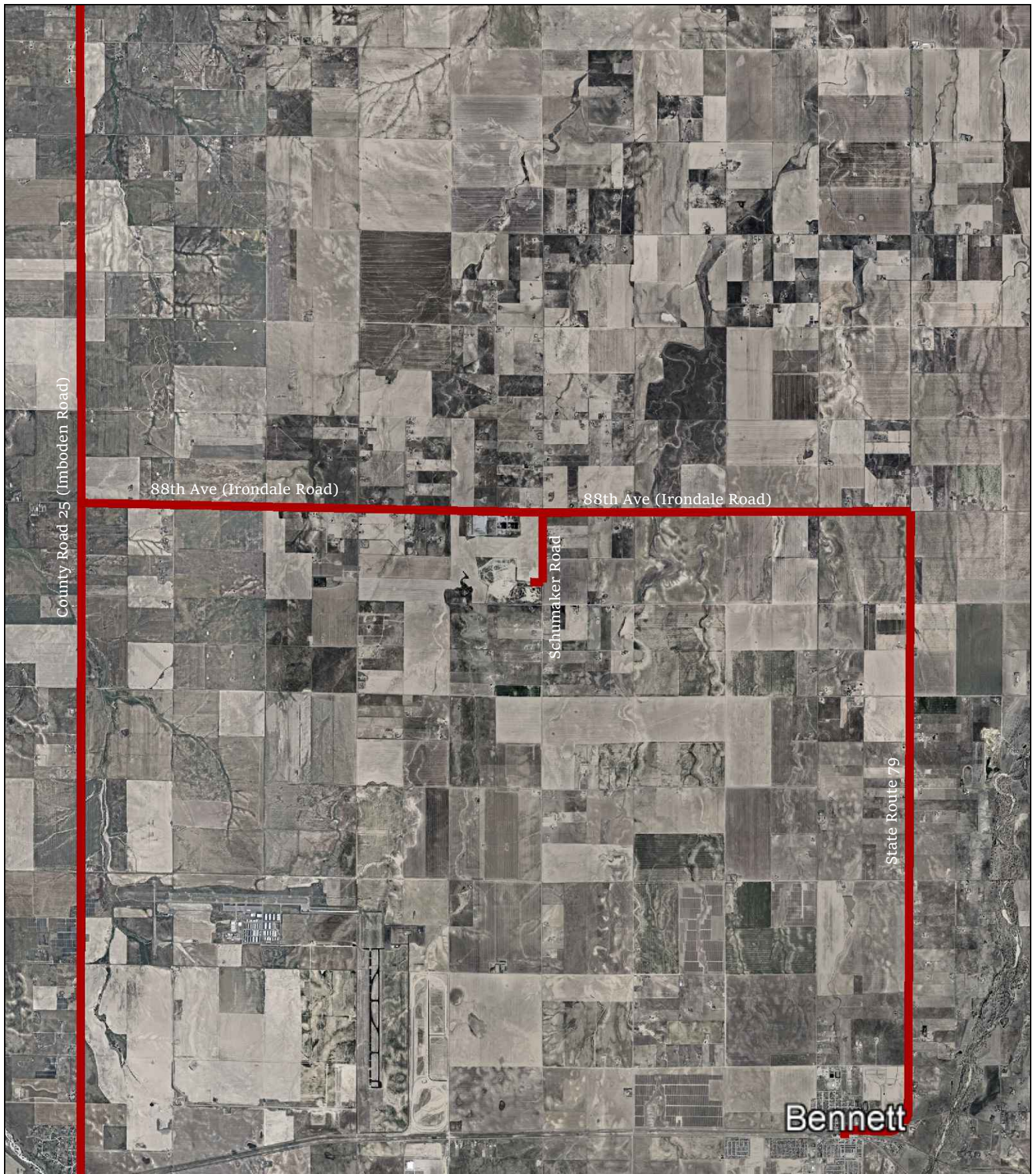
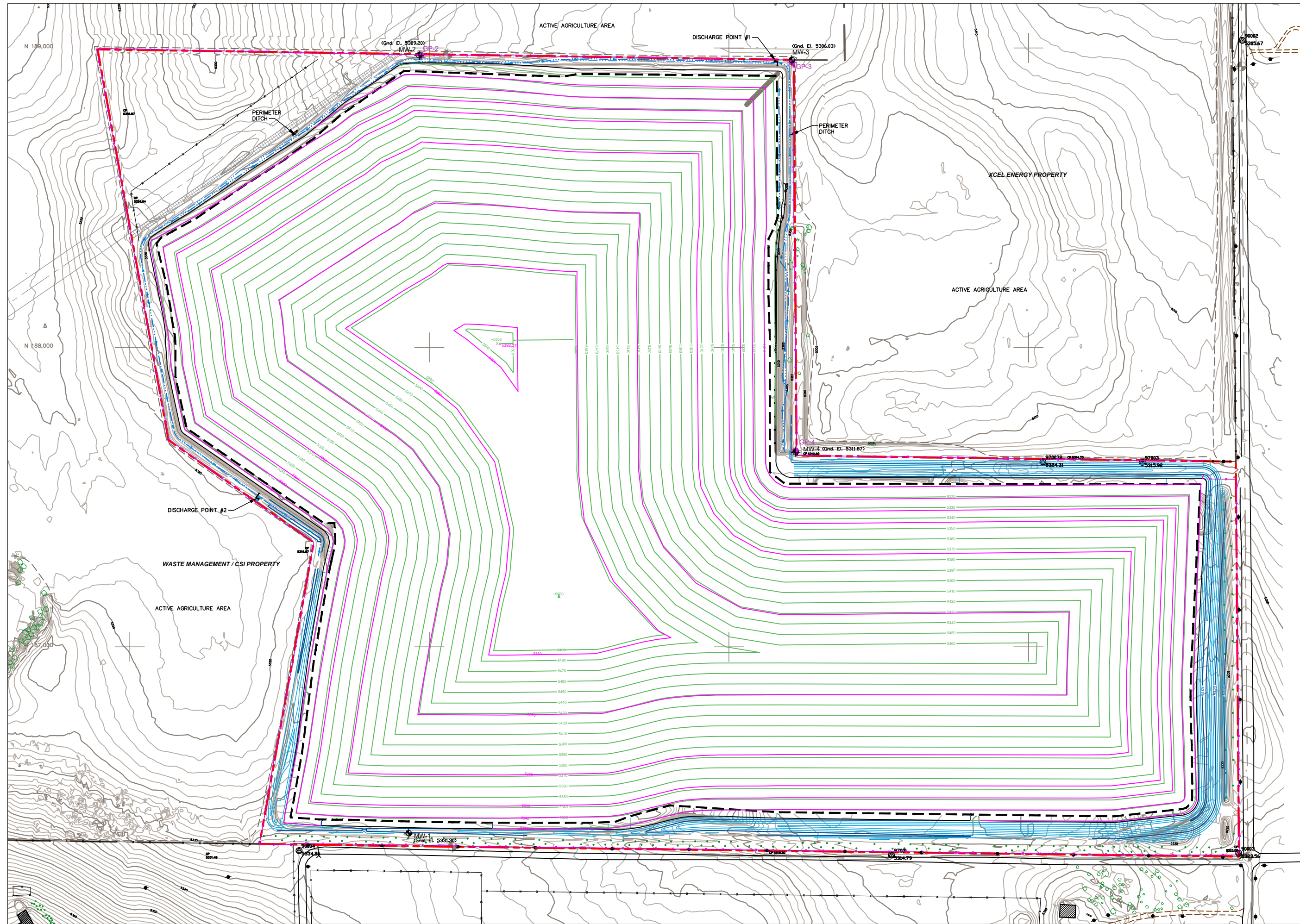


FIGURE 2 OF 2	ERL HAULING ACCESS ROUTES				AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC. 8191 Southpark Lane, Suite 107, Littleton, CO 80120 phone 303-948-7733 fax 303-948-7739
	ERL EXPANSION EDOP				
	ADAMS COUNTY				
	DATE: 12/4/2024	DRAWN BY: RDS			

Drawings



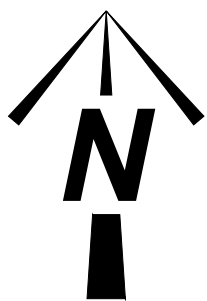
EAST REGIONAL LANDFILL

LANDFILL VERTICAL EXPANSION DESIGN DRAWINGS EAST REGIONAL LANDFILL BENNETT, COLORADO

FEBRUARY 2025

LIST OF SHEET:

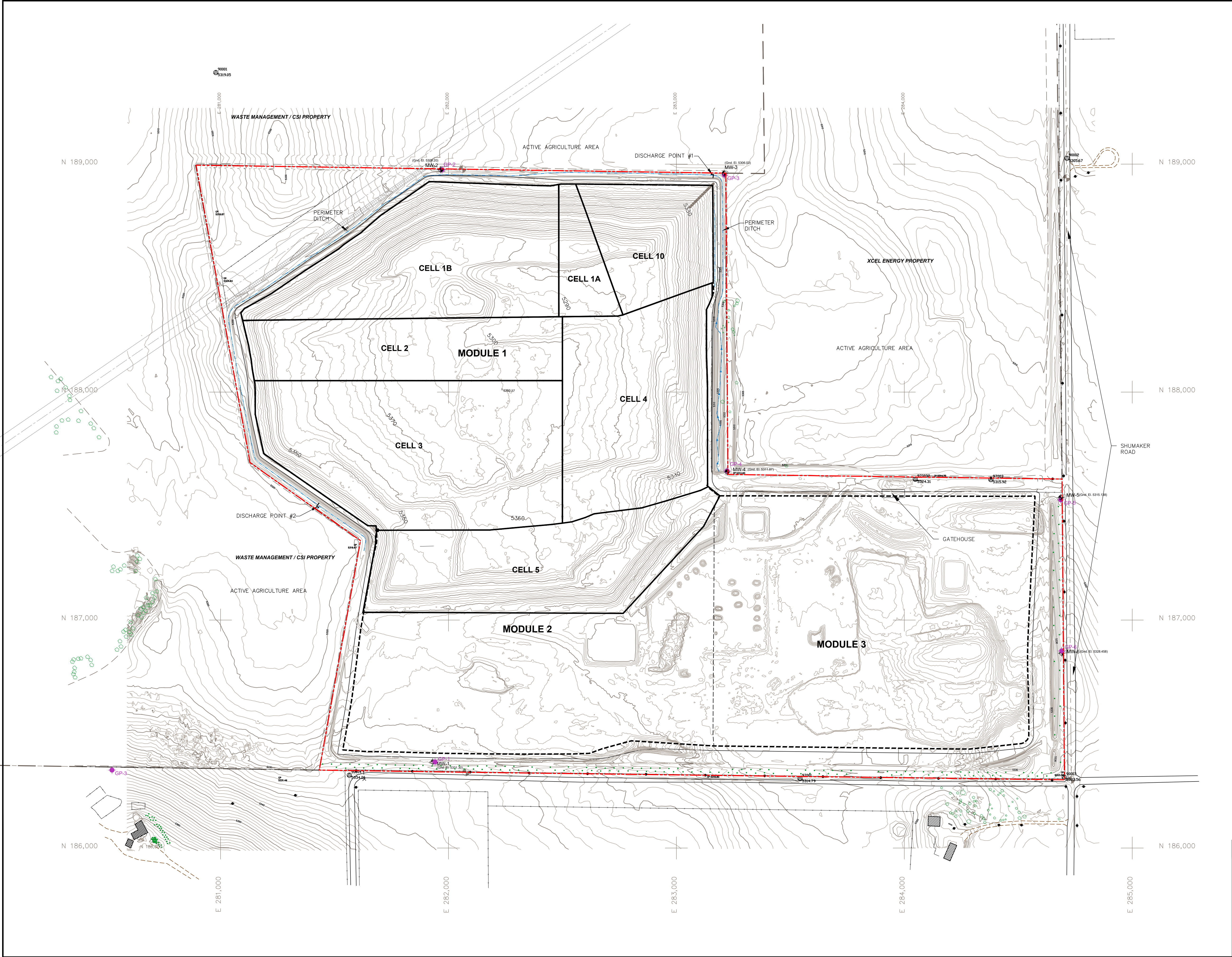
- NO. 1 COVER SHEET
- NO. 2 EXISTING CONDITIONS
- NO. 3A EXCAVATION PLAN - CCL OPTION
- NO. 3B EXCAVATION PLAN - GCL OPTION
- NO. 4 FINAL COVER PLAN WITH MONITORING LOCATIONS
- NO. 5 LINER DETAILS
- NO. 6 COVER DETAILS
- NO. 7 SUMP DETAILS
- NO. 8A STORMWATER AND SURFACE WATER CONTROL
- NO. 8B STORMWATER AND SURFACE WATER CONTROL DETAILS



PREPARED FOR:
FIVE PART DEVELOPMENT, LLC
BENNETT, COLORADO

PREPARED BY:
AMERICAN ENVIRONMENTAL CONSULTING, LLC
8191 SOUTHPARK LANE
SUITE 107
LITTLETON, COLORADO 80120

PLATE 1 COVER SHEET EAST REGIONAL LANDFILL BENNETT, COLORADO	
CLIENT: ADAMS COUNTY, COLORADO	
PROJECT: EAST REGIONAL LANDFILL	
PROJECT NO:	DATE COMPLETED: 6/2024
DESIGNED BY: AEC	APPROVED BY: CJA
DRAWN BY: TML	DWG NAME: PLATE 1 ERL COVER SHEET
REVISION:	REVISED BY: RDS DATE: 06/2024
0 ISSUED FOR REVIEW	
AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.	



LEGEND

- 5315 EXISTING CONTOURS (2 FT. INTERVAL)
- EXISTING AS-BUILT CELL LIMITS
- PROPOSED LIMIT OF WASTE
- PROPERTY LIMIT (BY R.W. BAYER & ASSOCIATES, 2007)
- 5007 PROPERTY CORNER SURVEY POINT (BY R.W. BAYER & ASSOCIATES, 2007, REBAR, CAP FOUND OR SET)
- ADJOINING PROPERTY BOUNDARY
- GAS PIPELINE RIGHT OF WAY
- AS BUILT STORM WATER DRAINAGE FLOW LINES
- GAS PIPELINE ACCESS ROAD
- SECTION MARKER
- MW-3 EXISTING GROUND WATER MONITORING LOCATION (APPROXIMATE HIGH GROUNDWATER ELEVATION)
- GP-2 EXISTING GAS MONITORING WELL LOCATION
- LANDSCAPED SCREENING BERM
- SCREENING TREE LOCATION
- SCREENING BUSH LOCATION

NOTE: PANEL CONTROL POINT LOCATIONS ARE SHOWN IN MODIFIED STATE PLANE THAT IS USED ON SITE FOR MONITORING, DESIGN AND CONSTRUCTION PURPOSES.

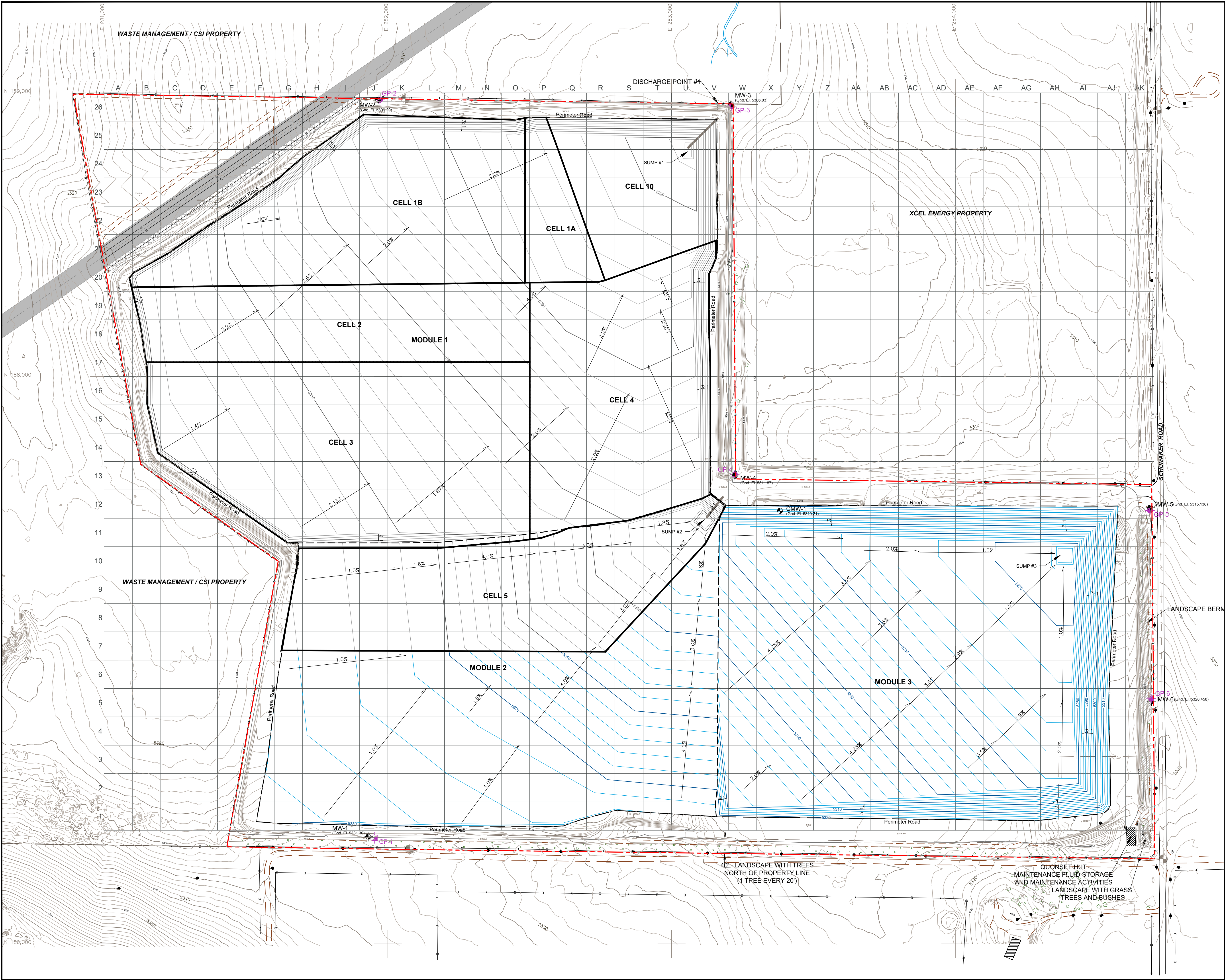
0 75 150 300
APPROXIMATE SCALE (FEET)

CONTOUR INTERVAL: 1'
DATE OF TOPOGRAPHY FLIGHT: 4/22/24
SURVEY BY COPPER AERIAL SURVEY CO.
Phoenix, Arizona

PLATE 2
2024 EXISTING CONDITIONS
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

CLIENT: FIVE PART DEVELOPMENT, LLC	
PROJECT: ERL EXPANSION 2024	DATE COMPLETED: 12/24
PROJECT NO:	APPROVED BY:
DESIGNED BY: AEC	DWG. NAME: PLATE 2 ERL - EXISTING COND
DRAWN BY: RDS	REVISED BY: DATE:
REVISION:	
0 ISSUED FOR REVIEW	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



LEGEND

- 5315 EXISTING CONTOURS (2 FT. INTERVAL)
- 5300 APPROVED SUBGRADE CONTOURS (2 FT. INTERVAL)
- LIMITS OF WASTE FOOTPRINT / LINED AREA
- MODULE BOUNDARIES
- PROPERTY LIMIT (BY R.W. BAYER & ASSOCIATES, 2007)
- ADJOINING PROPERTY BOUNDARY
- GAS PIPELINE RIGHT OF WAY
- GAS PIPELINE ACCESS ROAD
- GAS PIPELINE
- SECTION MARKER (NOT VARIFIED)
- EXISTING GROUND WATER MONITORING LOCATION
- EXISTING GAS MONITORING WELL LOCATION
- ACTIVE AGRICULTURAL AREA
- EXISTING BUILDING
- EXISTING SUMP RISER PIPE
- LANDSCAPED SCREENING BERM
- SCREENING TREE LOCATION
- SITE AREA GRID SYSTEM

Note:
See legal discription for precise location of property boundary.



SCHEDULE OF GROUNDWATER MONITORING AND METHANE MONITORING GAS PROBE INSTALLATION

WELL	INSTALLATION SCHEDULE
MW-1	2007 - COMPLETED
MW-2	2007 - COMPLETED
MW-3	2007 - COMPLETED
MW-4	2010 - COMPLETED
MW-5	2021 - COMPLETED
MW-6	2021 - COMPLETED
GMP-1	PRIOR TO OPERATION IN MODULE 2
GMP-2	2010 - COMPLETED
GMP-3	2010 - COMPLETED
GMP-4	2010 - COMPLETED
GMP-5	2021 - COMPLETED
GMP-6	2021 - COMPLETED

- Notes:
- Groundwater monitoring wells must be installed a minimum of two years prior to beginning waste disposal operations in the Module designated above to allow a minimum of eight quarters of sample collection to define background water quality.
 - Monitoring of probes and wells must begin concurrent with the installation schedule shown above.

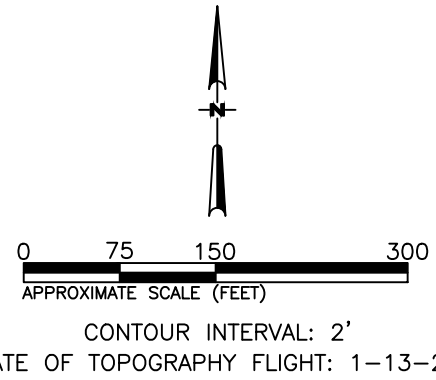
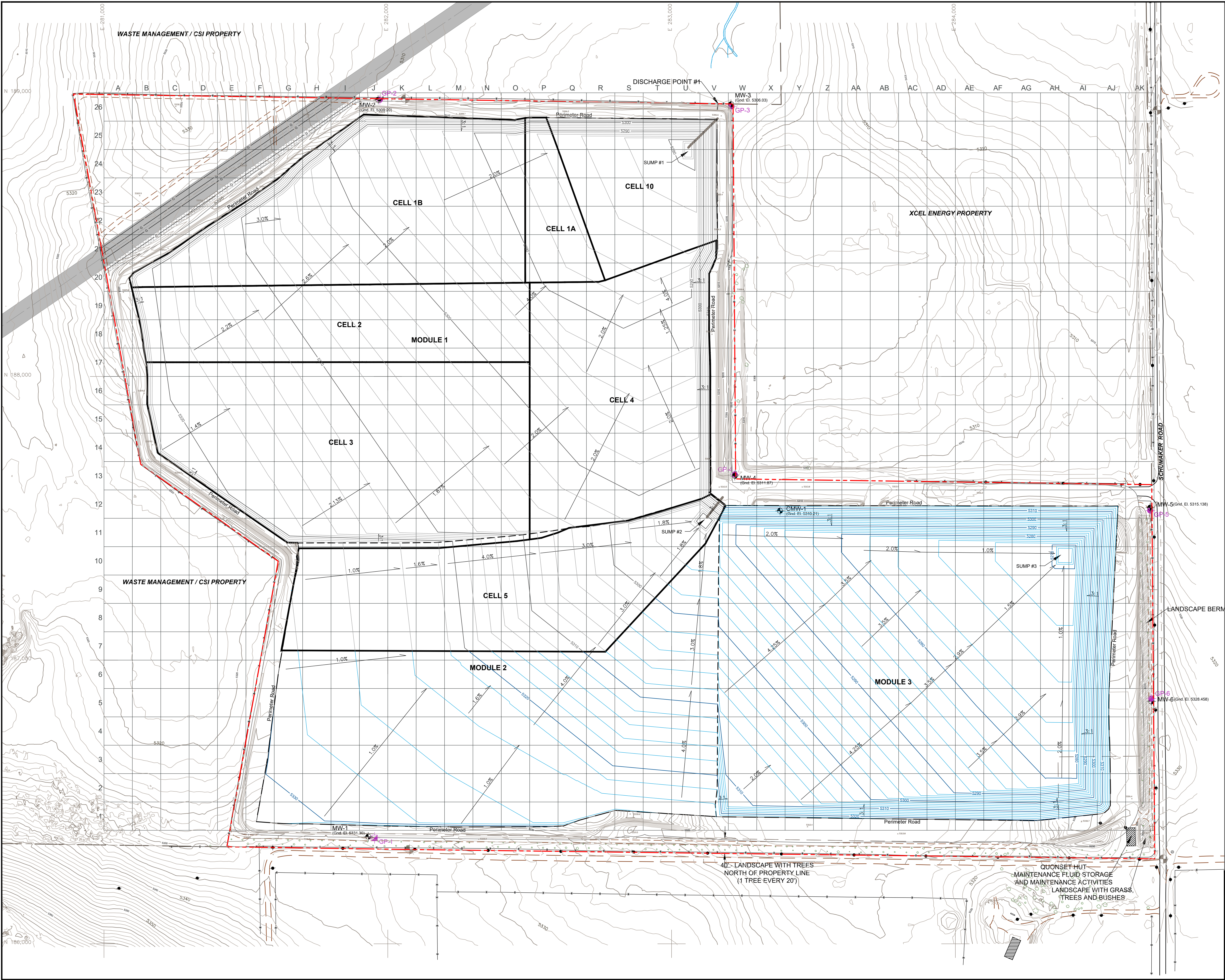


PLATE 3A
CLAY LINER OPTION EXCAVATION PLAN WITH SITE OPERATIONS GRID
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

CLIENT: FIVE PART DEVELOPMENT, LLC	PROJECT: 2024 EXPANSION EDP	DATE COMPLETED: 8/2013
DESIGNED BY: MAM	APPROVED BY: MAM	DWG NAME: PLATE 3A - CCL EXCAVATION PLAN.dwg
DRAWN BY: TML	REVISED BY: RDS	DATE: 12/24
REVISION:		
1. ISSUED FOR REVIEW		
2. UPDATE TO CURRENT, NO DESIGN CHANGE		

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



LEGEND

- 5315 EXISTING CONTOURS (2 FT. INTERVAL)
- 5300 APPROVED SUBGRADE CONTOURS (2 FT. INTERVAL)
- LIMITS OF WASTE FOOTPRINT / LINED AREA
- MODULE BOUNDARIES
- PROPERTY LIMIT (BY R.W. BAYER & ASSOCIATES, 2007)
- ADJOINING PROPERTY BOUNDARY
- GAS PIPELINE RIGHT OF WAY
- GAS PIPELINE ACCESS ROAD
- GAS PIPELINE
- SECTION MARKER (NOT VARIFIED)
- EXISTING GROUND WATER MONITORING LOCATION
- EXISTING GAS MONITORING WELL LOCATION
- ACTIVE AGRICULTURAL AREA
- EXISTING BUILDING
- EXISTING SUMP RISER PIPE
- LANDSCAPED SCREENING BERM
- SCREENING TREE LOCATION
- SITE AREA GRID SYSTEM

Note:
See legal discription for precise location of property boundary.



SCHEDULE OF GROUNDWATER MONITORING AND METHANE MONITORING GAS PROBE INSTALLATION

WELL	INSTALLATION SCHEDULE
MW-1	2007 - COMPLETED
MW-2	2007 - COMPLETED
MW-3	2007 - COMPLETED
MW-4	2010 - COMPLETED
MW-5	2021 - COMPLETED
MW-6	2021 - COMPLETED
GMP-1	PRIOR TO OPERATION IN MODULE 2
GMP-2	2010 - COMPLETED
GMP-3	2010 - COMPLETED
GMP-4	2010 - COMPLETED
GMP-5	2021 - COMPLETED
GMP-6	2021 - COMPLETED

- Notes:
- Groundwater monitoring wells must be installed a minimum of two years prior to beginning waste disposal operations in the Module designated above to allow a minimum of eight quarters of sample collection to define background water quality.
 - Monitoring of probes and wells must begin concurrent with the installation schedule shown above.

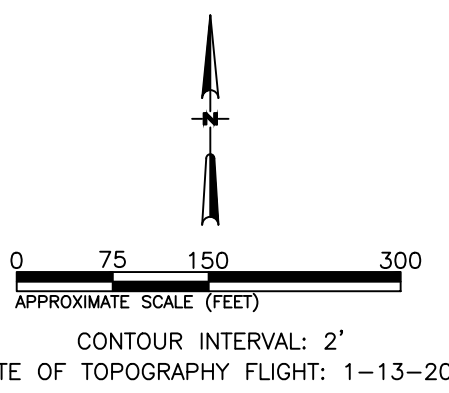
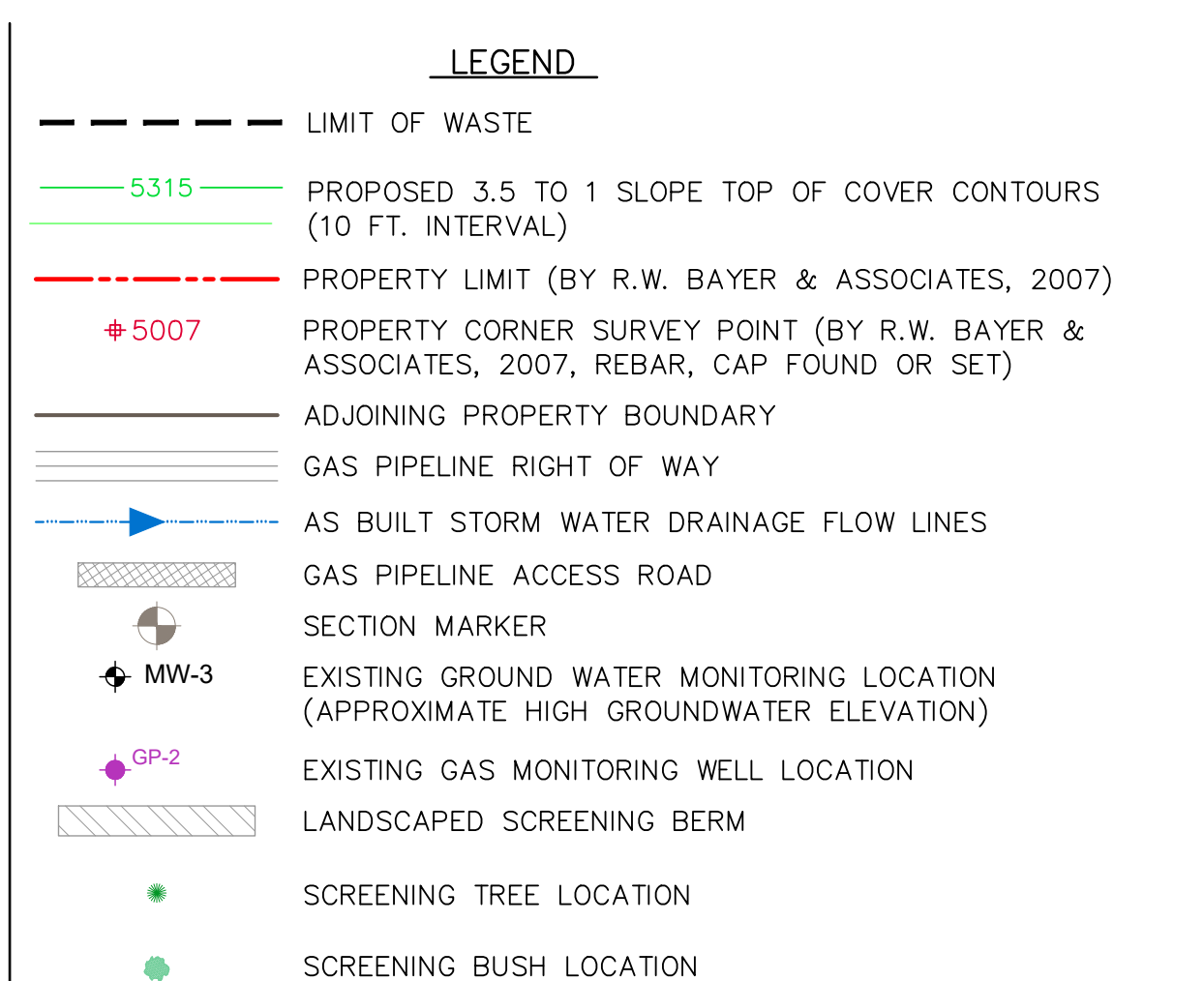


PLATE 3B
GCL OPTION EXCAVATION PLAN WITH SITE OPERATIONS GRID
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

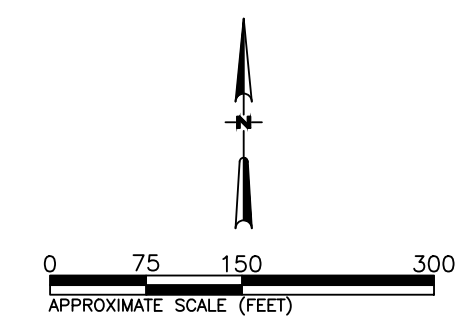
CLIENT: FIVE PART DEVELOPMENT, LLC	DATE COMPLETED: 8/2013
PROJECT: 2024 EXPANSION EDP	APPROVED BY: MAM
DESIGNED BY: MAM	DWG NAME: PLATE 3B - GCL EXCAVATION PLAN.dwg
DRAWN BY: TML	REVISED BY: RDS
REVISION:	DATE: 12/24
1 ISSUED FOR REVIEW	
2 UPDATE TO CURRENT, NO DESIGN CHANGE	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



TOTAL AIRSPACE VOLUME SUMMARY:	
	Fill (cu. Yds.)
Permitted Top of Cover	13,937,624
ADDITIONAL AIRSPACE FROM TOP OF PERMITTED FINAL COVER	
3.5:1 top of Cover	est 10,000,000

NOTE: PANEL CONTROL POINT LOCATIONS ARE SHOWN IN
MODIFIED STATE PLANE THAT IS USED ON SITE FOR
MONITORING, DESIGN AND CONSTRUCTION PURPOSES.



CONTOUR INTERVAL: 1'
DATE OF TOPOGRAPHY FLIGHT: 1/13/20
SURVEY BY COPPER AERIAL SURVEY CO.
Phoenix, Arizona

PLATE 4
EAST REGIONAL LANDFILL FINAL COVER PLAN
FIVE PART DEVELOPMENT
ADAMS COUNTY

CLIENT: FIVE PART DEVELOPMENT, LLC

PROJECT: VERTICAL EXPANSION

PROJECT NO:

DESIGNED BY: C

DRAWN BY: TML

REVISION:	
0	ISSUED FOR REVIEW

0	ISSUED FOR REVIEW
---	-------------------

DATE COMPLETED: 8/2024

DATE COMPLETED:	
APPROVED BY: BC	

DWG NAME:

REVISED BY:	DATE:
-------------	-------

[illegible]

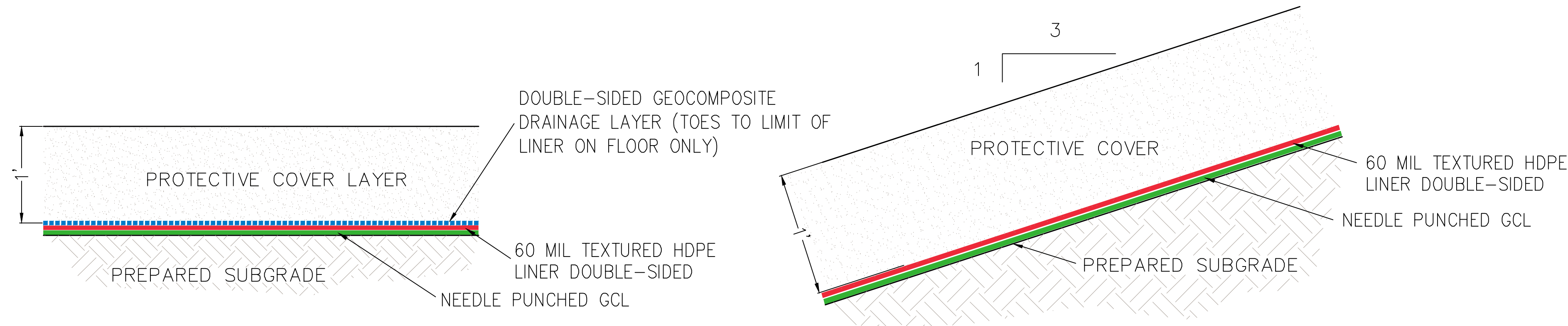
AFC AMERICA

AFI ENVIRONMENTAL

AEC ENVIRONMENTAL
CONSUMER

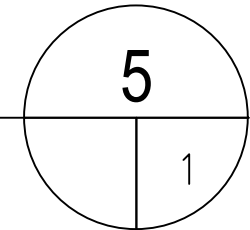
THE CONSUMERS

AEC AMERICAN
ENVIRONMENTAL
CONSULTING, LLC.



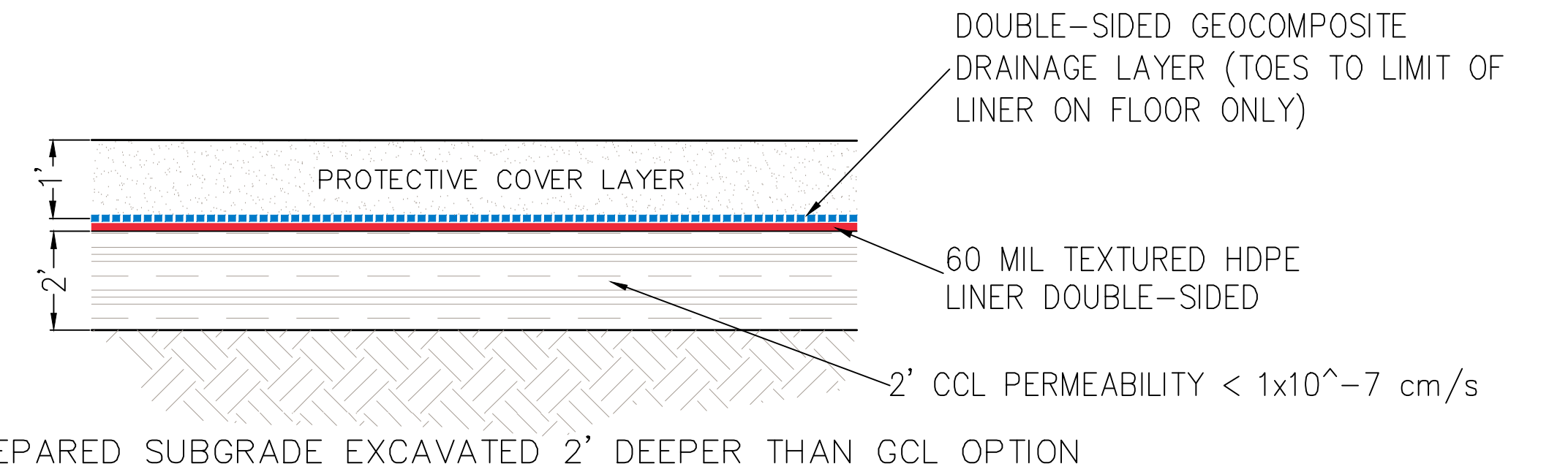
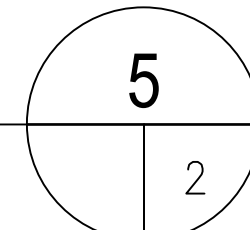
SECTION THROUGH LINER ON BOTTOM OF LANDFILL

DETAIL
SCALE: N.T.S.



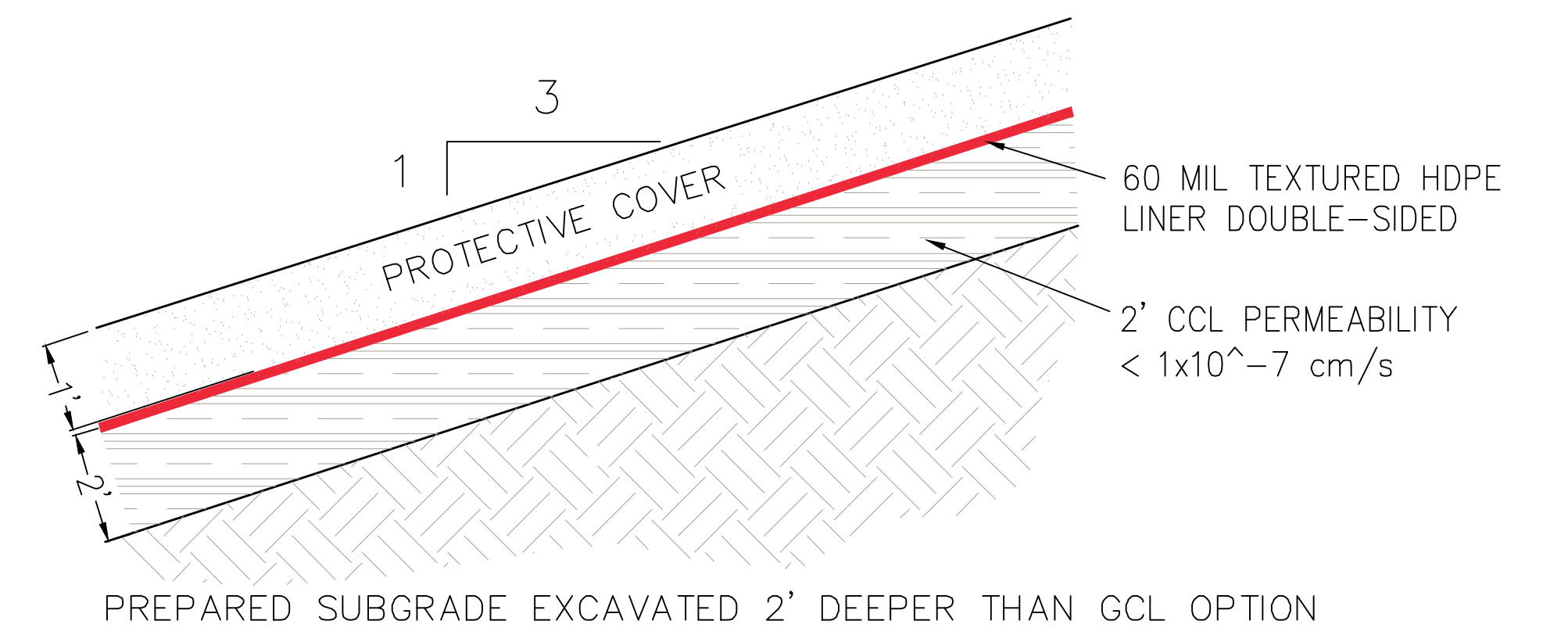
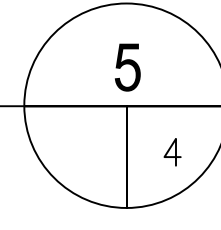
SECTION THROUGH LINER ON SIDE-SLOPE

DETAIL
SCALE: N.T.S.



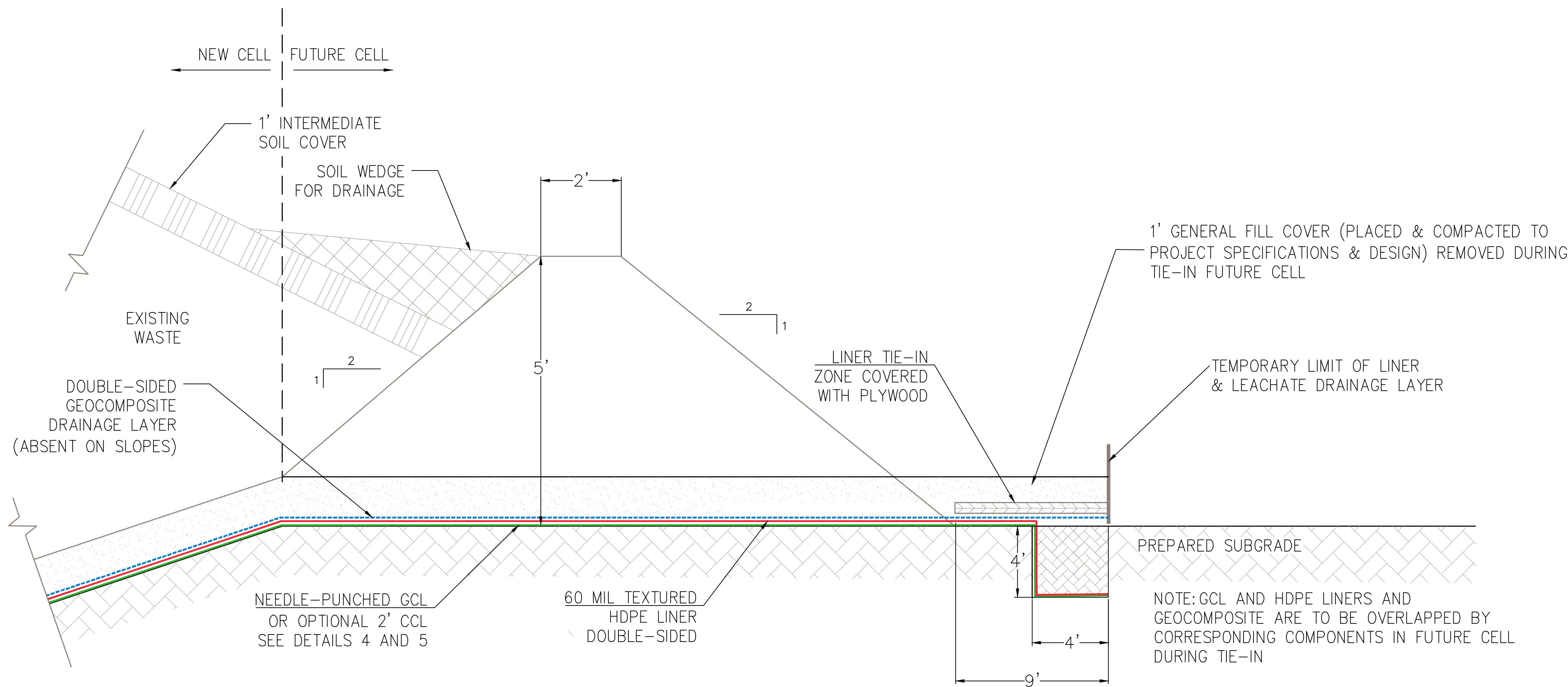
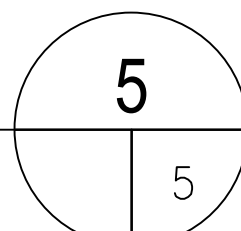
SECTION THROUGH LINER ON BOTTOM OF LANDFILL WITH OPTIONAL CCL

DETAIL
SCALE: N.T.S.



SECTION THROUGH LINER ON SIDE-SLOPE WITH OPTIONAL CCL

DETAIL
SCALE: N.T.S.



TYPICAL TEMPORARY BERM TIE IN

DETAIL
SCALE: N.T.S.

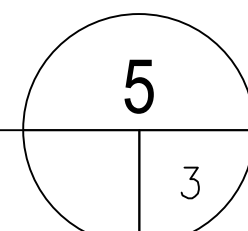


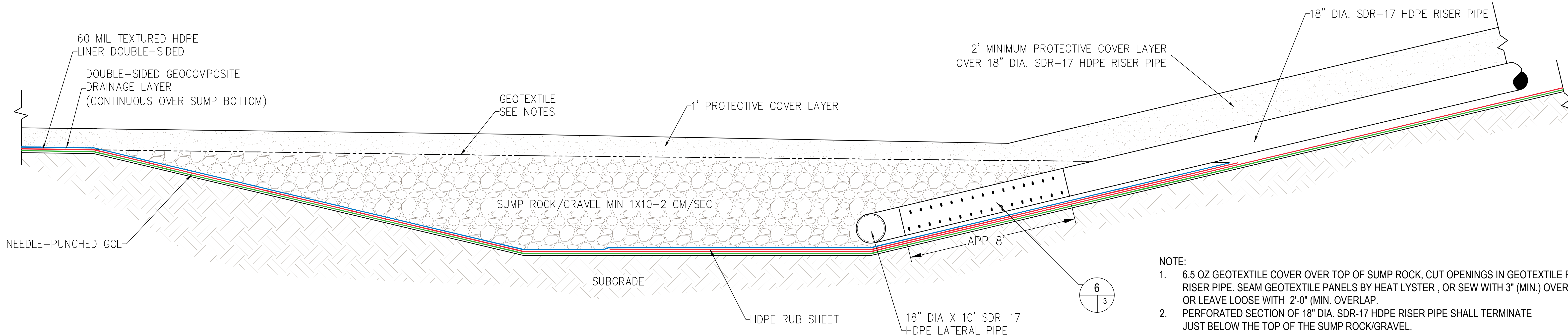
PLATE 5
LINER DETAILS
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

CLIENT: FIVE PART DEVELOPMENT, LCC			
PROJECT: 2024 ERL EXPANSION			
PROJECT NO:		DATE COMPLETED: 2/2022	
DESIGNED BY: AEC		APPROVED BY: MAM	
DRAWN BY: JGN/JGM		DWG NAME:PL-6-7 ERL_2021_MOD-2 CELL 5 DETAILS.dwg	
REVISION:		REVISED BY: RDS DATE: 8/2024	
1	2024 EDOP UPDATE, NO DESIGN CHANGES		

AEC

AMERICAN
ENVIRONMENTAL
CONSULTING, LLC.

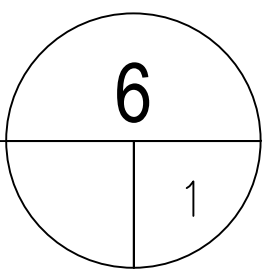
AEC AMERICAN
ENVIRONMENTAL
CONSULTING, LLC.



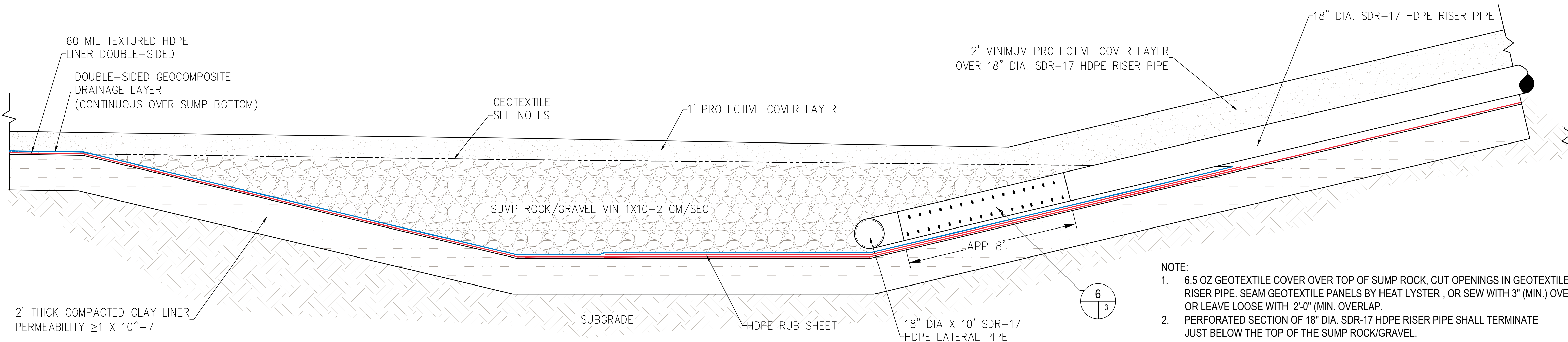
SUMP GCL OPTION - SECTION

DETAIL

SCALE: N.T.S.



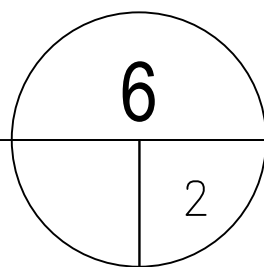
- NOTE:
- 6.5 OZ GEOTEXTILE COVER OVER TOP OF SUMP ROCK, CUT OPENINGS IN GEOTEXTILE FOR RISER PIPE. SEAM GEOTEXTILE PANELS BY HEAT LYSER , OR SEW WITH 3" (MIN.) OVERLAP, OR LEAVE LOOSE WITH 2'-0" (MIN. OVERLAP.
 - PERFORATED SECTION OF 18" DIA. SDR-17 HDPE RISER PIPE SHALL TERMINATE JUST BELOW THE TOP OF THE SUMP ROCK/GRAVEL.



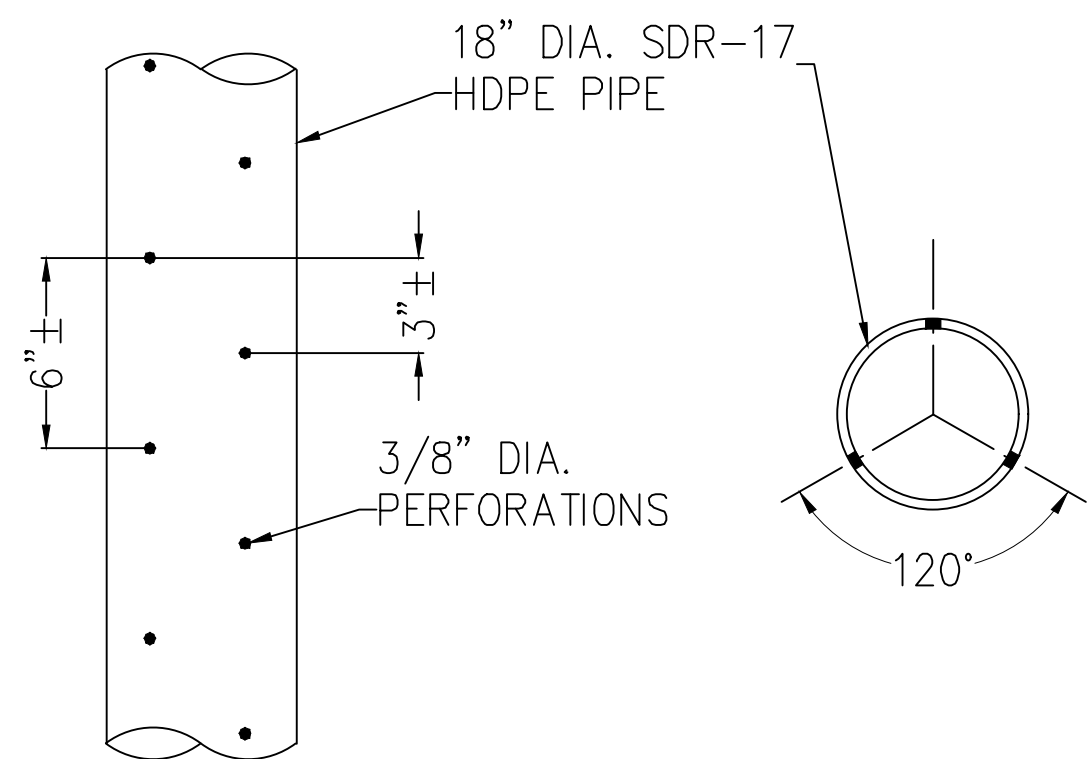
SUMP CCL OPTION - SECTION

DETAIL

SCALE: N.T.S.



- NOTE:
- 6.5 OZ GEOTEXTILE COVER OVER TOP OF SUMP ROCK, CUT OPENINGS IN GEOTEXTILE FOR RISER PIPE. SEAM GEOTEXTILE PANELS BY HEAT LYSER , OR SEW WITH 3" (MIN.) OVERLAP, OR LEAVE LOOSE WITH 2'-0" (MIN. OVERLAP.
 - PERFORATED SECTION OF 18" DIA. SDR-17 HDPE RISER PIPE SHALL TERMINATE JUST BELOW THE TOP OF THE SUMP ROCK/GRAVEL.



LEACHATE RISER AND LATERAL PIPE PERFORATION DETAIL

DETAIL

SCALE: N.T.S.

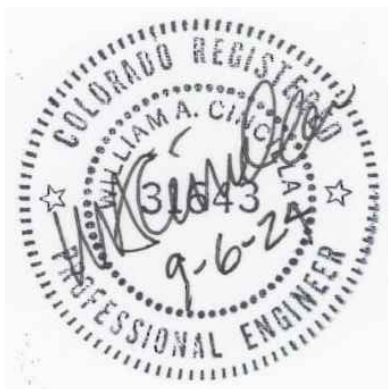
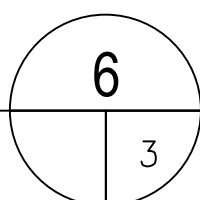
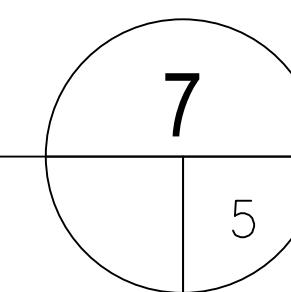
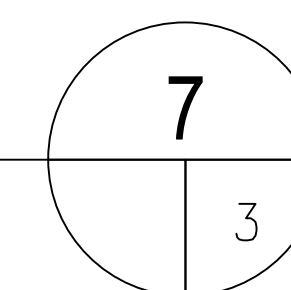
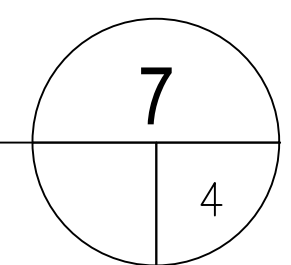
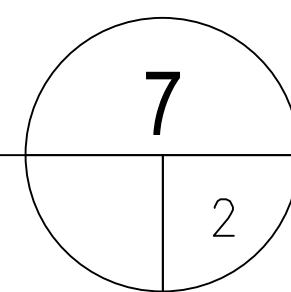
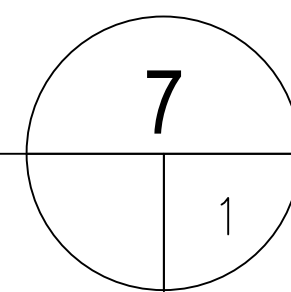
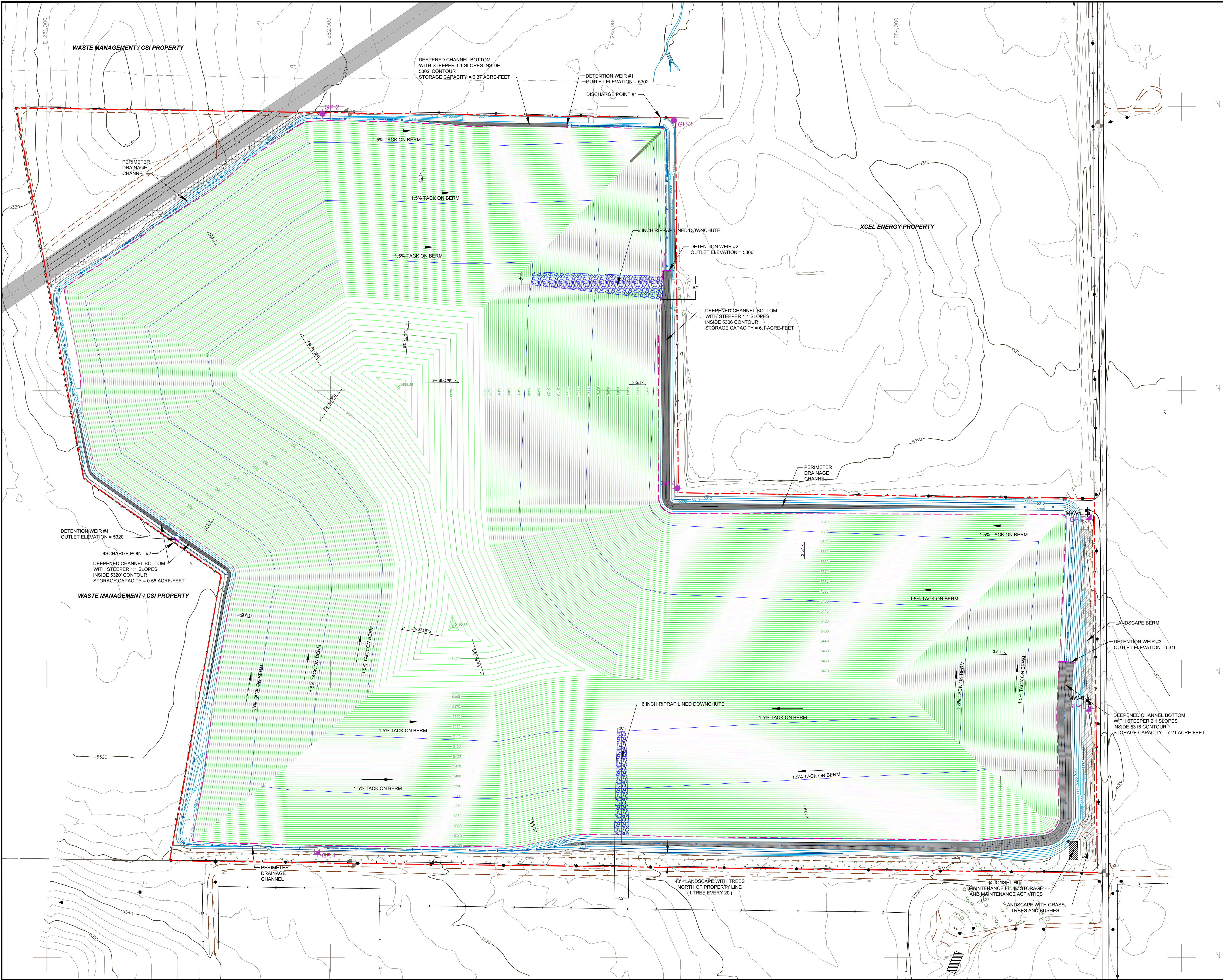


PLATE 6 SUMP DETAILS EAST REGIONAL LANDFILL ADAMS COUNTY, COLORADO		
CLIENT: FIVE PART DEVELOPMENT, LCC		
PROJECT: 2024 ERL EXPANSION		
PROJECT NO:		DATE COMPLETED: 2/2022
DESIGNED BY: AEC		APPROVED BY: MAM
DRAWN BY: RDS		DWG NAME: PL-6-7 ERL_2021_MOD-2 CELL 5 DETAILS.dwg
REVISION:		REVISED BY: RDS DATE: 8/2024
1	2024 EDOP UPDATE, NO DESIGN CHANGES	
		AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



AEC AMERICAN
ENVIRONMENTAL
CONSULTING, LLC.



LEGEND

- 5315 EXISTING CONTOURS (2 FT. INTERVAL)
- 5330 PROPOSED FINAL COVER CONTOURS (2 FT. INTERVAL)
- 5300 PERMITTED STORAGE DITCH CONTOURS (2 FT. INTERVAL)
- 5300 PROPOSED STORAGE DITCH CONTOURS (0.5 FT. INTERVAL)
- PROPOSED 1.5% TACK ON BERM
- LIMITS OF FINAL COVER
- PROPERTY LIMIT (BY R.W. BAYER & ASSOCIATES, 2007)
- PERIMETER DRAINAGE CHANNEL
- ADJOINING PROPERTY BOUNDARY
- GAS PIPELINE RIGHT OF WAY
- GAS PIPELINE ACCESS ROAD
- GAS PIPELINE
- SECTION MARKER (NOT VARIFIED)
- (Gnd. El. 5306.03) EXISTING GROUND WATER MONITORING LOCATION
- MW EXISTING GAS MONITORING WELL LOCATION
- GP EXISTING GAS MONITORING WELL LOCATION
- ACTIVE AGRICULTURAL AREA
- EXISTING BUILDING
- EXISTING SUMP RISER PIPE
- LANDSCAPED SCREENING BERM
- SCREENING TREE LOCATION
- SITE AREA GRID SYSTEM

Note:
See legal discription for precise location of property boundary.

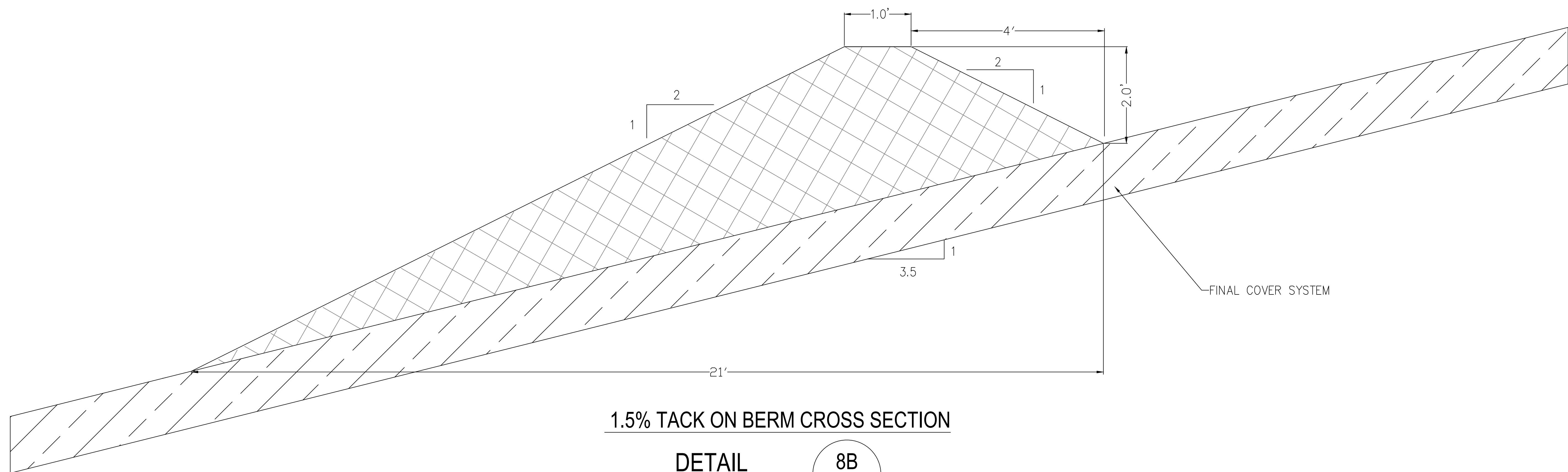
Professional Engineer Seal: J. J. Adams, No. 13643, State of Colorado, Professional Engineer, dated 9-6-22.

Scale: 0 75 150 300
APPROXIMATE SCALE (FEET)
CONTOUR INTERVAL: 2'
DATE OF TOPOGRAPHY FLIGHT: 1-6-12

PLATE 8A
SURFACE WATER MANAGEMENT PLAN
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

CLIENT: FIVE PART DEVELOPMENT, LLC	PROJECT: VERTICAL EXPANSION EDOP	DATE COMPLETED: 8/2013
DESIGNED BY: RDS	DRAWN BY: TML/RDS	APPROVED BY: WAC
REVISION: 2	ISSUED FOR REVIEW	DWG. NAME: DATE: 9/2024

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.

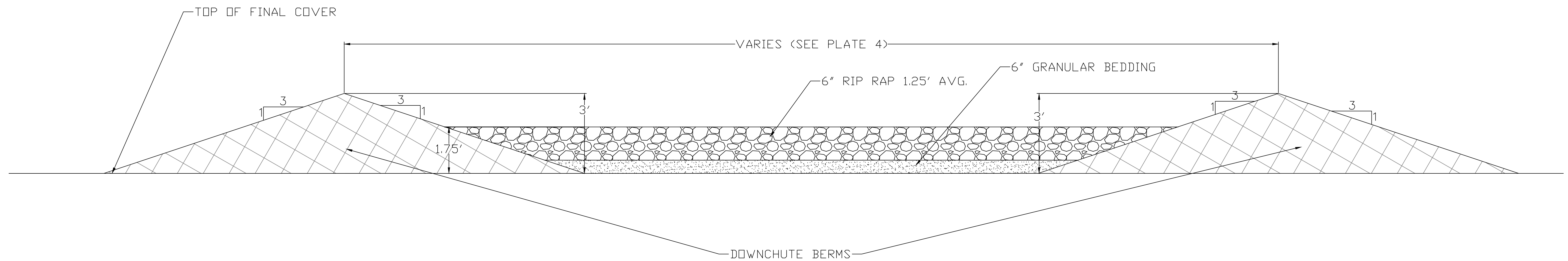


DETAIL

SCALE: N.T.S.

8B

—



DETAIL

SCALE: N.T.S.

8B

2



PLATE 8B STORMWATER CONTROL DETAILS EAST REGIONAL LANDFILL ADAMS COUNTY, COLORADO	
CLIENT: FIVE PART DEVELOPMENT, LLC	
PROJECT: 2024 ERL EXPANSION	
PROJECT NO:	DATE COMPLETED: 8/2024
DESIGNED BY: AEC	APPROVED BY: WAC
DRAWN BY: RDS	DWG NAME:
REVISION:	REVISED BY: DATE:
0 ISSUED FOR REVIEW	

Appendix A
Original (1993) EDOP and Original Site Characterization



Industrial Compliance

1746 Cole Blvd., Bldg. 21 #300 Golden, CO 80401 303/277-1400 FAX 303/277-1405

December 21, 1993

IC Project Number 061 4369

Board of County Commissioners
450 South 4th Avenue
Brighton, Colorado 80601

Dear Commissioners:

Enclosed is the revised Engineering Design and Operations Plan for the Metropolitan Coal Ash Disposal Facility located near the town of Bennett in Adams County, Colorado. The original application was submitted for County review on April 22, 1993. The facility received conditional approval following public hearings held on October 28 and November 8, 1993. This document is revised as required by the County Approval Resolution and incorporates all applicable conditions and stipulations set forth in the Resolution.

For ease of review, a reference letter is included stating the County conditions and stipulations, followed by the Section and Page in the document where these conditions and stipulations are addressed.

The Engineering Design and Operations Plan includes the following information:

- * Geologic, hydrologic, and hydrogeologic characteristics at the site
- * Description of the waste stream to be accepted
- * Design details
- * Facility operational features
- * Facility monitoring
- * Site reclamation and post-closure care

The facility meets current Adams County and State of Colorado solid waste requirements and is designed with anticipated future State regulations in mind.

Thank you for allowing Five Part Development and Public Service Company of Colorado to submit this document.

Respectfully,

Reviewed by:

INDUSTRIAL COMPLIANCE

Mark A. McMullen
Solid Waste Program Director

Gary R. Lake, P.E.
Senior Civil Engineer



Dedicated to solving your environmental problems.

A Subsidiary of SP Environmental Systems, Inc.



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GLOSSARY OF TERMS AND ACRONYMS

ASTM	American Society for Testing and Materials. Publishes standards for testing of various materials.
ALLUVIAL AQUIFER ZONE	An area delineated for the purposes of this application where the uppermost ground water is present within alluvial sands and gravels associated with an ephemeral stream. The Alluvial Aquifer Zone is outside of the proposed permit area.
AQUIFER	A geologic unit capable of yielding usable quantities of ground water to wells or springs.
BOTTOM ASH	One of two primary residues from the combustion of coal. Bottom ash is the heavier fraction of the combustion residue that falls to the bottom of the combustion boiler. Bottom ash is removed from the boiler by a water slurry.
CDH	The Colorado Department of Health
CSI	Conservation Services, Inc. - A non-hazardous industrial waste disposal facility located adjacent to the proposed coal ash disposal facility.
CAP	A minimum 18-inches thick layer of suitable soil placed above the foundation layer and compacted to a permeability of less than or equal to 1×10^{-7} cm/sec.
CELL	A volume of landfill airspace for disposal of coal ash. The proposed facility consists of four Cells, each of which is constructed with its own LCS.
COAL ASH	A by-product of the combustion of coal consisting predominantly of fly ash and bottom ash. In this case, the coal is burned to generate electricity.
DENVER AQUIFER	The uppermost regionally recognized aquifer beneath the proposed site.

DENVER AQUIFER ZONE	The area delineated for the purposes of this application where the uppermost ground water exists predominantly within sandstone of the Denver Aquifer.
DRAINAGE LAYER	A minimum 6-inch thick layer of sand, gravel or other suitable material with a minimum permeability of 1×10^{-1} cm/sec placed above the GCL liner.
EDOP	Engineering Design and Operations Plan for the proposed facility.
FGD	Flue-Gas Desulfurization. Sodium or calcium compounds present in the fly ash. Added to the combustion process to reduce sulfur compounds.
FINAL COVER SYSTEM	Four distinct layers of materials placed over the final lift of waste to minimize infiltration into the waste and promote runoff. The final cover system described herein consists of four separate components; 1) a foundation layer, 2) a cap, 3) a rooting/protective layer, and, 4) topsoil.
FIVE PART DEVELOPMENT	The entity which owns the permitted land and a borrow area.
FLY ASH	One of two primary components of coal ash. Fly ash is the lighter fraction that is collected in the emission stack.
FOUNDATION LAYER	A minimum 6-inch thick unspecified soil layer placed above the last lift of ash to provide a suitable base for construction of successive layers.
LCS	Leachate collection system - A system placed above the liner system to facilitate drainage, collection, and removal of liquids from the disposal cell. The leachate collection system as herein described consists of the following components; 1) a drainage layer, 2) a leachate collection pipe, 3) a sump, 4) a filter fabric, and, 5) a leachate discharge line.

LEACHATE	A liquid that has passed through or had contact with solid waste and may contain soluble, miscible, or suspended constituents removed from the waste. In this case the waste is coal ash.
LEACHATE COLLECTION PIPE	A 6-inch diameter, perforated pipe placed within the granular drainage layer to collect and route liquids in a disposal cell to a sump for removal.
LEACHATE DISCHARGE LINE	A 6-inch diameter pipe extending from the sump up to the ground surface. The bottom portion of the leachate discharge line is perforated within the sump to allow any liquids collected in the sump to be pumped to the surface for removal.
LINER SYSTEM	A combination of natural and synthetic materials placed on the base and sidewalls of a disposal area to minimize leakage from the landfill disposal cell. The liner system described herein consists of two components; 1) A low permeability soil barrier layer, and, 2) A synthetic membrane.
LIQUID LIMIT	The moisture content of a soil/water mixture in which a soil behaves as a liquid as determined by standardized tests.
MSW	Municipal Solid Waste.
PSC	Public Service Company of Colorado - The initial generator of the ash to be disposed at this proposed facility. Following issuance of the permit, the facility will be owned and operated by PSC.
PERCHED GROUND WATER	Ground water that is not a part of a regional aquifer system and is separated from an underlying regional system by unsaturated soils or rock. In this instance, perched ground water exists in sand or silt lenses which are laterally and vertically discontinuous within the permit boundaries of the proposed facility, and are within an unsaturated claystone matrix.

PERMIT BOUNDARY	The legal description or tract of land to be used for disposal of coal ash, construction of associated access roads and surface water diversion structures, and adjacent clay borrow area. The permit boundary is the legal description of the land covered under this application document.
PHASE	A volume of landfill airspace to be used for disposal of coal ash. The proposed coal ash disposal facility consists of two Phases, each Phase consisting of two Cells.
PLASTIC INDEX	The difference between the Liquid Limit and the Plastic Limit.
PLASTIC LIMIT	The moisture content of a soil/water mixture in which a soil behaves as a plastic as determined by standardized tests.
QA/QC	Quality Assurance/Quality Control - Methods of ensuring that construction activities are completed as intended within the appropriate guidelines, regulations, and permit conditions.
ROOTING/ PROTECTION LAYER	A minimum 18-inch thick layer of unspecified soil placed above the cap to protect the cap and provide a root zone for vegetation.
SOIL BARRIER LAYER	A minimum 24-inches of suitable soil compacted to achieve a permeability of less than or equal to 1×10^{-7} centimeters per second (cm/sec.).
SUMP	A depression constructed in the lowest elevation of a disposal cell, which collects liquids from the disposal cell for removal.
TEST PAD	A preliminary soil barrier layer, constructed either within or outside of a disposal area, using specific construction equipment, construction materials, and testing procedures. The construction methods and test results obtained from the test pad are used to develop detailed construction specifications and testing procedures to be following during actual soil barrier construction.

1.0 INTRODUCTION

This document presents the Engineering Design and Operations Plan (EDOP) for a proposed coal ash disposal facility located at Schumaker Road and East 88th Avenue (Irondale Road) in south-central Adams County. The proposed facility will be called the Metropolitan Denver Coal Ash Disposal Facility and will only be used to dispose of coal ash generated exclusively from power plants.

The submittal of this EDOP is a result of intensive site studies and technical plan development. The applicant is familiar with the area and has made an extensive effort to select and develop a facility which will provide a necessary service to the region in an environmentally and socially acceptable manner. This EDOP was developed in compliance with all pertinent Federal, State, and Local regulations governing the siting, design, and operations of solid waste disposal facilities. Appendix A is an outline of Sections 2.0 and 4.0 of the current Colorado Department of Health (CDH), Colorado State solid waste regulations and lists where the pertinent information can be found in this document.

The applicants' company name, address and phone number are:

Five Part Development Company
2090 East 104th Avenue, Suite 301
Thornton, Colorado 80233
(303) 450-0544

As per the Commissioners Approval Resolution of November 8, 1993,

"The Operations Plan shall be jointly reviewed by the County Staff and the operator at ten year intervals to determine if more appropriate buffering, operation/reclamation plans, or other items should be required. If the operator does not agree to suggested administrative decisions, a public hearing will be scheduled with the Board of County Commissioners for their review and decision."

Following permit issuance, the permitted land of the first two cells will be purchased from Five Part Development Company by PSC. The remaining disposal cells will be optioned by PSC for potential future purchase. The Certificate of Designation (CD), as issued, shall expire on November 8, 2023. Per the Commissioners approval resolution of November 8, 1993,

"Transfer of the Certificate of Designation shall be permitted. Notification by the applicant and Public Service of the transfer shall be made to Adams County and to the Colorado Department of Health. In the future, Public Service Company of Colorado may transfer the Certificate of Designation to a successor or assign. The new owner

may become the holder of the Certification of Designation and continue to utilize the facility, after review by Adams County, and if applicable the Colorado Department of Health, to determine the new owner's financial ability and operational experience to meet the continuing obligations under the Certificate of Designation."

Also per the November 8, 1993 approval resolution,

"In the event that, and at any time that, the State's financial assurance programs are not in place or are not applicable to this facility, and the applicant (has) provided a corporate guarantee acceptable to Adams County, Public Service Company shall provide financial statements evidencing its financial solvency to the Director of Planning and Development every five years from the date of approval of the application, and until the post-closure period has ended. Upon receipt of a financial statement, or at any other time within the discretion of the Adams County Board of County Commissioners, the Adams County Board of County Commissioners may cause to be held a hearing for a review of the adequacy of the corporate guarantee, and in their discretion, may require the submittal of a bond or some other form of financial assurance. In the event that ownership of the project is transferred to some person or entity other than the applicant or Public Service Company, then the Adams County Board of County Commissioners may, in their discretion, cause to be held a hearing to determine the amount and type of financial assurance required to be provided by such third party prior to continuation of the Project."

This EDOP is organized into several sections that present detailed information about the proposed coal ash disposal facility as follows:

- 1.0 Introduction
- 2.0 General Information
- 3.0 Site Description
- 4.0 Site Geology / Hydrogeology
- 5.0 Facility Configuration
- 6.0 Facility Operation
- 7.0 Environmental Monitoring
- 8.0 Construction Quality Assurance / Quality Control
- 9.0 Closure and Post-Closure Requirements
- 10.0 References

In addition, detailed drawings are included and referenced in the document. Information obtained from the field program indicates that the proposed ash disposal facility can be developed, operated, and closed in an environmentally sound manner in accordance with current environmental standards and regulations.

1.1 Legal Description

Per the Commissioners Approval Resolution of November 8, 1993, a revised legal description is included below for the Certificate of Designation that excludes the western portion designated as open space, since this area cannot be utilized for borrow material extraction without further approvals.

EXHIBIT A (PROPOSED PARCEL 1 AND 2 COMBINED)

NOVEMBER 1, 1993

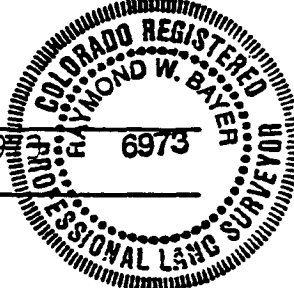
LEGAL DESCRIPTION: (PROPOSED CELLS A, B, C, D & BORROW AREA F
EXCLUDING 30 FEET FOR COUNTY ROAD RIGHT-OF-WAY)

THAT PART OF SECTION 25, TOWNSHIP 2 SOUTH, RANGE 64 WEST OF THE SIXTH PRINCIPAL MERIDIAN, COUNTY OF ADAMS, STATE OF COLORADO, DESCRIBED AS: BEGINNING AT THE SOUTHEAST CORNER OF SAID SECTION 25; THENCE N88°37'05"W ALONG THE SOUTH LINE OF THE SOUTHEAST ONE-QUARTER OF SAID SECTION 25 A DISTANCE OF 30.01 FEET TO THE TRUE POINT OF BEGINNING; THENCE CONTINUING N88°37'05"W ALONG SAID SOUTH LINE A DISTANCE OF 2,627.55 FEET TO THE SOUTH ONE-QUARTER CORNER OF SAID SECTION 25; THENCE; N88°29'52"W ALONG THE SOUTH LINE OF THE SOUTHWEST ONE-QUARTER OF SAID SECTION 25 A DISTANCE OF 644.01 FEET TO A POINT; THENCE N10°50'39"E A DISTANCE OF 1,023.42 FEET TO A POINT; THENCE N54°08'55"W A DISTANCE OF 593.30 FEET TO A POINT; THENCE N09°37'19"W A DISTANCE OF 1,327.80 FEET TO A POINT ON THE NORTH LINE OF THE SOUTHWEST ONE-QUARTER OF SAID SECTION 25; THENCE S88°28'45"E ALONG SAID NORTH LINE A DISTANCE OF 1,170.21 FEET TO THE CENTER CORNER OF SAID SECTION 25; THENCE S88°28'44"E ALONG THE NORTH LINE OF THE SOUTHEAST ONE-QUARTER OF SAID SECTION 25 A DISTANCE OF 1,325.54 FEET TO THE SOUTHWEST CORNER OF THE SOUTHEAST ONE-QUARTER OF THE NORTHEAST ONE-QUARTER OF SAID SECTION 25; THENCE N00°20'15"E ALONG THE WEST LINE OF THE SOUTHEAST ONE-QUARTER OF THE NORTHEAST ONE-QUARTER OF SAID SECTION 25 A DISTANCE OF 1,028.10 FEET TO A POINT; THENCE N56°17'47"E A DISTANCE OF 1,563.01 FEET TO A POINT 30.00 FEET WEST OF THE EAST LINE OF SAID SECTION 25, SAID POINT BEING A POINT ON THE WEST RIGHT-OF-WAY LINE OF SCHUMAKER ROAD; THENCE S00°20'05"W ALONG SAID WEST RIGHT-OF-WAY LINE A DISTANCE OF 1,929.81 FEET TO A POINT ON THE NORTH LINE OF THE SOUTHEAST ONE-QUARTER OF SAID SECTION 25; THENCE S00°11'50"W ALONG SAID WEST RIGHT-OF-WAY LINE A DISTANCE OF 2,641.39 FEET TO THE TRUE POINT OF BEGINNING. CONTAINS 252.960 ACRES MORE OR LESS. SUBJECT TO A 70 FOOT WIDE COLORADO INTERSTATE GAS COMPANY PIPELINE EASEMENT.

BASIS FOR BEARINGS:

THE EAST LINE OF THE SOUTHEAST ONE-QUARTER OF SECTION 25, TOWNSHIP 2 SOUTH, RANGE 64 WEST OF THE SIXTH PRINCIPAL MERIDIAN, COUNTY OF ADAMS, STATE OF COLORADO, IS ASSUMED TO BEAR S00°11'50"W.


RAYMOND W. BAYER, P.L.S. NO. 6973
DATE: Nov. 3, 1993



2.0 GENERAL INFORMATION

2.1 Facility Need

The proposed coal ash disposal facility will be used exclusively to dispose of the coal ash from coal burning power plants. To meet the estimated disposal needs of PSC over a 20+ year period, a facility with approximately 10 million cubic yard capacity is required. The proposed coal ash disposal facility is designed to offer an environmentally sound solution for non-hazardous coal ash disposal which will meet the anticipated disposal requirements of PSC. Per the CDH recommendation of approval letter dated September 14, 1993, "the facility shall comply with the health laws, standards, rules, and regulation of the State Health Department, the Water Quality Control Commission, the Air Quality Control Commission, and all applicable local laws and ordinances (§2.1.1)".

PSC is one of the largest energy producing companies in the State of Colorado and generates approximately 360,000 cubic yards per year of coal ash from their Cherokee, Arapahoe, and Valmont Plants. While the facility will accept coal ash for disposal from any PSC plant, the majority of the ash to be disposed of at the facility (currently approximately 80% of the total waste stream) is generated at the Cherokee Plant located in Adams County. PSC pays over \$5,500,000 in property taxes per year in Adams County, of which over \$900,000 is from the Cherokee power plant alone.

2.2 General Facility Description

As shown on Figure 2-1 the proposed facility is located at Schumaker Road and East 88th Avenue (Irondale Road). The facility is located approximately seven miles north - northwest of the Town of Bennett, Colorado and nine miles north - northeast of the Town of Watkins, Colorado. The area inside the permitted boundary of the facility will consist of approximately 253 acres of which approximately 179 acres will be used for ash disposal and approximately 74 acres for surface water control structures, access roads, and borrow area.

The legal description and the permit boundary is provided in Section 1.1 and on Plate 2. The facility is generally located in the south one-half and the east one-half of the northeast one-quarter of Section 25, Township 2 South, Range 64 West of the 6th Principal Meridian, Adams County, Colorado.

The waste accepted at the coal ash disposal facility will be coal ash from power plants. It is anticipated that the majority of the ash disposed of at the facility will be generated by the Cherokee power plant as mentioned above. The anticipated waste stream currently consists of approximately 80 percent fly ash and 20 percent bottom ash. More information regarding the composition of the waste stream is found in Section 5.0.

The ash disposal area will be constructed using natural and synthetic material, to create a nearly impermeable barrier to protect the subsurface. The operations area for the facility will be minimal due to the fact that the facility will accept only one waste stream.

In accordance with the CDH approval letter of September 14, 1993, the facility has designed and implemented a program for detecting, handling and disposal of unauthorized wastes arriving at the site (§2.1.2) These measures include: 1) A gated, entry checkpoint will be the only access to the facility; and, 2) landfill personnel to monitor the site for unauthorized wastes, which if discovered, will be handled and disposed of properly. Because this will not be a public landfill and access to the facility will be restricted by fencing and locking gates, the potential for unauthorized waste disposal is minimal.

2.2.1 Facility Access

It is estimated that approximately 40-50 trucks per day will travel to the facility. The present access route to the facility is identified on Figure 2-1. As per the Commissioners Approval Resolution of November 8, 1993,

" The haul route shall be limited to : East along Interstate 70, to U.S. 36, to State Route 79, North on State Route 79 to 88th Avenue, and then West on 88th Avenue to Schumaker Road to the site. Any change in this route shall be reviewed by the Director of Planning and Development and the Director of Public Works. If the applicant does not agree to an administrative decision concerning proposed changes in haul route, a public hearing will be scheduled with the Board of County Commissioners for this review. Emergency and short term re-routing shall be decided by the Director of Public Works."

In addition, per the same resolution,

"The Adams County Public Works shall monitor traffic volumes on a periodic basis, and if warranted, shall require the developer to construct certain roadway improvements at the intersection of East 88th Avenue and Schumaker Road."

The anticipated volume added by the operation of the proposed facility is well within the capacity for Imboden and Irondale Roads (1000 and 5000 vehicles per day respectively) as reported by Leigh, Scott and Cleary in the traffic study completed for the permitting of the adjacent Conservation Services, Inc. (CSI) industrial waste disposal facility.

Access into the facility will be from Schumaker Road south of the CIG pipeline easement.

2.3 Zoning and Land Use

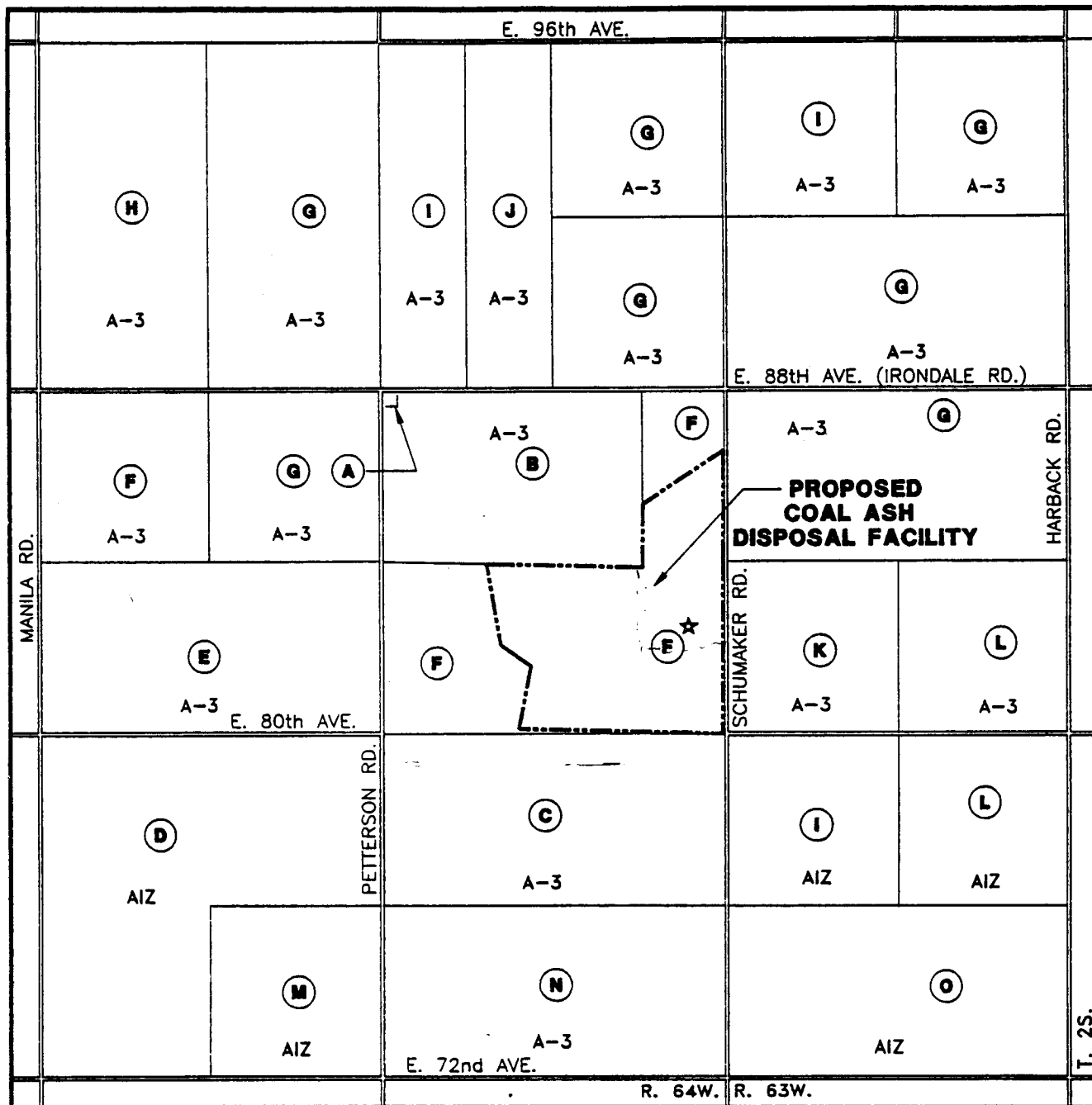
The immediate area of the facility is presently zoned A-3/Agricultural. Zoned land and land ownership in the vicinity of the facility is shown on Figure 2-2. Table 2-1 includes ownership and zoning information within an approximate 1-mile radius of the facility. The land around the facility property is currently used for dryland crop farming with the exception of the CSI facility.

Per the Commissioners Approval Resolution of November 8, 1993, "Easements shall be granted as necessary to Intermountain Rural Electric, if facilities requiring electrical service are ever needed in excess of what currently exists on the property."

2.4 Fees

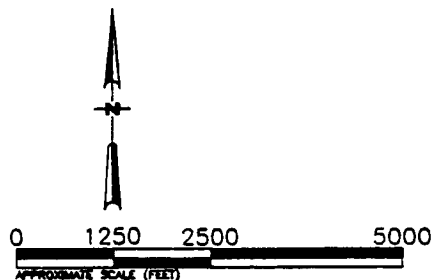
As per the Commissioners Approval Resolution of November 8, 1993,

" The (permit holder) is to remit the Solid Waste Management Fund fee to the County on a semi-annual basis at \$.05 (five cents) per every cubic yard of materials disposed of at the site. This fee schedule shall be reviewed each five years. At the first five year fee review, the maximum increase of the fee shall be to \$.10 (ten cents) per every cubic yard. At the first ten year fee review period, the fee shall be reviewed with no maximum amount but shall be based on the then prevailing market rate for hauling this material."



- A-3 AGRICULTURAL
 AIZ AIRPORT INFLUENCE ZONE
 (FRONT RANGE AIRPORT)
 * SEE TABLE 2-1 FOR
 OWNERSHIP INFORMATION
 ★ PROPERTY TO BE ACQUIRED BY PSCo

REFERENCE:
 CONSERVATION SERVICES, INC.
 DESIGN AND OPERATIONS PLAN,
 1991 (UPDATED)



PROJ.# 06104369 PAGE#
 SCALE: AS SHOWN DRAWN BY: GSL
 FN: 43696F25
 DATE: 11/8/93

FIGURE 2-2
 ADJACENT ZONING AND OWNERSHIP
 FIVE PART DEVELOPMENT
 METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY



Industrial Compliance
 A Subsidiary of SP Environmental Systems, Inc.



TABLE 2-1

LAND OWNERSHIP ONE-MILE RADIUS OF SITE

Designation ⁽¹⁾	Name	Address	City	State	Zip
A	093 School District	-----	Bennett	CO	80102
B	Green Valley Investments (Phil Spano)	2090 E. 104th, #301	Thornton	CO	80223
C	Sophie Wagner	5 North 13th	Brighton	CO	80601
D	Double A Farms Ltd.	RR1 - Box 5	Bennett	CO	80102
E	Sidney Allison and Richard Kimbrough	-----	Scotia	NE	68875
F	Five Part Development (Phil Spano)	2090 E. 104th, #301	Thornton	CO	80223
G	Bernice Bullard	208 10th Avenue	Longmont	CO	80501
H	Ivan and Irene Stark	P. O. Box 71	Commerce City	CO	80037
I	Virgil Piland	RR1	Bennett	CO	80102
J	Maily Cronk	43905 E. 64th Avenue	Bennett	CO	80102
K	Donna and Ella Trupp	RR1 - Box 111	Bennett	CO	80102
L	J. W. C. Davis	41500 E. 80th Avenue	Bennett	CO	80102
M	Ronald and Lillian Wagner	3685 S. Kittridge	Aurora	CO	80013
N	Pearl Sayer and Pearl Younger	3685 S. Kittridge	Aurora	CO	80013
O	Herbert Champlin	P. O. Box 1066	Enio	OK	73702

(1) Refer to Figure 2-2

3.0 SITE DESCRIPTION

Prior to the initial field program an initial site assessment was conducted of the proposed permit area. The initial site assessment was conducted to ensure that the area would comply with all location criteria set forth in proposed draft State of Colorado solid waste regulations. Existing topography, surface water conditions and local climatology as they relate to landfilling operations were also investigated and are presented in this Section.

3.1 Location Criteria

Proximity to Airports

Due to the non-putrescible nature of ash to be disposed of at the facility, there is no additional potential for bird-strike problems. The ash disposal facility will remain outside the zone of influence of the Denver International Airport which is presently under construction. The facility is not located within 10,000 feet of any airport serving either turbo-jet or piston type aircraft. The facility is located within five miles of the ultimate design of the Front Range Airport, which has been notified of the proposed facility.

Fault Areas

The site is not located within 200 feet of a fault that has had a displacement in Holocene time. The nearest reported fault to the site is the Rocky Mountain Arsenal Fault located approximately 15 miles to the west.

Unstable Areas

Based on site reconnaissance and document reviews, there is no evidence of unstable areas, geologic hazards or unstable human made features on the site.

Wetlands

According to the U.S. Soil Conservation Service (SCS) Soil Survey of Adams County and the U.S. Army Corps of Engineers, there are no designated wetlands in the permit area. Other surface water systems near the site are more fully discussed in other portions of this permit application. Ash will not be placed into surface waters or intermittent stream courses.

Flood Plain Information

The proposed ash disposal facility is not located within any designated 100-year flood plain according to the Federal Emergency Management Agency (FEMA) flood insurance rate maps (Community Panel Number 080001 0210A). Therefore, the facility will not restrict the flow or reduce the temporary storage capacity of the 100-year flood. A 100-yr, 24-hr flood plain on an unnamed tributary to Lost Sand Creek, located in the western portion of Section 25 and estimated by QCI Consultants (Northglenn, Colorado) is referenced throughout this document. This flood plain was defined in the drainage study completed in November, 1989, conducted during the permitting process for the adjacent CSI disposal facility, and assumed the maximum probable urban development upstream. The proposed coal ash disposal area is not located in this flood plain.

Ground Water

All disposal activities will take place above the natural ground-water table. Adequate ground-water protection will be provided at the facility by using a barrier soil layer and geocomposite bottom liner which will create a nearly impermeable barrier separating the ash from ground water. The liner system is discussed in detail throughout this permit application.

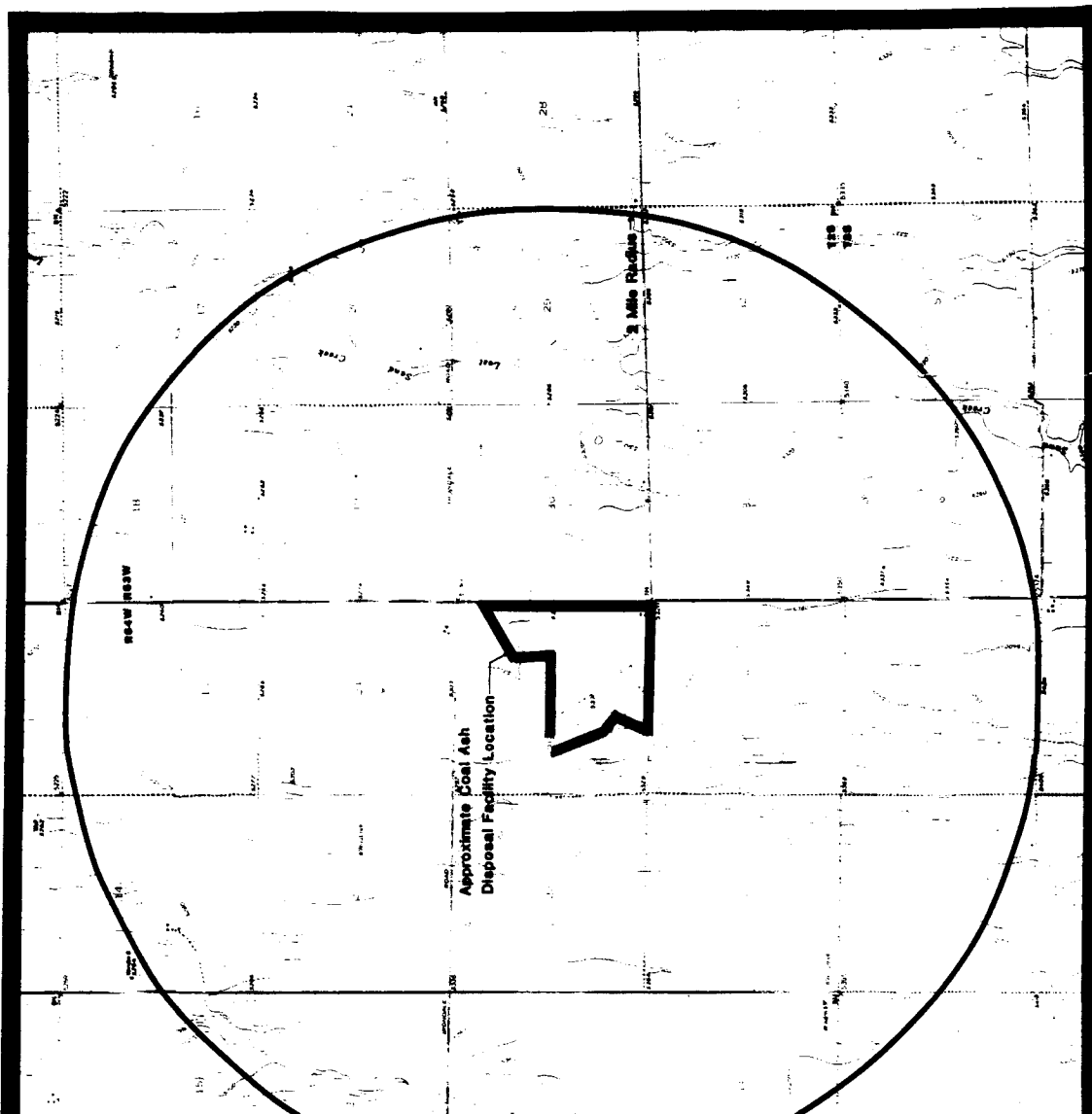
3.2 Existing Site Topography

The existing topography of the permit area is presented on Plate 2. The site is located in a gently sloping farmland that drains generally to the north from high points in the southeast and southwest corners of the permit area.

The property slopes an average of two percent (2%) in the area that is to be used for filling. The steepest section of the permit area is approximately 4%. In the northeastern portion of the permit area the topography is flatter with slopes less than 1%. The northwestern portion of the permit area is also flat with an average slope of 0.5%.

3.3 Surface Water Drainage

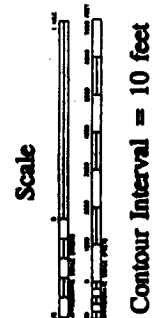
Surface water features within a two-mile radius of the facility are shown on Figure 3-1. On-site runoff is characteristically intermittent. The largest stream in the vicinity of the facility is Lost Sand Creek. The contributing off-site drainage basin above the coal ash disposal area and the general off-site and on-site drainage patterns are shown on Figure 3-2. Lost Sand Creek, located approximately 1.5 miles east of the site, is an intermittent stream

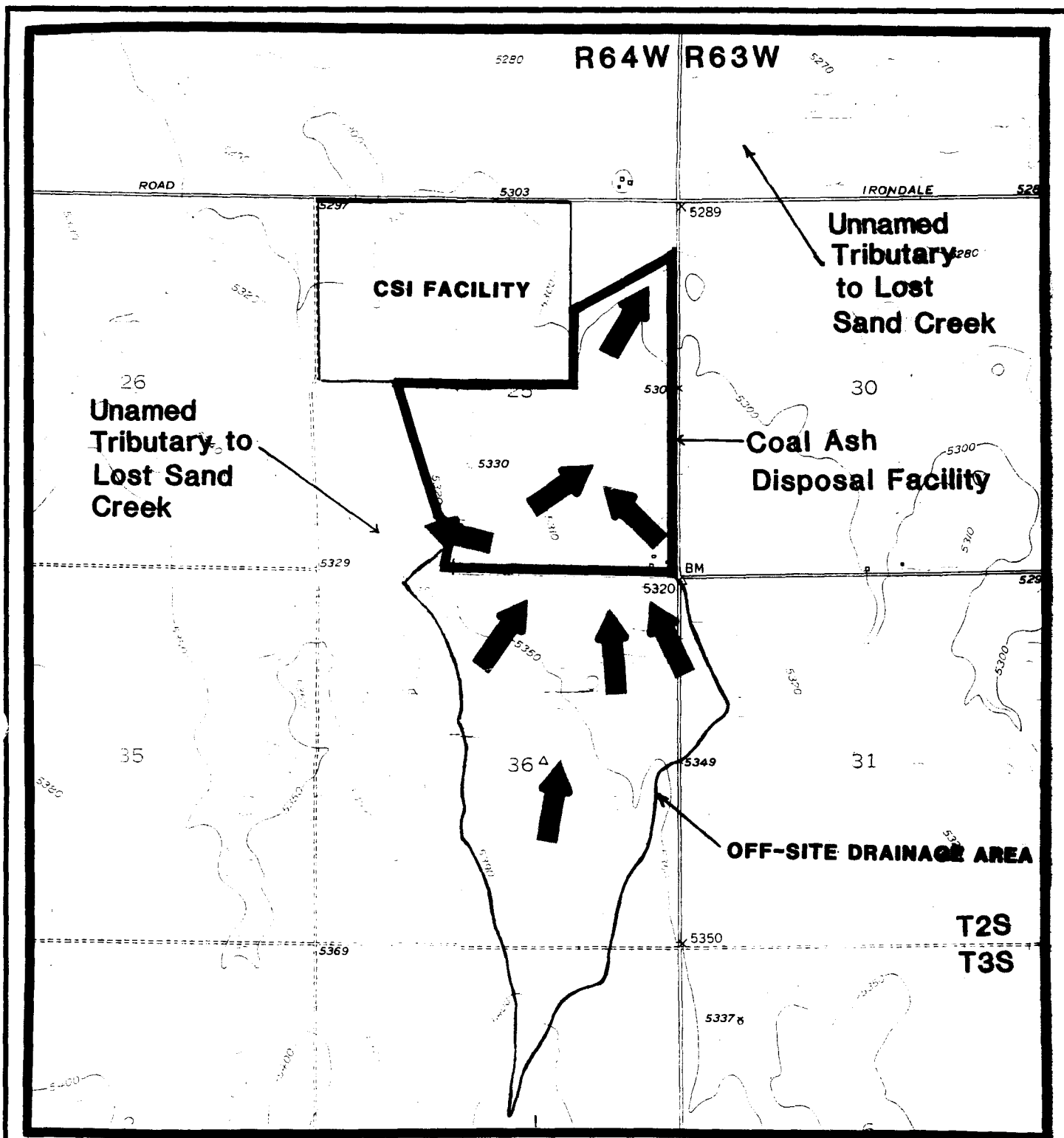


SOURCE:
USGS 7.5' QUADRANGLE MAPS
OF MANILA, COLO. & BENNETT, COLO.

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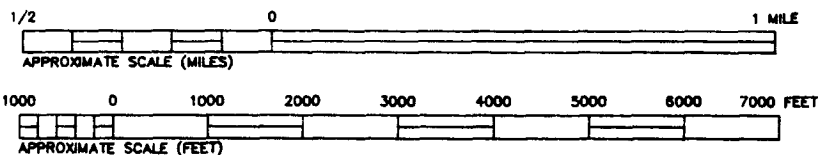
FIGURE 3-1
SURFACE WATER WITHIN A 2-MILE RADIUS
FIVE PART DEVELOPMENT
METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY





SOURCE:
USGS 7.5' QUADRANGLE MAPS OF
MANILA, COLO. & BENNETT,
COLO.

CONTOUR INTERVAL = 10 FT.



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FIGURE 3-2
ON-SITE AND OFF-SITE DRAINAGE PATTERNS
FIVE PART DEVELOPMENT
METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY



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that flows in a general northerly direction. Runoff from the eastern portion of the permit area is to intermittent stream courses that ultimately discharge to Lost Sand Creek. Runoff from the western area is to an unnamed intermittent drainage, located more than 800 feet west of the permit boundary, which flows north for approximately eight miles to its confluence with Lost Sand Creek (See Plate 1).

There is no significant stream channelization within the permit boundary. No vegetation exists in the permit area that would suggest any standing water or substantial volumes of runoff across the site. The 253-acre parcel is currently farmed and runoff generally occurs in the form of shallow sheet flow.

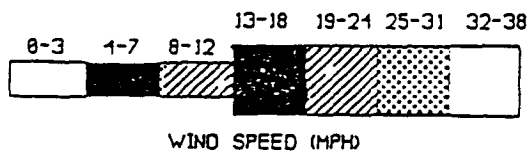
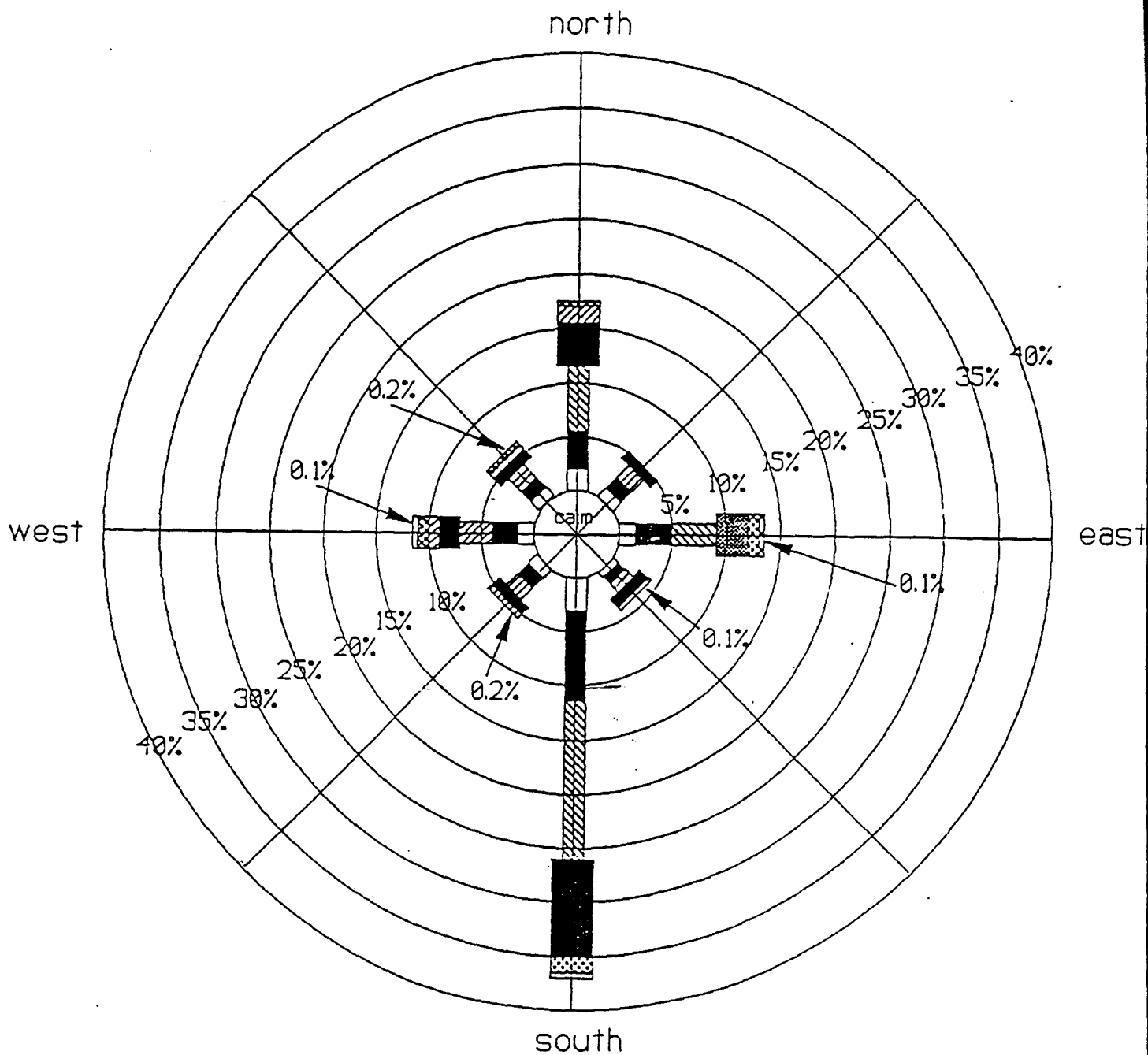
3.4 Climatology

Long-term regional climatology information was obtained from records compiled by the Colorado Climate Center, Department of Atmospheric Science and represents data gathered from the Byers, Colorado Meteorological Station for the years of 1931 to 1991 and from the Denver Meteorological Station at Stapleton International Airport. Climatological data is presented in Appendix C.

The average maximum and minimum monthly temperatures reported for the past 60 years are 64.2 degrees Fahrenheit (°F) and 33.9 °F, respectively.

Precipitation data for the Byers area is available for 1931 to 1991. The average annual precipitation for the area is 14.86 inches. The greatest annual precipitation recorded is 23.76 inches in 1969.

The prevailing wind direction at the site is from the south with peak gusts from the west. The average wind speed is approximately nine miles per hour (mph) with the strongest gusts at 56 mph. A wind rose diagram is included as Figure 3-3.



Source:
Conservation Services, Inc.
Design and Operations Plan
October, 1991

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FIGURE 3-3
WINDROSE DIAGRAM
FIVE PART DEVELOPMENT
METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY



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4.0 GEOLOGY AND HYDROGEOLOGY

4.1 Regional Geology

4.1.1 Regional Geologic Structure

Geologic information obtained during site investigations and operations of the CSI facility was used to characterize the geology and hydrogeology for the site due to the close proximity of the two areas.

The proposed facility is located approximately 35 miles east of the structural axis of the Denver Basin. The basin is asymmetric and extends from Pueblo, Colorado on the south to Torrington, Wyoming on the north. The beds are near vertical at the contact with the Front Range on the western flank of the basin with a rapidly-decreasing dip to the east. The town of Byers is at the approximate eastern Basin boundary.

The beds beneath the proposed facility are on the eastern flank of the Basin and generally strike north-south and dip gently to the west at approximately one degree (Bryant and others, 1981). The area is east and south of the most structurally complex region of the Denver Basin. The nearest major folds or faults are northwest of Broomfield, Colorado, approximately 35 miles northwest of the site. No indication of smaller-scale folding or faulting was observed during the site-specific investigation.

4.1.2 Regional Surficial Geology

The surficial materials found in the vicinity of the proposed facility include loess and eolian deposits and general pedisements derived from erosion of the Rocky Mountain system. The eolian and loess deposits are loam, silty loam, or very-fine sandy loam and contain relatively large percentages of very-fine sand. Tertiary and Pleistocene sediments originating at the eastern edge of the Rocky Mountain system are common. These deposits are variable in texture but they are predominantly sandy loam, sandy clay loam, or clay loam. Strata of sand with variable percentages of gravel are typical of these beds (Sampson and Baber, 1974).

4.1.3 Regional Bedrock Geology

Figure 4-1 is a generalized stratigraphic column showing the formational relationships in the region. Bedrock in this region represents virtually every geologic age group. The formations discussed in this report are limited to a section of sedimentary rocks of Upper Cretaceous Age including, from bottom to top, the Pierre Shale, Fox Hills Sandstone, the Laramie and Arapahoe Formations and the Denver Formation.

AGE	UNIT	THICKNESS	LITHOLOGIC DESCRIPTION
TERTIARY	Tdu	1-20'	SURFICIAL WEATHERED MATERIAL: silty, sandy, clay, light brown to light gray, weathered bedrock
		400'	DAWSON FORMATION: interbedded conglomerate, sandstone, and shale, light gray to yellow brown beds of pale green shale.
CRETACEOUS	TKd	300'	DENVER FORMATION: interbedded shale, claystone, conglomerate, siltstone, and shale, gray to yellowish brown
	Ka	700'	ARAPAHOE FORMATION: interbedded sandstone, conglomerate, siltstone, and shale, gray to yellowish brown
	Kl	200'	LARAMIE FORMATION: claystone, shale, and sandstone, light gray to brown
	Kfh	50'	FOX HILLS FORMATION: silty sandstone with interbedded shales, gray to brown
	Kp	6000' +	PIERRE SHALE: shale, sandy shale, and some sandstone/siltstone lenses near the top, brown to dark gray-brown, friable
	Kn	350'	NIOBRARA FORMATION: calcareous shale and limestone, gray to grayish-yellow
	Kcg	450'	CARLILE SHALE: silty claystone and siltstone, olive-gray GREENHORN LIMESTONE: limestone, claystone, and siltstone, gray GRANEROS SHALE: siltstone and claystone, dark gray
	Kd	230'	DAKOTA GROUP: sandstone siltstone, carbonaceous shale, and conglomerate near the base, light to dark gray
JURASSIC	Jmr	380'	MORRISON AND RALSTON CREEK FORMATION: shale, claystone, sandstone, and some thin limestone beds, varied colors
	Je	50'	ENTRADA FORMATION: sandstone, light brown to gray
TR	TRP1	470'	LYKINS FORMATION: shale, siltstone, and limestone, red to red brown
PERM	P1	230'	LYONS SANDSTONE: sandstone, orange to pink to gray
PENN	PPf	900'	FOUNTAIN FORMATION: sandstone, siltstone, and conglomerate, with thin shale beds, red-brown
PC	---	---	Undifferentiated Precambrian igneous rocks

Source: *
 Conservation Services, Inc.
 Design and Operations Plan
 October, 1991

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FIGURE 4-1
 GENERALIZED STRATIGRAPHIC COLUMN
 FIVE PART DEVELOPMENT
 METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY



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Formations below these are not discussed because they are isolated from surficial processes by the thick massive Pierre Shale.

The Pierre Shale is considered the basal confining unit for the major bedrock-aquifer system in the Denver Basin. The Pierre Shale is a marine deposit consisting primarily of shales with some interbedded siltstone and sandstone. Unit thickness ranges up to 8000 feet in the study area. The Pierre is characterized by extremely-low permeabilities and impervious clay layers. Because of its extensive thickness and low permeability, formations below the Pierre are unaffected by the natural and artificial surficial processes in the vicinity of the site and are not discussed further.

The Fox Hills Formation is a shallow marine deposit lying above the Pierre Formation. It is a silty sandstone with some interbedded shale units. The thickness of the Fox Hills Formation reportedly varies between 50 and 300 feet across the Denver Basin.

The Laramie Formation is a coastal plain deposit overlying the Fox Hills Formation. The Laramie is a series of alternating sandstones, claystones, and shales, with coal seams frequently occurring in the upper portion of the formation. The Laramie Formation varies in thickness from 400 to 600 feet across the Denver Basin.

Fluvial deposits characteristic of the Arapahoe Formation overlie the Laramie Formation. The Arapahoe consists of a series of interbedded conglomerates, sandstones, siltstones, and shales. Unit thickness varies between 400 and 700 feet across the Denver Basin.

The Denver Formation is present immediately beneath the surficial materials in the study area. The Denver Formation is a Tertiary Upper-Cretaceous age continental-type deposit characterized by interbedded shale, claystone, siltstone, and sandstone. Lignite lenses are found in abundance throughout the Denver Formation. Unit thickness ranges between 200 and 1000 feet across the entire Denver Basin.

4.1.4 Regional Economic Geology

Oil wells associated with the Radar and Bear Gulch Oil Fields are located approximately 1/2 mile west and 1/4 mile northeast of the proposed site boundaries. According to maps produced by the Adams County Planning Department (1983) and the U.S. Geological Survey (1977), additional wells are located about one mile south-southeast of the site. Wells that are apparently associated with the Chieftain and Hawkeye fields are located approximately one mile northeast of the site. Natural gas fields exist approximately two miles east and four miles west of the site. One 18-inch and one 24-inch high pressure gas lines trend northeast-southwest through the northern part of the proposed filling area.

The Denver Formation contains lignite to sub-bituminous coals that were mined through the early 1950's to satisfy local heating needs. The mining activities were concentrated in Boulder and Jefferson Counties. The boundary of the Denver Formation coals in Adams County occurs approximately five miles southwest of the site according to the Adams County Planning Department. The Scranton Mine is the nearest inactive coal mine in the area and is located near Watkins, Colorado about eight miles southwest of the site.

The site is at least four miles from any sand and gravel alluvial deposits defined as commercially extractable. According to the Adams County Planning Department (1983), the nearest "probable aggregate resources" of sand and gravel occur approximately six miles east of the site along Kiowa Creek and six miles west of the site along Box Elder Creek. Both of these deposits are identified by the Colorado Geological Survey as valley-fill material.

4.1.5 Geologic Hazards

The nearest major folds or faults are approximately 35 miles northwest of the site as discussed previously. In addition, no apparent geologic hazards that would adversely affect the development of the facility are associated with the site. No underground coal mining activity that could cause subsidence problems has occurred within eight miles of the site.

Minor earthquakes occurred in the area of the Rocky Mountain Arsenal (RMA) through the mid-1960s. The earthquakes apparently resulted from the deep-well disposal of hazardous fluids on the RMA property located approximately 20 miles west of the study area (Hollister and Weimer, 1968). The fluids were injected to depths of 12,000 feet. Earthquake activity subsided after the cessation of fluid injection in 1966 and therefore does not appear to pose a threat to the proposed facility.

The Adams County Soils Survey (Sampson and Baber, 1974) indicates that the soils at the site have moderate shrink-swell potential. Soil samples collected at the site were tested in a geotechnical laboratory to determine the actual shrink-swell potential of the soils. The results indicate that the soils have a low or low-to-moderate shrink-swell potential and thus will not affect facility operations.

4.2 Site Geology

The site has been divided into three areas for the purpose of outlining the site geology and these areas are referred to throughout this document. These areas are:

- * The Alluvial Aquifer Zone is the area west of the property including the ephemeral stream. It is typically characterized by sandy alluvial materials and relatively shallow depths to ground water. The alluvial area will not be discussed in detail in this

document as it is outside of the proposed permit area.

- * The Perched Ground-Water Zone includes the western and southern portions of the site. It is characterized by claystones with interbedded sand lenses and perched/discontinuous ground water at varying depths. A portion of the Perched Ground-Water Zone will be used for the construction of disposal cells and a possible source of borrow materials.
- * The Denver Aquifer Zone is in the central and northern portions of the site. It is characterized by sandstone bedrock formations and ground water elevations of approximately 5240 feet (60 feet below the ground surface). This area will be used primarily for constructing disposal cells.

A plan view of the site with each of these areas delineated is shown on Plate 11.

4.2.1 Field Investigations

Forty-eight soil borings were completed at 38 locations in or near the proposed ash disposal area from April 18, 1991 to October 13, 1992. Thirty-eight of the soil borings were completed as piezometers (PZ-37 through PZ-74) and five soil borings were completed as monitor wells (MW-109, MW-304, MW-112, MW-114, and MW-204). The remaining five borings were used to collect soil samples or to conduct packer tests. The locations of the piezometers and monitor wells are shown on Plate 4.

The purpose of the borings was to collect soil samples to assess the distribution of subsurface materials and the availability of claystone in the area for possible use as soil barrier and cap construction material in coal ash disposal cells. Additionally, the majority of the borings were completed as piezometers to assess ground-water depths and extents. Three piezometers (PZ-38R, PZ-40R, and PZ-41R) were reinstalled to replace the original piezometers (PZ-38, PZ-40, and PZ-41) destroyed by farming activities. The five monitor wells were installed to obtain background ground-water quality information as well as provide water quality information throughout the life of the facility.

All soil borings were drilled with a truck-mounted CME-75 or all-terrain vehicle (ATV) CME-750 drill rig using either 6-inch or 8-inch diameter, continuous-flight, hollow-stem auger. A continuous sampler system, California barrel, and/or split-spoon samplers were used to collect soil samples for geologic and hydrogeologic information.

Total depth of the soil borings ranged from 20 to 74-feet below the ground surface (bgs).

Piezometers were completed using 1-inch diameter, Schedule 40, polyvinyl chloride (PVC) pipe placed to final depth in selected soil borings. The lower ten to thirty-feet of the PVC pipe was hand-slotted to allow water-level measurements. Imported, unwashed sand was placed in each soil boring to approximately two feet above the slotted interval followed by approximately three to five feet of bentonite hole plug to seal the perforated section and minimize the potential for surface water effects. The remainder of the boring was backfilled with natural cuttings to within two feet of the ground surface. The top two feet were then backfilled with bentonite holeplug and hydrated with water.

The water level in each piezometer and monitor well was measured several days following completion and monthly thereafter. Water levels ranged from six feet in the alluvial area to 67 feet bgs in the Denver area.

Monitor wells were constructed using 2-inch diameter, threaded, flush-jointed, Schedule 40, PVC pipe. Ten or 15 feet of 0.010-inch factory slotted PVC screen pipe sections were placed at the base of each monitor well boring. The annular space around the screen was backfilled with # 10-20 size silica sand. A 2 to 3-foot bentonite plug was placed on top of the sand. The remainder of the boring was filled with a cement-bentonite grout mixture. Each monitor well was secured at the surface with a locking steel protective casing. Monitoring well completion forms are included in Appendix H.

Each monitor well was developed using a PVC bailer to remove a minimum of five casing volumes of water prior to ground-water sampling. Ground-water samples were collected in October 1992 and again in February 1993 and submitted to a qualified laboratory for analytical analysis (Appendix J) of the selected parameters outlined in Section 4.5. Field measurements of pH, specific conductance, and temperature were obtained from the monitor wells prior to sample collection to ensure the samples were representative.

Testing was performed at the site to evaluate the hydraulic properties of the site-specific surficial and bedrock materials. Testing was accomplished through packer tests and slug tests. Packer tests were performed at two locations; PK-46 (approximately 50-feet north of PZ-46), and PK-47 (approximately 50-feet south of PZ-47) as shown on Plate 4. Slug tests were performed in all five monitor wells installed for this program. These test are more fully detailed in Section 4.6.

4.2.2. Site Soil Classification

The soils at the site have been mapped by the U.S. Soil Conservation Service (SCS). The SCS states that the available soils information is highly generalized, may not accurately reflect local variations of the existing conditions, and is only relevant to a maximum depth of 60 inches (Sampson and Barber, 1974).

The existing soil association is the Weld-Adena-Colby. This association formed on nearly-level to steep, well-drained upland areas in loamy wind-deposited material. The western 50 percent of the proposed area is covered by Ascalon sandy loams while Weld loam underlies the remaining proposed area.

Ascalon series soils are well drained and are found in nearly-level to moderately-sloping upland areas. These soils typically form in loamy material containing varying amounts of sand and gravel. The surface is usually non-calcareous; however, visible lime splotches are found below depths of about 20 inches. These soils absorb water at a moderate to rapid rate. The available water capacity is high and surface runoff potential is low to medium. Typically, 30 to 50 percent of the material will pass through a U.S. Standard #200 sieve. The field infiltration rate ranges from 4×10^{-4} to 1×10^{-3} cm/sec. The available water capacity varies from 0.13 to 0.15 inch/inch of soil. The water erosion hazard is moderate, the soils have low to moderate shrink-swell potential, and the soil blowing hazard is severe in unprotected areas.

Weld series soils are found in well-drained nearly-level upland areas. They typically form in wind-worked loamy material. The surface is a non-calcareous loam while the lower profile is a calcareous sandy loam with visible lime splotches. These soils absorb water at a moderate rate and their available water capacity is high. Surface-runoff potential is moderate. In Weld series soils, 60 to 90 percent of the material typically pass a #200 sieve. The field infiltration rate ranges from approximately 4×10^{-5} to 1×10^{-4} cm/sec and the available water capacity varies from 0.15 to 0.17 inch/inch of soil. These soils have a moderate-to-severe water erosion hazard, a high shrink-swell potential, and the soil blowing hazard is severe in dryland farm areas receiving less-than-normal annual precipitation.

4.2.3 Site Surficial Materials

Site surficial deposits and bedrock units are illustrated on the geologic cross-sections shown on Plates 5 through 9. The cross-sections are completed through the adjacent CSI facility and the proposed site. Boring and lithology logs for the borings completed for the CSI site are found in the CSI Design and Operations Plan. Generally, surficial deposits increase in thickness from west to east across the site. Surficial deposit thicknesses range from 10 to 20 feet south of the CSI site in the proposed borrow area. Thicknesses range from 30 to 40 feet

east and southeast of the CSI facility and up to 50 feet along the eastern boundary adjacent to Schumaker Road.

A light-to-dark-brown silty, sandy clay extends from the CSI facility into the northern part of the Denver Aquifer Zone (see Plate 11). This material is generally less than 5-feet thick and was classified by visual field inspection according to Unified Soil Classification System (USCS) as CL/SC. The sand in this clay was typically very fine. The observed field moisture contents ranged from dry to medium moist and consistency ranged from medium stiff to very stiff.

A well-graded light-brown sand with varying amounts of clay is the dominant surficial material covering the majority of the claystone and sandstone filling and borrow areas. The sand particle size ranged from very fine to coarse (USCS SW). These sands were incorrectly identified on the field logs as poorly graded (USCS SP). The material's field moisture content ranged from dry to wet and was medium dense to dense. Representative geotechnical properties for these materials are discussed in Section 4.2.5.

4.2.4 Site Bedrock Deposits

The Denver Formation was the only bedrock unit encountered during the site-specific drilling program. This formation was identified by cuttings obtained during drilling that are representative of Denver Formation lithologies typically found in the Metropolitan Denver area. The two lithologic distributions encountered included claystones with discontinuous sandstone lenses and sandstones (Plates 5 through 9).

Claystone is the dominant bedrock material in the western, southern, and southeastern portions of the proposed site (Perched Ground-Water Zone shown on Plate 11) as shown on cross-sections D-D', E-E', F-F', G-G', and H-H' (Plates 6, 7, and 8). The claystone varied from light brown in the weathered zone to olive, green-gray to gray in the unweathered zone, and was generally dry to slightly moist. It is typically medium to very plastic and very stiff to hard when drilled. Iron oxide staining was observed in the majority of the soil borings. Gypsiferous infilling was also observed but to a lesser extent than the iron staining. A contour map, drawn on the top of the claystone bedrock, is presented on Plate 10.

The claystone contains interbedded lenses of sand, sandstone, siltstone, shale and lignite. These lenses generally vary in thickness from less than one inch to approximately four feet. The lateral extent of these lenses was generally less than 500 feet based on the soil boring data.

A massive, well-graded, weakly-to-moderately-cemented yellow-brown to yellow-gray, silty, sandstone was the dominant bedrock encountered in the central and northern parts of the site. The sandstone generally contains between 5 and 10-percent silt.

4.2.5 Representative Material Properties

Nearly three years of geotechnical data collected at the adjacent CSI facility indicate that the claystone materials present beneath the site, and currently used in CSI cell construction, exhibit properties adequate to construct disposal cells that meet State and Federal guidelines. These materials extend from the CSI facility south and southeastward beneath the proposed facility. Soils testing conducted in conjunction with permitting and construction operations at the CSI facility include:

- * Over 40 samples of clay and claystone submitted for suitability analysis including Atterberg Limits, grain size analysis, and Standard Proctor analysis.
- * Sixty-eight Shelby Tube samples collected from constructed soil barrier layer submitted for permeability analysis.
- * Five relatively-undisturbed samples submitted for permeability analysis.

To supplement the existing CSI data, representative materials were collected from the beneath the proposed site and submitted for geotechnical testing to verify that they exhibited the same suitable engineering properties as those found beneath the CSI site and currently used in construction at the CSI facility.

Samples composited from auger cuttings ranging in depth from 20 to 43 feet were collected from soil borings PZ-54, PZ-57, PZ-62, PZ-63, and PZ-64. All of these samples represent claystone bedrock materials with the exception of PZ-62 which is representative of the surficial silty, sandy clay. The laboratory testing included soil classification (sieve analysis and Atterberg limits), Standard Proctor tests (ASTM D-698), swell tests, remolded permeability tests, unconfined compressive strength tests, and direct shear tests.

A California Barrel Sampler was used to collect relatively undisturbed bedrock samples from soil borings PZ-60, PZ-62, PZ-63, PZ-64, and PZ-65. The sample intervals from borings PZ-60, PZ-62, and PZ-63 are representative of claystone bedrock. The samples collected from PZ-64 and PZ-65 are representative of very clayey, and silty sandstone bedrock. Sample depths ranged from 23.6 to 34.5 feet bgs. These samples were tested for natural moisture content and two samples (PZ-60 and PZ-63) were tested to obtain vertical permeability information. The results of all laboratory testing are presented in Table 4-1.

TABLE 4-1

SUMMARY OF BULK SOIL DATA

Sample #	PZ-54	PZ-57	PZ-62	PZ-63	PZ-64
USCS	CH	CL-CH	CL	CH	CH
Unit	Claystone Bedrock	Claystone Bedrock	Claystone Bedrock	Claystone Bedrock	Claystone Bedrock
Depth ft. below ground	21.5-43.5	18.0-35.5	22.0-50.0	30.0-57.0	23.5-54.0
Liquid Limit	68	50	46	56	61
Plastic Limit	22	18	17	20	22
Plastic Index	46	32	29	36	39
% Passing #200 Sieve	90	80	70	86	93
Optimum ⁽¹⁾ Moisture %	21.0	17.5	15.0	19.0	20.0
Maximum ⁽¹⁾ Density pcf	103.5	108.0	112.0	105.0	105.0
Permeability cm/sec. ⁽²⁾	2×10^{-8}	5×10^{-8}	1×10^{-7}	N/A	6×10^{-9}

- Note: 1) Optimum Moisture and Maximum Density Determined by ASTM D-698, Standard Proctor Analysis
- 2) Permeability determined after compaction to 95% of Standard Proctor Density (ASTM D-5084).

SUMMARY OF RELATIVELY-UNDISTURBED SOIL DATA

Sample	PZ-60	PZ-62	PZ-63	PZ-64	PZ-65
Depth ft. below ground	33-34.5	28.5-28.85	33-33.3	28-28.3	23.6-24
Natural Moisture %	24.3	29.1	19.7	19.2	20.3
Permeability cm/sec.	6×10^{-8}	N/A	4×10^{-7}	N/A	N/A

N/A = Testing not conducted

The composite soil and claystone materials, which were compacted to 95 percent of Standard Proctor Density prior to testing, exhibit very low permeabilities ranging from 1×10^{-7} cm/sec to 6×10^{-9} cm/sec. The low compacted permeabilities of these samples, in conjunction with the historical data from the CSI site, indicate the claystone materials are suitable for use in construction of low permeability barrier layers.

The California Barrel samples, representative of in-situ materials, also exhibit low permeabilities ranging from 4×10^{-7} cm/sec to 6×10^{-8} cm/sec and averaged 2.3×10^{-7} cm/sec.

4.3 Regional Hydrogeology

The proposed facility lies above the principal aquifers of the Denver Basin as well as within the boundaries of the Designated Lost Creek Ground-Water Basin. This section describes both of these basins and their relationships to the proposed facility.

4.3.1 Regional Aquifer Distribution

Three major ground-water aquifer units are present beneath the study site; the Laramie-Fox Hills, the Arapahoe, and Denver Aquifers. Important properties for each are discussed below.

4.3.1.1 Laramie-Fox Hills Aquifer

The Laramie-Fox Hills Aquifer occurs in a confined state in the lower sandstones of the Laramie Formation and the Fox Hills Sandstone. These units are considered to be a single aquifer since they are hydraulically connected. The aquifer is approximately 1,200 feet below the site and has an average thickness of 160 feet (Robson and Romero, 1981).

Figure 4-2 shows the potentiometric surface of the Laramie-Fox Hills Aquifer in 1978. Insufficient water level data in the central part of the Denver Basin precludes direct definition of the potentiometric surface at the proposed area. Extrapolation of indirect data from Robson and Romero (1981) suggest that the direction of ground-water flow is towards the north-northeast in the vicinity of the site. Water derived from this unit is generally of good chemical quality and is characterized as a sodium bicarbonate type.

EXPLANATION

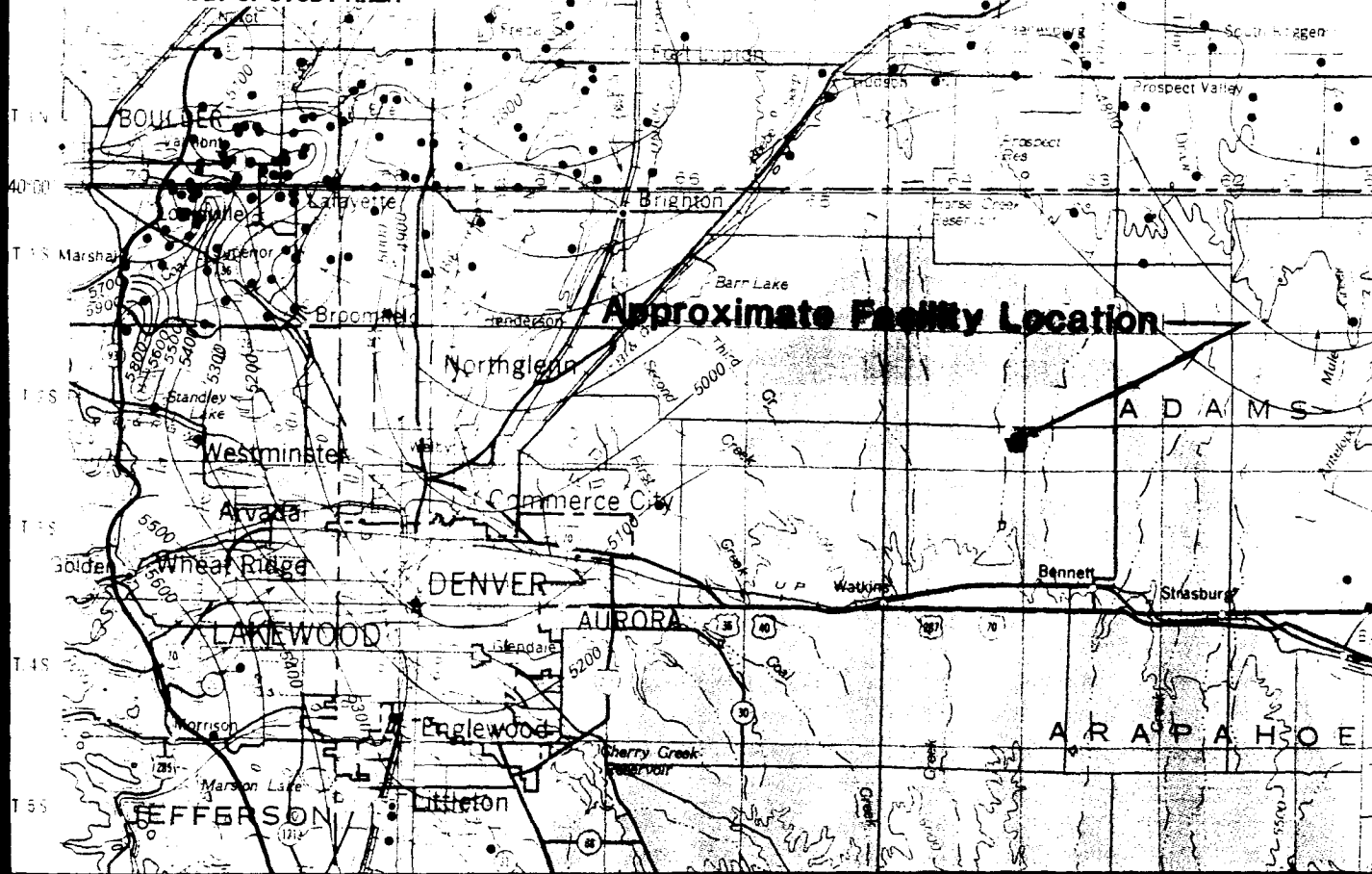
POTENTIOMETRIC CONTOURS
Shows approximate elevation of standing-water level in wells completed in the Laramie-Fox hills aquifer. Contour interval 100 feet. National Geodetic Vertical Datum of 1929. Arrows indicate general direction of ground-water movement

DATA POINT

AREA WHERE WATER-LEVEL DATA ARE INADEQUATE TO DEFINE POTENTIOMETRIC SURFACE IN LARAMIE-FOX HILLS AQUIFER

APPROXIMATE LIMIT OF LARAMIE-FOX HILLS AQUIFER

LIMIT OF STUDY AREA

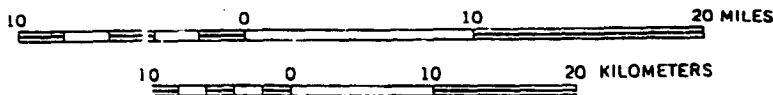


SOURCE:

GEOLOGIC STRUCTURE, HYDROLOGY, AND WATER QUALITY OF THE LARAMIE-FOX HILLS AQUIFER IN THE DENVER BASIN, COLORADO, ROBSON AND OTHERS, USGS MAP HA-650, 1981 - 1:500,000



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FIGURE 4-2
POTENTIOMETRIC SURFACE OF THE LARAMIE/FOX HILLS AQUIFER
FIVE PART DEVELOPMENT
METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY



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4.3.1.2 Arapahoe Aquifer

The Arapahoe Aquifer occurs in the sandstone and conglomerate beds that are characteristic of the Arapahoe Formation. The depth to the top of the Arapahoe Formation is approximately 450 feet with a total thickness of the sandstone and conglomerate beds ranging up to 150 feet in the vicinity of the site. The Arapahoe is considered a confined aquifer beneath the site.

Figure 4-3 shows the potentiometric surface of the Arapahoe Aquifer in 1978. Robson and Romero (1981) placed the potentiometric surface elevation of the Arapahoe Aquifer in the immediate vicinity of the site at 5175 feet with a predominant flow direction to the north-northeast. Water from the Arapahoe Aquifer typically yields water of acceptable chemical quality and is generally classified as sodium bicarbonate type.

4.3.1.3 Denver Aquifer

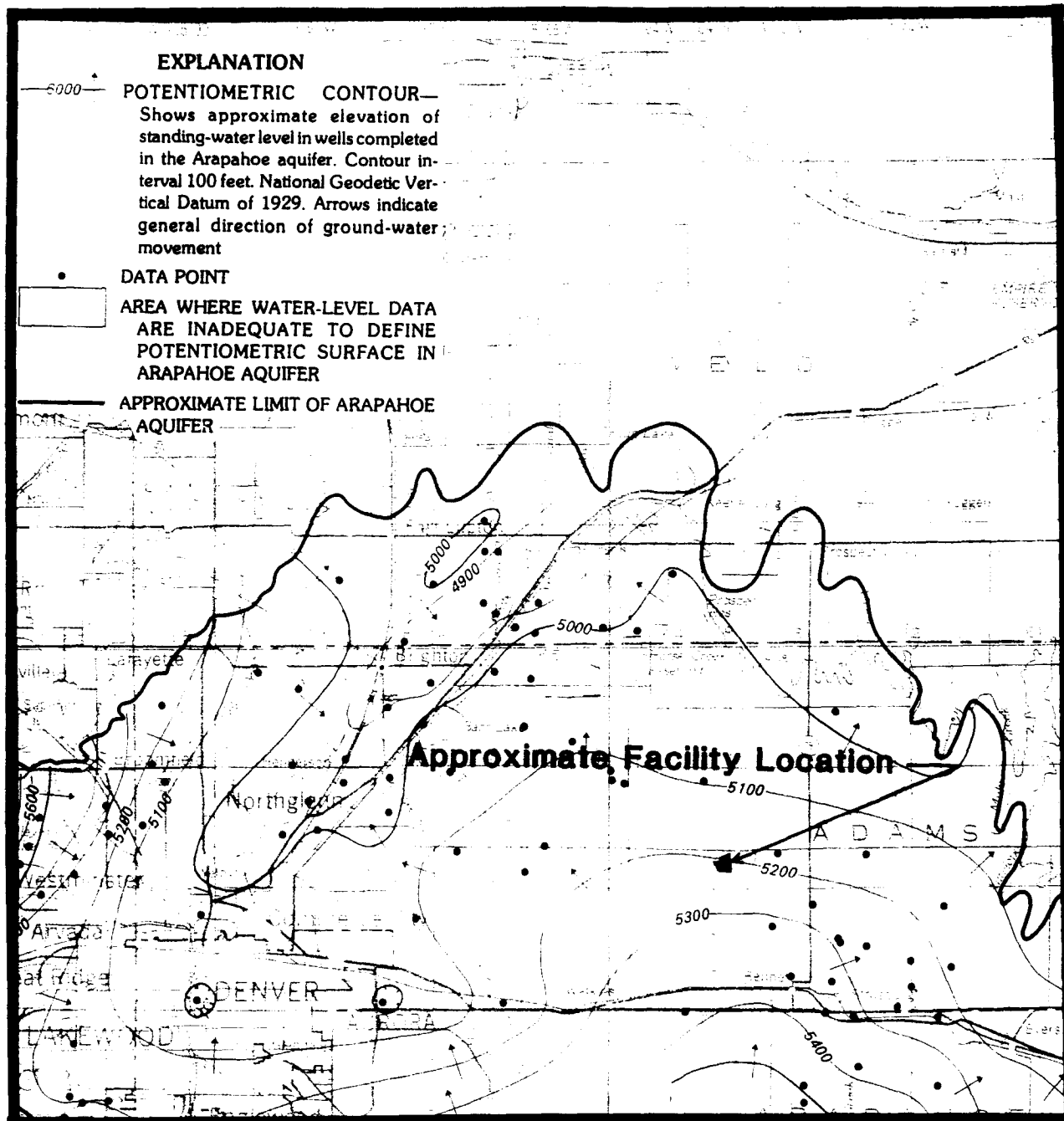
The Denver Aquifer is the uppermost aquifer beneath the site. Robson and Romero (1981) indicate a saturated thickness of less than 50 feet for this aquifer. They indicate that the base of the water-bearing strata is approximately 160 feet bgs, implying that generally, the top of the aquifer lies about 110 feet bgs.

The water-bearing strata are described as irregular lenses of interbedded sandstone and siltstone that are hydraulically separated by thick sequences of claystone. Robson and Romero (1981) report the potentiometric surface elevation to be at approximately 5250 feet with a northerly ground-water flow direction (Figure 4-4). Wells in the Denver Aquifer generally yield from 0.05 to 1.0 gallon per minute per foot of drawdown.

In general, the Denver Aquifer yields water of acceptable chemical quality, although it is not as good as water derived from the Arapahoe or Laramie-Fox Hills Aquifers. The water is classified as either a sodium sulfate or a sodium bicarbonate type.

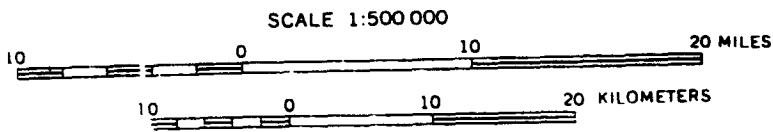
4.3.2 Lost Creek Ground-Water Basin

The proposed site is located in the southern portion of the Designated Lost Creek Ground-Water Basin. According to Nelson and others (1967), the Lost Creek Basin includes approximately 420 square miles in eastern Weld County, central Adams County and northern Arapahoe County. Nelson and others define the Lost Creek Alluvium and sands of the Laramie-Fox Hills Aquifer as the primary water-bearing members within the ground-water basin. They stated that the Denver and Arapahoe Aquifers "are somewhat erratic, do not make up a major water supply source within the basin, and extend well beyond the proposed basin".



SOURCE:

GEOLOGIC STRUCTURE, HYDROLOGY, AND WATER QUALITY OF THE ARAPAHOE AQUIFER IN THE DENVER BASIN, COLORADO, ROBSON AND OTHERS, USGS ATLAS HA-647, 1981



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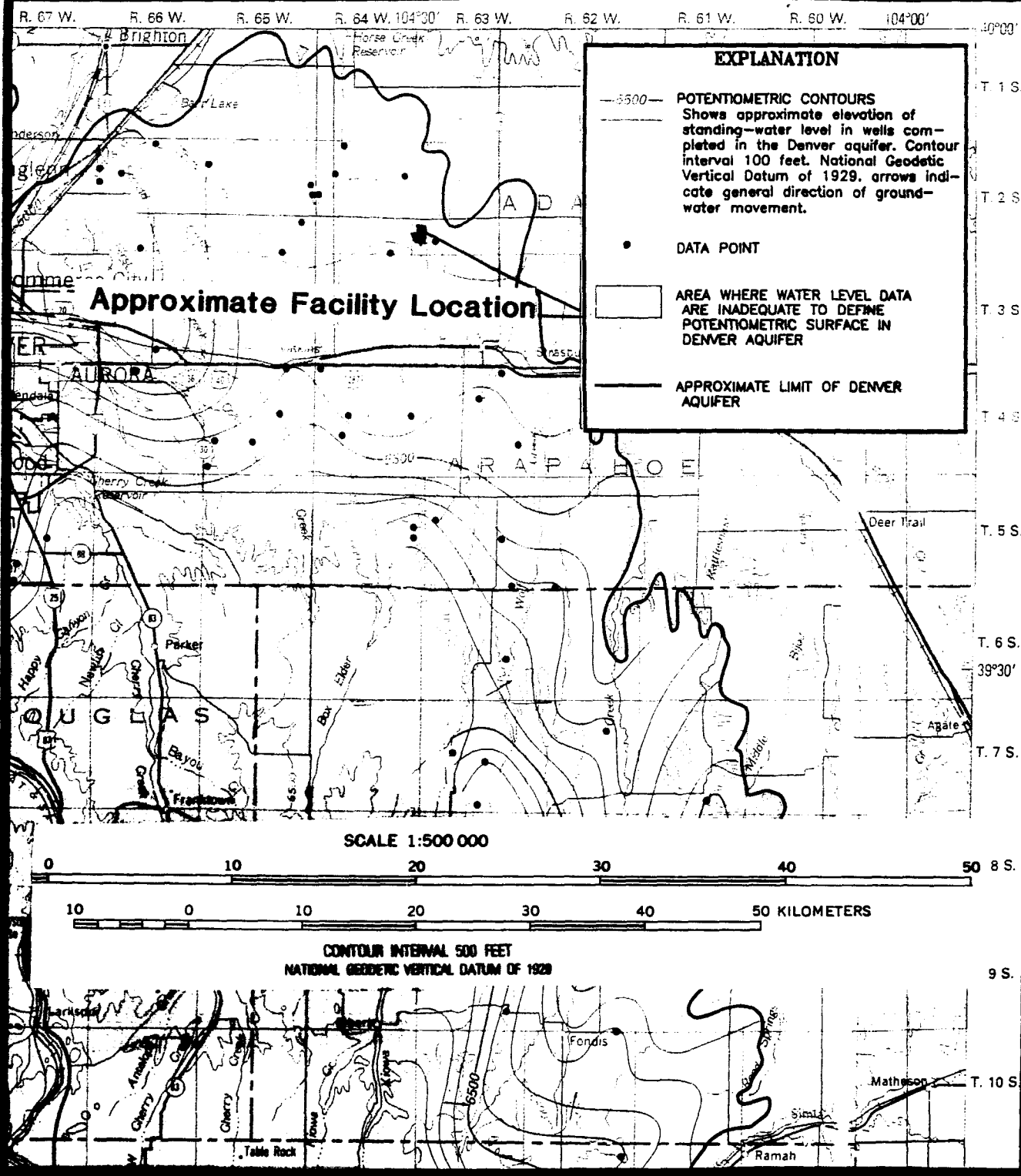
DATE: 3/23/93

FIGURE 4-3
POTENTIOMETRIC SURFACE OF THE ARAPAHOE AQUIFER
FIVE PART DEVELOPMENT
METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY



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SOURCE:
GEOLOGIC STRUCTURE, HYDROLOGY, AND
WATER QUALITY OF THE DENVER AQUIFER
IN THE DENVER BASIN, COLORADO
ROBSON AND ROMERO,
USGS ATLAS HA-646, 1981

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FIGURE 4-4
POTENTIOMETRIC SURFACE OF THE DENVER AQUIFER
FIVE PART DEVELOPMENT
METROPOLITAN DENVER COAL ASH DISPOSAL FACILITY



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The principal source of ground water in the Lost Creek Basin is the unconsolidated alluvial materials. The unconsolidated sediments include upland deposits, valley-fill deposits, and dune sand. The valley-fill deposits are the most important source of ground water for large capacity wells within the basin. These deposits, which primarily consist of sand and gravel, are generally thickest in the northern portion of the Basin and are located well to the north of the proposed site. No saturated valley fill deposits were identified during the site investigation beneath the proposed disposal area.

4.4 Site Hydrogeology

4.4.1 Water Well Inventory in the Site Vicinity

Records of ground-water wells within a 2-mile radius of the proposed facility were reviewed at the Colorado Division of Water Resources, State Engineers office. The data examined included well locations to the nearest quarter section, water usage designation, total well depths, water levels, and approximate well yields. This information is presented in Table 4-2. Based on the limited information available in the State files, it is not known which of the listed wells are currently in existence and/or in operation.

Most of the registered water wells were completed in the Arapahoe Aquifer. These are domestic and/or stock-use wells that are listed as producing an estimated maximum yield of 10 to 20 gallons per minute. In addition, two shallow wells, ranging from 60 to 80 feet in depth, were identified west and northwest of the site, respectively. These wells were completed as windmills.

CSI also has installed two water wells to supply their facility. The wells are 310 feet and 580 feet deep and tap the Lower Denver and the Upper Arapahoe Aquifers, respectively. The Arapahoe well was installed to supplement the Denver well because the Denver well, although it taps a 100-foot thick interval, yields only 15 gallons per minute and is insufficient for both a potable and commercial water source.

As noted in Table 4-2, which includes a listing of all monitor wells at the current facility, there are only five wells in a two-mile radius completed in the Denver Formation which are not monitor wells. One of these Denver wells is the CSI well described above. The other four Denver wells are located two miles north of the CSI facility in Section 13. These wells are reportedly used for recreation purposes. No information on the depths or yields of these wells was available. All of the monitor wells in Table 4-2 are on the CSI property and used in their quarterly monitoring program.

TABLE 4-2

WELLS WITHIN A TWO-MILE RADIUS OF THE SITE

LOCATION	DEPTH	AQUIFER	WATER LEVEL	YIELD *	USE
SW1\4 SE1\4 S18, T2S, R63W	315	AR	92	12	DS
SE1\4 SE1\4 S18, T2S, R63W	315	AR	90	12	DS
SW1\4 SW1\4 S18, T2S, R63W	NA	NA	NA	NA	D
SW1\4 NE1\4 S20, T2S, R63W	140	AR	95	20	S
NE1\4 NE1\4 S31, T2S, R63W	208	AR	50	15	S
SE1\4 SE1\4 S13, T2S, R64W	NA	TKD	NA	NA	R
SE1\4 SE1\4 S13, T2S, R64W	NA	TKD	NA	NA	R
SE1\4 SE1\4 S13, T2S, R64W	NA	TKD	NA	NA	R
SE1\4 SE1\4 S13, T2S, R64W	NA	TKD	NA	NA	R
NE1\4 SW1\4 S14, T2S, R64W	NA	NA	NA	8	D
SE1\4 NE1\4 S23, T2S, R64W	80	U	65	10	DS

U	= UNCONSOLIDATED MATERIAL	AR	= ARAPAHOE FORMATION
UKA	= UPPER ARAPAHOE FORMATION	TKD	= DENVER FORMATION
NA	= NOT AVAILABLE	D	= DOMESTIC
S	= LIVESTOCK	DS	= DOMESTIC/LIVESTOCK
R	= RECREATION	N	= INDUSTRIAL
OM	= MONITOR WELL	C	= COMMERCIAL

Yield = GALLONS PER MINUTE
+ = WELLS OWNED BY PHIL SPANO AT THE EXISTING CSI FACILITY
* = THESE VALUES REPRESENT THE ESTIMATED MAXIMUM YIELD

TABLE 4-2 (cont'd)

WELLS WITHIN A TWO-MILE RADIUS OF THE SITE

LOCATION	DEPTH	AQUIFER	WATER LEVEL	YIELD *	USE
SE1\4 SE1\4 S24, T2S, R64W	150	AR	90	15	DS
NW1\4 NE1\4 S25, T2S, R64W	310	TKD	110	10	N+
NW1\4 NE1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM+
NW1\4 NE1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM+
NW1\4 NE1\4 S25, T2S, R64W	NA	U	NA	NA	OM+
SW1\4 NE1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM+
NE1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM+
NE1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM+
NE1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM+
NE1\4 NW1\4 S25, T2S, R64W	580	UKA	150	50	C+
NW1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM+

U = UNCONSOLIDATED MATERIAL

UKA = UPPER ARAPAHOE FORMATION

NA = NOT AVAILABLE

S = LIVESTOCK

R = RECREATION

OM = MONITOR WELL

Yield = GALLONS PER MINUTE

+ = WELLS OWNED BY PHIL SPANO AT THE EXISTING CSI FACILITY

* = THESE VALUES REPRESENT THE ESTIMATED MAXIMUM YIELD

AR = ARAPAHOE FORMATION

TKD = DENVER FORMATION

D = DOMESTIC

DS = DOMESTIC/LIVESTOCK

N = INDUSTRIAL

C = COMMERCIAL

TABLE 4-2 (cont'd)

WELLS WITHIN A TWO-MILE RADIUS OF THE SITE

LOCATION	DEPTH	AQUIFER	WATER LEVEL	YIELD *	USE
NW1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM +
NW1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM +
SE1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM +
SW1\4 NW1\4 S25, T2S, R64W	NA	TKD	NA	NA	OM +
NE1\4 NE1\4 S26,T2S, R64W	60	U	NA	10	DS
SE1\4 NE1\4 S36, T2S, R64W	280	AR	140	15	D
SE1\4 NW1\2 S345, T2S, R64W	NA	NA	NA	NA	D

U	= UNCONSOLIDATED MATERIAL	AR	= ARAPAHOE FORMATION
UKA	= UPPER ARAPAHOE FORMATION	TKD	= DENVER FORMATION
NA	= NOT AVAILABLE	D	= DOMESTIC
S	= LIVESTOCK	DS	= DOMESTIC/LIVESTOCK
R	= RECREATION	N	= INDUSTRIAL
OM	= MONITOR WELL	C	= COMMERCIAL
Yield	= GALLONS PER MINUTE		
+	= WELLS OWNED BY PHIL SPANO AT THE EXISTING CSI FACILITY		
*	= THESE VALUES REPRESENT THE ESTIMATED MAXIMUM YIELD		

Source: Colorado Division of Water Resources, Office of State Engineers

4.4.2 Ground-Water Occurrence and Conditions

Data obtained from the piezometers and monitor wells installed in and immediately surrounding the proposed facility (Plate 4) indicates that the ground water exists under three differing regimes.

- * Shallow ground water associated with the Lost Creek Alluvium. Wells in this regime tap the alluvial ground-water system in the Alluvial Aquifer Zone (Plate 11) and are numbered as 200 series wells. This area is outside of the proposed permit area and will not be used for any facility purposes.
- * Ground water in discontinuous sands and sandstones within a claystone matrix in the Perched Ground-Water Zone on Plate 11. Wells in this regime tap perched zones of ground water and are numbered as 100-series wells. This area will be used for a portion of the disposal cell construction and borrow material if necessary.
- * Ground water associated with the Denver Aquifer Zone (Plate 11). Wells in this area tap the Denver Aquifer and are numbered as 300-series wells. This area will primarily be used for construction of disposal cells.

Specifics for each regime are presented below.

4.4.2.1 Shallow Alluvial Ground Water (Alluvial Aquifer Zone)

The approximate eastern limit of shallow alluvial ground water is more than 800 feet west of the disposal area as shown on Plate 11. Investigations completed for the initial permitting effort at the CSI site verified the presence of Lost Creek Alluvial materials in the Alluvial Aquifer Zone (Plate 11). Monitoring well MW-204 is located south southwest of the proposed facility and was installed during the recent field activities to verify and refine previous conclusions. The previous investigations at the CSI site had shown that depths to the top of the alluvial ground water ranged from 9.5 to 18 feet bgs. The water levels in MW-204 are similar. Monitor well MW-204 also verified that the ground water associated with the shallow alluvial aquifer lies above both the impervious claystone bedrock and the Denver Aquifer.

4.4.2.2 Discontinuous Ground Water In a Claystone Matrix (Perched Ground-Water Zone)

The ground water encountered in the Perched Area claystone as shown on Plate 11 generally occurs in sands or sandstone lenses within the claystone matrix in a condition that is similar to the situation found beneath the CSI filling area. The saturated materials are generally well-graded silty sands. The saturated material either occurs immediately above or as interbedded lenses within the claystone bedrock.

Results from the drilling program indicate that these lenses occur sporadically in the Perched Ground-Water Zone. They are present at a higher frequency than is found beneath the existing CSI site. As discussed above in Sections 4.2.3 and 4.2.4, these lenses appear to be discontinuous in the horizontal and vertical direction.

4.4.2.3 Ground Water Associated With the Denver Aquifer (Denver Aquifer Zone)

The zone of saturated materials in the Denver Aquifer Zone is typically found at a depth of approximately 60 feet bgs. The water level elevations vary from approximately 5,240 to 5,234 in the sandstone area. The ground-water gradient is nearly flat but generally trends north-northeast as indicated by the ground-water elevations shown on Plate 11. The observed ground-water flow direction is supported by published data as indicated on Figure 4-4.

Work completed for the permitting of the CSI facility indicated that the upper part of the regional Denver Aquifer was present as saturated sands at an elevation of approximately 5240 feet. IC believes that monitor wells MW-302 and possibly MW-301 at the CSI facility tap the uppermost portion of the Denver Aquifer. Monitoring data collected over the past three years indicates that the ground waters tapped in these wells is not geochemically equilibrated although it may have a weak hydraulic connection. This situation differs from the conditions found in the saturated materials of the discrete sand lenses in the Perched Ground-Water zone area that do not appear to be hydraulically connected. Further discussion on the continuity and geochemistry of the ground water is in Section 7.0

Plate 11 indicates the approximate region where the uppermost saturated materials are associated with sandstone in the regional Denver Aquifer. Ground-water elevations in the piezometers located in this region approximates that in MW-302 at the CSI site. The system is unconfined over most of the area but becomes confined north of PZ-42 where a claystone interval replaces the top part of the sandstone (see cross section J-J' on Plate 9). The saturated materials encountered were generally described in the field as well-graded sandstones with trace to moderate amounts of fines.

4.5 Hydrogeologic Characterization

Testing was performed at the proposed site to evaluate the in-situ hydraulic properties of the local materials. This evaluation was accomplished by conducting packer tests and slug tests. In addition, selected relatively undisturbed soil samples were submitted for permeability testing in the laboratory (Table 4-1). Table 4-3 summarizes the results of the packer and slug tests.

Packer tests were conducted in soil borings PK-46 (approximately 50-feet north of PZ-46) and PK-47 (approximately 50-feet south of PZ-47). The packer test results are summarized in Table 4-3 and the locations are shown on Plate 4.

One packer test was conducted at PK-46 in the surficial material above the claystone material at the site. The hydraulic conductivity for this material was calculated to be 5.6×10^{-4} cm/sec. The other packer test was conducted in PK-47 in the sandstone bedrock underlying the proposed disposal cell area. The hydraulic conductivity value here was qualitatively calculated as 3.4×10^{-8} cm/sec. or less. As can be seen by the data in Appendix K, the borehole at PK-47 did not take much, if any, water. A total of .03 gallon at 20 pounds per square inch (psi) of water pressure were recorded. This indication of water infiltration is not believed to be reliable and probably due to a jump in the flow meter as the formation did not continue to take water. However, to obtain a qualitative indication of the permeability in the tested interval at PK-47, the .03 gallon of water infiltration was assumed to be realistic; therefore, the calculated permeability is probably higher than the actual permeability.

Both slug in and slug out tests were conducted in monitor wells MW-109, MW-304 (formerly MW-111), MW-311 (formerly MW-112), MW-114 and MW-204 to estimate the saturated hydraulic conductivity of the in-situ materials. The test data is presented in Appendix L and summarized in Table 4-3. The slug out tests indicate the hydraulic conductivity for the monitoring wells range from 1.1×10^{-3} cm/sec at MW-204 (in the alluvium) to 2.4×10^{-5} cm/sec at MW-114 (in a sandstone lense in the claystone matrix) with an average of 9.6×10^{-5} cm/sec. The slug in test results ranged from 6.8×10^{-4} cm/sec to 3.4×10^{-6} cm/sec with an average of 5.9×10^{-5} cm/sec.

Permeability tests were conducted in the laboratory on selected remolded soil and bedrock samples collected as composite samples, and relatively-undisturbed samples from California Barrel samplers. These tests were performed to supplement the packer and slug test data in

TABLE 4-3

IN-SITU PERMEABILITY TEST DATA

PACKER TEST DATA

BORING #	PERMEABILITY	NOTES
PK-46	5.6×10^{-4} cm/sec	20 psi water pressure
PK-47	3.4×10^{-8} cm/sec	Conservative estimate assuming loss of 0.001 gal/min to formation

Note: PK-46 representative of silty, clayey sands above claystone bedrock
 PK-47 representative of low-permeability claystone bedrock

SLUG TEST DATA

WELL #	SLUG OUT PERMEABILITY	SLUG IN PERMEABILITY
MW-204	1.1×10^{-3} cm/sec	6.8×10^{-4} cm/sec
MW-114	2.4×10^{-5} cm/sec	3.8×10^{-5} cm/sec
MW-109	3.6×10^{-5} cm/sec	3.4×10^{-6} cm/sec
MW-304	1.8×10^{-4} cm/sec	1.4×10^{-4} cm/sec
MW-311	5.2×10^{-5} cm/sec	N/A

N/A = Testing not conducted

Note: MW-204 tested alluvial aquifer
 MW-114 and MW-109 tested saturated perched interval
 MW-304 and MW-311 tested Denver Aquifer

a effort to estimate hydraulic conductivity of the in-situ material at the site and the potential for these materials to be used for cell construction. The tests were performed in accordance with the American Society of Testing and Materials standards (ASTM D-5084). Table 4-1 contains the results of the constant rate permeability tests.

The composite samples were obtained from the auger cuttings collected from various depths (Refer to Table 4-1). This material generally consisted of claystone and brown, silty clay with a trace of very fine sand. The permeabilities for this material range from 1.0×10^{-7} cm/sec to 6.0×10^{-9} cm/sec with an average of 4.4×10^{-8} cm/sec.

Two relatively-undisturbed samples were obtained from specific lithologic intervals (see Table 4-1). These samples were submitted for laboratory permeability testing and were representative of claystone bedrock. Both samples were collected from the Perched Ground-Water Zone near the upper limit of the claystone bedrock at 33-feet bgs. The vertical permeabilities of this material were measured as 4.0×10^{-7} cm/sec in PZ-63 and 6.0×10^{-8} cm/sec in PZ-60.

4.6 Ground Water Flow Paths and Velocities

The site lies above the Denver Aquifer, and numerous claystones similar to those observed at the site occur in the transitional zone between the Denver and Arapahoe Aquifers.

The shallow ground water at the site exists as perched zones isolated by claystone aquitards in the Denver Formation. This regime exists primarily in the Perched Ground-Water Zone that will be used in part for cell construction and a possible source of borrow material (Plate 11).

Deeper ground water at the site exists within sandstones and sand lenses of the Denver Formation at elevations of approximately 5234 to 5240 feet. The area where the uppermost saturated materials are associated with the Denver Aquifer is delineated on Plate 11 as the Denver Aquifer Zone. This area will be used primarily for the construction of disposal cells.

The ground water velocity in the Denver Aquifer was calculated at 2.5 feet per year. This estimate is based upon the following:

- * Darcy's equation, $T = \frac{K \cdot i}{\text{Porosity}}$ is valid for this system.

where: T = Time of Travel

K = Permeability

i = Ground-Water Gradient

porosity is equal to specific yield

- * An average ground-water gradient of 0.0027 ft./ft. Based on the difference in water level elevations between PZ-67 and PZ-41R as indicated on Plate 11.
- * A typical saturated hydraulic conductivity of 1.8×10^{-4} cm/sec. (from slug testing of MW-304, formerly MW-111).
- * An estimated specific yield of 0.2 as derived from information reported by Lohman (1979).

The proposed ground-water monitoring plan for the facility will concentrate on monitoring of the Denver Aquifer since the uppermost saturated materials beneath the proposed disposal area generally exist within the Denver Aquifer. Details of the ground-water monitoring plan are presented in Section 7.0 of this document.

- 2) Liquids would then travel vertically through the three-foot soil barrier layer underlying the sump. The soil barrier layer has a design permeability of 1×10^{-7} cm/sec.
- 3) The liquid would then migrate vertically through 10 feet of natural material with a permeability of 5×10^{-4} cm/sec. The permeability of the in-situ material was estimated from the packer test performed in PK-46.

Travel time through the soil barrier and natural materials are calculated separately as follows:

ASSUMPTIONS:

T = Travel time through unsaturated materials
 Zo = Flow path length in unsaturated materials
 @ = Effective porosity (0.1 claystone, 0.2 silty sand)
 qu = Volume of infiltrated liquid. Also equal to unsaturated vertical hydraulic conductivity
 Ks = Saturated vertical hydraulic conductivity
 n = Brooks-Corey Parameter

- 1) Vertical migration through 3-foot soil barrier layer, unsaturated flow conditions
 Assume:

Zo = 3 feet
 @ = 0.1
 qu = 1×10^{-8} cm/sec
 Ks = 1×10^{-7} cm/sec
 n = 4

Therefore:

$$T = \frac{Z_o(@)}{(qu^{1-n/n})(Ks^{1/n})}$$

$$T = \frac{(3ft)(0.1)(30.48cm/ft)}{(1 \times 10^{-8} ** 3/4)(1 \times 10^{-7} ** 1/4)}$$

$$T = 5.14 \times 10^8 \text{ sec} = 16.30 \text{ years}$$

- 3) Vertical travel time through 10-foot thick native soil, unsaturated flow conditions

Assume:

$$Z_o = 10 \text{ feet}$$

$$@ = 0.2$$

$$q_u = 5 \times 10^{-5} \text{ cm/sec}$$

$$K_s = 5 \times 10^{-4} \text{ cm/sec}$$

$$n = 4$$

$$T = \frac{Z_o(@)}{(q_u^{1-n/n})(K_s^{1/n})}$$

$$T = \frac{(10\text{ft})(0.2)(30.48\text{cm/ft})}{(5 \times 10^{-5})^{3/4}(5 \times 10^{-4})^{1/4}}$$

$$T = 6.83 \times 10^5 \text{ sec} = 0.02 \text{ years}$$

Adding the travel times:

- 1) 16.30 years through the 3-foot barrier soil layer
 - 2) 0.02 years through natural materials
- Total = 16.32 years

The resulting travel time through the liner to the ground water is conservatively estimated as at least 16 years. Again, this estimate does not include the additional protection provided by the HDPE liner.

5.5.2.2 Liner System Details

Following excavation, a low permeability, composite liner system will be built on the fill area base and side slopes consisting of:

- 1) A barrier soil layer consisting of a minimum 24 inches of compacted soil material with a design permeability of 1×10^{-7} cm/sec. A minimum 36-inches soil barrier layer will be constructed beneath the sump area to provide additional protection.
- 2) A minimum 60-mil thick HDPE synthetic liner or other synthetic membrane which may be approved in the future. Manufacturers specifications for the membrane will be provided in the construction specifications document.

Details of the liner system are shown on Plate 13.

The barrier soil layer will be smoothed prior to the placement of the HDPE to provide uniform support and intimate contact between the materials. The HDPE will be anchored at the surface of the filling area using a trench, recompactd with soils after the HDPE is placed in it. Details of the anchor trench construction and HDPE installation will be included in the construction specifications document. Typical engineering design details are shown on Plate 13.

The use of HDPE as a barrier material in MSW and hazardous waste landfills is commonly accepted in the public, private, and regulatory communities. Leachate generated in MSW and hazardous waste landfills typically contain organics which are not a concern with coal ash or the associated leachate.

5.5.3 Leachate Collection System

5.5.3.1 HELP Model Results

The Hydrologic Evaluation of Landfill Performance (HELP) Model Version 2, was used as a basis to design an LCS which allows effective and regulatory compliant transport of leachate to collection sumps for removal.

An estimate of the amount of leachate that could be generated from the coal ash disposal facility was made using the HELP Model. The applicability and accuracy of the HELP model has been extensively researched and reviewed (Schroeder, 1984; Peyton and Schroeder, 1984; Peters et al., 1986) and has been accepted as a tool for estimating leachate production.

The model was run for two different scenarios. The first scenario represents potential leachate generation of the operating facility during filling and the second represents potential leachate generation for the entire facility following closure. The model results suggest that the leachate will be generated from the moisture in the ash at placement and not from percolation of precipitation. A typical value of 20% was used for an initial moisture content of the ash. The HELP model indicates that the design of the ash disposal facility will perform efficiently in limiting the moisture that could potentially enter disposal area through percolation. The model shows a peak daily value of head on the barrier soil layer of 1.2 inches after closure of the facility and 0.10 inch when the facility is operating. These results are to be expected intuitively because once the fill area is overlain by the nearly impermeable final cover the moisture in the ash can no longer evaporate to the atmosphere thus the moisture percolates by gravity through the waste and ultimately into the LCS. The HELP Model input parameters and summary of results are presented in Appendix O.

5.5.3.2 LCS Details

The LCS for each cell will be constructed on the base of the disposal areas over the liner system. The LCS is designed to route free liquid from the base of cell to the sump for removal and consists of the following components:

- 1) A 6-inch drainage layer with a minimum design permeability of 1×10^{-1} cm/sec.
- 2) A filter fabric overlaying the drainage layer.
- 3) A 6-inch perforated PVC piping system installed within the drainage layer.
- 4) A collection sump.
- 5) A leachate discharge line, for detection and removal of liquid from the collection sump.

The initial excavation of the disposal area includes overexcavating for the leachate collection sump in order ensure that there is a minimum 36-inch barrier soil layer beneath the sump area. The base of the disposal area is designed with minimum slopes ranging from 2-4 percent to ensure gravity flow of leachate from the edges of the cell to the sump for subsequent removal.

The LCS consists of a series of perforated pipes within a 6-inch drainage blanket and extending the length of the cell base to the sump (Plate 3). The granular material is specified to have a minimum design permeability of 1×10^{-1} cm/sec. The sump will be filled with similar drainage material as specified for the drainage blanket.

A leachate discharge line will be placed in the center of each sump to detect and remove liquids in the landfill. It will extend to the surface of the landfill along the sideslope and will consist of a 6-inch, schedule 80 PVC pipe, slotted in the bottom of the sump. The discharge line and leachate collection pipe will be covered by a minimum of 5 feet of soils or waste ash before heavy equipment may be driven over it.

The high permeability of the drainage layer coupled with the piping system and minimum 2% slopes of the base of the disposal area will ensure that the travel times in the LCS will not exceed 12 months for the longest drainage path. This is shown through the following EPA recommended travel time calculation using design criteria specified herein:

- Assuming; 1) 2 percent base grade
 2) Hydraulic conductivity of 1×10^{-1} cm/sec.

$$V = ki$$

where:

V = average velocity

k = permeability of the material = 1×10^{-1} cm/sec

i = the slope of the base of the fill = 0.02 ft/ft

Average velocity (unit travel time) = 0.002 cm/sec = 2,069 feet/year.

The longest drainage path designed in the disposal area is 1,085 feet, therefore the LCS is designed to route liquids from the farthest point in the cell to the sump within the time frame specified in the draft Colorado Solid Waste Regulations, December 24, 1992. This is a conservative estimate and does not take into account the flow through the leachate collection pipe.

The leachate discharge line will be protected at the surface using steel guards or an equivalent system. The leachate discharge line will be monitored on a periodic basis during waste placement operations and following closure of the cell in accordance with Section 7.1 of this document.

The LCS will be overlain with a filter fabric to protect the LCS components and to ensure it functions properly.

5.5.4 Liner System Construction

Construction of the liner system within the filling areas may be staged in order to segregate runoff from the active filling area from runoff in unused portions of the fill area. The staged construction of the liner systems is left to the discretion of the facility manager and will be based on the anticipated volumes, seasonal changes, etc.

If segregation of runoff is desired, the liner system will be placed and feathered down to the natural materials at the base of the disposal area and a segregation berm will be constructed (Plate 13). The berm will be placed on top of the liner system to minimize runoff that may come in contact with the working face of the waste materials. The LCS will be installed to within 20 feet of the berm and the perforated pipe will be capped for protection.

Subsequent construction will continue by tying into the existing liner and LCS in a similar fashion. The segregation berms separating the phases will be removed when ash filling progresses.

Precipitation that may have come into contact with the ash and collected on the disposal side of the segregation berm will be removed. These waters will be returned to the disposal cell by means of spray irrigation over the active disposal areas. Precipitation that has not contacted the ash will be used for dust control or allowed to evaporate. This will be done at the discretion of the facility manager.

5.5.5 Final Cover System Installation

A final cover system will be placed over completed portions of the fill to minimize the infiltration of surface water into the ash. The disposal area will be filled with coal ash to approximately the crest of the side slopes and covered with the final cover system. Final grading of the facility is shown on Plate 12. Per the Commissioners Approval Resolution of November 8, 1993, detailed final grading and drainage plans for construction of a given cell will also be submitted prior to notice to proceed for a cell's construction.

The maximum elevation upon closure of the coal ash disposal facility is designed to be approximately 40-feet above the existing ground surface and will generally correspond with the existing grades of the site in the area. However, if the excavation elevations are revised upward to maintain a 10-foot separation from ground water, the final elevations may be revised to maintain a roughly 10-million CY capacity. The maximum slope of the final cover is approximately 5% and the minimum slope is approximately 0.5%. Although the 0.5% slopes are below the 5% minimum slope required by the Colorado draft solid waste regulations, December 24, 1992, the final cover system will provide minimal potential for the infiltration of precipitation (See HELP Model, Appendix O), and a much lower erosion potential than steeper slopes. This equates to a protective final cover system and minimal potential for infiltration from erosion.

The final cover system will consist of the following:

- 1) A 6-inch thick foundation layer constructed to provide a suitable base for cap construction.
- 2) An 18-inch thick cap consisting of compacted soil material with a design permeability of 1×10^{-7} cm/sec.
- 3) An 18-inch protective cover layer of lightly compacted, unspecified soils.
- 4) A revegetated 6-inch topsoil layer. The topsoil will be reseeded in accordance with Section 9.1 of this document.

The final cover system may be completed as filling areas reach final grades during the operating period of the facility to help minimize infiltration of surface water to the ash. If this option is selected incoming truck traffic will be routed to prevent from damage to the completed portions of the cover system.

Although the final cover system does not incorporate a synthetic component, it limits the infiltration as shown through the results of the HELP model, Appendix O. The model results indicate that the design of the final cover system will inhibit the infiltration of any precipitation. The model suggests that all moisture after closure will be a result of moisture in the ash and not from percolation of moisture through the final cover system.

The construction specifications document will address in detail the procedures and specifications necessary to construct the final cover system.

5.5.6 Material Balance

A total of 1,425,000 CY of suitable material is required for the barrier soil layer and cap construction. This material will be excavated from Cells C and D in Phase 2, and from a borrow area located outside of the permit boundary west of Phase 2 (Plate 2). Appendix M indicates an estimated 1,430,000 CY of suitable low permeability materials are available from the borrow area.

Topsoil from the borrow area will be stockpiled separately for use during reclamation of the facility and borrow area. The borrow area will be excavated on an as-needed basis and will be regraded to match the final topography grades shown on Plate 12. The reclamation of the borrow area is discussed in Section 9.0 of this plan.

A total of 176,000 CY of topsoil and 528,000 CY of non-specified miscellaneous soils is required to complete the cover system of the coal ash disposal facility. These materials will be obtained from the ash disposal area excavation and the borrow area.

5.6 Surface Water Runoff Control

Diversion structures and detention ponds will be used for surface water runoff control at the facility, and will include temporary and permanent facilities. Temporary structures will be designed to prevent flow to active portions of the landfill during the peak discharge from a 25-year event. Permanent structures will be designed to collect volume resulting from a 24-hour event and control volumes from a 100-year storm event. Beginning with initial cell filling, storm water runoff can be diverted to temporary on-site detention ponding areas and controlled site release rates can be maintained. At final site closure, it is anticipated that only nominal site detention storage will be required and can be accommodated in the proposed perimeter drainage channel along the south and east permit area boundaries.

The surface water control system is designed to safely intercept, divert and route the contributing runoff originating in the unnamed watershed area to the south of the site and upstream of the coal ash disposal facility throughout disposal activities. The estimated total drainage area ranges from a maximum of 490 acres during filling of Cell A, Phase 1 to 300 acres at final site closure. The maximum design flow rate used for sizing the on-site surface water structures is 340 cubic feet per second (cfs).

The maximum diverted runoff release rate from the proposed ash facility to off site will not exceed that for existing drainage design conditions in the site vicinity, as reported previously for the CSI facility (Plate 12). The reported estimated 100-year peak discharge at the intersection of East 88th Avenue and Schumaker Road is 502 cfs for an estimated total contributing watershed area of 744 acres (QCI Development Consultants, Northglenn, Colorado; November, 1989). The discharge estimate of 502 cfs at this location is compatible with the projected future land use plan in the site vicinity as reported in the "2010 Airport Environs Plan" (refer to Appendix P).

A stormwater discharge permit will be obtained for all stormwater runoff and erosion controls prior to construction and operation of the ash disposal facility.

5.6.1 Temporary Control Structures

Temporary berms and detention ponds are proposed for the individual disposal cells and/or maximum site acreage to be disturbed at any one time. The berms will be constructed to divert peak runoff away from the disposal cells during a 25-year storm. The dimensions for temporary surface water runoff control structures will be similar to those of the permanent control structures, but will be dependent upon the individual cell design geometry(s) and the overall order of cell construction. Once the phasing/order of construction is established, the temporary runoff control facilities and network will be final designed. The locations of temporary control structures will change as filling operations change and will be left up to the discretion of the facility manager.

5.6.2 Permanent Control Structures

The permanent surface water runoff control system consists of a perimeter drainage channel along the south and east boundaries of the permit area. It will be constructed in phases as disposal operations evolve and is shown in its entirety on Plate 12. The permanent diversion structures are designed to control runoff associated with a 100-year flood event to be compatible with the runoff control facilities for the CSI facility proposed by QCI Development Consultants in their on-site Phase III Drainage Study completed for that facility. As indicated on Plate 12, an earthen berm currently exists along the north property boundary of the existing CSI facility. This berm was designed and constructed to control, in part, local runoff from the CSI site and will be incorporated into the permanent surface water

runoff control system for the coal ash disposal facility. The appurtenant sizes and configurations of the IC and QCI proposed permanent runoff control structures are shown on Plate 13.

5.7 Erosion and Sediment Control

Temporary erosion and sediment control structures will be used at the coal ash disposal facility during all disposal activities. Typical erosion and sediment control structures are shown on Plate 13. Their specific dimensions, configurations, and locations will be dependent upon the disposal area geometry and overall order of cell construction.

5.8 Landscape Plan

Per the Commissioners Approval Resolution of November 8, 1993, a landscape plan to address the following is required: topsoil berms shall be located in a manner as to maximize screening and buffering wherever possible subject to non-interference with cell design, cell construction, and operational considerations. These berms shall be seeded with native grasses acceptable to the East Adams Soil Conservation District. All such temporary berming shall be removed upon final closure of each cell and upon final closure of the project.

A permanent landscape/buffering plan shall be submitted to the County within six-months of the start of operations. This plan will incorporate the proposed channel along Schumaker Road. All landscaping shall be installed not later than one-year after the start of operations, unless an extension of up to six-months is granted in writing by the Director of Planning and Development. Such extension may only be approved due to weather conditions that would make installation of landscape improvements infeasible within one-year of start of operations.

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A permanent landscape/buffering plan shall be submitted to the County within one year of the start of operations. This plan will at a minimum include the diversion channel along Schumaker Road.

5.0 FACILITY CONFIGURATION

5.1 Facility Overview

The 253-acre ash facility is designed to provide a high degree of environmental protection for the disposal of ash from PSC facilities. Ash disposal is much simpler than disposal of other waste streams for the following reasons:

- 1) The ash characteristics are consistent.
- 2) The ash is relatively chemically inert compared to typical municipal solid waste.
- 3) The ash is easily handled and is self-compacting to a degree.

Upon transfer of the permit to PSC, the intention is to utilize the facility initially to accept for disposal coal from three coal fired electric generating stations in the greater Denver Metropolitan area, the largest of which is the Cherokee Plant located in Adams County. These stations utilize approximately three million tons of coal annually, the majority of which is purchased pursuant to two long term contracts providing for coal from three different mines. The remaining requirements are purchased periodically as the requirements are determined in what is known as the spot market. The source of this coal may be different from the mines utilized under the long term contracts. All of the coal purchased is low sulphur compliance coal produced from mines in the Rocky Mountain Region. Due to the similarity of the coals being utilized, the ash produced has similar characteristics, although due to the variety of source coal mines from day to day, the characteristics are never identical. The types of ash generated from the combustion of this coal is characterized as fly ash, bottom ash, boiler slag and flue gas desulphurization sorbents. Fly ash rises to the top of the boiler and is collected from flue gases in the air emissions control devices. Bottom ash drops to, and is removed from, the bottom of the boiler during the coal burning process. Boiler slag is ash that has caked onto, and periodically air jetted from, the boiler and into the ash waste stream. Desulphurization compounds may be added to the fly ash. All of these products have recently been determined by the EPA to be non-hazardous wastes.

As provided in the following Section 5.2, should a new source of coal be used at the local power plants, or ash from a new source is to be disposed of at this facility which PSC expects will cause changes in the physical and chemical characteristics of the ash, both CDH and Adams County will be notified.

The facility is designed according to these features of the waste stream and incorporates the following components:

- * A composite liner consisting of two distinct protective layers including a minimum 24-inches compacted soil barrier layer and a 60-mil thick High Density Polyethylene (HDPE) or other synthetic material as approved in the future.
- * A Leachate Collection System (LCS) comprised of a 6-inch drainage layer, a 6-inch perforated PVC piping system installed within the drainage layer, a collection sump, and a leachate discharge line for detection and removal of liquid from the collection sump.
- * A geofilter fabric to ensure the LCS will function as designed.
- * A final cover system consisting of a 6-inch foundation layer, 18-inch compacted soil barrier layer, 18-inch unspecified soil layer, and a 6-inch topsoil layer to support revegetation
- * Temporary and permanent surface water control structures.

This section of the EDOP outlines the types and volumes of ash to be accepted, the design and configuration of the facility, and the surface water controls to be incorporated at the site.

5.2 Types and Volumes of Waste

The only type of waste that will be disposed of at the facility is coal ash. The waste consists of by-products of coal combustion, including bottom ash, fly ash, and flue-gas emission by-products.

The current ash has consistent physical and chemical characteristics because the coal burned at power generation facilities all originates from similar coal reserves in western states.

The ash has been generated for over 30 years in the Metropolitan Denver area and the chemical and physical characteristics have been periodically studied by PSC and by others. These studies have been used to prepare a sound design for this facility and are referred to throughout this document. Appendix N presents technical data regarding the characteristics of the PSC ash. The ash consists almost exclusively of inorganic constituents. The ash characteristics will remain consistent as long as the sources of the coal are from mines in the Rocky Mountain area and the ash collection techniques are unchanged.

Per the Commissioners Approval Resolution of November 8, 1993,

" The facility shall be restricted to accepting coal ash from only Public Service Company owned power plants within the State of Colorado; provided, however, that if Public Service Company of Colorado transfers any such plant to a successor or assign, the new owner of any such plant may continue to utilize the facility, subject to the same restrictions of the Certificate of Designation on sources of coal. Adams County and the Colorado Department of Health shall be notified of any such plant transfer if that plant intends to continue to utilize the facility, and the new owner shall certify conformance with the sources of coal restriction to Adams County and the Colorado Department of Health."

Furthermore,

" The applicant shall notify Colorado Department of Health and Adams County if and when Public Service Company changes its coal source from the traditional low-sulphur compliance coal. In such event, a change in additional operational requirements may result."

These requirements are also in accordance with the September 14, 1993 CDH approval letter which requires:

"notification to CDH and Adams County of any expected changes in physical or chemical characteristics of the ash to be received, because of changes in source or type of coal used at the local Public Service power plants, sources of ash, etc. A substantial change may result in additional operational requirements."

5.2.1 Physical Characteristics of Coal Ash

The physical characteristics of ash are relatively consistent. There are two primary components of the ash waste stream, as identified below:

- * Fly Ash: Heat and gases in the combustion boiler trap and collect fly ash. Flue-Gas Desulfurization (FGD) is found in the fly ash as sodium sulfate, sodium sulfite, calcium sulfate, calcium sulfite, or the original compounds of sodium and calcium (sodium carbonates or calcium carbonates).
- * Bottom Ash: This portion of the ash is collected from the bottom of the combustion boiler where the coal ash settles and is removed using a water slurry. Boiler slag, which is generally a part of the bottom ash, is a conglomerate of coal, fly ash and gases that have formed a solid mass ("clinker") on the boiler side walls. This buildup is normally removed by air or water jets and is collected in the bottom ash.

The significant difference between fly ash and bottom ash for disposal purposes is that fly ash is dry when loaded in to the trucks, although it is moistened for transport, and bottom ash is generally moist because it is conveyed in slurry form.

The physical properties of coal ash are:

- * Density of approximately 40 to 70 pounds per cubic foot (pcf) with moisture content of 15-30 percent by weight.
- * Particle sizes vary from 0.001 mm to 0.400 mm with an average size of 0.02 mm in fly ash, and 0.5 mm to 20 mm with an average size of 2.2 mm in the bottom ash.

5.2.2 Chemical Characteristics of Coal Ash

Chemical analysis of the ash generated by PSC indicates that it is predominately comprised of silica (50-60%), alumina (12-33%), and iron (2-15%) with smaller concentrations of barium, calcium, magnesium, potassium, sodium and other inorganic elements. The only organic constituent in the ash is non-combusted elemental carbon. The ash is a product of the combustion of coal in which the resulting constituents are inorganic elements typically found in the earth's crust (Appendix N).

5.2.3 Coal Ash Regulatory Status

Coal ash does not exhibit any hazardous characteristics and is not a listed hazardous waste as defined in 40 CFR 261. The analysis performed on the ash from PSC power generating facilities has shown that the ash consistently passes characteristic analysis including the Toxicity Characteristic Leachate Procedure (TCLP). In general, the test results indicate TCLP metal concentrations below the typical detection limits which are in turn far below regulatory limits. This information is detailed below.

<u>TCLP Metal</u>	<u>Typical Detection Limit</u>	<u>Regulatory Limit</u>
Arsenic	0.5 mg/L	5.0 mg/L
Barium	1.0 mg/L	200 mg/L
Cadmium	0.03 mg/L	1.0 mg/L
Chromium	0.05 mg/L	5.0 mg/L
Lead	0.5 mg/L	5.0 mg/L
Mercury	0.02 mg/L	0.2 mg/L
Selenium	0.5 mg/L	1.0 mg/L
Silver	0.5 mg/L	5.0 mg/L

Barium is the only inorganic constituent that is extractable from the ash using a TCLP test. The resulting barium concentrations are 50 to 100 times lower than the TCLP Standard. It should also be noted that, currently, ash derived from the combustion of coal or other fossil fuels is exempt from Federal hazardous waste regulation under 40 CFR 261.4(b)(4) and Colorado State hazardous waste regulations under 6 CCR 1007-3 Subpart 261.4(b)(4).

5.3 Ash Transport and Receiving Procedures

Ash from power generating facilities will be the only source of waste disposed of at the facility. The ash removed for disposal originates primarily from two sources, bottom ash pits and fly ash silos. The bottom ash is moved from the boiler in a water slurry to pits located away from the boiler. The pits are drained of water and the ash is physically removed using hydraulic equipment, typically a backhoe or drag-line. The ash is loaded into trucks and transported to the disposal facility. Per the Commissioners Approval Resolution of November 8, 1993, "all trucks shall be covered during transport to the facility."

The fly ash is removed from the boiler gases through scrubbers and other mechanical devices and is pneumatically transferred to silos for temporary storage. Trucks pass under the silos and ash is gravity-fed into them. The fly ash is typically wetted down when it is loaded to suppress any dust emission. Once in the truck, the fly ash will be delivered to the ash disposal facility.

5.4 Waste Ash Placement

Ash received at the disposal facility is not subject to the same concerns as wastes received at typical MSW facilities. The ash is not putrescible, does not produce methane gas as a result of decomposition, does not attract birds or rodents, and is largely "self-compacting". Therefore, there is no need for regular daily cover or specific compaction techniques. Traffic across the waste during disposal and distribution will provide sufficient compaction to limit settling.

Ash will be transported by trucks and unloaded into the disposal areas for final placement. If the ash is not wet enough to prevent dust emissions during transportation, the ash in the truck is covered. A bulldozer or front-end loader will spread the ash into the cell in a manner that protects the liner system.

As filling nears the sump area, the leachate discharge line will be constructed and the sump will be filled with drainage material and covered with filter fabric.

Phases and cells are numbered in sequence on Plate 3 although actual construction sequencing is left to the discretion of the facility manager as conditions warrant.

5.5 Waste Disposal Area

The ash disposal filling area is approximately 179 acres of the 253 acre total permit area. Plate 3 illustrates the proposed facility configuration plan for the coal ash disposal facility. The facility design is based on a thorough understanding of the following factors:

- * The hydrogeologic regime underlying the site as discussed in Section 4.0 of this document
- * The engineering properties of the soils available at the site
- * The chemical and physical properties of the ash
- * Access to the site
- * Site physiographic and hydrologic features

The design is configured to remain a minimum of 50 feet from the Colorado Interstate Gas (CIG) pipeline easement, and approximately 100 feet from the Schumaker Road right-of-way (ROW). The design also maintains a minimum 10-foot separation between the bottom elevation of the ash and the highest recorded ground water elevation beneath the facility.

Per the Commissioners Approval Resolution of November 8, 1993, no internal coal ash hauling routes may cross the CIG pipelines without coordination with CIG and an executed "Agreement and Partial Release" between the owner and CIG defining the exact easement and conditions of use within this easement shall be submitted prior to a notice to proceed is issued.

5.5.1 Ash Disposal Volumes and Filling Area Phasing

Over 300,000 cubic yards (CY) of ash from PSC power facilities is currently being disposed of each year. Typically, the coal ash consists of 80 percent fly ash and 20 percent bottom ash. The future estimated average annual volume of ash is 360,000 CY with a corresponding estimated daily average volume of 1380 CY. The waste ash volumes disposed of may vary depending on electrical demand and other factors.

The facility is designed to provide a total disposal capacity estimated at 10,600,000 CY. The facility will have two filling phases. Phase 1, consisting of Cells A and B, is approximately 85 acres with a disposal capacity of 5,500,000 CY. Phase 2, consisting of Cells C and D, includes 107 acres with a capacity of approximately 5,100,000 CY. This results in an estimated site life of approximately 29 years. Phases A and B may be closed separately and a revised grading and drainage plan will be completed in this case. The purpose for this

configuration is for design and construction feasibility more than to set forth a rigid filling system. Each cell will be constructed to have its own leachate removal sump. Final designs for each cell will determine the exact dimensions, sump location, disposal volume, monitoring well locations, timing of cell construction, cell depth, and final topography.

5.5.2 Excavation and Liner System Design

The ash disposal area is designed so that a minimum of 10 feet of separation is maintained between the top of the liner system and the nearest ground water. The ten-foot minimum separation is generally only in the sump area where an additional one foot of soil barrier is placed. The average separation between the ash and ground water across the disposal area is 18 feet. The water levels in existing piezometers located within the footprint of the filling area will be recorded monthly for a period of 12 months to determine the highest ground-water level in each. Excavation depths will be modified as necessary, to ensure the required 10-foot separation. Following completion of the 12-month monitoring period, the piezometers will be abandoned.

The projected depths of excavation below existing ground surface will range from approximately 30 to 60 feet. The sidewalls of the disposal area are designed at a 3 horizontal to 1 vertical (3H:1V) slope.

Prior to constructing a liner system, a test pad will be constructed to determine the proper construction techniques and materials required to install a soil barrier layer as outlined in this document. A detailed construction specifications and Quality Assurance/Quality Control (QA/QC) document will be submitted under separate cover following the completion of the test pad. The test pad and specifications document is discussed in detail in Section 8.0 of this plan.

5.5.2.1 Travel Time Calculations

Travel time calculations were completed to estimate the length of time for liquids to reach ground water beneath the disposal area if a release through the liner were to occur. The following assumptions and resulting calculations were used to prepare this estimate:

- 1) The liquid would first need to breach the synthetic liner. Permeability of HDPE synthetic liners is so low that no reliable method of direct permeability measurements has been developed. Permeability of HDPE liners has been calculated indirectly using vapor transmissions tests and is on the order of 10^{-11} cm/sec or less. Because of the uncertainty in the HDPE permeability and flow characteristics, flow through the HDPE is not considered in this calculation.

6.0 FACILITY OPERATION

6.1 Facility Management

6.1.1 Operations Schedule

Normal hours of facility operation will be from 6:00 A.M. to 6:00 P.M., Monday through Friday. The facility may operate 24 hours a day, seven days a week, at the discretion of the Facility Manager.

6.1.2 Personnel and Equipment Requirements

Personnel at the facility will include employees in the following capacities:

- * Facility Manager
- * Facility Supervisor
- * Truck Drivers
- * Heavy Equipment Operators
- * Laborers

Circumstances may exist when personnel have more than one duty and more than one title and/or responsibility. The Facility Manager shall have the authority to take corrective action for non-compliance at the facility.

Depending on the activities at the facility, certain equipment may be needed. The operation will typically have the following equipment available for use:

- * Dozer Ripper
- * Scraper
- * Motor Grader
- * Compactor
- * Front End Loader
- * Water Truck
- * Soil Disc

The personnel and equipment may change as a function of the volume of materials being disposed of and/or construction activities at the facility. All of the equipment may not be on site at all times. Per the Commissioners Approval Resolution of November 8, 1993, equipment storage, beyond that needed for landfilling operations, is not permitted.

6.1.3 Recordkeeping

Per the CDH approval letter of September 14, 1993 and in accordance with Subsection 2.4 and 3.4, Recordkeeping, the owner or operator must place designated information in the operating record maintained on site. The following information, at a minimum, is to be place in the operating record at the appropriate time:

- a. engineering design and operation report; the CD
- b. report that designed construction is in accordance with approved plans (§3.2.7)
- c. construction as-built details
- d. inspection records, and training procedures
- e. ground water monitoring per Subsection 2.2 and Appendix B
- f. closure and post-closure care plans per Subsection 2.5 and 2.6
- g. incoming waste volumes
- h. variations from approved operation procedures
- i. temporary surface water control structures
- j. cost estimate and financial assurance documents per Subsection 1.8 (effective April 9, 1994)

The EDOP includes information on the following items:

- * Site geologic/hydrogeologic/hydrologic settings
- * Environmental monitoring
- * Construction information
- * Closure and post-closure requirements

The records will be maintained at the site or at the adjacent CSI office, and at the headquarters of the owner of the site. All the records are available to the Adams County Board of Commissioners and CDH upon request.

6.1.4 Facility Security

Unauthorized dumping at the facility should not be a problem at the facility. The facility will be a privately owned and operated disposal area used only for the disposal of ash. The facility will not be used for public disposal purposes. Fencing will be employed as determined by the Facility Manager to prevent unauthorized access to areas used for waste placement.

The main gate will be kept unlocked during business hours. Keys to the gate will be held by the Bennett Fire Department for emergency access when the facility is closed. In the event of an emergency, the Fire Department will be allowed entry by the use of the key or cutting the locks, as necessary.

Temporary lighting will be used at the active facility waste placement area as necessary to provide a safe working environment for the personnel on site. Additional security measures may be taken to protect employees, visitors and equipment at the site as deemed necessary by the Facility Manager.

6.2 Control of Nuisance Situations

The potential for nuisance situations resulting from ash disposal is much less than that for MSW due to the non-putrescible, non-flammable, and odorless nature of the ash.

6.2.1 Vector and Litter Control

The waste disposed of at the facility should not cause a vector problem. Therefore, control measures will not be necessary for vectors such as birds and rodents. Litter problems are also not a concern due to the physical nature of the waste.

6.2.2 Dust Control

Dust may be created at the site by vehicle traffic on access roads and during the unloading of ash. Dust on the site roads and in the unloading areas will be controlled by periodic watering. Water for dust control will be purchased from commercial sources or obtained from ponded precipitation. Precipitation that has contacted ash may be pumped from the sumps and used to control dust from the working face. An existing water well is currently available for limited use in the southeast corner of the site.

Dust suppressants such as calcium chloride, magnesium chloride and surfactant (or equivalent materials) may also be used in addition to or in lieu of water on roads and disturbed areas. Material Safety Data Sheets (MSDS) for these compounds are included in Appendix Q. Recycled asphalt aggregate may also be used in high traffic areas. Dust control measures are the responsibility of the Facility Manager and the application of dust suppressants is discretionary.

Operations will cease at the facility when the facility experiences high sustained winds of $\geq$ 40 mph or gusts of $\geq$ 50 mph that persist for more than one hour.

Per the Commissioners Approval Resolution of November 8, 1993, a valid Air Emissions Permit will be obtained prior to a notice to proceed being issued by the County.

6.2.3 Odor Control

Due to the physical and chemical nature of the waste ash, odors will not be a problem at the facility.

6.2.4 Fire Prevention

There is no fire hazard associated with the ash disposal. Per the Commissioners Approval Resolution of November 8, 1993, the Uniform Fire Code Regulations 10.203 (concerning access roads), 10.206 (concerning signage), and 10.301 (concerning street road signs and address signs) shall be met.

6.2.5 Controlling Water in Open Disposal Areas

Water may accumulate in the disposal area as a result of precipitation events. Water that contacts the working face and water that does not contact the working face will be segregated by berms (Plate 13). Runoff that has contacted the working face will be spray irrigated back onto the active waste placement area. Precipitation that has not contacted the working face will be allowed to evaporate or be used for dust control.

6.2.6 Health and Safety

A list of emergency personnel and agency contacts and their phone numbers will be available either at the facility entrance and/or posted inside the most frequently used equipment. The list includes, but is not limited to, company emergency coordinators, local fire department, local police or sheriff, closest hospital, closest hospital with air life emergency transport service, and local and state health officials.

6.2.7 Other Facilities

A small office trailer, tool trailer(s), storage shed(s), parking of equipment, etc., shall be allowed on a portion of the site. Such facilities, if installed, shall only be utilized in the operation of this facility and all appropriate building and other relevant permits shall be obtained from Adams County, Tri-County and other appropriate agencies.

7.0 ENVIRONMENTAL MONITORING

Monitoring for leachate, ground-water quality, and facility operations will be performed throughout the life of the facility. There is a very low potential for the facility operations to effect surface water, therefore, no sampling of surface water should be necessary under this permit. Contingency plans, however, will be prepared as part of the storm water management plan (SWMP) for the facility. The SWMP will be submitted prior to construction of the facility.

The results of all environmental monitoring shall be provided to Adams County and CDH quarterly. In addition, per the Commissioners Approval Resolution of November 8, 1993 and the Tri-County Health Department (TCHD) recommendations of October 10, 1993, TCHD shall also receive copies of all environmental monitoring reports.

7.1 Leachate Monitoring

The leachate discharge line will be used to monitor for the presence of liquids in the sumps and remove these liquids if necessary. Each sump will be monitored quarterly following the installation of the leachate discharge line. If liquids are detected in the sump in removable quantities, they will be removed and sprayed back onto active portions of the fill area. If no active portions exist (e.g., following closure), the liquids may be sprayed onto completed areas of the landfill, if testing indicates the liquid is compatible with plant growth. The leachate will only be sprayed onto completed portions of the fill area in quantities which will be transpired or evaporated to the atmosphere and not infiltrate into the fill.

Following final capping over the individual cells, the leachate discharge lines of the individual cells will be monitored concurrently with ground-water monitoring (either quarterly or semi-annually). Per the CDH approval letter of September 14, 1993, all leachate discharge lines are to be monitored for the life of the facility and post-closure period (§3.6.1), and not abandoned if no leachate is detected. The Department (CDH) may allow the owner or operator to stop managing leachate in the post-closure care period if it is shown that leachate no longer poses a threat to human health and the environment (§ 3.6.1(C)).

7.2 Ground-Water Monitoring

The facility ground-water monitoring program is designed to detect potential releases from the facility. The proposed ground-water monitoring system is shown on Plate 3 and includes one existing well and nine additional wells. The ground-water wells will be monitored quarterly for a minimum of eight quarters to establish background water quality. Following collection of eight quarters of data, the ground-water wells will be monitored semi-annually throughout the remaining life of the facility and for a 10-year post closure period.

7.2.1 Existing Ground-Water Monitoring Wells

Five ground-water monitoring wells were installed during the site investigation to characterize the ground-water chemistry and hydrogeologic conditions in each hydrogeologic regime (Plate 11) below the ash facility. These wells include MW-109, MW-311 (formerly MW-112), MW-114, MW-204, and MW-304 (formerly MW-111). All of these wells with the exception of MW-304, will be abandoned because they are not included in the proposed monitoring system at the facility.

Ground-water monitoring wells MW-109 and MW-114 will be abandoned because they tap perched lenses that are at elevations higher than the adjacent cell sump elevations. These saturated sand lenses are laterally and vertically discontinuous and perched within a low permeability claystone matrix above the Denver Aquifer.

Monitor well MW-204 will be abandoned because it is approximately 1500 feet west of the disposal area. This well taps saturated alluvial materials perched above the claystone bedrock and above the Denver Aquifer.

Ground-water monitoring well MW-311 will be abandoned, and replaced with new wells that are closer to the disposal area. MW-311 taps the Denver Aquifer which is the uppermost saturated interval below the majority of the disposal area.

Monitor well MW-304 also taps the Denver Aquifer but will remain as part of the permanent ground-water monitoring system.

The above five wells were sampled during October 1992 and February 1993 and the analytical results are included in Appendix J.

7.2.2 Permanent Ground-Water-Monitoring System

The proposed permanent ground-water monitoring system shown on Plate 3 is designed considering three important factors:

- 1) The Denver Aquifer represents the uppermost saturated materials below the majority of the fill area and may be continuous beneath the fill area. The ground-water monitoring system will focus on monitoring the Denver Aquifer.
- 2) The locations of the monitoring wells were established based on a northerly ground-water flow direction in the Denver Aquifer.
- 3) The ground-water monitoring wells are concentrated near the cell sumps and located within 450 feet of the disposal area boundary. Due to the potential for

temporary increase of hydraulic head in the sumps, the sump area is the most likely point source for a potential release.

Existing monitoring well MW-304 will remain as a part of the permanent monitoring system. An additional nine monitoring wells are proposed to complete the permanent monitoring system for the facility. The ground-water elevations in the Denver Aquifer are projected to range from approximately 5240 feet in the south portions of the site (near Cell D) to approximately 5235 feet in the northern portions (near Cell A).

All of the proposed monitoring wells will be downgradient from the facility with the exception of upgradient wells MW-312 and MW-313. Monitoring wells MW-312 and MW-313 are intended to tap the Denver Aquifer but also will be located within the zone of perched ground water. It is likely that perched ground water above the Denver Aquifer may be encountered during completion of either, or both, of these wells and may be more appropriate for monitoring if the perched interval extends below the fill area. The value of the perched interval for monitoring purposes will be evaluated prior to completing a well. If appropriate, a monitoring well will be completed into the perched ground water interval(s) in addition to the Denver Aquifer monitoring well.

The ground-water quality in MW-312 and MW-313 may be such that these monitoring wells will not be useful as upgradient ground-water quality indicators when using an inter-well statistical comparison (see Section 7.2.3) and may be abandoned following approval by Adams County and the CDH. Any unusable ground-water monitoring wells will be abandoned by over-drilling, removing the casing when possible, and grouting the well from its total depth to the ground surface.

The downgradient ground-water monitoring wells will be installed in phases to coincide with the phases of disposal operations. Initially, monitoring wells MW-312 and MW-313 will be installed regardless of the phase of disposal operations and will be used in collecting background water quality data.

Soil borings for the installation of the monitor wells will be completed with an auger type drill rig using 6 or 8-inch diameter, continuous flight, hollow-stem auger. Sampling will be conducted as necessary during drilling every 5 feet to more accurately define the subsurface conditions. Sampling will be accomplished using either five-foot continuous sample barrel or a split spoon sampler.

Ground-monitor wells will be constructed in accordance with the Water Well and Pump Installation Contractors Act as follows:

- 1) After reaching total depth, the center plug will be removed from the Hollow-Stem Auger.
- 2) Two-inch diameter, flush-joint, threaded Polyvinyl Chloride (PVC) pipe will be placed through the auger to total depth of the hole. The lower 10 or 15 feet of the pipe will be factory slotted. The specific length of slotted interval will be dependent on the hydrological conditions encountered in the borehole such as the saturated thickness and observed permeability.
- 3) A clean graded sand, such as 10-20 size sand will be placed in the annular space from total depth to approximately 2 feet above the slotted interval of the pipe.
- 4) A two-foot thick bentonite seal will be placed in the annular space above the sand pack to prevent surface water infiltration.
- 5) The remaining annular space from the bentonite seal to the ground surface will be filled with neat cement grout containing approximately 5 percent bentonite.
- 6) The well will be completed at the surface with a protective steel casing and locking cap to prevent unauthorized entry.

7.2.3 Analytes

Since the physical and chemical nature of the ash is well defined (consisting predominantly of metals) and will remain consistent throughout the life of the facility, the suite of analytes necessary to provide a reliable indication of a potential release is limited.

The composition of coal ash is similar to the composition of natural earth materials as shown in Appendix N. As opposed to MSW, organics, pesticides, and herbicides are not constituents of concern in coal ash. The appropriate list of parameters for the detection of releases consists of the most mobile and water soluble metals found in the ash as shown in the listing below. Selenium is also added to the analytical suite to detect any potential release and migration of heavy metals. In addition, gross alpha and beta concentrations and physical properties are included in the analytical suite.

Ground-water samples will be collected and analyzed for the following parameters on a quarterly schedule until a full eight quarters of background data have been collected and evaluated. Per the CDH approval letter of September 14, 1993, total aluminum (Al) and total iron (Fe) were added to the below list of ground water analytes, and all sampling and analyses are to be in accordance with EPA SW-846 and Appendix B of the solid waste regulations.

- * pH
- * Specific Conductance
- * Total Dissolved Solids (TDS)
- * Sulfate
- * Total Boron
- * Total Calcium
- * Total Sodium
- * Total Magnesium
- * Total Selenium
- * Total Aluminum
- * Total Iron
- * Gross Alpha concentrations
- * Gross Beta concentrations

Once background data is established, a reduced parameter list may be implemented with agency approval.

7.2.4 Data Evaluation

The ground-water data will be evaluated following each sampling episode to determine whether disposal operations are or are not impacting ground water. Under appropriate conditions (i.e., a continuous ground-water system with representative uniform chemistry), this is accomplished by comparing the concentrations of selected analytes from a suite of upgradient wells to their concentrations in downgradient wells (inter-well comparison). In this case, the chemical concentrations in the upgradient wells MW-312 and/or MW-313 would be compared to chemical concentrations in the downgradient wells. However, the hydrogeologic setting for this site may preclude this type of analysis because of differing natural ground-water chemistries between monitoring wells. Although the ground-water tapped by MW-312 and MW-313 appear to represent a continuous ground-water system within the area of investigation (based on relative static ground-water elevations), it has not yet been determined if the chemistry in the Denver Aquifer below the site is consistent enough between wells to apply an inter-well comparison method.

An appropriate statistical method to reasonably evaluate impacts to the ground water will be developed after the proposed ground-water-monitoring system has been approved and in use, and when sufficient data has been collected to establish background water quality.

7.2.5 Proposed Action in the Event of Negative Monitoring Results

A negative monitoring event will be defined relative to the statistical method chosen to evaluate impacts to the ground water. If at any time during the active life or the post-closure period of the facility negative monitoring results are observed, Adams County and CDH will be notified within 10 working days following review of the statistical data. If necessary, confirmation sampling and testing will be conducted. If negative monitoring results are confirmed, the operator will evaluate the data and present a plan of action to the County and State within 30 days. The plan will be implemented on approval by the appropriate regulatory agencies.

7.3 Operational Monitoring

Temporary and permanent surface water control structures will be inspected monthly to note any erosional damage, excess siltation problems, and overall structural integrity and function. These structures will also be inspected following any substantial precipitation event. Any problems noted will be rectified as soon as practical.—

General facility inspections will be conducted daily during the operating hours. The general facility inspection will include visual inspection of the active disposal cell for signs of erosion or damaged liner systems. In addition, daily inspections of conditions of any fencing, roads, and equipment will be conducted.

8.0 CONSTRUCTION PROCEDURES AND SPECIFICATIONS

An overview of the construction procedures and specifications to be used for the coal ash disposal facility is presented in this section.

8.1 Disposal Cell Construction Components

The materials used to construct the disposal cells, listed from the base of the excavation up, will include:

Liner System

- 1) Suitable soil material for the soil barrier layer.
 - * Maximum design permeability 1×10^{-7} cm/sec.
 - * Minimum 24-inches thick over base and sidewalls
 - * Minimum 36-inches thick over sump area
- 2) A synthetic membrane liner over the soil barrier layer.
 - * Consists of a 60-mil minimum thickness High Density Polyethylene (HDPE) geomembrane, or other membrane as may be approved in the future.

Leachate Collection System

- 1) Granular material to ensure proper drainage in the LCS.
 - * Minimum design permeability 1×10^{-1} cm/sec.
 - * Minimum six-inches thick over base of cell
- 2) Leachate collection piping system.
 - * Six-inch diameter, schedule 80 minimum
 - * Placed within six-inch drainage layer
 - * Routed along base of disposal cell to sump

3) Filter fabric to ensure the LCS remains functional.

- * Placed over drainage material to provide physical separation of the ash and the LCS
- * Designed to filter particles over the #100 sieve size
- * Minimum weight of 10 ounces

Final Cover System

1) Unspecified soil material above ash to provide foundation for compaction.

- * Minimum 6-inches thick

2) Suitable soil material for use in compacted soil cap.

- * Maximum design permeability of 1×10^{-7} cm/sec.
- * Minimum 18-inches thick

3) Unspecified fill soil to promote revegetation and protect the compacted cap

- * Minimum 18-inches thick

4) Topsoil for revegetation of the final cover.

- * Minimum 6-inches thick

A representative cross section of the landfill materials is shown on Plate 13.

8.2 Proposed Construction of a Test Pad to Verify Design Permeabilities

Construction of a test pad is proposed at the ash disposal facility to verify the design specifications and permeabilities of the clay barrier and cover materials, as well as the general construction techniques that will be followed. This information in turn will be used to develop final construction specifications by demonstrating that, using representative soils at the site, selected construction equipment and techniques, and acceptable construction Quality Assurance and Quality Control (QA/QC) procedures, the soil barrier layer and cap can be built to meet the proposed CDH design criteria. Per the Commissioners Approval Resolution of November 8, 1993, the CDH approval letter of September 14, 1993, and the TCHD recommendation letter of October 19, 1993, the final construction documents will be submitted to Adams County, CDH, and TCHD prior to a notice to proceed being issued.

The construction specification document will include material specification, construction methods and equipment, survey requirements, and QA/QC procedures for the following aspects of cell construction:

- * Excavation
- * Base preparation
- * Soil Barrier layer construction
- * Synthetic liner installation and anchor trench details
- * Leachate Collection System construction
- * Final Cover System construction

The test pad will be constructed and tested in accordance with the following sections.

8.2.1 Clay Soils Testing

Clay soils to be used for the test fill will be sampled and tested as indicated below to ensure and/or establish the following physical properties:

- 1) Sieve analysis with greater than 50 percent of material (by weight) passing the U.S. Standard No. 200 sieve.
- 2) Natural Moisture Content.
- 3) Liquid Limit (LL) greater than 25.
- 4) Plasticity Index (PI) greater than 10.
- 5) Standard Proctor test for determination of maximum dry density and optimum moisture content.

Bulk samples of soil will be collected and tested for compliance with the above criteria. Soils not meeting the above criteria will be evaluated by laboratory testing prior to their use in a test pad. The final material specifications will be presented for regulatory approval prior to disposal cell construction.

8.2.2 Test Pad Construction Sequence

- 1) The test pad area will be cleared of all vegetation. The top six (6) inches of materials will be stockpiled for later reclamation of the test pad site.
- 2) The size of the test pad is dependent on the equipment used to compact the materials. The pad width will be a minimum of four times the selected equipment width and will be of a sufficient length to allow the equipment to reach full operating speed (approximately 75 feet).
- 3) An initial sacrificial lift of six (6) inches of miscellaneous soil material may be placed on the pad and compacted to support the subsequent lifts. This lift will not be tested and compared to any specifications.
- 4) Soils will be excavated and stockpiled for use on the pad. The soils will be processed, as necessary, to reduce the size of any clods prior to placement of the soils. the operator will use a disc, pulverizer, tiller, or mulcher as necessary to perform the processing.
- 5) The soils will be placed in loose lifts not to exceed eight (8) inches and resulting in compacted lifts of approximately six (6) inches. Four lifts totaling a maximum of two (2) feet will be compacted to construct the pad.
- 6) Compaction must be accomplished using a Sheepsfoot-type roller.
- 7) The test pad liner will be field tested using a nuclear density gauge to determine if the following design specifications are met:
 - a) 95% of maximum dry density (Standard Proctor)
 - b) -2 to +4% wet of optimum moisture content

Field testing with the nuclear density gauge will be completed at two randomly chosen locations on each run (or compactor width) of each lift. This will total eight locations per lift and 32 total for the pad. If the compacted soils do not meet the design specifications, the materials will be reprocessed, compaction adjustments will be made and the materials retested to ensure the pad meets the specifications.

- 8) Permeability testing of the test pad liner will be completed using a flexible wall permeameter apparatus. Shelby Tube samples will be collected and the permeameter test will be conducted in a geotechnical laboratory. Eight samples, two from each lift, will be collected and tested using the flexible permeameter test.
- 9) If the liner permeability is greater than the design specification of 1×10^{-7} cm/sec, the liner will be removed, reworked and replaced by varying the initial construction techniques. This will be done until the design permeability requirements are met.
- 10) All construction activities will be documented. The techniques used to construct the test pad will later be used to construct the barrier soil layer and cover.

Per the CDH approval letter of September 14, 1993, the results of test pad trials, and the ensuing construction specification document detailing material specifications, construction methods, survey requirements and QA/QC procedures for cell construction shall be submitted for review and approval prior to start of cell construction. This document is to include final plans for these items covered herein in Section 8.0.

8.3 Disposal Cell Excavation Inspections

Prior to liner placement in any disposal cell, an excavation inspection will be completed. The areal limits, slopes, and elevations of the various cell components will be surveyed by a Colorado registered professional land surveyor. Observations made during the excavation inspection, as well as the survey data, will be included in an as-built construction report. This report will be prepared following construction completion of the clay barrier layer and leachate collection system and submitted to Adams County.

8.4 Compacted Soil Barrier Layer and Cap Inspections

To ensure that the soil barrier layer and cap for each disposal cell are constructed in accordance with design specifications, all construction will be observed and tested. The observation and testing program will consist of laboratory physical properties testing for every 3000 CY of soil barrier material used in the liner and cover systems. This program will help ensure that the construction materials are suitable for their intended uses. In addition, moisture-density testing will be conducted on the compacted soil barrier layer and cap.

8.5 Leachate Collection System (LCS)

Observation will be provided during the construction of the LCS in each disposal cell to verify that it is built in accordance with the design specifications. Verification will include laboratory permeability testing of the drainage material and thickness.

8.6 Synthetic Liner Inspection

The synthetic membrane will be installed by a qualified firm experienced in HDPE membrane installations of this type. Quality control will be provided during installation of the synthetic liner.

8.7 As-built Report

A report detailing the construction activities will be prepared following completion of the construction stage. The report will include a construction narrative, laboratory results of materials testing, and field test results.

An as-built drawing will also be prepared and submitted with the as-built report. The drawing will include:

- * Excavation elevations
- * Surface dimensions of the constructed area
- * Side slope grades
- * Base grades both laterally and longitudinally
- * Construction component thicknesses
- * Permanent surface water diversion structure types and their locations

The as-built report and drawing for each construction stage will be submitted to Adams County and the CDH for their records. Per the Commissioners Approval Resolution of November 8, 1993, the applicant/operator shall be required to submit certification from a Colorado Professional Engineer certifying all disposal cells are designed and built to the committed requirements of CDH and TCHD prior to depositing the coal ash waste. A Notice to Proceed shall be required prior to the start of filling for each disposal cell. All applicable conditions precedent and applicable stipulations shall be met prior to issuance of Notice to Proceed.

8.5 Leachate Collection System (LCS)

Observation will be provided during the construction of the LCS in each disposal cell to verify that it is built in accordance with the design specifications. Verification will include laboratory permeability testing of the drainage material and thickness.

8.6 Synthetic Liner Inspection

The synthetic membrane will be installed by a qualified firm experienced in HDPE membrane installations of this type. Quality control will be provided during installation of the synthetic liner.

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An as-built drawing will also be prepared and submitted with the as-built report. The drawing will include:

- * Excavation elevations
- * Surface dimensions of the constructed area
- * Side slope grades
- * Base grades both laterally and longitudinally
- * Construction component thicknesses
- * Permanent surface water diversion structure types and their locations

The as-built report and drawing for each construction stage will be submitted to Adams County and the CDH for their records. Per the Commissioners Approval Resolution of November 8, 1993, the applicant/operator shall be required to submit certification from a Colorado Professional Engineer certifying all disposal cells are designed and built to the committed requirements of CDH and TCHD prior to depositing the coal ash waste. A Notice to Proceed shall be required prior to the start of filling for each disposal cell. The County Staff and the Operator shall jointly determine prior to initiating construction which conditions precedent and stipulations must be completed prior to a Notice to Proceed being issued.

9.0 CLOSURE AND POST-CLOSURE REQUIREMENTS

9.1 Final Site Closure

Per the Commissioner's Approval Resolution of November 8, 1993, as a condition of Notice to Proceed,

" Prior to commencement of filling operations, the applicant shall provide evidence that all performance, closure, and post-closure bonding has been completed with the appropriate State agency. In the event the State's financial assurance programs are not in place, or at any time are not applicable to the facility, Public Service shall provide a corporate guarantee acceptable to the Adams County Attorney's Office to provide assurance of compliance with the operating condition of the Certificate of Designation and all conditions of the closure and post-closure bond."

Final site closure at the coal ash disposal facility will be completed after the final disposal cell is filled. CDH and the Adams County Commissioners will be notified at least 60 days in advance of the final closure date. Although this is a private facility and not open to the public, a sign will be posted notifying the public of closure. A record of notation will be added to the deed of the property. The proposed final topography is shown on Plate 12.

At closure, any temporary surface-water control berms will be removed. Following cover installation over the final cell, any remaining disturbed portions of the site will be brought to final grades and revegetated, and post-closure maintenance procedures will begin. The proposed final topography shown on Plate 12 may be modified to maintain capacity if the base elevations are raised and depending on the availability of soils at closure and potential post-closure uses.

There should be no problems associated with unauthorized use of the facility after closure. During the operational life of the facility it will only be used for the disposal of ash from PSC, its successors or assigns, and not for use of the general public. If unauthorized dumping does become a problem, fences may be placed to prevent access to the closed facility.

Per the CDH approval letter of September 14, 1993, this closure plan was modified to:

- a. include a sign to inform the public closure (§ 2.5.3) (see Section 9.1, 2nd paragraph)
- b. extend the post closure care and monitoring period to at least ten (10) years. After ten years, the owner or operator may apply to CDH and Adams County for a limit to the care and maintenance period. (see Section 9.3)

- c. continue monitoring all leachate discharge lines on same schedule as site ground water monitoring, that is, a minimum of ten (10) years after closure. (see Section 9.3.1)
- d. add a record of notation on the deed to the property (§ 3.4.1) (see Section 9.1, 2nd paragraph)

9.2 Reclamation and Revegetation

All disturbed areas on site will be reclaimed in accordance with this closure plan. The individual cells will be covered as soon as practical after reaching final grades. The reclamation process includes the procedures specified in this section for topsoil storage, fertilization, seed bed preparation, and seeding.

During excavation of the cells and the borrow area, a minimum six (6) inches of topsoil will be removed and stockpiled separately from the other excavated materials. The stockpile location(s) will depend on the cell or area of borrow to be excavated, but it will generally be on undisturbed property in the vicinity of the excavated cell. Topsoil will be placed so ongoing operations are not disrupted. Topsoil stockpiles that are expected to remain for periods exceeding six months will require vegetation with native grasses to minimize erosion potential.

Interim reclamation will be ongoing until all portions of the property have been filled and final reclamation will begin once final grades are reached for a given area. As other areas are excavated for cell use or borrow, previously filled areas will receive interim revegetation or final revegetation depending upon whether final grades have been reached. The acreage of any disturbed area(s) will be kept to a minimum at all times.

In conformance with the Commissioners Approval Resolution of November 8, 1993, revegetation will be based on recommendations of the East Adams Soil Conservation District. Both interim and final revegetation will be an ongoing process, and annual evaluations will be made to determine if revegetation is successful. Interim and final reclamation will proceed according to the guidelines outlined below:

- * Interim revegetation will consist of seeding as follows:

<u>Grass</u>	<u>Percent (%) of mix</u>	<u>PLS/acre Seeding Rate^(1,2)</u>
Pubescent Wheatgrass (or approved SCS equal) ³	100	9.0

¹PLS - Pure Live Seed.

²This rate is for drill seeding; rate should be doubled when broadcast seeding.

³SCS - Soil Conservation Service (U.S. Department of Agriculture).

- * All topsoil and overburden stockpiles that will be left exposed for six (6) months or more, and all temporary and permanent drainage channels requiring seeding shall be seeded as outlined above. For areas larger than 10 acres in size, 1/2 ton per acre of hay, straw, or barnyard manure should be provided as mulch to protect the soil from erosion.
- * For interim revegetation, all areas that are subjected to compaction by traffic or other activity, shall be scarified to a depth of 4-6 inches prior to seeding. The same scarification depth will also be used for final revegetation prior to topsoil replacement, except that over a fill area(s) the scarification should only be undertaken after a minimum 18 inches of overburden has been placed over any filled area(s) where the cap is in place.
- * Upon completion of any cell area where final revegetation is proposed, a minimum thickness of six (6) inches of topsoil will be placed as the final component of the cover system (see Plate 13). The ground surface beneath the topsoil will be properly prepared prior to placement of the topsoil.
- * Unless an area is immediately returned to dry-land crop production final revegetation will consist of seeding as follows:

<u>Grass Type *</u>	<u>Rate</u>	<u>% of mix</u>	<u>PLS/acre Seeding Rate</u>
Pastura Blue Grama	1.5	20	0.3
Vaughn Side Oats Grama	4.5	25	10/25
Arriba Western Wheat Grass	8.0	25	2.0
Goshen Prairie Sandreed	3.5	30	1.05
Prairie Clover		Trace	---

* Or other SCS-approved dryland vegetation type requiring low maintenance

All rates are for drill seeding; rates should be doubled when broadcast seeding. Prior to final revegetation, soil tests will be completed to determine fertilizer needs. Barnyard manure may be employed both for mulch and to replace part of the fertilizer requirement.

- * Weed control to prevent undesirable plants such as Canadian Thistle, Mush Thistle, Knapweed (all varieties), Leafy Spurge and Russian Thistle shall be controlled by cutting and chemical spraying. For interim revegetation areas, mowing should be employed when weeds reach a height of approximately 18 inches. For final revegetation, an initial application of "Glean" or similar weed control agent shall be used, then mowed as needed, until a satisfactory stand of grass is established.

The revegetation plan outlined above is based on generalized guidelines developed for the CSI facility by the SCS. Modifications to these reseeding specifications may be made depending upon observations of the progress made concerning the revegetation of previously completed cells.

9.3 Post-Closure Monitoring

The post-closure monitoring period for the coal ash disposal facility will be 10 years. A typical municipal solid waste disposal facility must be monitored for extended periods of time following closure due to continued waste degradation and consolidation which enhances leachate and methane generation and the potential for differential settlement. Because ash is non-putrescible, does not degrade, and is subject to very limited settlement, a 10-year post-closure monitoring period is sufficient to determine if the ash has stabilized (i.e., not producing leachate or settling).

9.3.1 Ground-Water and Leachate Monitoring

Ground water in the monitoring wells installed at the site will be sampled and analyzed semi-annually for the quality parameters specified in Section 7.2 over a period of 10 years following site closure. Site post-closure monitoring will begin following completion of the final cover system of the last cell. If, at any time during the post-closure period, negative monitoring results are confirmed, the proposed actions discussed in Section 7.2.4 will be undertaken.

In addition to the monitoring well sampling, the leachate discharge lines will be monitored for the presence of liquids on a semi-annual basis for a period of ten (10) years following final cell closure. All leachate monitoring results will be submitted to Adams County for their records. Any leachate will be removed and sprayed back onto completed disposal areas. Individual leachate discharge lines will be abandoned following the ten year post-closure period after approval of CDH and Adams County.

9.3.2 Inspections and Maintenance

Post-closure inspections at solid waste landfill sites are typically conducted to detect possible settling of the waste material and degradation of the cover. The cell cover will be inspected for settlement, cracking, erosion, and condition of the vegetation semi-annually for 10 years following closure. One of the inspections will be completed in the late spring season, since freeze and thaw cycles are most likely to cause damage. Any detected damage will be promptly repaired.

Permanent surface water runoff control structures will be inspected semi-annually for damage, including local erosion and siltation for a 10-year period following closure. Any structure damage will be repaired and channel maintenance effected, as necessary.

9.4 Staged Closure

The final cover system will be applied in stages as the portions of the landfill reach the final elevations with ash. The foundation layer, cap, protection/root zone, and topsoil will be placed and the area will receive either interim or final vegetation. The post-closure period for areas that have reached the final filling elevations will begin following construction of the final cover system and application of either interim or final vegetation.

9.5 Projected Post-Closure Land Use

It is anticipated that future land use at the facility will be determined with the completion of a revised Adams County Comprehensive Plan. There are no specific redevelopment plans existing at this time. Adams County, CDH, and other local governing bodies will be notified of projected post-closure land use(s) and also will be involved in determining whether the use(s) could impact the integrity of the closed facility.

10.0 REFERENCES CITED

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4. Guidelines and Criteria for Identification and land-Use Controls of Geologic Hazard and Mineral Resource Areas, Colorado Geological Survey, 1974
5. Subsidence Above Inactive Coal Mines, Colorado Geological Survey and Colorado Mine Land Reclamation Program, 1985
6. USGS Open File Report 82-1033, Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States, 1982
7. Soil Survey of Adams County, USDA, SCS and Colorado Agricultural Experiment Station, 1984
8. Engineering Design and Operations Report - Certificate of Designation, Shale Mine Ash Backfill Project, Western Aggregates, Inc.(1992)
9. Specific Yield-Compilation of Specific Yields for Various Materials, Geologic Survey Water-Supply Paper 1662-D (1976)
10. Conservation Services, Incorporated, Design and Operations Plan, October 4, 1991.
11. Geological Structure, Hydrology, and Water Quality of the Laramie-Fox Hills Aquifer in the Denver Basin, Colorado. Robson and others, USGS Map HA-650, 1981
12. Geological Structure, Hydrology, and Water Quality of the Arapahoe Aquifer in the Denver Basin, Colorado. Robson and others, USGS Atlas HA-647, 1981
13. Geological Structure, Hydrology, and Water Quality of the Denver Aquifer in the Denver Basin, Colorado. Robson and Romero, USGS Atlas HA-646, 1981
14. Managing Power Plant Wastes, Power Magazine (1991), Issue #135, page 97

TABLE 1
SUMMARY OF SOIL DATA

Project Name IC/2-4079/CO Project Number 923-2499
Location COLORADO

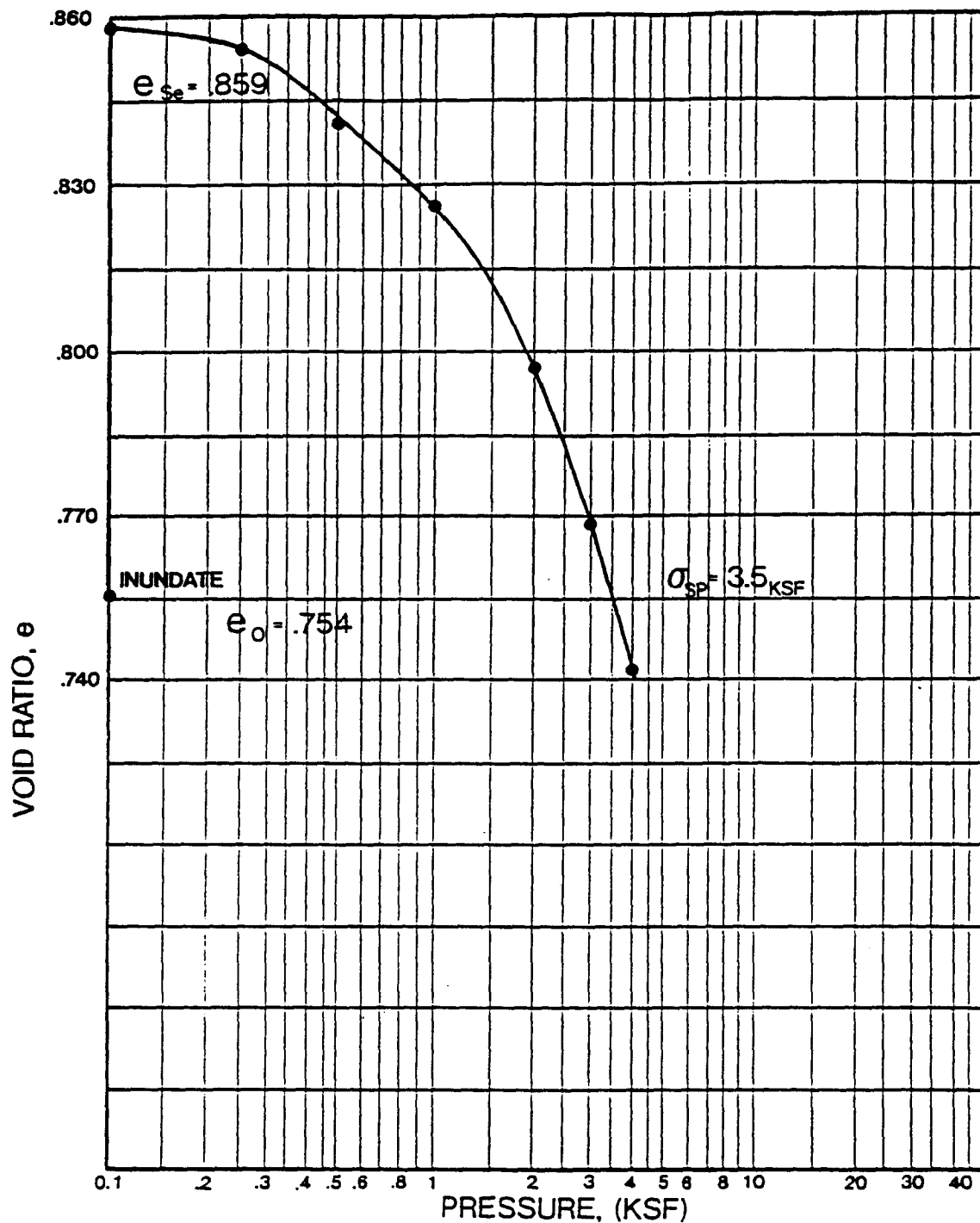
SAMPLE TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	USCS SOIL CLASSIFICATION	NATURAL MOISTURE %	ATTERBERG LIMITS				GRAIN SIZE DISTRIBUTION		SPECIFIC GRAVITY	VOID RATIO	UNIT WEIGHT PCF		ADDITIONAL TESTS COMMENTS (SEE NOTES)
					LL	PL	PI	SL	% FINER NO. 4 SIEVE	% FINER NO. 200 SIEVE			WET	DRY	
BULK	PZ-54	20-40'	CH	19.6	68	22	46	--	100	90	--	--	--	--	P, PERM, DS, S, U
BULK	PZ-57	20-25'	CH	20.2	50	18	32	--	100	80	--	--	--	--	P, PERM
BULK	PZ-62	21-26'	CL	13.3	46	17	29	--	100	70	--	--	--	--	P, PERM
BULK	PZ-63	30-35'	CH	15.1	56	20	36	--	100	86	--	--	--	--	P
BULK	PZ-64	35-43'	CH	19.1	61	22	39	--	100	93	--	--	--	--	P, PERM
BRASS LINER	PZ-60	33-34.5'	--	24.3	--	--	--	--	--	--	--	--	118.1	95.0	PERM
BRASS LINER	PZ-62	28.5-28.85'	--	29.1	--	--	--	--	--	--	--	--	--	--	--
BRASS LINER	PZ-63	33-33.3'	--	19.7	--	--	--	--	--	--	--	--	124.8	104.3	PERM
BRASS LINER	PZ-64	28-28.3'	--	19.2	--	--	--	--	--	--	--	--	--	--	--
BRASS LINER	PZ-65	23.6-24'	--	20.3	--	--	--	--	--	--	--	--	--	--	--
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NOTES: LL = LIQUID LIMIT
PL = PLASTIC LIMIT
PI = PLASTIC INDEX
SL = SHRINKAGE LIMIT

T = TRIAXIAL TEST
U = UNCONFINED COMPRESSION TEST
C = CONSOLIDATION TEST
P = PROCTOR TEST
DS = DIRECT SHEAR TEST
Perm = PERMEABILITY

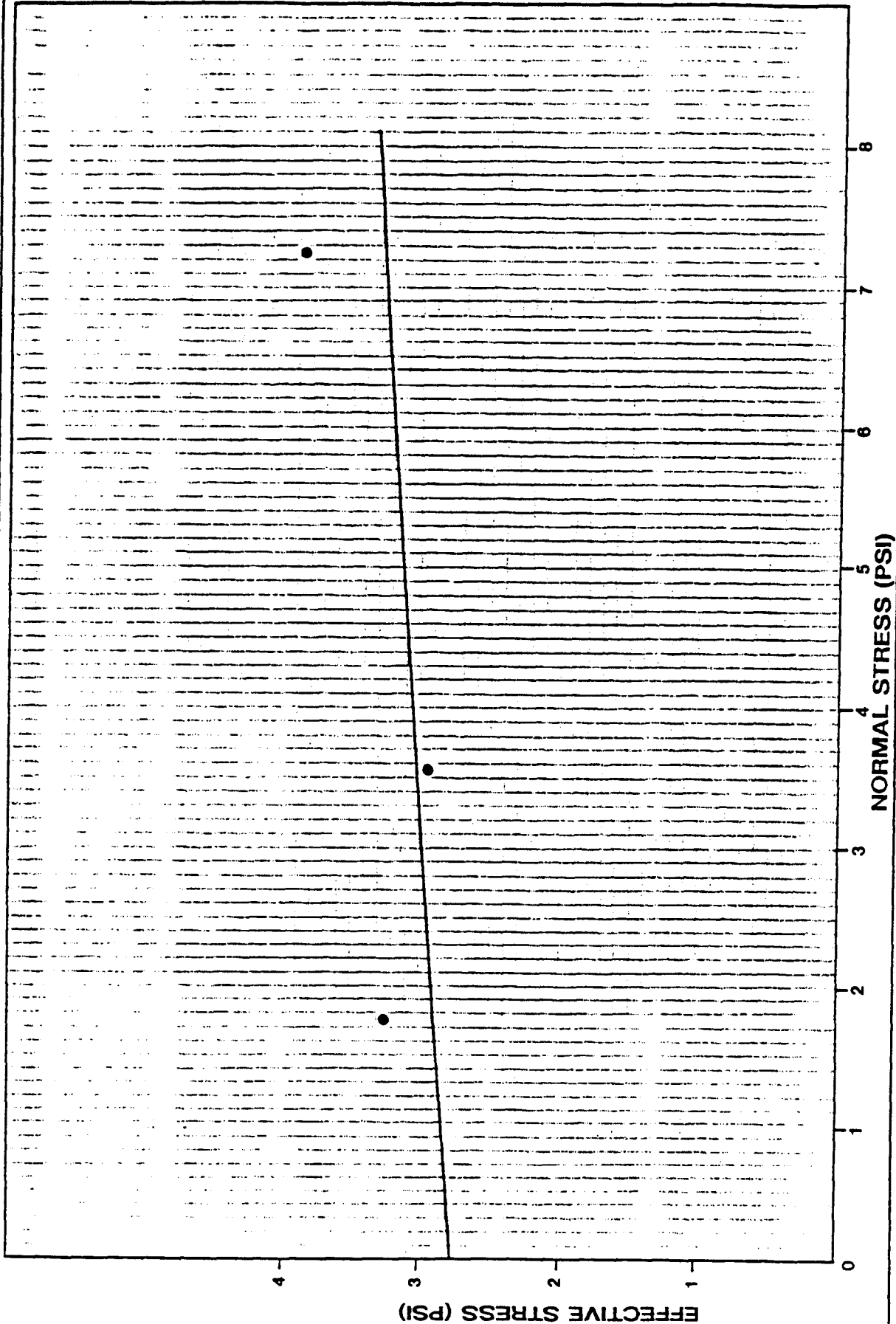
TABLE 2
IC/2-4079/CO
923-2499
SUMMARY OF LABORATORY PERMEABILITY TEST RESULTS

SAMPLE NUMBER	PZ-54	PZ-57	PZ-60	PZ-62	PZ-63	PZ-64
Sample Length (cm)	8.97	8.93	5.81	8.96	6.60	8.91
Sample Diameter (cm)	7.30	7.29	3.51	7.28	4.87	7.27
Sample Dry Density (pcf)	98.6	102.4	95.0	106.5	104.3	101.5
Maximum Dry Density (pcf)	103.5	108.0	-	112.0	-	105.0
Compaction (%)	95.3	94.8	-	95.1	-	96.7
Initial Moisture Content (%)	21.0	18.3	24.3	15.5	19.7	19.6
Optimum Moisture Content (%)	21.0	17.5	-	15.0	-	20.0
Effective Stress (psi)	5	5	5	5	5	5
Back Pressure (psi)	95	95	95	95	95	95
Gradient	23	26	26	27	19	24
Average Permeability (cm/sec)	2×10^{-9}	5×10^{-9}	6×10^{-9}	1×10^{-7}	4×10^{-7}	6×10^{-9}



BORING No _____ SAMPLE No PZ-54
 ELEV. or DEPTH 20'-40' JOB No _____
 SAMPLE CLASSIFICATION CLAY with little fine to coarse sand (CH)

 Golder Associates Inc. Denver, Colorado			TITLE		
			VOID - PRESSURE CURVES SWELL TEST, METHOD A		
CLIENT/PROJECT			DATE	SCALE	JOB NO.
<u>IC/2-4079/CO</u>			<u>AUG 1992</u>	<u>AS SHOWN</u>	<u>923-2499</u>
DRAWN	CHECKED	REVIEWED	FILE	DWG. NO.	FIGURE
<u>TT</u>	<u>DR</u>				<u>1</u>



CONSOLIDATED-DRAINED DIRECT SHEAR TEST

Project IC/2-4079/CO

Type of Sample RECOMPACTED

Depth of Sample 20'-40'

Drawn TT Checked DR

Job No. 923-2499

Boring No. C

Description of Soil CLAY with little fine to coarse sand (Ch)

Reviewed _____

Sample No. PZ-54

Swell Pressure 24.3 psi

Date AUGUST 1992

Figure 2

DIRECT SHEAR TEST RESULTS
IC/2-4079/CO
923-2499

SAMPLE NUMBER	PZ54	PZ54	PZ54
NOMINAL NORMAL STRESS (psi)	1.7	3.5	6.9
DISPLACEMENT RATE (in./min)	0.0013	0.0013	0.0013
SAMPLE HEIGHT (in.)	1.00	1.00	1.00
SAMPLE DIAMETER (in.)	2.50	2.50	2.50
DRY DENSITY (pcf)	100.2	100.2	100.2
MOISTURE CONTENT (%)	20.9	20.9	20.9
NORMAL SHEARING			
NORMAL STRESS (psi)	1.75	3.54	7.15
SHEAR STRESS (psi)	3.24	2.90	3.82
DISPLACEMENT (in.)	0.02	0.03	0.05

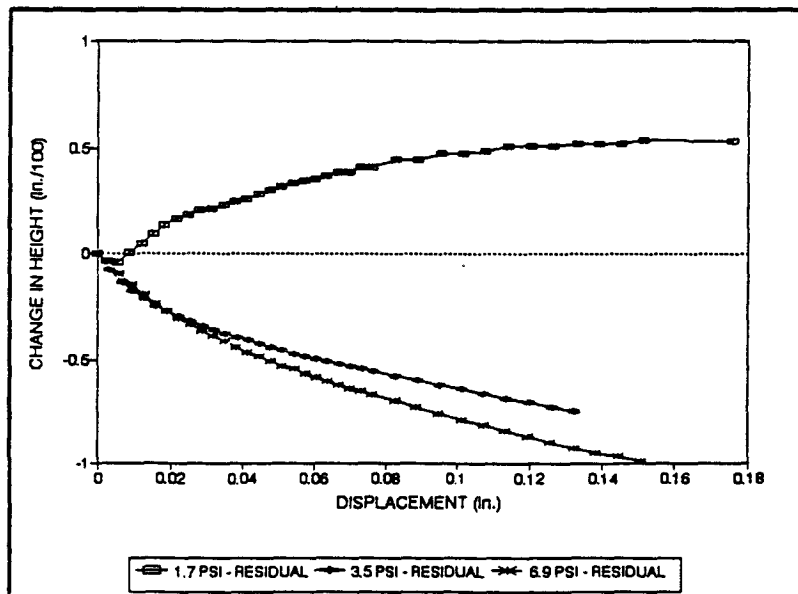
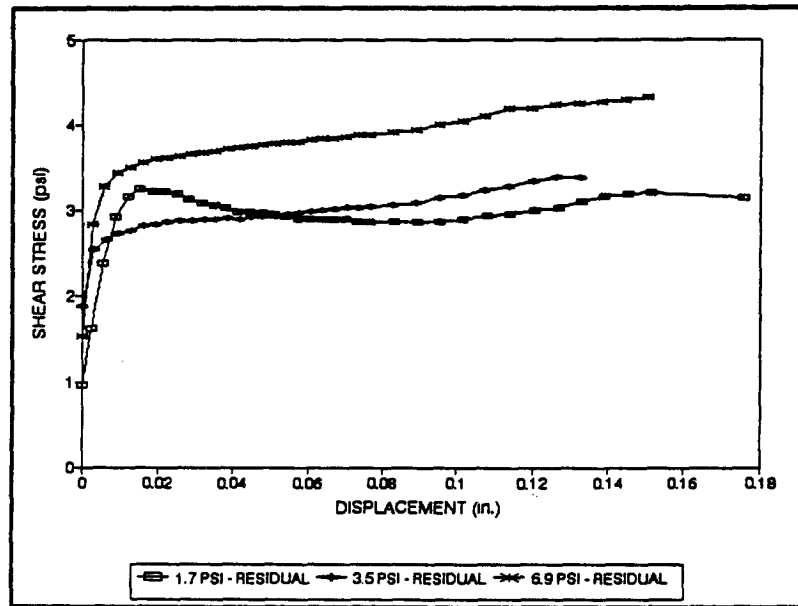


Figure 3

IC/2-4079/CO
DIRECT SHEAR DATA
SAMPLE: PZ54
CONFINING PRESSURE 1.7 PSI - RESIDUAL

Reading	vertical change (in./100)	stress (psi)	displacement (in.)	vertical change (cm/100)	stress (ksf)	strain (%)
1	0.0000	1.0	0.00	0.0000	0.1404	0.0000
2	-0.0365	1.6	0.00	-0.0927	0.2329	0.0976
3	-0.0417	2.4	0.01	-0.1058	0.3431	0.2189
4	0.0029	2.9	0.01	0.0073	0.4209	0.3496
5	0.0477	3.2	0.01	0.1212	0.4545	0.4850
6	0.0921	3.2	0.02	0.2339	0.4668	0.6079
7	0.1324	3.2	0.02	0.3362	0.4638	0.7449
8	0.1636	3.2	0.02	0.4155	0.4626	0.8756
9	0.1832	3.2	0.03	0.4653	0.4595	1.0031
10	0.2024	3.1	0.03	0.5142	0.4505	1.1307
11	0.2127	3.1	0.03	0.5403	0.4454	1.2630
12	0.2313	3.1	0.03	0.5874	0.4403	1.3953
13	0.2463	3.0	0.04	0.6257	0.4352	1.5213
14	0.2613	3.0	0.04	0.6637	0.4300	1.6520
15	0.2828	3.0	0.04	0.7184	0.4288	1.7827
16	0.3009	3.0	0.05	0.7642	0.4275	1.9087
17	0.3168	2.9	0.05	0.8047	0.4243	2.0378
18	0.3326	2.9	0.05	0.8449	0.4210	2.1669
19	0.3461	2.9	0.06	0.8792	0.4178	2.2976
20	0.3530	2.9	0.06	0.8967	0.4185	2.4236
21	0.3702	2.9	0.06	0.9404	0.4172	2.5496
22	0.3884	2.9	0.07	0.9866	0.4160	2.6835
23	0.3904	2.9	0.07	0.9917	0.4166	2.8079
24	0.4083	2.9	0.07	1.0372	0.4133	2.9339
25	0.4083	2.9	0.08	1.0372	0.4140	3.0614
26	0.4446	2.9	0.08	1.1292	0.4135	3.3197
27	0.4464	2.9	0.09	1.1339	0.4129	3.5764
28	0.4788	2.9	0.10	1.2161	0.4142	3.8220
29	0.4796	2.9	0.10	1.2181	0.4176	4.0724
30	0.4848	2.9	0.11	1.2314	0.4231	4.3260
31	0.5078	2.9	0.11	1.2897	0.4245	4.5717
32	0.5096	3.0	0.12	1.2944	0.4321	4.8236
33	0.5091	3.0	0.13	1.2930	0.4377	5.0677
34	0.5217	3.1	0.13	1.3250	0.4474	5.3134
35	0.5204	3.2	0.14	1.3218	0.4551	5.5591
36	0.5198	3.2	0.15	1.3203	0.4587	5.8079
37	0.5413	3.2	0.15	1.3750	0.4603	6.0567
38	0.5362	3.2	0.18	1.3620	0.4539	7.0331

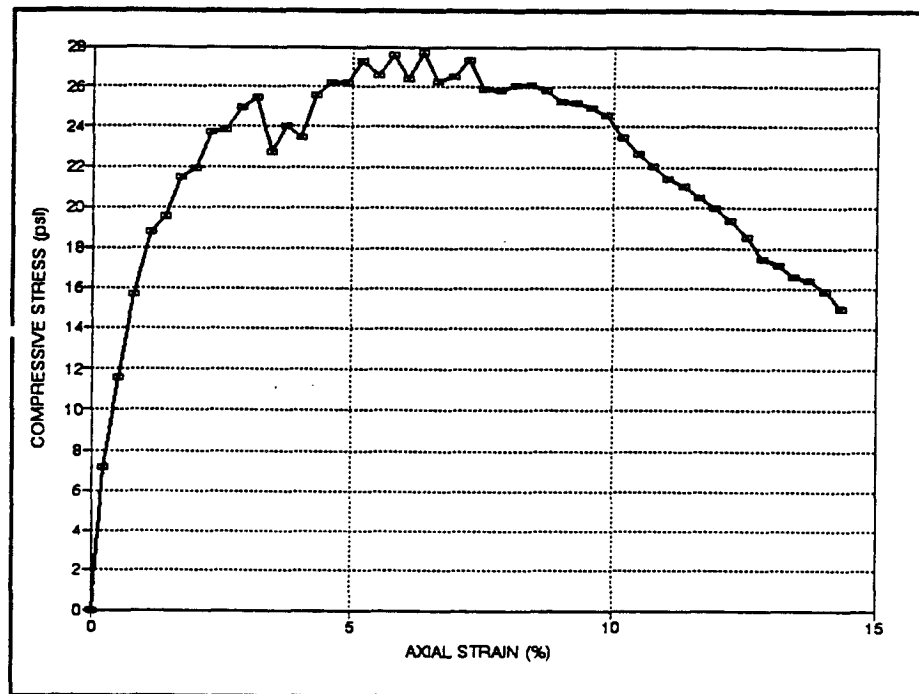
IC/2-4079/CO
DIRECT SHEAR DATA
SAMPLE: PZ54
CONFINING PRESSURE 3.5 PSI - RESIDUAL

Reading	vertical change (in./100)	stress (psi)	displacement (in.)	vertical change (cm/100)	stress (ksf)	strain (%)
1	0.0000	1.9	0.00	0.0000	0.2711	0.0000
2	-0.0776	2.5	0.00	-0.1972	0.3658	0.1244
3	-0.1330	2.7	0.01	-0.3377	0.3838	0.2667
4	-0.1767	2.7	0.01	-0.4487	0.3940	0.3811
5	-0.2131	2.8	0.01	-0.5413	0.3986	0.5165
6	-0.2429	2.8	0.02	-0.6170	0.4051	0.6425
7	-0.2725	2.8	0.02	-0.6922	0.4096	0.7701
8	-0.2938	2.9	0.02	-0.7463	0.4122	0.9024
9	-0.3174	2.9	0.03	-0.8062	0.4149	1.0283
10	-0.3399	2.9	0.03	-0.8634	0.4156	1.1606
11	-0.3581	2.9	0.03	-0.9095	0.4182	1.2882
12	-0.3764	2.9	0.04	-0.9560	0.4169	1.4157
13	-0.3935	2.9	0.04	-0.9996	0.4196	1.5512
14	-0.4093	2.9	0.04	-1.0396	0.4184	1.6756
15	-0.4263	2.9	0.04	-1.0828	0.4210	1.7984
16	-0.4413	2.9	0.05	-1.1208	0.4217	1.9228
17	-0.4559	2.9	0.05	-1.1581	0.4204	2.0504
18	-0.4696	3.0	0.05	-1.1929	0.4251	2.1780
19	-0.4826	3.0	0.06	-1.2257	0.4277	2.3055
20	-0.4943	3.0	0.06	-1.2554	0.4285	2.4331
21	-0.5064	3.0	0.06	-1.2862	0.4312	2.5606
22	-0.5173	3.0	0.07	-1.3140	0.4339	2.6913
23	-0.5313	3.0	0.07	-1.3496	0.4366	2.8173
24	-0.5426	3.0	0.07	-1.3781	0.4353	2.9402
25	-0.5548	3.0	0.08	-1.4092	0.4381	3.0677
26	-0.5771	3.1	0.08	-1.4658	0.4395	3.3150
27	-0.5971	3.1	0.09	-1.5167	0.4450	3.5669
28	-0.6172	3.1	0.10	-1.5677	0.4525	3.8126
29	-0.6391	3.2	0.10	-1.6233	0.4581	4.0598
30	-0.6604	3.2	0.11	-1.6773	0.4657	4.3071
31	-0.6788	3.3	0.11	-1.7241	0.4714	4.5575
32	-0.6994	3.3	0.12	-1.7765	0.4811	4.8063
33	-0.7222	3.4	0.13	-1.8343	0.4868	5.0520
34	-0.7430	3.4	0.13	-1.8873	0.4864	5.2992

IC/2-4079/CO
DIRECT SHEAR DATA
SAMPLE: PZ54
CONFINING PRESSURE 6.9 PSI - RESIDUAL

Reading	vertical change (in./100)	stress (psi)	displacement (in.)	vertical change (cm/100)	stress (ksf)	strain (%)
1	0.0000	1.5	0.00	0.0000	0.2211	0.0000
2	-0.0401	2.8	0.00	-0.1018	0.4100	0.1118
3	-0.0903	3.3	0.00	-0.2294	0.4724	0.2409
4	-0.1474	3.4	0.00	-0.3743	0.4944	0.3764
5	-0.1946	3.5	0.00	-0.4943	0.5030	0.5102
6	-0.2356	3.6	0.00	-0.5984	0.5116	0.6409
7	-0.2720	3.6	0.00	-0.6910	0.5183	0.7685
8	-0.3060	3.6	0.00	-0.7772	0.5210	0.8945
9	-0.3363	3.6	0.00	-0.8541	0.5239	1.0252
10	-0.3654	3.7	0.00	-0.9281	0.5267	1.1543
11	-0.3896	3.7	0.00	-0.9895	0.5295	1.2850
12	-0.4140	3.7	0.00	-1.0516	0.5324	1.4126
13	-0.4399	3.7	0.00	-1.1173	0.5352	1.5433
14	-0.4619	3.7	0.00	-1.1733	0.5381	1.6709
15	-0.4846	3.7	0.00	-1.2309	0.5390	1.7984
16	-0.5045	3.8	0.00	-1.2815	0.5418	1.9244
17	-0.5260	3.8	0.01	-1.3360	0.5427	2.0504
18	-0.5445	3.8	0.01	-1.3830	0.5456	2.1764
19	-0.5642	3.8	0.01	-1.4330	0.5465	2.3039
20	-0.5831	3.8	0.01	-1.4810	0.5494	2.4299
21	-0.6008	3.8	0.01	-1.5260	0.5523	2.5591
22	-0.6169	3.8	0.01	-1.5670	0.5532	2.6819
23	-0.6346	3.9	0.01	-1.6120	0.5562	2.8094
24	-0.6504	3.9	0.01	-1.6520	0.5591	2.9354
25	-0.6657	3.9	0.01	-1.6910	0.5580	3.0614
26	-0.6945	3.9	0.01	-1.7640	0.5639	3.3102
27	-0.7228	3.9	0.01	-1.8360	0.5678	3.5591
28	-0.7520	4.0	0.01	-1.9100	0.5757	3.8094
29	-0.7795	4.0	0.01	-1.9800	0.5817	4.0598
30	-0.8067	4.1	0.01	-2.0490	0.5918	4.3071
31	-0.8335	4.2	0.01	-2.1170	0.6019	4.5528
32	-0.8630	4.2	0.01	-2.1920	0.6038	4.7937
33	-0.8961	4.2	0.01	-2.2760	0.6099	5.0409
34	-0.9217	4.2	0.01	-2.3410	0.6120	5.2882
35	-0.9441	4.3	0.01	-2.3980	0.6140	5.5323
36	-0.9669	4.3	0.01	-2.4560	0.6182	5.7757
37	-0.9854	4.3	0.02	-2.5030	0.6224	6.0243

Sample Number	PZ-54
Depth (ft.)	20-40'
Sample Diameter (in.)	2.88
Sample Height (in.)	7.01
Dry Density (pcf)	95.8
Moisture Content (%)	23.5
Strain Rate (in./min)	.59
Unconfined Compressive Strength (psi)	27.7
Shear Strength (psi)	13.9

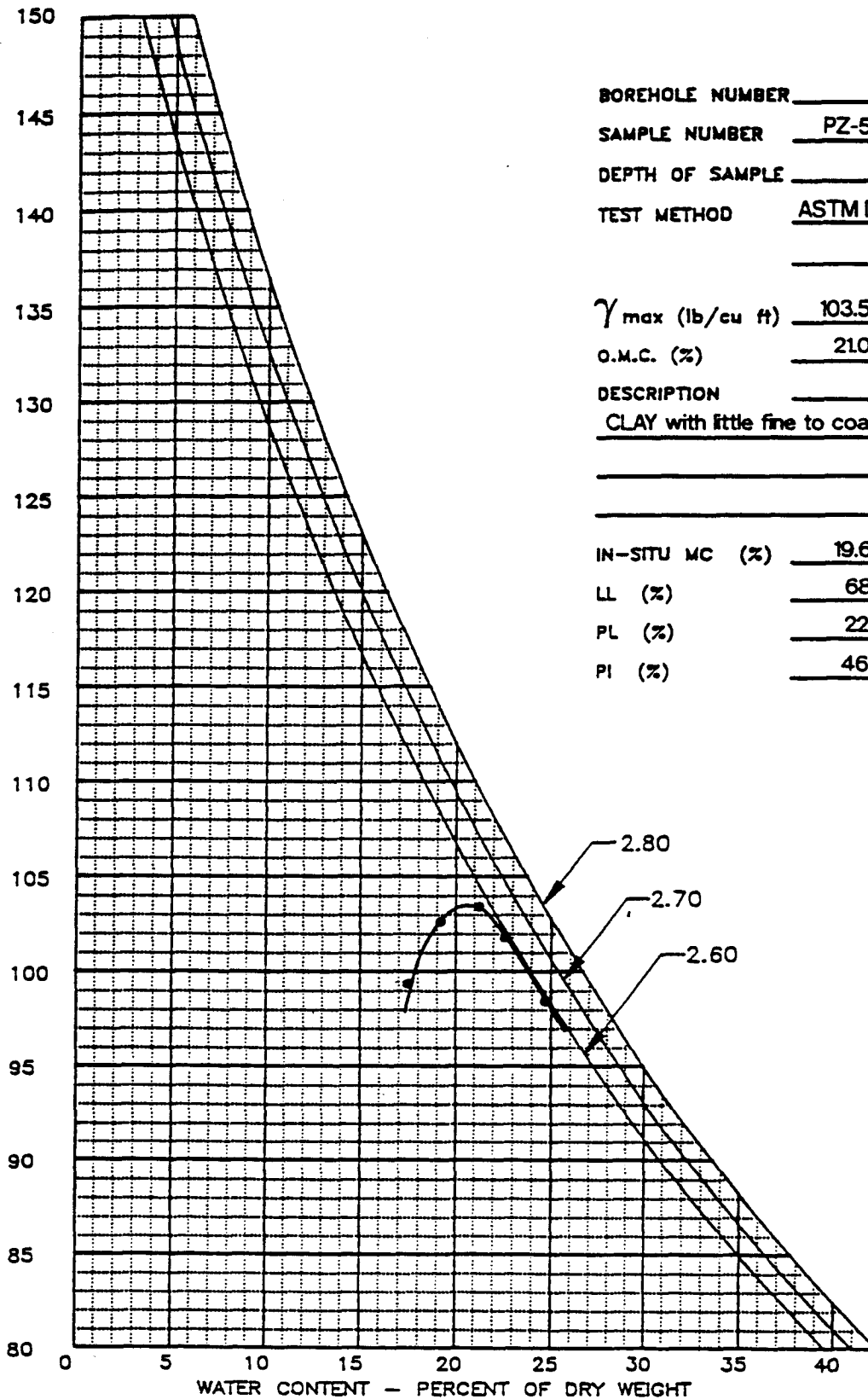


GOLDER ASSOCIATES INC					TITLE			
IC/2-4079/CO					UNCONFINED COMPRESSION TEST RECOMPACTED SAMPLE			
DRAWN	JDM	CHECKED	TGT	REVIEWED	DR	DATE	AUG 1992	JOB NO. 923-2499
						FIGURE	4	

IC/2-4079/CO
UNCONFINED COMPRESSION TEST
SOLID WASTE

READING	AXIAL STRAIN (%)	AXIAL STRESS (psi)	SHEAR STRESS (psi)
1	0.00	0.0	0
2	0.22	7.1	1.0286
3	0.52	11.6	1.6688
4	0.82	15.7	2.2622
5	1.12	18.8	2.7049
6	1.41	19.6	2.8169
7	1.70	21.5	3.0986
8	1.99	21.9	3.1585
9	2.28	23.7	3.4163
10	2.56	23.8	3.4299
11	2.85	25.0	3.6012
12	3.15	25.5	3.6716
13	3.44	22.7	3.2711
14	3.73	24.0	3.4618
15	4.03	23.5	3.3863
16	4.32	25.6	3.6893
17	4.61	26.2	3.7787
18	4.90	26.3	3.7826
19	5.20	27.3	3.9272
20	5.49	26.6	3.8281
21	5.79	27.6	3.9767
22	6.08	26.4	3.8045
23	6.37	27.7	3.9901
24	6.67	26.3	3.7905
25	6.96	26.6	3.8239
26	7.26	27.3	3.9347
27	7.55	25.9	3.7322
28	7.85	25.9	3.7279
29	8.14	26.1	3.7633
30	8.43	26.1	3.7613
31	8.72	25.9	3.7296
32	9.01	25.3	3.6415
33	9.30	25.2	3.6298
34	9.59	25.0	3.5937
35	9.89	24.6	3.5379
36	10.18	23.5	3.3877
37	10.48	22.7	3.2651
38	10.77	22.0	3.1749
39	11.07	21.5	3.0921
40	11.36	21.0	3.0292
41	11.66	20.5	2.9569
42	11.95	20.0	2.8803
43	12.25	19.3	2.7851
44	12.55	18.6	2.6715
45	12.85	17.5	2.521
46	13.14	17.2	2.4818
47	13.44	16.6	2.389
48	13.74	16.4	2.3643
49	14.04	15.9	2.291
50	14.34	15.0	2.1555

DRY UNIT WEIGHT - POUNDS PER CUBIC FOOT



BOREHOLE NUMBER _____
 SAMPLE NUMBER PZ-54
 DEPTH OF SAMPLE _____
 TEST METHOD ASTM D698 METHOD A

γ_{max} (lb/cu ft) 103.5
 O.M.C. (%) 21.0
 DESCRIPTION _____
CLAY with little fine to coarse sand (CH)

IN-SITU MC (%) 19.6
 LL (%) 68
 PL (%) 22
 PI (%) 46



**Golder
Associates**

Denver, Colorado

CLIENT/PROJECT

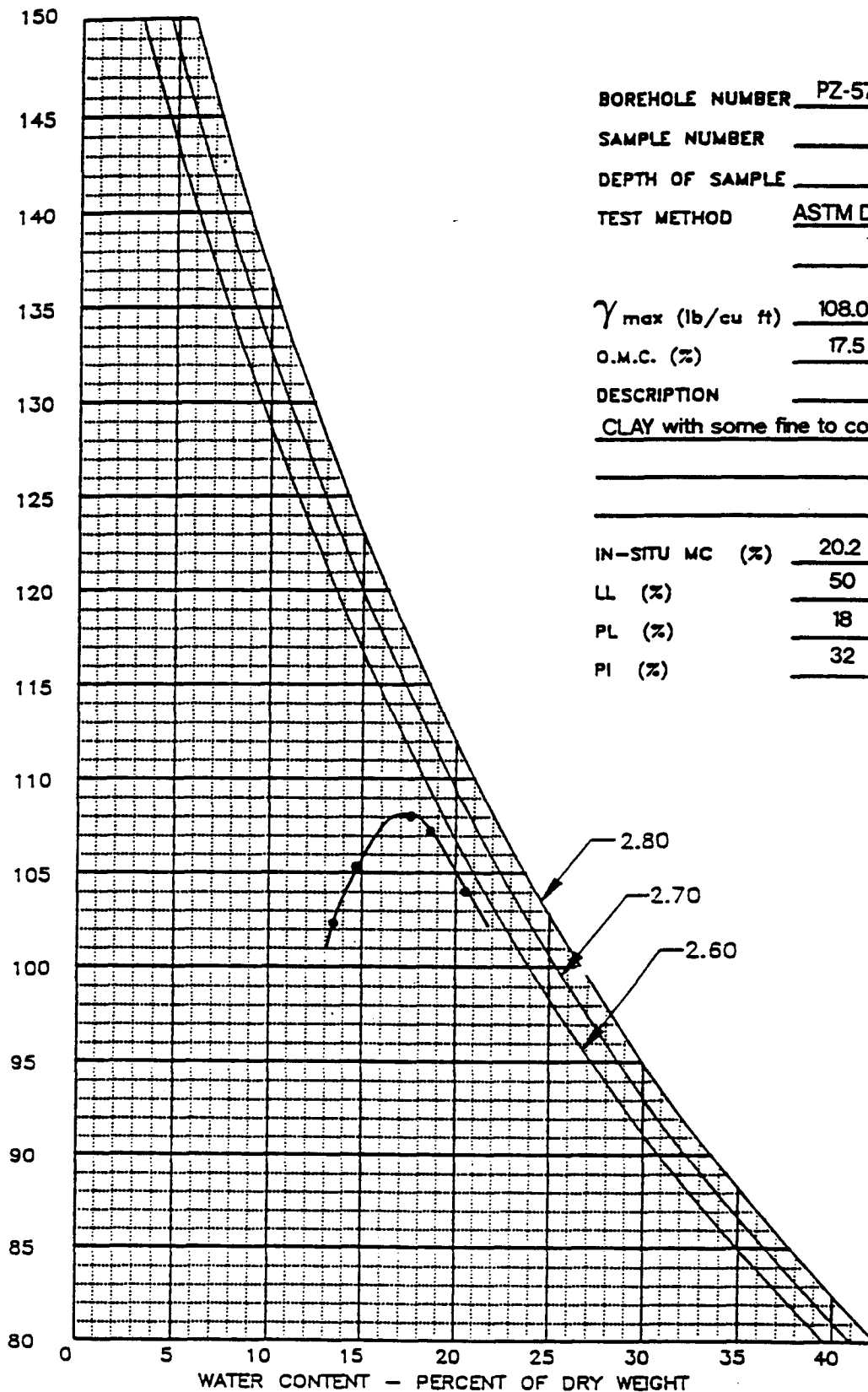
IC/2-4079/CO

TITLE

**PROCTOR CURVE
PZ-54**

DRAWN MS	DATE AUG 1992	JOB NO. 923-2499
CHECKED TT	SCALE	DWG NO./REV. NO.
REVIEWED	FILE NO.	FIGURE NO. 5

DRY UNIT WEIGHT - POUNDS PER CUBIC FOOT



BOREHOLE NUMBER PZ-57
 SAMPLE NUMBER _____
 DEPTH OF SAMPLE _____
 TEST METHOD ASTM D698 METHOD A

γ_{max} (lb/cu ft) 108.0
 O.M.C. (%) 17.5
 DESCRIPTION _____
CLAY with some fine to coarse sand (CH)

IN-SITU MC (%) 20.2
 LL (%) 50
 PL (%) 18
 PI (%) 32



**Golder
Associates**

Denver, Colorado

CLIENT/PROJECT

IC/2-4079/CO

TITLE

**PROCTOR CURVE
PZ-57**

DRAWN MS

DATE AUG 1992

JOB NO. 923-2499

CHECKED TT

SCALE

DWG NO./REV. NO.

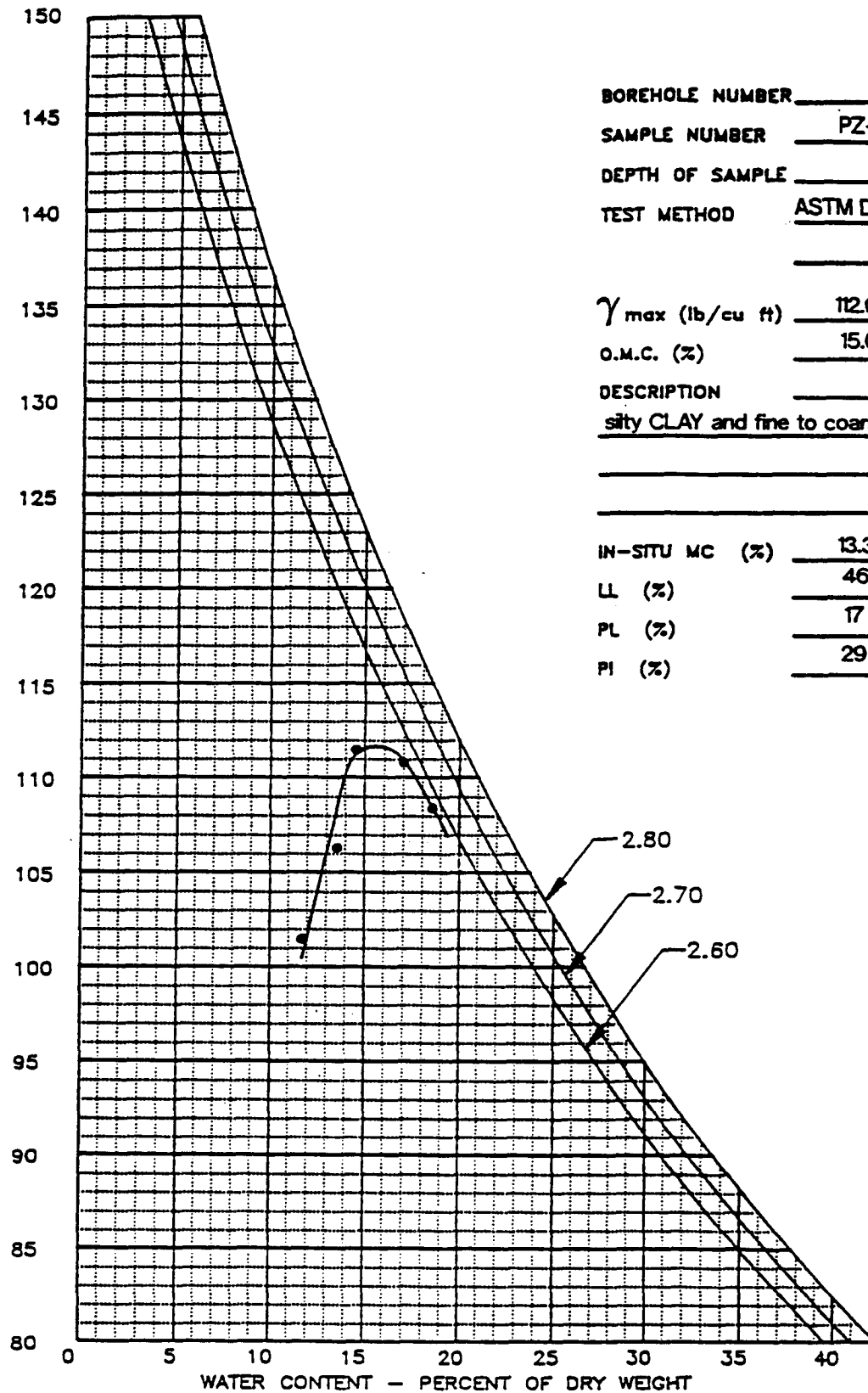
REVIEWED

FILE NO.

FIGURE NO.

6

DRY UNIT WEIGHT - POUNDS PER CUBIC FOOT



BOREHOLE NUMBER _____
 SAMPLE NUMBER PZ-62
 DEPTH OF SAMPLE _____
 TEST METHOD ASTM D698 METHOD A

 γ_{max} (lb/cu ft) 112.0
 O.M.C. (%) 15.0
 DESCRIPTION _____
silty CLAY and fine to coarse SAND (CL)

 IN-SITU MC (%) 13.3
 LL (%) 46
 PL (%) 17
 PI (%) 29



Golder Associates

Denver, Colorado

CLIENT/PROJECT

IC/2-4079/CO

TITLE

**PROCTOR CURVE
PZ-62**

DRAWN MS

DATE AUG 1992

JOB NO. 923-2499

CHECKED TT

SCALE

DWG NO./REV. NO.

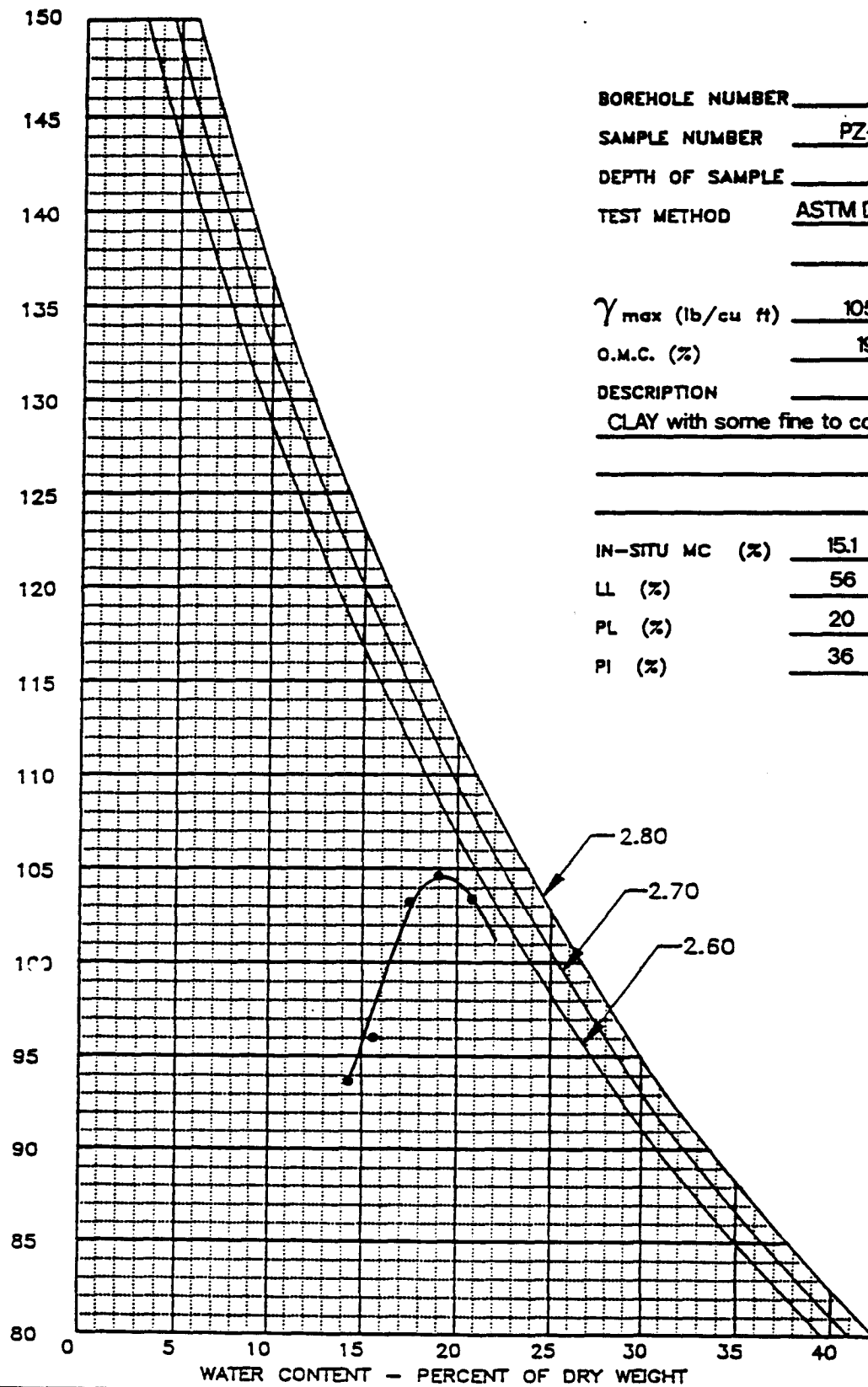
REVIEWED

FILE NO.

FIGURE NO.

7

DRY UNIT WEIGHT - POUNDS PER CUBIC FOOT



BOREHOLE NUMBER _____

SAMPLE NUMBER PZ-63

DEPTH OF SAMPLE _____

TEST METHOD ASTM D698 METHOD A

γ_{max} (lb/cu ft) 105.0

O.M.C. (%) 19.0

DESCRIPTION _____

CLAY with some fine to coarse sand (CH)

IN-SITU MC (%) 15.1

LL (%) 56

PL (%) 20

PI (%) 36



Denver, Colorado

CLIENT/PROJECT

IC/2-4079/CO

TITLE

PROCTOR CURVE
PZ-63

DRAWN MS

DATE AUG 1992

JOB NO. 923-2499

CHECKED TT

SCALE

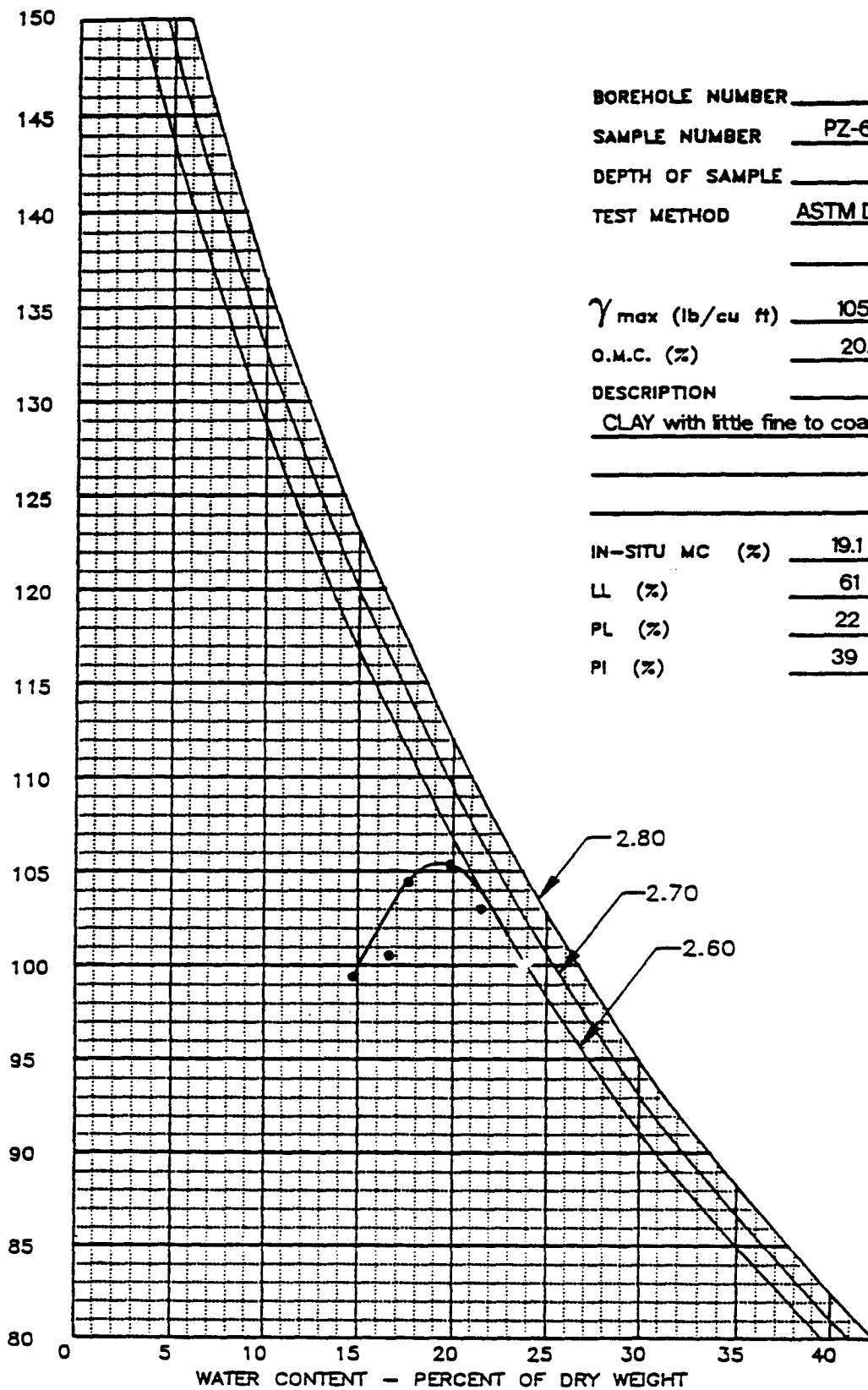
DWG NO./REV. NO.

REVIEWED

FILE NO.

FIGURE NO. 8

DRY UNIT WEIGHT - POUNDS PER CUBIC FOOT



BOREHOLE NUMBER _____

SAMPLE NUMBER PZ-64

DEPTH OF SAMPLE _____

TEST METHOD ASTM D698 METHOD A

γ_{max} (lb/cu ft) 105.0

O.M.C. (%) 20.0

DESCRIPTION _____

CLAY with little fine to coarse sand (CH)

IN-SITU MC (%) 19.1

LL (%) 61

PL (%) 22

PI (%) 39



Golder Associates

Denver, Colorado

CLIENT/PROJECT

IC/2-4079/CO

TITLE

**PROCTOR CURVE
PZ-64**

DRAWN MS

DATE AUG 1992

JOB NO. 923-2499

CHECKED TT

SCALE

DWG NO./REV. NO.

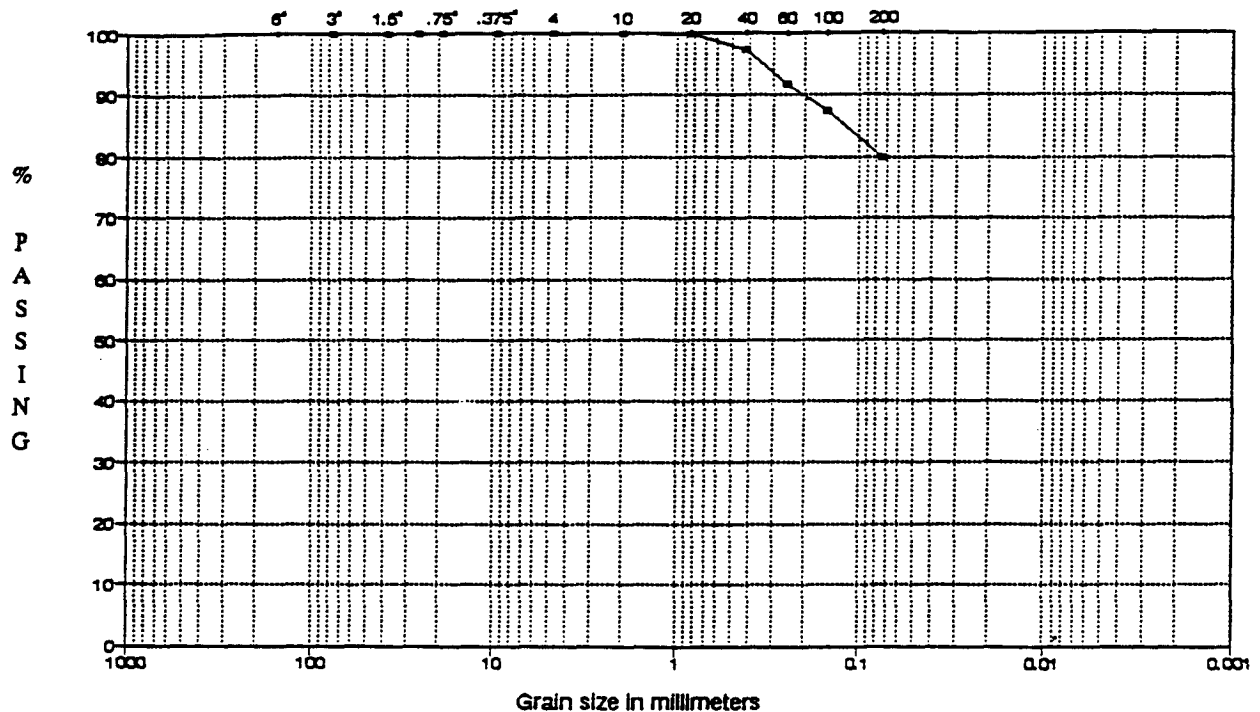
REVIEWED

FILE NO.

FIGURE NO. 9

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS

	Coarse	Fine	C	Med	Fine	
COBBLES	GRAVEL		SAND			FINES (Silt or Clay)

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	20.2	50	18	32		CLAY with some fine to coarse sand
SAMPLE NO. PZ-57						
DEPTH (FT.) 20'-25'						
Sample Type:		Date Tested: AUGUST 1992				USCS: CH

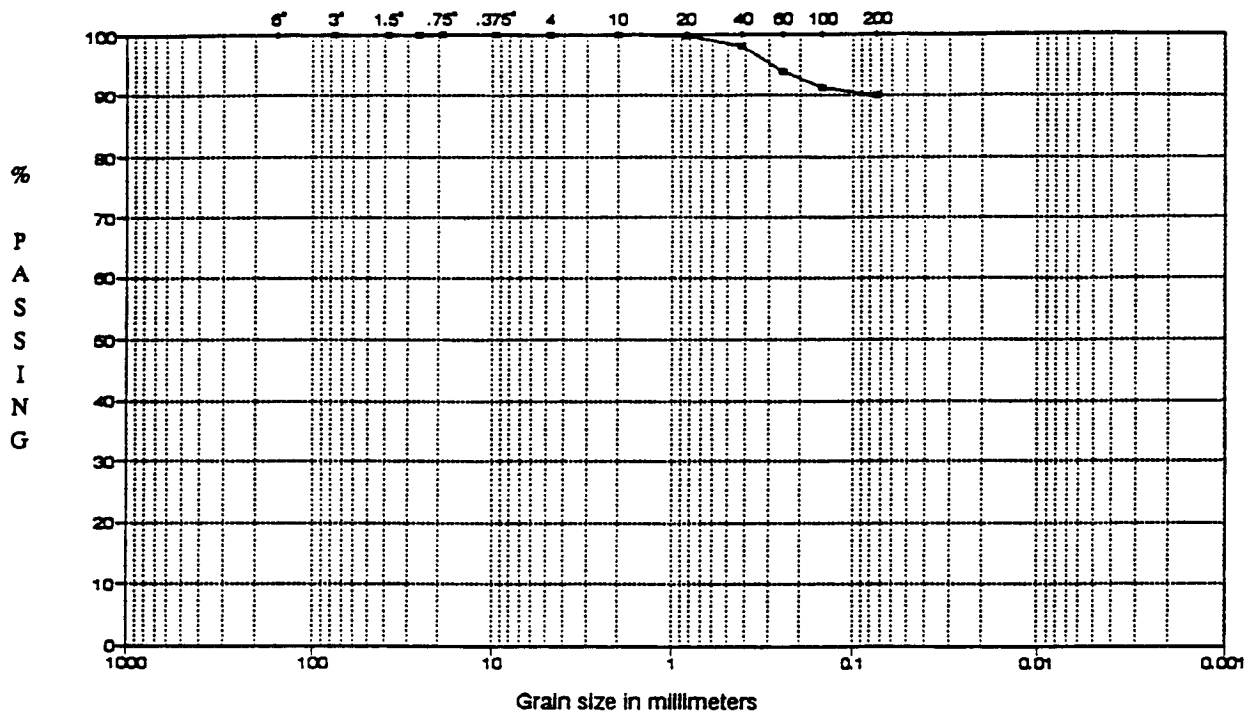
TECH: CG
 DATE: 08/19/92
 CHECKED: TT
 REVIEWED: DR

IC/2-4079/CO
 923-2499

GOLDER ASSOCIATES INC.
 LAKEWOOD, COLORADO

FILENAME: 300PZ57

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	Coarse	Fine	C	Med	Fine	FINES (Silt or Clay)
	GRAVEL		SAND			

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	19.6	68	22	46		CLAY with little fine to coarse sand
SAMPLE NO. PZ-54						
DEPTH (FT.) 20'-40'						
	Sample Type:		Date Tested: AUGUST 1992			USCS: CH

TECH: CG
 DATE: 08/19/92
 CHECKED: TT
 REVIEWED: DR

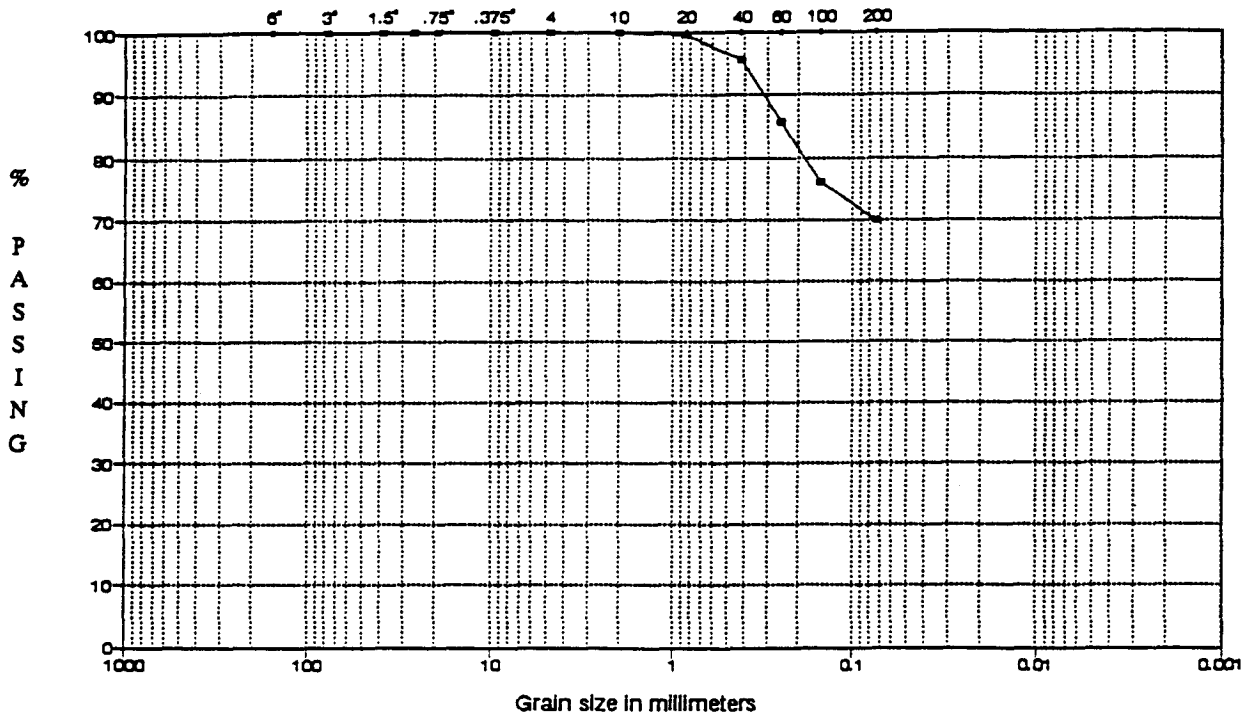
IC/2-4079/CO
 923-2499

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

FILENAME: 344724

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS

	Coarse	Fine	C	Med	Fine	
COBBLES	GRAVEL		SAND			FINES (Silt or Clay)

SAMPLE ID	W%	LL	PL	PI	G _s	DESCRIPTION
BOREHOLE	13.3	46	17	29		Silty CLAY and fine to coarse SAND
SAMPLE NO. PZ-62						
DEPTH (FT.) 21'-26'						

Sample Type: Date Tested: AUGUST 1992 USCS: CL

TECH: CG

DATE: 08/19/92

CHECKED: TT

REVIEWED: DR

IC/2-4079/CO

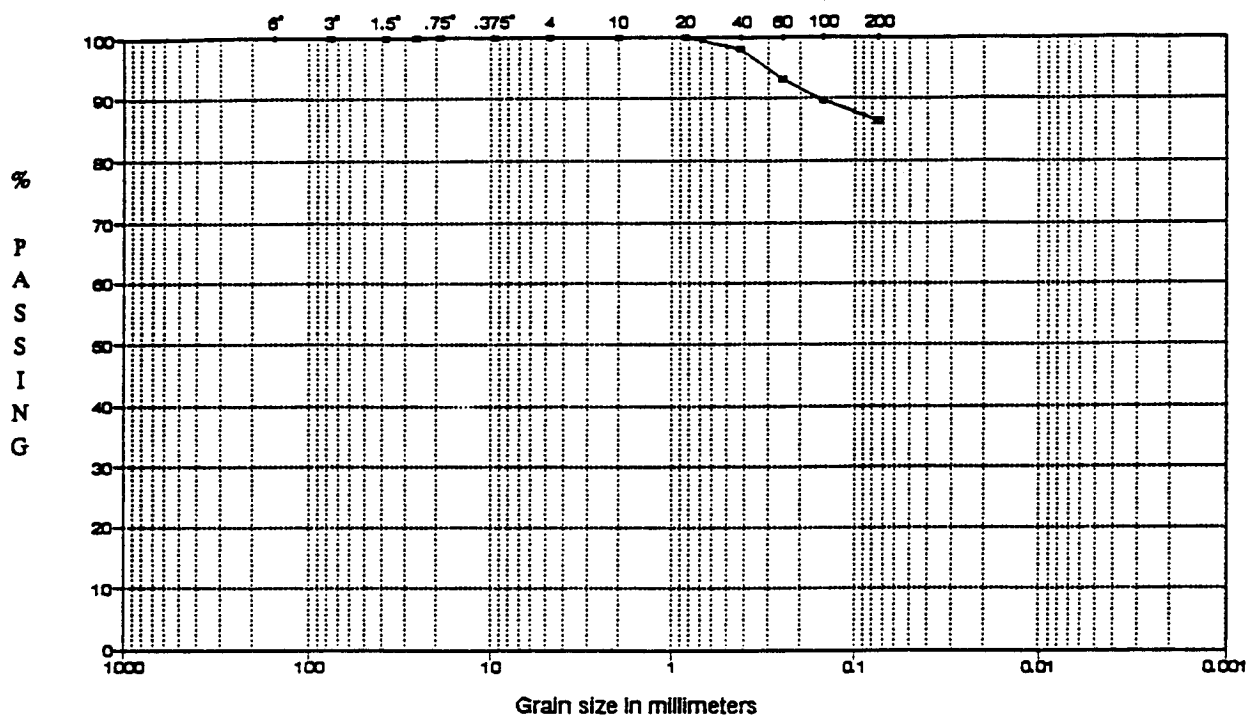
923-2499

FILENAME: 300721

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	Coarse	Fine	C	Med	Fine	FINES (Silt or Clay)
	GRAVEL		SAND			

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	15.1	56	20	36		CLAY with some fine to coarse sand
SAMPLE NO. PZ-63						
DEPTH (FT.) 30'-35'						
Sample Type:		Date Tested: AUGUST 1992				USCS: CH

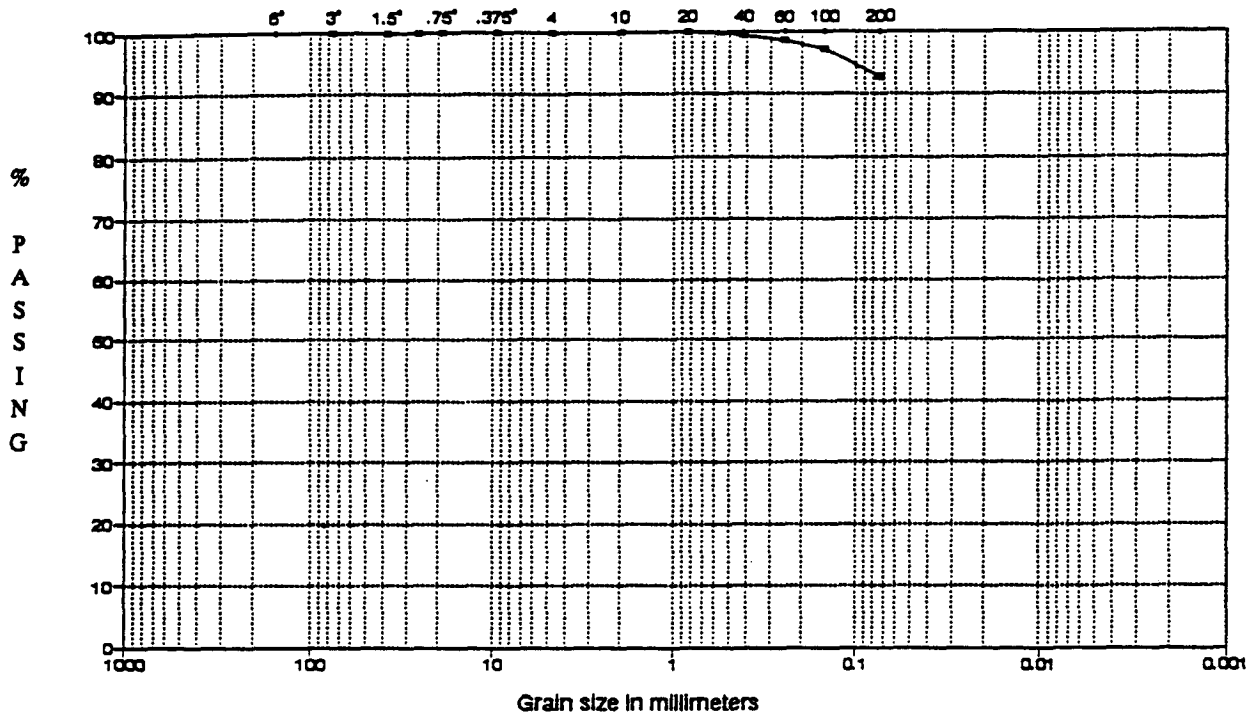
TECH: CG
 DATE: 08/19/92
 CHECKED: TT
 REVIEWED: DR

IC/2-4079/CO
 923-2499

FILENAME: 30PZ63

GOLDER ASSOCIATES INC.
 LAKEWOOD, COLORADO

**PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES**



USCS

	Coarse	Fine	C	Med	Fine	
COBBLES	GRAVEL		SAND			FINES (Silt or Clay)

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	19.1	61	22	39		CLAY with little fine to coarse sand
SAMPLE NO. PZ-64						
DEPTH (FT.) 35'-43'						
Sample Type:		Date Tested: AUGUST 1992				USCS: CH

TECH: CG
DATE: 08/19/92
CHECKED: TT
REVIEWED: DR

IC/2-4079/CO
923-2499

**GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO**

FILENAME: 200724

APPENDIX E
ORIGINAL SOIL BORING LOGS

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

CSI Facility
PZ-37

Location Diagram

DATUM ELEVATION

JOB NO. 2-3311	CLIENT CSI	LOCATION Bennett
DRILLING METHOD: 6" Hollow Stem Auger		BORING NO. PZ-37
SAMPLING METHOD: CONTINUOUS sampler		SHEET 1 of 4
WATER LEVEL 52.6'	TIME 4/18	ORILLING START TIME 9:10
DATE 12/10	CASING DEPTH 63'	DATE 4/18/91

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						1	CL	clay, silty, slightly sandy, brown, moist
						2		
						3		
CS	32" / 60"					4		
						5		
						6	CL	clay, sandy, some sand lenses, light brown, moist, fine grain to coarse grain F.g. - C.g.
						7		
CS						8		
	34" / 60"					9		
						10	CL	clay, sandy, light brown, moist, fine grain, CaCO ₃
						11		
						12		
CS						13		
	37" / 60"					14	SP	sand, slightly clayey, med. moist, fine grain to med. graded, light brown
						15		
						16		
						17	CL	clay, slightly sandy, moist, brown
						18		
CS						19		
						20	SP	sand, F.g. - C.g., slightly clayey, silty, med. moist, brown

DRILLING CONTR. Lane Western

by Mike Ungar / Judy Plombeck / John Cocroft
DATE 4/18/91

CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-37

SHEET

2 OF 4

SAMPLING METHOD:

Continuous Sampler

DRILLING

START

FINIS

TIME

TIME

9:10 2:10

WATER LEVEL

TIME

DATE

DATE

DATE

4/18/11 4/18/11

CASING DEPTH

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN RECOVERED	DEPTH OF CASING	SAMPLE NO.	BLOWS/FT. SAMPLER	OVA	Reading	DEPTH IN FEET	SOIL GRAPH
CS	25' / 60"						21	SP
							22	
↓							23	CH
CS	60' / 60"						24	
							25	
							26	CH
							27	
↓							28	CLS
CS							29	
							30	
							31	
							32	
↓							33	SMS
CS	38' / 60"						34	
							35	
							36	
							37	
drilled out							38	
CS							39	SPS
							40	

SURFACE CONDITIONS:

sand, f.g.-c.g., slightly clayey in part, l.brown, med. moist

clay, sandy, (f.g.-m.g.), moist, brown,

clay, sli. sandy to sandy, moist, brown,

claystone, gray, med. fractured, moist

siltstone and sandstone, v.f.g., gray to yellow to red brown, dry to med. moist, occasional thin (1") claystone lense (gray), sand size varies from v.f.g. to c.g.

sandstone, l.brown to yellow brown, v.f.g. to f.g., med. moist in part, some well cemented lenses from 40'-42'

DRILLING CONTR. Lane Western

BY Mike Unger / Judy Plambeck, John Corroff
DATE 4/18/11 CHKD BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-3

SHEET

3 OF 4

SAMPLING METHOD:

Continuous Sampler

DRILLING

START

FIN

WATER LEVEL

52.6'

TIME

4/18

DATE

12:10

9:15

2:

DATE

DA

4/18/11 4/18

CASING DEPTH

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVER INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS		40" / 100"				41	SPS
						42	
						43	
CS						44	
		24" / 100"				45	SPS
						46	
						47	
						48	
CS						49	
		28" / 100"				50	SPS
						51	
						52	
						53	
CS		48" / 146"				54	
						55	
						56	SPS
						57	
						58	Sms
						59	CLS
						60	

SURFACE CONDITIONS:

sandstone, v.f.g. - f.g., l. brown to yellow brown, moist in part, quartz grains predominantly, some well cemented lenses from 40' - 42'

sandstone, v.f.g. - f.g., yellow gray, moist, poorly cemented, iron stained, possible saturated * area?

sandstone, v.f.g. to coarse grained, yellow gray, poorly cemented, damp, iron stained in part,

sandstone, v.f.g. - c.g., yellow gray to yellow brown, poorly cemented, white, iron stained

siltstone, v. well cemented, d. brown, med. moist, drills v. hard

claystone, gray-blue, moist, hard

DRILLING CONTR. Lane Western

by Mike Unger, John Plambeck, John Caroff
DATE 4/18/11 CHK'D BY

drilled out of center plug

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

8" Hollow Stem Auger

BORING NO.

PZ-38

SHEET

1 of 4

SAMPLING METHOD:

CONTINUOUS sampler

DRILLING

START TIME

2:50

FINISH TIME

11:05

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

4/18/91

DATE

4/19/91

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES BATH RECORDED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						1	CL
						2	CL
						3	
						4	
CS	60" / 60"					5	SP
						6	
						7	
						8	
CS	58" / 60"					9	
						10	
						11	
						12	
						13	CL
CS	44" / 60"					14	
						15	
						16	SP
						17	
						18	
CS						19	
						20	

SURFACE CONDITIONS:

clay, silty, sandy, brown, dry
(F.g.)

clay, silty, sandy, brown, moist
(F.g.)

sand, silty, silty clay, to clay, brown, med. moist,
F.g.-c.g.

clay, sandy to v. sandy, silty, F.g.-c.g., brown,
med. moist to moist

sand, clay, silty, F.g.-c.g., brown, med. moist

DRILLING CONTR. Lane Western

DATE 4/18/91

CHD BY

CS

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-3311	CLIENT CSI	LOCATION Bennett
DRILLING METHOD: 6" Hollow Stem Auger		BORING NO. PZ-38
SAMPLING METHOD: Continuous Sampler		SHEET 2 of 4
WATER LEVEL		DRILLING START TIME 2:50
TIME		FINISH TIME 11:00
DATE		DATE 4/18/91
CASING DEPTH		DATE 4/19

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DOWN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS		60"				21	SP
						22	SM
						23	
CS		47"				24	
		60"				25	CL
						26	
						27	SM
						28	CL
CS						29	
		58"				30	
						31	
						32	
						33	CL
CS						34	
		60"				35	
						36	
						37	
						38	
CS						39	CL
						40	

SURFACE CONDITIONS:

sand, slightly clayey to clayey, Fg. - Cg, brown, med. moist

sand, v. silty, clayey, moist, brown, v.f.g.

clay, sandy (v.f.g. - m.a.), brown, moist

~~sand, v. silty, clayey, moist, brown, v.f.g.~~

clay, silty sand to sandy, brown, moist, CaCO₃

clay, silty sand to sandy, brown, moist, occasional thin sand lines (2-3"), Fg. - Cg, CaCO₃

clay, sandy to v. sandy, silty, brown, moist, CaCO₃ (Fg. - Cg)

DRILLING CONTR. Lane Western

BY Mike Unger
DATE 4/18/91 CHECKED BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

8" Hollow Stem Auger

BORING NO.

PZ-38

SHEET

3 OF 4

SAMPLING METHOD:

Continuous Sampler

DRILLING

START

TIME

2:50

DATE

4/8/91

WATER LEVEL

TIME

DATE

CASING DEPTH

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
	60"	60"				41	CL
						42	
						43	
CS						44	
	46 1/4"	60"				45	SP
						46	
						47	SP
						48	
CS						49	
	37 1/4"	60"				50	SC
						51	
						52	
CS						53	CLS
						54	
	60"	60"				55	
						56	
						57	
CS						58	SCS
						59	CLS
						60	CLS

SURFACE CONDITIONS:

clay, sandy to v. sandy (v.f.g.-c.g.), brown, moist

sand, v. clayey, brown, moist, v.f.g.-m.g.

sand, silty clayey, brown, moist, v.f.g.-c.g.

sand, v. clayey, silty, claystone fragments, brown, moist, v.f.g.-m.g.

52.7' claystone, gray to yellow gray, iron stained, moist

one thin SCS lense (4") from 56.6'-57'

interbedded clay, sandstone & claystone lenses (1/4"-1"), gray to yellow brown, moist, v.f.g.

claystone, gray, moist, iron stained in part

DRILLING CONTRACTOR: Lane Western

BY: Mike Unger

DATE: 4/18/91

CHECKED BY:

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-3311	CLIENT CSI	LOCATION Bennett
DRILLING METHOD: 8" Hollow Stem Auger		BORING NO. PZ-38
SAMPLING METHOD: Continuous Sampler		SHEET 4 of 4
WATER LEVEL 67.6	TIME 10:00	START TIME 2:50
DATE 4/19	CASING DEPTH 70'	DATE 4/18/11

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GROUP
CS	58" / 60"					61	CLS
CS						62	SPS
CS						63	
CS						64	
CS	60" / 60"					65	CLS
CS						66	
CS						67	
CS						68	SPS
CS	30" / 34"					69	
						70	
						71	
						72	
						73	
						74	
						75	
						76	
						77	
						78	
						79	
						80	

SURFACE CONDITIONS:

Claystone, gray, moist

sandstone, v.f.g.-m.g., yellow brown, moist, clayey
iron stained

Claystone, gray to blue gray, moist, some iron stain

sandstone, clayey, v.f.g.-m.g., v. moist, yellow brown

(wet)

70.0' T.D.

1" PVC 0-70'

1" PVC 0-40'

Cuttings: none

0-23.5'

hole plug: ~~40'~~ 47' 2 bps

23.5-28' 2 bps

sand: 47-70'

28'-40'

20' screen
(hand slot)

10' screen

28' - 73' 3"

DRILLING CONTR. Lane Western

BY Mike Unger

DATE 4/19/11 CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-3311	CLIENT CSI	LOCATION Bennett
DRILLING METHOD: 6" Hollow Stem Auger		BORING NO. PZ-39
SAMPLING METHOD: Continuous Sampler		SHEET 2 of 4
WATER LEVEL		DRILLING START TIME 11:15
TIME		FINISH TIME 5:05
DATE		DATE 4/19/91
CASING DEPTH		

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						21	CL
		43" 60"				22	
						23	
CS						24	
		50" 60"				25	SP
						26	
						27	SP
						28	
CS						29	SP
		55" 60"				30	
						31	
						32	
						33	
CS						34	SP
		57" 60"				35	
						36	
						37	
						38	
CS						39	
						40	SP

SURFACE CONDITIONS:

clay, sandy, silty, brown, med. moist to moist, CaCO₃
(F.g.)

sand, clayey to v. clayey, brown, v. F.g. - c.g., med. moist, CaCO₃

sand, v. F.g. - m.g.
v. clayey, CaCO₃, l. brown, med. moist

sand, clayey, F.g. - c.g., med. moist, l. brown

sand, slightly clayey to clayey, v. F.g. - c.g., med. moist, silty, l. brown, CaCO₃ in part

S.G.A.

DRILLING CONTR. **Lane Western**

BY **Mike Unger**
DATE **4/19/91**
CHECKED BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-3311		CLIENT CSI		LOCATION Bennett	
DRILLING METHOD: 6" Hollow Stem Auger				BORING NO. PZ-39	
SAMPLING METHOD: Continuous Sampler				SHEET 3 of 4	
WATER LEVEL				START	FINI
TIME				TIME	TIME
DATE				DATE	DATE
CASING DEPTH				4/19/11	4/19/11

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
		45"				41	SP
		60"				42	
						43	
CS						44	
						45	Ch
		51"				46	
						47	
						48	
CS						49	Ch
		60"				50	
		60"				51	
						52	SP
CS						53	
						54	
		49"				55	Ch
		60"				56	SP
						57	
CS						58	
						59	
						60	SP

SURFACE CONDITIONS:

sand, clayey, v. f.g.-c.g., med. moist, brown, CaCO₃
silty, two thin (1"-2") sandy clay lenses, brown, med. moist

clay, v. sandy, silty, med. moist to moist, brown, CaCO₃

clay, sandy, silty, med. moist to moist, brown, CaCO₃

sand, f.g.-c.g., silty, sli. clayey to clayey, brown, med. moist

clay, v. sandy, silty, brown, moist

sand, f.g.-c.g., clayey, brown, med. moist

S.R.A.

DRILLING CONTRACTOR: **Lane Western**

DATE: **4/19/11**
BY: **Mika Ungar**
CHECKED BY:

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

ICB NO. 2-3311	CLIENT CSI	LOCATION Bennett
DRILLING METHOD: CME 75 6" 8" Hollow Stem Auger		BORING NO. PZ-39
SAMPLING METHOD: Continuous Sampler		SHEET 4 of 4
WATER LEVEL dry	TIME 5:00	DATE 4/19/11
CASING DEPTH 69'	DATE 4/19/11	TIME 5:00

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN	INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO.	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
							61	
							62	
							63	
							64	
							65	
							66	
							67	
							68	
							69	
							70	
							71	
							72	
							73	
							74	
							75	
							76	
							77	
							78	
							79	
							80	

SURFACE CONDITIONS:

sand, Fg.-cg., clayey to v. clayey, brown, med. moist to moist

sandstone, v. Fg.-mg., moist, yellow brown to yellow gray

sandstone, v. Fg.-Fg., v. well cemented, had to drill w/ center plug, reddish-brown, med. moist to dry

sandstone, v. Fg.-mg., poorly cemented, yellow gray, silty, moist

69.0' T.D. stickup - 2.85'

0-69 1" PVC 10' slot

cuttings - 0-48'

hole plug: 48'-54'

sand: 54'-69'

destroyed 3 teeth on bit

DRILLING CONTR. Lane Western

BY Mike Unger
DATE 4/19/11 CHECK'D BY

Chap, S.O.O.

DATE 4/22/91

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JCU NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-40

SHEET

2 of 4

SAMPLING METHOD:

Continuous Sampler

DRILLING

START FINIS

TIME TIME

11:30 11:4

DATE DATE

4/22/91 4/22

WATER LEVEL

TIME

DATE

CASING DEPTH

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES BY INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	43" 60"					21	CL
						22	
						23	
CS						24	
						25	
	39" 60"					26	SP
						27	
						28	
CS						29	
						30	SP
						31	
	41" 60"					32	
						33	CL
CS						34	SP
						35	
	53" 60"					36	
						37	CL
						38	
CS						39	SP
						40	

SURFACE CONDITIONS:

clay, silty, sandy (v.f.g.-f.g.), brown, med. moist

sand, clayey, silty, v.f.g.-c.g., l. brown, CaCO₃, med. moist

sand, s.g.

clay, silty, sandy (v.f.g.-f.g.), brown, med. moist, Cal

sand, f.g.-c.g., silty, sli. clay, to clayey, med. moist, brown

clay, v. sandy, silty, brown, red. moist

sand, clayey, brown, red. moist, f.g.-c.g.

DRILLING CONTIN. Lane Western

CHK'D BY

DATE 4/22/91

by Mike Chaga

4/22/91
4/22

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-40

SHEET

3 of 4

SAMPLING METHOD:

Continuous Sampler

DRILLING

START TIME

11:30

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

4/22/91

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES ALCOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	56" / 60"					41	SP
						42	CL
						43	
						44	SP
						45	
						46	
						47	SP
						48	
						49	SPS
						50	
						51	
						52	SPS
						53	
						54	
						55	
						56	SPS
						57	
						58	
						59	
						60	

SURFACE CONDITIONS:

clay, sandy (v.f.g.-m.g.), brown, moist, CaCO₃ silty

sand (f.g.-c.g.), slightly clayey to clayey, med. moist, brown to yellow brown

sand, s.a.a., some iron concretions (1/4"-1/2" diam.)

sandstone, v.f.g.-c.g., poorly cemented, med. moist, yellow brown to light gray, iron stained slightly clayey, in part

sandstone, s.a.a., some thin (1") moderately cemented lenses

sandstone, f.g.-c.g., poorly to moderately cemented lenses, iron stained, some small (1/2"-1") concretions med. moist to moist, yellow brown to olive slightly clayey, brown

DRILLING CONTRACTOR: Lane Western
Soils & Inc.

BY: Mike Upen
DATE: 4/24/91
CHECKED BY:

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

ICB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

8" Hollow Stem Auger

BORING NO.

PZ-4

SHEET

A of 4

SAMPLING METHOD:

Continuous Sampler

DRILLING

START

TIME

11:30

DATE

4/22/11

WATER LEVEL

63.05 bgs

TIME

11:20

DATE

4/23/11

CASING DEPTH

69.5'

DATE

4/22/11

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVER INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	DOWN/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPE
CS	39"	60"				61	SPS
						62	
						63	
						64	
						65	
						66	SPS
						67	
						68	SPS
						69	
						70	

SURFACE CONDITIONS:

sandstone, f.f.g. - c.g., moderately cemented, slightly clay
iron stained, some small concretions, damp @ 62',
yellow brown to olive brown

sandstone, s.a.a., wet

sandstone, s.a.a., some thin (1"-2") claystone lenses (gray,
wet, v.f.g. c.g., yellow brown - yellow gray

20' hard slab 50'-70'

69.5' T.D.

cuttings: 0 - 33.5'

hole plug: 33.5 - 47.5 5 bgs

sand: 47.5 - 69.5'

stickup: 3.0'

DRILLING CONTINUED: Lane Western

DATE: 4/23/11

CHK'D BY:

BY: Mike Cope

Industrial Compliance Inc.

17-6 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-41

SHEET

1 OF 4

SAMPLING METHOD:

CONTINUOUS sampler (CS)

DRILLING

START TIME

11:55

FIN TIME

4:00

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

4/23/91

DATE

4/23/91

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	40" 48"					1	CL
						2	CL SC
						3	SP
						4	
CS						5	
	51" 60"					6	SP
						7	
						8	
						9	CL
CS						10	
	51" 60"					11	
						12	SP
						13	
						14	
CS						15	CL
	50" 60"					16	SP
						17	
						18	CL
						19	
CS						20	

SURFACE CONDITIONS:

clay, silty, sandy, dry, brown

clay, silty, sandy, med. moist, brown
v. clay sandy, v. f. - m. g., brown, med. moist

sand, v. f. g. - c. g., brown, med. moist, silty,

sand, v. f. g. - c. g., silty, s. li. clayey, brown, med. moist

clay, silty, sandy (v. f. g. - f. g.), med. moist to moist, brown

sand, v. f. g. - c. g., clayey, silty, med. moist, brown

clay, silty, sandy (v. f. g. - f. g.), brown, med. moist to moist, brown

sand, v. f. g. - c. g., brown, med. moist

clay, sandy, silty, brown, med. moist to moist

DRILLING CONTR. Lake Western
Dallas & Son

Mike L. L. L.
DATE 4/23/91
SIGNED BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401CSI
Facility

37

38

PZ-41

Location Diagram

DATUM

ELEVATION

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-41

SHEET

2 of 4

SAMPLING METHOD:

Continuous Sampler (CS)

DRILLING

START FINIS

TIME TIME

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE DATE

4/23/11 4/23/11

SURFACE CONDITIONS:

CS SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
		60"				21	CL
		60"				22	
						23	SP
↓						24	
CS						25	
		59"				26	SP
		60"				27	
						28	
↓						29	
CS						30	
		60"				31	
		60"				32	SC
						33	
↓						34	SP
CS						35	
		60"				36	
		60"				37	SP
						38	
↓						39	
CS						40	

clay, sand to v. sandy, silty, CaCO₃, med. moist, brownsand, slightly clayey to clayey, med. moist, l. brown
v.f.g. - c.g.sand, silty, clayey, med. moist, l. brown to brown,
v.f.g. - c.g.v. clayey sand, v.f.g. - m.g., silty, CaCO₃, brown, med.
moist

sand, v.f.g. - c.g., clayey, l. brown, med. moist

sand, v.f.g. - c.g., clayey to v. clayey, CaCO₃,
brown, med. moistDRILLING SORTH: Layne Western
Dallas & JimBY: Mike Unger
DATE: 4/23/11
CHK'D BY:

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

CSI
Facility

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PZ-41

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Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRILLER RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOL GRAVITY
CS						41	
						42	
	51 60"					43	
CS						44	
						45	
						46	
	40 60"					47	
						48	
CS						49	
						50	
	59 60"					51	
						52	
						53	
CS						54	
	33 36"					55	
						56	
CS						57	
	24 24"					58	
						59	
CS						60	

SURFACE CONDITIONS:

JOB NO.

CLIENT

LOCATION

2-3311

CSI

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-4

SHEET

3 of 1

SAMPLING METHOD:

Continuous Sampler (CS)

DRILLING

START TIME

11:55

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

4/23/11

DRILLING CONTRACTOR: Layne Western
Dadler & Son

DATE: 4/23/11
CHECKED BY: Mike Unger

SPS sandstone, v.f.g.-m.g., slightly clayey, yellow gray to light gray, med. moist, poorly cemented, some small concretions (1/2"), reddish-brown, iron stained

SPS sandstone, v.f.g.-c.g., slightly clayey, yellow brown to light gray, med. moist, poorly cemented, some small concretions, iron stained

SPS sandstone, s.a.a. poorly to moderately cemented

SPS sandstone, v.f.g.-c.g., v. well cemented, moist, yellow gray, d. brown silty sandstone from 56.5-56
thin interbedded claystone (gray) + sandstone lenses, sand gypsum (1/4"), moist
waited 30 minutes (phone call) no water

SPS sandstone, v.f.g.-c.g., yellow gray, moderately cemented, moist, iron stained

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

CSI
Facility

37

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PZ-41

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Location Diagram

DATUM

ELEVATION

ICB NO.

2-3311

CUEN

CSI

LOCATION

Bennett

DRILLING METHOD:

6" Hollow Stem Auger

BORING NO.

PZ-4

SHEET

4 of 4

DRILLING

SAMPLING METHOD:

Continuous Sampler

START	FIN
1	2
2	3
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99	100

[illegible]

1155 4:

TIME	4:30
------	------

62.63' 595

TIME 4:30

DATE 4-23-64

DATE | 3

40. 61. 41-

CASING DEPTH

6A'

4/23/91	4/23/91
---------	---------

SURFACE CONDITIONS:

[illegible]

sandstone, moderately cemented, v.fg.-c.g., v. moist & wet, yellow brown to yellow, slightly clay iron stained

64.017D

T¹ PVC

Cuttings : 0-34.5

hole plug: 34.5-45

sand: 45-64

10' hand slot

Stack up: 2.06'

DATE 4/25/91 CHRG'D BY

Mike Green

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett

DRILLING METHOD:

8" Hollow Stem Auger

BORING NO.

PZ-4

SHEET

1 OF 1

SAMPLING METHOD:

CONTINUOUS sampler (CS)

DRILLING

START

TIME

8:15 10:30

DATE

4/24/91 4/25

WATER LEVEL

TIME

DATE

CASING DEPTH

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA	Reading	DEPTH IN FEET	SOIL GRAPE
CS							1	CL
		48" / 40"					2	CL
							3	
↓							4	SP
CS							5	
		52" / 60"					6	
							7	SP
							8	
↓							9	CL
CS							10	SP
		54" / 60"					11	
							12	
							13	
↓							14	SC
CS							15	
		60" / 60"					16	
							17	SP
							18	
↓							19	
CS							20	

SURFACE CONDITIONS:

clay, sandy, silty, dry, brown

clay, silty, sandy, med. moist, brown

sand, v.f.g.-c.g., l.brown, med. moist, silty, sli. clay to clayey

sand, v.f.g.-c.g., silty, sli. clayey to clayey, med. moist, l.brown

clay, sandy, silty, med. moist to moist, brown

sand, v.f.g.-c.g., clayey to v. clayey, silty, brown to l.brown, CaCO₃

clayey sand, silty, v.f.g.-m.g., brown, med. moist, CaCO₃

sand, v.f.g.-c.g., silty, slightly clayey to clayey, med. moist, l.brown

DRILLING CONTR. Loge Western
Dells + Jm

Dr. Mike Unger
DATE 4/24/91
CURED BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

CSI
Facility

37

38

41

42

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Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES BYPASS INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA	Reading	DEPTH IN FEET	SOIL GRAPH
CS						21	SP	
						22		
	60"					23		
CS						24		
						25		
						26	SP	
	60"					27		
						28		
CS						29		
						30		
						31	SP	
	60"					32		
						33		
CS						34		
						35	CL	
	60"					36		
						37		
						38		
CS						39		
						40	CL	

ICB NO. 2-3311	CLIENT CSI	LOCATION Bennett
DRILLING METHOD: 6" Hollow Stem Auger		BORING NO. PZ-40
SAMPLING METHOD: Continuous Sampler		SHEET 2 of 4
WATER LEVEL		START TIME 8:15
TIME		FIN TIME 10:15
DATE		DATE 4/24/91
CASING DEPTH		FIN 4/24

SURFACE CONDITIONS:

sand, slightly clayey to clayey, silty, v.f.g.-c.g., med. moist
light brown to brown, CaCO₃

sand, s.a.a.

sand, clayey to v. clayey, silty, v.f.g.-c.g., med. moist
brown to l. brown, CaCO₃, some thin (2"-4") sand
clay lenses

clay, sandy, silty, moist, brown, CaCO₃

clay, s.a.a.

DRILLING CONTRACTOR: Layne Western
Dallas, TX

DATE 4/24/91
CHECKED BY: Mike Cramer

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80-01

CSI
Facility

37

38

41

PZ-42

32

40

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVER INCHES RECORDED	DEPTH OF CASING	SAMPLE NO.	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL CLASS
						41	CL
						42	
		60"				43	
CS						44	SP
						45	
		60"				46	SP
						47	
CS						48	SP
						49	
		46"				50	
		60"				51	SPS
						52	
CS						53	
						54	
						55	SPS
		31"				56	
		60"				57	
						58	SPS
CS						59	
						60	

JOB NO. 2-3311	CLIENT CSI	LOCATION Bennett
DRILLING METHOD: 6" Hollow Stem Auger		BORING NO. PZ-42
SAMPLING METHOD: Continuous Sampler		SHEET 3 of 4
WATER LEVEL		START TIME 8:15
TIME		FINISH TIME 10:15
DATE 4/24/91		DATE 4/24/91
CASING DEPTH 64.0'		DATE 4/24/91

SURFACE CONDITIONS:

clay, sandy, silty, brown, moist, CaCO₃, some iron staining

sand, clayey, silty, brown, mod. moist to moist, v.f.g. - c.g.

sand, clayey to v. clayey, brown, moist, v.f.g. - c.g.

sand, slightly to clayey with thin clay lenses (1"-2"), sandstone fragments (well cemented, 1/4"-1"), probably washed w. small iron concretions (1/4"), moist, brown to yellow brown

sandstone, slightly clayey with thin (1") claystone lenses (gray), poorly cemented with occasional moderately cemented lenses (2"-3"), iron stained, moist, olive gray to yellow brown

thin (1") silt/lense @ 53.6', d. brown, moist, highly organic appearance (see PZ-41)

sandstone, some thin (1"-3") sandy claystone lenses, iron concretions, yellow brown to d. gray, moist, v.f.g. - c.g.

sandstone, v.f.g. - c.g., slightly clayey, yellow gray to yellow brown, iron stained, v. moist to wet

DRILLING CONTING. Wayne Western
Dell & Jim

Mike Unger

DATE 4/24/91 CHECKED BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

CSI

JOB NO.

2-3311

CLIENT

CSI

LOCATION

CSI Bennett

DRILLING METHOD:

CME 75
8" hollow stem auger

BORING NO.

PZ-43

SHEET

1 of 3

SAMPLING METHOD:

continuous sampler (C.S.)

DRILLING

START

FINIS

TIME

TIME

WATER LEVEL

29.73' bgs

TIME

8:30

DATE

7-1

DATE

DATE

CASING DEPTH

49'

DATE

DATE

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						1	CP
						2	
						3	SP
						4	
						5	
						6	
						7	SP
						8	
						9	
						10	
						11	
						12	SP
						13	CLS
						14	
						15	
						16	
						17	
						18	CLS
						19	
						20	

SURFACE CONDITIONS:

South 320 Acres

sand, silty, clayey, v.f.g. - m.g., dry, brown

sand, silty, clayey, v.f.g. - m.g., med. moist, 1. brown to yellow brown, gravel
GRANULES

sand, silty, slightly clayey, v.f.g. - m.g., sh. moist, 1. brown to yellow brown, gravel

sand, v.c.g. to pea gravel, yellow brown - red-brown, med. moist

claystone, weathered, gray to dark gray, iron fracture stains, moist, silty in part

claystone, med. hard, gray, iron stained in fracture, moist, occasional thin carbonaceous lenses (<1" thick), d. brown

DRILLING CONTR. Site Services
Mike Unger

BY Mike Unger
DATE 6/25/98

CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 Ave

DRILLING METHOD:

8" Hollow Stem Auger

BORING NO.

PZ-43

SHEET

2 of 3

SAMPLING METHOD:

CONTINUOUS sampler (CS)

DRILLING

START FINISH

TIME TIME

9:45 12:30

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

DATE

6-15-9 6-28-9

see page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES BAITER RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						21	
						22	
✓		60"	60"			23	
C.S.						24	
						25	
						26	
						27	
						28	
✓		60"	60"			29	
C.S.						30	
						31	
						32	
		60"	60"			33	
✓						34	
C.S.						35	
						36	
						37	
						38	
✓		60"	60"			39	
C.S.						40	

SURFACE CONDITIONS:

CLS

claystone, gray, iron stained in fractures, moist, med. hard to hard

CLS

claystone, gray to yellow gray, iron stained in fractures, moist, med. hard to hard

←

1" v.f.g. sand lenses, v. moist to wet, yellow brown loose 29' to 29'1"

CLS

claystone, yellow gray to dark gray, iron stained in fractures, moist, hard, thin carbonaceous lenses (<2"), d. gray to black

Lignite coal, black, med. moist, moisture in fractures

CLS

claystone, greenish gray, silty, moist

SPS

sandstone, loose, moist, yellow brown to gray, moist

DRILLING CONTR. Site Services
Mike Unger

BY Mike Unger
DATE 6-25-99 CHK'D BY

[REDACTED]

JOB NO.		CLIENT		LOCATION	
2-3311		CSI		South 320 ac	
DRILLING METHOD:				BORING NO.	
CME-75				PZ-43	
8" AS				SHEET	
SAMPLING METHOD:				3 of 3	
CONTINUOUS sampler				DRILLING	
				START	FINISH
WATER LEVEL				TIME	TIME
TIME				9:25	12:30
DATE				DATE	DATE
CASING DEPTH				6-25-91	6-25-91

See page 1 diagram

DATUM	ELEVATION
-------	-----------

SURFACE CONDITIONS:

[illegible]

1" PVC	
cuttings	0 - 15'
barite	15' - 16'
sand pack	16' - 49'
hand slot	19' - 49'

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300

Golden, CO 80401

CSI

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acre

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

SAMPLING METHOD:

continuous sampler

BORING NO.

PZ-49

SHEET

1 of 3

DRILLING

START

FINISH

TIME

TIME

12:40

2:40

DATE

DATE

6-25-91

6-25-91

WATER LEVEL

34.15' bgs

TIME

DATE

7-1

CASING DEPTH

44



Schumaker Rd.

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
C.S.						1	SC
						2	CL
		31" / 48"				3	
						4	
C.S.						5	SP
						6	CL
		60" / 60"				7	
						8	SP
						9	CLS
C.S.						10	
						11	
		60" / 60"				12	CLS
						13	
						14	
						15	
		60" / 60"				16	
						17	
						18	CLS
						19	
C.S.						20	

SURFACE CONDITIONS:

sand, v. clayey, dry, v. f.g. - m.g., brown

clay, v. sandy, silty, brown, med. moist

sand, clayey, brown, slightly moist

clay, sandy, silty, brown, med. moist to moist

sand, clayey, silty, brown, sil. moist

claystone, gray, moist, weathered, iron stained in fractures

claystone, gray to yellow gray, moist, iron stained in fractures, med. hard

claystone, gray to yellow gray, iron stained in fractures, moist, occasional thin (1"-2") sand lenses

DRILLING CONTR. Site Services

BY Mike Wagner

DATE 6/25/91 CHK'D BY

Industrial Compliance Inc.

1745 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-3311		CLIENT CSI	LOCATION South 320 acres	
DRILLING METHOD: CME-75 8" H.S.			BORING NO. PZ-44	
SAMPLING METHOD: continuous sampler			SHEET 2 of 3	
WATER LEVEL			DRILLING START	FINISH
TIME			TIME	TIME
DATE			DATE	DATE
CASING DEPTH			6-25-91	6-2

see page 1 diagrams

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						21	CLS	claystone, gray to reddish brown, iron stained, med. moist to moist
						22	SP/SPS	sand/sandstone, loose, gray, med. moist, v.f.g.-m.g.
	56" / 60"					23	CLS	claystone, gray, moist, med. hard
↓						24	SP/SPS	sand/sandstone, gray, med. moist to moist, loose to poorly cemented, v.f.g.-f.g.
C.S.						25		
						26		
	27" / 60"					27	SPS	sandstone, reddish brown, hard, dry, iron stained
↓						28	SP/SPS	sand/sandstone, loose, brown to yellow brown
C.S.						29		
						30		
						31	CLS	claystone, gray, moist
	43" / 60"					32		
						33	SPS	sandstone, v. well cemented, l. gray, dry
↓						34	SP/SPS	sand/sandstone, loose to poorly cemented, yellow brown, f.g.-m.g., moist to v. moist
C.S.						35		
						36		
	55" / 60"					37		
						38		
↓						39	SP/SPS	
C.S.						40		original level

DRILLING CONTR. Site Services
Nash & Tim

BY Mike Unger
DATE 6/25/91 CHK'D BY

SECRET

JOB NO. 2-3311		CLIENT C.S.I.		LOCATION South 320 acre	
DRILLING METHOD: CME-75 8" H.S.				BORING NO. PZ-44	
SAMPLING METHOD: continuous sampler				SHEET 3 of 3	
				DRILLING	
WATER LEVEL				START TIME	FINISH TIME
TIME				12:40	2:45
DATE				DATE	DATE
CASING DEPTH				6/25/84	6/25/84

see page 1 diagram

DATUM ELEVATION

[illegible]

SURFACE CONDITIONS:

sand/sandstone, loose, V.F. g.-m.g., brown, wet,
to poorly cemented

4470

cuttings	0 - 10'
banquette	10 - 12.7'
sand peak	12.7' - 44'
hard silt	24' - 44'

DRILLING CONTR. Site Services
Nail + Tin

DATE 6/6/91 CHK'D BY Mike Ungas

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300

Golden, CO 80401

CSI

JOB NO.

2-3311

CLIENT

CSI

LOCATION

Bennett
South 320 Acres

DRILLING METHOD:

CMF-75

8" A.S. Auger

SAMPLING METHOD:

continuous sampler

BORING NO.

PZ-45

SHEET

1 of 2

DRILLING

START

TIME

2:50

DATE

6-25-9

FINI

TIME

9:00

DATE

6/6

WATER LEVEL

11.43' bgs

TIME

DATE

7-1

CASING DEPTH

34'

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECORDED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS.						1	SC
						2	SC
		31" / 48"				3	
						4	
CS.						5	
						6	
		53" / 60"				7	SP
						8	
						9	
C.S.						10	
						11	
		35" / 60"				12	CLS
						13	
						14	
CS.						15	CLS
						16	
		59" / 60"				17	
						18	
						19	
C.S.						20	

SURFACE CONDITIONS:

sand, v. clayey, silty, brown, v.f.g.-f.g.

sand, v. clayey, silty, brown, med. moist, v.f.g.-m.g.

sand, silty, slightly clayey, silty moist, l. brown, f.g.-m.g.

sand, silty, v. moist to wet, l. brown, f.g.-m.g.

claystone, gray to dark brown, moist, iron stained

claystone, gray to yellow brown, iron stained & in fractures, moist

DRILLING CONTR. Site Services
Neil & Tim

BY Mike Vager
DATE 6/26/91 CHK'D BY

Schumaker Rd

N

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO 2-3311		CLIENT CSI		LOCATION Bennett South 320 Acres	
DRILLING METHOD: CME-75 8" H.S. Auger				BORING NO. PZ-45	
SAMPLING METHOD: continuous sampler				SHEET 2 OF 2	
WATER LEVEL				START	FINISH
TIME				TIME 2:50	TIME 9:50
DATE				DATE 6-15-91	DATE 6/26/91
CASING DEPTH					

see page 1 diagram

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						21	CLS	claystone, gray to dark brown, moist, iron staining and in fractures, med. hard
						22		
						23		
						24		
						25		
						26	SCS	sandstone, v. clayey, y. gray, v. f. g., med. moist
						27	CLS	claystone, gray, moist, hard
						28	SCS	sandstone, v. clayey, y. gray, v. f. g., med. moist
						29	CLS	claystone, gray, moist, hard [29' cross-section]
						30		
						31		
						32	CLS	claystone, gray to yellow gray, moist, some sandy claystone lenses, hard
						33		
						34		
						35		34' TD
						36		
						37		cuttings - bank into sand pit hard slot
						38		0' - 4' 4' - 34' 9' - 34'
						39		
						40		

DRILLING CONTR. **Site Services**
Neil & Tim

BY **Mike Unger**
DATE **6/25/91** CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300

Golden, CO 80401 **CSI**

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acres

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

BORING NO.

PZ-46

SHEET

1 of 3

SAMPLING METHOD:

Continuous sampler

DRILLING

START FINISH

TIME TIME

9:55 1:40

DATE DATE

6/26/99 6/26/99

WATER LEVEL

23.11' bgs

TIME

DATE

CASING DEPTH

54'

Location Diagram

DATUM

ELEVATION

Schumaker Rd.

N

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	/	31" / 48"	/	/	/	1	SC
CS	/	35" / 60"	/	/	/	2	SP
CS	/	35" / 60"	/	/	/	3	SP
CS	/	35" / 60"	/	/	/	4	SP
CS	/	35" / 60"	/	/	/	5	SP
CS	/	35" / 60"	/	/	/	6	SP
CS	/	35" / 60"	/	/	/	7	SP
CS	/	35" / 60"	/	/	/	8	SP
CS	/	35" / 60"	/	/	/	9	SP
CS	/	35" / 60"	/	/	/	10	SP
CS	/	35" / 60"	/	/	/	11	SP
CS	/	35" / 60"	/	/	/	12	SP
CS	/	35" / 60"	/	/	/	13	CL
CS	/	35" / 60"	/	/	/	14	CL
CS	/	35" / 60"	/	/	/	15	SC
CS	/	35" / 60"	/	/	/	16	SC
CS	/	35" / 60"	/	/	/	17	SC
CS	/	35" / 60"	/	/	/	18	SP
CS	/	35" / 60"	/	/	/	19	SP
CS	/	35" / 60"	/	/	/	20	SP

SURFACE CONDITIONS:

sand, v. clayey, dry, silty, v.f.g. - m.g.

sand, silty, slightly clayey, brown to brown, sli. moist

v.f.g. - m.g.

sand, silty, slightly clayey to clayey, brown, sli. moist

v.f.g. - f.g.

sand, clayey, silty, sli. moist, brown, v.f.g. - f.g.

clay, v. sandy, silty, med. moist, brown, calcareous

sand, v. clayey, silty, sli. moist, brown, calcareous

v.f.g. - f.g.

sand, clayey, yellow gray, sli. moist, v.f.g. - m.g.

DRILLING CONTR. **Site Services**
Neil Flinn

BY **Mike Unger**
DATE **6/26/99** CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-331

CLIENT

CSI

LOCATION

South 320 acre

DRILLING METHOD:

CME-75
8" H.S.

BORING NO.

PZ-46

SHEET

2 OF 3

SAMPLING METHOD:

continuous sampler

DRILLING

START

FINISH

TIME

TIME

9:55

1:4

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

DATE

6-26-9

6/26

see page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						21	SP
						22	
		31" 60"				23	I
CS						24	CLS
						25	
		59" 60"				26	CLS
						27	
						28	
CS						29	
						30	
		60" 60"				31	
						32	CLS
						33	
CS						34	
		60" 60"				35	
						36	CLS
						37	
						38	
CS						39	
						40	

SURFACE CONDITIONS:

sand, silty clay, yellow gray to reddish brown
v. moist from 22' to 23'

claystone, d. gray, moist, med. hard, some
moisture in fractures

claystone, yellow gray to d. gray, moist, hard
iron stained in fractures

claystone, yellow gray to d. gray, moist, hard
iron stained in fractures

claystone, gray to yellow gray, moist, hard
iron stained in fractures

DRILLING CONTR.

Site Services

DATE 6/26/99 CHK'D BY

BY

Mike Unger

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 300 acre

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

BORING NO.

PZ-46

SHEET

3 OF 3

SAMPLING METHOD:

CONTINUOUS sampler

DRILLING

START TIME

9:55

FINISH TIME

1:40

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

DATE

6-26-91

6-26-91

see page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						41	CS
						42	
	44" / 60"					43	
						44	
CS						45	
						46	
						47	CLS
	60" / 60"					48	SP/SPS
						49	
CS						50	
						51	SP/SPS
	60" / 60"					52	
						53	CLS
						54	
						55	
						56	
						57	
						58	
						59	
						60	

SURFACE CONDITIONS:

claystone, gray to yellow gray, moist, hard, iron stained

CLS claystone, v. carbonaceous to lignitic, d. brown to blk moist to v. moist

SP/SPS sand/sandstone, poorly cemented, yellow gray, v. fig., moist

SP/SPS sand/sandstone, yellow gray to gray, moist to v. moist, v. fig. - fig.

SP/SPS sand/sandstone, same as above, wet

CLS claystone, yellow gray to d. brown, moist, iron stained

54' TD

1" PVC

cuttings 0 - 5'
bentonite (hole plug) 5' - 10'
sand pack 10' - 54'
hard shelled 14' - 54'

DRILLING CONTR. Site Services

Nail & Tim

DATE 6-26-91

CHK'D BY

Mike Unger

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300

Gldn. CO 80401 CSI

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acre

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

BORING NO.

PZ-47

SHEET

1 OF 4

SAMPLING METHOD:

continuous sampler

DRILLING

START

FINIS

WATER LEVEL

6'10" bgs

TIME

DATE

CASING DEPTH

6'9"

TIME

9:10

DATE

6-27-91

DATE

6/2

Location Diagram

DATUM

ELEVATION

Schumaker Rd

N

SAMPLER TYPE	INCHES DRIVEN INCHES RECORDED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	31" 48"					1	SC
						2	
						3	
CS						4	SC
						5	
						6	
						7	SP
						8	
CS						9	
						10	
						11	
						12	SC
						13	
CS						14	
						15	
						16	SC
						17	
						18	
						19	
CS						20	

SURFACE CONDITIONS:

sand, v. clayey, silty, brown, dry
v.f.g. to f.g.

sand, v. clayey, silty, brown, sli. moist,
calcareous

sand, clayey, silty, brown, sli. moist to dry,
calcareous, v.f.g. - m.g.

sand, v. clayey, silty, brown, sli. moist to med. moist
calcareous, v.f.g. to f.g.

sand, v. clayey, silty, some thin (2"-3") clay
lenses, moist, v.f.g. to f.g.

DRILLING CONTR. Site Services

Neel & Tim

BY Mike Unger

DATE 6-27-91

CHECK BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acres

DRILLING METHOD:

CME-75
8" Hollow stem auger

BORING NO.

PZ-47

SHEET

2 OF 4

SAMPLING METHOD:

continuous sampler

DRILLING

START

TIME

9:40

DATE

6-27-91

FINIS

TIME

3:00

DATE

6/2

WATER LEVEL

TIME

DATE

CASING DEPTH

see page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						21	SC
						22	
		46" / 60"				23	Ch
						24	
CS						25	
						26	
		59" / 60"				27	
						28	Ch
						29	
CS						30	
						31	CLS
		60" / 60"				32	
						33	
CS						34	
						35	CLS
		60" / 60"				36	
						37	MLS
						38	
						39	
CS						40	

SURFACE CONDITIONS:

sand, v. clayey, silty, some thin (3"-5") clay lam.
med. moist to moist, brown

clay, sandy, silty, moist, brown, calcareous,

clay, silty, sandy, some claystone fragments,
brown, moist

claystone, gray to yellow, moist, iron staining
in fractures

claystone, gray, moist, iron staining in fractures

siltstone, clayey, some v.f.g. sand, yellow gray,
med. moist

DRILLING CONTR.

Site Services
Neil & Tim

DATE 6-27-91

CHKD BY

Mike Ungr

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-3311	CLIENT CSI	LOCATION South 320 Acres
DRILLING METHOD: CME-75 8" Hollow Stem Auger		BORING NO. PZ-47
SAMPLING METHOD: continuous sampler		SHEET 3 of 4
WATER LEVEL		DRILLING START TIME 9:10
TIME		FINISH TIME 3:05
DATE		DATE 6/27
CASING DEPTH		6279

see page 1 diagram

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						41	CLS	claystone, gray to yellow gray, iron stained, moist
						42		
		49" 60"				43		
CS						44	SCS	sandstone, poorly cemented, clayey, l. brown, moist
						45		
						46	CLS	claystone, silty, some thin (2"-3") sand lenses, gray to yellow brown, moist, iron stained
		47" 60"				47		
						48		
CS						49		
						50	CLS	claystone, gray to d. gray, moist
						51		
		60" 60"				52		
						53		
CS						54		
						55	CLS	claystone, gray to yellow gray, moist
						56		
		60" 60"				57		
						58	SCS	sandstone, poorly cemented, gray to yellow brown v.f.g., silty, v. clayey, moist
						59		
CS						60		

DRILLING CONTR. State Services
Neil H. Tim

BY Mike Unger
DATE 6-27-91 CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-3311	CLIENT CSI	LOCATION South 320 acre
DRILLING METHOD: CME-75 8" Hollow Stem Auger		BORING NO. PZ-4
SAMPLING METHOD: continuous sampler		SHEET 4 of 4
WATER LEVEL		DRILLING
TIME		START TIME
DATE		FINISH TIME
CASING DEPTH		DATE
		6-27-91 6:12

See page 1. diagram

Location Diagram

DATUM	ELEVATION
SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED
DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH
BLOWS/FT. SAMPLER	OVA Reading
DEPTH IN FEET	SOIL GRAPH
61	SCS
62	CLS
63	
64	
65	
66	CLS
67	
68	SP/SPS
69	
70	

SURFACE CONDITIONS:

Claystone, gray to d. brown (V. carbonaceous), moist, hard

Clay stone, same as above
original water level

sand/sandstone, v. f. g. - f. g., v. moist to wet, gray to yellow brown

69' T.D.

1" PVC

cuttings 0 - 12'
bentonite 12 - 17'
sand pack 17 - 69'
hand slotted 19 - 69'

DRILLING CONTR. **Site Services**
Nel & Tim

BY **Mike Unger**
DATE **6-27-91** CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401 **CSI**

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acres

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

SAMPLING METHOD:

continuous sampler (CS)

BORING NO.

PZ-48

SHEET

1 of 3

DRILLING

START

TIME

3:10

DATE

6-27-91

FINISH

TIME

10:00

DATE

6-28

WATER LEVEL

58.36' bgs nd

TIME

DATE

CASING DEPTH

59'

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						1	CL
						2	
		29" / 48"				3	SC
						4	
CS						5	
						6	SP
		60" / 60"				7	
						8	
						9	
CS						10	SP
						11	
		41" / 60"				12	
						13	
CS						14	
						15	SC
						16	
		53" / 60"				17	
						18	
						19	
CS						20	

SURFACE CONDITIONS:

clay, sandy to v. sandy, brown, silty moist, calcareous

sand, v. clayey, brown, silty moist, v. f.g. to f.g.

sand, v. f.g. - m.g., silty clayey, silty, brown, silty moist

sand, f.g. - m.g., clayey, silty, brown, silty moist

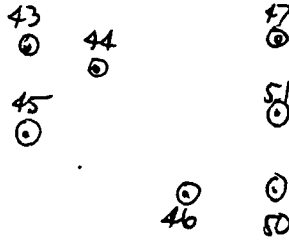
sand, v. clayey, silty, brown, silty moist, calcareous

DRILLING CONTR. Solo Services
Neap X 7/11

BY Mike Unger
DATE 6-27-91 CHK'D BY

Schneider Rd.

PZ-48



Industrial Compliance Inc.

1745 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acres

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

BORING NO.

PZ-48

SHEET

3 OF 3

SAMPLING METHOD:

continuous sampler

DRILLING

START

FINISH

TIME

TIME

WATER LEVEL

TIME

DATE

CASING DEPTH

3:10

10:00

DATE

DATE

6-27-91

6-27-91

See page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						41	SP/SC
						42	
		60"				43	
		60"				44	
CS						45	
						46	SP
		50"				47	
		60"				48	
CS						49	CLS
						50	
						51	
		55"				52	
		60"				53	SP/SPS
CS						54	
						55	
						56	
						57	
						58	SP/SPS
						59	
						60	

SURFACE CONDITIONS:

interbedded sand and v. clayey sand lenses,
silty, brown, sli. moist, v. f. g. - m. g.

sand, v. f. g. - m. g., sli. clayey to clayey, brown to
yellow brown

claystone, d. gray, moist, carbonaceous

sand/sandstone, f. g. - m. g., v. poorly cemented,
med. moist, brown to yellow brown

same as above

cuttings : 0 - 12'
bentonite 12' - 17'
sand pack 17' - 59'
hard slot 19' - 59'

DRILLING CONTR. S.A. Services

DATE 6-28-91

CHK'D BY

BY Mike Unger

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

CSI

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 Ave

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

BORING NO.

PZ-40

SHEET

1 of 4

SAMPLING METHOD:

Continuous sampler

DRILLING

START

FINIS

WATER LEVEL

65.09' bgs

TIME

10:05

TIME

1:4

DATE

7-1

DATE

DAT

CASING DEPTH

69'

6-289

7-1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECORDED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						1	Cl
						2	
		45" 48"				3	Cl
CS						4	
						5	
		6" 60"				6	Cl
						7	
CS						8	Cl
						9	
						10	
		47" 60"				11	
						12	
CS						13	
						14	
						15	SP
		33" 60"				16	
						17	
						18	Cl
						19	
CS						20	

SURFACE CONDITIONS:

clay, v. sandy, silty, dry, brown

clay, v. sandy, silty, med. moist, brown

clay, v. sandy, silty, sli. moist, l. brown, calcareous

clay, silty, sli. sandy, brown, moist to med. moist

sand, v. g. - m. g., l. brown, silty, sli. clay to clayey, sli. moist

clay, sandy, silty, brown, med. moist

DRILLING CONTR. Site Services

DATE 6-28-91 CHK'D BY

BY Mike Unger

Schneider Rd.

N

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acre

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler

BORING NO.

DZ-49

SHEET

2 OF 4

DRILLING

START TIME

10:05

DATE

6-28-91

FINISH TIME

1:40

DATE

7-1

see page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						21	Cl
						22	
	5 1/2"	60"				23	SC
CS						24	
						25	
	6 1/2"	60"				26	SC
						27	
CS						28	
						29	
	5 1/2"	60"				30	SC
						31	
CS						32	
						33	
	6 1/2"	60"				34	Cl
						35	
						36	
	6 1/2"	60"				37	SP
						38	
CS						39	
						40	SPS

SURFACE CONDITIONS:

clay, sandy, silty, brown, med. moist

sand, v. clayey, silty, brown, silty moist to med. moist, v. fig. to fig.

sand, v. clayey, silty, brown, v. fig. - med. fig. moist to med. moist, some silty clay sand lenses (4"-6")

sand, v. clayey, same as above

clay, sandy, silty, med. moist, brown

sand, silty, v. fig. - med. fig., yellow brown, silty moist

sandstone, well cemented

DRILLING CONTRACTOR: Site Services

Neal J. Lim

BY: Mike Unger

DATE: 6-28-91

CHK'D BY:

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acres

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler

BORING NO.

PZ-49

SHEET

3 of 4

DRILLING

START

TIME

0:05

DATE

6-28-91

FINISH

TIME

1:40

DATE

7-1

WATER LEVEL

TIME

DATE

CASING DEPTH

page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						41	SPS
						42	SPS
		37" 60"				43	CLS
CS						44	CLS
						45	
		60" 60"				46	CLS
						47	
						48	
CS						49	SP/SPS
						50	
		60" 60"				51	SP/SPS
						52	
						53	
CS						54	
						55	SPS
						56	
		60" 60"				57	
						58	
CS						59	
						60	

SURFACE CONDITIONS:

sandstone, v. well cemented, brown, dry, v. frag.
drills v. hard

interbedded sandstone &
claystone lenses, moist, brown to
yellow gray

drilled w/ center plug from
41' to 41.5' bgs.

claystone, gray, moist

claystone, d. brown, moist

sand/sandstone, v. poorly cemented, bright yellow
brown, sli. moist to med. moist

sand/sandstone, clean to clayey, v. poorly
cemented, gray to yellow gray, v. frag. - med. frag.,
sli. moist

sandstone, poorly cemented, gray to yellow gray,
sli. moist, v. frag. - frag.

DRILLING CONTR. *Site Services*
Neil & Tim

DATE 6-28-91 CHK'D BY

BY *Mike Unger*

[REDACTED]

JOB NO. 2-3311		CLIENT CSI		LOCATION South 320	
DRILLING METHOD: CME-75 8" Hollow Stem Augers				BORING NO. PZ-	
SAMPLING METHOD: continuous sampler				SHEET 4 of 4	
				DRILLING	
WATER LEVEL				START	FIN
TIME				TIME	TIME
DATE				10:05	3:15
CASING DEPTH				DATE	D
				6-23-91	6-

Location Diagram

DATUM	ELEVATION
1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18
19	20
21	22
23	24
25	26
27	28
29	30
31	32
33	34
35	36
37	38
39	40
41	42
43	44
45	46
47	48
49	50
51	52
53	54
55	56
57	58
59	60
61	62
63	64
65	66
67	68
69	70
71	72
73	74
75	76
77	78
79	80
81	82
83	84
85	86
87	88
89	90
91	92
93	94
95	96
97	98
99	100

SURFACE CONDITIONS:

[illegible]

DRILLING CONTR.

DATE 06-28-80 CLK'D BY

Mike Unger

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300

Golden, CO 80401 CSI

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 Ave

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

SAMPLING METHOD:

CONTINUOUS Auger (CS)

BORING NO.

PZ-50

SHEET

1 of 3

DRILLING

START

FINIS

TIME

TIME

4:55

1:40

DATE

DATE

7/1/91

7-1

WATER LEVEL

40.65 bgs

TIME

DATE

7-1

CASING DEPTH

59'

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						1	CL
						2	
		43" 40"				3	CL
						4	
CS						5	
						6	
		37" 60"				7	
						8	
						9	SP
CS						10	
						11	CL
		54" 60"				12	
						13	CLS
						14	
CS						15	
						16	
						17	
						18	SPS
						19	CLS
CS		54" 60"				20	

SURFACE CONDITIONS:

clay, v. sandy, silty, brown, sli. moist

clay, sandy, silty, d. brown, sli. moist to med. moist

sand, clayey to v. clayey, brown, sli. moist
v.t.g. - m.g.

clay, sandy, brown, med. moist

claystone, gray to yellow gray, moist,
iron stained

sandstone, v. poorly cemented, f.g., yellow brown, sli. moist

claystone, sandy, silty, yellow brown to yellow gray

DRILLING CONTR.

Sub Services

Nat'l & Int'l

CHK'D BY

DATE 7-1-91

BY

Mike Wagner

[illegible]

JCB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acres

DRILLING METHODS

CME 75

8" H.S. angle

BORING NO.

PZ-50

SHEET

2 of 3

SAMPLING METHOD:

continuous sample

DRILLING

START

FINIS

TIME

324

TIME

9.55

140

DATE _____

DATE _____

DATE _____

CASING DEPTH

71-91

71

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA	Reading	DEPTH IN FEET	SOIL GRAPH
CS	/		/				21	CLS
		53" 60"	/				22	
			/				23	
↓			/				24	
CS	/		/				25	
			/				26	
		59" 60"	/				27	SCS SC
			/				28	
↓			/				29	
CS	/		/				30	SC/SCS
		56" 60"	/				31	CLS
			/				32	
			/				33	
↓			/				34	
CS	/		/				35	
		58" 60"	/				36	CLS
			/				37	
			/				38	
↓			/				39	
CS	/		/				40	
			/					

SURFACE CONDITIONS:

CS

Chertstone, silty, gray to yellow gray, moist,
iron stained in fractures

$$\frac{505}{50}$$

sandstone/sand, vit. g. - f. g., yellow brown to yellow gray, sh. moist to red. moist

~~SC~~
SCS

moist @ 30'

CLS

claystone, gray to yellow gray, moist, iron stained in fractures

25

claystone, gray, moist, iron stained

DRILLING CONCRETE

11. Sub Services
Need X 1/m

DATE 7-1-91 CHK'D BY Mike Chgoz

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acre

DRILLING METHOD:

CME-75

8" H.S. auger

BORING NO.

P2-50

SHEET

3 of 3

SAMPLING METHOD:

continuous sampler

DRILLING

START

TIME

9:55

DATE

7-1-91

WATER LEVEL

TIME

DATE

CASING DEPTH

7-1-91

See page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
						41	CLS
						42	
		60"				43	
						44	
CS						45	CLS
						46	
		59"				47	
		60"				48	SC
						49	SCS
CS						50	
						51	
						52	CLS
						53	
		58"				54	
		60"				55	
CS						56	SPS
						57	
		59"				58	
		60"				59	
						60	

SURFACE CONDITIONS:

claystone, gray to yellow gray, moist, iron stained, some thin s.s. lenses (1"-3"), occasional carbonaceous lenses (3")

V. clayey sand / V. clayey sandstone, poorly cemented, v.f.g., yellow brown to yellow gray, med. moist to v. moist

original water level

claystone, gray, moist, fossil leaf imprints

sandstone, v.f.g. - m.g., yellow brown, wet, moderately cemented

59' TEL. cuttings 0-12'
bentonite 12'-17'
sand part 17'-59'
hard silt 17'-59'

1" PVC

DRILLING CONTR.

Site Services
Neil A. Tia

DATE 7-1-91 CHK'D BY

BY Mike Caper

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300

Golden, CO 80401

CSI

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acre

DRILLING METHOD:

CME-75

8" Hollow Stem Auger

BORING NO.

PZ-51

SHEET

1 OF 4

SAMPLING METHOD:

continuous sampler (CS)

DRILLING

START

FINISH

TIME

TIME

DATE

DATE

WATER LEVEL

160.44' bgs

TIME

9:45

DATE

7-3

CASING DEPTH

69'

7-1-91

7-3

SURFACE CONDITIONS:

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						1	CL
						2	SC
		39" / 48"				3	
						4	
CS						5	
						6	
		60" / 60"				7	SC
						8	
						9	
CS						10	
						11	
						12	
		54" / 60"				13	
CS						14	CL
						15	
						16	SC
						17	CL
		54" / 60"				18	
						19	CLS
CS						20	

clay, v. sandy, silty, dry to sh. moist, brown

sand, v. f.p. - f.p., v. clayey, silty, brown, sh. moist, calcareous

sand, v. f.p. - f.p., v. silty, v. clayey, brown, sh. moist, calcareous

clay, v. sandy, silty, med. moist, brown

sand, v. f.p., v. clayey, brown, med. moist

clay, sandy, brown, med. moist, calcareous

chertstone, yellow gray to gray, moist, iron stained

DRILLING CONTR.

Site Services
Nail & Lin

BY Mike Unger
DATE 7-1-91

CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

CSI

CLIENT

2-3311

LOCATION

South 320 acre

DRILLING METHOD:

CME-75

8" H.S. auger

BORING NO.

PZ-51

SHEET

2 of 4

SAMPLING METHOD:

continuous sampler

DRILLING

START

TIME

2:30

DATE

7-1-91

FINIS

TIME

9:4

DATE

7-3

WATER LEVEL

TIME

DATE

CASING DEPTH

See page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER
TYPE

INCHES
DRIVEN
RECOVERED

DEPTH OF
CASING

SAMPLE
NO.
DEPTH

BLOWS/FT.
SAMPLER

OVA
Reading

DEPTH
IN FEET

SOIL
GRAPH

SURFACE CONDITIONS:

✓

✓

✓

✓

✓

✓

✓

✓

CL5 claystone, yellow gray to gray, moist, iron stained

✓

✓

✓

✓

✓

✓

✓

✓

CL5 claystone, yellow gray to gray, moist, some gypsum crystal seams (< 1/4" thick)

✓

✓

✓

✓

✓

✓

✓

✓

CL5 claystone, same as above

✓

✓

✓

✓

✓

✓

✓

✓

SCS v. clayey sandstone, v. f. p. - fig., silty, yellow brown, red, moist

✓

✓

✓

✓

✓

✓

✓

✓

CL5 claystone, gray, moist, iron stained

✓

✓

✓

✓

✓

✓

✓

✓

SCS sandstone, v. clayey, red, moist, yellow gray

✓

✓

✓

✓

✓

✓

✓

✓

CL5 claystone, gray, moist

✓

✓

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✓

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CL5 claystone, gray, moist

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CL5 claystone, gray, moist

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CL5 claystone, gray, moist

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CL5 claystone, gray, moist

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CL5 claystone, gray, moist

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CL5 claystone, gray, moist

✓

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✓

✓

✓

CL5 claystone, gray, moist

DRILLING CONTR. Site Services

Neil & Tim

BY Mike Unger

DATE 7-1-91 CHK'D BY

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

south 320 a

DRILLING METHOD:

CME-75
8" H.S. auger

BORING NO.

DZ-5

SHEET

3 of 4

SAMPLING METHOD:

continuous sample

DRILLING

START

TIME

2:30

FIN

TIME

9:30

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

DATE

7-1-91

7-3

See page 1 diagram

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						41	CLS	claystone, gray, moist
						42	SCS	sandstone, clayey, v.f.g., yellow brown, med. moist, poorly cemented
						43	CLS	claystone, cl. brown to gray, leaf imprints, moist
						44		
						45		
						46		
						47	CLS	claystone, cl. brown to gray, leaf & stem imprints, iron stained, moist
						48		
						49		
						50		
						51	CLS	interbedded lenses of claystone and clayey sandstone, gray to yellow brown, med. moist to moist, v.f.g., iron stained
						52	SCS	
						53		
						54	SPS	sandstone, v.f.g., slightly clayey to clayey, med. moist to moist, gray to yellow gray, poorly cemented
						55		
						56	CLS	claystone, gray, moist
						57	SPS	sandstone, v.f.g., sli. clayey, yellow brown to brown, med. moist
						58		
						59	CLS	claystone, gray, moist
						60		

DRILLING CONTR.

DATE 7-2-91

CHK'D BY

BY Mike Wagner

Industrial Compliance Inc.

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

2-3311

CLIENT

CSI

LOCATION

South 320 acres

DRILLING METHOD:

CME-75

8" H.S. auger

SAMPLING METHOD:

continuous sampler

BORING NO.

PZ-51

SHEET

4 of 4

DRILLING

START TIME

2:30

9:45

DATE

7-23-91

7-1-90

WATER LEVEL

7.3

14.0 ft' bgs

TIME

8:05

9:15

DATE

dry @

7-23-91

CASING DEPTH

64'

64'

See page 1 diagram

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN	INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO.	BLOWS/FT. SAMPLER	OVA	Reading	DEPTH IN FEET	SOIL GRAPH
								61	CES
								62	SPS
								63	
								64	
								65	
								66	SPS
								67	
								68	
								69	
								70	

SURFACE CONDITIONS:

claystone, d. brown, leaf + stem imprints, moist

sandstone, v. f. g. - f. g., yellow brown, med. moist, poorly cemented

sandstone, same as above, v. moist

14' TD

1" PVC

with in 0 - 10.5'
baritone 10.5 - 15'
sand pack 15' - 69'
hard shot 19' - 69'

DRILLING CONTR. Site Services

BY Mike Unger

DATE 7-23-91 CHK'D BY

1746 Colz Blvd., Bldg. 21 #300

Golden, CO 80401

OPZ-48

PZ-52 $\approx 400'$ $\rightarrow$ slit road $\approx 350'$ $\rightarrow$

OPZ-49

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	RECOVERY BLOWCOUNT SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	/	/	/	/		1	SP
/	/	/	/	58" 60"		2	SC
/	/	/	/	/		3	SP
/	/	/	/	/		4	
V	/	/	/	/		5	
CS	/	/	/	/		6	
/	/	/	/	/		7	
/	/	/	/	49" 60"		8	
/	/	/	/	/		9	SP
V	/	/	/	/		10	
CS	/	/	/	/		11	
/	/	/	/	/		12	
/	/	/	/	51" 60"		13	
/	/	/	/	/		14	
V	/	/	/	/		15	
CS	/	/	/	/		16	
/	/	/	/	/		17	
/	/	/	/	54" 60"		18	SP
/	/	/	/	/		19	
V	/	/	/	/		20	
CS	/	/	/	/			

JOB NO.

2-4079 CSI

CLIENT

LOCATION

Bennett, Colo

DRILLING METHOD:

CME-75

8" AB/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
california barrel

WATER LEVEL

TIME

DATE

CASING DEPTH

BORING NO.

PZ-52

SHEET

1 of 4

DRILLING

START

FINISH

TIME

TIME

8:25

1:20

DATE

DATE

7/14/92

7-2

SURFACE CONDITIONS:

sand, v. silty, clayey, slightly moist, brown,
v.f.g. - m.g.sand, v. clayey, silty, calcareous, brown,
v.f.g., sli. moist to med. moistsand, v. silty, clayey, sli. moist, brown,
v.f.g. - m.g.sand, silty, sli. clayey, sli. moist, brown
to l. brown, v.f.g. - m.g., slightly calcareous
(CaCO₃)sand, silty, sli. clayey to clayey, sli. moist,
brown, v.f.g. - m.g.

DRILLING CONT. Layne

Robert v. Red

CHECKED BY

DATE 7/14/92

BY LILKE UNQAT

17-6, Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Col

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

BORING NO.

PZ-52

SHEET

2 of 4

DRILLING

START

FINISH

TIME
8:25

TIME
1:20

DATE

DATE

7/14/92

7-20

CASING DEPTH

see diagram on page 1

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	DOWN/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						21	SP
						22	
			55" 60"			23	
						24	
CL						25	CL
						26	
			69" 60"			27	
						28	
SP						29	SP
						30	
			36" 36"			31	
						32	
CS						33	SC
						34	
			57" 60"			35	
						36	
						37	
						38	
CS						39	
						40	SP

SURFACE CONDITIONS:

sand, silty, sli. clayey, sli. moist, brown to l.b.
v.f.g. - m.g.

clay, v. sandy, silty, med. moist, brown
(v.f.g.)

sand, silty, clayey, sli. moist, brown to
(v.f.g. - m.g.) l. brown

7/14/92 (refusal) 33'

7/20/92 ATV 750 high torque gear box

sand, v. clayey, silty, v.f.g. - f.g., sli. moist
l. brown, calcareous

drills hard, added ~ 5 gallons
water to lift cuttings

sand, silty to v. silty, clayey, v.f.g. to m.g.,
sli. moist, calcareous

DRILLING CONT. Layne
B66 A B66-X

DATE 7/18/92

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.

CLIENT

2-4079 CSI

Bennett, Co

DRILLING METHOD:

CME-750 (ATV)

8" Ab/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

BORING NO.

PZ-52

SHEET

3 of 4

DRILLING

START

FINISH

TIME

TIME

8:25

1:12

DATE

DATE

7/14/92

7/14/92

WATER LEVEL

TIME

DATE

CASING DEPTH

see diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DOWN INCHES RECORDED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
				58" 60"		41	SP
						42	
CS						43	
						44	
				56" 60"		45	
						46	
						47	SP
						48	
CS						49	
						50	
				53" 60"		51	
						52	SP
						53	
CS						54	
						55	
						56	CL
				58" 60"		57	CLS
						58	
CS						59	CLS
						60	

SURFACE CONDITIONS:

sand, silty to v. silty, clayey, v.f.g. - m.g.,
sh. moist, calcareoussand, silty, clayey, v.f.g. to c.g., med. moist,
calcareoussand, silty, clayey, v.f.g. - m.g., med. moist,
sh. calcareous

v. moist @ 55.5' bps *

clay, sandy, claystone fragments, moist to v. moist
brown to grayclaystone, gray to yellow gray, moist,
iron stained and in fracturesclaystone, gray to brown (lignite), med.
iron stained in partDRILLING CONTRACTOR: Layne
BoggsDATE: 7/14/92
UT 11:15 AM
CHKD BY: [signature]

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Co

DRILLING METHOD:

CME-750 (ATV)

8" AB/bw-Stem Auger

BORING NO.

DZ-S

SHEET

4 of 4

SAMPLING METHOD:

Continuous sampler (CS) and/or
California barrel

DRILLING

START

FINISH

TIME

TIME

8:25

1:20

DATE

DATE

7/4/92

7/6

WATER LEVEL

dry

TIME

1:20

DATE

7-20

CASING DEPTH

68'

see diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						61	CLS
						62	
						63	SPS
						64	
						65	
						66	
						67	SPS
						68	
						69	
						70	
						71	
						72	
						73	
						74	
						75	
						76	
						77	
						78	
						79	
						80	

SURFACE CONDITIONS:

claystone, brown, lignitic fragments, med. moist
iron stained in fractures, leaf imprintssandstone, v.f.g. - f.g., moderately cemented,
gray to yellow gray, med. moist, iron stainingsandstone, v.f.g. - f.g., moderately cemented,
yellow gray to yellow brown, sli. moist to
med. moist, iron stained

68' TD

1" PVC

hand slotted: 48' - 68' logs

hole plug: 0 - 3' 2 bags

cuttings: 3' - 34'

hole plug: 34' - 39' 3 bags

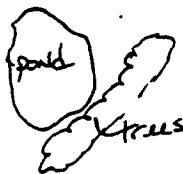
sand: 39' - 68'

stickup: 3.0'

DRILLING METHOD: Layne

DATE 7/6/92 CHECK'D BY

BY LINDA UNTER

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

PZ-45
 ≈ 600'
 ↓
 PZ-53



JOB NO. 2-4079 CSI

CLIENT

Bennett, C

DRILLING METHOD:

CME-75

8" AB/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

BORING NO.

PZ-53

SHEET

1 OF 2

DRILLING

START

TIME

10:35

DATE

7/14/92

WATER LEVEL

TIME

DATE

CASING DEPTH

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
CS						1	SP	sand, v. silty, clayey, d. brown, v. f. g. - m. g.
						2		
				5 1/2" / 60"		3	SP	sand, silty, silty clayey, brown, v. f. g. - m. g.
						4		
CS						5		
						6		
						7	SP	sand, silty, brown, v. f. g. - m. g., moist to med. v. f. g. - m. g.
				5 3/4" / 60"		8		
						9		
CS						10	I	
						11		
						12		
						13	SP	sand, silty, brown to yellow brown, wet v. f. g. & c. g.
				4 1/4" / 60"		14	CLS	claystone, d. gray
CS						15		
						16		
						17		
						18	CLS	claystone, gray to d. gray, moist
				50" / 60"		19		
						20	CLS	1" lignitic clay layer from 19.6' to 19.7' logs

DRILLING CONTRACTOR
 Layne
 Root & Root

CHK'D BY

DATE 7/14/92

BY Mike Unger

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Col

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

BORING NO.

PZ-53

SHEET

2 of 2

DRILLING

START FINISH

TIME TIME

10:35 1:45

DATE DATE

7/14/92 7/14

WATER LEVEL

9.84'

TIME

1:00

DATE

7/14

CASING DEPTH

25'

SURFACE CONDITIONS:

See diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	DOWN/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	/					21	CLS
	/					22	
	/		57"	60"		23	
	/					24	SCS
✓	/					25	
	/					26	
	/					27	
	/					28	
	/					29	
	/					30	
	/					31	
	/					32	
	/					33	
	/					34	
	/					35	
	/					36	
	/					37	
	/					38	
	/					39	
	/					40	

claystone, d. brown, lignitic in part,

sandstone, v. clayey, v. f.g. - f.g., yellow brown to
yellow gray, v. moist to wet

25' TD

1" PVC hole plug: 0-5'

sand: 5-25'

hand slotted from 7'-25'

stickup: 3.1'

2 bags hole plug

DRILLING CONTIN. Layne

DATE 7/18/92

BY L. J. LAYNE

Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

PZ-43

150'
CIG Gas Lines
300'

PZ-54

JOB NO. 2-4079 CSI

CLIENT Bennett, Col

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
california barrel

WATER LEVEL

TIME

DATE

CASING DEPTH

BORING NO.

PZ-54

SHEET

1 OF 3

DRILLING

START

FINISH

TIME
11:45

TIME
3:27

DATE

DATE

7/19/92

7/19/92

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						1	SP
						2	
				5 1/4" 60"		3	
						4	
✓						5	SP
CS						6	
						7	CLS
				60" 60"		8	
						9	
✓						10	
CS						11	
						12	SP
				43" 60"		13	
						14	
✓						15	
CS						16	
						17	
				5 1/4" 60"		18	SP
						19	
✓						20	

SURFACE CONDITIONS:

sand, v. silty, clayey, brown, sli. moist, v. f. g. - m.

sand, v. f. g. - c. g., silty, sli. clayey, moist
v. f. g. - v. c. g., brown to yellow brown

claystone, gray, iron stained in fractures,
weathered, med. moist to moist

sand (unconsolidated sandstone), v. f. g. - c. g.,
yellow brown, iron stained, sli. moist to
med. moist

sand (unconsolidated sandstone), v. f. g. - v. c. g.,
yellow brown, iron stained, med. moist to
moist

DRILLING CONTR. Layne
Roger X RB

BY Mike Under
DATE 7/19/92

CHK'D BY

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, C.

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
california barrel

BORING NO.

PZ-54

SHEET

2 of 3

DRILLING

START

FINISH

TIME

TIME

DATE

DATE

WATER LEVEL

TIME

DATE

CASING DEPTH

7/14/92

7/14/92

See diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						21	SP
						22	CLS
						23	
						24	
						25	
CS						26	
						27	CLS
						28	
						29	
						30	SCS
CS						31	
						32	
						33	CLS
						34	
						35	
CS						36	
CS						37	
						38	CLS
						39	
						40	

SURFACE CONDITIONS:

claystone, gray to yellow gray, iron stained,
med. hard, med. moist

claystone, gray to yellow gray, iron stained,
med. moist, lignitic in part from 28.6 to
29.1 bgs

v. clayey sandstone, yellow brown, med. moist, v. frag.

claystone, gray to yellow gray, iron stained,
med. moist, med. hard to hard

claystone, gray to d. gray, iron stained
in fractures, med. moist, drills harder

DRILLING CONTIN. Layne

BY: Mike Unger
DATE: 7/15/92
CHK'D BY:

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, C.

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

Continuous sampler (CS) and/or
California barrel

WATER LEVEL

41.6'

TIME

1:55

DATE

7/14

CASING DEPTH

BORING NO.

PZ-54

SHEET

3 of 3

DRILLING

START FINIS

TIME TIME

DATE DATE

7/14/92 7/14/92

see diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	DOWN/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						41	CLS
						42	
						43	
				60" / 60"		44	
CS						45	Lignite, poor grade, black, wet in fractures, very moist overall, soft will make water
						46	
				58" / 60"		47	CLS claystone, d. gray to black, lignitic in part, moist
						48	
						49	SP sand (unconsolidated sandstone), v. fig.-m. g., silty v. moist, yellow brown to gray
						50	
CS						51	
						52	Lignite, black, wet, soft, clayey
				60" / 60"		53	
						54	CLS claystone, d. gray to black, v. moist
						55	Lignite, black, wet, clayey 55' TD
						56	piezometer well completion:
						57	
						58	1" PVC
						59	hole plug: 0-3.9'
							sand: 3.9'-55'
							hand slotted: 10'-55'
							2 1/2 bags hole plug
							stickup: 3.0'
						60	

SURFACE CONDITIONS:

CLS claystone, gray to d. gray, iron stained in fractures, med. moist

Lignite, poor grade, black, wet in fractures, very moist overall, soft will make water

CLS claystone, d. gray to black, lignitic in part, moist

SP sand (unconsolidated sandstone), v. fig.-m. g., silty v. moist, yellow brown to gray

Lignite, black, wet, soft, clayey

CLS claystone, d. gray to black, v. moist

Lignite, black, wet, clayey 55' TD

piezometer

well completion:

1" PVC

hole plug: 0-3.9'

sand: 3.9'-55'

hand slotted: 10'-55'

2 1/2 bags hole plug

stickup: 3.0'

DRILLING CONTIN. Layne

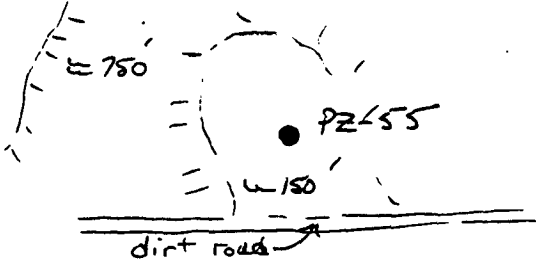
DATE 7/14/92

BY Mike Wagner

1746 Cole Blvd., Bldg. 21 #300

Golden, CO 80401

● PZ-54



Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						1	SP
						2	
			31" / 60"			3	
						4	SP
						5	
CS						6	
						7	
			41" / 60"			8	SP
						9	
						10	
CS						11	
						12	
			48" / 60"			13	SP
						14	
						15	
CS						16	
						17	
			58" / 60"			18	CL
						19	
						20	SP

SURFACE CONDITIONS:

sand, v. silty, clayey, brown, dry, v. f.g. - c.g.

sand, silty, sli. clayey, l. brown, sli. moist, v. f.g. - m.g.

sand, silty, sli. clayey to clayey, l. brown, v. f.g. - m.g. sli. moist

sand, v. f.g. - m.g., silty, sli. clayey, l. brown to brown, sli. moist

clay, v. silty, sandy, brown, med. moist

sand, silty, clayey, l. brown to brown, sli. moist to med. moist, v. f.g. - m.g.

2-4079 CSI

Bennett, Col

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or California barrel

WATER LEVEL

TIME

DATE

CASING DEPTH

BORING NO.

PZ-55

SHEET

1 of 3

DRILLING

START

TIME

3:40

FINISH

TIME

8:30

DATE

7/14/92

DATE

7/15

DRILLING CONTIN. Layne
Roger & BobDATE 7/14/92
BY Mike Unger
CHECKED BY

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Col

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

Continuous sampler (CS) and/or
California barrel

BORING NO.

PZ-55

SHEET

2 of 3

DRILLING

START

TIME

3:40 8:30

DATE

7-14-92 7/15

WATER LEVEL

TIME

DATE

CASING DEPTH

See diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN RECOVERED	DEPTH OF CASING	SAMPLE NO. DEPTH	DOWN/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	/					21	SP
/	/					22	CL
/	/			58" 60"		23	
/	/					24	
✓	/					25	CL
CS	/					26	CLS
/	/					27	SP
/	/			59" 60"		28	
/	/					29	CLS
✓	/					30	SP
CS	/					31	SP
/	/					32	
/	/			59" 60"		33	SP
/	/					34	
✓	/					35	Wet
CS	/					36	CLS
/	/					37	
/	/			60" 60"		38	
/	/					39	
✓	/					40	

SURFACE CONDITIONS:

sand, silty, clayey, brown, v.f.g -
sl. moist

clay, sandy to v. sandy, silty, brown, slightly
calcareous, med. moist

clay, yellow brown, med. moist to moist

claystone, gray, weathered, med. moist to moist

sand (unconsolidated sandstone), gray, med. moist,
v.f.g - m.g.

claystone, gray to yellow gray, iron stained, med. moist

sand (unconsolidated sandstone), v.f.g - f.g., gray to
yellow gray, moist

sand (unconsolidated sandstone), v. moist @ 34' bgs

Wet

claystone, gray to yellow gray, moist, iron stained

DRILLING METHOD: Layne
Roger & Bob

DATE 7/14/92
BY T. J. JONES

CHK'D BY

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Colo

DRILLING METHOD:

CME-75

Ab/bw-Stem Auger

BORING NO.

PZ-55

SHEET

3 of 3

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

DRILLING

START

TIME

3:40

FINISH

TIME

8:30

TIME

7:45

DATE

7/15

DATE

DATE

CASING DEPTH

45'

7-1492

7/15/92

see diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						41	
						42	CLS
						43	
						44	
						45	SD
						46	
						47	
						48	
						49	
						50	
						51	
						52	
						53	
						54	
						55	
						56	
						57	
						58	
						59	
						60	

SURFACE CONDITIONS:

claystone, gray to brown, moist, iron stained
in fractures, lignitic @ 43.1-43.3' bgs

~ sand (sandstone), v.f.g. - f.g., gray, moist
45' TD

piezometer completion:

hole plug: 0-3' 4 bags

cuttings: 3'-13'

hole plug: 15'-20'

sand: 20'-45'

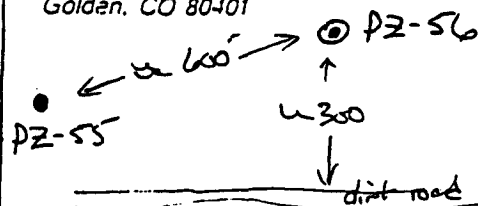
hand slotted: 25'-45'

stick up: 3.0'

DRILLING CONTINUED

CHIEF BY

DATE 7/15/92

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DOWN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	DOWN/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
CS	/					1	SP	sand, v. silty, clayey, brown, sli. moist, v. f.g. - c.g.
	/			53 1/2"		2	CL	clay, sandy, silty, brown, sli. moist to med. moist
	/					3	SP	sand, clayey, brown, sli. moist, v. f.g. - m.g.
	/					4	CL	clay, v. silty, sandy, brown, med. moist
✓	/					5		
CS	/					6		
	/					7	SP	sand, v. f.g. - m.g., silty, clayey, sli. moist, lbrown
	/			58 1/2"		8		
	/					9		
✓	/					10	CL	clay, sandy, silty, brown, sli. moist to med. moist
CS	/					11		
	/					12	SP	sand, silty, sli. clayey, lbrown, sli. moist to v. f.g. - m.g. med. moist
	/			56 1/2"		13		sli. calcareous
	/					14		
✓	/					15		
CS	/					16		
	/					17	CL	clay, gray to brown, silty, sli. sandy to sandy, med. moist, sli. calcareous
	/			54 1/2"		18		
	/					19	SP	sand, v. f.g. to pebbles (d. brown iron concretions), silty, med. moist to moist, brown to yellow brown, iron stained
✓	/					20		

JCO NO. 2-4079 CSI CLIENT Bennett, Cal

DRILLING METHOD:

CME-75

8" Ab/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
california barrel

BORING NO.

PZ-56

SHEET

1 of 4

DRILLING

START

FINISH

TIME

TIME

8:35

WATER LEVEL

TIME

DATE

CASING DEPTH

DATE

DATE

7/5/92

7/15

DRILLING COMPANY: Layne
Roper & R3BY: Mike Under
DATE: 7/5/92

CHECK'D BY:

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, C. L.

DRILLING METHOD:

CME-75

8" AB/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

BORING NO.

PZ-56

SHEET

2 of 4

DRILLING

START

TIME

8:35

TIME

DATE

DATE

7/15/92 7/15

CASING DEPTH

see diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	DOWN/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	/	/	/	/		21	SP
/	/	/	/	/		22	CLS
/	/	/	60" 60"	/		23	
/	/	/	/	/		24	
✓	/	/	/	/		25	SCS
CS	/	/	/	/		26	
/	/	/	60" 60"	/		27	CLS
/	/	/	/	/		28	
/	/	/	/	/		29	
✓	/	/	/	/		30	
CS	/	/	/	/		31	
/	/	/	60" 60"	/		32	CLS
/	/	/	/	/		33	
/	/	/	/	/		34	
✓	/	/	/	/		35	
CS	/	/	/	/		36	
/	/	/	60" 60"	/		37	
/	/	/	/	/		38	CLS
/	/	/	/	/		39	
✓	/	/	/	/		40	

SURFACE CONDITIONS:

sand, v.f.g. - pebbles, yellow brown, med. moist *, iron stained

claystone, weathered, gray to yellow gray, iron stain
med. moist

sandstone, v.f.g. & clayey, moderately cemented, harder to
drill, med. moist, yellow brown to reddish brown, s
limonite concretions, med. moist to moist @ 25.5' bgs.
*

claystone, gray to yellow gray, iron stained with
iron staining in most fractures, med. moist

claystone, gray to yellow gray, iron stained in
part and in fractures, med. moist

claystone, gray to yellow gray, iron stained
in fractures, med. moist

DRILLING CORN. Layne

DATE 7/15/92 CHK'D BY

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Col.

DRILLING METHOD:

CME-75

8" Ab/low-Stem Auger

SAMPLING METHOD:

Continuous sampler (CS) and/or
California barrel

BORING NO.

PZ-56

SHEET

3 of 4

DRILLING

START TIME

8:35

DATE

7/15/92

FINISH TIME

DATE

7/15

see diagram on page 1

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						41	CLS
						42	
						43	
						44	
CS						45	SCS
						46	
						47	CLS
						48	
						49	
						50	
CS						51	
						52	CLS
						53	
						54	SPS
						55	
						56	CLS
						57	
						58	
						59	
						60	

SURFACE CONDITIONS:

claystone, gray to yellow gray, iron stained in fractures, med. moist

60"/60"

sandstone, v. clayey; fair to moderate cementation, yellow brown to yellow gray, med. moist, v.f.g.

60"/60"

claystone, gray, iron stained in fractures, med. moist.

2" sand lense @ 47.5' bgs, reddish brown, iron stained, med. moist to moist *

60"/60"

claystone, gray, iron stained in fractures, med. moist, 1/2" sandstone lense @ 51' bgs, gray, moderately cemented, v.f.g.

SPS sandstone, v.f.g., silty, well cemented, drills very hard, gray, leaf imprints, switched to center bit to drill through sandstone

CLS claystone, gray,

58.75'

Lignite, fair quality, black, wet in fractures, v. moist overall, should make water *

DRILLING CONTIN. Log

DATE 7/15/92

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Colo

DRILLING METHOD:

CME-75

8" AB/bw-Stem Auger

SAMPLING METHOD:

Continuous sampler (CS) and/or
California barrel

BORING NO.

PZ-56

SHEET

4 of 4

DRILLING

START

FINISH

TIME

TIME

8:35 1:40

DATE

DATE

7/5/92 7/5

WATER LEVEL

dry

dry

TIME

1:40

1:40

DATE

7/5

7/5

CASING DEPTH

70

30

see diagram on page 1

Location Diagram

DATUM

ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS						61	
						62	
						63	
						64	
CS						65	
						66	
						67	
						68	
						69	
						70	
						71	
						72	
						73	
						74	
						75	
						76	
						77	
						78	
						79	
						80	

SURFACE CONDITIONS:

Lignite, black, v. moist overall, wet in fractures,

CLs claystone, gray, silty, med. moist to moist

CLs claystone, sandy to v. sandy (v.f.g.), gray, med. moist

CLs claystone, gray, med. moist

70' TD

dual

piezo. completion: 2 PVC pipes (0-70' & 0-30')
(1" PVC) 12:25 to 1:40

70'

30'(29')

hole plug: 0-3' (2 bags)

cuttings: 3'-28'

hand slotted: 40'-70' bgs

hand slotted: 15-30' bgs

hole plug:

sand: 28'-29'

hole plug: 29'-35' (3 bags)

hole plug: 29'-35'

sand: 35'-70'

stickup: 2.5'

stickup: 3.0'

DRILLING SUPERVISOR
Roger Layne

DATE 7/5/92
CHECKED BY
UT 111582 UNOGR

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

PZ-56

PZ-55



100' dirt road

Schumaker Rd.

Location Diagram

DATUM ELEVATION

2-4079 CSI

Bennett, Colo.

DRILLING METHOD:

CME-75

8" AB/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

WATER LEVEL

TIME

DATE

CASING DEPTH

BORING NO.

PZ-57

SHEET

1 of 3

DRILLING

START

TIME

1:45

FINISH

TIME

4:00

DATE

7-15-92

DATE

7/15

SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	/	/	/	/	/	1	SP
/	/	/	/	50" / 60"	/	2	CL
/	/	/	/	/	/	3	/
/	/	/	/	/	/	4	SP
✓	/	/	/	/	/	5	/
CS	/	/	/	/	/	6	/
/	/	/	/	49" / 60"	/	7	SP
/	/	/	/	/	/	8	/
/	/	/	/	/	/	9	/
✓	/	/	/	/	/	10	CL
CS	/	/	/	53" / 60"	/	11	/
/	/	/	/	/	/	12	SP
/	/	/	/	/	/	13	/
/	/	/	/	/	/	14	/
✓	/	/	/	/	/	15	CL
CS	/	/	/	/	/	16	/
/	/	/	/	60" / 60"	/	17	CL
/	/	/	/	/	/	18	/
/	/	/	/	/	/	19	CLS
✓	/	/	/	/	/	20	/

sand, v. silty, clayey, brown, v.f.g. - m.g., sli. moist

clay, silty, sandy to v. sandy, brown, sli. moist to med. moist

sand, silty, clayey, brown, sli. moist, v.f.g. - m.g.

sand, silty, sli. clayey, brown, med. moist
v.f.g. - m.g.

clay, silty, sli. sandy, brown, med. moist

sand, v.f.g. - m.g., silty, sli. clayey, brown, med. moist

clay, silty, sandy to v. sandy, brown, med. moist

clay, sli. sandy, brown to gray, claystone fragments, med. moist

claystone, gray to yellow gray, iron stained, med. moist, weathered

DRILLING CONT. Layne

DATE 7/15/92

BY Mike Under

1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

2-4079 CSI

Bennett, Col.

DRILLING METHOD:

CME-75

8" AB/bw-Stem Auger

SAMPLING METHOD:

CONTINUOUS sampler (CS) and/or
California barrel

WATER LEVEL

TIME

DATE

CASING DEPTH

BORING NO.

PZ-57

SHEET

2 OF 3

DRILLING

START

FINISH

TIME

TIME

1:45

4:00

DATE

DATE

7-15-92

7-15

see diagram on page 1

Location Diagram

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH
CS	/	/	/	/		21	CLS
/	/	/	/	/		22	
/	/	/	60" 60"	/		23	
/	/	/	/	/		24	CLS
↓	/	/	/	/		25	
CS	/	/	/	/		26	
↓	/	/	/	/		27	CLS
/	/	/	60" 60"	/		28	
/	/	/	/	/		29	CLS
↓	/	/	/	/		30	
CS	/	/	/	/		31	SPS
/	/	/	/	/		32	
/	/	/	60" 60"	/		33	CLS
/	/	/	/	/		34	
↓	/	/	/	/		35	
CS	/	/	/	/		36	SCS
/	/	/	/	/		37	
/	/	/	60"	/		38	
/	/	/	/	/		39	SPS
↓	/	/	/	/		40	

SURFACE CONDITIONS:

claystone, yellow brown to gray, med. moist,
iron stained, 3" lignitic claystone lense
@ 22.6' bgs

claystone, yellow brown to gray, med. moist,
iron stained, collected soil sample
5-gallon bucket

claystone, v. silty, sli. sandy (v.f.g.), med. moist to moist,
yellow gray to gray

claystone, med. moist, yellow brown to gray,
5" lignitic claystone @ 28' (d. brown)
lense

sand (unconsolidated sandstone), v.f.g.-f.g., yellow
brown, v. moist X, gray from 31.6 to 31.5' bgs

claystone, gray to brown, iron stained in
fractures, med. moist to moist

sandstone, v.f.g., poorly cemented, yellow brown to
yellow gray, moist

sandstone, v.f.g., poorly cemented to well cemented
lenses (2"-3"), gray, sli. moist (well cemented)
to v. moist. (poorly cemented)

DRILLING CONTR. Layne

DATE 7/15/92 CHK'D BY



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-107
SHEET NUMBER: 3 OF 3

WATER LEVEL:
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				41	CLS	
				42	Lignite	Lignite interbedded with claystone, d. brown to black, wet, soft
	59" / 60"			43	CLS	claystone, silty, gray to yellow gray, med. moist, iron stained, stain imprints
CS				44		
				45	Lignite	Lignite, mostly claystone, d. brown to black, wet, soft
	60" / 60"			46	SPS	sandstone, v. f. g. - m. g., poorly cemented, l. gray
				47		
				48	CLS	claystone, gray, med. moist, iron stained in fractures
✓				49	SPS	sandstone, v. f. g. - f. g., yellow gray to yellow brown, med. moist, iron stained
				50		49' TD
				51		48.5' TD
				52		stickup: 2" PVC solid 0 - 38.5' 2" PVC screen (0.00) 38.5' - 48.5'
				53		
				54		
				55		
						grout 0 - 32' bentonite (slurry) 32' - 34' bentonite (kip) 34' - 35.8' sand 35.8' - 48.5'

GEOLOGIST: *Ungr*
CHECKED BY:
DRILLING CONTRACTOR: Site Services

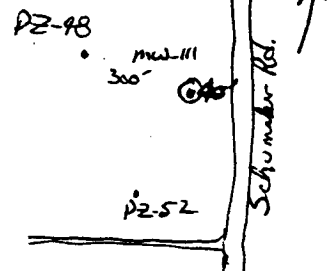
DATE: 10-5-92



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-111
SHEET NUMBER: 1 OF 4

LOCATION DIAGRAM:



CLIENT: CSI
PROJECT NAME: CSI Bennett
PROJECT NUMBER: 2-4074
PROJECT LOCATION:
BORING LOCATION:
START DATE: 10-6-92 FINISH DATE: 10-7-92
START TIME: 12:20 FINISH TIME: 10:40
DRILLING METHOD: CME-75
8" H.S. Auger
SAMPLING METHOD: Continuous sampler
SURFACE ELEVATION:
WATER LEVEL:
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	SOIL GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
CS				1	CL	clay, sandy, silty, brown, med. moist
	35" / 30			2		
				3	SP	sand, v.f.g. - v.c.g., brown, silty, clayey
CS				4		
				5	SP	
	60" / 60			6		sand, v.f.g. - v.c.g., brown, silty, clayey to clayey
				7		
				8		
CS				9		
	59" / 60			10	SC	sand, v. clayey, silty, v.f.g. - c.g., silty, brown
				11		
				12	SP	sand, v. silty, silty, clayey, v.f.g. - m.g., dry to silty, med. moist, calcareous
CS				13		
				14		
				15		
	59" / 60			16		
				17	SP	sand, v.f.g. - v.c.g., silty, silty, clayey to clayey, dry to silty, med. moist
CS				18		
				19		
				20	CL	clay, sandy, silty, med. moist, brown

GEOLOGIST: Orger
CHECKED BY:
DRILLING CONTRACTOR: Site Services
DATE: 10-6-92



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-111
SHEET NUMBER: 2 OF 4

WATER LEVEL:
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				21	Ch	clay, sandy, silty, brown, red. moist
	69" / 100"			22	SP	sand, silty, clayey, brown, v.f.g.-c.g., sli. moist, calcareous stringers
				23		
CS				24		
				25		
	60" / 100"			26		
				27		
				28		
CS				29		
				30	SC	sand, v. clayey, silty, sli. moist, brown, v.f.g.-m.g.
	59" / 100"			31		
				32	SP	sand, silty, sli. clayey, sli. moist, l. brown to brown, v.f.g.-m.g., calcareous stringers
				33		
CS				34		
				35		
	60" / 100"			36		
				37		
				38		
CS				39		
				40		
	57" / 100"			41		
				42	SPS	sandstone, v.f.g.-m.g., sli. moist, yellow brown, poorly cemented
				43		
CS						

GEOLOGIST: *W. J. ...*

CHECKED BY:

DATE: 10-6-92

DRILLING CONTRACTOR:

Sub Services



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: HW-111
SHEET NUMBER: 3 OF 4

WATER LEVEL:

--	--	--

TIME:

--	--	--

DATE:

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SAMPLER TYPE	SAMPLE NO. & DEPTH	QVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				44		
				45	SPS	sandstone, v.f.g. to m.g., sh. moist, yellow brown to reddish brown, moderately cemented
	5 1/2" / 60"			46		
				47		
↓				48	CLS	claystone, gray, med. moist
CS				49		
				50		
				51	SPS	sandstone, v.f.g. - m.g., reddish brown, med. moist, iron stained, poorly to moderately cemented
	5 1/2" / 60"			52	CLS	interbedded claystone and sandstone lenses, 1" to 5" thick, sh. moist to med. moist, 1. gray to yellow gray, v.f.g. - f.g.
↓				53	SPS	
CS				54		
				55	SPS	sandstone, v.f.g. - m.g., yellow gray, moderately cemented, sh. moist to med. moist, drills hard (dry cuttings)
	5 1/2" / 60"			56		
				57		
↓				58		
CS				59		
				60		
				61	SPS	sandstone, v.f.g. - m.g., olive gray, moderately cemented, moist to v. moist
	5 1/2" / 60"			62		
↓				63		
CS				64		
				65		
				66	SPS	sandstone, v.f.g. - m.g., some c.g., moderately cemented with several well cemented lenses, v. moist to wet, olive

GEOLOGIST: Unger
CHECKED BY: Site Services DATE: 10-6-92
DRILLING CONTRACTOR: Site Services



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-111
SHEET NUMBER: 4 OF 4

WATER LEVEL: 14.6
TIME: 9:00
DATE: 10-7-92

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
↓	60" / 60"			67	SPS	sandstone, v.f.g. - m.g., olive brown to reddish brown, wet, moderately cemented
				68		
CS				69		
				70		
	58" / 60"			71		
				72	SPS	sandstone, v.f.g. - m.g., wet, same as above
↓				73		
				74		
				75		2" PVC solid 0 - 63'
				76		2" PVC slotted (0.010) 63' - 73'
				77		stickup: 2.4'
				78		
				79		
				80		grout 0 - 55'
				81		bentonite (crumbles) 55 - 57 1 bag
				82		bentonite (1/2 pellets) 57 - 59 1 bucket
				83		sand (10-20) 59' - 73' 3 bags
				84		
				85		
				86		
				87		
				88		
				89		

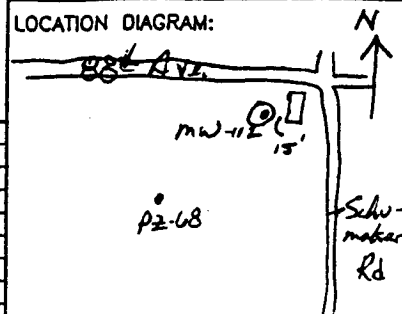
GEOLOGIST: JNGR
CHECKED BY: DATE: 10-6-92
DRILLING CONTRACTOR: Site Services



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-112
SHEET NUMBER: 1 OF 3

LOCATION DIAGRAM:



CLIENT: CST
PROJECT NAME: CST Bennett
PROJECT NUMBER: 2-4079
PROJECT LOCATION: CST Bennett Facility

DRILLING METHOD:
CHE-75
8" H.S. auger
SAMPLING METHOD:
Continuous sampler (CS)

BORING LOCATION:

SURFACE ELEVATION:

START DATE: 10-7-92 FINISH DATE: 10-8-92

WATER LEVEL:

START TIME: 10:50 FINISH TIME: 4:15

TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	SOIL GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
CS				1	SC	
	36" / 36"			2		sand, v. clayey, silty, brown, med. moist, v. f.g. - c.g.
↓				3		
CS				4	SP	
				5		sand, clayey, silty, brown, v. f.g. - c.g., sil. moist to med. moist
↓	58" / 100"			6		
				7	SC	
↓				8		sand, v. clayey, silty, brown, v. f.g. - c.g., med. moist to sil. moist, calcareous stringers
CS				9		
↓				10		
				11	SP	
↓	60" / 60"			12		sand, clayey to v. clayey, silty, v. f.g. - m.g., brown, med. moist, calcareous stringers
CS				13		
↓				14		
				15		
				16	SP	
↓	56" / 100"			17		sand, sil. clayey to clayey, v. f.g. - c.g., lbrown, sil. moist
CS				18		
↓				19		
				20		

GEOLOGIST: ONG

CHECKED BY:

DATE: 10-7-92

DRILLING CONTRACTOR:

Site Services

Rich + Arnold



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-112
SHEET NUMBER: 2 OF 3

WATER LEVEL:
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				21	SP	
	5 1/2" / 60"			22		
✓				23	SC	sand, v. clayey, silty, brown, v. f.g.-f.g., med. moist, calcareous stringers
CS				24		
				25		
	5 1/2" / 60"			26		
				27		
✓				28		
CS				29	SP	
				30		sand, silty, sli. clayey to clayey, v. f.g.-mg., brown, sli. moist to med. moist
	60" / 60"			31		
				32		
✓				33		
CS				34		
				35		
	5 1/2" / 60"			36	SP	sand, clayey to v. clayey, brown, med. moist, v. f.g.-mg., some gray claystone fragments (1/2") and limonite concretions (1/8")
✓				37		
				38		
CS				39	CLS	claystone, gray, med. moist, some moisture in some fractures, some carbonaceous lenses (d. brown)
				40		
	60" / 60"			41		
				42		
✓				43		

GEOLOGIST: Unge

CHECKED BY:

DATE: 10-7-92

DRILLING CONTRACTOR: Site Services



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-112
SHEET NUMBER: 3 OF 3

WATER LEVEL: 50.2' bgs
TIME: 4:00
DATE: 10-8-92

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
CS				44	SMS	sandstone, v. silty, v. f.g. - f.g., v. moist to wet, l. gray, poorly cemented
				45	CLS	claystone, silty, gray to y. gray, med. moist to moist
	60" / 60"			46	SCS	sandstone, v. clayey, silty, reddish brown to yellow brown, v. f.g. - f.g., moist, poorly cemented
				47		
V				48	CLS	claystone, gray, med. moist
CS				49		
				50		let boring set open for 15 minutes, produced 1/4" water
	51" / 60"			51		
				52	SMS	sandstone, v. silty, v. f.g. - f.g., reddish brown, moist, poorly to moderately cemented, iron stained
V				53		
CS				54		
				55	SPS	sandstone, v. f.g. - m.g., silty, moderately cemented, wet, brown
	60" / 60"			56		
				57		
V				58		
				59		SB TD
				60		2" PVC FJT sch. 40 solid 0-43' 2" PVC screen 43'-58'
				61		
				62		grout 0-36' bentonite 36'-39.6' 2 bags sand (10-20) 39.6'-58' 6 bags
				63		
				64		
				65		stickup: 2.5'
				66		

GEOLOGIST: Unger

CHECKED BY:

DATE: 10-7-92

DRILLING CONTRACTOR:

Safe Services



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-114
SHEET NUMBER: 1 OF 2

LOCATION DIAGRAM:

~~dist road~~

N



① MW-114

120'

PZ-46

CLIENT: CSI

PROJECT NAME: CSI Bennett

PROJECT NUMBER: 2-4074

PROJECT LOCATION:

DRILLING METHOD:

CME-75

6" H.S. auger

SAMPLING METHOD:

Continuous sampler (CS)

BORING LOCATION:

SURFACE ELEVATION:

WATER LEVEL:

START DATE: 9-24-92

FINISH DATE: 9-25-92

START TIME: 2:30

FINISH TIME: 12:30

TIME:

DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	SOIL GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
CS				1	SP	sand, v.f.g.-c.g., silty, clayey, brown, sil. moist
				2		
	15 1/4" / 48"			3		
				4		
CS				5	SP	
	4 1/2" / 60"			6		sand, v.f.g.-c.g., silty, sil. clayey, l. brown, sil. moist
				7		
				8		
				9		
CS				10		
				11		
	38" / 60"			12	SC	sand, v. clayey, v.f.g.-f.g., silty, brown, med. moist
				13		
				14		
CS				15		
				16	CL	clay, sandy to v. sandy, brown, med. moist, calcareous
	44" / 60"			17	SC	sand, v. clayey, v.f.g.-m.g., silty, brown, med. moist to moist
				18		
				19		
CS				20		

GEOLOGIST: Ungr

CHECKED BY:

DATE: 9-24-92

DRILLING CONTRACTOR:

Laguer



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-114
SHEET NUMBER: 2 OF 3

WATER LEVEL:
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
CS				21	I SP	
	43" / 60"			22		Sand, v.f.g. - c.g., clayey to sil. clayey, wet, yellow brown to reddish brown, iron stained
				23	CLS	claystone, gray, med. moist, weathered, fractured
CS				24		
	42" / 60"			26		
				27	CLS	claystone, gray to yellow gray, med. moist, iron stained
				28		
				29		
	60" / 60"			31		
				32	CLS	claystone, gray to yellow gray, med. moist, some 3"-4" MLS lenses, yellow gray, med. moist to moist
				33		
				34		
	52" / 60"			36		
				37		
				38		
				39		
				40	CLS	claystone, gray to yellow gray, med. moist, occasional 1"-3" MLS lense, moist, yellow gray
				41		
	51" / 60"			42		
				43		

GEOLOGIST: Unax
CHECKED BY: Layne
DRILLING CONTRACTOR: Layne

DATE: 9-29-92



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-114
SHEET NUMBER: 3 OF 3

WATER LEVEL:
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
↓				44	CLS	claystone, gray to yellow gray, med. moist
CS				45		
				46		
	60" / 60"			47		
↓				48	SPS	sandstone, v.f.g.-m.g., yellow brown, moderately cemented, <u>wet</u>
CS				49		
				50		
	60" / 60"			51	CLS	claystone, yellow gray, med. moist
				52	SCS	sandstone, v. clayey, v.f.g.-f.g., yellow brown, v. moist to wet
↓				53	SPS	v.f.g., sandstone, v. silty, v. well cemented, med. moist to silty moist
CS				54	SCS	sandstone, v. clayey, v.f.g.-f.g., yellow brown, v. moist, moderately cemented
				55		
				56	CLS	claystone, gray to brown (carbonaceous areas) med. moist, some thin (2"-3") 'CS lenses'
	60" / 60"			57		
				58		
↓				59		
				60	59' TD	
				61	2" PVC: solid (O.G.O): screen, stickup: 2.5	0-49' 49'-59'
				62	grout	0-22
				63	bent (hole plug)	22-33 4 bags
				64	bent (pillars)	33-35.0 1 bucket
				65	bent (hole plug)	35.0-44.1 3 bags
				66	same	44.1-59 3 1/2 bags

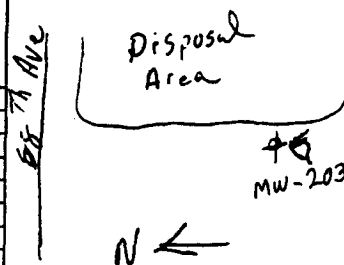
GEOLOGIST: Jager
CHECKED BY: Jager
DRILLING CONTRACTOR: Layne
DATE: 9-25-92



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-203
SHEET NUMBER: 1 OF 1

LOCATION DIAGRAM:



CLIENT: CSI
PROJECT NAME: CSI
PROJECT NUMBER: 2-2562
PROJECT LOCATION: Bennett Co
BORING LOCATION: Adjacent to MW-1054
MW-1054, MW-203
START DATE: 2-14-92 FINISH DATE:
START TIME: 0915 FINISH TIME:
DRILLING METHOD: HSA-CME 35
LANYE DRILLING
SAMPLING METHOD: CONTINUOUS
SURFACE ELEVATION:
WATER LEVEL:
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	SOIL GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
CONT.	1/0-8' 1/10-20m	N/A		2	ML	Moist, tan silty clay, plant material (silty loam) Moist dark brown silty clay, minor fine grained sand
CONT.	2/5-10'	N/A		7		No Return on 5-10 interval - cuttings of tan silty clay, fine sand & fine grained
	1/2 16m 3/10-15			8		
				10		Silty, clayey sand (fine to med grained) tan to lt. brown, moist.
				12		
				14	CL	12.5-14.5' sand w/ minor silt, increase g/r. size to granules above clay contact, moist to wet at contact.
	4/15-20 6.0-20m			16		14.5' Claystone bedrock? unfractured, slightly sandy - NOT bedrock. cutting returned, sand very fine grained.
				18	SM	15-22' lt brown fine to med grained sand, saturated; minor silt.
	5/			20		
				22	TD=22.0	21.5' Claystone Bedrock TD at 22'

GEOLOGIST: James RUGELIS

CHECKED BY:

DATE:

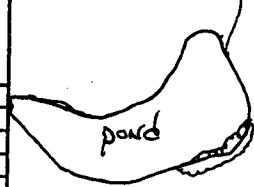
DRILLING CONTRACTOR: LANYE ENVIRONMENTAL



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-204
SHEET NUMBER: 1 OF 2

LOCATION DIAGRAM:



CLIENT: PSI

PROJECT NAME: CSI Bennett

PROJECT NUMBER: Z-4079

PROJECT LOCATION: CSI Facility

DRILLING METHOD:

CME-75

6" H.S. Auger

SAMPLING METHOD:

CONTINUOUS SAMPLER (CS)

BORING LOCATION:

SURFACE ELEVATION:

WATER LEVEL:

TIME:

DATE:

START DATE: 9-24-92 FINISH DATE: 9-24-92

START TIME: 12:30 FINISH TIME: 2:25

Sta. 25

Sta. 30 PZ-4

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	SOIL GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
CS				1	SP	sand, silty, clayey, v.f.g.-v.c.g., brown, sh. moist
	35" / 48"			2		
				3		
				4		
CS				5		
				6		
	33" / 60"			7	SP	sand, silty, sh. clayey, l. brown, v.f.g.-mg
				8		
				9		
CS				10		
				11		
	41" / 60"			12		
				13		
				14	SP	sand, v.f.g. to v.c.g., wet, brown
CS				15		
	39" / 60"			16		
				17		
				18		
				19	CLS	claystone, gray to yellow gray, med. moist
CS	12" / 12"			20		20.0' TD

GEOLOGIST: Dugan

CHECKED BY:

DATE: 9-24-92

DRILLING CONTRACTOR:

Layne (Dallas & Randy)



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: *mw-204*
SHEET NUMBER: *2* OF *2*

WATER LEVEL: *22'*
TIME:
DATE:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				21	SP	
				22		
				23	SPS	sandstone, yellow-brown, v.f.g.-m.g., partly to moderately cemented, wet
✓				24		
				25		moist, lowball
				26		
				27		
				28		
				29		
				30		
				31		
				32		
				33		
				34		
				35		
				36		
				37		
				38		
				39		
				40		
				41		
				42		
				43		

GEOLOGIST: *Wgs*
CHECKED BY: *J* DATE: *9-24-92*
DRILLING CONTRACTOR: *Layne*



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-204
SHEET NUMBER: 1 OF

LOCATION DIAGRAM:



P2-53

P2-58

CLIENT: CST
PROJECT NAME: CSI Bennett
PROJECT NUMBER: 2-4074
PROJECT LOCATION: CSI Bennett Facility

DRILLING METHOD:
CME-75
6" H.S. Auger
SAMPLING METHOD:
continuous sampler (CS)

BORING LOCATION:

SURFACE ELEVATION:

WATER LEVEL:

TIME:

DATE:

START DATE: 9-24-92 FINISH DATE:

START TIME: FINISH TIME:

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	SOIL GRAPH
--------------	--------------------	-------------	-----	---------------	------------

SOIL DESCRIPTION AND DRILLING CONDITIONS

CS				1	SP	sand, silty, clayey, brown, silty moist, v.f.g.-m.g.
				2		
	21 1/4"			3		
				4	SP	
CS				5		sand, silty, silty clayey to clayey, brown, v.f.g.-c.g., silty moist
				6		
				7		
	27 1/2"			8		
				9		
CS				10		
				11	SP	sand, silty, l. brown to yellow brown, red moist
	27 1/2"			12		
				13		
				14		
CS				15		
				16		
				17		
	38 1/2"			18	SP	sand, silty, silty, l. brown to yellow brown, red moist to moist
				19		
CS				20		

GEOLOGIST: Jager

CHECKED BY:

DRILLING CONTRACTOR:

DATE: 9-24-92

Lagore (Dellus + Rending)



INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
GOLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: *mw-204*
SHEET NUMBER: *2* OF *2*

WATER LEVEL: *13'*
TIME: *2:00*
DATE: *9-24-92*

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				21		
				22		2" PVC
				23		0.010 shot
				24		
				25		10' solid
				26		10' shot (screen 0.010)
				27		2.5' stickup
				28		grout 0-2.5'
				29		bent. (hole plug) 2.5-5.5' 1 bag
				30		bent. (1/2 pellets) 5.5-8.0' 1 bucket
				31		sand (10-20) 8.0-20' 3 bags (100#)
				32		
				33		
				34		
				35		
				36		
				37		
				38		
				39		
				40		
				41		
				42		
				43		

GEOLOGIST: *Unge*

CHECKED BY:

DRILLING CONTRACTOR: *Unge*

DATE: *9-24-92*

APPENDIX G
SITE GROUND-WATER ELEVATIONS

PROPOSED WSI - WATER LEVEL DATA

PIEZ. No.	TOTAL Depth	ELEV (surface)	ELEV (top)	STICK UP (ft)	7/1/91			7/15/91		
					top	Depth to Water surf	Elevation	top	Depth to Water surf	Elevation
37	63.00	5287.84	5288.78	0.94						
38	40.00	5286.35	—							
38R	70.00	5285.91	5288.76	2.85						
39	69.00	5308.92	5311.72	2.8						
40										
40R	69.50	5296.08	5298.88	2.80						
41										
41R	64.00	5297.93	5300.38	2.45						
42	64.00	5289.41	5292.58	3.17						
43	49.00	5318.95	5320.09	1.14		29.73	5289.22		29.91	5289.04
44	44.00	5312.57	5314.55	1.98		34.15	5278.42		34.38	5278.19
45	34.00	5315.72	5317.09	1.37		11.43	5304.29		11.23	5304.49
46	54.00	5329.21	5330.49	1.28		23.11	5306.10		23.07	5306.14
47	69.00	5296.95	5300.33	1.38		61.61	5237.34		28.76 ^a	
48	59.00	5305.69	5307.02	1.33		dry			dry	
49	69.00	5310.28	5313.37	3.09		65.09	5245.19		64.97	5245.31
50	59.00	5306.99	5308.55	1.56		40.65	5266.24		26.93	5279.96
51	69.00	5304.39	5307.40	3.01		66.44	5237.55		66.52	5237.47
52	68.00	5316.43	5318.91	2.48						
53	25.00	5314.00	5316.87	2.87						
54	55.00	5325.06	5327.78	2.72						
55	45.00	5329.00	5331.41	2.41						
56D	70.00	5305.45	5307.26	1.81						
56S	30.00	5305.45	5306.90	1.45						
57	46.50	5315.72	5318.29	2.57						
58	25.00	5321.99	5324.74	2.75						
59D	50.00	5318.81	5321.35	2.54						
59S	15.00	5318.81	5321.64	2.83						
60S	43.00	5304.62	5307.14	2.52						
60D	74.50	5304.19	5307.49	3.3						
61	43.00	5312.13	5315.94	3.81						
62D	68.00	5307.35	5308.44	1.09						
62S	27.00	5307.35	5309.37	2.02						
63D	73.00	5303.20	5305.85	2.65						
63S	35.50	5303.20	5306.09	2.89						
64D	58.00	5299.70	5301.43	1.73						
64S	29.00	5299.70	5302.31	2.61						
65	63.00	5303.91	5306.65	2.74						
66	54.00	5288.34	5291.28	2.94						
67	70.00	5300.33	5303.68	3.35						
68	49.00	5285.08	5288.12	3.04						
69	65.50	5294.92	5298.46	3.54						
70D	70.00	5300.06	5303.26	3.20						
70S	25.00	5301.01	5303.81	3.80						
71	70.00	5299.90	5303.05	3.15						
72	65.00	5293.81	5297.01	3.20						
73	68.50	5318.67	5322.57	3.90						
74	58.50	5305.11	5308.81	3.70						

^a anomalous reading

PROPOSED WSI - WATER LEVEL DATA

PIEZ. No.	TOTAL Depth	ELEV (surface)	ELEV (top)	STICK UP (ft)	5/4/92			6/8/92		
					top	Depth to Water surf	Elevation	top	Depth to Water surf	Elevation
37	63.00	5287.84	5288.78	0.94						
38	40.00	5286.35	—							
38R	70.00	5285.91	5288.76	2.85						
39	69.00	5308.92	5311.72	2.8						
40										
40R	69.50	5296.08	5298.88	2.80						
41										
41R	64.00	5297.93	5300.38	2.45						
42	64.00	5289.41	5292.58	3.17						
43	49.00	5318.95	5320.09	1.14		29.62	5289.33	30.63	29.49	5289.46
44	44.00	5312.57	5314.55	1.98		33.68	5278.89	35.50	33.52	5279.05
45	34.00	5315.72	5317.09	1.37		8.73	5306.99	9.75	8.38	5307.34
46	54.00	5329.21	5330.49	1.28		21.88	5307.33	22.47	21.19	5308.02
47	69.00	5298.95	5300.33	1.38		61.11	5237.84	62.40	61.02	5237.93
48	59.00	5305.69	5307.02	1.33		dry		dry		
49	69.00	5310.28	5313.37	3.09		64.60	5245.68	65.62	62.53	5247.75
50	59.00	5306.99	5308.55	1.56		26.51	5280.48			
51	69.00	5304.39	5307.40	3.01		66.19	5237.80	67.19	64.18	5240.21
52	68.00	5316.43	5318.91	2.48						
53	25.00	5314.00	5316.87	2.87						
54	55.00	5325.06	5327.78	2.72						
55	45.00	5329.00	5331.41	2.41						
56D	70.00	5305.45	5307.26	1.81						
56S	30.00	5305.45	5306.90	1.45						
57	46.50	5315.72	5318.29	2.57						
58	25.00	5321.99	5324.74	2.75						
59D	50.00	5318.81	5321.35	2.54						
59S	15.00	5318.81	5321.64	2.83						
60S	43.00	5304.62	5307.14	2.52						
60D	74.50	5304.19	5307.49	3.3						
61	43.00	5312.13	5315.94	3.81						
62D	68.00	5307.35	5308.44	1.09						
62S	27.00	5307.35	5309.37	2.02						
63D	73.00	5303.20	5305.85	2.65						
63S	35.50	5303.20	5306.09	2.89						
64D	58.00	5299.70	5301.43	1.73						
64S	29.00	5299.70	5302.31	2.61						
65	63.00	5303.91	5306.65	2.74						
66	54.00	5288.34	5291.28	2.94						
67	70.00	5300.33	5303.68	3.35						
68	49.00	5285.08	5288.12	3.04						
69	65.50	5294.92	5298.46	3.54						
70D	70.00	5300.06	5303.26	3.20						
70S	25.00	5301.01	5303.81	3.80						
71	70.00	5299.90	5303.05	3.15						
72	65.00	5293.81	5297.01	3.20						
73	68.50	5318.67	5322.57	3.90						
74	58.50	5305.11	5308.81	3.70						

PROPOSED WSI - WATER LEVEL DATA

PIEZ. No.	TOTAL Depth	ELEV (surface)	ELEV (top)	STICK UP (ft)	7/30/92		9/3/92		top	surf	Elevation
					top	Depth to Water	Depth to Water	surf			
37	63.00	5287.84	5288.78	0.94	52.27	51.33	5236.51	52.21	51.27	5236.57	
38	40.00	5286.35	—		dry	dry		PVC broken			
38R	70.00	5285.91	5288.76	2.85			5285.91				
39	69.00	5308.92	5311.72	2.8	dry			dry			
40					63.80	61.00	5235.08	Destroyed			
40R	69.50	5296.08	5298.88	2.80							
41					64.36	61.91	5236.02	Destroyed			
41R	64.00	5297.93	5300.38	2.45							
42	64.00	5289.41	5292.58	3.17	58.99	55.82	5233.59	59.02	55.85	5233.56	
43	49.00	5318.95	5320.09	1.14	29.98	28.84	5290.11	29.07	27.93	5291.02	
44	44.00	5312.57	5314.55	1.98	35.01	33.03	5279.54	34.59	32.61	5279.96	
45	34.00	5315.72	5317.09	1.37	9.22	7.85	5307.87	8.04	6.67	5309.05	
46	54.00	5329.21	5330.49	1.28	22.40	21.12	5308.09	22.58	21.30	5307.91	
47	69.00	5298.95	5300.33	1.38	62.15	60.77	5238.18	62.19	60.81	5238.14	
48	59.00	5305.69	5307.02	1.33	dry			dry			
49	69.00	5310.28	5313.37	3.09	67.64	64.55	5245.73	71.03	67.94	5242.34	
50	59.00	5306.99	5308.55	1.56	27.68	26.12	5280.87	27.33	25.77	5281.22	
51	69.00	5304.39	5307.40	3.01	69.39	66.38	5238.01	69.12	66.11	5238.28	
52	68.00	5316.43	5318.91	2.48	dry			dry			
53	25.00	5314.00	5316.87	2.87	7.45		5314.00	7.01	4.14	5309.86	
54	55.00	5325.06	5327.78	2.72	33.18	30.46	5294.60	31.60	28.88	5296.18	
55	45.00	5329.00	5331.41	2.41	37.61	35.20	5293.80	37.22	34.81	5294.19	
56D	70.00	5305.45	5307.26	1.81	35.21	33.40	5272.05	34.25	32.44	5273.01	
56S	30.00	5305.45	5306.90	1.45	27.95	26.30	5278.95	27.78	26.33	5279.12	
57	46.50	5315.72	5318.29	2.57	36.03	33.46	5282.26	35.78	33.21	5282.51	
58	25.00	5321.99	5324.74	2.75	14.98	12.23	5309.76	15.15	12.40	5309.59	
59D	50.00	5318.81	5321.35	2.54	19.92	17.38	5301.43	20.14	17.60	5301.21	
59S	15.00	5318.81	5321.64	2.83	11.30	8.47	5310.34	11.53	8.70	5310.11	
60S	43.00	5304.62	5307.14	2.52	dry		5304.62	dry			
60D	74.50	5304.19	5307.49	3.3			5304.19				
61	43.00	5312.13	5315.94	3.81	34.29	30.48	5281.65	34.18	30.37	5281.76	
62D	68.00	5307.35	5308.44	1.09	60.59	59.50	5247.85	60.56	59.47	5247.88	
62S	27.00	5307.35	5309.37	2.02	dry			dry			
63D	73.00	5303.20	5305.85	2.65	68.05	65.40	5237.80	67.96	65.31	5237.89	
63S	35.50	5303.20	5306.09	2.89	dry		5303.20	dry		5303.20	
64D	58.00	5299.70	5301.43	1.73	35.07	33.34	5266.36	34.84	33.11	5266.59	
64S	29.00	5299.70	5302.31	2.61	dry			dry			
65	63.00	5303.91	5306.65	2.74	34.18	31.44	5272.47	33.88	31.14	5272.77	
66	54.00	5288.34	5291.28	2.94							
67	70.00	5300.33	5303.68	3.35							
68	49.00	5285.08	5288.12	3.04							
69	65.50	5294.92	5298.46	3.54							
70D	70.00	5300.06	5303.26	3.20							
70S	25.00	5301.01	5303.81	3.80							
71	70.00	5299.90	5303.05	3.15							
72	65.00	5293.81	5297.01	3.20							
73	68.50	5318.67	5322.57	3.90							
74	58.50	5305.11	5308.81	3.70							

PROPOSED WSI - WATER LEVEL DATA

PIEZ. No.	TOTAL Depth	ELEV (surface)	ELEV (top)	STICK UP (ft)	10/2/92 Depth to Water			11/13/92 Depth to Water		
					top	surf	Elevation	top	surface	elevation
37	63.00	5287.84	5288.78	0.94	52.20	51.26	5235.64	52.21	51.27	5236.57
38	40.00	5286.35	—	—	—	—	—	dry	—	—
38R	70.00	5285.91	5288.76	2.85	57.45	54.60	5231.31	53.53	50.68	5235.23
39	69.00	5308.92	5311.72	2.8	dry	—	—	dry	—	—
40	—	—	—	—	—	—	—	—	—	—
40R	69.50	5296.08	5298.88	2.80	69.00	66.20	5229.88	62.90	60.10	5235.98
41	—	—	—	—	—	—	—	—	—	—
41R	64.00	5297.93	5300.38	2.45	65.03	62.58	5235.35	65.01	62.56	5235.37
42	64.00	5289.41	5292.58	3.17	59.00	55.83	5233.58	59.02	55.85	5233.56
43	49.00	5318.95	5320.09	1.14	28.15	27.01	5291.94	27.34	26.20	5292.75
44	44.00	5312.57	5314.55	1.98	34.38	32.40	5280.17	34.37	32.39	5280.18
45	34.00	5315.72	5317.09	1.37	8.60	7.23	5308.49	9.07	7.70	5308.02
46	54.00	5329.21	5330.49	1.28	22.81	21.53	5307.68	23.08	21.80	5307.41
47	69.00	5298.95	5300.33	1.38	62.14	60.76	5238.19	62.15	60.77	5238.18
48	59.00	5305.69	5307.02	1.33	dry	—	—	dry	—	—
49	69.00	5310.28	5313.37	3.09	67.45	64.36	5245.92	67.48	64.39	5245.89
50	59.00	5306.99	5308.55	1.56	27.17	25.61	5281.38	27.02	25.46	5281.53
51	69.00	5304.39	5307.40	3.01	69.00	65.99	5238.40	69.08	66.07	5238.32
52	68.00	5316.43	5318.91	2.48	dry	—	—	dry	—	—
53	25.00	5314.00	5316.87	2.87	7.41	4.54	5309.46	7.63	4.76	5309.24
54	55.00	5325.06	5327.78	2.72	26.80	24.08	5300.98	20.93	18.21	5306.85
55	45.00	5329.00	5331.41	2.41	36.82	34.41	5294.59	35.49	33.08	5295.92
56D	70.00	5305.45	5307.26	1.81	34.02	32.21	5273.24	33.75	31.94	5273.51
56S	30.00	5305.45	5306.90	1.45	27.66	26.21	5279.24	27.49	26.04	5279.41
57	46.50	5315.72	5318.29	2.57	35.49	32.92	5282.80	35.28	32.71	5283.01
58	25.00	5321.99	5324.74	2.75	15.29	12.54	5309.45	15.31	12.56	5309.43
59D	50.00	5318.81	5321.35	2.54	20.32	17.78	5301.03	20.55	18.01	5300.80
59S	15.00	5318.81	5321.64	2.83	11.70	8.87	5309.94	11.68	8.85	5309.96
60S	43.00	5304.62	5307.14	2.52	dry	—	—	dry	—	—
60D	74.50	5304.19	5307.49	3.3	69.40	66.10	5238.09	69.29	65.99	5238.20
61	43.00	5312.13	5315.94	3.81	34.13	30.32	5281.81	33.98	30.17	5281.96
62D	68.00	5307.35	5308.44	1.09	60.50	59.41	5247.94	60.54	59.45	5247.90
62S	27.00	5307.35	5309.37	2.02	dry	—	—	dry	—	—
63D	73.00	5303.20	5305.85	2.65	68.00	65.35	5237.85	67.93	65.28	5237.92
63S	35.50	5303.20	5306.09	2.89	dry	—	—	dry	—	—
64D	58.00	5299.70	5301.43	1.73	34.75	33.02	5266.68	34.71	32.98	5266.72
64S	29.00	5299.70	5302.31	2.61	dry	—	—	dry	—	—
65	63.00	5303.91	5306.65	2.74	33.72	30.98	5272.93	33.69	30.95	5272.96
66	54.00	5288.34	5291.28	2.94	52.05	49.11	5239.23	52.08	49.14	5239.20
67	70.00	5300.33	5303.68	3.35	69.55	66.20	5234.13	63.68	60.33	5240.00
68	49.00	5285.08	5288.12	3.04	42.52	39.48	5245.60	41.68	38.64	5246.44
69	65.50	5294.92	5298.46	3.54	64.65	61.11	5233.81	64.64	61.10	5233.82
70D	70.00	5300.06	5303.26	3.20	63.64	60.44	5239.62	63.51	60.31	5239.75
70S	25.00	5301.01	5303.81	3.80	27.50	23.70	5276.31	26.88	23.08	5276.93
71	70.00	5299.90	5303.05	3.15	66.15	63.00	5236.90	66.78	63.63	5236.27
72	65.00	5293.81	5297.01	3.20	60.10	56.90	5236.91	60.31	57.11	5236.70
73	68.50	5318.67	5322.57	3.90	dry	—	—	dry	—	—
74	58.50	5305.11	5308.81	3.70	45.80	42.10	5263.01	43.22	39.52	5308.81

PROPOSED WSI - WATER LEVEL DATA

PIEZ. No.	TOTAL Depth	ELEV (surface)	ELEV (top)	STICK UP (ft)	12/22/92 Depth to Water			1/18/93 Depth to Water		
					top	surface	elevation	top	surface	elevation
37	63.00	5287.84	5288.78	0.94	52.10	51.16	5236.68	52.03	51.09	5236.75
38	40.00	5286.35	—	—	dry	—	—	dry	—	—
38R	70.00	5285.91	5288.76	2.85	53.22	50.37	5235.54	53.00	50.15	5235.76
39	69.00	5308.92	5311.72	2.8	dry	—	—	dry	—	—
40	—	—	—	—	—	—	—	—	—	—
40R	69.50	5296.08	5298.88	2.80	62.74	59.94	5236.14	62.67	59.87	5236.21
41	—	—	—	—	—	—	—	—	—	—
41R	64.00	5297.93	5300.38	2.45	64.92	62.47	5235.46	64.90	62.45	5235.48
42	64.00	5289.41	5292.58	3.17	59.02	55.85	5233.56	58.95	55.78	5233.63
43	49.00	5318.95	5320.09	1.14	26.94	25.80	5293.15	27.13	25.99	5292.96
44	44.00	5312.57	5314.55	1.98	34.06	32.08	5280.49	34.00	32.02	5280.55
45	34.00	5315.72	5317.09	1.37	9.29	7.92	5307.80	9.50	8.13	5307.59
46	54.00	5329.21	5330.49	1.28	23.11	21.83	5307.38	23.25	21.97	5307.24
47	69.00	5298.95	5300.33	1.38	61.89	60.51	5238.44	61.78	60.40	5238.55
48	59.00	5305.69	5307.02	1.33	dry	—	—	dry	—	—
49	69.00	5310.28	5313.37	3.09	67.38	64.29	5245.99	67.33	64.24	5246.04
50	59.00	5306.99	5308.55	1.56	26.63	25.07	5281.92	26.58	25.02	5281.97
51	69.00	5304.39	5307.40	3.01	68.76	65.75	5238.64	68.70	65.69	5238.70
52	68.00	5316.43	5318.91	2.48	dry	—	—	dry	—	—
53	25.00	5314.00	5316.87	2.87	7.76	4.89	5309.11	7.93	5.06	5308.94
54	55.00	5325.06	5327.78	2.72	20.86	18.14	5306.92	21.00	18.28	5306.78
55	45.00	5329.00	5331.41	2.41	34.78	32.37	5296.63	34.70	32.29	5296.71
56D	70.00	5305.45	5307.26	1.81	33.27	31.46	5273.99	33.06	31.25	5274.20
56S	30.00	5305.45	5306.90	1.45	27.25	25.80	5279.65	27.09	25.64	5279.81
57	46.50	5315.72	5318.29	2.57	34.68	32.11	5283.61	34.89	32.32	5283.40
58	25.00	5321.99	5324.74	2.75	15.35	12.60	5309.39	15.44	12.69	5309.30
59D	50.00	5318.81	5321.35	2.54	20.51	17.97	5300.84	20.70	18.16	5300.65
59S	15.00	5318.81	5321.64	2.83	11.72	8.89	5309.92	11.75	8.92	5309.89
60S	43.00	5304.62	5307.14	2.52	dry	—	—	dry	—	—
60D	74.50	5304.19	5307.49	3.3	68.96	65.66	5238.53	68.82	65.52	5238.67
61	43.00	5312.13	5315.94	3.81	33.76	29.95	5282.18	33.69	29.88	5282.25
62D	68.00	5307.35	5308.44	1.09	60.44	59.35	5248.00	60.40	59.31	5248.04
62S	27.00	5307.35	5309.37	2.02	dry	—	—	dry	—	—
63D	73.00	5303.20	5305.85	2.65	71.21	68.56	5234.64	67.60	64.95	5238.25
63S	35.50	5303.20	5306.09	2.89	dry	—	—	dry	—	—
64D	58.00	5299.70	5301.43	1.73	34.24	32.51	5267.19	34.32	32.59	5267.11
64S	29.00	5299.70	5302.31	2.61	dry	—	—	dry	—	—
65	63.00	5303.91	5306.65	2.74	33.32	30.58	5273.33	33.27	30.53	5273.38
66	54.00	5288.34	5291.28	2.94	52.09	49.15	5239.19	52.04	49.10	5239.24
67	70.00	5300.33	5303.68	3.35	63.44	60.09	5240.24	63.40	60.05	5240.28
68	49.00	5285.08	5288.12	3.04	41.64	38.60	5246.48	41.70	38.66	5246.42
69	65.50	5294.92	5298.46	3.54	64.58	61.04	5233.88	64.56	61.02	5233.90
70D	70.00	5300.06	5303.26	3.20	63.31	60.11	5239.95	63.42	60.22	5239.84
70S	25.00	5301.01	5303.81	3.80	26.70	22.90	5277.11	26.99	23.19	5276.82
71	70.00	5299.90	5303.05	3.15	66.71	63.56	5236.34	66.65	63.50	5236.40
72	65.00	5293.81	5297.01	3.20	60.11	56.91	5236.90	60.90	57.70	5236.11
73	68.50	5318.67	5322.57	3.90	dry	—	—	dry	—	—
74	58.50	5305.11	5308.81	3.70	42.97	39.27	5265.84	43.01	39.31	5265.80

PROPOSED WSI - WATER LEVEL DATA

PIEZ. No.	TOTAL Depth	ELEV (surface)	ELEV (top)	STICK UP (ft)	2/16/93 Depth to Water			3/26/93 Depth to Water		
					top	surface	elevation	top	surface	elevation
37	63.00	5287.84	5288.78	0.94	51.98	14.98	5236.80	55.45	54.51	5233.33
38	40.00	5286.35	—	—	dry	—	—	dry	—	—
38R	70.00	5285.91	5288.76	2.85	52.81	49.96	5235.95	58.42	55.57	5230.34
39	69.00	5308.92	5311.72	2.8	dry	—	—	dry	—	—
40	—	—	—	—	—	—	—	—	—	—
40R	69.50	5296.08	5298.88	2.80	62.68	59.88	5236.20	62.44	59.64	5236.44
41	—	—	—	—	—	—	—	—	—	—
41R	64.00	5297.93	5300.38	2.45	64.87	62.42	5235.51	64.73	62.28	5235.65
42	64.00	5289.41	5292.58	3.17	58.94	55.77	5233.64	54.84	51.67	5237.74
43	49.00	5318.95	5320.09	1.14	27.28	26.14	5292.81	27.09	25.95	5293.00
44	44.00	5312.57	5314.55	1.98	33.94	31.96	5280.61	33.50	31.52	5281.05
45	34.00	5315.72	5317.09	1.37	9.46	8.09	5307.63	9.35	7.98	5307.74
46	54.00	5329.21	5330.49	1.28	23.35	22.07	5307.14	23.35	22.07	5307.14
47	69.00	5296.95	5300.33	1.38	61.67	60.29	5238.66	61.24	59.86	5239.09
48	59.00	5305.69	5307.02	1.33	dry	—	—	dry	—	—
49	69.00	5310.28	5313.37	3.09	67.33	64.24	5246.04	67.18	64.09	5246.19
50	59.00	5306.99	5308.55	1.56	26.53	24.97	5282.02	30.04	28.48	5278.51
51	69.00	5304.39	5307.40	3.01	68.61	65.60	5238.79	68.18	65.17	5239.22
52	68.00	5316.43	5318.91	2.48	dry	—	—	dry	—	—
53	25.00	5314.00	5316.87	2.87	7.86	4.99	5309.01	7.67	4.80	5309.20
54	55.00	5325.06	5327.78	2.72	21.36	18.64	5306.42	21.57	18.85	5306.21
55	45.00	5329.00	5331.41	2.41	34.77	32.36	5296.64	34.83	32.42	5296.58
56D	70.00	5305.45	5307.26	1.81	32.85	31.04	5274.41	32.37	30.56	5274.89
56S	30.00	5305.45	5306.90	1.45	26.96	25.51	5279.94	26.60	25.15	5280.30
57	46.50	5315.72	5318.29	2.57	34.85	32.28	5283.44	34.45	31.88	5283.84
58	25.00	5321.99	5324.74	2.75	15.47	12.72	5309.27	15.38	12.63	5309.36
59D	50.00	5318.81	5321.35	2.54	20.81	18.27	5300.54	24.23	21.69	5297.12
59S	15.00	5318.81	5321.64	2.83	11.59	8.76	5310.05	14.70	11.87	5306.94
60S	43.00	5304.62	5307.14	2.52	dry	—	—	dry	—	—
60D	74.50	5304.19	5307.49	3.3	68.71	65.41	5238.78	68.30	65.00	5239.19
61	43.00	5312.13	5315.94	3.81	33.64	29.83	5282.30	33.40	29.59	5282.54
62D	68.00	5307.35	5308.44	1.09	60.39	59.30	5248.05	60.15	59.06	5248.29
62S	27.00	5307.35	5309.37	2.02	dry	—	—	dry	—	—
63D	73.00	5303.20	5305.85	2.65	67.53	64.88	5238.32	—	—	—
63S	35.50	5303.20	5306.09	2.89	dry	—	—	—	—	—
64D	58.00	5299.70	5301.43	1.73	34.24	32.51	5267.19	34.02	32.29	5267.41
64S	29.00	5299.70	5302.31	2.61	dry	—	—	dry	—	—
65	63.00	5303.91	5306.65	2.74	33.18	30.44	5273.47	32.77	30.03	5273.88
66	54.00	5288.34	5291.28	2.94	52.01	49.07	5239.27	51.95	49.01	5239.33
67	70.00	5300.33	5303.68	3.35	63.29	59.94	5240.39	63.10	59.75	5240.58
68	49.00	5285.08	5288.12	3.04	41.82	38.78	5246.30	45.54	42.50	5242.58
69	65.50	5294.92	5298.46	3.54	64.55	61.01	5233.91	64.45	60.91	5234.01
70D	70.00	5300.06	5303.26	3.20	63.77	60.57	5239.49	63.31	60.11	5239.95
70S	25.00	5301.01	5303.81	3.80	27.39	23.59	5276.42	27.52	23.72	5276.29
71	70.00	5299.90	5303.05	3.15	66.64	63.49	5236.41	69.58	66.43	5233.47
72	65.00	5293.81	5297.01	3.20	60.03	56.83	5236.98	59.63	56.43	5237.38
73	68.50	5318.67	5322.57	3.90	dry	—	—	dry	—	—
74	58.50	5305.11	5308.81	3.70	43.02	39.32	5265.79	42.80	39.10	5266.01

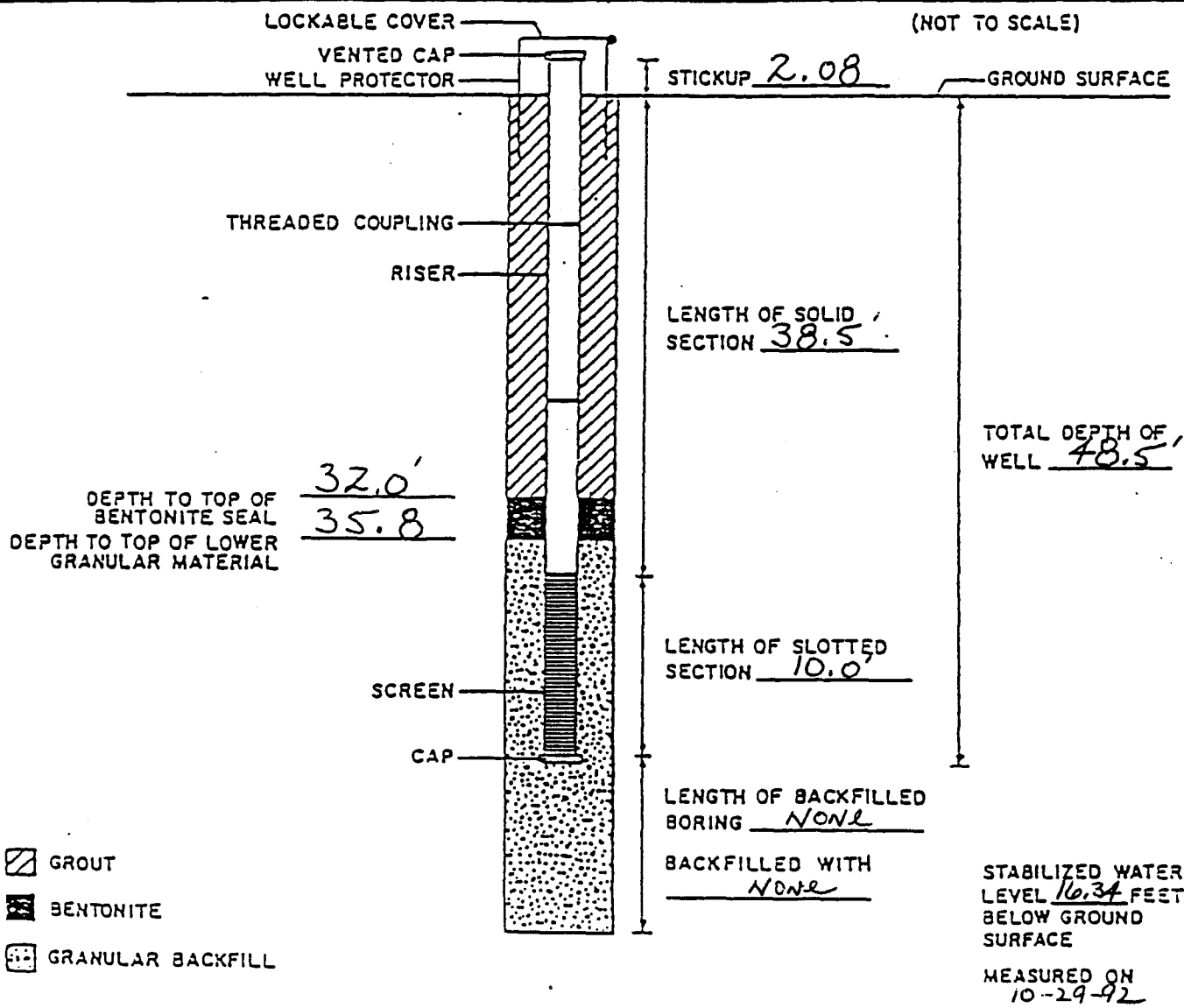
PROPOSED WSI - MONITORING WELL WATER LEVEL DATA

MW-#	1/18/93		2/16/93		3/26/93		W.L. Elevation	W.L. Elevation
	Elevation surface	Elevation (toc)	W.L. (toc)	W.L. Elevation	W.L. (toc)	W.L. Elevation	W.L. (toc)	W.L. Elevation
MW-109	5318.91	5320.99	49.00	5271.99	18.84	5302.15	22.60	5298.39
MW-111	5303.55	5305.78	73.00	5232.78	73.00	5232.78	66.61	5239.17
MW-112	5287.58	5289.78	58.00	5231.78	58.00	5231.78	52.12	5237.66
MW-114	5323.76	5324.00	59.00	5265.00	25.68	5298.32	26.57	5297.43
MW-204	5321.14	5323.69			14.59	5309.10	14.55	5309.14

APPENDIX H
MONITORING WELL COMPLETION FORMS

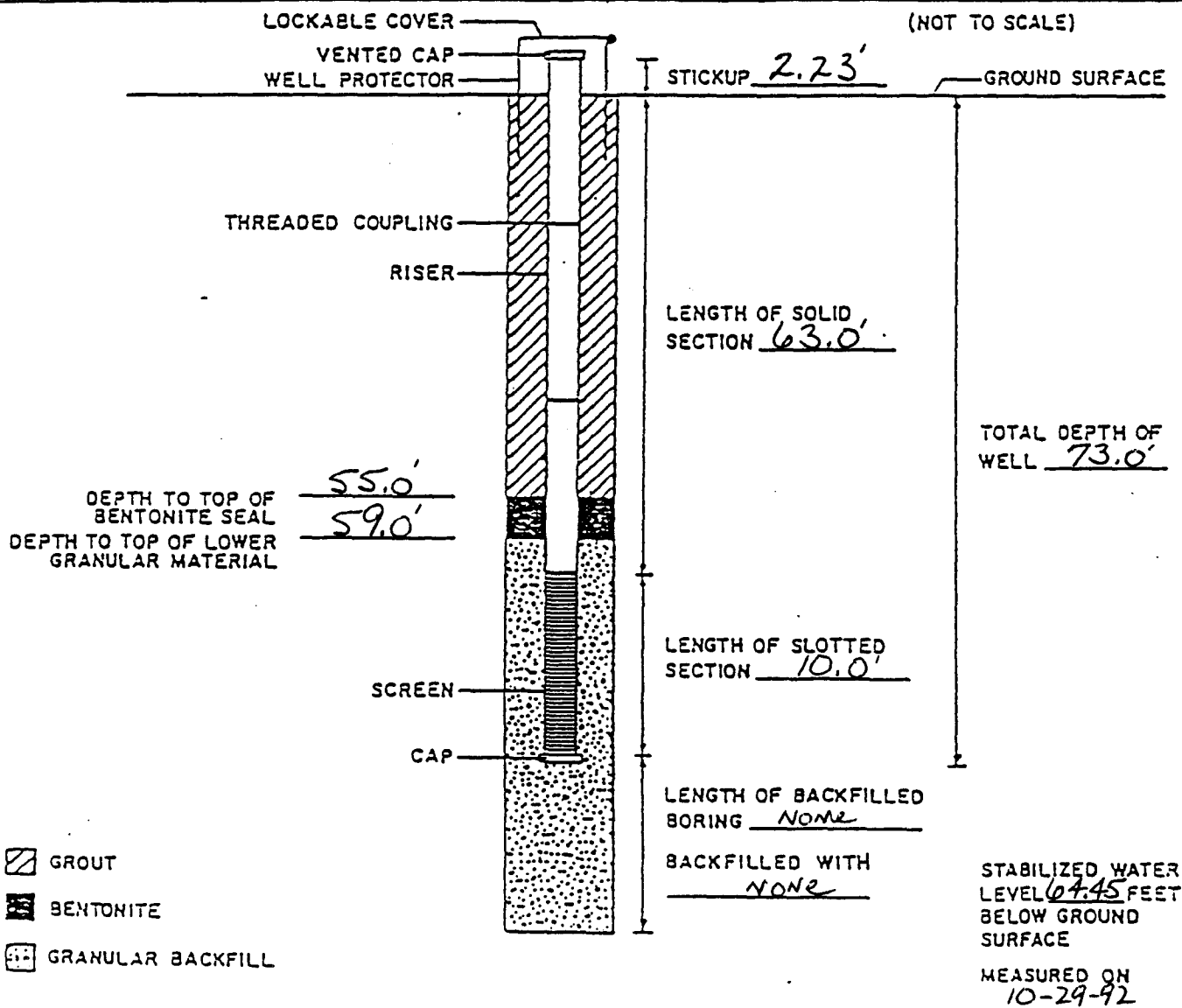


JOB NAME CSI Bennett WELL NUMBER MW-109
 JOB NUMBER 2-4079 INSTALLATION DATE 10/5/92 LOCATION _____
 DATUM FOR WATER LEVEL MEASUREMENT Top of PVC 2.08' stickup U.S.G.S.
 DATUM ELEVATION 5320.99 GROUND SURFACE ELEVATION 5318.91
 SCREEN DIAMETER AND MATERIAL 2" PVC SLOT SIZE 0.010
 RISER DIAMETER AND MATERIAL 2" PVC BOREHOLE DIAMETER 8 inches
 GRANULAR BACKFILL MATERIAL 10-20 size silica sand REPRESENTATIVE Unger
 DRILLING TECHNIQUE 8" Hollow Stem Augers DRILLING CONTRACTOR Site Services

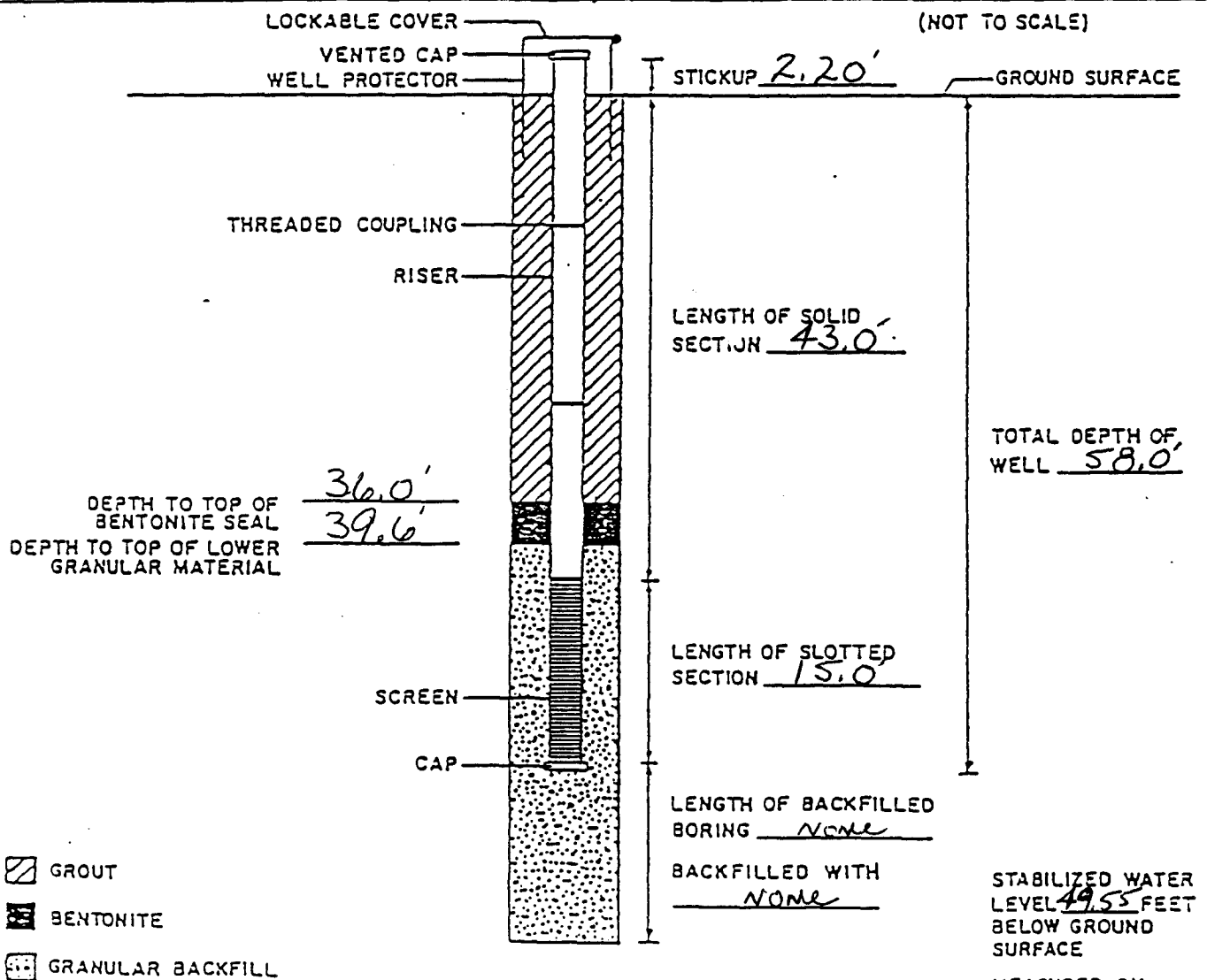




JOB NAME CSI Bennett WELL NUMBER MW-111
JOB NUMBER 2-4079 INSTALLATION DATE 10/7/92 LOCATION _____
DATUM FOR WATER LEVEL MEASUREMENT Top of PVC U.S.G.S. elevations
DATUM ELEVATION 5305.78 GROUND SURFACE ELEVATION 5303.55
SCREEN DIAMETER AND MATERIAL 2" PVC SLOT SIZE 0.010
RISER DIAMETER AND MATERIAL 2" PVC BOREHOLE DIAMETER 8 inch
GRANULAR BACKFILL MATERIAL 10-20 size silica sand REPRESENTATIVE Ungr
DRILLING TECHNIQUE 8" Hollow Stem Augers DRILLING CONTRACTOR Site Services

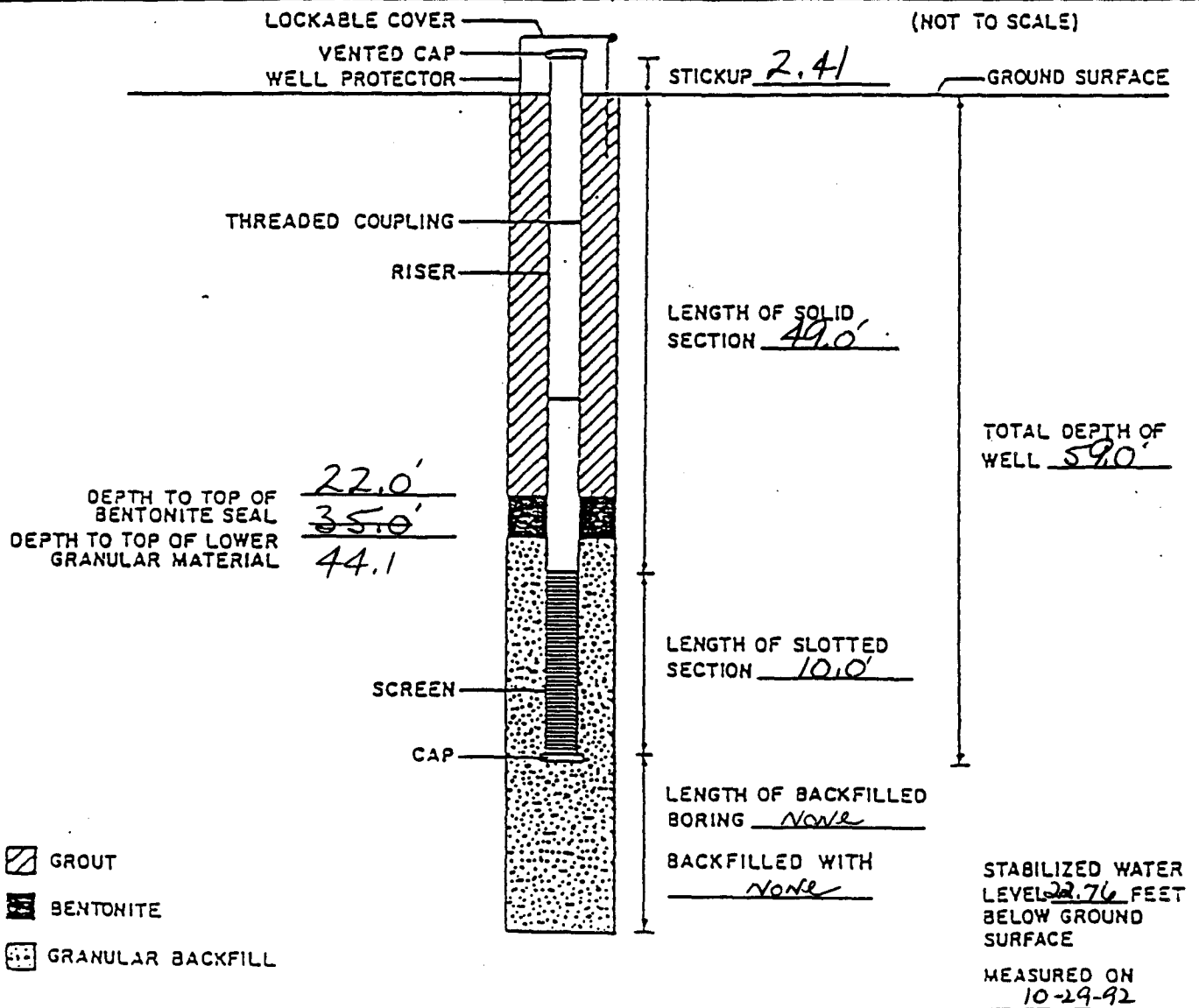


JOB NAME CSI Bennett WELL NUMBER MW-112
JOB NUMBER 2-4079 INSTALLATION DATE 10/8/92 LOCATION _____
DATUM FOR WATER LEVEL MEASUREMENT U.S.G.S.
DATUM ELEVATION 5289.78 GROUND SURFACE ELEVATION 5287.58
SCREEN DIAMETER AND MATERIAL 2" PVC SLOT SIZE 0.010
RISER DIAMETER AND MATERIAL 2" PVC BOREHOLE DIAMETER 8-inch
GRANULAR BACKFILL MATERIAL 10-20 size silica sand REPRESENTATIVE Unger
DRILLING TECHNIQUE 8" Hollow Stem Auger DRILLING CONTRACTOR Site Services





JOB NAME CSI Bennett WELL NUMBER MW-114
 JOB NUMBER 2-4079 INSTALLATION DATE 9/25/92 LOCATION _____
 DATUM FOR WATER LEVEL MEASUREMENT U.S.G.S.
 DATUM ELEVATION 5330.98 GROUND SURFACE ELEVATION 5328.57
 SCREEN DIAMETER AND MATERIAL 2" PVC SLOT SIZE 0.010
 RISER DIAMETER AND MATERIAL 2" PVC BOREHOLE DIAMETER 8-inch
 GRANULAR BACKFILL MATERIAL 10-20 size silica sand REPRESENTATIVE Unger
 DRILLING TECHNIQUE 8" Hollow Stem Auger DRILLING CONTRACTOR Layne





JOB NAME CSI Bennett WELL NUMBER MW-204
JOB NUMBER 2-4079 INSTALLATION DATE 9/24/92 LOCATION _____
DATUM FOR WATER LEVEL MEASUREMENT U.S.G.S.
DATUM ELEVATION 5323.69 GROUND SURFACE ELEVATION 5321.14
SCREEN DIAMETER AND MATERIAL 5323.69 2" PVC SLOT SIZE 0.010
RISER DIAMETER AND MATERIAL 2" PVC BOREHOLE DIAMETER 8-inch
GRANULAR BACKFILL MATERIAL 10-20 size silica sand REPRESENTATIVE Ungr
DRILLING TECHNIQUE Hollow Stem Augers DRILLING CONTRACTOR Layne

