REPUBLIC SERVICES

8201 Schumaker Road, Bennett, CO 80102
O 303-685-2700 republicservices.com

May 28, 2026

Mr. Greg Barnes
Adams County Planning and Development Division
Adams County Community and Economic Development Department
4430 S. Adams County Parkway
1st Floor, Suite W2000A
Brighton, Colorado 80601

RE: Five Part Development, LLC
East Regional Landfill Major CD Amendment for Vertical Expansion Re-submittal
Case Name/Number: EXG2026-00002

Dear Mr. Barnes:

Five Part Development, LLC (FPD) submits this response to review comments received from the Adams County Development Team for the Major Amendment to the East Regional Landfill Certificate of Designation (CD). The comments were provided to FPD on May 1, 2026.

Enclosed with this re-submittal are the following documents:

- **Attachment A:** Completed resubmittal form
- **Attachment B:** Responses to Development Team Review Comments
- **Attachment C:** Proposed Engineering Design and Operations Plan
- **Attachment D:** Site Development Plan/Site Plan
- **Attachment E:** Updated Tables – Landfill Capacities
- **Attachment F:** Compost Operations Plan
- **Attachment G:** 3D Renderings
- **Attachment H:** Title Commitment

Documents submitted with the initial application that have not changed do not accompany this submittal.

If you have questions pertaining to this resubmittal, please contact the undersigned at 303-802-0924 or Mmontgomery5@republicservices.com.

Sincerely,

Melissa Montgomery

Melissa Montgomery, PE
Environmental Manager

Cc: Katie Keefe, Adams County
Rachel DeRosa, CDPHE
Jill Parisi, CDPHE
Justin Keever, Five Part Development, LLC
Mazen Haydar, Five Part Development, LLC
Steve Derus, Five Part Development, LLC
Curtis Ahrensdsen, American Environmental Consulting

ATTACHMENT A

Completed Resubmittal Form

Community & Economic
Development Department
www.adcogov.org

ADAMS COUNTY
COLORADO

4430 South Adams County Parkway
1st Floor, Suite W2000
Brighton, CO 80601-8204
PHONE 720.523.6800
FAX 720.523.6998

Re-submittal Form

Case Name/ Number: EXG2026-00002

Case Manager: Greg Barnes

Re-submitted Items:

- [X] Development Plan/ Site Plan
- [ ] Plat
- [ ] Parking/ Landscape Plan
- [ ] Engineering Documents
- [ ] Subdivision Improvements Agreement (Microsoft Word version)
- [X] Other: Response to Comments

*** All re-submittals must have this cover sheet and a cover letter addressing review comments.**

Please note the re-submittal review period is 21 days.

The cover letter must include the following information:

- Restate each comment that requires a response
- Provide a response below the comment with a description of the revisions
- Identify any additional changes made to the original document

For County Use Only:

Date Accepted:

Staff (accepting intake):

Resubmittal Active: Engineering; Planner; Right-of-Way; Addressing; Building Safety;

Neighborhood Services; Environmental; Parks; Attorney; Finance; Plan Coordination

ATTACHMENT B

Responses to Development Team Review Comments

8201 Schumaker Road, Bennett, CO 80102
O 303-685-2700 republicservices.com

Response to Comments Received from the East Regional Landfill Major CD Amendment for Vertical Expansion

Each comment provided by the Development Team is listed in italics below, followed by a response.

Commenting Division: Environmental Analyst Review
Name of Reviewer: Megan Grant
Date: 05/01/2026
Email: MGrant@adamscountyco.gov
Resubmittal Required

The following comments apply to regulation and documentation:

ENV1. All original and amendment conditions and requirements of the Certificate of Disposal (CD) must be met/maintained.

Response: Acknowledged

ENV2. All Adams County, ACHD (and former TCHD), CDPHE, state, and federal requirements and permits must be met/maintained. The applicant shall follow all applicable hazardous materials and waste management regulations to ensure proper management of hazardous materials and waste such that they do not present a significant actual or potential hazard to public health, safety, or environment. Refer to Adams County Development Standards and Regulations (ACDSR) Section 2-02-04.

Response: Acknowledged

ENV3. All applicable operational standards found within the Solid and Hazardous Waste Disposal section of the Adams County Development Standards shall be followed.

Response: Acknowledged

ENV4. Adams County will require submittal of the current, approved Engineering Design and Operations Plan (EDOP), a description of all proposed changes to the approved EDOP with this major modification, and a redlined version of EDOP indicating all proposed changes/modifications for review as part of the major amendment application process. The provided EDOP apparently highlights all changes since 2009, not when or what was changed in the text.

Response: The proposed EDOP and highlighted version showing revisions to the 2006 EDOP were provided in the East Regional Landfill Major Amendment to Certificate of Designation Application submitted to Adams County on March 30, 2026.

The original, approved EDOP was developed by Doty and Associates in 2006 and is included in the proposed EDOP as Appendix A. The EDOP was amended through the years and the changes with dates were noted in the summary memo provided in the March 30, 2026 submittal as Attachment 2-4. The documents have changed sufficiently in content and layout so any redline/strikeout version would be nearly unreadable. Therefore, this item was originally discussed with Adams County and agreed that the submittal of the highlighted changed areas of the EDOP was more useful if accompanied by the summary memo. The highlighted changes are noted both in the table of contents (including highlighting changes to the drawings, appendices, and other parts of the EDOP) as well as in the text, in Attachment 2-4. A clean copy of the proposed EDOP is included in Attachment C.

ENV5. Adams County will require submittal of the original as-built site plan, current site plan, and a site plan that clearly shows all proposed changes in elevations, slopes, waste amounts, and disposal cell operations. Please provide an updated drawing that demonstrates distance and elevation changes for sightlines of adjacent residential properties.

Response: The revised site development plan, which reflects the proposed changes to site elevations and slopes, is provided as Sheet 1 in Attachment D. An additional drawing showing the existing permitted cover site plan is included in Attachment D as Sheet 2. The revised Plate 4 in Attachment D is the proposed final cover site plan.

ENV6. Please clarify the justification for the proposed vertical expansion. If the need was to address the overfill, the height increase would be 14 feet, not 107 feet. How and why was 107 feet the selected increase for expansion? The overfill remediation and the proposed vertical expansion are separate issues.

From the application:
"Justify change for overfill remediation:
The landfill was overfilled over an area of approximately 7.3 acres and up to 14 feet over the permitted top of waste. The vertical expansion of the landfill will remedy the overfill and add much needed capacity to this landfill. The additional capacity is a benefit to the community helping to keep disposal costs reasonable, offering capacity in the event other landfills close temporarily or permanently, and minimizing the need to permit new landfills that likely will be farther away and more expensive for disposal."

Response: The proposed vertical expansion serves meeting ongoing disposal demands while minimizing environmental impacts. Expanding vertically within the existing permitted footprint avoids the need for additional land disturbance, preserving surrounding areas and reducing impacts to adjacent resources and land uses.

From an operational standpoint, the expansion optimizes the use of existing infrastructure, including liner systems, stormwater controls, landfill gas collection systems, and groundwater monitoring network. This approach reduces the need for new construction, while maintaining consistency with current design and monitoring programs.

The design of the vertical expansion meets or exceeds all applicable regulatory requirements, including stability, slope design, stormwater management, and landfill gas

control. Updated engineering analyses as presented in the proposed EDOP have been completed to confirm that the facility will continue to operate safely and in compliance under the proposed final grades.

Additionally, the proposed vertical expansion will provide a direct benefit to Adams County by supporting long-term capacity needs for the service area, ensuring continuity of essential waste management services without interruption, and by generating Solid Waste Management Service Fee through waste disposal fees. Without this expansion, alternative disposal facilities would need to be developed which would likely result in increased future disposal costs and associated environmental impacts.

The proposed expansion will provide a total life expectancy with estimated volumes of 26.6 years. The current permitted site capacity of Waste Management Conservation Service Inc (CSI) landfill is 70-100 years. The CSI landfill is one mile to the north of the East Regional landfill.

ENV7. Please provide an updated table that summarizes current and remaining fill and airspace volumes for the existing approved landfill configuration. Please also provide a table demonstrating the current values with the proposed vertical expansion values. The current Table 1 (Attachment 2-2) provides only values for the proposed vertical expansion.

Response: The landfill permitted versus proposed capacity and remaining soil requirements as well as anticipated site life are included in Attachment E as Table 1-A and Table 1-B, respectively.

ENV8. Please provide the revised waste acceptance plan that reflects updated standards for TENORM levels as specified in Regulation 20 or indicate where this information can be found.

Response: The Waste Acceptance Plan was revised on February 26, 2026 and was submitted with the proposed EDOP submitted to Adams County on March 30, 2026. The Waste Acceptance Plan reflects the TENORM levels as outlined in Regulation 20 as noted in Section 4.5 of the plan. East Regional Landfill will only accept waste streams that are exempt as per Section 20.4 of 6 CCR 1007-1 Part 20.

ENV9. Please provide the revised Compost Operations Plan as conditioned in the minor amendment (2025). This is not included in Attachment 2-4.

Response: The Compost EDOP was revised to include CDPHE comments and Adams County comments and resubmitted to the departments for approval on May 5, 2026. The revised Compost EDOP with responses to comments is included as Attachment G.

The following comments apply to operations:

ENV10. All complaints received by the applicant concerning impacts to offsite properties, and the resolution of those complaints shall be conveyed to the Director of Community and Economic Development. Impacts to offsite properties shall be responded to and resolved immediately by the applicant. If the impact cannot be immediately resolved, within five (5) days of complaint receipt

the applicant shall notify the Director of the offsite impact, proposed resolution, and expected completion date.

Response: Acknowledged

ENV11. The applicant/operator shall provide details of complaints received, offsite impact resolution, and high-wind shutdown periods, as applicable, within the required quarterly report submissions to Adams County.

Response: Acknowledged

ENV12. Control of the fill material and record keeping of the sources of the materials used at this site shall be the responsibility of the applicant/operator. Records concerning sources of fill materials and certifications shall be made available to Adams County inspectors upon request. This site is subject to inspection from Adams County inspectors, during reasonable working hours. Advance notice of inspection is at the discretion of Adams County.

Response: Acknowledged

The following comments apply to nuisance controls:

ENV13. Please address how nuisance hazard controls will require modification due to proposed vertical expansion, including visual impacts, offsite vehicle tracking, fugitive dust, odor, lighting, noise, and offsite solid waste (i.e., windblown debris from facility and trucks). The assessment of visual impacts and nuisance controls provided in the application information summary is not sufficient. The substantial height increase will have an impact to sightlines and adjacent residential properties.
From the application:

"The landfill final elevation will be approximately 107 feet higher than the permitted height. The landfill is located on a property surrounded by agricultural property and an industrial landfill. Therefore, even with higher final profile, the visual impacts are not significantly different from the current landfill. Additionally, during the neighborhood meeting, the local residents did not discuss the height of the landfill as being an issue."

"The nuisance impacts are the same as the current landfill (traffic, odors, blowing litter, dust, birds and pests). The EDOP outlines operational controls for each of these conditions and these are the same as used at the landfill now. It is not anticipated that significantly more waste and traffic will come to the landfill so the nuisance conditions will be similar to those managed at the landfill now. The landfill also has a bird mitigation plan it follows and will continue to follow."

Response: The proposed vertical expansion is not expected to result in increased nuisance controls. The expansion will occur within the existing landfill footprint and will continue to operate under established waste placement practices, daily cover procedures, and landfill gas management systems that are designed to control odors.

Impact to sightlines are shown on the Site Development Plan included as Attachment D and 3D renderings included as Attachment G.

ENV14. In response to application information summary, item 4: While technically correct as far as zoning (agricultural), the surrounding properties do include residential uses and visual impacts need to be assessed within this context. The statement that local residents did not mention height of the landfill during the neighborhood meeting does not preclude the requirement for an actual assessment and representation of visual impacts with the proposed vertical expansion.

Response: 3D renderings showing the landfill at the current approved final contours and the landfill at the proposed vertical expansion final contours are included as Attachment G.

ENV15. The applicant/operator shall implement sediment control measures that effectively prevent the tracking of mud, dirt, or debris from the site onto adjacent public rights-of-way.

Response: FPD agrees to implement sediment control measures designed to effectively prevent the tracking of mud, dirt, or debris from the facility onto adjacent public rights-of-way. These measures will be maintained and adjusted as necessary to support compliance during varying site and weather conditions.

It should be noted that Schumaker Road, south of the landfill entrance, is unpaved. During weather events, sediment may be tracked onto the paved roadway by vehicles traveling north that are not associated with landfill operations. As a result, observed sediment in this area may not be solely attributable to site traffic.

The Site will continue to monitor conditions at and near the facility access point and take appropriate actions within its control to minimize off-site tracking from landfill-related activities.

ENV16. The applicant/operator shall permanently install a wind gauge, such as an anemometer, with datalogging capabilities to continuously monitor wind speeds during material handling operations. The operator shall stop all material management activities when wind speeds exceed a sustained 25 mph and when gusts exceeding 35 mph occur.

Response: FPD will replace its existing wind gauge with one that has datalogging capabilities to continuously monitor wind speeds during material handling operations that will support operational decision-making. This will allow the landfill to better document conditions and ensure consistent implementation of wind-related controls.

At this time, FPD respectfully requests that the high wind threshold for suspension of landfill operations remain at 40 mph as required in the current Certificate of Designation. This threshold has been effective in managing wind-related impacts at the facility and aligns with the current operating procedures and site conditions. FPD will continue to implement best management practices, including the use of cover materials and operational controls, to minimize litter and other wind-related impacts below this threshold.

FPD believes that maintaining the 40 mph criterion, combined with the addition of on-site wind monitoring and litter controls provides a practical and proactive approach to managing litter control at the landfill.

ENV17. Applicant/operator should limit engine idling to the maximum extent feasible to mitigate off-site noise and air quality impacts to surrounding properties and shall not exceed five minutes within any sixty-minute period, except as authorized. Refer to CRS Title 42 – Vehicles and Traffic Idling Standard, Article 14 – State Idling Standard, Section 42-14-105. Idling for Colorado law.

Response: Acknowledged

ENV18. Regular exposure to elevated sound levels can have a negative impact on both physical and mental health by increasing the risk of stress, hearing impairment, hypertension, ischemic heart disease, and sleep disturbance. Noise attenuation shall comply with the Colorado Noise Statute (CRS 25-12-103) and applicable, local noise regulations. All necessary steps should be taken to mitigate off-site noise.

Response: Acknowledged

ENV19. The applicant shall install radar activated or white noise backup alarms for their equipment to minimize noise impacts to the area unless specifically prohibited in writing by a regulatory authority.

Response: Acknowledged

ENV20. Lighting facilities shall be arranged and positioned so no direct light or reflection creates a nuisance or hazard on any adjacent property or right-of-way.

Response: Acknowledged

ENV21. The operators shall remove trash, or other waste material, of the type which is brought to the facility, along public rights-of-way within one-half (1/2) mile of the facility which is attributable to the facility operations.

Response: Acknowledged

The following comments apply to fuel storage, if applicable:

ENV22. If fuel will be stored on this site:
a) All fuel storage at this site shall be provided with secondary containment, which complies with State of Colorado Oil Inspection Section Regulations; and
b) Fueling areas shall be separated from the rest of the site's surface area, and protected from storm water; and
c) Applicant shall provide a spill prevention plan and release prevention plan for fuel storage and fueling operations. Good housekeeping shall be practiced at this site. Spill and drip containment pans shall be emptied frequently, and all spills shall be cleaned up and disposed of immediately at a facility permitted for such disposal. The applicant/operator shall implement sediment control

measures that effectively prevent the tracking of mud, dirt, or debris from the site onto adjacent public rights-of-way.

Response: Acknowledged

Commenting Division: Planner Review
Name of Reviewer: Jen Rutter
Date: 05/01/2026
Email: jrutter@adamscountyco.gov
Resubmittal Required

PLN01: The applicant is requesting a major amendment to the Certificate of Designation (CD) for a solid waste disposal facility issued under Case EXG2009-00001 to allow for the vertical expansion of the existing landfill to increase the capacity from 11,916,558 cy to 22,022,035 cy by raising the height by approximately 107 feet.

Response: None required

PLN02: Please provide an updated site plan to show which cells are being impacted by the vertical expansion. Clearly label each.

Response: The revised site plan is included as Attachment D.

PLN03: Provide an updated, redlined EDOP as part of the amendment. This is required in order to refer this to CDPHE.

Response: Please refer to the response for comment ENV4 above.

PLN04: Provide rendering depicting existing pile heights vs proposed pile heights and how the expansion will be seen from the surrounding area.

Response: 3D renderings showing the landfill at the current approved final contours and the landfill at the proposed vertical expansion final contours are included as Attachment G.

PLN05: Provide justification as to why increasing the final grade elevation by 107 feet is necessary.

Response: Please refer to the response for comment ENV6 above.

PLN06: Four public comments were received and three were in opposition. One of the reasons cited for opposition was the odors coming from the site. Describe the steps you are taking to mitigate the current odors. What will be done to mitigate odors coming from the increase in landfill height?

Response: The proposed vertical expansion is not expected to result in increased odor generation.

The expansion will occur within the existing landfill footprint and the site will continue to operate under the permitted conditions of waste placement practices, daily cover

procedures, and landfill gas management systems that are designed to control odors and meet applicable regulatory requirements.

The Landfill has an existing site-specific odor management plan (OMP) that site personnel will continue to follow. The primary objective of the OMP is to identify and mitigate odors from the facility before they can impact the local community. The OMP provides guidance on the identification, documentation, and mitigation of odors. All employees are trained on the OMP on an annual basis and the site team reviews the OMP annually or as major site changes occur.

Site personnel will continue to conduct daily odor patrols by monitoring a consistent route through and around the facility. Any odor complaints are investigated by the site team immediately, documented and addressed.

FPD is committed to being an environmentally responsible neighbor and contributor to the local community. Controlling odors at our facilities and minimizing their potential to move off site are important parts of our commitment.

Commenting Division: ROW Review
Name of Reviewer: Thayeng Chang
Date: 04/30/2026
Email: TChang@adamscountyco.gov
Resubmittal Required

ROW1: Please submit the title commitment from Fidelity, dated February 17, 2026, commitment number 17-F00202-26.

Response: Title Commitment included as Attachment I.

ADVISORY:
ROWx: Pending engineering review, any future storm water quality facilities will require a permanent drainage easement conveyed to the county by separate instrument. The easement agreement shall include a legal description and illustration depicting the legal description prepared by a licensed professional land surveyor.

Response: Acknowledged

Commenting Division: Development Engineering Review
Name of Reviewer: Laurie Clark
Date: 04/30/2026
Email: LClark@adamscountyco.gov
Complete

ENG1: There are no engineering concerns with the request to increase height.

Response: None required

ENG2: Access to the site must remain in the existing, approved location(s). No site access amendments are approved at this time.

Response: Acknowledged

ENG3: Existing, approved drainage patterns must remain. No drainage amendments are approved at this time.

Response: Acknowledged

Commenting Division: Neighborhood Services Review
Name of Reviewer: Laurie Clark
Date: 04/29/2026
Email: LClark@adamscountyco.gov
Complete

There are no open violations at this location at this time. No comments.

Commenting Division: Addressing Review
Name of Reviewer: Ian Cortez
Date: 04/24/2026
Email: ICortez@adamscountyco.gov
Complete

No change in address needed.

Commenting Division: Adams County Health Department
Name of Reviewer: Joey Caruso

1: Appendix reference throughout need to be corrected/updated
- *a. Multiple appendix references in EDOP revision are incorrect due to addition of new appendices, please correct for clarity and ease of document navigation.*

Response: Appendix references have been revised, a clean copy of the proposed EDOP is included in Attachment C.

2: 1.2 History, pg 8 and 3.1.1 Design Concept Summary pg 14
- *a. The East Regional Landfill Gas Collection & Control System Plan that describes GCCS operation, maintenance and compliance details should also be included in the EDOP revision document as an appendix.*

Response: The GCCS plan is included as Appendix T to the proposed EDOP included as Attachment C.

3: 2.1.2 Bird Mitigation Plan and Proximity to the Denver International Airport Pg. 11
- *a. Given significant change in final height, is FAA approval/input necessary again?*

Response: FPD completed the prescreening to determine if FAA notice was required. Results of the prescreen indicated no notice was necessary. Notwithstanding that, FPD did prepare a form 7460-1 (Notice of Construction or Alteration) and included all the pertinent information. This was submitted to the FAA. See attachment 2-3 in the Certificate of Design Application submitted on March 30, 2026.

4: 6.2 Groundwater Monitoring, pg. 27

a. Please remove Tri-County/TCHD references that are in current documents that are being submitted for review/updates (i.e. historical references or historical documents are expected and fine, but TCHD/Tri-County references in new or revised documents should be changed to ACHD or Adams County).

Response: References to Tri-County/TCHD have been removed, a clean copy of the proposed EDOP is included in Attachment C.

5: 7.6 Leachate Management pg. 36

a. Has ERL received CDPHE approval for a variance to use leachate as dust control? Provide documentation if so.

Response: Leachate is only intended to be used as a dust control measure in the working face within lined areas of the landfill. The EDOP which includes this variance is approved by CDPHE as documented in the approval letter. See Attachment 2-6 in the Certificate of Design Application submitted on March 30, 2026.

6: Plate 6, page 57

a. Add typical sump dimensions to drawing or notes section of drawings/plates (this information is included in sump text description section 4.2.2, but not on drawing), this is an important design feature to call out and ensure adequate interim storage of leachate.

Response: Plate 6 is not updated since the three sumps vary significantly in how they are dimensioned. Plate 3A/3B have been updated to add notes on the sizing of the sumps. A clean copy of the proposed EDOP is included in Attachment C.

7: Appendix L Updated HELP Modeling, pg 606

a. Precipitation data table references Leadville, CO in table, but lat./long. In text is for near DIA, correct for clarity.

Response: The precipitation data table utilized in the HELP modeling was derived from Bennett, but was previously mislabeled as Leadville. This has been corrected, and the updated HELP modeling table is provided as Appendix L in the proposed EDOP included as Attachment C.

8: Appendix O Slope Stability Analysis, 2.2 Material Data, pg 796

a. Is it appropriate to use TLF material data rather than ERL site specific data for slope stability given it is a safety, integrity analysis of cover system?

Response: The material data is appropriate to use from the Tower Road Landfill (TLF) to complete

the slope stability analysis for the East Regional Landfill (ERL) for the following reasons:

1. Both facilities are municipal solid waste landfills and accept and fill the same general types of solid waste materials. Therefore, the material characteristics are the same.
2. The filling and compaction processes are similar at both facilities.
3. TLF had more material data available, so the slope stability analysis results are more accurate.

ATTACHMENT C

Proposed Engineering Design and Operations Plan

Sustainability in Action

EAST REGIONAL LANDFILL
ENGINEERING\ DESIGN AND OPERATIONS PLAN

Prepared for:

Five Part Development, LLC
East Regional Landfill
8201 Schumaker Road
Bennett, Colorado 80102
Adams County, Colorado

Prepared by:

American Environmental Consulting, LLC
8191 Southpark Lane, Suite 107
Littleton, Colorado 80120

February 2025 (Revised May 21, 2026)

Original Document prepared by:
Doty & Associates
June 2006

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 PURPOSE 1
1.2 HISTORY 1
1.3 SITE DESCRIPTION 3
1.4 ACCESS 4
1.5 ZONING 4
1.6 FEES 5
2.0 SITE DESCRIPTION 6
2.1 LOCATION RESTRICTIONS 6
2.1.1 Seismic Impact Zone 6
2.1.2 Bird Mitigation Plan and Proximity to the Denver International Airport 6
2.2 SURFACE WATER/GROUNDWATER 7
2.3 PERMITTED WELLS WITHIN TWO MILES OF SITE 7
2.4 ADJACENT LAND OWNERSHIP 7
2.5 SITE CHARACTERIZATION 7
2.6 CLIMATOLOGY 7
3.0 SITE GRADING & PHASED DEVELOPMENT 8
3.1 DESIGN CONCEPTS 8
3.1.1 Design Concept Summary 8
3.2 GRADING AND EXCAVATION PLAN 10
3.3 LINER DESIGN MODIFICATION 11
3.4 LEACHATE COLLECTION SYSTEM MODIFICATION 12
3.5 STORMWATER CONTROL SYSTEM REDESIGN 12
3.6 FINAL GRADES 13
3.7 FINAL COVER SYSTEM 13
3.8 SOIL/MATERIAL BALANCE 13
3.9 PHASING PLAN 13
4.0 FACILITY DESIGN DETAILS 15
4.1 LINER 15
4.2 LEACHATE COLLECTION SYSTEM 15
4.2.1 Geocomposite Drainage Layer 15

4.2.2 Sumps *15*
4.3 PROTECTIVE COVER 16
4.4 FINAL COVER 16
4.5 SLOPE STABILITY 17
5.0 SURFACE WATER CONTROL 18
6.0 ENVIRONMENTAL MONITORING 19
6.1 GAS MONITORING SYSTEM 19
6.1.1 Gas Monitoring Schedule *19*
6.1.2 New Source Performance Standards Applicability *20*
6.2 GROUNDWATER MONITORING 20
6.2.1 Groundwater Statistical Analysis and Reporting *22*
6.3 LEACHATE 23
6.4 STORMWATER 23
7.0 OPERATIONS PLAN 24
7.1 GENERAL 24
7.2 SITE ACCESS & CONTROLS 24
7.3 WASTE IDENTIFICATION AND SCREENING 25
7.3.1 Acceptable Waste Types *25*
7.3.2 Prohibited Waste Types *25*
7.3.3 Waste Screening *26*
7.4 WASTE PLACEMENT AND COVER 26
7.5 NUISANCE CONTROL 28
7.5.1 Litter *28*
7.5.2 Odor, Vectors & Noise *29*
7.5.3 Dust *29*
7.5.4 Fire *30*
7.6 LEACHATE MANAGEMENT 31
7.7 PERSONNEL TRAINING 31
7.8 RECORDKEEPING 31
8.0 CLOSURE/POST-CLOSURE PLANS 33
8.1 GENERAL CLOSURE 33
8.1.1 Closure Notification and Certification Requirements *33*
8.1.2 Routine Site Closure *33*

8.1.3 Closure Requirements *34*
8.1.4 Early Closure Scenario Provisions *34*
8.2 POST-CLOSURE 35
8.2.1 General *35*
8.2.2 Monitoring *36*
8.2.3 Explosive Gas Control *36*
8.2.4 Access Control *37*
8.2.5 Financial Assurance *37*
8.2.6 Completion *37*
9.0 REFERENCES 38

TABLES

Table 1 Volumes and Soil Balance

FIGURES

Figure 1 Site Location Map
Figure 2 Commercial Hauler Route

DRAWINGS

Plate 1 Cover Sheet and Vicinity Map
Plate 2 Existing Topography and Site Features
Plate 3A Clay Liner Option Excavation Plan with Site Operations Grid
Plate 3B GCL Liner Option Excavation Plan with Site Operations Grid
Plate 4 Final Cover Plan
Plate 5 Liner and Leachate Drainage Layer Details
Plate 6 Leachate Collection and Removal System Details
Plate 7 Final Cover Details
Plate 8A Stormwater Control System Plan
Plate 8B Stormwater Control Details

APPENDICES

Appendix A Original (1993) EDOP and Original Site Characterization
Appendix B Legal Description
Appendix C Location Restrictions
Appendix D Bird Mitigation Plan
Appendix E Surface Water Management Design
Appendix F Water Well Ownership
Appendix G Adjacent Land Ownership
Appendix H CIG Pipeline Right of Way and Easement Agreement
Appendix I Climate Information
Appendix J Excavation and Liner Plan Modification with HELP Modeling
Appendix K Leachate Drainage Material Modification Approval
Appendix L Updated HELP Modeling
Appendix M Construction Quality Assurance Plan
Appendix N Alternative Final Cover Demonstration
Appendix O Slope Stability Analysis
Appendix P Gas Probe Installation Logs
Appendix Q Waste Characterization Plan
Appendix R Alternative Daily Cover Request and Approval
Appendix S Post-Closure Inspection Form
Appendix T Gas Collection and Control System Plan

1.0 INTRODUCTION

1.1 Purpose

This Engineering Design and Operations Plan (EDOP) and supporting appendices presents the design, monitoring, operating, closure, and post-closure plans for the East Regional Landfill (ERL) facility, located in Adams County near Bennett, Colorado for a vertical expansion of the facility. The ERL, originally called the Five Part Development Landfill and referred to as such in earlier documents, is owned and operated by Five Part Development, LLC (Five Part). This expansion does not include an increase in the filling footprint or landfill property size and only includes the vertical expansion. As such, many originally permitted portions of the landfill remain unchanged. The intention of this expansion EDOP is to update the entire EDOP and include both the unchanged portions of the current permit and the modifications as a result of this vertical expansion.

This EDOP provides a written overview of the landfill design and the operational methods used by ERL in meeting applicable County and State requirements including the Colorado Regulation Pertaining to Solid Waste Disposal Sites and Facilities 6 CCR 1007-2, hereinafter referred to as the "Regulations" or "State Regulations". The EDOP is a compilation of information and plans including the original permit work for the site proposed as an ash fill, the revisions to the permit to modify it to a Municipal Solid Waste (MSW) disposal facility, and the modifications made since the MSW permit approval.

Pertinent portions of the original EDOP are attached to this document as appendices. This EDOP and other referenced documents supersede all previous plans.

1.2 History

This document makes extensive reference to an EDOP (Industrial Compliance (IC), 1993) completed for a large parcel of property for which a Certificate of Designation (CD) for the disposal of coal combustion ash was originally granted on March 5, 1994 by Adams County Case Number 52-93-CD. This facility was called the Metropolitan Denver Coal Ash Disposal Facility (MDCADF) and was never developed. Conditions at the site were investigated in detail prior to the initial approval of the facility. This work is described in Section 3.0 of the 1993 EDOP, which is attached to this document as Appendix A. Relevant topics covered and approved in that EDOP include location restrictions, climatology, and characterization of the site. Location restrictions are excerpted from the 1993 EDOP and are included as Appendix C. In 2005, Alpine Disposal Services (Alpine) purchased Five Part Development and a portion of the MDCADF property and submitted an application for a new CD from Adams County as a Municipal Solid Waste (MSW) disposal facility, taking the form of a new EDOP called the *Engineering Design and Operations Plan, Five Part Disposal Facility* (Doty & Associates, November 4, 2005, Volume 1 and June 1, 2006, Volume 2), hereinafter referred to as the 2006 EDOP. Following an extensive public hearing process the Adams County Board of County Commissioners approved Alpine's application by Resolution, Case #EXG2009-00001, dated July 29, 2009. After fulfilling the necessary conditions precedent set forth in the Resolution, Adams County issued a conditional CD on September 1, 2010 to operate as an MSW disposal facility and the ERL began disposal operations on September 2, 2010.
In 2011, ERL applied for and was granted an amended CD to conduct composting operations at the facility, Case #EXG2011-00003. The design plan and requirements for the composting

operation are contained withing the document called *Engineering Design and Operations Plan Compost Operations, East Regional Landfill* (American Environmental Consulting, LLC March 10, 2011). Referred to as the 2011 Compost EDOP, this EDOP is not included in this document since it is a standalone document and was permitted separately from the MSW landfill.

Since the 2006 EDOP a number of revisions to the facility design and operations have been approved as a result of conditions in the CD, changing regulations, and changes requested by ERL. This revised EDOP is a complete, stand-alone EDOP meeting the requirements in the regulations and incorporates changes from the 2006 EDOP to the disposal cell designs, liner systems, facility configuration, surface water control, waste types, financial assurance, inspections and maintenance, ground-water monitoring, explosive gas monitoring, facility operations, environmental monitoring and closure/post-closure care, as well as operations that have been updated to meet the current Colorado Department of Public Health and Environment (CDPHE) standards, regulations, and ERL operating practices.

This EDOP was developed to incorporate the following approved design and operational changes:

1) Improved construction methods and operations of the facility from a reconfigured landfill footprint and modified base grades that optimized the use of the existing permitted landfill area to:

   a) maintain a 10-foot separation to ground water,
   b) provided an additional 10 feet of right-of-way (ROW) along Schumaker Road and deeded the ROW to Adams County,
   c) prohibited landfilling or permanent structures within 40 feet of the southern property boundary along the south Section line of the facility, and provided at least 25 feet of landscaping depth along Schumaker Road and a landscaped buffer along the south side of the site.

2) The liner system was revised to substitute a Geosynthetic Clay Liner instead of using a 2-foot thickness of compacted clay and the leachate collection system was modified to substitute a geocomposite drainage layer in place of the one-foot layer of aggregate material and piping on the floor of the landfill.

3) Minor modifications to the facility final cover extent are incorporated to correspond to the re-configured landfill footprint in accordance with State Regulations.

4) A revised Waste Characterization Plan in compliance with the current standards and ERL practices.

5) Revisions to the facility operations, including but not limited to, the use of Alternative Daily Cover (ADC) materials and changes to the environmental monitoring network from that shown in the 2006 EDOP.

6) Updated site topography and coordinate system. The original site topography was developed in 1993 based on a local coordinate system. The site topography was updated by aerial

photography in January 2012 based on a modified state plane system to allow correlation with offsite features and control points. This change in coordinate system resulted in an elevation change of approximately +3.87 feet. This elevation change did not actually change any of the points in space, but only the elevation designation.

7) A Landfill Gas Collection and Control System (GCCS) was installed in Module 1 of the ERL in 2022. Details on maintenance, compliance requirements, and monitoring of the of the GCCS are included in the Title V Operating Permit for the facility, Permit No. 10OPAD353.

Additionally, this EDOP was developed to incorporate the following not yet approved design changes.

1) Vertical expansion design. The revised final cover design modifies the cover slopes from a compound slope consisting of a 4:1 side slope with a grade break at 5,350 feet amsl to a 20:1 top slope to an apex at 5,392.37 ft amsl to a compound slope consisting of 3.5:1 side slopes from the cover toe to a higher grade break at 5,484 feet amsl where the slope changes to a 20:1 top slope with two apex points at 5,495.66 and 5,499.25 feet amsl. This design change increases the cover height by approximately 107 feet.

2) Final cover system redesign. The revised final cover system changes the final cover design from an Alternative Cover with 4-8 feet of loosely compacted soil to two possible options, a 3.5 foot-thick Alternative Final Cover System designed in accordance with the March 2013 Final Guidance Document Water Balance Covers in Colorado or an LLDPE lined cover with drainage system and protective soil. Additionally, construction requirements for both of the final cover options are presented in a revised CQA Plan.

1.3 Site Description

The facility is located west of Schumaker Road approximately one-half mile south of 88th Avenue (Irondale Road) in south central Adams County, Colorado. The site is located in the South 1/2 of Section 25, Township 2 South, Range 64 West, 6th Principal Meridian, Adams County, Colorado, approximately 6.75 miles northwest of the town of Bennett (Figure 1) with the following physical address:

Physical and Mailing Address:

East Regional Landfill
8201 Schumaker Road
Bennett, CO 80102
(303) 685-2700 phone

The property consists of four parcels designated Parcel A through Parcel D originally totaling 164.17 acres, a slight reduction from that proposed in the 2006 EDOP. The eastern property boundary originally permitted and shown in the 2006 Plan extended to the 30-foot County Right-of-Way (ROW) along Schumaker Road. As a condition of the CD, Five Part Development granted Adams County an additional 10-feet of Right-of-Way (ROW), extending the County ROW to a total of 40-feet along Schumaker Road. The additional 10-foot ROW was deeded to Adams County, reducing the property by approximately 0.33 acres to 164.17 acres more or less. The

original legal description of the property prior to the elimination of the 10-foot ROW and the ROW deed to Adams County are included in Appendix B.

The northwest corner of the property is also bisected by four buried gas lines running in a northeast to southwest orientation. Five Part Development granted a 70-foot ROW and a 20-foot access easement to Colorado Interstate Gas (CIG) for these pipelines. The pipelines have been surveyed and are shown along with the ROW and easement on the drawings included with this EDOP. The gas pipeline easements are also included in Appendix H. All disposal operations (the landfill footprint) are designed outside of this ROW and easement. There is some ERL property located across the ROW and easement that the ERL may use to support the landfill operations, such as buildings or equipment/soil storage. If approved by the pipeline company, ERL reserves the right to also use the property for borrow soils or any other potential needs of the landfill.

Disposal will occur on approximately 132 acres within the 164-acre permit boundary, with the remainder of the property used for surface water control, setbacks, easements, access roads and facility structures. Municipal solid waste is delivered to the facility by commercial solid waste collection operators and the general public. The majority of the solid waste is from local collection operations and the general public in the area. More information on the composition of the solid waste is found in Section 7.3 of this document.

The ERL also operates a Class II (by Colorado designation) compost facility under a separate CD dated September 28, 2011 (Case #EXG2011-00003) based on a March 10, 2011 EDOP for the compost operations. The compost operations are not a part of this EDOP.

1.4 Access

Commercial haulers are allowed to use State Route 79 to reach 88th Avenue (Irondale Road) then west on 88th Avenue and south on Schumaker Road to the site entrance. They may also use County Road 25 (Imboden Road) from the north or south to 88th Avenue, then east to Schumaker Road to the site entrance. The approved routes are shown on Figure 2. The owner may be required to assist Adams County in construction of a deceleration/right turn lane on 88th Avenue for turning onto Schumaker if warranted based on a traffic study to be conducted by Adams County. In addition, the ERL has an agreement to assist Adams County with paving Schumaker Road from 88th Avenue to the facility entrance when Adams County determines it is feasible.

On average, approximately 70-85 vehicles arrive daily to deliver waste to the facility. This is slightly more than the 25-50 vehicles anticipated in the 2006 Plan prior to operations but is still well within the capacity of the roads, based on the traffic study performed by Leigh, Scott and Cleary for the permitting of the adjacent Conservation Services, Inc., (CSI) Facility. The traffic study demonstrated capacities of 1,000 vehicles per day for Imboden Road and 5,000 vehicles per day for Irondale Road.

1.5 Zoning

The ERL property is zoned A-3/Agricultural and has a Certificate of Designation for MSW disposal from Adams County as well as a Class II compost operation. Adams County has deemed these uses compatible with the zoning and surrounding land uses following review of the application and the public hearing process.

1.6 Fees

The ERL will make payments to the Colorado Hazardous Substance Response Fund (HSRF), as required by the CDPHE solid waste regulations. In addition, the facility will make payments to Adams County for administrative, monitoring, and inspection costs and expenses as required by the July 29, 2009 resolution granting the September 1, 2010 Certificate of Designation.

2.0 SITE DESCRIPTION

2.1 Location Restrictions

ERL meets each of the nine siting criteria described in Section 3.1 "Location Restrictions/Site Standards" of The Colorado State Regulations and the site location was previously approved. Documentation demonstrating compliance with the location restrictions is included in Appendix C and has been placed within the facility operating record.

2.1.1 Seismic Impact Zone

The USGS 2014 Dynamic Seismic Hazard Map for the conterminous United States was used to find the seismic hazards at the East Regional Landfill. There is a 2% or less chance that the peak ground acceleration at ERL will exceed 8.18% of the earth's gravitational pull in 50 years (equivalent to 10% chance in 250 years), so the site is not located in a seismic impact zone. All components of the landfill design are designed to resist the maximum horizontal acceleration in lithified material for the site. Slope stability analyses are included in Appendix O.

2.1.2 Bird Mitigation Plan and Proximity to the Denver International Airport

As a part of the location restriction information requested by the Federal Aviation Administration (FAA), ERL worked closely with the FAA, the Denver International Airport (DIA) and the Front Range Airport (FRA) to prepare a bird mitigation plan for the facility. The control of birds at ERL deserves special consideration because of the potentially dangerous occurrences of bird strikes by aircraft. Federal regulations (40 CFR § 258.10), require owners and operators of municipal solid waste landfills to demonstrate that landfills within 10,000 feet of any airport runway used by turbo-jet aircraft or within 5,000 feet of any airport runway which receives only piston-type aircraft be designed and operated in a manner which does not pose a bird hazard to aircraft, and requires notification if a landfill is outside of these ranges but within five miles of certain airports. The CDPHE regulations mirror those in 40 CFR§ 258.10.

The ERL facility is located approximately four miles north of the Front Range Airport and eight miles east of the Denver International Airport and is in compliance with all of the USEPA and CDPHE requirements. The facility is not within 10,000 feet of any runway at either of the airports, and ERL provided notification to Ms. Linda Bruce, Colorado State Planner with the FAA of the planned development to accept putrescible waste in October 2007. Although not required by regulation, the ERL also submitted a completed Form 7460-1 dated June 1, 2009 at the request of the FAA for informational purposes.

In 2009, ERL prepared a bird mitigation plan for the facility (Appendix D) because of its relative location to the Denver International Airport. ERL met with and worked closely with representatives of the FAA, United States Department of Agriculture (USDA, as wildlife consultant to the FAA), DIA, and the Front Range Airport to explain the planned operations and develop effective bird mitigation procedures. Each entity was provided an opportunity to review the facility development and voice any concerns they may have as part of the permitting process for the ERL to accept putrescible wastes for disposal. The facility did not receive any negative responses and received a number of positive responses. This bird mitigation plan provides more

specific guidance for the control of birds at the facility in Section 7.5.2, Vector Control of this EDOP.

2.2 Surface Water/Groundwater

No waste will be placed below or into surface or ground water. The facility disposal areas are specifically designed to remain outside the limits of any surface water and above ground water. Additional precautions to control surface water runon and runoff have been taken and include berms and ditches as necessary during operations. The permanent surface water control system is redesigned in this EDOP as part of the final cover vertical expansion. Operational and post-closure surface water drainage information and calculations are provided in Appendix E and the permanent stormwater control design is based on containing the 24-hour, 25-year storm event and controlling the 24-hour, 100-year storm event.

2.3 Permitted Wells Within Two Miles of Site

The Division of Water Resources data access page was used to update the water well information within two miles of the site, registered as of February 2024. Records provided by the State Engineers Office generally locate the wells by ¼, ¼ Section. A list of these wells based on the information provided is included in Appendix F.

2.4 Adjacent Land Ownership

The original permit document presents the information regarding landowners adjacent to the ERL Facility, as required by Adams County. This information was updated for this EDOP with records obtained from Adams County, and provides the name and address information and is included in Appendix G.

2.5 Site Characterization

Site geologic and hydrogeologic conditions were investigated in detail prior to the initial approval of the facility. This work is described in Section 4.0 of IC (1993), which is attached to this document as Appendix A. Topics covered there include:

- Regional and Site Geology,
- Regional and Site Hydrogeology,
- Hydrogeologic Characterization, and
- Groundwater Flow Paths & Velocities.

Specific site characterization work results including boring logs, packer test results, slug tests, etc. are included in Appendix A. Some additional characterization work including HELP modeling has been done since the original work and is discussed in Section 3.2 of this document and is included in the base grade redesign in Appendix J.

2.6 Climatology

The climate data was prepared in the original permit document and is included in Appendix I.

3.0 SITE GRADING & PHASED DEVELOPMENT

3.1 Design Concepts

The facility was redesigned using the basic design concepts of the 1993 approval when it was modified from the ash fill to a solid waste landfill. It was redesigned again in 2011 with a request to have the option of using a Geosynthetic Clay Liner (GCL) in place of the 2 feet of re-compacted clay. Another modification was completed in 2008 to use a geocomposite material in place of the granular collection material for leachate drainage on the floor of the landfill to the sump. A modification to the cover design is included as part of this revised EDOP. This modification includes a vertical expansion of the landfill fill area and a more detailed Alternative Final Cover design than what is presented in the 2006 EDOP as well as an optional final cover design that includes a LLDPE liner, drainage layer, protective soils, and vegetative soils.

3.1.1 Design Concept Summary

Specific design concepts were incorporated in the 2006 EDOP. Some of these concepts were modified subsequent to the issuance of the CD, predominantly as a condition of the CD, and have received approval from the CDPHE and Adams County and are incorporated in this EDOP. A comparison of the design concepts from the approved 2006 design with the designs incorporated herein are summarized below.

1. Disposal Area Footprint. The eastern and southern boundaries of the disposal area footprint have been modified from the 2006 design out of necessity to accommodate Adams County requirements for issuance of the CD and modify the perimeter drainage system to remain on the ERL property (the drainage system for the ERL in the 2006 EDOP extended northward into property not owned by ERL). The southern boundary of the drainage system and footprint was moved northward to comply with Condition Precedent #3 and #5 of the Resolution prohibiting landfill and permanent structures within forty feet of the South Section line and install a landscape buffer on the southern property boundary. The eastern boundary of the drainage system and the landfill footprint was moved westward to accommodate the additional 10-foot ROW deeded to Adams County and the Condition Precedent #5 of the Resolution requiring at least 25-feet of landscape depth and screening berm along Schumaker Road. These modifications resulted in a slight reduction in size of the landfill disposal area footprint from the 2006 design. The disposal footprint is unchanged for this updated EDOP.

2. Excavation Slopes. Consistent with the 2006 design, all excavation slopes of the disposal area footprint are designed at 3H:1V (horizontal to vertical). The excavation slopes are unchanged for this updated EDOP.

3. Separation from Ground Water. The 2006 EDOP maintained the minimum 10-foot separation between waste and the shallowest ground water from the 1993 design, a design requirement that is maintained in the approved design included in this EDOP. The depths to ground water in the wells and piezometers that remained accessible on the property in July 2005 were checked against the data presented in IC (1993) and were found to adequately represent current conditions. Additional piezometers installed in 2010 and discussed in

Section 3.2 also verified the original concept of the site. Water levels from the "Perched Ground Water Zone" defined in IC (1993) were contoured and assumed to continue at a uniform grade to the east where the "Denver Aquifer Zone" has much lower water levels. As a result, this water level contour map is conservative in the eastern portions of the site, and with the data from the 2010 piezometers was used as the basis for designing the top of liner grades.

In addition the excavation for Cell 10 remained open without maintenance for approximately two years before liner was constructed. This allowed surface water to accumulate in and surrounding the cell that infiltrated into the subsurface, resulting in the presence of temporary shallow groundwater above the designed base of Cell 10. An attempt was made to drain the artificially-induced groundwater so that the cell could be constructed as originally designed, but was unsuccessful. In order to expedite construction, the base grades for Cell 10 were raised a minimum 10-feet above the artificial groundwater, necessitating a redesign of the base grades in the vicinity of Module 3 and minor changes in the rest of the landfill as reflected in the approved March 2, 2011 *East Regional Landfill Revised Excavation Plan and Liner Design* document included in Appendix J.

4. Liner System. The 2006 design consisted of two feet of compacted clay with a saturated hydraulic conductivity of 1×10^{-7} centimeters per second (cm/s) or less, overlain by a 60 mil high density polyethylene (HDPE) geomembrane. Subsequent to construction of the first disposal cell (Cell 10) the ERL was approved to substitute a geosynthetic clay liner (GCL) in place of the two feet of compacted clay as an option for the remaining landfill construction.

5. Leachate Collection System. The leachate collection system design presented in the 2006 EDOP consists of a one-foot thick drainage layer with leachate collection piping leading to two sumps. Prior to construction of the first disposal cell the ERL was approved to substitute a geocomposite drainage layer in place of the one-foot aggregate material and piping. The one-foot aggregate drainage layer and piping is no longer an approved option.

6. Landfill Gas Collection and Control System. To meet the requirements of 40 CFR Part 60 Subpart WWW (now subpart Cf with state plan approval) a Landfill Gas Collection and Control System (GCCS) was installed in Module 1 in 2022. The GCCS consists of 31 vertical extraction wells, transmission piping, 3 condensate traps, one condensate sump at the flare skid, a flare, and gas handling skid. Design, operational, and monitoring details for the GCCS are included in the approved documents: East Regional Landfill's Gas Collection & Control System Plan, dated August 13, 2021, developed by Smith and Gardener Engineers, and the facility's Title V Operating Permit, Permit No. 10OPAD353.

7. Final Cover Height and Elevation. The 2006 final cover configuration was designed with two "peaks" and a maximum height of approximately 90 feet above the lowest portion of the surrounding ground surface at an elevation of approximately 5,392-feet amsl (above mean sea level) based on the updated state plane coordinate system discussed is Section 1.2. The side slopes in the 2006 Plan were designed at a 4:1 maximum slope up to an elevation of approximately 5,356-feet amsl and five percent up to the final grades. The final sideslope configuration included in this EDOP was designed with a maximum height of approximately

200 feet above the lowest portion of the surrounding ground surface and changes the side slope configuration to be 3.5:1 slopes from the cover toe to a higher grade break at approximately 5,484-feet amsl to the 5% grade at the top to the two peaks resulting in a peak design elevation of approximately 5,499-feet amsl (adjusted for the change in coordinate system).

8. Final Cover Design. The 2006 final cover design proposed an Alternative Final Cover system using a water balance model to limit infiltration into the waste mass. This EDOP continues to propose an AFC using the same water balance model, but provides additional design and construction criteria including a demonstration of the feasibility of this type of AFC and a CQA Plan for its construction. This EDOP also proposes a possible final cover option of using a synthetic-lined cover for the final cover and includes a CQA Plan for its construction.

3.2 Grading and Excavation Plan

The site excavation was designed to continue using the concept that a minimum separation of 10 feet must be maintained between waste and the shallowest ground water. The fill area side slopes have 3:1 grades. The base grades of the landfill floor range in slope from a 1 percent grade to a 4.25 percent grade depending on the module and module area. As previously noted, the redesigned landfill excavation plan maintains a 10-foot separation from the top of the liner to the highest groundwater elevation. The ERL submitted a document entitled *East Regional Landfill Revised Excavation Plan and Liner Design* (AEC, March 2, 2011) that reflected the following:

1. Adjustments to the disposal area footprint necessitated by the Adams County ROW and landscape requirements,
2. Raised the original base grades to ensure the minimum separation to groundwater was maintained.
3. Modified the configuration of the base grades to incorporate three separate leachate sumps instead of the two sumps shown in the 2006 EDOP.

A copy of the March 2, 2011 Plan and CDPHE approval is included in Appendix J. Drawings showing the approved plan for each liner system options and final cover are included in this EDOP as Plates 3A, 3B, and 4.

Modifications to the approved grading plan became necessary after changes were made to the disposal area footprint and property boundary during the public hearing process and also by conditions encountered during construction of Cell 10 requiring raising the base grades in some areas. Additionally, supporting documentation was prepared to demonstrate that the plan meets the CDPHE regulatory requirements.

As stated above, the facility has a minimum 10-foot separation requirement between the top of the clay liner surface and underlying groundwater. A number of piezometers were installed at the facility in 1991 and 1992 to characterize the subsurface for the original permitting of the facility as a coal ash disposal facility. The water levels in these piezometers were measured at various times between installation and March 1993 to establish static groundwater elevations.

Nearly all of those piezometers have been destroyed, so an additional 18 piezometers were installed in November 2010 through February 2011 to verify the original groundwater characterization data and better define the groundwater surface for purposes of the redesign of the grading plan. The piezometers installed in 1991 and 1992 are noted as "pre-existing" and the piezometers installed in 2010 noted as "new" in the attached drawings in Appendix J. In general, the piezometers installed in 2010 verify that the 1991/1992 groundwater data was accurate. As can be seen on Sheet 4, Appendix J, many piezometers are nested or placed in very close proximity to each other, but they indicate a difference in groundwater elevations. For purposes of designing the base grades for the landfill that ensure the required separation, the highest groundwater elevations, which are shown on Sheet 4, Appendix J, were used in these cases. The resulting redesigned landfill grades demonstrate a minimum 10-foot separation between the top of clay (or GCL liner) and the underlying groundwater.

A few of the piezometers, particularly those completed in February 2011 (PZ-98, PZ-99, and PZ-100) are dry to the total depth completed. For purposes of developing groundwater contours and establishing a minimum separation between the top of the liner elevations and the underlying groundwater, groundwater was assumed to be present at the total depth of the dry piezometers. The resulting redesigned landfill grades demonstrate a minimum 10-foot of separation between the top of clay (or GCL liner) and the underlying groundwater. The drawing showing the groundwater contours and the landfill grades on the top of clay surface (or GCL surface) are included in Appendix J. The groundwater contours were developed based on the highest recorded groundwater elevation where conflicting elevations are indicated in nested or nearby piezometers, so the drawings in Appendix J include only the piezometers and groundwater elevations used to develop the groundwater contours.

Additionally, the March 2, 2011 Plan modified the excavation plan to include 3 sumps instead of the originally planned 2 sumps. Updated HELP modeling is included in in Appendix L demonstrating that the modified excavation plan is in compliance with the Regulations.

As discussed in Section 1.2, the site topography was updated with new aerial photography in January 2012. The 2006 EDOP and the March 2, 2011 Plan was designed using the original local coordinate system. In conjunction with the 2012 aerial mapping the coordinate system was converted to a modified state plane system, resulting in an approximately +3.87-foot conversion factor for elevation from the original local coordinate system. Therefore, the elevations shown on the attached design drawings have been updated to reflect an elevation conversion factor of approximately 3.87 feet higher than the local coordinate system (shown in Appendix J) although they represent the same point in space.

3.3 Liner Design Modification

The March 2, 2011 Plan included a request to use an optional Geosynthetic Clay Liner (GCL) instead of 2-feet of clay and that option is reflected in this EDOP. As with the previously approved design, a 60-mil HDPE membrane will remain but be placed on top of the GCL rather than the clay. The grading plan continues meet the requirement of a minimum separation between the top of the liner and the groundwater of 10 feet, as approved in the EDOP prepared by Doty & Associates, LLC (June 2006).

An equivalency determination to compare the option of using a GCL in place of the originally approved 24 inches of clay beneath the High Density Polyethylene (HDPE) liner was prepared as part of the March 2, 2011 Plan. This change was approved by the Division and Adam's County and incorporated into the EDOP. Liner details are shown on Plate 5. A revised Construction Quality Assurance Plan (CQAP) was developed as part of this EDOP to incorporate final cover modifications and includes the requirements for installing a GCL. No other changes are made to the CQAP from previous versions regarding the liner system. The revised CQAP is included in Appendix M.

3.4 Leachate Collection System Modification

The leachate collection system was modified to use a geocomposite drainage material rather than the originally approved aggregate material layer. This modification was revised in 2008 by Terracon, Inc. and approved by the CDPHE in a letter dated July 15, 2008 (Appendix K). The CQAP (Appendix M) was also modified to include the installation procedures and testing for the material. Transit time calculations to estimate the length of time it would take leachate to travel from the farthest point in each module to that module's sump are included in Appendix J. The transit times were prepared based on the modified landfill base grades and longest flow pathways, including leachate travel down the landfill sideslopes, and are well within the maximum 365-day requirement. Details of the approved leachate collection system are included in Plate 6.

3.5 Stormwater Control System Redesign

The disposal area boundary and fill limits were revised from the 2006 design to provide additional ROW along Schumaker Road and landscaping as a condition of the CD as well as to provide room for design of a permanent perimeter surface water control system. The permanent surface water control system was designed to control the 100-year, 24-hour storm event in compliance with regulations and documented in the *Drainage Report and Plan, Five Part Landfill* dated December 2009. The vertical expansion of the final cover necessitates a redesign to the permanent surface water control system. The redesigned surface water control system is included in Appendix E. This redesigned system is designed to fully contain the runoff from a 25-year, 24-hour Type II storm and control the runoff from a 100-year, 24-hour Type II storm. The system consists of tack on berms on the final cover that route runoff to perimeter drainage ditches around the disposal area and to two site outfall locations. The ditch system also incorporates detention weirs to fully contain the 24-hour, 25-year storm volume and assist in limiting off-site sediment transport and is designed between the disposal area footprint and the required landscape areas on the south and east property boundaries. It is designed on the inside (landfill side) of the 20-foot KinderMorgan gas pipeline easement adjacent to the disposal area. The ditch and associated structures will be constructed in phases concurrent with the disposal area phasing and closure to control run-on to the active disposal areas and runoff from the landfill.

3.6 Final Grades

The final grades and landfill height are modified in this EDOP. The maximum height at the top of the final cover is at an elevation of approximately 5499-feet (modified state plane system), approximately 107 feet higher than the previously approved cover design (elevation 5392). The final cover topography is shown on Plate 4.

3.7 Final Cover System

The final cover system design is updated in this EDOP from the originally approved water balance cover of 4-8 feet thickness of monolithic lightly compacted soils to two options. The first option is a water balance cover with 3.5 feet of thickness of monolithic lightly compacted soils. The second option is a final cover consisting of one foot of prepared subbase overlain by a LLDPE membrane covered by 1.5 foot thick vegetative layer. These final cover options are discussed further in Section 4.4.

3.8 Soil/Material Balance

The facility was originally designed to result in a material quantity balance, considering clay toe berm, daily and intermediate cover and final cover requirements. However, due to the base grade redesign, less excavation soil is available than originally anticipated. In the future, the ERL will acquire a borrow source. The various excavation and fill volumes are presented in Table 1.

3.9 Phasing Plan

The 2006 EDOP segregates the landfill footprint into pre-established "cells" of a specific size. The designation of specific cells is arbitrary and cumbersome in that only portions of cells may be constructed at any one time in practice, requiring a change in the designation of the area constructed during any one event (e.g., Cell 8-Phase 1) or any construction event includes portions of one or more cells (e.g., Cell 8-Phase 3;Cell 9-Phase 1). To simplify the nomenclature, the landfill footprint in the approved grading plan is segregated into three Modules that are defined by physical design features (i.e., a drainage area). A Module is defined as an excavated disposal area of the landfill that drains to a single leachate collection sump located in that module. Within each Module, individual cells will be constructed as they are needed and the size and timing of cell construction is left to the discretion of the landfill operator and based on such considerations as the volume of airspace desired for a period of time and budgetary constraints. With the exception of Cell 10, which was named based on the nomenclature in the 2006 EDOP, any portion of a disposal area constructed at one time will define a cell and the cells number will be sequential. For example, Cell 1 was constructed in one continue construction event, but has two designations, Cell 1A and Cell 1B because it was necessary to document the construction in two separate construction reports. The next cell to be constructed will be called Cell 2, the following cell name Cell 3, etc.

Development of the disposal area at the site began with Cell 10 of Module 1 located in the northeast corner of the site and contains the sump for Module 1. Cell 1 was constructed in 2011 adjacent to Cell 10 to the west and extends to the western boundary of the fill area footprint.

Cell 2 was constructed in 2014 adjacent to Cell 1 to the south and extends to the western boundary of the fill area footprint. Cell 3 was constructed in 2015 adjacent to Cell 2 to the south and extends to the western boundary of the fill area footprint. Cell 3 extends to the southern boundary of the Module 1 fill area footprint. Cell 4 was constructed in 2018 adjacent to Cell 2 and Cell 3 to the east and Cell 10 and Cell 1 to the south. Cell 4 was the final cell in Module 1. Cell 5 was constructed in 2022 as the first cell in Module 2 and contains the sump for Module 2. Cell 5 is in the northern part of Module 2 and is immediately south of Module 1. The currently constructed area includes all of Module 1 and the first cell (Cell 5) of Module 2. Cell construction will generally progress southward in an east-west configuration until the southern boundary of the disposal area footprint is reached, and then cell development will progress eastward to the eastern footprint boundary. Overall, cell development of the site will progress in a northwest to southeast manner.

It is envisioned that the next cell area will be under excavation and/or construction while filling continues in previously constructed cells. Daily and intermediate cover soils may be borrowed from the excavation for the next cell or from existing stockpiles.

4.0 FACILITY DESIGN DETAILS

4.1 Liner

The entire excavation will be covered with a composite liner system consisting of a GCL and 60-mil HDPE geomembrane, or optionally a CCL and 60-mil HDPE geomembrane. Details of liner system are shown on Plate 5. The revised CQA Plan is included in Appendix M.

The 60 mil HDPE geomembrane will be new material, manufactured with first quality high density polyethylene resin. Textured HDPE will be used. The geomembrane will be anchored along the crest of the excavation or the toe berm in a two-foot wide by two foot deep anchor trench. Seams will be sealed between the separate geomembrane sheets using either double fusion welds or extrusion welds. Construction quality assurance procedures are specified in Appendix M.

4.2 Leachate Collection System

A leachate collection system consisting of a geocomposite drainage layer and three leachate removal sumps (one for each module) is designed on top of the composite liner (above the HDPE membrane) to route any free liquid at the base of the facility to leachate removal sumps located in each Module.

4.2.1 Geocomposite Drainage Layer

The 2006 EDOP incorporated a one-foot thick drainage layer of aggregate materials supplemented by a piping system. The aggregate material and piping has been eliminated as an option for the leachate drainage layer and a geocomposite drainage material was approved in its place in a series of design modifications prior to the construction of Cell 10. The geocomposite consists of a polyethylene drainage net with geotextile fabric bonded to each side and designed over the entire floor of the landfill (not the side slopes). The material requirements, installation procedures, and CQA procedures are detailed in the CQA Plan in Appendix M. Details of the leachate collection system are included on Plate 6.

4.2.2 Sumps

Three sumps, one in each Module, are designed at the landfill to provide for collection and removal of leachate. Each of the sumps are configured slightly different but range from approximately 68 to 85 feet wide at the top and all are approximately four feet deeper than the surround elevations on the floor. The sump is lined identically to the floor and sideslopes of the landfill (a composite liner with the 60-mil HDPE overlaying either the compacted clay or GCL).

An 18-inch diameter perforated SDR 17 HDPE pipe will be installed on the floor of the sumps and connected to a similar solid riser pipe running up the composite-lined side slope. Perforations will be 3/8-inch in diameter and the sump will be filled with aggregate meeting the requirements in the CQA Plan to the level of the surround liner surface on the floor. In Module 1 and planned for Module 3, an 8 Oz/Yard^2 geotextile covers the sump aggregate and is overlapped/seamed with the upper geotextile layer of the geocomposite drainage. The Module 2

sump was constructed by completely covering the sump aggregate with the geocomposite layer. Submersible pumps will be installed in the sumps and fluid will be removed such that the fluid thickness is less than 24 inches (less than 12 inches on the liner outside the sumps). The management of fluid and leachate removed from the sumps including collection, treatment, and disposal methods is outlined in Section 7.6. Sump details are included on Plate 6 and installation requirements, construction methods, and CQA procedures for the sump and its components are included in the CQA Plan in Appendix M.

4.3 Protective Cover

The landfill liner and leachate collection system will be protected by the placement of a one-foot thick layer of specified soils. The protective soils are designed to cover the entire floor (including the sumps) and side slopes out to the lateral limits of the liner. The required characteristics of the soils were engineered to minimize plugging of the upper fabric of the geotextile. Required characteristics, placement methods, and CQA criteria are included in the CQA Plan in Appendix M.

4.4 Final Cover

The final cover has been designed to allow the option of either a water balance cover or a synthetic liner. The water balance cover will consist of a monolithic lightly compacted vegetated evapotranspirative cover designed using guidance from the Final Guidance Document, Water Balance Covers in Colorado (CDPHE, March 2013). The site has suitable soils meeting the criteria in the guidance document for permitting a 3.5-foot thick water-balance type Alternative Final Cover (AFC). Excess excavation of primarily silty sandy clay and clayey sand (based on data from IC, 1993 and construction geotechnical analysis conducted since the facility has opened) will be placed as loosely as possible over the final lift of refuse. The final lift of refuse requires a minimum one-foot of unspecified intermediate cover soils if final cover is not placed within 30 days, and these soils may be used as part of the AFC if suitable soil properties, compaction, and moisture conditions are present or constructed. Alternatively the ERL may remove the intermediate soil cover and replace it with the specified thickness of suitable soils or place suitable soils directly over the intermediate final cover. A demonstration to the adequacy of the above described AFC and a CQA Plan for the construction of the AFC is included in Appendix M.

The optional synthetic-lined final cover will consist of a one-foot prepared subbase. Overlying the subbase is a LLDPE membrane overlain by a 12-inch thick protective soil layer overlain by a 6-inch vegetative layer. In-place densities will be in the range of 80 to 90 percent of the Standard Proctor maximum dry density. The moisture content will be equal to or less than the Standard Proctor optimum. The combined protective soil layer and vegetative layer thickness on the LLDPE will be a minimum of 18 inches. The LLDPE will be anchored into the upper layer of soil using anchor trenches (detail on Plate 5). Gas vents are not included in the final cover configuration because the facility has installed a gas collection system. Detail 5 on Plate 7 shows details for boots on penetrations through the LLDE cover by the GCCS system.

After placement of the final cover, it will be planted with a seed mixture recommended by the local office of the National Resources Conservation Service. The mixture will include

predominantly cool weather species.

4.5 Slope Stability

Appendix O contains the slope stability evaluation of the East Regional Landfill (ERL) expanded final cover. The slope stability analyses include multiple potential failure alignments through the landfill and multiple different methods of analysis to ensure that the slopes are stable during the construction and at the point the municipal solid waste (MSW) reaches final cover grades. Four different scenarios were modelled as outlined in the evaluation.

The worst-case factors of safety, probabilities of failure, and reliability indices for all four scenarios are shown below. Based on these modelling results, the worst factor of safety observed at the ERL is 1.471 in Scenario 1 – the open condition after the landfill has been constructed and before waste has been placed. This factor of safety exceeds the minimum design criteria of 1.3, so the landfill design is acceptable.

Worst-Case Slope Stabilities for Four Scenarios

Method	Factor of Safety (Deterministic)	Mean Factor of Safety	Probability of Failure	Reliability Index
Scenario 1	1.471	1.478	0.040%	2.748
Scenario 2.A	1.921	1.932	0.000%	5.442
Scenario 2.B	1.934	1.944	0.000%	5.348
Scenario 3	1.665	1.672	0.000%	4.399

5.0 SURFACE WATER CONTROL

The surface water control system was designed in a document entitled *Drainage Report and Plan, Five Part Landfill* (AEC, December 2009) and received approval from the CDPHE and Adams County Health Department (ACHD). The surface water control system is redesigned in this EDOP as part of the final cover modification. The surface water control system was designed in compliance with the Colorado Regulations Pertaining to Solid Waste Sites and Facilities (6 CCR 1007-2, Part 1, Section 2.5.7) that require permanent surface water control facilities at solid waste sites to prevent run-on from the 24-hour, 25 year storm event, collect run-off from the 24-hour 100 year storm event, and control run-off and run-on for a 24-hour 100-year storm event at the site. The commonly used model HydroCAD (version 10.20-5) was used to evaluate the needed detention pond capacity and performance of the tack-on berm and perimeter channel design. Appendix E includes the drainage analysis for the facility.

Surface water runon to the site is only possible in an area along the south landfill boundary. That has been effectively blocked using a tree-lined berm and a road on the south property. The runoff is controlled using tack-on berms on the final cover, drop chute structures and perimeter berms. (Plate 8A).

The revised surface water control system consists of four grass-lined channels around the perimeter of the final cover on the landfill, representing anticipated post-closure conditions at the site. The channels will be built in phases as necessary based on the progression of landfilling throughout the operating life of the landfill. This scenario assumes that all operating facilities, including the gatehouse and scales will be removed from the site after it is closed as these structures are within the ultimate disposal area footprint.

Surface water control structures for operational purposes will be constructed as needed during the operating life of the landfill to collect and control the 24-hour, 25-year event as required in 6 CCR 1007-2, Part 1, Sections 2.1.6 and 3.2.6. Generally, these temporary operational controls will consist of proper landfill sloping, temporary ditches or control berms, and excavated retention areas. The operational surface water control structures are highly dependent on the landfill configuration and operating needs such as access roads, soil stockpile areas, etc. and their location and design will change based on the particular landfill configuration at any time. The operational surface water control structures are not included since they will change based on the landfill progress. Aside from operational surface water controls required by regulation to control surface water to and from the refuse fill area, the natural drainage through the site will be maintained as much as possible until the permanent system is constructed.

6.0 ENVIRONMENTAL MONITORING

6.1 Gas Monitoring System

The Regulations state that the concentration of explosive gas generated by landfill facilities shall not exceed 100 percent of the lower explosive limit (LEL) by volume, which is equal to 5 percent methane in air, at the property boundary, or 25 percent of the LEL, which is equal to 1 percent methane in air, in facility structures.

Explosive gas monitoring at the ERL is conducted by six explosive gas monitoring probes constructed near the facility property boundaries and adjacent to the six groundwater monitoring wells used to monitor groundwater at the site as shown on Plate 2. In 2010, ERL installed three of the gas monitoring probes (GP-2, GP-3, and GP-4) adjacent to the current areas being filled for detecting any gas from the landfill. In 2022, the ERL installed the remaining three gas probes (GP-1, GP-5, and GP-6). The gas probes are completed from five feet below ground to the approximate elevation of the landfill floor adjacent to the probe location. The monitoring probes are equipped with caps containing normally closed quick connect fittings for the explosive gas monitoring purposes. The completion diagrams are included as Appendix P.

Explosive gas concentrations in the probes are measured with a calibrated explosive gas meter.

The condition of each explosive gas monitoring probe is inspected during each monitoring event. The results of the inspection is documented and any deficiencies are remedied within 60 days of the inspection, weather permitting. If deficiencies, malfunctions or deteriorations in the well are observed at other times, such deficiencies will also be documented and remedied within 60 days of discovery, weather permitting.

In compliance with Regulations, the ERL will notify the CDPHE and Adams County of explosive gas levels that exceed the regulatory standards stated above and take immediate steps to ensure protection of human health. A record of the levels detected above regulatory limits and actions taken shall be placed in the Operating Record within seven days, and the ERL will implement an approved remediation plan within 60 days, place the plan in the Operating Record, and notify the CDPHE and Adams County that the plan has been implemented. These steps will be followed unless an alternative approach is approved by the CDPHE and Adams County.

6.1.1 Gas Monitoring Schedule

In compliance with Regulations, gas monitoring of the probes and facility structures will be conducted quarterly unless an alternative schedule is approved by the CDPHE and Adams County.

The current probes are monitored for explosive gas concentrations on a quarterly basis and although the gatehouse is far removed from current disposal operations will also be monitored for the presence of explosive gas on a quarterly basis.
The quarterly monitoring results are submitted to CDPHE and Adams County as part of the ground-water monitoring report if conducted concurrently with the groundwater monitoring or within 60 days in a separate report if ground-water monitoring is not performed that quarter. The report will include a tabulation of the data, as well as the results of any inspections and

maintenance performed.

6.1.2 New Source Performance Standards Applicability

The ERL is subject to Subpart Cf of the New Source Performance Standards (NSPS) of the Clean Air Act due to its design capacity and is subject to the applicable Air Pollution Control Division (APCD) regulations. The ERL installed a landfill Gas Collection and Control System in November 2022 in accordance with the regulations. Applicability to Subpart Cf requires the ERL to obtain a Title V Operating Permit. The ERL received a Title V Operating Permit on August 1, 2016. This permit was renewed on November 1, 2022, Operating Permit 10OPAD353. Due to the vertical expansion, an amended design capacity report and permit modification request for the Title V permit will be submitted to the APCD within 90 days of approval of this EDOP.

6.2 Groundwater Monitoring

There are a total of six groundwater monitoring wells approved for the landfill, all six wells are currently installed and used in the detection monitoring program in accordance with Appendix B of 6 CCR 1007-2, Part 1. The approved groundwater monitoring system wells include MW-1, MW-2, MW-3, and MW-4 currently in the detection monitoring system and sampled on a semi-annual basis. MW-5 and MW-6 were installed in March 2021 and are now in detection monitoring and sampled on a semi-annual basis.

A seventh well, CMW-1, is present on the site and used to monitor the compost operations. Because the compost operations are permitted under a separate CD, CMW-1 is not a part of this EDOP. The location of the existing water monitoring wells is shown on Plate 2.

Wells representing upgradient and downgradient conditions for the currently active area include MW-1 (upgradient), MW-2, MW-3, MW-4 (all three downgradient from the northern portions of the facility), MW-5, and MW-6 (both downgradient from the southern portions of the facility). It should be noted that MW-1 was originally planned in a different location as shown in the 2006 Doty EDOP; however, MW-1 was moved to a more appropriate upgradient position on the southern property boundary as documented in a letter to the CDPHE (AEC, March 1, 2010) and approved in a CDPHE letter dated May 11, 2010.

The wells have been, and will continue to be, sampled for analysis of the parameters listed in Appendix IA and IB of the CDPHE solid waste regulations (6 CCR 1007-2, Part 1) unless a modified analytical suite is approved by the CDPHE. Analytical methods are specified in EPA SW-846 or other appropriate sources and the laboratory results are validated using standard methods. Samples are currently collected on a semi-annual basis in MW-1 through MW-4.

The wells will be purged and sampled using dedicated bailers. The dedicated bailers are suspended on dedicated polypropylene rope. Alternatively, at the operator's option, dedicated pumps may be installed in the wells and used for purging and sampling.

If dedicated bailers are used, the wells are purged of three wellbore storage volumes (the volume standing inside the casing at the start of purging) or to dryness, whichever occurs first. Periodic

field measurements of pH, temperature, and specific conductance are taken and recorded prior to collecting the sample. Purging continues until these parameters have stabilized to within 0.2 pH units, 2 degrees C or F, and 10 percent of the specific conductance reading for 2 consecutive readings. Samples are then collected as soon as possible after purging, but no longer than 24 hours after purging.

If dedicated pumps are used, low flow techniques will be used in accordance with the EPA document *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, the wells will be purged of minimum three pump and tubing volumes at flow rates of 100-500 milliliters per minute or less and sampled immediately after purging. Drawdown will be checked periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval and may require adjustment based on site-specific conditions and personal experience. Periodic field measurements, every 3-5 minutes of pH, temperature, specific conductance, Oxidation Reduction Potential (ORP), Dissolved Oxygen (DO), and turbidity are taken and recorded prior to collecting the sample. Purging continues until these parameters have stabilized to within ± 0.1 pH units, ± 10% for temperature, ± 3% of specific conductance, ± 10mv for ORP, and ± 10% for DO and turbidity for three consecutive readings. Samples are then collected as soon as possible after purging, but no longer than 24 hours after purging.

Samples are transferred directly from the bailers or discharge tubing into sample bottles provided by the laboratory. Sample bottles and preservation are as specified in the analytical methods employed, except that volatile organic compound (VOC) samples are chilled but otherwise unpreserved (consistent with CDPHE policy). Sample bottles are placed in a cooler or other shipping container and chilled on ice as soon as possible after collection.

Chain-of-custody procedures are used to track the sample from the time of collection until it, or its derived data, is used. A chain-of-custody form is initiated at the time that the samples leave the site. Field personnel complete all applicable sections of the form. The chain-of-custody forms are protected from moisture by encasing them in plastic (e.g., Ziplock plastic bags) and they are then placed inside the shipping containers. The chain-of-custody forms accompany the containers during shipment to the laboratory. The shipping containers are sealed with custody seals.

Field personnel collecting the samples are responsible for custody until the samples are delivered to the laboratory or relinquished to a commercial shipping company. Sample transfer requires the individuals relinquishing and receiving the samples to sign, date, and note the time of transfer on the chain-of-custody forms. Common carriers (e.g., Federal Express) are not expected to sign the chain-of-custody forms. However, the bill of lading or airbill becomes part of the chain-of-custody record when a common carrier is used to transport the samples. The chain-of-custody is considered complete after the analytical laboratory accepts custody of the samples (acceptance of custody is indicated by signature on the chain-of-custody form). A copy of the chain-of-custody record will be maintained along with other field records.

The following quality assurance and quality control (QA/QC) actions are implemented to

minimize the potential for biasing the analytical results by laboratory preparation, sampling, and transport activities.

1. Field work is performed by qualified and trained personnel.

2. Samples are analyzed by a qualified laboratory. The laboratory uses appropriate chain of custody, analytical, and QA/QC procedures.

3. A trip blank for VOC analysis is included in each sampling event.

4. Equipment blanks and field duplicates are not collected on a routine basis because disposable or dedicated sampling equipment will be used; however, they may be prepared and analyzed if questions arise relative to the quality of the analytical data.

5. The laboratory results are validated using standard methods.

6. The full laboratory report, including laboratory QC data, is attached to the monitoring reports and are submitted by the operator to both CDPHE and Adams County Health.

The condition of the ground-water monitoring system is inspected during each monitoring event. The results of the inspection are documented and any deficiencies are remedied within 60 days of the inspection, weather permitting. If deficiencies, malfunctions or deteriorations are observed at other times, such deficiencies will also be documented and remedied within 60 days of discovery, weather permitting.

The monitoring results are submitted to CDPHE and Adams County along with a statistical evaluation following each monitoring event.

The report includes a tabulation of the data (including water level data), statistical evaluations as appropriate, the results of the system inspection, and a description of any maintenance performed.

6.2.1 Groundwater Statistical Analysis and Reporting

The following is included in a typical semi-annual groundwater monitoring report:

- Time series graphs for all parameters
- Groundwater measurements and elevations charts
- Analytical results presentations and laboratory reports
- Statistical results for groundwater monitoring wells
- Landfill gas measurements

The analytical results for all wells are statistically analyzed in accordance with methods and procedures allowed by Regulation. All of the groundwater results through June of 2010 was collected without any waste having been received at the ERL facility and is considered to be unadulterated. Data collected after September 1, 2010 was collected after the facility had

opened. Sampling of each of the monitoring wells was completed and the results were collected in the initial eight quarters of data was used to establish background conditions.

Data is evaluated for statistical outliers and seasonality in accordance with Regulations. The data is adjusted as allowed for outliers and seasonality if appropriate.

6.3 Leachate

The leachate levels in the landfill sumps will initially be checked a minimum of once every month and after large precipitation events during the initial stages of refuse filling in a newly constructed cell to verify that the depth of leachate is in compliance with regulatory requirements. In compliance with regulations, leachate will be removed from the sump prior to reaching a depth of 30 centimeters (12-inches) over the floor on the liner surrounding the sump. When these monthly measurements indicate that the frequency of measuring leachate levels can be reduced and still maintain compliance with regulations, leachate levels will be checked a minimum of every three months on an ongoing basis. Leachate quality will be monitored (sampled and analyzed) annually and the results will be submitted to the CDPHE and Adams County.

6.4 Stormwater

The ERL is regulated by a stormwater permit under the Colorado Water Quality Control Act and the Colorado Discharge Permit System (CDPS permit number COR900439). As a permit requirement, the ERL has a Stormwater Management Plan (SWMP) that provides guidance for inspections, surface water control structures, monitoring, and reporting for the site. The purpose of the SWMP is to protect waters of the State from potentially contaminated site discharges, specifically those associated with site drainage and stormwater runoff. The Permit requires monthly visual inspections, an initial four quarterly benchmark samples, potential additional quarterly samples if conditions occur that trigger the additional implementation measures contained within the COR900000 permit, potentially annual effluent limitations sampling for the first year, and annual benchmark and effluent limitation sampling if approved thereafter. For purposes of the annual permit, the monitoring period is from January 1 through December 31.

7.0 OPERATIONS PLAN

7.1 General

This section discusses the day to day operational aspects of the ERL including, but not limited to, site security and safety, personnel and equipment, waste identification and acceptance procedures, disposal and daily cover protocol, control of nuisance conditions, leachate management, personnel training, and recordkeeping.

The number and type of personnel employed at the landfill and equipment used in various operations may vary from that discussed in this EDOP depending upon current conditions; however, sufficient qualified staff is available to operate the site in a safe and efficient manner. All personnel are trained in safe and proper operating procedures as they relate to their assigned duties and responsibilities.

7.2 Site Access & Controls

Personnel sufficiently knowledgeable in operating the facility will control the site entrance located on Schumaker Road as shown on the attached drawings. A gatehouse with a scale is constructed at the entrance and all vehicles must stop there to gain access to the site. The cashier will inquire as to the nature of the material being delivered and its quantity. The cashier will have authority to deny site access if the material is unacceptable or its characteristics are suspect. The cashier may have other operational duties, such as heavy equipment operation.

As stated earlier, only municipal solid waste as defined in the CDPHE solid waste regulations is accepted at the site. Customers on account are required to sign an agreement stipulating that they will only bring acceptable waste to the facility. Signage at the facility entrance further stipulates the types of waste that may be accepted. Questionable materials transported to the site will be rejected until it can be determined that the material is acceptable. Waste screening procedures are outlined in the Waste Characterization Plan (WCP), provided in Appendix Q. Additional information on waste identification and screening procedures is presented later in this Section.

The entire active area of the facility is fenced. Fencing will be expanded as needed to enclose current and past disposal areas, as well as those under development. A gate is installed at the site entrance and others may be placed at other locations as may prove convenient for the operator. All gates will be locked except during actual operating hours.

Roads interior to the site are all-weather roads providing safe access during operating hours in all seasons. Roads accessing the active disposal area (used by customers) have posted speed limits. Roads accessing areas under development (used by the operator) are established but may change in response to operational needs. In addition, roadways are constructed around the perimeter of the site and to well locations for inspections and monitoring.

7.3 Waste Identification and Screening

Waste identification and screening procedures implemented at the ERL are outlined in the WCP included in Appendix Q. The current WCP for the ERL received CDPHE approval on October 24, 2018. The WCP is slightly revised with this EDOP to include updated Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) regulations (6 CCR 1007-1 Part 20). The WCP discusses acceptable wastes streams, identifies those wastes that are specifically prohibited, waste identification and screening procedures to preclude acceptance of prohibited wastes, and employee training.

This plan is designed to hold the waste generator responsible for:

- Adequately characterizing particular waste streams proposed for disposal at the facility
- Ensuring that these wastes are acceptable for disposal at the ERL

This responsibility is maintained by the generator through a documented formal waste application and acceptance document included with the WCP. The ERL reserves the right to deny acceptance of any waste stream for any reason.

7.3.1 Acceptable Waste Types

The ERL facility is designed for disposal of municipal solid wastes as defined in the CDPHE solid waste regulations and most typically consists of residentially and commercially generated trash. Other non-hazardous wastes may be acceptable for disposal at the facility in accordance with the approved WCP included in Appendix Q. Certain acceptable wastes require testing and/or specific handling and burial procedures that are also discussed in the WCP.

Additionally, as a condition of the ERL CD, Mill tailings, mining wastes, and treated domestic waste water and water treatment residues that do not contain hazardous waste, as defined by C.R.S. §25-15-101(6), as amended, and 6 CCR 1007-2, Part 2, §2.2(J), as amended, may be accepted on a case-by-case basis, after review and approval by the Adams County Department of Planning and Development. The waste stream shall be submitted by the ERL to the CDPHE for its comments.

7.3.2 Prohibited Waste Types

The ERL CD prohibits acceptance of the following wastes for disposal:

- Hazardous wastes as defined by C.R.S. §25-15-101(6), as amended, 6 CCR 1007-2, Part 2, §2.2(J), as amended, and Adams County Development Standards and Regulations §11-02-235, as amended.
- Radioactive waste, as defined by C.R.S. §25-11-201(3), as amended, classified material, as defined by C.R.S. §25-11-201(1), and low-level radioactive wastes, as defined by C.R.S. §24-60-2204(3), as amended, including, but not limited to, Naturally Occurring Radioactive Material (NORM), as defined by C.R.S. §25-11-101(2.7), as amended, and Technically

Enhanced Naturally Occurring Radioactive Material (TENORM), as defined by C.R.S. §25-11-201(4), as amended.
- Liquid waste as defined by CCR 1007-2, Part 1 §1.2, as amended.
- Friable asbestos waste, as defined by 6 CCR 1007-2, Part 1, §1.2, as amended.
- Raw domestic sewage and septage.
- Polychlorinated Biphenyls (PCBs).
- Dioxin
- Used lead acid batteries, used oil, and tires (except tire shreds used as approved ADC), as defined by 6 CCR 1007-2, Part 1, §1.2 and §16, as amended.
- Non-sterilized (non-treated) infectious medical waste.
- Electronic waste as described in the WCP and 6 CCR-1007-2, Part 1, §1.2 and §16, as amended.

Additional wastes that are, or maybe, prohibited for various reasons are identified and discussed in the WCP in Appendix Q.

7.3.3 Waste Screening

To ensure only acceptable waste is disposed of at the facility the ERL implements an active screening program. Signs at the entrance to the ERL notify customers of waste that is not accepted and the gatehouse is equipped with a radiation monitor for identifying wastes containing potentially regulated level of radioactivity. The ERL requires generators wishing to deliver waste to the landfill that require special testing or characterization before a determination can be made on their acceptability complete an application form that describes the source and nature of the waste, and laboratory test results, and a statement by the generator.

Waste arriving at the facility are inspected at the gatehouse. If the waste is visible, the gatehouse attendant may question the transporter as to the nature of the waste. The waste is also observed at the working face for potentially unacceptable materials as it is offloaded and spread out for compaction. The ERL also institutes a random waste screening program where one waste load for every 5,000 tons received is randomly selected for more detailed inspection at the working face.

The gatehouse attendant and employees responsible for operations at the working face receive training in the identification of hazardous and prohibited wastes and screening procedures as discussed in the WCP in Appendix Q.

7.4 Waste Placement and Cover

To minimize the potential for damage to the drainage layer, the first lift of waste placed directly on the protective soil layer will be a minimum of four foot thick and composed of select waste that does not contain materials likely to damage the drainage layer. Trained landfill operators and spotters will observe the waste placement and remove or reorient waste that may potentially disrupt the leachate collection system or the liner and this first lift is not specifically compacted. Landfill equipment and delivery vehicles will not be allowed to operate above the liner and leachate collection system until the select waste layer has been placed.

Landfilling will be done in multiple refuse lifts and numerous refuse cells within the three Modules. Refuse will be placed in a waste cell and kept to the smallest area practical based on the waste volumes received each day. Incoming waste will be spread into layers and compacted with four to six passes of the landfill equipment. The process of layering and compacting is repeated until the compacted waste elevation reaches the intended top of the lift or until the end of the working day.

A six-inch thick daily cover soil layer or approved Alternative Daily Cover (ADC) will be placed over the compacted refuse at the end of each workday. Once an area has reached final grade or an interim grade that will not be disturbed for more than 30 days, a twelve inch thick intermediate soil cover will be placed. Intermediate cover will be graded to minimize erosion and prevent ponding of water.

The ERL is currently approved to use a spray-on product known as Posi-Shell® from Posi-Shell Environmental Coatings or 12-inch nominal shredded tires as an alternative to six-inches of soil used to cover exposed waste at the end of each day. The CDPHE approved the use of Posi-Shell ADC on July 7, 2011 and Adams County approved the material for use on August 11, 2011. The CDPHE and Adams County approved the use of 12-inch nominal shredded tires ADC on September 22, 2016. The request and approval information for both Posi-Shell and 12 inch nominal shredded tire ADCs included in Appendix R. The ERL may request approval for other ADC materials that will be used following approval of the CDPHE and Adams County. The ERL will continue to use a six-inch thick soil cover once per week to mitigate fly infestation in accordance with guidance provided by the CDPHE for other facilities using an ADC. The weekly application of soil cover will also help provide periodic fire breaks within the refuse mass. In accordance with regulations, any refuse disposal area that is unused for a period of 30 days or longer will have a minimum of one foot of intermediate cover soil applied.

The ERL currently has a GCCS. Special care will be taken when filling around GCCS components and will be conducted by experienced personnel. Prior to filling in the vicinity, within 30 feet of a vertical gas wells, extensions will be installed to the vertical well casings. The outside of these vertical well casings will be marked with clearly visible and bright paint to prevent heavy equipment travel from damaging the casing extensions. Some GCCS components, such as condensate traps and variable frequency drives, may be temporarily removed so they may be reincorporated back into the system after filling in an area has ceased.

7.5 Nuisance Control

7.5.1 Litter

Litter is primarily controlled by the application of daily and intermediate cover and by maintaining the smallest practical working face while considering traffic volumes and safety. Additional controls include:

- Temporary and permanent litter control fencing,
- Discouraging uncovered loads through charging a penalty fee
- Litter collection on an as-needed basis, and
- Site closure during high winds.

As stated earlier, perimeter fencing will be installed to completely encircle all active and past disposal areas. Interior in-ground and portable fencing will also be used as necessary to minimize off-site excursions of windblown debris. These litter control fences will be relocated as necessary; typically, the portable fencing will be placed downwind of the active face. The fences will be inspected for the presence of debris on a daily basis and any debris will be removed, weather permitting.

Vehicles transporting uncovered loads to the facility can also be a source of windblown litter. To encourage proper covering of loads, uncovered loads will be charged twice the normal disposal fee.

The site will be closed during high wind events. A high wind event is defined as sustained winds of 40 miles per hour or greater, or gusts of 55 miles per hour or greater, that are expected to persist for one hour or longer. An on-site wind meter will be used to monitor the wind speed in order to allow the landfill manager (or appropriate alternate) to make the determination that a high wind event exists. Upon making that determination, the manager will direct personnel to close the site to additional deliveries and to cover the working face with daily cover as rapidly as possible.

The facility will assess the presence of escaped litter within their property, surrounding private property (only with approval from the property owner), and along the public-rights-of-way listed in this Section within 24 hours of a high wind warning (see definition below) occurring during operation of the facility, with the exception of on Sundays and other days the facility is closed due to weather, holidays, etc. The facility manager will respond promptly to concerns voiced by surrounding property owners with respect to the reasonable cleanup and removal of windblown litter. The patrol and pickup of litter on affected private property will conform to the reasonable requirements of the property owners and only conducted with their permission. Based on the results of this assessment, escaped litter will be collected and returned to the facility as soon as feasible. It is not expected that the exclusion of Sundays and other closure days will decrease the ability of the facility to contain refuse because the refuse will be covered with daily cover material the day prior to the closure so litter will not escape. As an additional measure, the ERL has on-call contracts with temporary labor firms to provide labor for the collection of refuse, including Sundays, holidays, and any other days the facility is closed.

In compliance with Adams County regulation 4-10-02-03-03(h) requiring that the operator remove trash or other waste material, disposed of or treated at their facility, along all public rights-of-way within one (1) mile of the facility and up to five (5) miles along the approved haul routes, or as otherwise specified, the facility will continue to implement the following practice as specified in the August 10, 2009 addendum to the June 1, 2006 EDOP:

1. Facility personnel will patrol the following public-right-of way at least twice per day on days that the facility is open:

    a. Schumaker Road from one mile south of the facility entrance north to the intersection with 88th Avenue.
    b. 88th Avenue between one-mile west to one-mile east of the intersection with Schumaker Road.

2. Facility personnel will collect any litter that appears to have escaped from either the facility or vehicles delivering refuse to the facility and dispose of it properly in the facility.

3. The facility will patrol within their facility at least once per day for the presence of litter.

4. The facility will respond as quickly as feasible to valid complaints of litter from surrounding property owners.

7.5.2 Odor, Vectors & Noise

The major source of odors at the facility is the working face and odors from the working face normally dissipate within a few hundred feet. Daily and intermediate cover control odors from the rest of the facility. In the event odors are a persistent and pervasive problem, alternative remedies will be investigated and implemented as appropriate.

Vectors are controlled by good waste compaction and expeditious application of daily cover. Remedies for nuisance vectors in the event they become a problem include the installation of bird lines, noise guns, and controlled predator introduction within the landfill area. The Bird Mitigation Plan in Appendix D includes procedures that are implemented to control bird population at the facility. Through nearly three years of operation, the procedures implemented at the facility have proven to be very effective in reducing food sources and controlling birds.

Noise will be reduced and controlled by operation of all equipment in a manner consistent with manufacturer recommendations.

7.5.3 Dust

During periods of dry weather and any time that dust is observed leaving the property, haul roads and areas under development will be sprayed with water or dust suppression fluid (e.g., a magnesium chloride solution). The portion of the customer haul road used to access the disposal area is paved with crushed asphalt that inhibits the generation of dust due to traffic. The ERL also has posted speed limit signs at the entrance to the facility and along the customer road to limit the generation of dust due to traffic.

The facility has a valid Title V Operating Permit (Permit No. 10OPAD353) issued by the CDPHE Air Pollution Control Division (APCD) that includes additional dust control measures required by the facility as follows:

- Adequate soil moisture must be maintained in topsoil and overburden to control emissions during removal. Watering shall be implemented if necessary.
- Active material stockpiles shall be watered to control fugitive particulate emissions.
- Topsoil and overburden stockpiles shall be compacted and revegetated within one year.
- Haul roads shall be paved with recycled asphalt aggregate and watered as often as needed to control fugitive particulate emissions such that the above guidelines are met.
- The size of the working face shall be reduced to control fugitive dust emissions during windy days.
- The facility shall cease operations during periods of high winds. High winds are defined as sustained winds of forty (40) miles per hour or greater, or gusts of fifty five (55) miles per hour or greater, that are expected to persist for one hour or longer. The facility shall operate and maintain a wind velocity measuring device capable of determining wind speeds at the landfill site. The main purpose of this requirement is to limit blowing litter, but the implementation of this practice also limits traffic and dust migration during periods of high wind.

The Title V Operating Permit is valid for 5 years and these requirements may change with the issuance of a new Title V Operating Permit. The requirements in the active Title V Operating Permit will supersede the requirements listed above.

In addition, the facility will consider the strategic placement of soil stockpiles and berms on the site to further inhibit dust migration if determined to be effective.

7.5.4 Fire

Waste will not be intentionally burned at this facility. Unintentional waste fires will be extinguished as rapidly as possible using heavy equipment. The burning waste will be excavated and isolated from the non-burning materials. It will be spread on a convenient working surface and the fire smothered under a temporary soil cover. After the waste has cooled, it will be moved to the working face, compacted and covered with the waste being received at that time.

The ERL is within the Bennett Fire Department (BFD) district and the BFD has been provided tours of the facility and has a gate key for access during hours the facility is closed. The BFD has conducted inspections of the facility on an annual basis since opening and it is anticipated they will continue to conduct period inspections. For fire situations that cannot be dealt with internally, the BFD will be contacted, and their phone number is listed on the facilities emergency contact list.

The ERL maintains an area for “hot loads” to isolate any incoming loads that are discovered to be on fire. The ERL maintains fire extinguishers are on heavy equipment (compactors, dozers, graders, etc.).

7.6 Leachate Management

The level of leachate in any newly constructed sump will initially be monitored on a monthly basis and following any large precipitation event. In compliance with regulations, leachate will be removed from the sump prior to reaching a depth of 30 centimeters (12-inches) over the floor on the liner surrounding the sump and either transported off-site for disposal at an appropriate facility or used for dust control on the roads. If leachate samples are to be collected for analysis, they will be analyzed for the same parameters as the groundwater wells. The analysis will provide information on the proper disposal of the leachate (sent to a treatment plant, used for dust suppression, etc.) or for comparison to the groundwater monitoring results.

When monthly measurements indicate that the frequency of measuring leachate levels can be reduced and still maintain compliance with regulations and with Division approval, leachate levels will be checked a minimum of every three months on an ongoing basis. Leachate quality will be monitored (sampled and analyzed) annually and the results will be submitted to the CDPHE and Adams County.

7.7 Personnel Training

Landfill personnel shall be trained in various activities depending on each individual's role in the organization. Training topics may include, but are not limited to the following:

1. Waste Screening and Hazardous Waste Identification: Training will be completed for all employees including the gatehouse staff, equipment operators, and others with responsibility for the working face and disposal operations. More specific details on training requirements are included in the WCP in Appendix Q.
2. Annual Storm Water Management Plan Review and Sampling Requirements and Techniques
3. Annual Spill Prevention, Control, and Countermeasure Plan (SPCC)
4. Waste placement procedures. More detail on specific waste placement and disposal procedures is included in the WCP in Appendix Q.
5. Safety training. Monthly training often includes safety training for various site operations.
6. Miscellaneous other training as it relates to the equipment used at the site and ERL management requirements. An example of this might be training on the use of the trailer tipper and scale.

Training procedures and employee training records will be retained as part of the Operating Record. These records will be made available at reasonable time to CDPHE and Adams County.

7.8 Recordkeeping

The operation will maintain an operating record documenting including a minimum of the following:

- location restriction demonstration
- inspection records, and training procedures
- incoming waste volumes

- waste characterization activities
- ground-water monitoring results
- explosive gas monitoring results
- leachate monitoring results
- construction as-built details
- variations from approved operating procedures
- demonstrations and waiver documentation
- cost estimates and financial assurance documentation
- closure and post-closure care plans and any monitoring, testing, or analytical data

All records contained in the Operating Record will be furnished upon request or be made available at all reasonable times for inspection by Adams County or the CDPHE. The operating record will generally be maintained on-site although some portions of the operating record may be stored at the Five Part offices.

8.0 CLOSURE/POST-CLOSURE PLANS

8.1 General Closure

The site will be closed in increments, as areas reach intermediate cover final grade. These areas may vary in acreage during the life of the landfill. The active gas control system described in Section 6.1 of this EDOP will be incrementally installed during the operational life of the facility. It is anticipated that final portions of the active gas control system and the surface water control system will be installed during final closure of the ERL. Other systems (i.e., ground-water monitoring and landfill gas monitoring) will be installed prior to closure.

8.1.1 Closure Notification and Certification Requirements

Notification and certification requirements for the closure of ERL will include the following:

- 60 days prior to closure, submit written notification to the CDPHE and Adams County that the landfill will be closing.
- 60 days prior to closure, notify the general public of the landfill closure by posting clearly visible signs of a suitable size at the site entrance.
- Enact precautions to prevent further use of the site for unauthorized disposal.
- Water pollution will not occur at or beyond the Point of Compliance after closure.
- Nuisance conditions will not occur at or beyond the site boundary after closure.
- Initiate routine closure activities within 30 days of reaching final design grades in any phase, unless an extension beyond 30 days is granted by the CDPHE.
- Complete closure within 180 days after closure initiation, or if necessary, obtain an extension from the CDPHE.
- Following closure of each area, submit a report certified by a Colorado registered Professional Engineer (P.E.) to the CDPHE documenting that closure has been completed in accordance with the closure plan. Place a copy of the report in the facility operating record.
- Following closure, record a notation on the deed or other title instrument stating that the land was used as a landfill and that future land use is restricted under Section 3.6.1(7) of the CDPHE solid waste regulations. Notify the CDPHE and Adams County Planning that the notation has been recorded and place a copy of the notation in the operating record.

8.1.2 Routine Site Closure

Construction of the final cover system will occur concurrent with the progression of landfilling operations. As final design grades are reached, final cover will be completed and certified by a Colorado P.E. in accordance with the EDOP and CQA Plan. By employing this "close as you go" process, only a limited portion of the fill area will require final cover construction after site closure. Final closure activities will begin within 30 days of reaching the final design grades for the final portion of the site unless an extended time period has been granted by the CDPHE. After the site is closed, no off-site waste will be accepted for disposal. However, any refuse generated on site as a result of construction activities will continue to be disposed of in the landfill until final cover placement has been completed.

8.1.3 Closure Requirements

As noted previously, the site will be closed in increments, as areas reach final grade. These areas may vary in acreage during the life of the landfill and will be based on the configuration of the area ready for final cover that is large enough in size to make final cover installation economically feasible. Final cover will be placed within 30 days of reaching final refuse grades in any phase in accordance with Regulations and closure of each phase will be completed within 180 days of commencing final cover placement. Due to seasonal, budgetary, or contractor availability these time frames may be extended with approval from the CDPHE and Adams County. A report documenting the final cover installation work will be submitted to CDPHE and Adams County for review and approval.

The ERL final cover system is redesigned as part of this EDOP revision. The proposed final cover design is an option of either a 3.5-foot thick Alternative Final Cover (AFC) or a LLDPE lined cover with a 1.5-foot thick layer of cover soils including a 1 foot thickness of protective soils and a 6-inch thick vegetative layer. The proposed top of the final cover grades and elevations are shown on Plate 4. AFC material requirements, placement methods, testing requirements, and CQA criteria are also provided in the revised CQA Plan. The AFC will be seeded with a mixture of cool and warm weather grass species as presented in the CQA Plan and any fertilizer and amendments will be applied after testing the soils to be vegetated. Because a one-foot thick intermediate soil cover is required for any waste placement areas not used for at least one month, the final lift of waste in any area may require intermediate cover. If the intermediate cover meets all of the material and placement criteria for an AFC, it may be left in place as part of the final cover system. Alternatively, the required minimum thickness of AFC may be constructed on top of the intermediate cover or the intermediate cover may be removed prior to installation of the final cover. Regardless of the presence of intermediate final cover, the final grades and elevations at the top of the final cover system will conform to those shown on Plate 4.

A financial assurance instrument consistent with those acceptable under the CDPHE solid waste regulations covering the cost of closure has been established for the ERL. The closure cost estimate will be revised every five years to reflect the remaining closure liability for the subsequent five-year period or more frequent if necessary to reflect a change in the design or maximum area assumed open at any one time. The cost estimate will be adjusted annually to account for inflation in the intervening years. The annual adjusted cost estimate will be submitted to the CDPHE by April 30th of each year.

8.1.4 Early Closure Scenario Provisions

The facility is designed with a specific area designated for refuse and specific final grades and elevations based on a designed refuse capacity needed to achieve these grades and elevations. The CD for the facility includes an expiration date of June 29, 2039. While the CD may be renewed at that time, the potential exists that the CD may not be renewed, and the facility will be forced to close prior to reaching the design elevations and grades. The following protocol for early closure in the case that the facility is not filled to design elevations, and the CD is allowed to expire was included in the August 10, 2009 amendment to the 2006 EDOP and has received approval from the CDPHE and Adams County.

In the case that the CD is allowed to expire and no new CD is issued, and the facility has not reached approved design grades, the owner will evaluate the existing condition of the facility by taking the following steps:

1. The existing refuse fill area and other pertinent site features will be surveyed to determine the magnitude of differences between the existing conditions at closure and the approved final closure conditions.
2. The existing site monitoring system will be evaluated to determine if any changes are necessary to the approved monitoring system to comply with regulatory requirements based on the existing conditions at closure.
3. The surface water drainage and control system will be evaluated to determine if any changes to the approved system are required to comply with regulations based on the existing conditions at closure.
4. An evaluation of the volume and type of soils required to close the facility in compliance with regulations and the soils available on site to conduct closure.

After completion of the above efforts, the owner will develop an alternative closure plan that will address the following:

1. The type and thickness of the final cover system
2. Final slopes on the refuse filling area must be constructed with a maximum of 4H:1V and a minimum of 5%.
3. The surface water drainage and control structures must be designed to comply with regulations considering the existing landfill footprint at closure.
4. A soil balance evaluation discussing the soil needs and soil availability.
5. A groundwater and methane monitoring program specific to the configuration of the facility upon closure.
6. Updated financial assurance costs to reflect the necessary closure and post-closure efforts based on the configuration of the facility upon closure.
7. The facility's ability to provide notification in compliance with regulatory requirements given the timing of the notice that the CD will not be renewed.

The alternative closure plan will be submitted to Adams County and the CDPHE for their review and approval prior to initiating final closure.

8.2 Post-Closure

8.2.1 General

The site will be maintained for a post-closure care period of a minimum of 30 years after the date of final site closure. The site is expected to remain in a vegetated undeveloped state during the post-closure care period; however, other uses may occur as long as the final cover and other control/monitoring systems are not disturbed.

8.2.2 Monitoring

During the post-closure care period, the following environmental/physical monitoring will be conducted.

1. Ground-water monitoring will be performed on a semi-annual basis during the 30-year period. Analytes, methods and reporting will be as described in Section 6.3 of this document or alternative requirements with approval from the CDPHE and Adams County.

2. Explosive gas monitoring will be performed on a quarterly basis during the 30-year period and the methods and reporting will be as described in Section 6.2 of this document unless an alternative schedule is approved by the CDPHE and Adams County.

3. Leachate levels in the sumps will be checked on the Division approved monitoring schedule (monthly or quarterly as described in Section 7.6).

4. Leachate sampling and analysis will be performed on an annual basis during the post-closure care and maintenance period. Leachate levels will also be taken during the annual sampling and may be used to increase the frequency of leachate level measurements to ensure compliance with regulations. Analytes, methods and reporting will be as described in Section 6.3 of this document.

5. Overall site conditions will be inspected on a semi-annual basis. Items covered by the inspections include, but not necessarily limited to; erosion of the final cover and surface water control structures, the success of the vegetation on the final cover and other areas on the site than have been revegetated, and the condition of the environmental monitoring system including the groundwater wells and gas monitoring probes, the active gas collection and control system, and the condition of the security systems at the site such as fencing, gates, and locks, and verification that all required monitoring has been completed according to the approved schedule. A typical list of items for inspection is included in Appendix S and will be used for reference during the inspections. The results of the inspections will be maintained in the Operating Record for the facility through the post-closure period.

As data are developed on the performance of the site during the post-closure care period, the operator may petition CDPHE and Adams County for changes in the scope and frequency of the above described post-closure monitoring.

8.2.3 Explosive Gas Control

As discussed in Section 6.1, the landfill installed an active gas collection and control system. The system will be operated until emissions from the facility meet the requirements of and are demonstrated to the Colorado Air Pollution Control Division to cease operation of the system. The approval of Adams County and the CDPHE is required to cease operation of the gas control system prior to the end of the post-closure period. All NSPS requirements will be complied with during this time.

8.2.4 Access Control

The perimeter fencing and locking gate will be retained and maintained throughout the post-closure care period to limit unauthorized access to the site.

8.2.5 Financial Assurance

A financial assurance instrument consistent with those acceptable under the CDPHE solid waste regulations covering the cost of post-closure care has been established and in force since the facility opened. The post-closure cost estimate will be revised every five years to reflect the remaining post-closure care requirements. The cost estimate will also be adjusted annually to account for inflation. The annual inflation adjusted cost estimate will be submitted by April 30th of each year. Additionally, since closure will be completed as the landfill reaches final elevations incrementally, the post-closure periods may be staggered and portions of the landfill may be taken out of the post-closure funding over time with approval from the CDPHE and Adams County.

8.2.6 Completion

CDPHE and Adams County will be notified when the post-closure care obligation has been met. The notification will consist of a certification from an independent Colorado registered professional engineer that the post-closure care has been completed in accordance with this post-closure care plan.

9.0 REFERENCES

1. IC, 1993, Engineering Design and Operations Plan for the Metropolitan Coal Ash Disposal Facility, prepared for Five Part Development Company, Industrial Compliance Project Number 061 4369, December 21.

2. Earth Quake Potential in Colorado, Bulletin 43, Colorado Geological Survey, 1981

3. Flood Insurance Rate Map, Adams County Colorado, Community Panel Number 080001 0210A, Effective Date 1979, Department of Housing and Urban Development

4. Colorado Landslide Hazard Mitigation Plan, Colorado Geological Survey, Colorado Division of Disaster Emergency Services, University of Colorado Center for Community Development and Design, 1988

5. Guidelines and Criteria for Identification and Land-Use Controls of Geologic Hazard and Mineral Resource Areas, Colorado Geological Survey, 1974

6. Subsidence Above Inactive Coal Mines, Colorado Geological Survey and Colorado Mine Land Reclamation Program, 1985

7. USGS Open File Report 82-1033, Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous. United States, 1982

8. Soil Survey of Adams County, USDA, SCS and Colorado Agricultural Experiment Station, 1984

9. Engineering Design and Operations Report - Certificate of Designation, Shale Mine Ash Backfill Project, Western Aggregates, Inc.(1992)

10. Specific Yield-Compilation of Specific Yields for Various Materials, Geologic Survey Water-Supply Paper 1662-D (1976)

11. Conservation Services, Incorporated, Design and Operations Plan, October 4, 1991.

12. 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

13. Geological Structure, Hydrology, and Water Quality of the Arapahoe Aquifer in the Denver Basin, Colorado. Robson and others, USGS Atlas HA-647, 1981

14. Geological Structure, Hydrology, and Water Quality of the Denver Aquife~.in the~ Denver Basin, Colorado. Robson and Romero, USGS Atlas HA-646, 1981

15. Managing Power Plant Wastes, Power Magazine (1991), Issue #135, page 97

Table 1

Volumes and Soil Balance

AEC

Table 1-A

ERL Permitted v. Proposed Capacity and Remaining Soil Requirements[1]		
Existing Gross Airspace (top of liner to top of final cover)[2]	**11,640,618**	CY
Expanded Gross Airspace (top of liner to top of final cover)[2]	**22,566,116**	CY
Existing Total Waste Airspace (top of protective soil to bottom of synthetic final cover)[3]	**11,420,937**	CY
Expanded Total Waste Airspace (top of protective soil to bottom of synthetic final cover)[3]	**22,022,035**	CY
Remaining Waste Airspace without expansion (2024 topo basis)[4]	**5,657,467**	CY
Remaining Waste Airspace after Expansion (2024 topo basis)[4]	**16,258,565**	CY
Current Waste in Place (total waste airspace minus remaining waste airspace)	**5,763,470**	CY
Total Area	132.4	Acre
Module 1	61.2	Acre
Module 2	36.1	Acre
Module 3	35.1	Acre
SOIL REQUIREMENTS		
General Fill Soil Required to Bring Subgrade Up in Future Cells[5]	35,535	CY
General Fill Soil Required to Outside of Cells[6]	21,852	CY
Protective Cover Soil over Liner Needed for future cells[7]	94,577	CY
Final Cover Soil Volume Required[8]		
Water Balance Alternative Final Cover (AFC) (3.5-foot-thick soil)	772,449	CY
Synthetic Geomembrane Final Cover (1.5-foot-thick soil)	353,048	CY
Soil for Tack On Berms[9]	58,317	CY
Remaining Daily/Int Cover Required (10% of Remaining Airspace)	1,625,856	CY
Remaining Soil Volume Required		
Total Soil Required Using AFC	**2,608,586**	CY
Using Synthetic Final Cover	**2,189,185**	CY
Available Soil from future Excavation[10]	1,292,819	CY
Soil Deficit		
Soil Deficit using AFC	**-1,315,767**	CY
Soil Deficit using Synthetic FC	**-896,366**	CY

Notes:

1 All existing conditions calculations are based on the topography from April 22, 2024. All volume units "CY" are bank cubic yards.

2 Gross Airspace includes volume from top of liner to top of final cover (including previously filled areas). Includes the 1-ft protective (operations layer) soils. All future cells will be lined with synthetics, and so they do not require any site soils.

3 Total Waste Airspace is the volume available for solid waste and daily/intermediate cover in the entire landfill (including previously filled areas) without the 1-foot protective (operations layer) soil and without the 1.5-foot final cover soil required for the synthetic final cover option. If the AFC final cover option is used, the total waste airspace volume will be reduced to accommodate the additional two feet of soil used in the final cover construction.

4 Remaining Waste Airspace is the remaining volume available for solid waste and daily/intermediate cover in the landfill. It is the volume from the 2024 existing top of waste in Cells 1-5 (already constructed at this time) and from the top of protective (operations layer) in future cells, to the base of the 1.5-foot-thick synthetic final cover system. If the AFC final cover option is used, the remaining waste airspace volume will be reduced to accommodate the additional two feet of soil used in the final cover construction.

5 Volume of soil required to fill the 2024 existing ground surface to the design excavation grades in the future cells, within the limit of waste.

6 Volume of soil required to fill the 2024 existing ground surface to the design excavation grades in the future cells, outside of the limit of waste. This is primarily the volume of soil required to build perimeter surface water control features and to build the portions of side slopes outside the limits of waste.

7 Volume of soil required to construct the 1-foot protective/operations layer atop the liner in future cells.

8 Volume of soil required to build the final cover system. There are two final cover options in the EDOP: a synthetic geomembrane final cover which requires an additional 1.5 feet of soil, and a water-balanced (alternative) final cover system requiring 3.5 feet of soil. These volumes do not include intermediate cover, which is budgeted separately.

9 Additional soil required to construct the surface water control berms atop the final cover.

10 Soil gained by excavating from the 2024 existing ground surface to the design excavation grades in future cells.

Table 1-B

ERL Permitted v. Proposed Site Life Estimate				
Existing Remaining Airspace (Waste and Daily/Intermediate Cover)	5,657,467	cy		
Expanded Remaining Airspace (Waste and Daily/Intermediate Cover)	16,258,565	cy		
Volume of daily/intermediate Soil Cover Used	15%	of airspace volume =	848,620	cy existing
			2,438,785	cy expanded
Volume of Waste Remaining without Expansion =	4,808,847	cy		
Volume of Waste Remaining after Expansion =	13,819,780	cy		
Volume of Waste Airspace Landfill Used Daily =	2,000	cy		
Existing Remaining Days of Site Life =	2,404	days		
Expanded Remaining Days of Site Life =	6,910	days		
Days Open Per Year =	260	days		
Existing Years of Remaining Site Life =	9.2	years		
Expanded Years of Remaining Site Life =	26.6	years		

Figure 1

Site Location Map

AEC

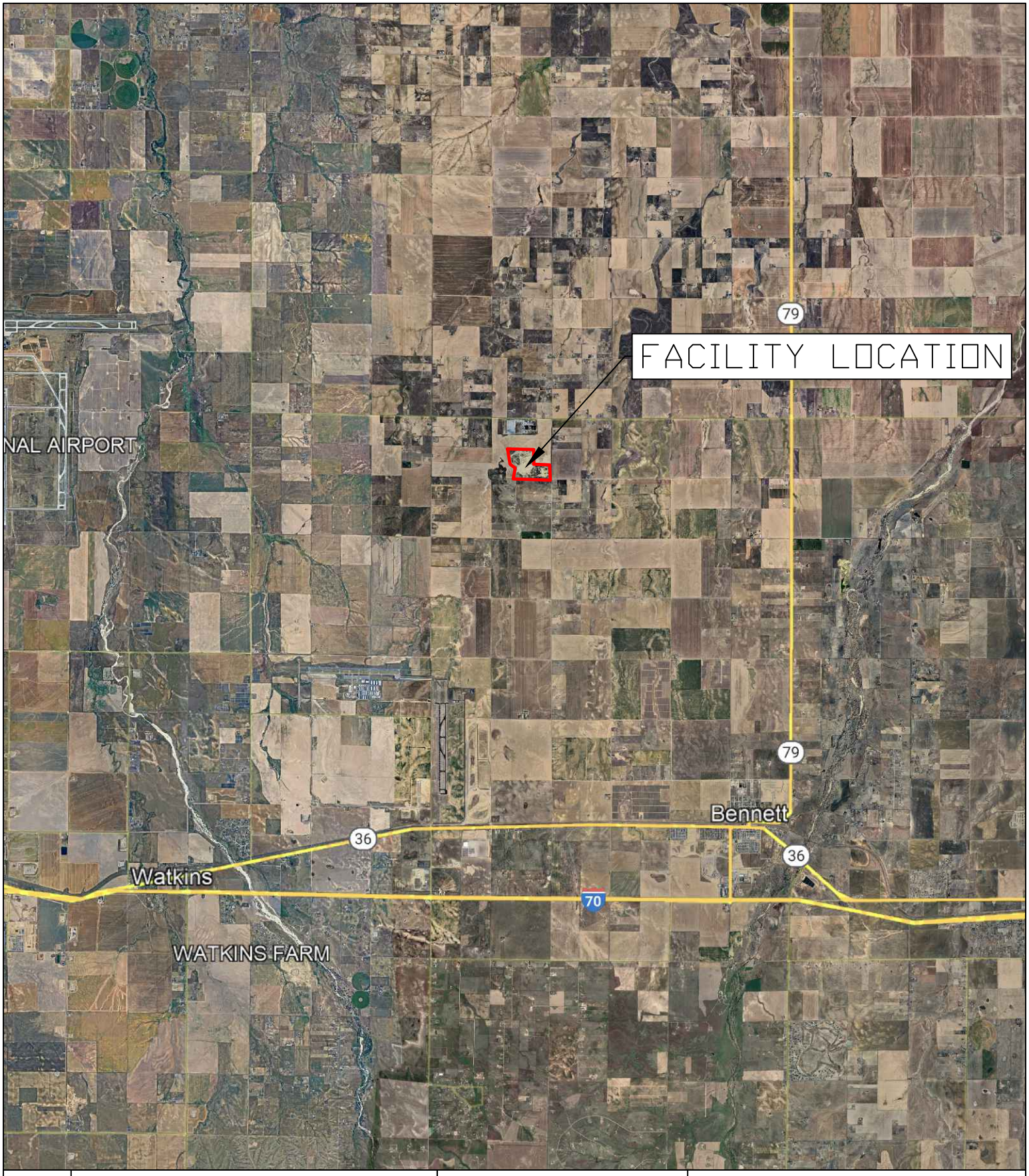


FIGURE 1 OF 2

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

AEC

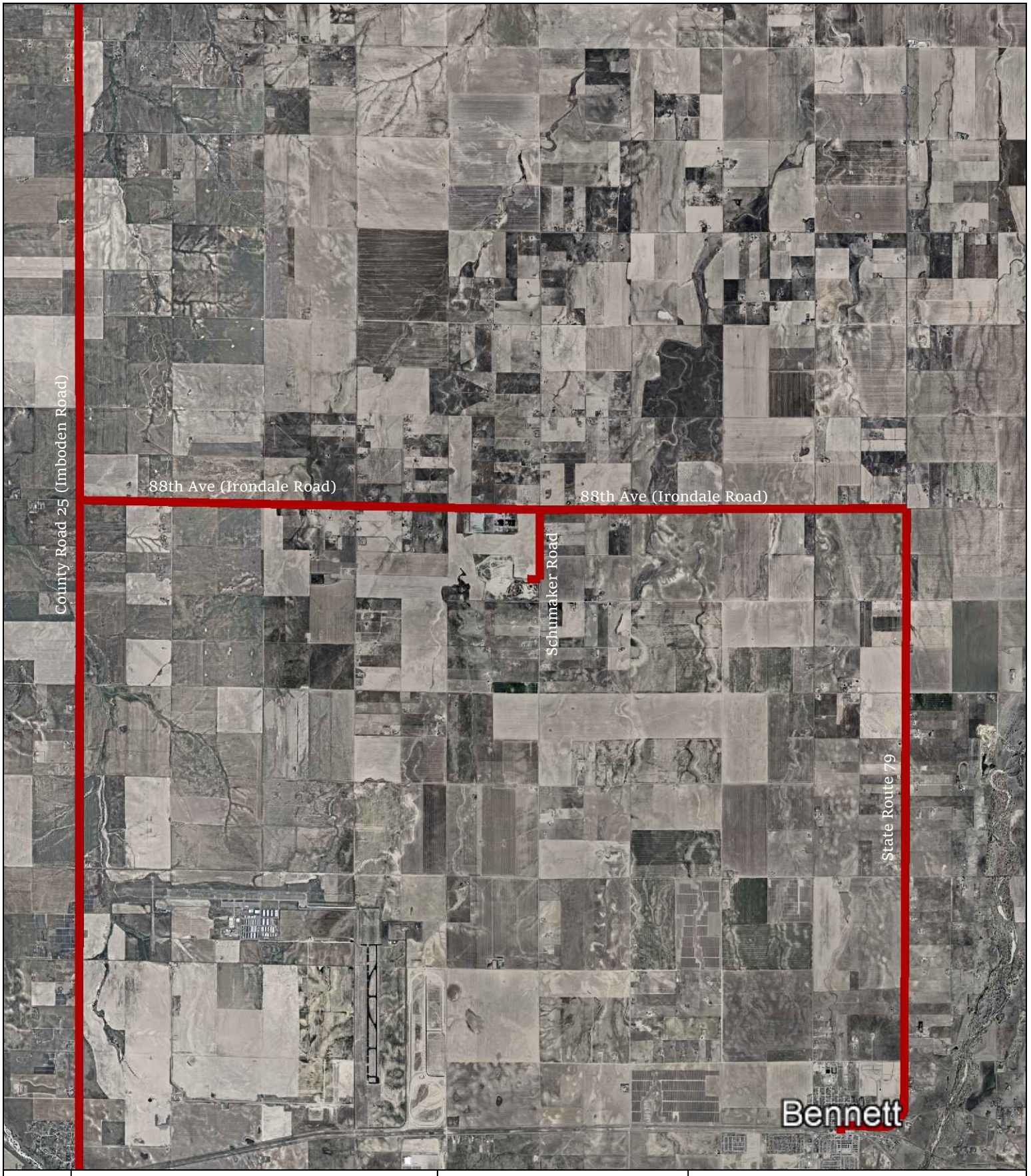


FIGURE 2 OF 2

ERL HAULING ACCESS ROUTES

ERL EXPANSION EDOP

ADAMS COUNTY

DATE: 12/4/2024 DRAWN BY: RDS

0 KM 5 KM

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.

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

Drawings

AEC

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

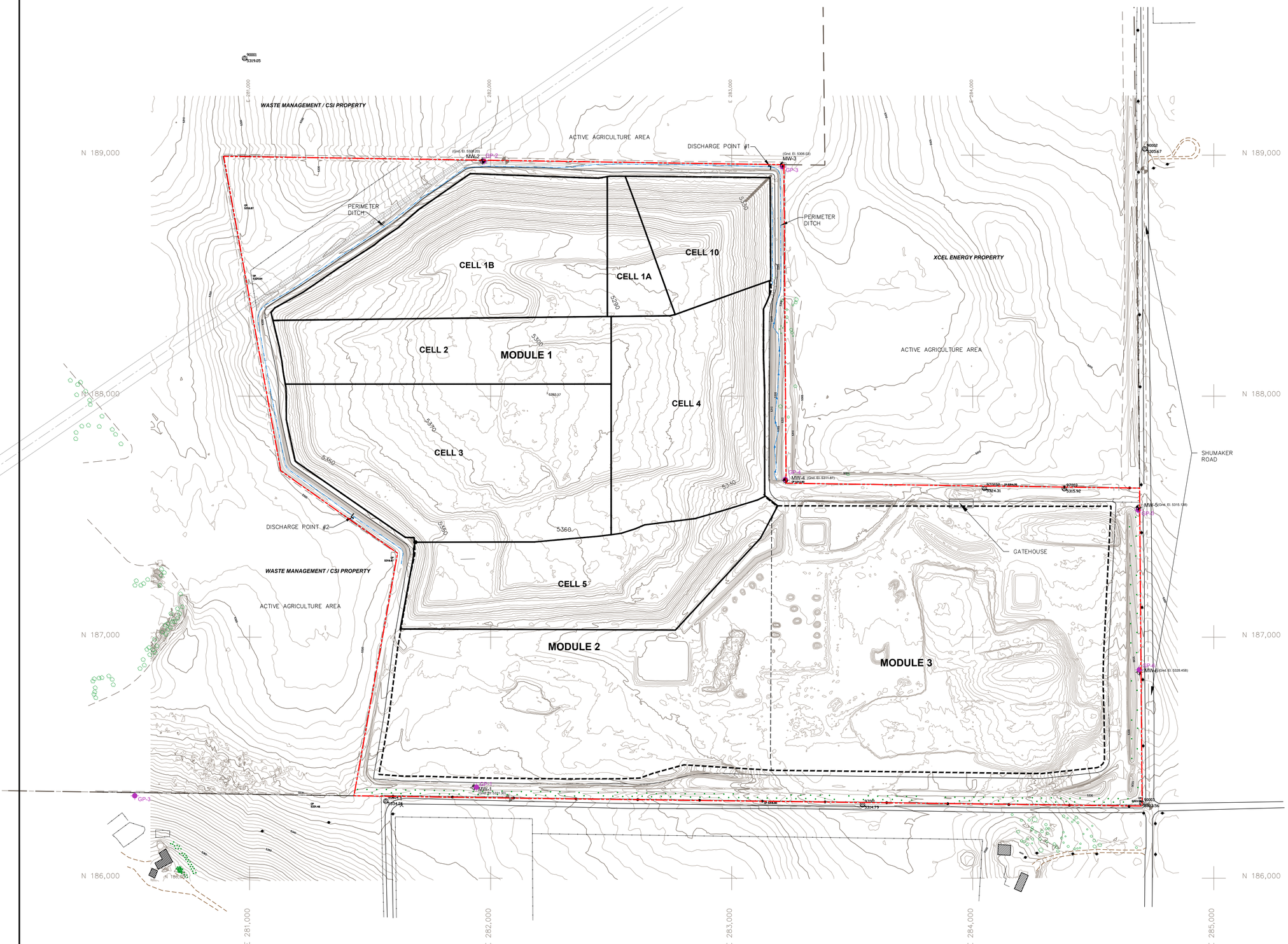
PREPARED BY:
AMERICAN ENVIRONMENTAL CONSULTING, LLC
8191 SOUTHPARK LANE
SUITE 107
LITTLETON, COLORADO 80120

COLORADO REGISTERED
TIMOTHY A. CHAMBERLAIN
31343
9-6-24
PROFESSIONAL ENGINEER

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

- EXISTING CONTOURS (2 FT. INTERVAL)
- EXISITNG AS–BUILT CELL LIMITS
- PROPOSED LIMIT OF WASTE
- PROPERTY LIMIT (BY R.W. BAYER & ASSOCIATES, 2007)
- 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
- EXISTING GROUND WATER MONITORING LOCATION (APPROXIMATE HIGH GROUNDWATER ELEVATION)
- EXISTING GAS MONITORING WELL LOCATION
- LANDSCAPED SCREENING BERM
- SCREENING TREE LOCATION
- SCREENING BUSH LOCATION

COLORADO REGISTERED
LIANA A. CIVCO
37843
9-6-24
PROFESSIONAL ENGINEER

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

N

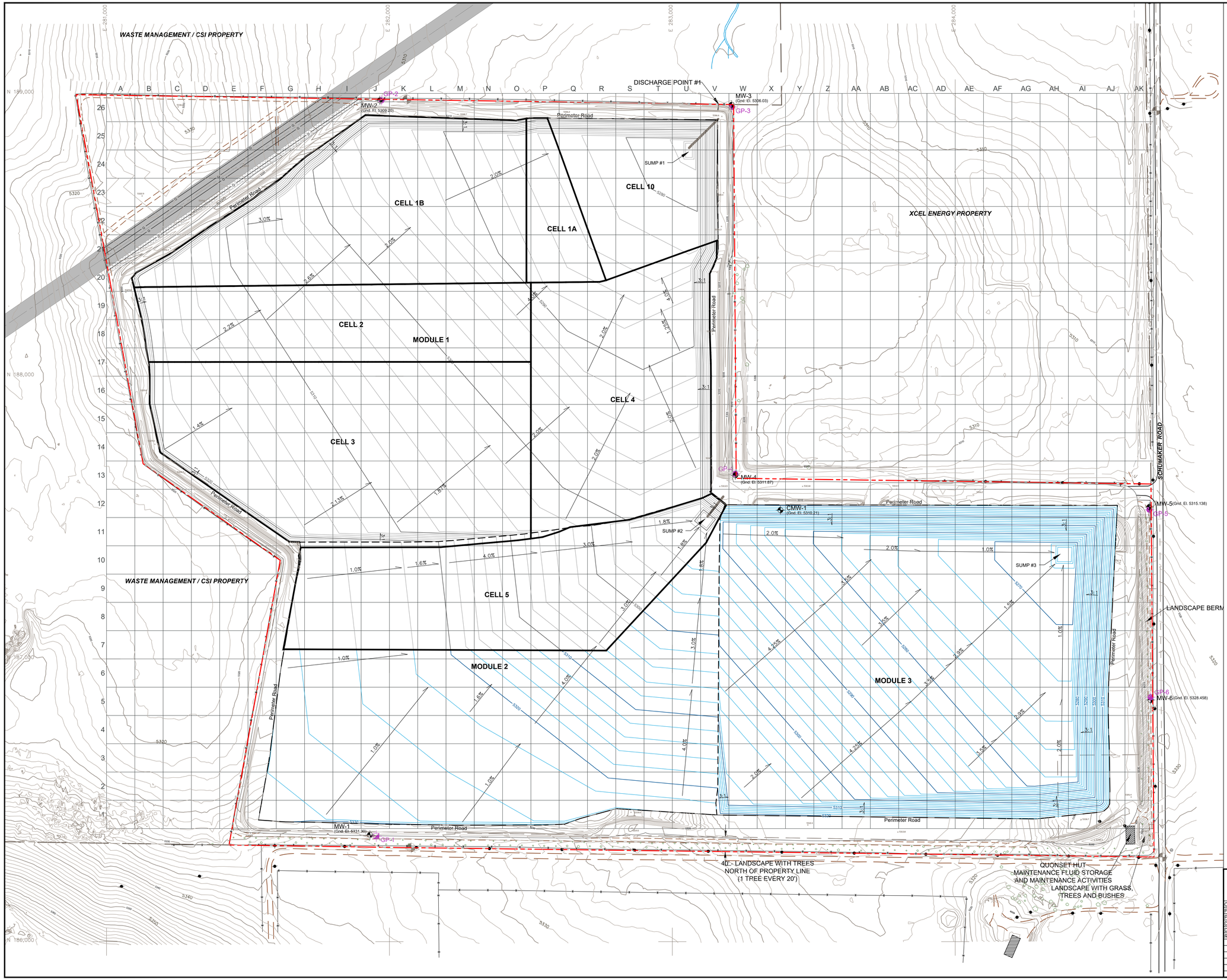
0 75 150 300
APPROXIMATE SCALE (FEET)

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	
PROJECT NO:	DATE COMPLETED: 12/24
DESIGNED BY: AEC	APPROVED BY:
DRAWN BY: RDS	DWG NAME: PLATE 2 ERL – EXISTING COND
REVISION:	REVISED BY: DATE:
0 ISSUED FOR REVIEW	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



LEGEND

- EXISTING CONTOURS (2 FT. INTERVAL)
- 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)
- MW-3 (Gnd. El. 5306.03) EXISTING GROUND WATER MONITORING LOCATION
- GP-2 EXISTING GAS MONITORING WELL LOCATION
- ACTIVE AGRICULTURAL AREA
- EXISTING BUILDING
- EXISTING SUMP RISER PIPE
- LANDSCAPED SCREENING BERM
- SCREENING TREE LOCATION
- SITE AREA GRID SYSTEM

Notes:
See legal discription for precise location of property boundary.
The Module 1 sump is 24.3' x 49.5' on the bottom and 4' below the surrounding subgrade
The Module 2 sump is 42.0' x 38.0' on the bottom and 4' below the surrounding subgrade
The Module 3 sump is 49.8' x 50.0' on the bottom and 4' below the surrounding subgrade

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:
1. 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.
2. Monitoring of probes and wells must begin concurrent with the installation schedule shown above.

N

0 75 150 300
APPROXIMATE SCALE (FEET)

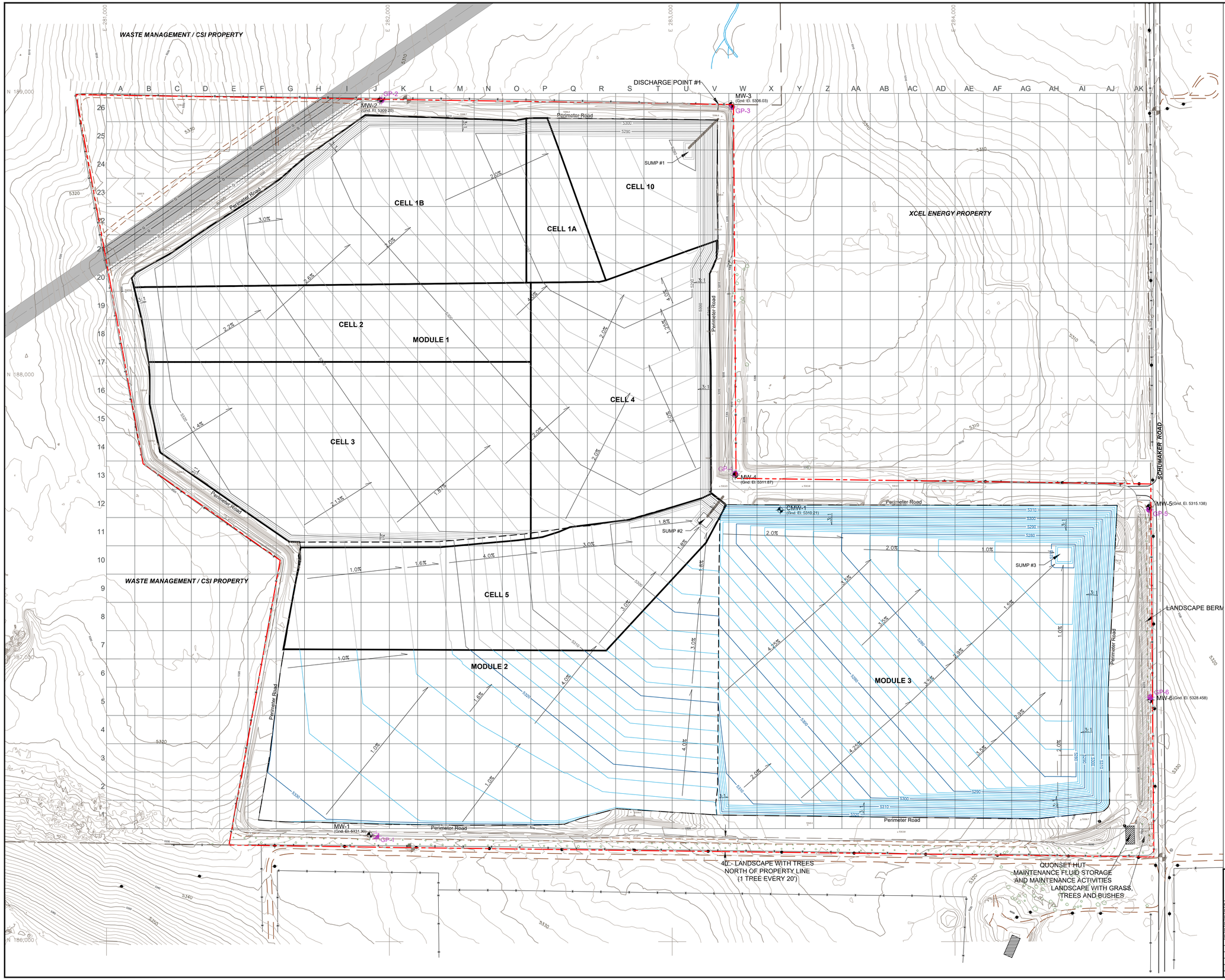
CONTOUR INTERVAL: 2'
DATE OF TOPOGRAPHY FLIGHT: 1-13-20

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

CLIENT: FIVE PART DEVELOPMENT, LCC	
PROJECT: 2024 EXPANSION EDDP	
PROJECT NO:	DATE COMPLETED: 8/2013
DESIGNED BY: MAM	APPROVED BY: MAM
DRAWN BY: TML	DWG NAME: PLATE 3A - CCL EXCAVATION PLAN.dwg
REVISION:	REVISED BY: RDS DATE: 12/24

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
- G — GAS PIPELINE
- SECTION MARKER (NOT VARIFIED)
- MW-3 (Gnd. El. 5306.03) — EXISTING GROUND WATER MONITORING LOCATION
- GP-2 — EXISTING GAS MONITORING WELL LOCATION
- ACTIVE AGRICULTURAL AREA
- EXISTING BUILDING
- EXISTING SUMP RISER PIPE
- LANDSCAPED SCREENING BERM
- SCREENING TREE LOCATION
- SITE AREA GRID SYSTEM

Notes:
See legal discription for precise location of property boundary.
The Module 1 sump is 24.3' x 49.5' on the bottom and 4' below the surrounding subgrade
The Module 2 sump is 42.0' x 38.0' on the bottom and 4' below the surrounding subgrade
The Module 3 sump is 49.8' x 50.0' on the bottom and 4' below the surrounding subgrade

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:
1. 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.
2. Monitoring of probes and wells must begin concurrent with the installation schedule shown above.

0 75 150 300
APPROXIMATE SCALE (FEET)

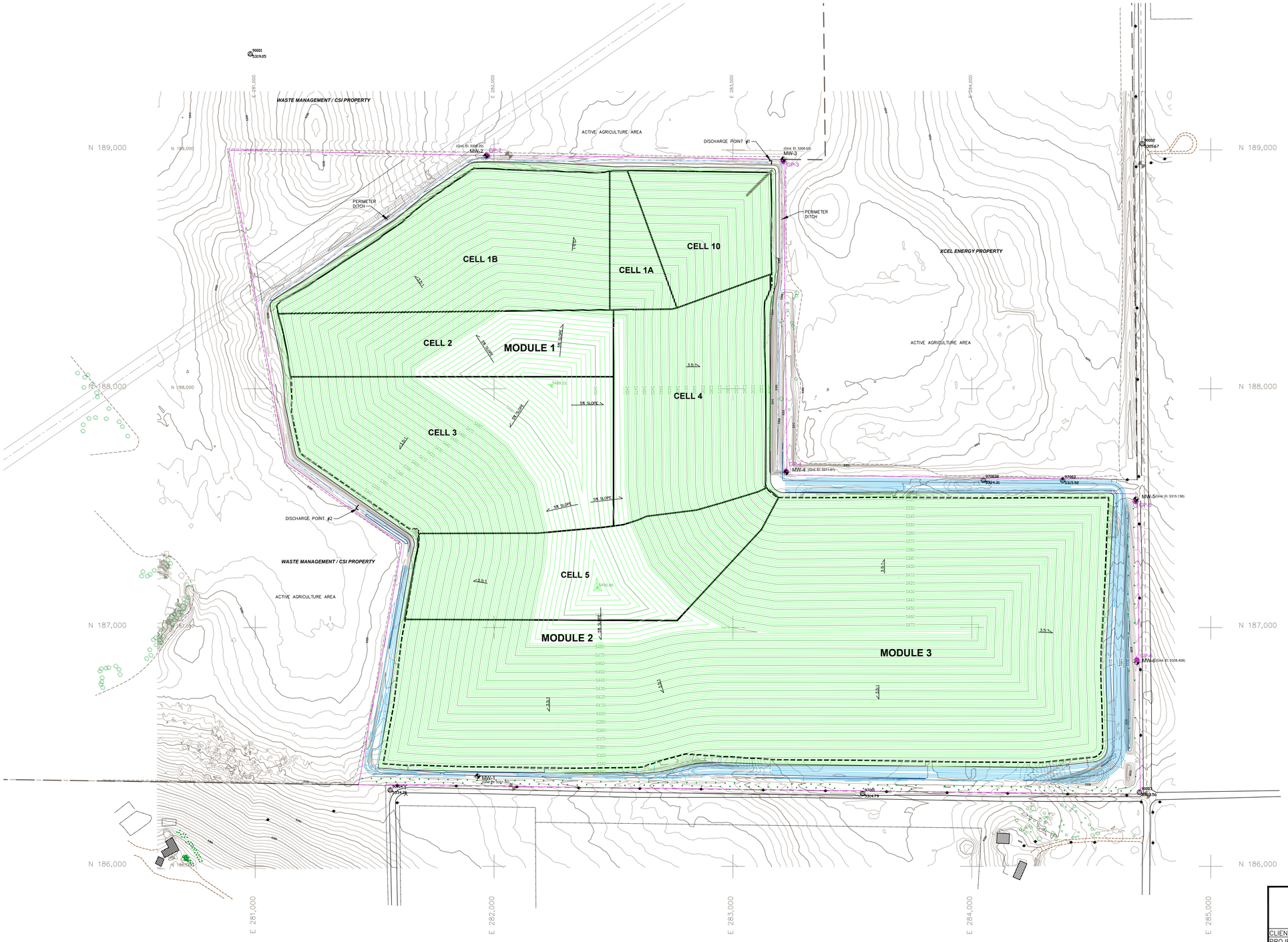
CONTOUR INTERVAL: 2'
DATE OF TOPOGRAPHY FLIGHT: 1-13-20

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

CLIENT: FIVE PART DEVELOPMENT, LLC	
PROJECT: 2024 EXPANSION EDDP	
PROJECT NO:	DATE COMPLETED: 8/2013
DESIGNED BY: MAM	APPROVED BY: MAM
DRAWN BY: TML	DWG NAME: PLATE 3B - GCL EXCAVATION PLAN.dwg
REVISION:	REVISED BY: RDS DATE: 12/24

1	ISSUED FOR REVIEW
2	UPDATE TO CURRENT, NO DESIGN CHANGE

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



LEGEND

- LIMIT OF WASTE
- PROPOSED 3.5 TO 1 SLOPE TOP OF COVER CONTOURS (2 FT. INTERVAL)
- PROPERTY LIMIT (BY R.W. BAYER & ASSOCIATES, 2007)
- CONTROL POINTS
- 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

TOTAL AIRSPACE VOLUME SUMMARY:

Fill (cu. Yds.)

Permitted Top of Cover	11,640,618
ADDITIONAL AIRSPACE FROM TOP OF PERMITTED FINAL COVER	
3.5:1 top of Cover	10,925,498

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

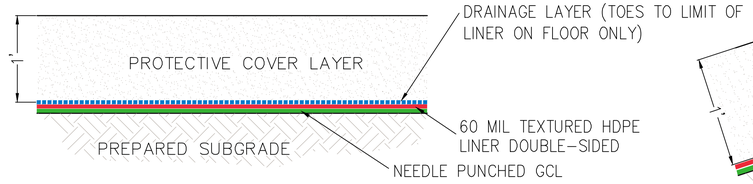
0 100 200 400
APPROXIMATE SCALE (FEET)

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

PLATE 4
EAST REGIONAL LANDFILL PROPOSED FINAL COVER PLAN
ALLIED WASTE SYSTEMS OF COLORADO
ADAMS COUNTY

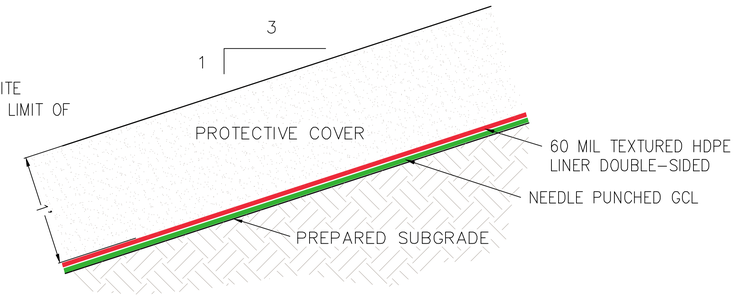
CLIENT: FIVE PART DEVELOPMENT, LLC		
PROJECT: VERTICAL EXPANSION		
PROJECT NO:	DATE COMPLETED: 8/2024	
DESIGNED BY: CJA	APPROVED BY: BC	
DRAWN BY: TML	DWG NAME:	
REVISION:	REVISED BY: RDS	DATE: 05/26
0 ISSUED FOR REVIEW		
1 REV FOR ADCO COMMENTS		

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



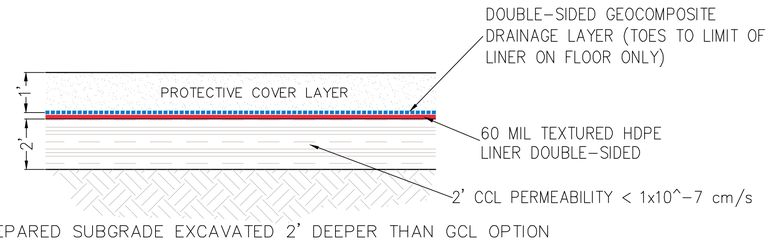
SECTION THROUGH LINER ON BOTTOM OF LANDFILL

DETAIL 5/1
SCALE: N.T.S.



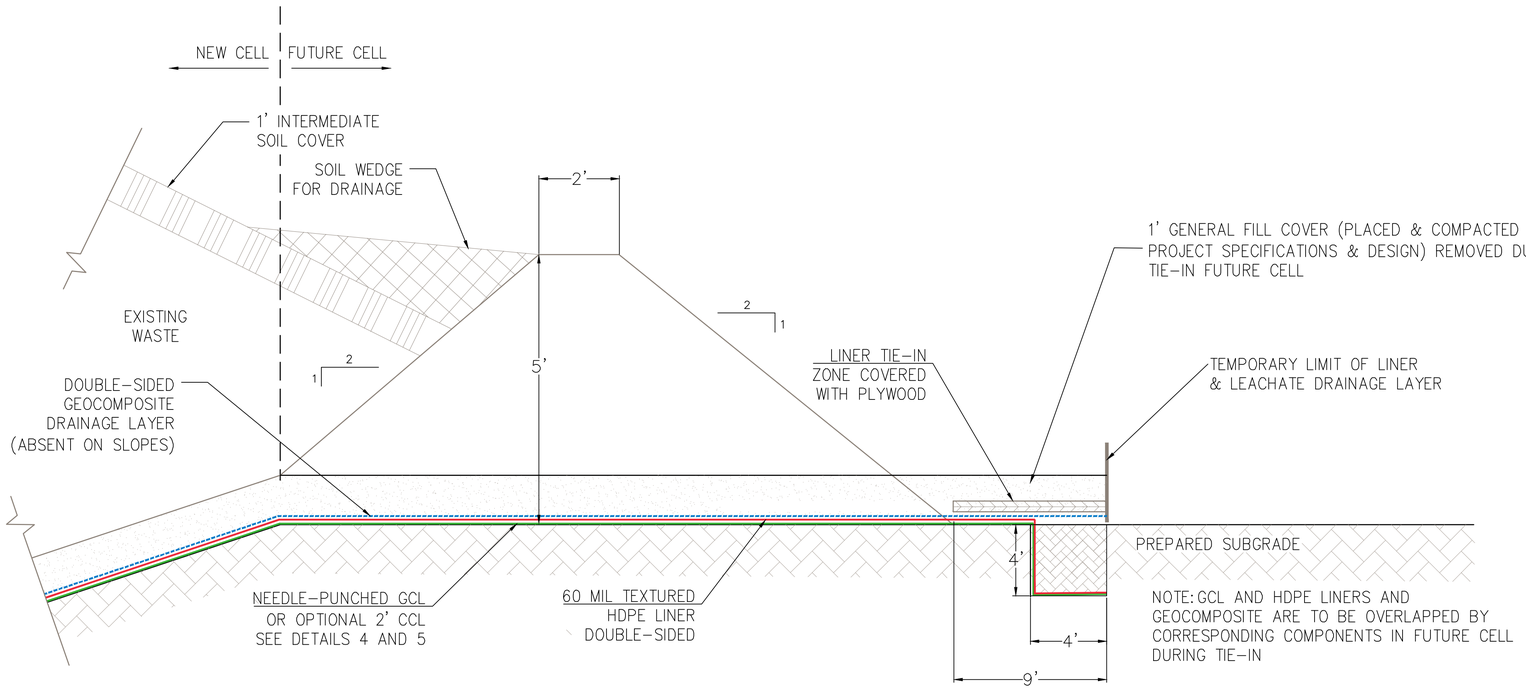
SECTION THROUGH LINER ON SIDE-SLOPE

DETAIL 5/2
SCALE: N.T.S.



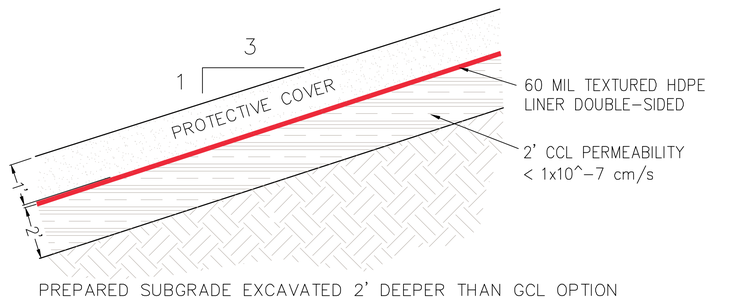
SECTION THROUGH LINER ON BOTTOM OF LANDFILL WITH OPTIONAL CCL

DETAIL 5/4
SCALE: N.T.S.



TYPICAL TEMPORARY BERM TIE IN

DETAIL 5/3
SCALE: N.T.S.



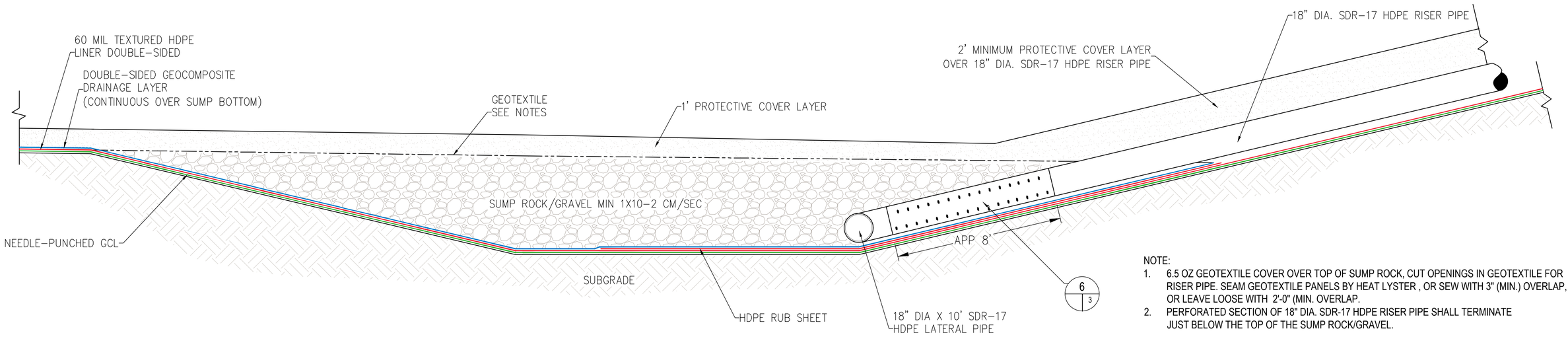
SECTION THROUGH LINER ON SIDE-SLOPE WITH OPTIONAL CCL

DETAIL 5/5
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	

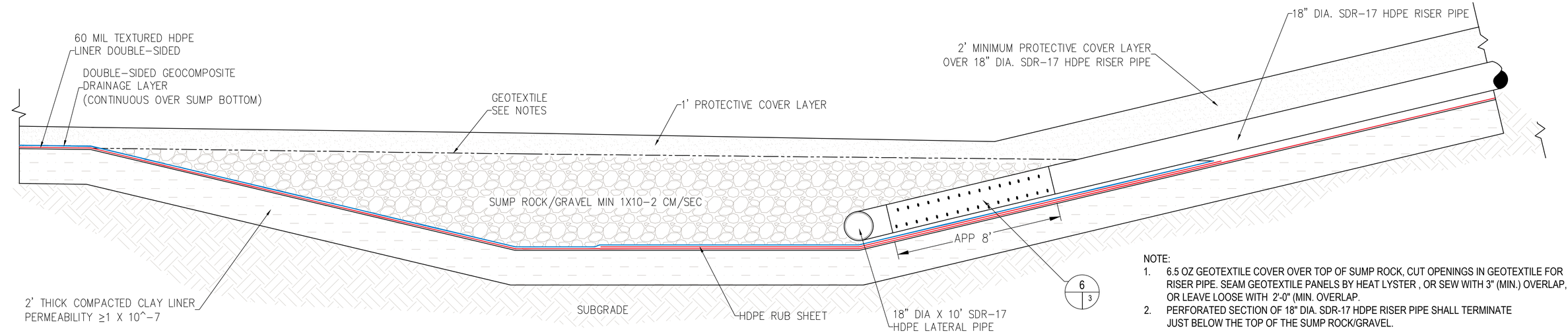
AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



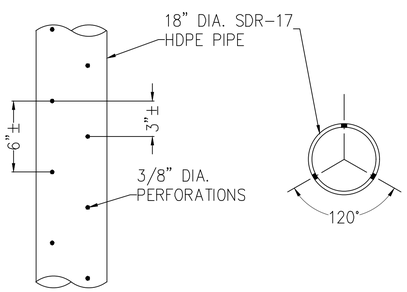
NOTE:
1. 6.5 OZ GEOTEXTILE COVER OVER TOP OF SUMP ROCK, CUT OPENINGS IN GEOTEXTILE FOR RISER PIPE. SEAM GEOTEXTILE PANELS BY HEAT LYSTER , OR SEW WITH 3" (MIN.) OVERLAP, OR LEAVE LOOSE WITH 2'-0" (MIN. OVERLAP.
2. PERFORATED SECTION OF 18" DIA. SDR-17 HDPE RISER PIPE SHALL TERMINATE JUST BELOW THE TOP OF THE SUMP ROCK/GRAVEL.

SUMP GCL OPTION - SECTION

DETAIL 6/1
SCALE: N.T.S.



NOTE:
1. 6.5 OZ GEOTEXTILE COVER OVER TOP OF SUMP ROCK, CUT OPENINGS IN GEOTEXTILE FOR RISER PIPE. SEAM GEOTEXTILE PANELS BY HEAT LYSTER , OR SEW WITH 3" (MIN.) OVERLAP, OR LEAVE LOOSE WITH 2'-0" (MIN. OVERLAP.
2. 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 6/3
SCALE: N.T.S.

SUMP CCL OPTION - SECTION

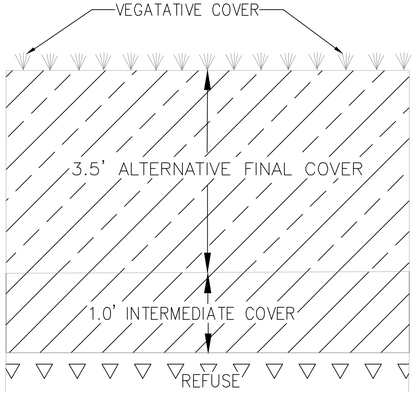
DETAIL 6/2
SCALE: N.T.S.

COLORADO REGISTERED ENGINEER — 31043 — 9-6-24 — PROFESSIONAL ENGINEER

PLATE 6
SUMP DETAILS
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

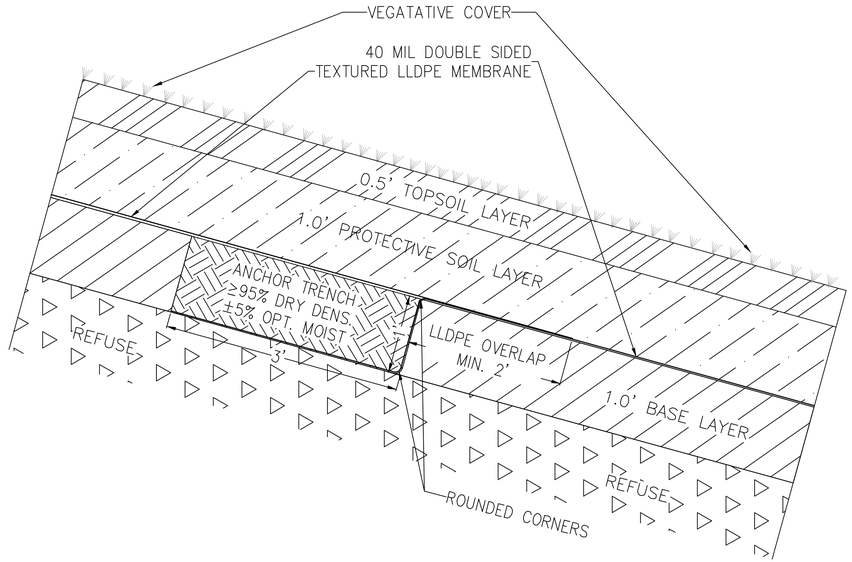
CLIENT: FIVE PART DEVELOPMENT, LCC		
PROJECT: 2024 ERL EXPANSION		
PROJECT NO:	DATE COMPLETED: 2/2022	
DESIGNED BY: AEC	APPROVED BY: MAM	
DRAWN BY: RDS	DWG NAME: PL-6-7 ERL_2021_MOD-2 CELL 5 DETAILS.dwg	
REVISION:	REVISED BY: RDS	DATE: 8/2024
1	2024 EDOP UPDATE, NO DESIGN CHANGES	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



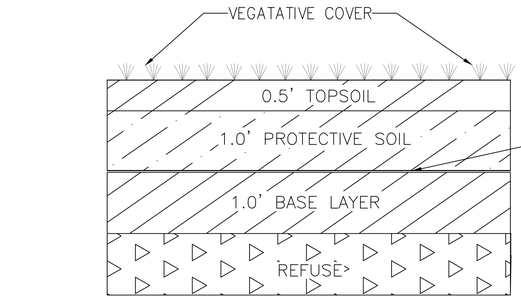
AFC SYSTEM DETAIL

DETAIL 7/1
SCALE: N.T.S.



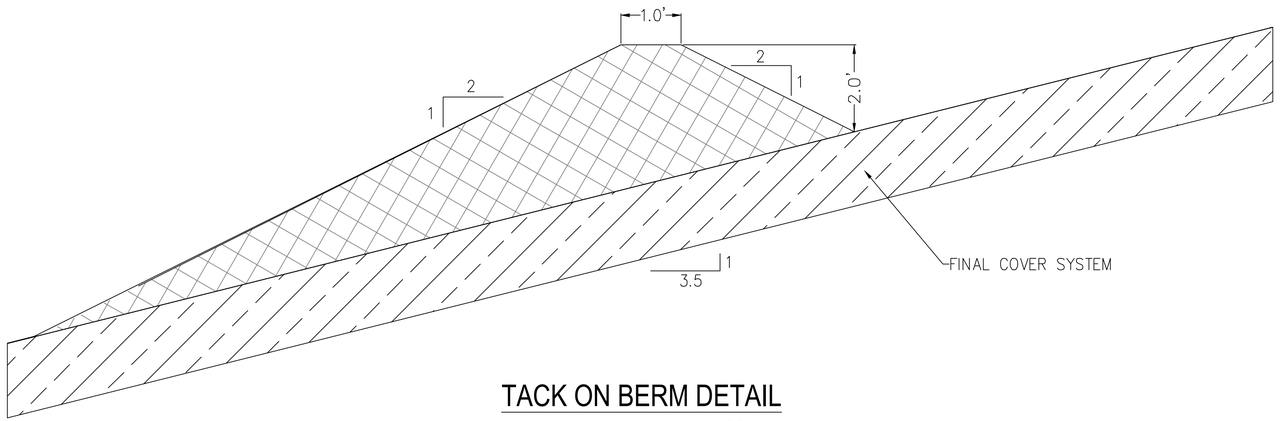
LLDPE FINAL COVER/ANCHOR TRENCH/LLDPE OVERLAP (OPTIONAL COVER)

DETAIL 7/2
SCALE: N.T.S.



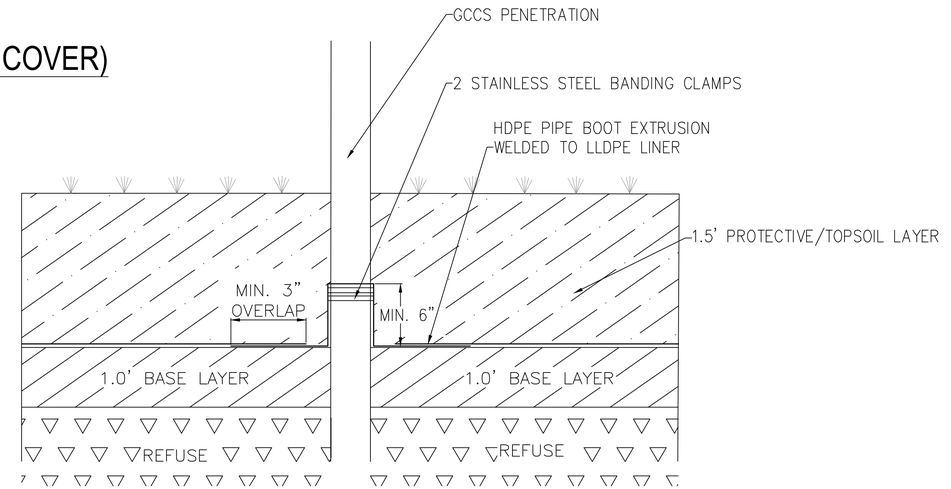
LINED FINAL COVER SYSTEM (OPTIONAL COVER)

DETAIL 7/3
SCALE: N.T.S.



TACK ON BERM DETAIL

DETAIL 7/4
SCALE: N.T.S.



GCCS LLDPE PENETRATION BOOT DETAIL (OPTIONAL COVER)

DETAIL 7/5
SCALE: N.T.S.

COLORADO REGISTERED
CYNTHIA A. CIRILLO
31043
9-6-24
PROFESSIONAL ENGINEER

PLATE 7
COVER DETAILS
EAST REGIONAL LANDFILL
BENNET, COLORADO

CLIENT: FIVE PART DEVELOPMENT, LLC	
PROJECT:	
PROJECT NO: ERL	DATE COMPLETED: 7/2024
DESIGNED BY: RDS	APPROVED BY:
DRAWN BY: RDS	DWG NAME:
REVISION:	REVISED BY: / DATE:
0 ISSUED FOR REVIEW	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.

WASTE MANAGEMENT / CSI PROPERTY

XCEL ENERGY PROPERTY

DEEPENED CHANNEL BOTTOM
WITH STEEPER 1:1 SLOPES INSIDE
5302' CONTOUR
STORAGE CAPACITY = 0.37 ACRE-FEET

DETENTION WEIR #1
OUTLET ELEVATION = 5302'

DISCHARGE POINT #1

GP-2

GP-3

1.5% TACK ON BERM

PERIMETER
DRAINAGE
CHANNEL

6 INCH R/PRAP LINED DOWNCHUTE

DETENTION WEIR #2
OUTLET ELEVATION = 5306'

DEEPENED CHANNEL BOTTOM
WITH STEEPER 1:1 SLOPES
INSIDE 5306 CONTOUR
STORAGE CAPACITY = 6.1 ACRE-FEET

5% SLOPE

6% SLOPE

PERIMETER
DRAINAGE
CHANNEL

MW-5

MW-4

DETENTION WEIR #4
OUTLET ELEVATION = 5320'

DISCHARGE POINT #2

DEEPENED CHANNEL BOTTOM
WITH STEEPER 1:1 SLOPES
INSIDE 5320' CONTOUR
STORAGE CAPACITY = 0.56 ACRE-FEET

WASTE MANAGEMENT / CSI PROPERTY

LANDSCAPE BERM

DETENTION WEIR #3
OUTLET ELEVATION = 5316'

MW-6

DEEPENED CHANNEL BOTTOM
WITH STEEPER 2:1 SLOPES
INSIDE 5316 CONTOUR
STORAGE CAPACITY = 7.21 ACRE-FEET

6 INCH RIPRAP LINED DOWNCHUTE

40' - LANDSCAPE WITH TREES
NORTH OF PROPERTY LINE
(1 TREE EVERY 20')

QUONSET HUT
MAINTENANCE FLUID STORAGE
AND MAINTENANCE ACTIVITIES

LANDSCAPE WITH GRASS,
TREES AND BUSHES

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
- G — GAS PIPELINE
- SECTION MARKER (NOT VARIFIED)
- (Gnd. El. 5306.03) EXISTING GROUND WATER MONITORING LOCATION
- GP-2 EXISTING GAS MONITORING WELL LOCATION
- MW EXISTING GROUND WATER MONITORING 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.

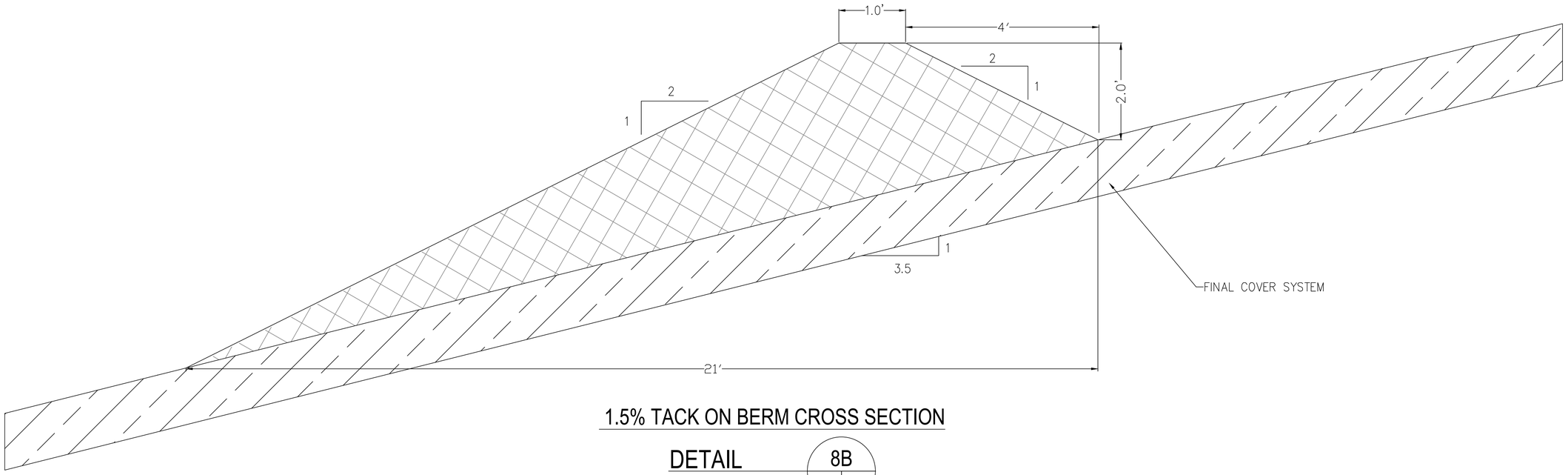
0 75 150 300
APPROXIMATE SCALE (FEET)

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 EXPANSTION EDOP	
PROJECT NO:	DATE COMPLETED: 8/2013
DESIGNED BY: RDS	APPROVED BY: WAC
DRAWN BY: TML/RDS	DWG NAME:
REVISION:	REVISED BY: RDS DATE: 9/2024
2 ISSUED FOR REVIEW	

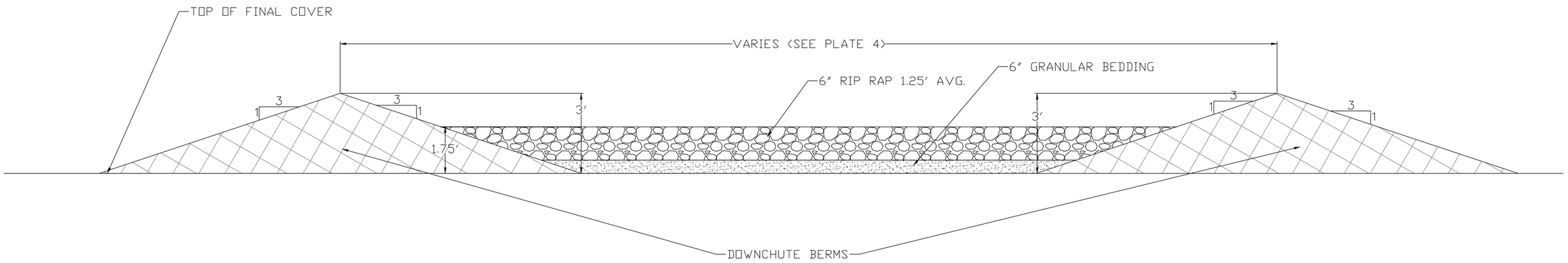
AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



1.5% TACK ON BERM CROSS SECTION

DETAIL 8B / 1

SCALE: N.T.S.



DOWNCHUT CROSS SECTION

DETAIL 8B / 2

SCALE: N.T.S.

COLORADO REGISTERED
WILLIAM A. CRAIGHEAD
31043
9-6-24
PROFESSIONAL ENGINEER

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	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.

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,

INDUSTRIAL COMPLIANCE

Mark A. McMullen
Solid Waste Program Director

Reviewed by:

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

COLORADO REGISTERED GARY ROBERT LAKE 17183 PROFESSIONAL ENGINEER

TABLE OF CONTENTS

GLOSSARY OF TERMS AND ACRONYMS . . . . . i-iv

1.0 INTRODUCTION 1-1

1.1 Legal Description 1-3

2.0 GENERAL INFORMATION 2-1

2.1 Facility Need 2-1
2.2 General Facility Description 2-1

2.2.1 Facility Access 2-3

2.3 Zoning and Land Use 2-4
2.4 Fees 2-4

3.0 SITE DESCRIPTION 3-1

3.1 Location Criteria 3-1
3.2 Existing Site Topography 3-2
3.3 Surface Water Drainage 3-2
3.4 Climatology 3-5

4.0 GEOLOGY AND HYDROGEOLOGY 4-1

4.1 Regional Geology 4-1

4.1.1 Regional Geologic Structure 4-1
4.1.2 Regional Surficial Geology 4-1
4.1.3 Regional Bedrock Geology 4-1
4.1.4 Regional Economic Geology 4-3
4.1.5 Geologic Hazards 4-4

4.2 Site Geology 4-4

4.2.1 Field Investigations 4-5
4.2.2 Site Soil Classification 4-7
4.2.3 Site Surficial Materials 4-7
4.2.4 Site Bedrock Deposits 4-8
4.2.5 Representative Material Properties 4-9

4.3 Regional Hydrogeology 4-11

4.3.1 Regional Aquifer Distribution 4-11

4.3.1.1 Laramie-Fox Hills Aquifer 4-11
4.3.1.2 Arapahoe Aquifer 4-13
4.3.1.3 Denver Aquifer 4-13

4.3.2 Lost Creek Ground-Water Basin 4-13

4.4 Site Hydrogeology 4-16

4.4.1 Water Well Inventory 4-16
4.4.2 Ground Water Occurrence and Conditions 4-20

4.4.2.1 Shallow Alluvial Ground Water 4-20
4.4.2.2 Discontinuous Ground Water in a Claystone Matrix 4-21
4.4.2.3 Ground Water Associated with the Denver Aquifer 4-21

4.5 Hydrogeologic Characterization 4-22

4.6 Ground Water Flow Paths and Velocities 4-24

5.0 FACILITY CONFIGURATION 5-1

5.1 Facility Overview 5-1
5.2 Types and Volumes of Waste 5-2

5.2.1 Physical Characteristics of Coal Ash 5-3
5.2.2 Chemical Characteristics of Coal Ash 5-4
5.2.3 Coal Ash Regulatory Status 5-4

5.3 Ash Transport and Receiving Procedures 5-5
5.4 Waste Ash Placement 5-5

5.5 Waste Disposal Area 5-6

5.5.1 Ash Disposal Volumes and Filling Area Phasing 5-6
5.5.2 Excavation and Liner System Design 5-7

5.5.2.1 Travel Time Calculations 5-7
5.5.2.2 Liner System Details 5-9

5.5.3 Leachate Collection System 5-10

5.5.3.1 HELP Model Results 5-10
5.5.3.2 LCS Details 5-11

5.5.4 Liner System Construction 5-12
5.5.5 Final Cover System Installation 5-13
5.5.6 Material Balance 5-14

5.6 Surface Water Runoff Control 5-14

5.6.1 Temporary Control Structures 5-15
5.6.2 Permanent Control Structures 5-15

5.7 Erosion and Sediment Control 5-16

5.8 Landscape Plan 5-16

6.0 FACILITY OPERATION 6-1

6.1 Facility Management 6-1

6.1.1 Operations Schedule 6-1
6.1.2 Personnel and Equipment Requirements 6-1
6.1.3 Recordkeeping 6-2
6.1.4 Facility Security 6-2

6.2 Control of Nuisance Situations 6-3

6.2.1 Vector and Litter Control 6-3
6.2.2 Dust Control 6-3
6.2.3 Odor Control 6-3
6.2.4 Fire Prevention 6-4
6.2.5 Controlling Water in Open Disposal Areas 6-4
6.2.6 Health and Safety 6-4

6.2.7 Other Facilities 6-4

7.0 ENVIRONMENTAL MONITORING 7-1

7.1 Leachate Monitoring 7-1
7.2 Ground-Water Monitoring 7-1

7.2.1 Existing Ground Water Monitoring Wells 7-2
7.2.2 Permanent Ground Water Monitoring System 7-2
7.2.3 Analytes 7-4
7.2.4 Data Evaluation 7-5
7.2.5 Proposed Action in the Event of Negative Monitoring Results 7-6

7.3 Operational Monitoring 7-6

8.0 CONSTRUCTION PROCEDURES AND SPECIFICATIONS 8-1

8.1 Disposal Cell Construction Components 8-1
8.2 Proposed Construction of a Test Pad to Verify Design Permeabilities 8-2

8.2.1 Clay Soils Testing 8-3
8.2.2 Test Pad Construction Sequence 8-4

8.3 Disposal Cell Excavation Inspections 8-5
8.4 Compacted Soil Barrier Layer and Cap Inspections 8-5
8.5 Leachate Collection System (LCS) 8-6
8.6 Synthetic Membrane Liner Inspections 8-6
8.7 As-Built Report 8-6

9.0 CLOSURE AND POST CLOSURE REQUIREMENTS 9-1

9.1 Final Site Closure 9-1
9.2 Reclamation and Revegetation 9-2
9.3 Post Closure Monitoring 9-4

9.3.1 Ground Water and Leachate Monitoring 9-4
9.3.2 Inspections and Maintenance 9-5

9.4 Staged Closure 9-5
9.5 Projected Post-Closure Land Use 9-5

10.0 REFERENCES CITED 10-1

FIGURES

Figure 2-1 General Site Location 2-2
Figure 2-2 Adjacent Zoning and Ownership 2-5
Figure 3-1 Surface Water within a 2-mile Radius 3-3
Figure 3-2 On-site and Off-site Drainage Patterns 3-4
Figure 3-3 Windrose Diagram 3-6
Figure 4-1 Generalized Stratigraphic Column 4-2
Figure 4-2 Potentiometric Surface of the Laramie-Fox Hills Aquifer 4-12
Figure 4-3 Potentiometric Surface of the Arapahoe Aquifer 4-14
Figure 4-4 Potentiometric Surface of the Denver Aquifer 4-15

TABLES

Table 2-1 Land Ownership within 1-Mile Radius of Site 2-6
Table 4-1 Summary of Soil Geotechnical Data 4-10
Table 4-2 Wells within a 2-Mile Radius of the Site 4-17
Table 4-3 In-Situ Permeability Test Data 4-23

APPENDICES

Appendix A CDH Regulation Checklist
Appendix B Air Emission Permit Application
Appendix C Local Climate Information
Appendix D Geotechnical Test Results
Appendix E Original Soil Boring Logs
Appendix F Lithologic and Piezometer/Monitoring Well Completion Logs
Appendix G Site Water Level Elevations
Appendix H Monitoring Well Completion Forms
Appendix I Field Parameter and Ground-Water Sampling Forms
Appendix J Water Quality Laboratory Results
Appendix K Packer Test Results
Appendix L Slug Test Results
Appendix M Soil Balance Estimates
Appendix N Coal Ash Technical Data
Appendix O HELP Model
Appendix P Drainage Design Data
Appendix Q Dust Suppressant MSDS Sheets

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 $1x10^{-7}$ 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 $1x10^{-1}$ cm/sec placed above the GCL liner.
EDOP	Engineering Design and Operations Plan for the proposed facility.
FGD	Flue-Gas Desulferization. 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 $1x10^{-7}$ 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

RAYMOND W. BAYER, P.L.S. NO. 6973

DATE: Nov. 3, 1993

COLORADO REGISTERED RAYMOND W. BAYER 6973 PROFESSIONAL LAND SURVEYOR

File: CELLS/EXHIBA.mem

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)".

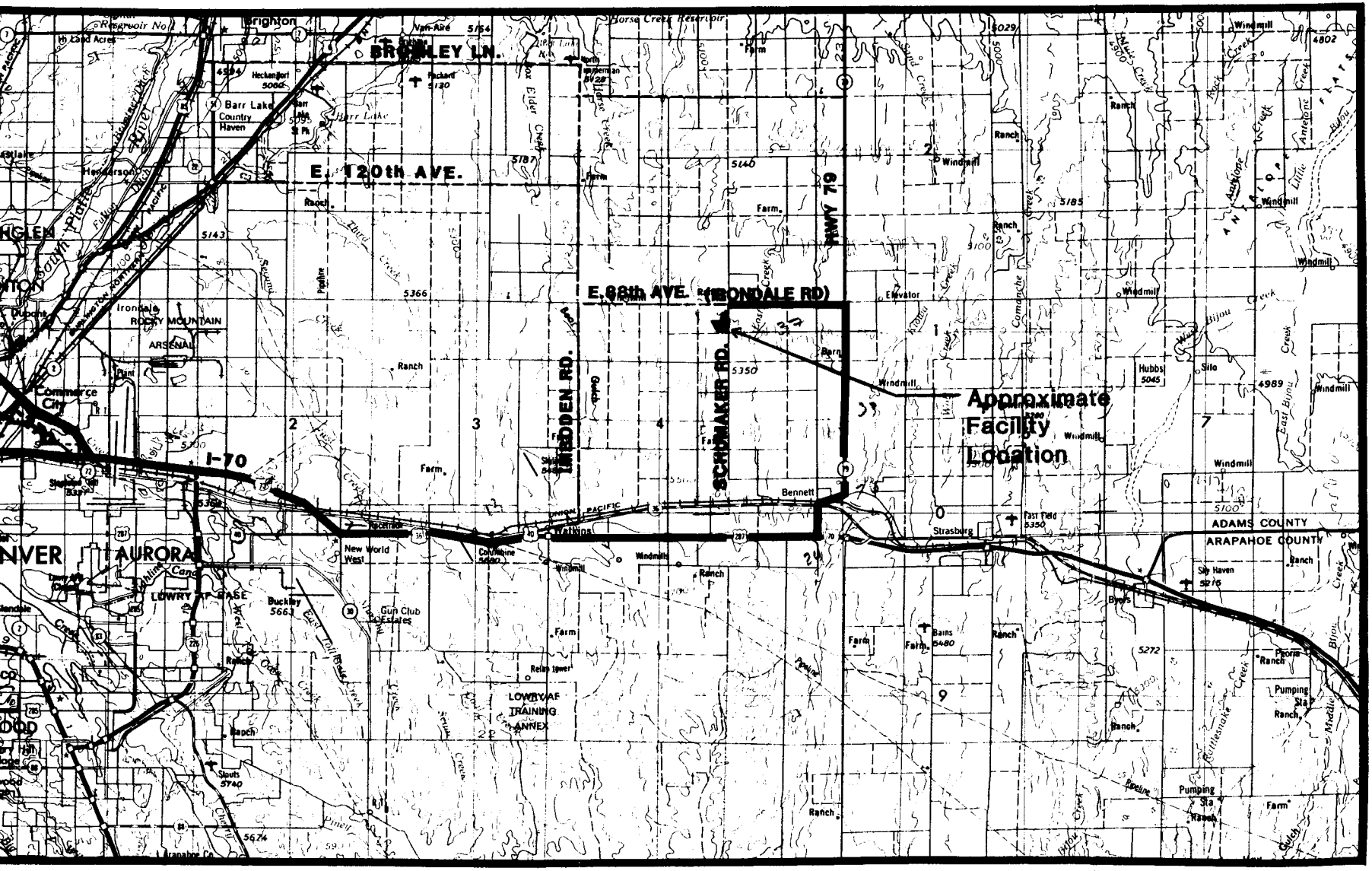
PSC is one of the largest energy producing companies in the State of Colorado and generates approximately 360,000 cubic yards per year of coal ash from their Cherokee, Arapahoe, and Valmont Plants. While the facility will accept coal ash for disposal from any PSC plant, the majority of the ash to be 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.



PRESENT ACCESS ROUTE

FUTURE ACCESS ROUTES

0 5 10

SCALE (MILES)

ATION
NT
DISPOSAL FACILITY

REVISED:

PROJ.# 06104369	DRAWN BY: GSL
FN: 4369F21	SCALE: AS SHOWN
DATE: 3/23/93	PAGE#

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.

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

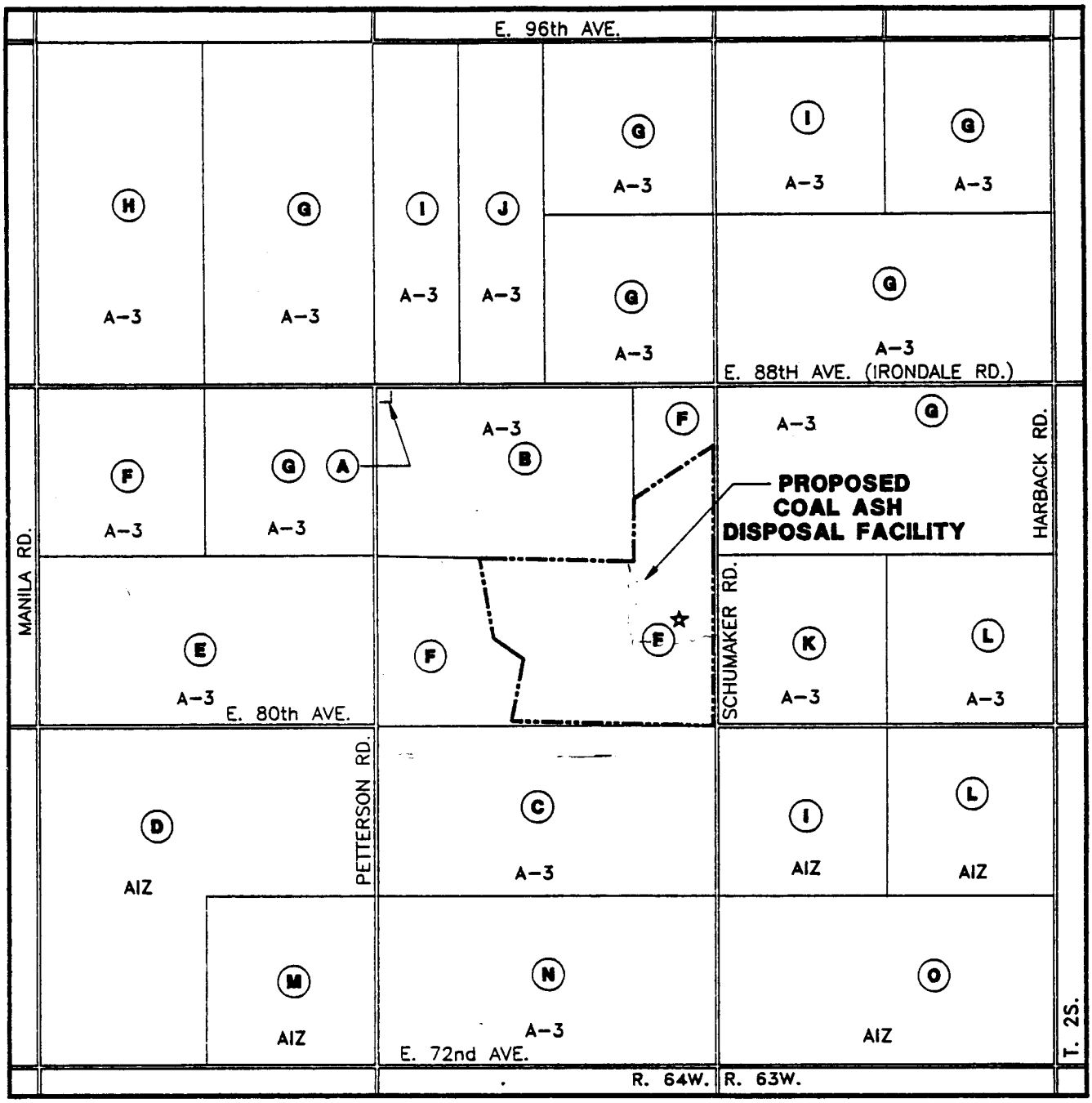
The immediate area of the facility is presently zoned A-3/Agricultural. Zoned land and land ownership in the vicinity of the facility is shown on Figure 2-2. Table 2-1 includes ownership and zoning information within an approximate 1-mile radius of the facility. The land around the facility property 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 AQUIRED BY PSCo

0 1250 2500 5000

APPROXIMATE SCALE (FEET)

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	Mailyn 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 inital field program an initial site assessment was conducted of the proposed permit area. The inital site assessement 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.

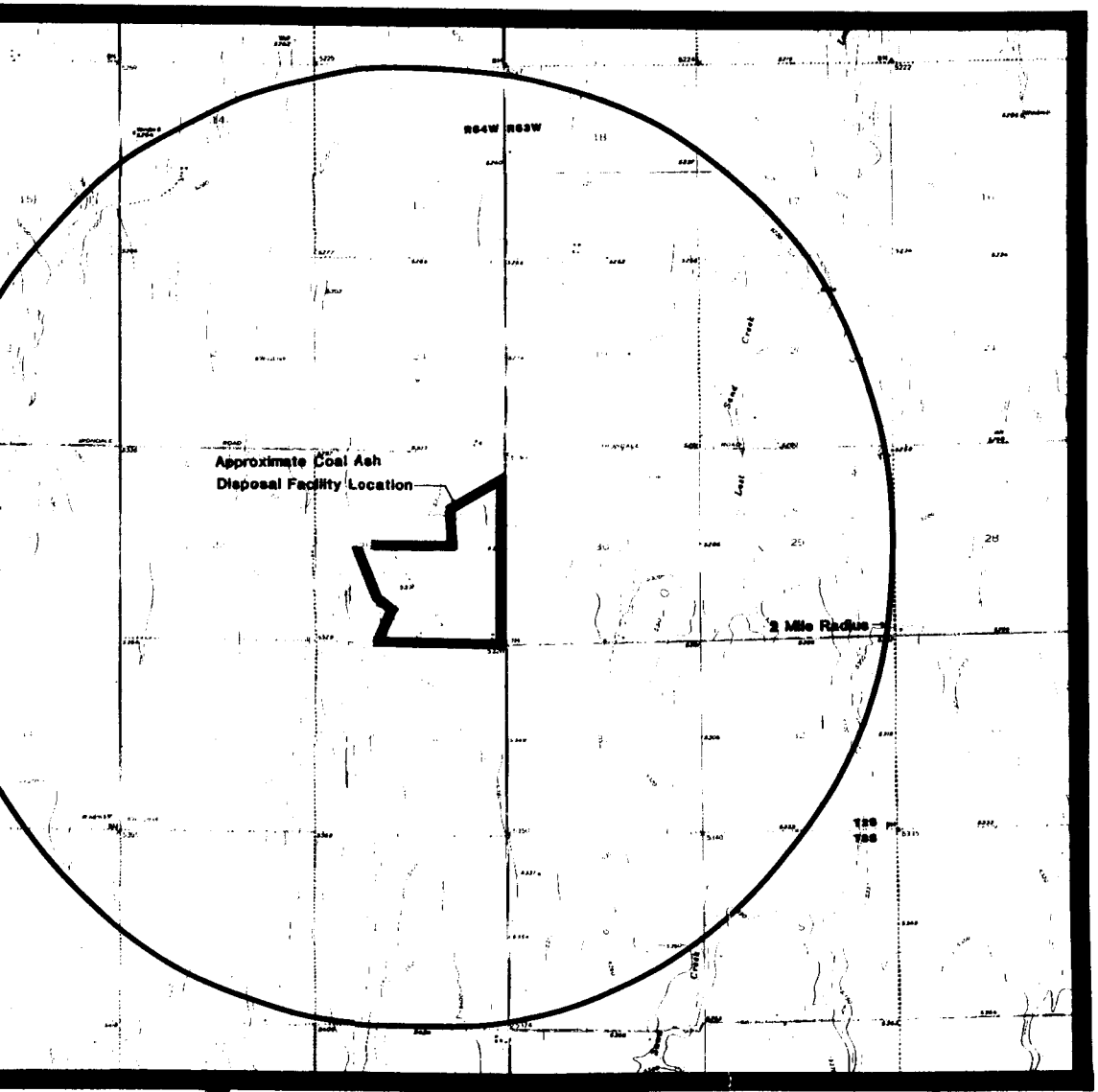
3.2 Existing Site Topography

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



Scale

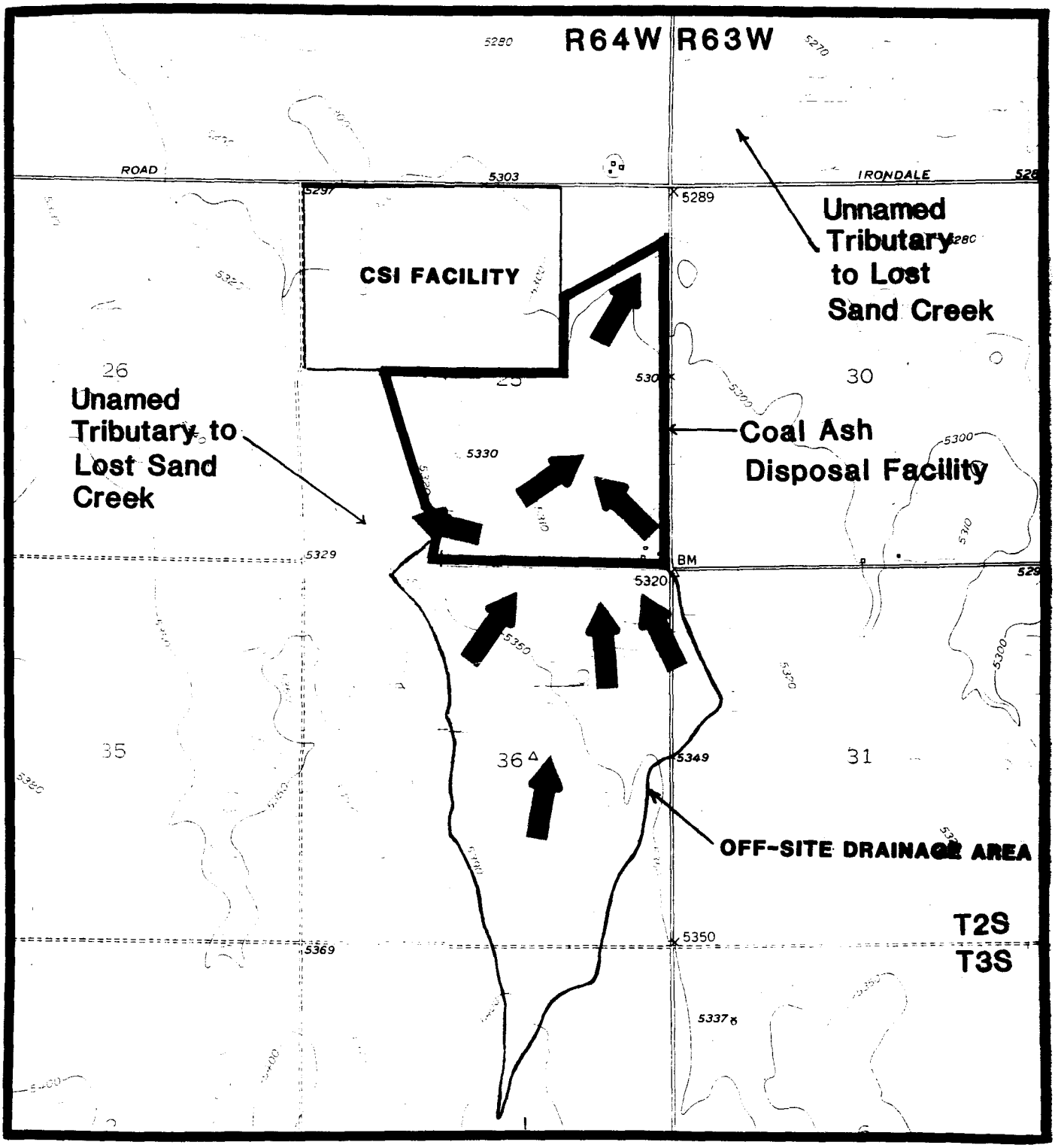
Contour Interval = 10 feet

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

PROJ.# 06104369	DRAWN BY:
FN: 4369F31	SCALE: AS SHOWN
DATE: 3/23/93	PAGE#

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

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.



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

CONTOUR INTERVAL = 10 FT.

1/2 0 1 MILE
APPROXIMATE SCALE (MILES)

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
APPROXIMATE SCALE (FEET)

PROJ.# 06104369	PAGE#
SCALE: AS SHOWN	DRAWN BY: GSL
FN: 4369F32	
DATE: 3/23/93	

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

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.

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.

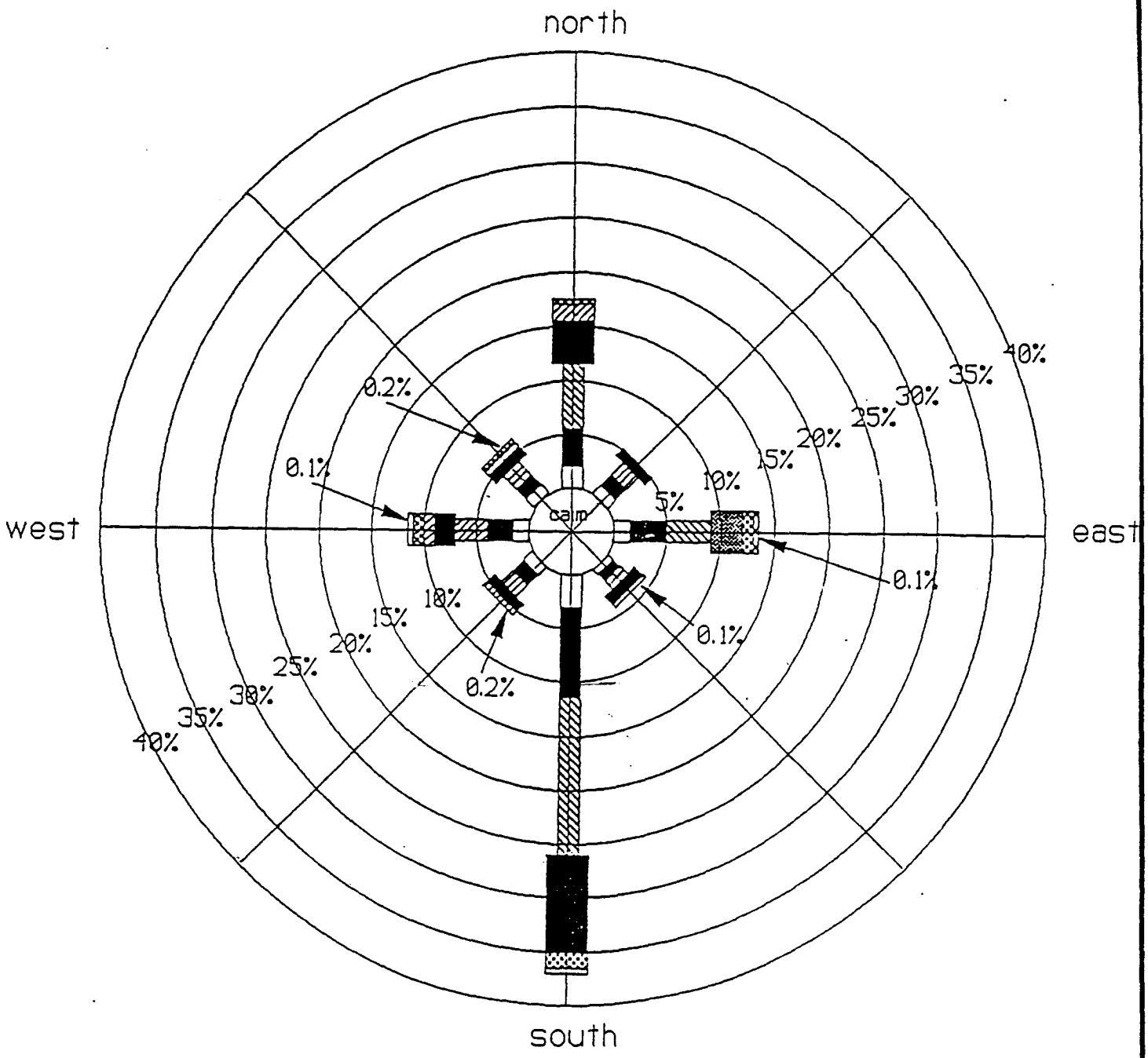
3.4 Climatology

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

PROJ.# 06104369	PAGE#
SCALE: NA	DRAWN BY:
FN: 4369F33	
DATE:	

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

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.

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 pedisediments 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: [4]
Conservation Services, Inc.
Design and Operations Plan
October, 1991

PROJ.# 06104369	PAGE#
SCALE: NA	DRAWN BY:
FN: 4369F-1	
DATE:	

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

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.

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 $4x10^{-4}$ to $1x10^{-3}$ 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 $4x10^{-5}$ to $1x10^{-4}$ 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]	$2x10^{-8}$	$5x10^{-8}$	$1x10^{-7}$	N/A	$6x10^{-9}$

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.	$6x10^{-8}$	N/A	$4x10^{-7}$	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 $1x10^{-7}$ cm/sec to $6x10^{-9}$ 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 $4x10^{-7}$ cm/sec to $6x10^{-8}$ cm/sec and averaged $2.3x10^{-7}$ 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.

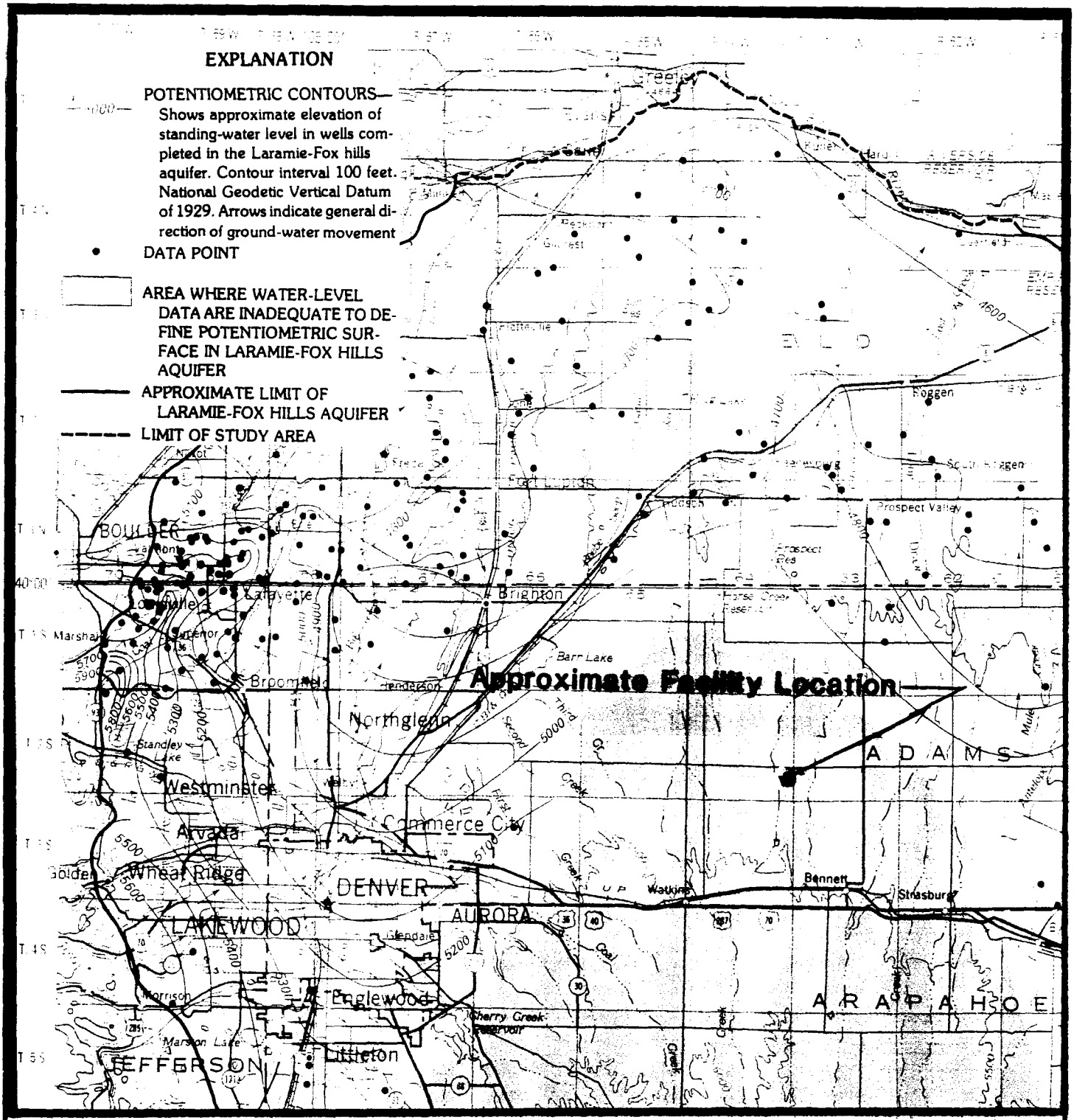
4.3.1 Regional Aquifer Distribution

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.



SOURCE:
GEOLOGIC STRUCTURE, HYDROLOGY, AND WATER QUAILITY OF THE LARIMIE–FOX HILLS AQUIFER IN THE DENVER BASIN, COLORADO, ROBSON AND OTHERS, USGS MAP HA–650, 1981 – 1:500,000

SCALE 1:500 000

10 0 10 20 MILES

10 0 10 20 KILOMETERS

PROJ.# 06104369	PAGE#
SCALE: AS SHOWN	DRAWN BY: GSL
FN: 4369F42	
DATE: 3/23/93	

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

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.

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

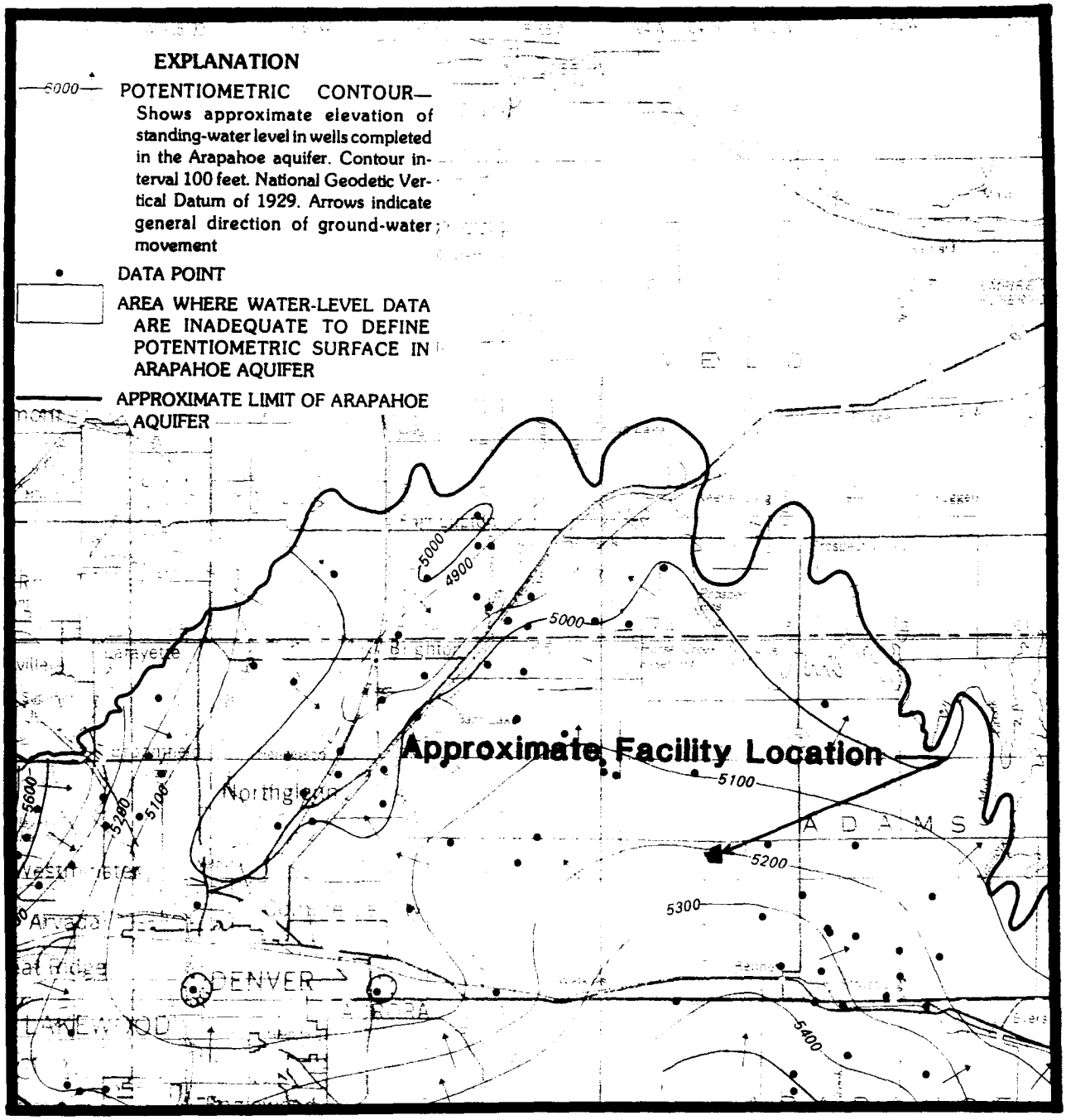
The Denver Aquifer is the uppermost aquifer beneath the site. Robson and Romero (1981) indicate a saturated thickness of less than 50 feet for this aquifer. They indicate that the base of the water-bearing strata is approximately 160 feet bgs, implying that generally, the top of the aquifer lies about 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 QUAILTY OF THE ARAPAHOE AQUIFER IN THE DENVER BASIN, COLORADO, ROBSON AND OTHERS, USGS ATLAS HA-647, 1981

SCALE 1:500 000

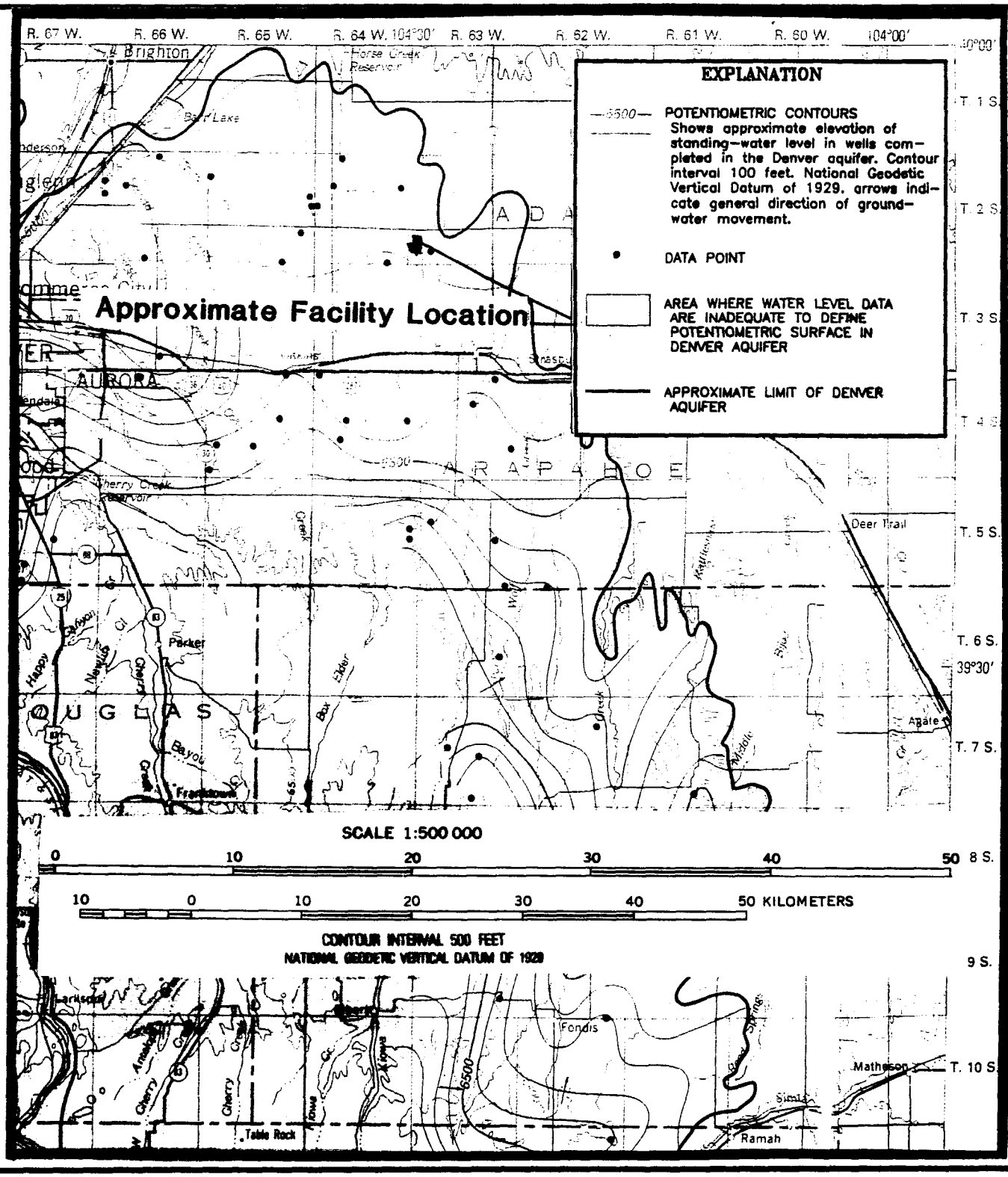
10 0 10 20 MILES

10 0 10 20 KILOMETERS

PROJ.# 06104369	PAGE#
SCALE: AS SHOWN	DRAWN BY: GSL
FN: 4369F43	
DATE: 3/23/93	

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

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.



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

PROJ.# 06104369	PAGE#
SCALE: AS SHOWN	DRAWN BY: GSL
FN: 4369F44	
DATE: 3/23/93	

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

Industrial Compliance
A Subsidiary of SP Environmental Systems, Inc.

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 ofthe 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
UKA = UPPER ARAPAHOE FORMATION
NA = NOT AVAILABLE
S = LIVESTOCK
R = RECREATION
OM = MONITOR WELL
Yield = GALLONS PER MINUTE
AR = ARAPAHOE FORMATION
TKD = DENVER FORMATION
D = DOMESTIC
DS = DOMESTIC/LIVESTOCK
N = INDUSTRIAL
C = COMMERCIAL
\+ = 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
AR = ARAPAHOE FORMATION
TKD = DENVER FORMATION
D = DOMESTIC
DS = DOMESTIC/LIVESTOCK
N = INDUSTRIAL
C = COMMERCIAL
\+ = 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
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
UKA = UPPER ARAPAHOE FORMATION
NA = NOT AVAILABLE
S = LIVESTOCK
R = RECREATION
OM = MONITOR WELL
Yield = GALLONS PER MINUTE
AR = ARAPAHOE FORMATION
TKD = DENVER FORMATION
D = DOMESTIC
DS = DOMESTIC/LIVESTOCK
N = INDUSTRIAL
C = COMMERCIAL
+ = 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 $1.0x10^{-7}$ cm/sec to $6.0x10^{-9}$ cm/sec with an average of $4.4x10^{-8}$ 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 $4.0x10^{-7}$ cm/sec in PZ-63 and $6.0x10^{-8}$ 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, $T = \frac{K\ i}{\text{Porosity}}$ 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~~.8x10^{-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 $1x10^{-7}$ cm/sec.

3) The liquid would then migrate vertically through 10 feet of natural material with a permeability of $5x10^{-4}$ 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 = $1x10^{-8}$ cm/sec
Ks = $1x10^{-7}$ cm/sec
n = 4

Therefore:

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

$$T = \frac{(3ft)(0.1)(30.48cm/ft)}{(1x10^{-8}**3/4)(1x10^{-7}**1/4)}$$

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

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

Assume:

$Zo = 10$ feet
$@ = 0.2$
$qu = 5x10^{-5}$ cm/sec
$Ks = 5x10^{-4}$ cm/sec
$n = 4$

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

$$T = \frac{(10ft)(0.2)(30.48cm/ft)}{(5x10^{-5}**3/4)(5x10^{-4}**1/4)}$$

$T = 6.83 \times 10^{5}$ sec $= 0.02$ 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 $1x10^{-7}$ 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, recompacted 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 $1x10^{-1}$ 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 $1x10^{-1}$ 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 1x10-1 cm/sec.

$V = ki$

where:
V = average velocity
k = permeability of the material = $1x10^{-1}$ 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 $1x10^{-7}$ 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.

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 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.

TCLP Metal	Typical Detection Limit	Regulatory Limit
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 $1x10^{-7}$ 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 $1x10^{-1}$ 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 $1x10^{-7}$ 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.

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. 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:

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

[1]PLS - Pure Live Seed.
[2]This rate is for drill seeding; rate should be doubled when broadcast seeding.
[3]SCS - 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:

Grass Type *	Rate	% of mix	PLS/acre Seeding Rate
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

1. Earth Quake Potential in Colorado, Bulletin 43, Colorado Geological Survey, 1981

2. Flood Insurance Rate Map, Adams County Colorado, Community Panel Number 080001 0210A, Effective Date 1979, Department of Housing and Urban Development

3. Colorado Landslide Hazard Mitigation Plan, Colorado Geological Survey, Colorado Division of Disastor Emergency Services, University of Colorado Center for Communiity Development and Design, 1988

4. Guidelines and Criteria for Identification and land-Use Controls of Geologic Hazard and Mineral Resource Areas, Colorado Geological Surey, 1974

5. Subsidence Above Inactive Coal Mines, Colorado Geological Survey and Colorado Mine Land Reclamation Program, 1985

6. USGS Open File Report 82-1033, Probalistic 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

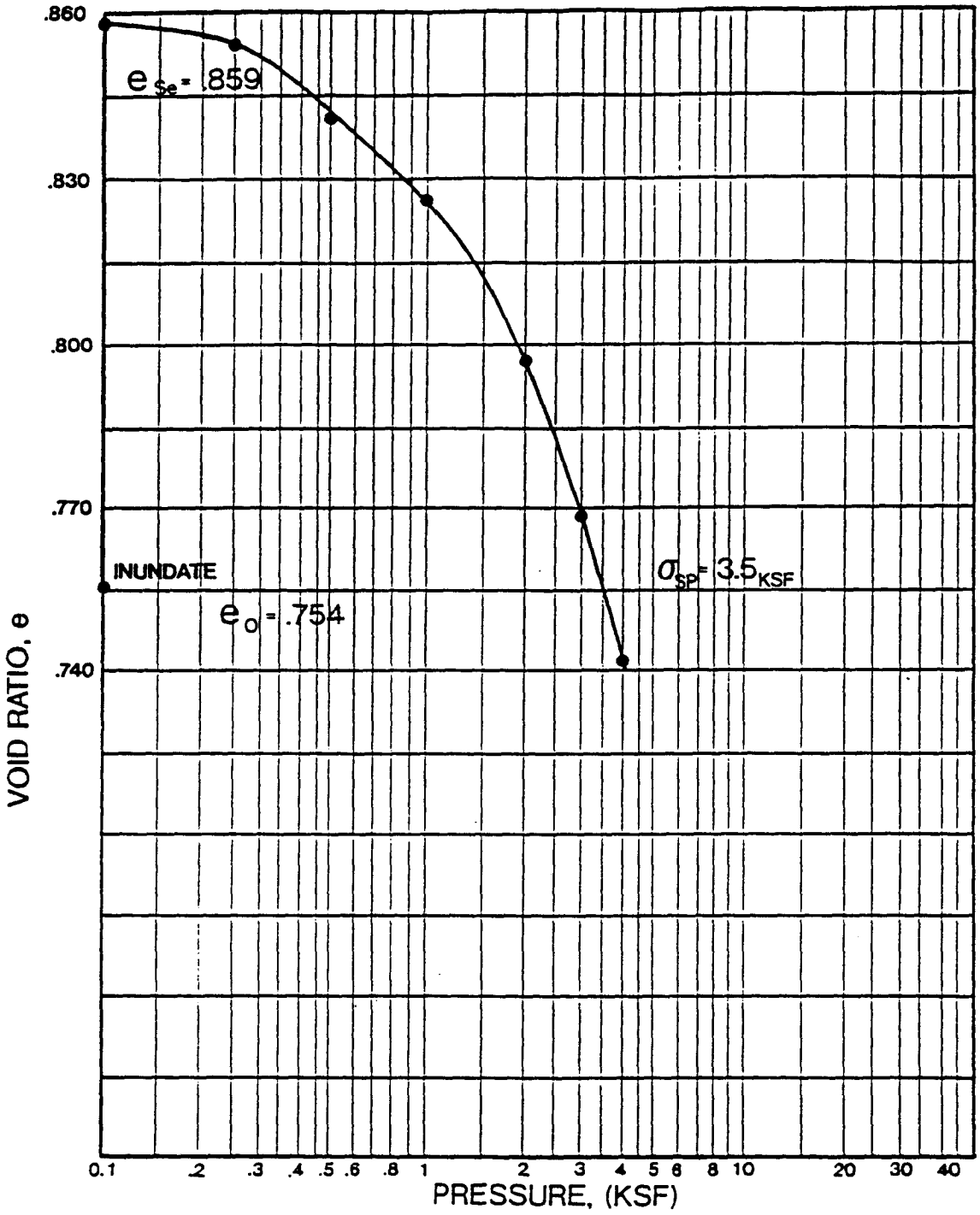
Project Name: IC/2-4079/CO
Location: COLORADO
Project Number: 923-2499

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)
					L.L.	P.L.	P.I.	S.L.	% 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	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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)	$2x10^{-8}$	$5x10^{-8}$	$6x10^{-8}$	$1x10^{-7}$	$4x10^{-7}$	$6x10^{-9}$		

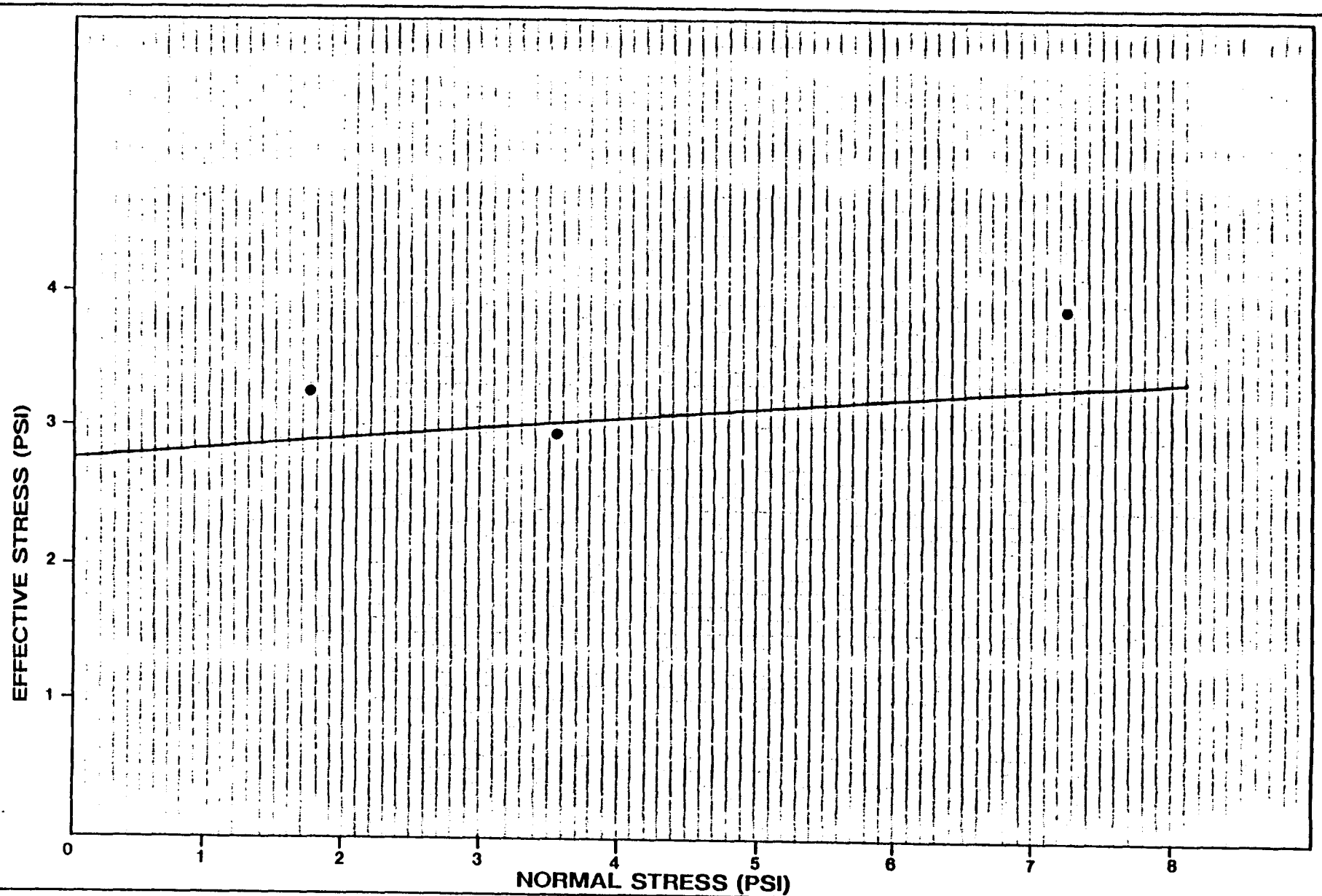


BORING No _____ SAMPLE No PZ-54

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: IC/2-4079/CO			DATE: AUG 1992	SCALE: AS SHOWN	JOB NO.: 923-2499
DRAWN: TT	CHECKED: DR	REVIEWED:	FILE:	DWG. NO.:	FIGURE: 1



Golder Associates Inc.

CONSOLIDATED–DRAINED DIRECT SHEAR TEST

Project IC/2-4079/CO Job No. 923-2499 C 28 psi ϕ 7°

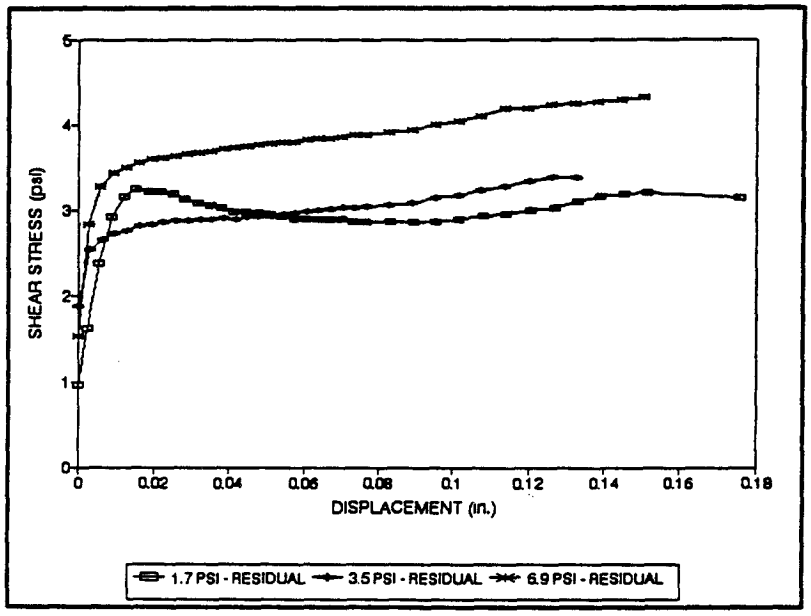
Type of Sample RECOMPACTED Boring No. _____ Sample No. PZ-54

Depth of Sample 20'-40' Description of Soil CLAY with little fine to coarse sand (CH) Swell Pressure 24.3 psi

Drawn TT Checked DR Reviewed _____ 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



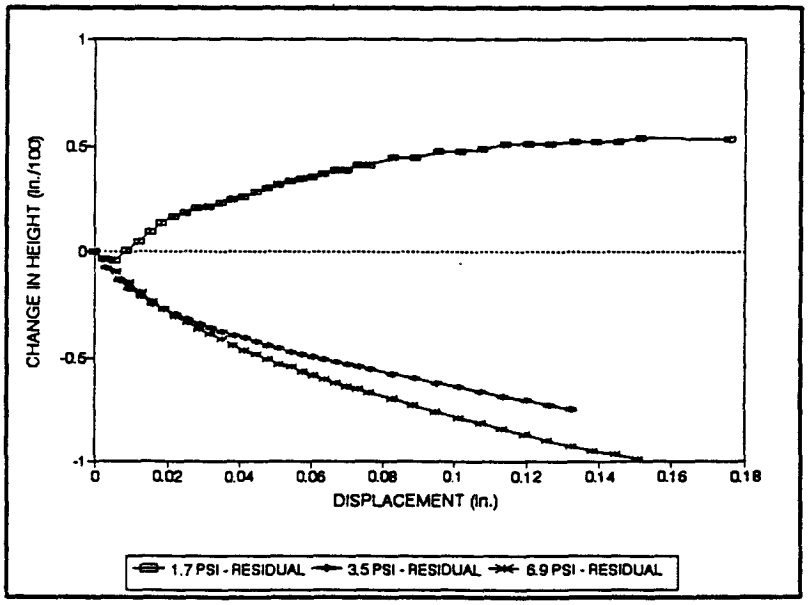


Figure 3

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

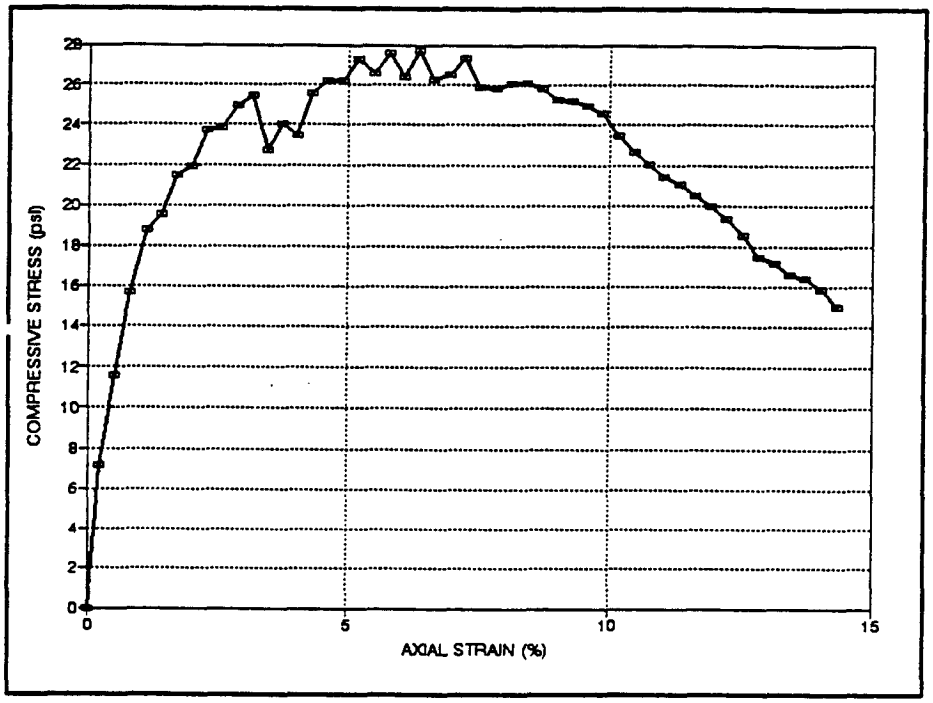
IC/2-4079/CO
DIRECT SHEAR DATA
SAMPLE: PZ54
CONFINING PRESSURE 3.5 PSI - RESIDUAL

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

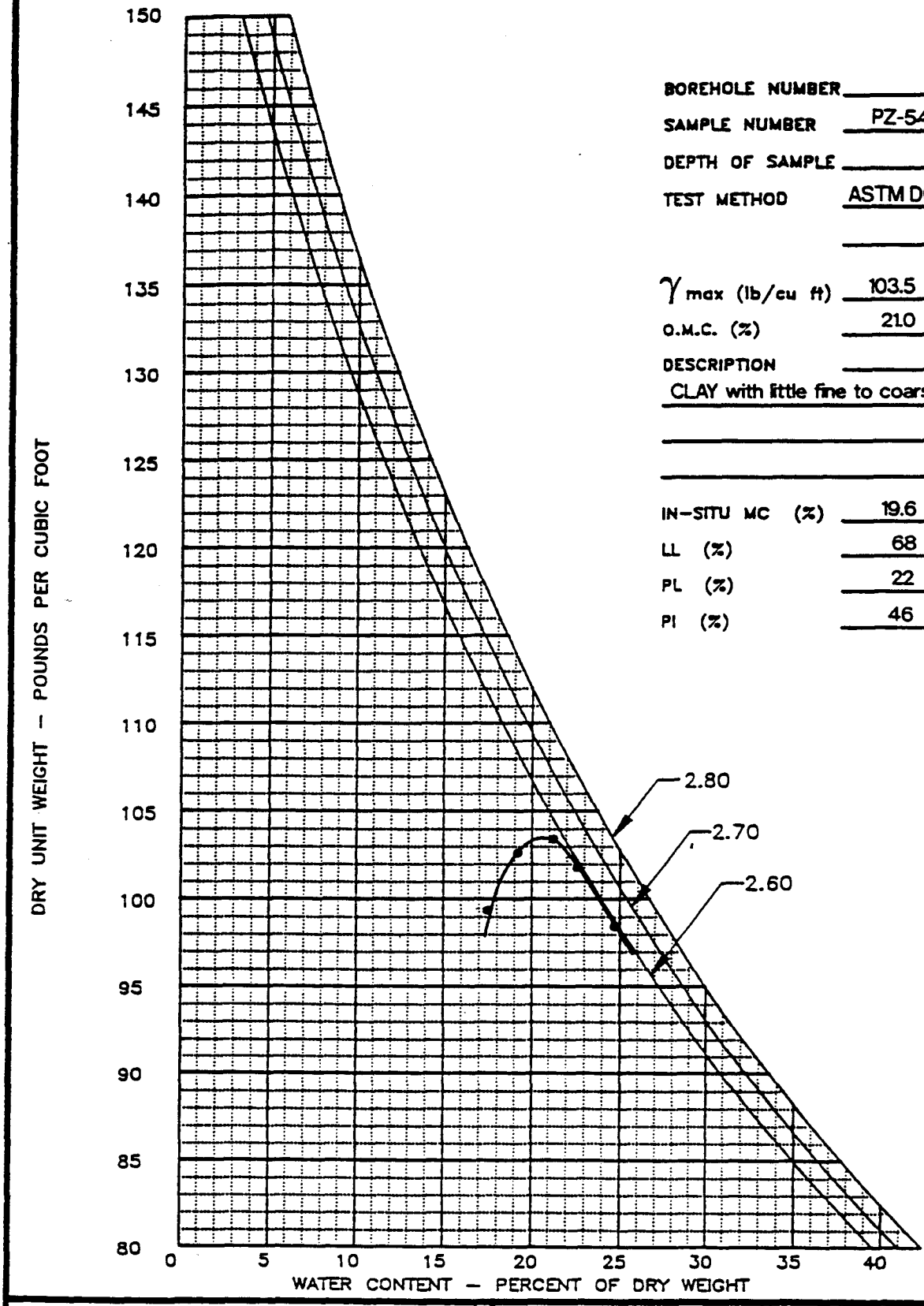
Sample Number	PZ-54
Depth (ft.)	20-40'
Sample Diameter (in.)	2.88
Sample Height (in.)	7.01
Dry Density (pcf)	95.8
Moisture Content (%)	23.5
Strain Rate (in./min)	.59
Unconfined Compressive Strength (psi)	27.7
Shear Strength (psi)	13.9



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



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

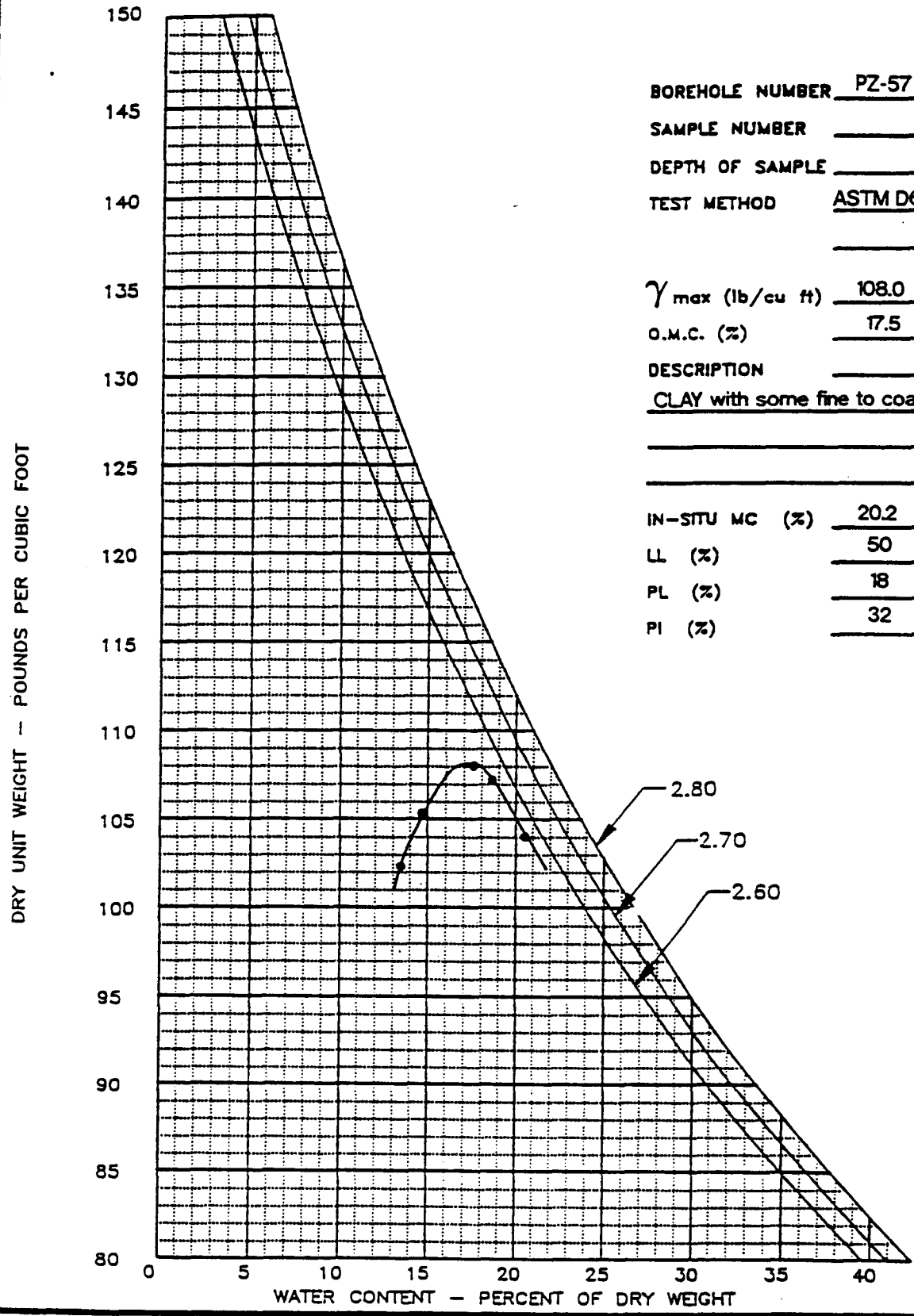
TITLE

PROCTOR CURVE PZ-54

CLIENT/PROJECT

IC/2-4079/CO

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



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

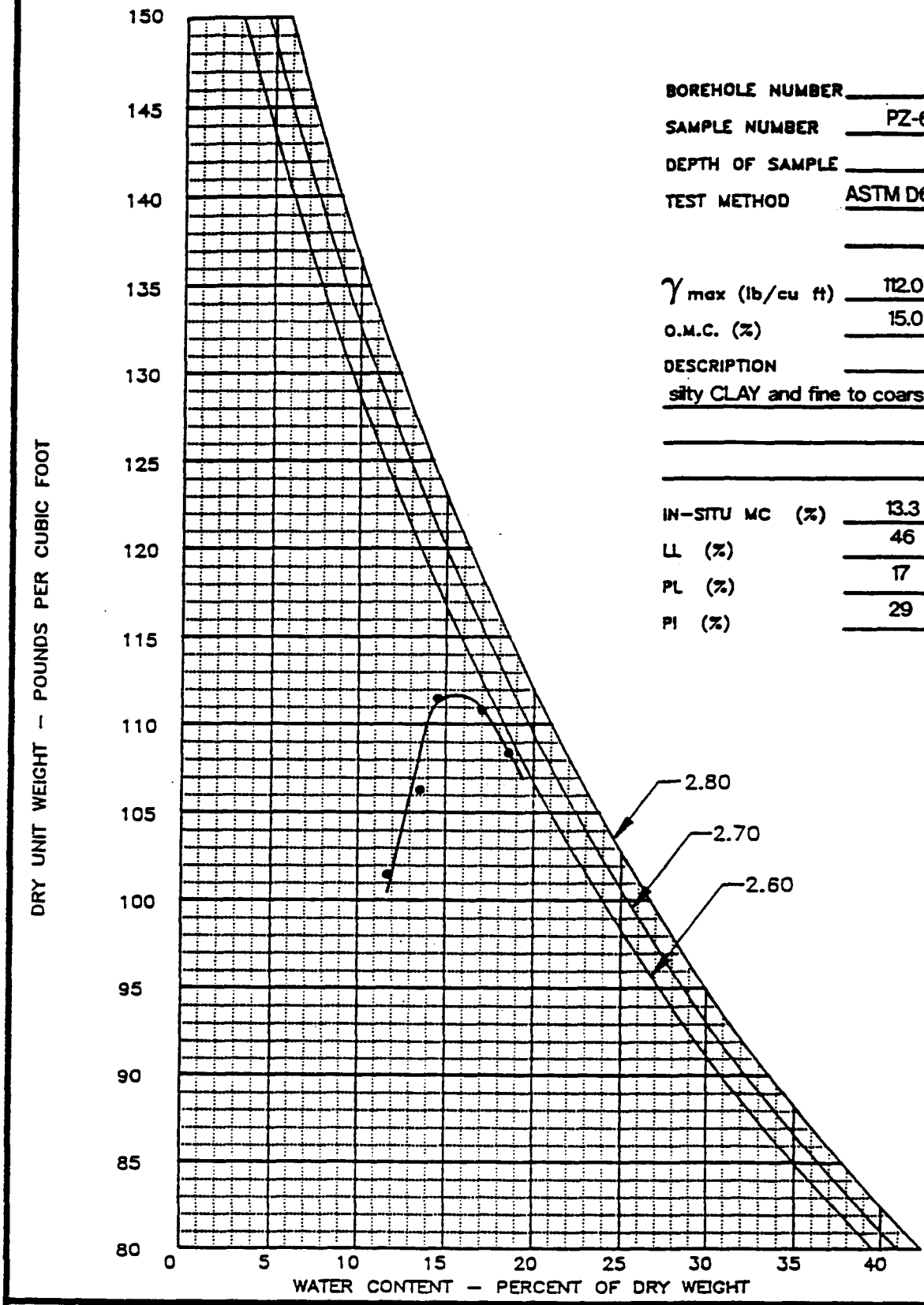
TITLE

PROCTOR CURVE PZ-57

CLIENT/PROJECT

IC/2-4079/CO

DRAWN MS	DATE AUG 1992	JOB NO. 923-2499
CHECKED TT	SCALE	DWG NO./REV. NO.
REVIEWED	FILE NO.	FIGURE NO. 6



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

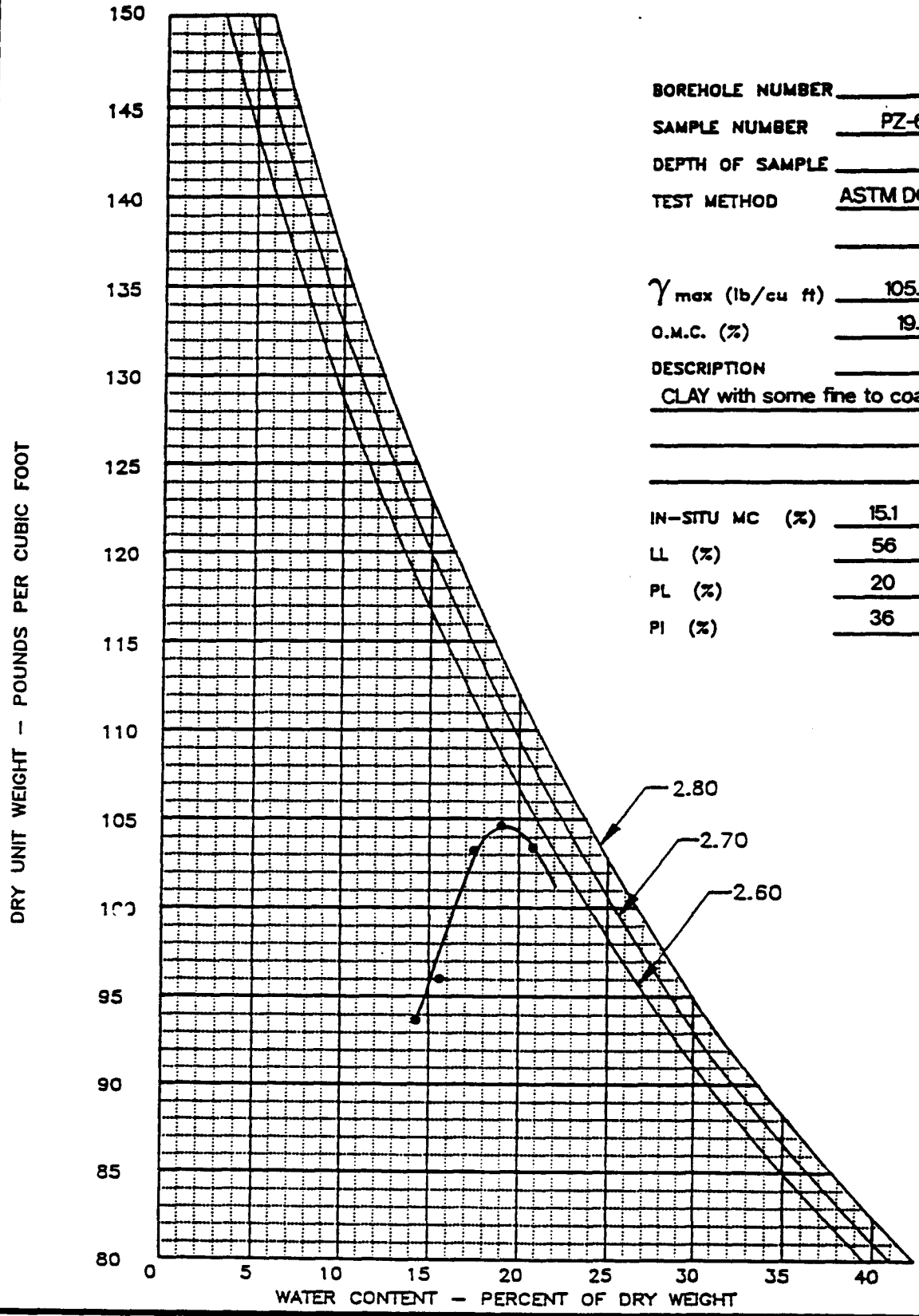
TITLE

PROCTOR CURVE PZ-62

CLIENT/PROJECT

IC/2-4079/CO

DRAWN MS	DATE AUG 1992	JOB NO. 923-2499
CHECKED TT	SCALE	DWG NO./REV. NO.
REVIEWED	FILE NO.	FIGURE NO. 7



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

Golder Associates Denver, Colorado

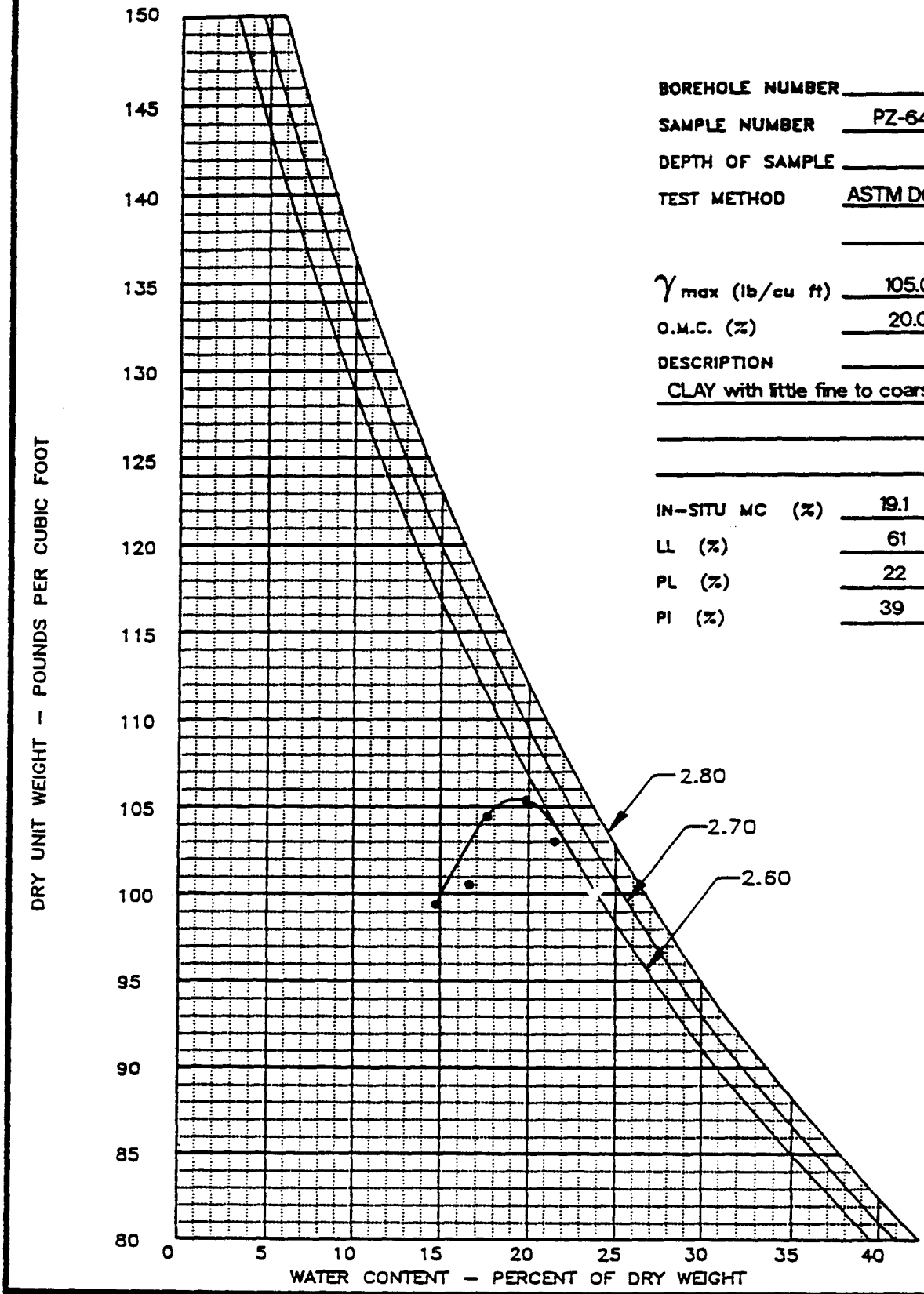
TITLE

PROCTOR CURVE PZ-63

CLIENT/PROJECT

IC/2-4079/CO

DRAWN MS	DATE AUG 1992	JOB NO. 923-2499
CHECKED TT	SCALE	DWG NO./REV. NO.
REVIEWED	FILE NO.	FIGURE NO. 8



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

TITLE

PROCTOR CURVE PZ-64

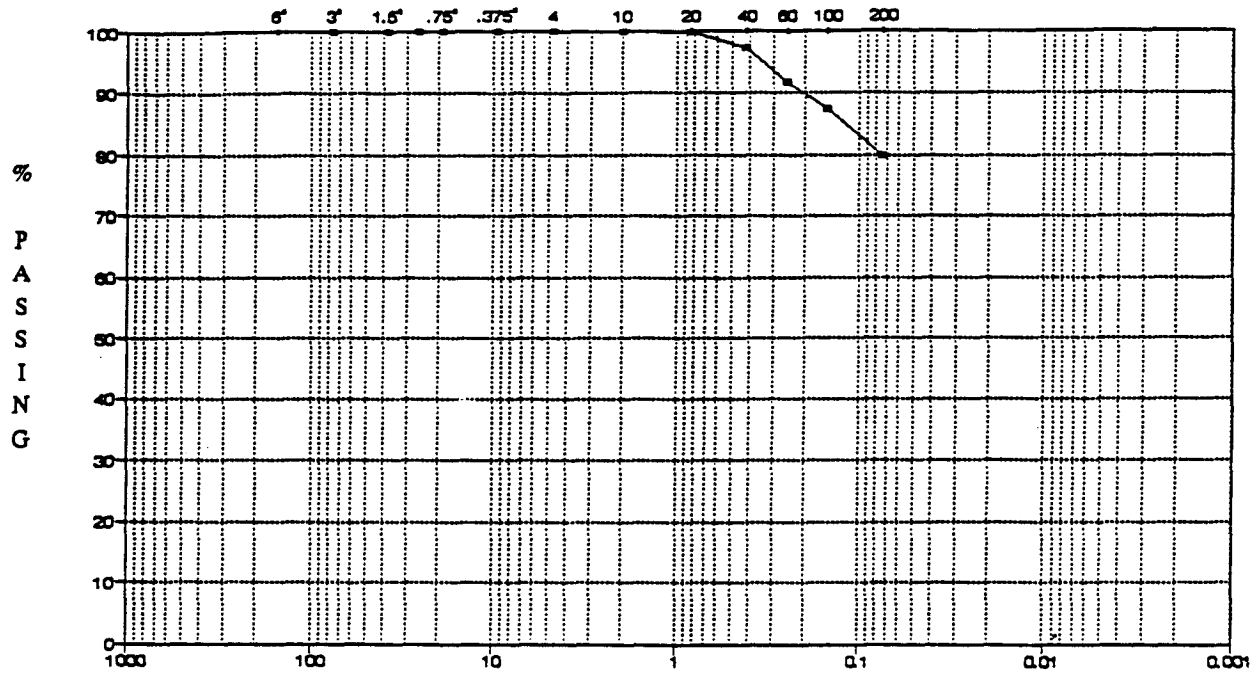
CLIENT/PROJECT

IC/2-4079/CO

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

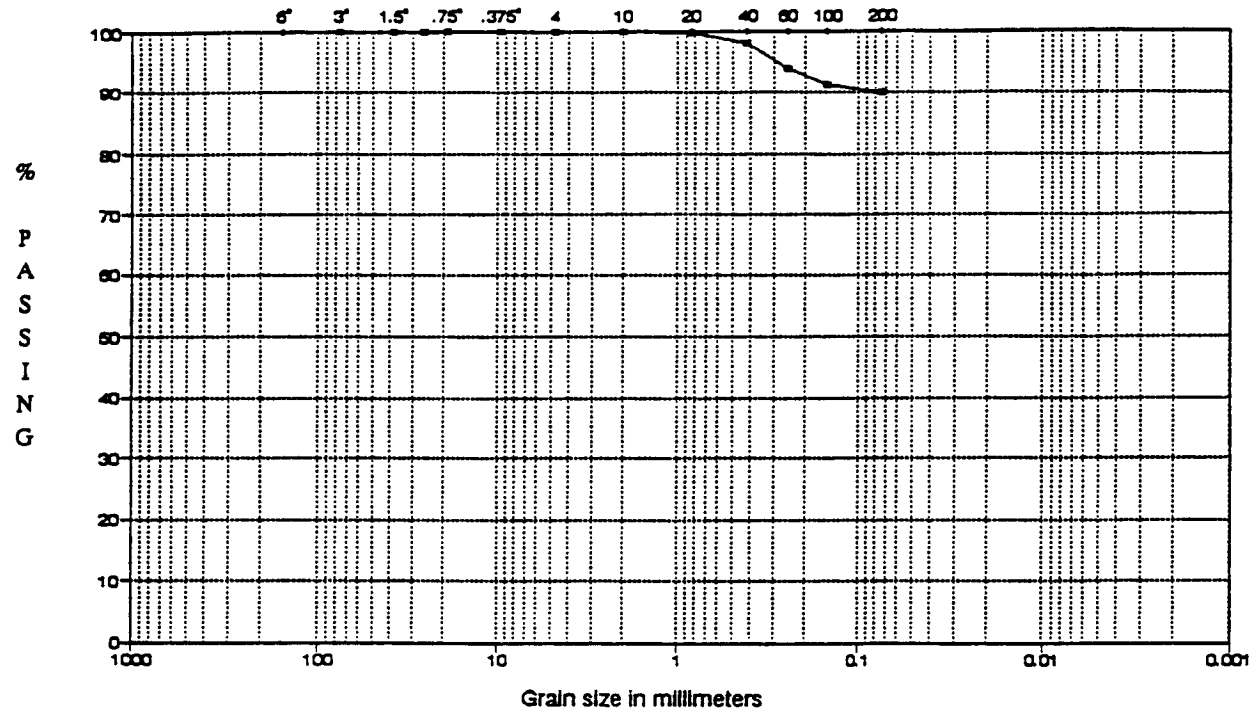
IC/2-4079/CO
923-2499

FILENAME: [illegible]

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		19.6	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

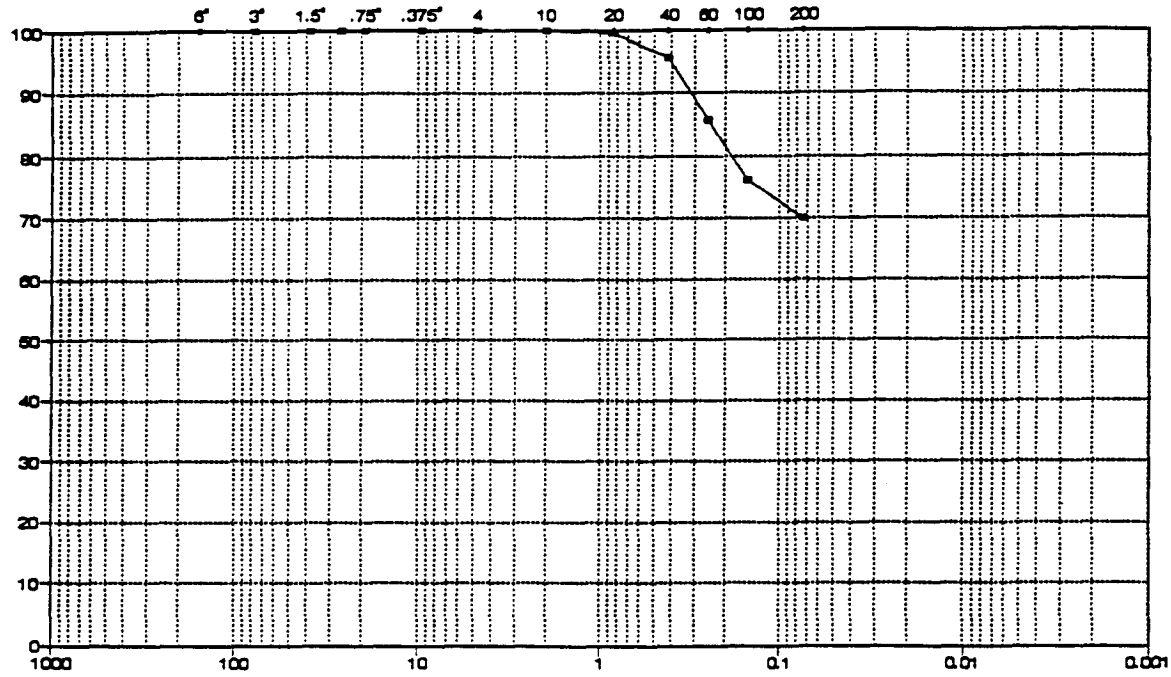
IC/2-4079/CO
923-2499

FILENAME

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS

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

SAMPLE ID		W%	LL	PL	PI	Gs	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

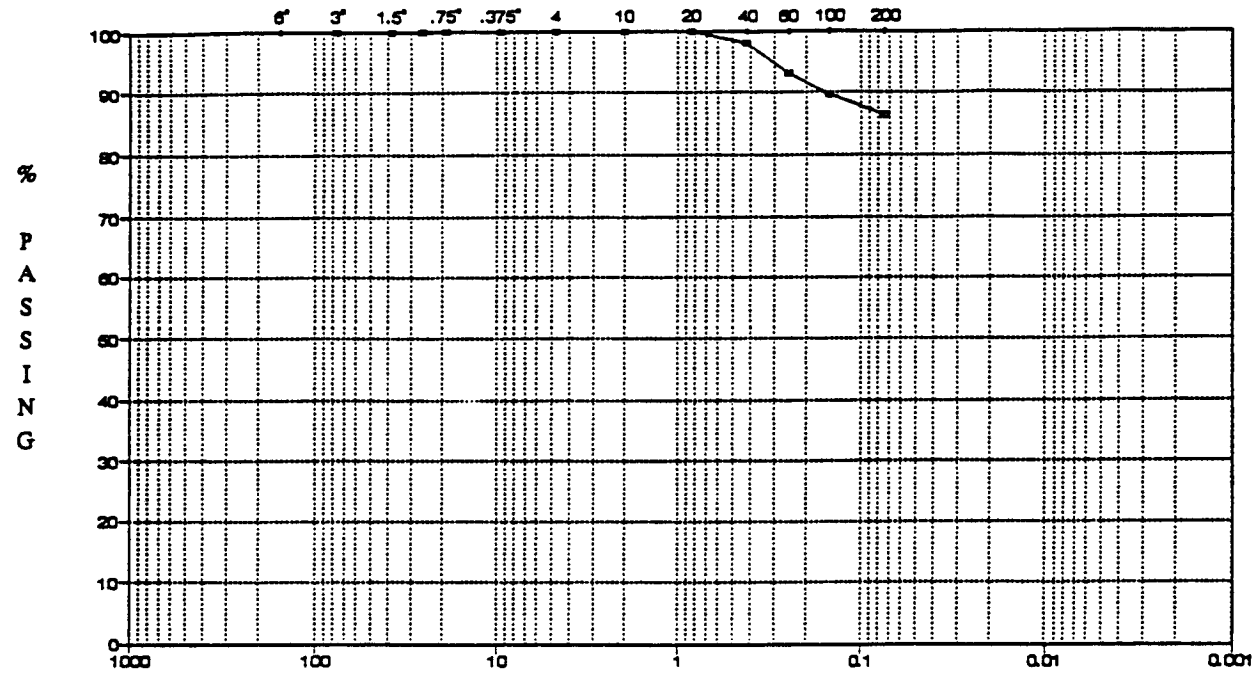
IC/2-4079/CO
923-2499

FILENAME

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS

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

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

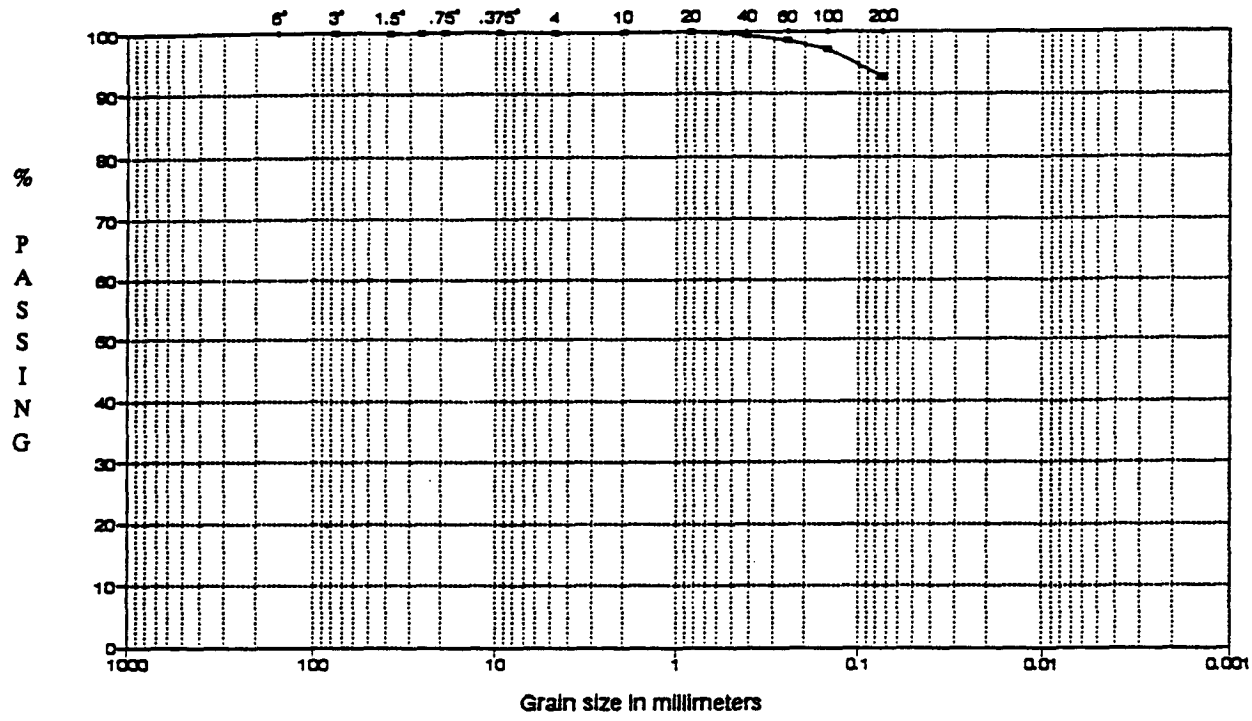
IC/2-4079/CO
923-2499

FILENAME: [illegible]

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

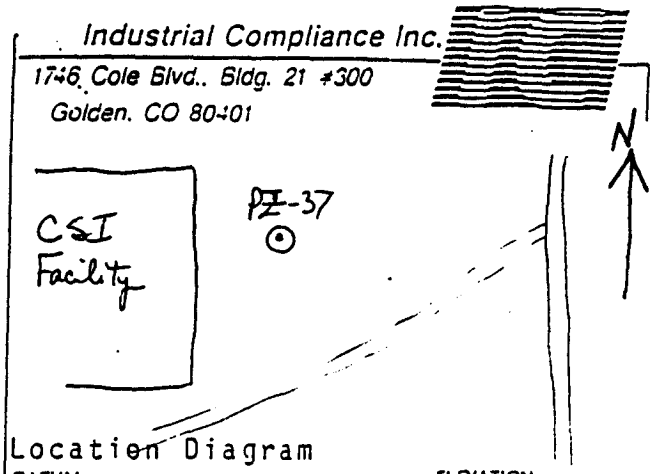
FILENAME: [illegible]

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

APPENDIX E

ORIGINAL SOIL BORING LOGS

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 ⅝" Hollow Stem Auger
BORING NO. PZ-37
SHEET 1 OF 4
SAMPLING METHOD: Continuous sampler
DRILLING START FINI

					TIME	TIM
WATER LEVEL	52.6'				9:10	2:
TIME	4/18				DATE	DA
DATE	12:10				4/18/91	4/18
CASING DEPTH	63'					

DATUM ELEVATION

DRILLING CONTR. Lone Western

BY Mike Unger / Judy Plamback / John Cocroft DATE 4/18/91 CHK'D BY

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		
						9		
	24"/60"					10	CL	clay, sandy, light brown, moist, fine grain, $CaCO_3$
						11		
						12		
CS						13		
						14	SP	sand, slightly clayey, med. moist, fine grain to med. grained, light brown
	37"/60"					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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 3/8" Hollow Stem Auger
BORING NO. PZ-37
SHEET 2 OF 4
SAMPLING METHOD: Continuous Sampler

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					9:10	2:
DATE					DATE 4/18/91	DATE 4/18/
CASING DEPTH						

Location Diagram

CSI

PZ-37

N

DRILLING CONTR. Lane Western
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:
CS		25'/60"				21	SP	sand, f-g-c.g., slightly clayey in part, l. brown, wet. moist
						22		
						23	CL	clay, sandy, (f-g-m.g.), moist, brown,
CS						24		
		60'/60"				25		
						26	CL	clay, sli. sandy to sandy, moist, brown,
						27		
						28	CLS	claystone, gray, iron fractured, moist
CS						29		
						30		
		60'/60"				31		
						32	SMS	siltstone and sandstone, v.f.g., gray to yellow to red brown, dry to wet. moist, occasional thin (1" claystone lense (gray), sand size varies from v.f.g. to c.g.
CS						33		
						34		
		38'/60"				35		
						36		
						37		
drilled out						38	SPS	sandstone, l. brown to yellow brown, v.f.g. to f.g., moist in part, some well cemented lenses from 40'-42'
CS						39		
						40		

DRILLED BY Mike Unger / Teddy Plunkett JOHN CROFT
DATE 4/18/91
CHK'D BY

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 3/4" Hollow Stem Auger
BORING NO. PZ-3
SHEET 3 OF 4
SAMPLING METHOD: Continuous Sampler
DRILLING START FIN

WATER LEVEL	52.6'				9:15	TIM
TIME	4/18				2:45	2:
DATE	12:10				DATE 4/18/91	DA 4/18
CASING DEPTH						

Location Diagram

DRILLING CONTR. Lane Western
LOGGED BY Mike Unger, Jody Plambeck, Jim Crafft
DATE 4/18/91

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:
CS	40"/60"					41	SPS	sandstone, V.F.g.-F.g., l.brown to yellow brown, moist in part, quartz grains predominantly, some well cemented lenses from 40'-42'
						42		
CS						43		
	24"/60"					44		
						45	SPS	sandstone, V.F.g-F.g., yellow gray, moist, poorly cemented, iron stained, possible saturated
						46		* area?
						47		
CS						48		
	28"/60"					49		
						50	SPS	sandstone, V.F.g. to coarse grained, yellow gray, poorly cemented, damp, iron stained in part,
						51		
						52		
						53		
CS	48"/48"					54		
						55		
						56	SPS	sandstone, V.F.g-C.g., yellow gray to yellow brown, poorly cemented, wet, iron stained
						57		
drilled out w/cone plug						58	SMS	siltstone, V. well cemented, d.brown, med. moist drills V. hard
CS						59	CLS	claystone, gray-blue, moist, hard
						60		

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

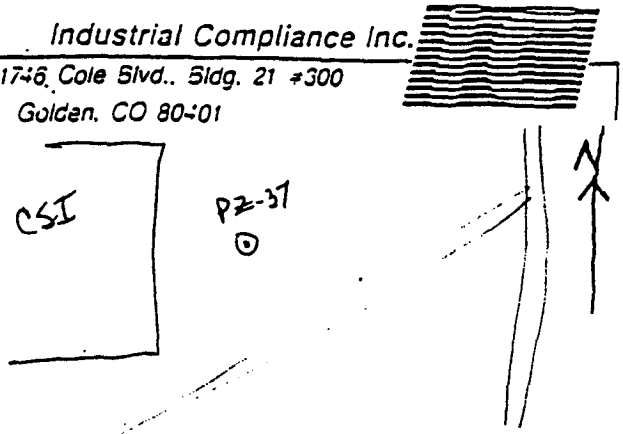
JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6"&8" Hollow Stem Auger
BORING NO. PZ-37
SHEET 4 of 4
SAMPLING METHOD: Continuous Sampler
DRILLING START / FINISH

WATER LEVEL				
TIME				
DATE				
CASING DEPTH	63'			

TIME: 9:10 / 2:45 — DATE: 4/18/11 / 4/18

Location Diagram



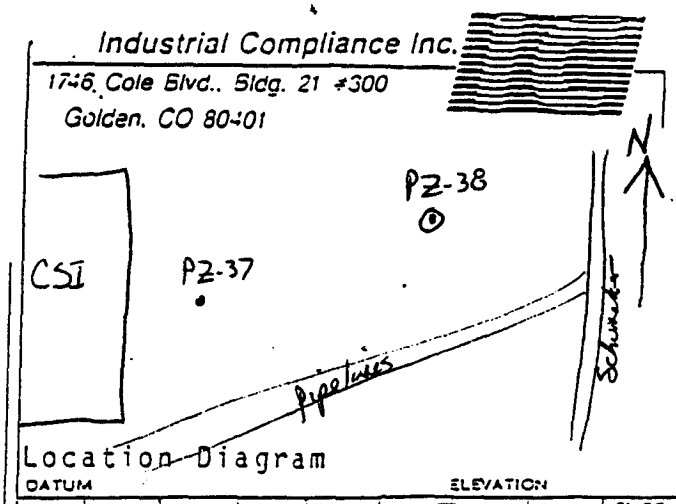
DATUM: ELEVATION:

DRILLING CONTR. Lane Western

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:
CS		60" / 60"				61	CLS	claystone, blue-gray, moist
						62	SPS	sandstone, f.g.-c.g., v. moist (possibly wet), y. brown
						63		63.0 T.D.
						64		
						65		1" PVC piezometer — 20' screen (hand slot)
						0		Cuttings: 0-28'
								hole plug: 28'-41'
								sand: 41'-63'
								(Tank)
						0		

LOGGED BY Mike Unger / Judy Plamback, John Cocroft
DATE 4/18/11 CHKD BY

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



JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 8" Hollow Stem Auger

BORING NO. PZ-38

SHEET 1 OF 4

SAMPLING METHOD: CONTINUOUS sampler

DRILLING: START TIME 2:50 DATE 4/18/91; FINISH TIME 11:05 DATE 4/19/91

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING CONTR. Lane Western

DATUM ELEVATION

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	
						1	CL	clay, silty, sandy (F.g.), brown, dry
						2	CL	clay, silty, sandy (F.g.), brown, moist
						3		
CS						4		
		60"/60"				5	SP	sand, silty, sli. clayey to clayey, l. brown, wet, F.g.-C.g.
						6		
						7		
						8		
CS		58"/60"				9		
						10		
						11		
						12		
						13	CL	clay, sandy to v. sandy, silty, F.g.-C.g., brown, med. moist to moist
CS						14		
		49"/60"				15		
						16	SP	sand, clayey, silty, F.g.-C.g., brown, wet
						17		
						18		
CS						19		
						20		

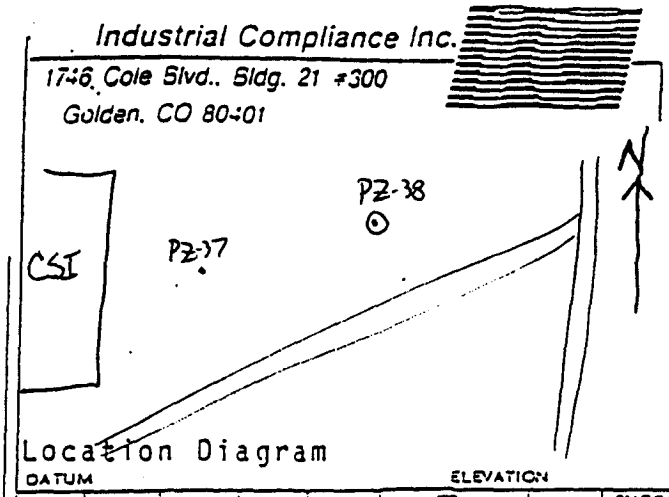
LOGGED BY Mike Lyttle DATE 4/18/91

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 ⅝" Hollow Stem Auger
BORING NO. PZ-38
SHEET 2 OF 4
SAMPLING METHOD: Continuous Sampler
DRILLING

	START	FINIS
WATER LEVEL		
TIME	2:50	11:0
DATE	4/18/91	4/19



Location Diagram

DATUM ELEVATION

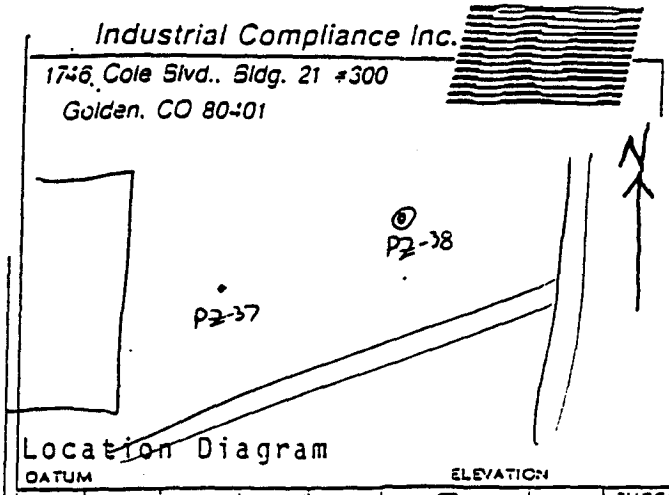
DRILLING CONTR. Lane Western

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		60"/60"				21	SP	sand, slightly clayey to clayey, F.g.-C.g., brown, wet, moist
						22	SM	sand, v. silty, clayey, moist, brown, V.F.g.
						23		
CS						24		
		47"/60"				25	CL	clay, sandy (V.F.g.-M.g.), brown, moist
						26		
						27	~~SM~~	~~sand, v. silty, clayey, moist, brown, V.F.g.,~~
CS						28	CL	clay, sli. sandy to sandy, brown, moist, $CaCO_3$
		59"/60"				29		
						30		
						31		
						32		
						33	CL	clay, sli-sandy to sandy, brown, moist, occasional thin sand lenses (2"-3"), F.g.-C.g., $CaCO_3$
CS						34		
		60"/60"				35		
						36		
						37		
						38		
CS						39	CL	clay, sandy to v. sandy, silty, brown, moist, $CaCO_3$ (F.g.-C.g.)
						40		

LOGGED BY: Mike Unger DATE: 4/18/91
CHKD BY

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 8" Hollow Stem Auger — BORING NO. PZ-3

SAMPLING METHOD: Continuous Sampler — SHEET 3 of 4

WATER LEVEL		
TIME	2:50	11:
DATE	4/18/11	4/1

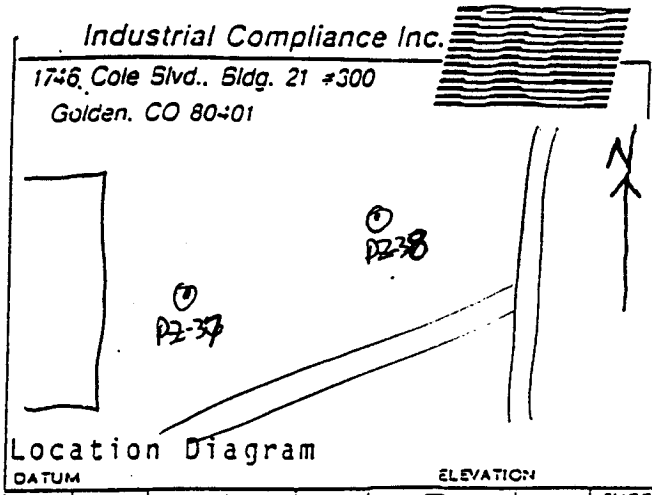
DRILLING CONTR. Lane Western — DATUM — ELEVATION

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:
CS	60"/60"					41	CL	clay, sandy to v. sandy (v.f.g.-c.g.), brown, moist
						42		
						43		
CS	46"/60"					44	SP	sand, v. clayey, brown, moist, v.f.g.-m.g.
						45		
						46	SP	sand, sli. clayey, brown, moist, v.f.g.-c.g.
						47		
						48		
CS	37"/60"					49		
						50	SC	sand, v. clayey, silty, claystone fragments (gray), brown
						51		moist v.f.g.-m.g.
						52		
						53	CLS	52.7' claystone, gray to yellow gray, iron stained, moist
CS	60"/60"					54		one thin SCS lense (4") from 56.6'-56.7'
						55		
						56		
						57		
						58	SCS/CLS	interbedded clayey sandstone & claystone lenses (¼"-1"),
CS						59		gray to yellow brown, moist, v.f.g.
						60	CLS	claystone, gray, moist, iron stained in part

4/19

LOGGED BY Mike Unger — DATE 4/18/11 — CHK'D BY

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 8" Hollow Stem Auger — BORING NO. PZ-3
SHEET 4 of 4
SAMPLING METHOD: Continuous Sampler — DRILLING
START FIN

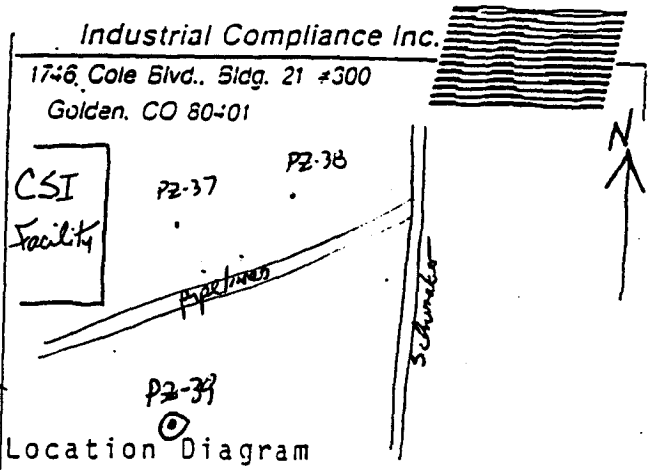
WATER LEVEL	67.6				TIME	TI
TIME	10:00				2:50	11:
DATE	4/9				DATE	DA
CASING DEPTH	70'				4/8/91	4/

DRILLING CONTR. Lane Western
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:
CS		58" / 60"				61	CLS	claystone, gray, moist
						62	SPS	sandstone, v.f.g.-m.g., yellow brown, moist, clayey iron staining
CS						63		
		60" / 60"				64	CLS	claystone, gray to blue gray, moist, some iron stai
						65		
						66		
						67		
CS		20" / 24"				68	SPS	sandstone, clayey, v.f.g.-m.g., V. moist, yellow brow
						69		wet
						70		70.0' T.D.
						71		
						72		1"PVC 0-70' — 1"PVC 0-40'
						73		Cuttings: none — 0-23.5'
						74		hole plug: ~~47'~~ 40' 2bag — 23.5-28'
						75		sand: 47-70' — 28'-40'
						76		20' screen (hand slot) — 10' screen
						77		
						78		
						79		
						80		

LOGGED BY Mike Unger
DATE 4/12/91
CHK'D BY

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 & 8" Hollow Stem Auger — BORING NO. PZ-3[illegible]

SHEET 1 OF 4

SAMPLING METHOD: Continuous sampler

	DRILLING START	DRILLING FIN
WATER LEVEL		
TIME	11:15	5:[illegible]
DATE	4/19/91	4/[illegible]
CASING DEPTH		

DRILLING CONTR. Lane Western Allen & Sandy

DATUM ELEVATION

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	
						1	CL	clay, v. silty, sandy, dry, brown
						2	SP	sand, clayey to v. clayey, brown, med. moist (fg - cg.)
CS						3		
		25"/60"				4		
						5		
						6		
						7		
CS						8		sand, slightly clayey to clayey, l. brown, med. moist fg. - c.g.
		34"/60"				9		
						10	SP	
						11		
						12		
CS						13		
						14		
		51"/60"				15		
						16	SP	s.a.a.
						17		
CS						18		
						19		
						20		

LOGGED BY Mike Unger DATE 4/19/91

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 1/8" Hollow Stem Auger
BORING NO. PZ-39
SHEET 2 OF 4
SAMPLING METHOD: Continuous Sampler
DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					11:15	5:05
DATE					DATE	DATE
CASING DEPTH					4/19/91	4/19/

DRILLING CONTR. Lane Western

Location Diagram

DATUM ELEVATION

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						21	CL	clay, sandy (f-g), silty, brown, med. moist to moist, $CaCO_3$
	43"/60"					22		
						23		
CS						24		
	56"/60"					25	SP	sand, clayey to v. clayey, brown, v.f.g.-c.g., moist, $CaCO_3$
						26		
						27	SP	sand, v.f.g.-m.g. v. clayey, $CaCO_3$, l. brown, med. moist
CS						28		
						29	SP	sand, clayey, f.g.-c.g., med. moist, l. brown
	55"/60"					30		
						31		
						32		
						33		
CS						34	SP	sand, slightly clayey to clayey, v.f.g.-c.g., med. moist, silty, l. brown, $CaCO_3$ in part
	54"/60"					35		
						36		
						37		
						38		
CS						39		
						40	SP	S.A.A.

LOGGED BY Mike Unger
DATE 4/19/91

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 & 8" Hollow Stem Auger
BORING NO. PZ-3
SHEET 3 OF 4
SAMPLING METHOD: Continuous Sampler
DRILLING START FINI

WATER LEVEL				TIME	TIM
TIME				11:15	5:
DATE				DATE	DAT
CASING DEPTH				4/19/91	4/19

DRILLING CONTR. Lane Western

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:
		45/60"				41	SP	Sand, clayey, V.F.g-C.g, med. moist, l. brown, CaCO3 silty, two thin (1"-2") sandy clay lenses, brown, med moist
						42		
						43		
CS						44		
						45	Cl	Clay, V. sandy, CaCO3, silty, med. moist to moist, brown
		51"/60"				46		
						47		
						48		
CS						49	Cl	Clay, sandy, silty, med. moist to moist, brown, CaCO3
		60"/60"				50		
						51		
						52	SP	Sand, F.g-C.g, silty, sli. clayey to clayey, brown, med. moist
CS						53		
						54		
						55	Cl	Clay, V. sandy, silty, brown, moist
		49"/60"				56	SP	
						57		Sand, F.g-C.g, clayey, brown, med. moist
						58		
CS						59		
						60	SP	S.A.A.

LOGGED BY Mike Unger DATE 4/19/91

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: CME 75 6 8" Hollow Stem Auger
BORING NO. PZ-39
SHEET 4 of 4
SAMPLING METHOD: Continuous Sampler
DRILLING START FIN

WATER LEVEL	dry				TIME 11:15	TIME 5:0
TIME	5:00					
DATE	4/19				DATE 4/19/91	DATE 4/1
CASING DEPTH	69'					

Location Diagram

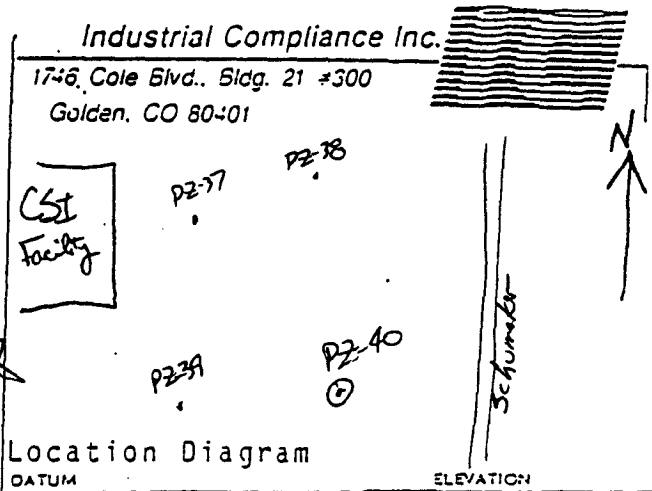
DRILLING CONTR. Layne Western

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:
						61	SP	sand, f.g.-c.g., clayey to v. clayey, brown, med. moist to moist
	25"/60"					62		
						63	SPS	sandstone, v.f.g-m.g, moist, yellow brown to yellow gray
CS						64		
						65	SPS	sandstone, v.f.g-f.g, v.well cemented, hard to drill w/ cuttings, reddish-brown, med. moist to dry
						66		
						67		
						68	SPS	sandstone, v.f.g-m.g, poorly cemented, yellow gray, silty moist,
						69		
						70		69.0' T.D. stickup - 2.85'
						71		0-69 1" PVC 10' slot
						72		cuttings: 0-48'
						73		hole plug: 48'-54'
						74		sand: 54-69'
						75		
						76		destroyed 3 teeth on bit
						77		
						78		
						79		
						80		

LOGGED BY Mike Ugar DATE 4/19/91 CHK'D BY

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



Location Diagram

DATUM ELEVATION

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: CME 75
6 5/8" Hollow Stem Auger (Mobile auger)

BORING NO. PZ-4

SHEET 1 OF

SAMPLING METHOD: CONTINUOUS sampler

DRILLING START FIN

WATER LEVEL					
TIME					
DATE					
CASING DEPTH					

TIME 11:30 (10:40) TI
DATE 4/22/91 DA

DRILLING CONTR. Layne Western (Allen Ready)

BY Mike Unger DATE 4/22/91 CHKD BY

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	SM	v. silty sand, clayey, mod. moist to dry, v.f.g.-m.g., brown
		47" / 48"				2	CL	clay, v. sandy, silty, mod. moist, brown
						3	SP	sand, silty, sli. clayey to clayey, l. brown, v.f.g.-c.g.
CS						4		
						5	SC	v. clayey sand, v.f.g.-m.g., silty, l. brown, $CaCO_3$, mod. mo
		57" / 60"				6		
						7	SP	sand, silty, slightly clayey to clayey, l. brown, mod. moist
						8		
CS						9		
		41" / 60"				10		
						11	SP	sand, silty, slightly clayey to clayey, l. brown, mod. moist
						12		
						13		
CS						14		
		49" / 60"				15		
						16	CL	clay, silty, sandy (v.f.g.-f.g.), brown, mod. moist
						17		
						18		
						19		
CS						20	CL	Clay, s.a.a.

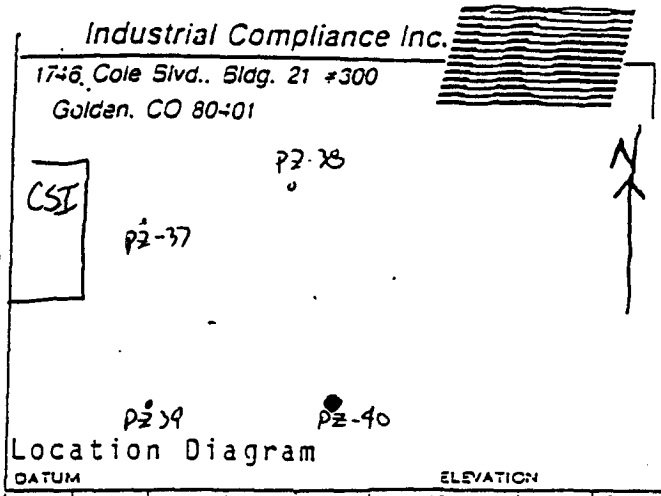
Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 8" Hollow Stem Auger
BORING NO. PZ-40
SHEET 2 OF 4
SAMPLING METHOD: Continuous Sampler
DRILLING START FINIS

WATER LEVEL					
TIME					TIME 11:30 TIME 11:4
DATE					DATE 4/22/91 DATE 4/23
CASING DEPTH					

Location Diagram

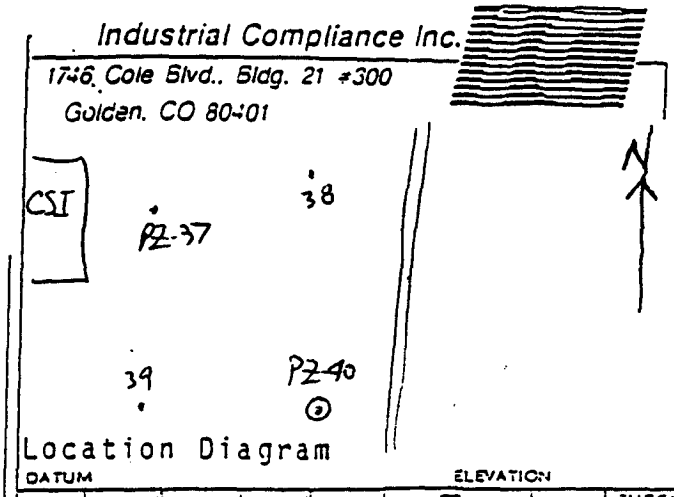


DRILLING CONTR. Lane Western
DATUM
ELEVATION
SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	
CS		43"/60"				21	Cl	Clay, silty, sandy (v.f.g.-f.g.), brown, med.moist
						22		
						23		
						24		
CS						25		
		39"/60"				26	SP	sand, clayey, silty, v.f.g.-c.g., l.brown, $CaCO_3$, med. moist
						27		
						28		
						29		
CS						30	SP	sand, s.g.a.
		41"/60"				31		
						32		
						33	Cl	Clay, silty, sandy (v.f.g.-f.g.), brown, med. moist, Cl
						34	SP	sand, f.g.-c.g., silty, sli. clayey to clayey, med moist brown
CS						35		
						36		
		53"/60"				37	Cl	Clay, v.sandy, silty, brown, med. moist
						38		
						39	SP	sand, clayey, brown, med. moist, f.g.-c.g.
CS						40		

LOGGED BY Mike Cryer DATE 4/22/91 CHK'D BY
4/22/91 4/23

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 8" Hollow Stem Auger — BORING NO. PZ-40

SAMPLING METHOD: Continuous Sampler — SHEET 3 OF 4

					DRILLING START	DRILLING FINI
WATER LEVEL					TIME	TIM
TIME					11:30	11:4
DATE					DATE	DA
CASING DEPTH					4/22/91	4/2

DRILLING CONTR. Lane Western Drilling Co. of Inc.

DATUM ELEVATION

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	
							SP	
		56" / 60"				41	CL	clay, sandy (v.f.g.-m.g.), brown, moist, $CaCO_3$ silty
						42		
						43	SP	
CS						44		sand (F.g.-C.g.), slightly clayey to clayey, med. moist, brown to yellow brown
						45		
						46		
		44" / 60"				47	SP	sand, s.a.a., some iron concretions (1/4"-1/2" diam.)
						48		
CS						49	SPS	sandstone, v.f.g.-c.g., poorly cemented, med. moist, yellow brown to light gray, iron stained in part, slightly clayey,
						50		
		51" / 60"				51		
						52	SPS	sandstone, s.a.a., some thin (1") moderately cemented lenses
						53		
						54		
CS						55		
						56	SPS	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 brown, slightly clayey,
		41" / 60"				57		
						58		
						59		
CS						60		

LOGGED BY Mike Capps DATE 4/22/91

CHKD BY

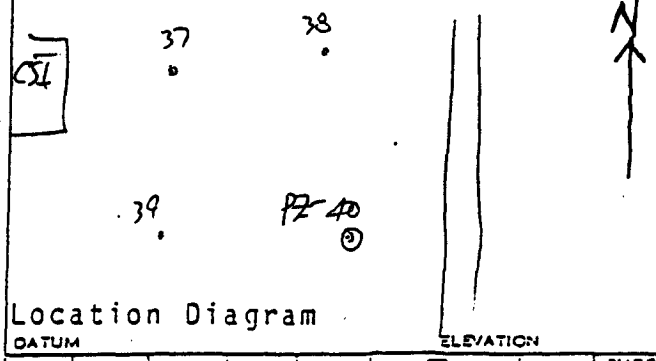
Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 8" Hollow Stem Auger
BORING NO. PZ-4
SHEET 4 OF 4
SAMPLING METHOD: Continuous Sampler
DRILLING START TIME 11:30 DATE 4/22/11
FIN TIME 11:- DATE 4/2

WATER LEVEL	63.05 bgs		
TIME	11:20		
DATE	4/23/11		
CASING DEPTH	69.5'		

Location Diagram



DATUM ELEVATION

DRILLING CONTR. Layne Western

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	
						61	SPS	sandstone, v.f.g.-c.g., moderately cemented, slightly clay, iron stained, some small calcretions, clump @ 62', yellow brown to olive brown
		39/60"				62		
						63		
						64		
CS						65		
						66	SPS	sandstone, s.a.a., wet
		44/60"				67		
						68	SPS	sandstone, s.a.a., some thin (1"-2") claystone lenses Gray wet, v.f.g.-c.g., yellow brown - yellow gray
						69		20' hand slot 50'-70'
						70		69.5' T.D.

cuttings: 0 - 33.5'

hole plug: 33.5 - 47.5 5 bags

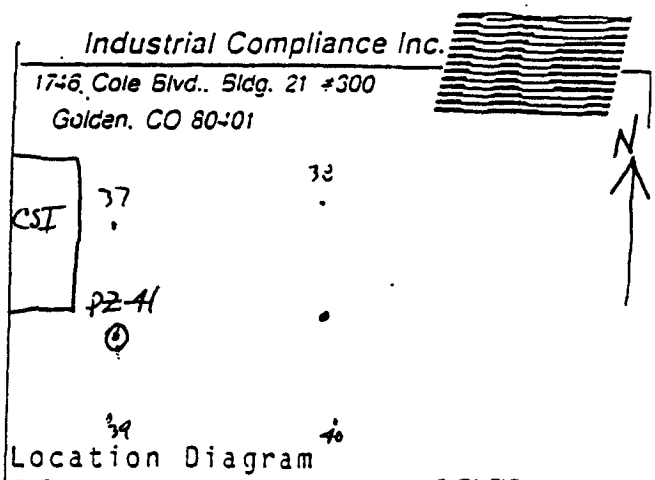
sand: 47.5 - 69.5'

stick up: 3.0'

LOGGED BY Mike Cupp DATE 4/23/11 CHK'D BY

0

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6 3/8" Hollow Stem Auger
BORING NO. PZ-41
SHEET 1 OF 4
SAMPLING METHOD: CONTINUOUS sampler (CS)
DRILLING START FIN

					TIME	TIME
WATER LEVEL						
TIME					11:55	4:
DATE					DATE	DA
CASING DEPTH					4/23/91	4/23

DRILLING CONTR. Layne Western Dallas, Tx
DATUM
ELEVATION
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	CL	clay, silty, sandy, dry, l.brown
	40"/48"					2	CL	clay, silty, sandy, med. moist, brown
							SC	v.clay sand, V.F.g.-M.g., brown, med. moist
						3	SP	sand, v.F.g.-C.g., l.brown, med.moist, silty,
CS						4		
						5		
	51"/60"					6	SP	sand, v.F.g.-C.g., silty, sli. clayey, l.brown, med.m
						7		
						8		
CS						9	CL	clay, silty, sandy (v.F.g.-F.g.), med. moist to moist, brown
						10		
	51"/60"					11		
						12	SP	sand, v.F.g.-C.g., clayey, silty, med. moist, l.brown
						13		
						14		
CS						15	CL	clay, silty, sandy (v.F.g.-F.g.), brown, med. moist to moist, brown
	50"/60"					16	SP	sand, V.F.g.-V.C.g., l.brown, med. moist
						17		
						18	CL	clay, sandy, silty, brown, med. moist to moist
						19		
CS						20		

DRILLED BY Mike Unger DATE 4/23/91 CHK'D BY

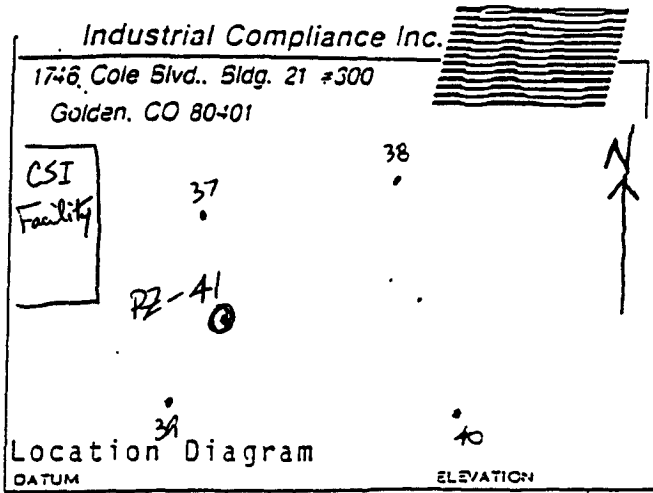
Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6" Hollow Stem Auger
BORING NO. PZ-41
SHEET 2 OF 4
SAMPLING METHOD: Continuous Sampler (CS)
DRILLING

	START	FINISH
WATER LEVEL		
TIME	11:55	4:40
DATE	4/23/91	4/23

Location Diagram



DATUM ELEVATION

DRILLING CONTR. Layne Western Geotech Services
LOGGED BY Mike Unger
DATE 4/23/91 CHK'D BY

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						21	CL	clay, sand to v. sandy, silty, $CaCO_3$, med. moist, brown
	60"/60"					22		
						23	SP	sand, slightly clayey to clayey, med. moist, l. brown v.f.g - c.g.
						24		
CS						25		
						26		
	59"/60"					27	SP	sand, silty, clayey, med. moist, l. brown to brown, v.f.g - c.g.
						28		
						29		
CS						30		
						31		
	60"/60"					32	SC	v. clayey sand, v.f.g - m.g., silty, $CaCO_3$, brown, med. moist
						33		
						34	SP	sand, v.f.g - c.g., clayey, l. brown, med. moist
CS						35		
						36		
	60"/60"					37	SP	sand, v.f.g. - c.g., clayey to v. clayey, $CaCO_3$, brown, med. moist
						38		
						39		
CS						40		

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6" Hollow Stem Auger — BORING NO. PZ-4

SAMPLING METHOD: Continuous Sampler (CS) — SHEET 3 OF

					DRILLING START	FI
WATER LEVEL					TIME	T
TIME					11:55	4:
DATE					DATE	D
CASING DEPTH					4/23/91	4/

Location Diagram

CSI Facility
37
38
39
40
PZ-41
N

DRILLING CONTR. Layne Western — Dallas Tex

DATUM — ELEVATION

SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPHIC	
						41	SPS	sandstone, v.f.g.-m.g., slightly clayey, yellow gray to light gray, med. moist, poorly cemented, some small concretions (1/8"), reddish-brown, iron stained
		51" / 60"				42		
						43		
						44		
CS						45		
						46		
						47	SPS	sandstone, v.f.g.-c.g., slightly clayey, yellow brown to light gray, med. moist, poorly cemented, some small concretions, iron stained
		40" / 60"				48		
						49		
CS						50		
						51	SPS	sandstone, S.A.A. poorly to moderately cemented
		59" / 60"				52		
						53		
						54		
CS						55		
		33" / 36"				56	SPS	sandstone, v.f.g.-c.g., v. well cemented, moist, yellow gray, d. brown silty sandstone from 56.5-56
CS						57	CLS / SPS	thin interbedded clay stone (gray) + sandstone lenses, sand gypsum (1/4"), moist — waited 30 minutes (phone c... NO water
		24" / 24"				58		
						59	SPS	sandstone, v.f.g.-c.g., yellow gray, moderately cemented, moist, iron stained
CS						60		

LOGGED BY Mike Unger — DATE 4/23/91 — 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-41

SHEET 4 OF 4

SAMPLING METHOD: Continuous Sampler

DRILLING START TIME 11:55 DATE 4/23/11

WATER LEVEL	62.63' bgs				
TIME	4:30				
DATE	4/23/11				
CASING DEPTH	64'				

DRILLING CONTR. Layne Western

Location Diagram

CSI Facility

37 38 PZ-41 39 40 N

DATUM ELEVATION

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
SS						61	SP
		34"				62	
		60"				63	
						64	
						65	
						66	
						67	
						68	
						69	
						70	

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

64.0' TD

1" PVC

cuttings: 0 - 34.5'

hole plug: 34.5 - 45

sand: 45 - 64'

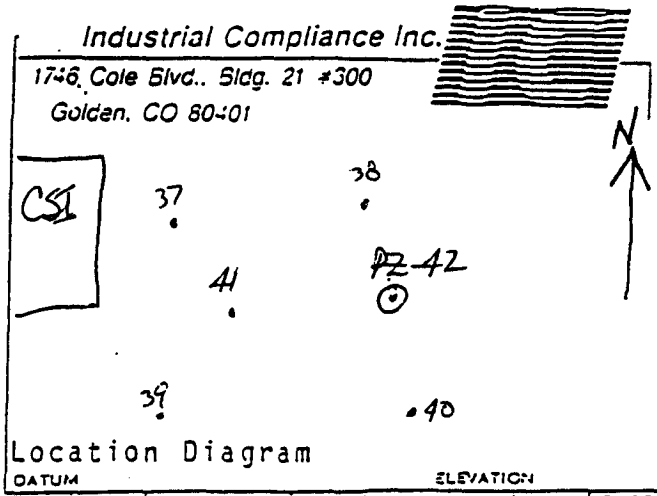
10' hand slot

stick up: 2.06'

LOGGED BY Mike Chase DATE 4/23/11

0

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 8" Hollow Stem Auger — BORING NO. PZ-4

SAMPLING METHOD: Continuous sampler (CS) — SHEET 1 OF

	DRILLING START	DRILLING FIN
WATER LEVEL		
TIME	8:15	10:
DATE	4/24/91	4/2
CASING DEPTH		

DATUM — ELEVATION

DRILLING CONTR. Lowe Western — DRILLER Dallas Tim

LOGGED BY Mike Unger — DATE 4/24/91

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:
CS						1	CL	clay, sandy, silty, dry, brown
	48"/48"					2	CL	clay, silty, sandy, med. moist, brown
						3	SP	
CS						4		sand, v.f.g.-c.g., l. brown, med. moist, silty, sli. clay to clayey
	52"/60"					5		
						6		
						7	SP	sand, v.f.g.-c.g., silty, sli. clayey to clayey, med. moist, l. brown
						8		
CS						9	CL	clay, sandy, silty, med. moist to moist, brown
						10	SP	sand, v.f.g.-c.g., clayey to v. clayey, silty, brown to l. brown, $CaCO_3$
	59"/60"					11		
						12		
						13		
CS						14	SC	v. clayey sand, silty, v.f.g.-m.g., brown, med. moist, $CaCO_3$
						15		
	60"/60"					16		
						17	SP	sand, v.f.g.-c.g., silty, slightly clayey to clayey, med. moist, l. brown
						18		
						19		
CS						20		

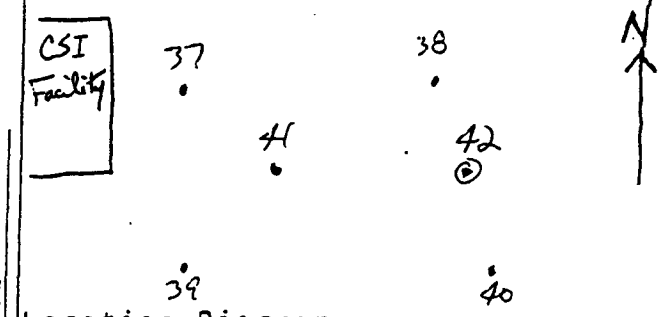
Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6" Hollow Stem Auger
BORING NO. PZ-4
SHEET 2 OF 4
SAMPLING METHOD: Continuous Sampler
DRILLING START FIN

WATER LEVEL				TIME	8:15
TIME				DATE	4/24/11
DATE					
CASING DEPTH					

Location Diagram

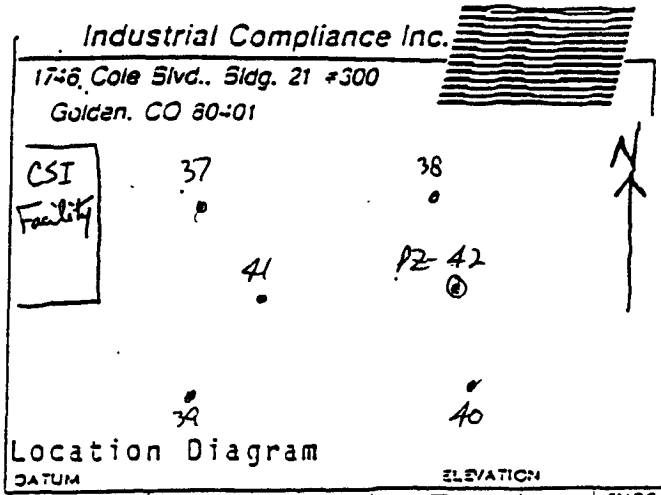


DRILLING CONTR. Layne Western
DRILLER Dallas Tim
DATUM
ELEVATION
SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	
CS						21	SP	sand, slightly clayey to clayey, silty, vf-g-c.g., med. moist, l. brown to brown, CaCO3
		60"/60"				22		
						23		
						24		
CS						25		
						26	SP	sand, s.a.a.
						27		
		60"/60"				28		
						29		
CS						30		
						31	SP	sand, clayey to v. clayey, silty, vf-g-c.g., med. moist brown to l. brown, CaCO3, some thin (2"-4") sandy clay lenses
		58"/60"				32		
						33		
						34		
CS						35	CL	clay, sandy, silty, moist, brown, CaCO3
		60"/60"				36		
						37		
						38		
						39		
CS						TD	CL	clay, s.a.a.

LOGGED BY Mike Lange
DATE 4/24/11
CHECKED BY

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett

DRILLING METHOD: 6" Hollow Stem Auger — BORING NO. PZ-42

SAMPLING METHOD: Continuous Sampler — SHEET 3 OF 4

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					8:15	10:
DATE	4/24/11				DATE	DATE
CASING DEPTH	64.0'				4/24/11	4/24

DRILLING CONTR. Layne Western Dallas, Tx

DATUM ELEVATION

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	
						41	CL	clay, sandy, silty, brown, moist, CaCO3, some iron staining
		60"/60"				42		
						43		
						44	SP	sand, clayey, silty, brown, med. moist to moist, V.F.G. - C.G.
CS						45		
						46		
		60"/60"				47	SP	sand, clayey to V. clayey, brown, moist, V.F.G. - C.G.
						48		
						49	SP	sand, slightly to clayey with thin clay lenses (1"-2"), gray sandstone fragments (well cemented, ½"-1"), probably washed in, some small iron concretions (¼"), moist, brown to yellow brown
CS						50		
		46"/60"				51	SPS	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,
						52		
						53		thin (1") silt lense @ 53.6', d. brown, moist, highly organic appearance (see PZ-41)
CS						54		
						55	SPS	sandstone, some thin (1"-3") sandy claystone lenses, iron concretions, yellow brown to d. gray, moist, V.F.G. C.G.
		59"/60"				56		
						57		
						58	SPS	sandstone, V.F.G. - C.G., slightly clayey, yellow gray to yellow brown, iron stained, V. moist to wet,
						59		
CS						60		

LOGGED BY Mike Usgr DATE 4/24/11 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-42

SAMPLING METHOD: Continuous Sampler | SHEET 1 OF 1

		TOC	START	FINISH
WATER LEVEL	56.78 bgs	59.04'	TIME	
TIME	10:35	11:10	8:15	10
DATE	4/24/91	4/24	DATE	
CASING DEPTH	64.0		4/24/91	4/2

Location Diagram

CSI Facility

PZ-42

N

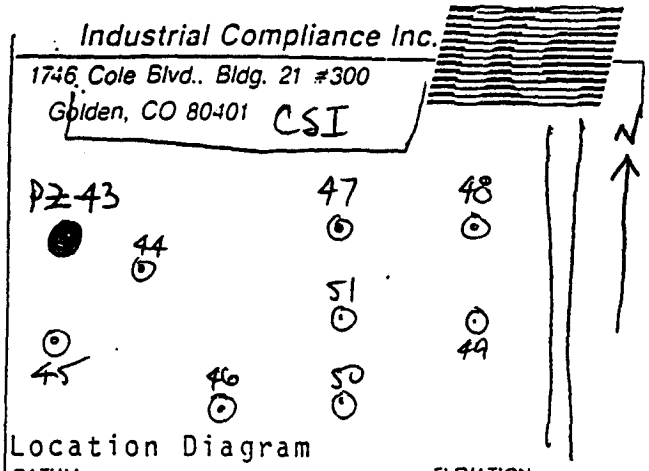
DATUM ELEVATION

DRILLING CONTR. Layne Western Rocky Mtn

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:
							SPS	
						61	CLS	claystone, gray, slightly sandy, moist to v. moist
	24" / 10					62		
						63	SPS	sandstone, v.f.g.-c.g., yellow brown, iron stained, v moderately cemented one 2" d.brown sand lense
						64		64.0' T.D.
						65		
						66		1" PVC
						67		
						68		cuttings: 0-25'
						69		hole plug: 25.0-36.5'
						70		sand: 36.5-64.0
								20' hand slot
								stickup: 3.29'
								33.5" + 6.0" = 39.5"

LOGGED BY Mike Unger DATE 4/24/91

Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401 CSI



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	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 TIME	DRILLING FINISH TIME
WATER LEVEL	29.75' bgs					
TIME	8:30				9:25	12:?
DATE	7-1				DATE 6-25-91	DATE 6/2
CASING DEPTH	49'					

DRILLING CONTR. Site Services Mike & Tim

DATUM ELEVATION

SURFACE CONDITIONS: South 320 Acres

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	
						1	SP	sand, silty, clayey, V.F.g. - m.g., dry, brown
						2		
C.S.		45'/48"				3	SP	sand, silty, clayey, v.f.g. - mg., med moist, l. brown to yellow brown, gravel stains
						4		
						5		
						6	SP	sand, silty, slightly clayey V-F.g. - m.g, Sli. moist l. brown to yellow brown, gravels
						7		
						8		
C.S.		46"/60"				9		
						10		
						11		
						12	SP	sand, V.C.g. to pea gravel, yellow brown - red-brown, med. mois
						13	CLS	claystone, weathered, gray to dark gray, iron fract stains, moist, silty in part
		60"/60"				14		
						15		
						16		
						17		
						18	CLS	claystone, med. hard, gray, iron stained in fractures moist, occasional thin (carbonaceous lenses (<1" thick), d. brown
		60"/60"				19		
C.S.						20		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	south 320 acre

DRILLING METHOD: 8" Hollow Stem Auger

BORING NO. PZ-43

SHEET 2 OF 3

SAMPLING METHOD: CONTINUOUS sampler (CS)

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					9:25	12:30
DATE					DATE	DATE
CASING DEPTH					6-25-9	6-28

see page 1 diagram

N

Location Diagram

DATUM ELEVATION

DRILLING CONTR. Site Services Mud Tim

BY Mike Ungar DATE 6-25-91 CHK'D BY

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	
						21	CLS	Claystone, gray, iron stained in fractures, moist, med. hard to hard
C.S.	60"/60"					22		
						23		
						24		
						25		
						26	CLS	Claystone, gray to yellow gray, iron stained in fractures, moist, med. hard to hard
						27		
						28		
	60"/60"					29		1" v.f.g. sand loose, v. moist to wet, yellow brown 29' to 29'1"
C.S.						30		
						31	CLS	Claystone, yellow gray to dark gray, iron stained in fractures, moist, hard, thin carbonaceous lenses (<2"), d.gray to black
						32		
	60"/60"					33		
						34		
C.S.						35		
						36		Lignite coal, black, med. moist, moisture in fractures
						37	CLS	Claystone, greenish gray, silty., moist
						38	SPS	sandstone, loose, moist, yellow brown to gray moist
	60"/60"					39		
C.S.						40		

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acr

DRILLING METHOD: CME-75 8" HS
BORING NO. PZ-43
SHEET 3 of 3
SAMPLING METHOD: continuous sampler

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME 9:25	TIME 12:30
TIME						
DATE					DATE 6-25-91	DATE 6-25-
CASING DEPTH						

See page 1 diagram

Location Diagram

DRILLING CONTR. Nielsen Site Services

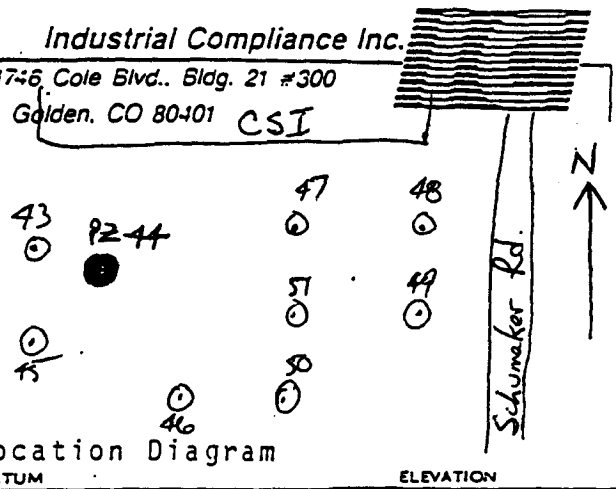
DATUM ELEVATION

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:
						41	SPS	sandstone, loose to poorly cemented, yellow brown to gray, v. moist to wet, f.g. to m.g., silty
		60'/60'				42		
						43		
						44	CLS	Claystone, gray, moist, carbonaceous, hard
C.S						45		
								Lignite coal, black, wet,
						46		
						47	CLS	claystone, gray, moist to v. moist, hard
						48		
						49		
						50		49' T.D.

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

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

Industrial Compliance Inc.
1746 Cole Blvd.. Bldg. 21 #300
Golden. CO 80401 CSI



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" Hollow Stem Auger
BORING NO. PZ-44
SHEET 1 OF 3
SAMPLING METHOD: continuous sampler
DRILLING START TIME 12:40 DATE 6-25-91
DRILLING FINIS TIME 2:4 DATE 6-2

WATER LEVEL	34.15' bgs			
TIME				
DATE	7-1			
CASING DEPTH	44			

DRILLING CONTR. Site Services Well Tech
DATUM ELEVATION
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	
C.S.							SC	sand, v. clayey, dry, v.f.g. - m.g., brown
						1	CL	clay, v. sandy, silty, brown, med. moist
						2		
	31"/48"					3		
						4		
C.S.							SP	
						5		sand, clayey, l. brown, slightly moist
						6	CL	
	60"/60"							clay, sandy, silty, brown, med. moist to moist
						7		
						8	SP	sand, clayey, silty, brown, sli. moist
						9	CLS	claystone, gray, moist, weathered, iron stained in fractures
C.S.								
						10		
						11		
	60"/60"					12	CLS	claystone gray to yellow gray, moist, iron stained in fractures, med. hard
						13		
						14		
C.S.								
						15		
	60"/60"					16		
						17		
						18	CLS	claystone, gray to yellow gray iron stained in fractures, moist, occasional thin (1"-2") sand lense
						19		
C.S.								
						20		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acres

DRILLING METHOD: CME-75 8" H.S.

BORING NO. PZ-44

SHEET 2 OF 3

SAMPLING METHOD: Continuous sampler

DRILLING: START TIME 12:10 DATE 6-25-91; FINISH TIME 2:45 DATE 6-2

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

see page 1 diagram

Location Diagram

DRILLING CONTR. Site Services Nat'l Inc

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
C.S.						24	SP/SPS	sand/sandstone, gray, med. moist to moist, loose to poorly cemented, v.f.g.-f.g.
						25		
		27"/60"				26		
						27	SPS	sandstone, reddish brown, hard, dry, iron stained
						28	SP/SPS	sand/sandstone, loose, brown to yellow brown
C.S.						29		
						30		
		43"/60"				31	CLS	claystone, gray, moist
						32		
						33	SPS	sandstone, v. well cemented, l. gray, dry
C.S.						34	SP/SPS	sand/sandstone, loose to poorly cemented, yellow brown, f.g.-m.g., moist to v. moist
						35		
		55"/60"				36		
						37		
						38		
C.S.						39	SP/SPS	
						40		original level

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

Industrial Compliance Inc.

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" H.S.

BORING NO. PZ-44

SHEET 3 OF 3

SAMPLING METHOD: continuous sampler

DRILLING

					START TIME	FINISH TIME
WATER LEVEL						
TIME					12:40	2:45
DATE					DATE 6/25/91	DATE 6/25/91
CASING DEPTH						

see page 1 diagram

Location Diagram

DRILLING CONTR. Site Services Well + Tim

DATUM ELEVATION

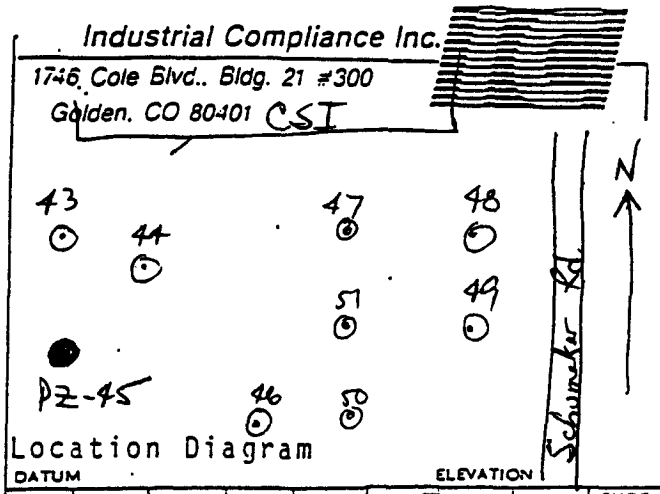
SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	
C.S.						41	SP/SPS	sand/sandstone, loose, v.f.g.-m.g., brown, wet, to poorly cemented
		39'/60'				42		
						43		
						44		
						45		44' TD

cuttings 0 - 10'
bentonite 10 - 12.7'
sand pack 12.7' - 44'
hand slot 24' - 44'

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

Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401 CSI



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	Bennett South 320 Acres

DRILLING METHOD: CME-75 8" H.S. Auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-45
SHEET 1 OF 2

WATER LEVEL	11.43' bgs					DRILLING START		FINISH
TIME						TIME	2:50	TIME 9:4
DATE	7-1					DATE	6-25-91	DATE 6/6
CASING DEPTH	34'							

DRILLING CONTR. Site Services BY Neil & Tim
DATUM ELEVATION
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	
C.S.						1	SC	sand, v. clayey, silty, brown, v.f.g.-f.g.
		31"/48"				2	SC	sand, v. clayey, silty, brown, mod. moist, v.f.g.-m.g.
C.S.						3		
						4		
						5		
		53"/60"				6		
						7	SP	sand, silty, slightly clayey, sli. moist, l.brown, f.g.-m.g.
C.S.						8		
						9		
						10		
		35"/60"				11	▼	sand, silty, v. moist to wet, l.brown, f.g.-m.g.
						12	CLS	Claystone, gray to dark brown, moist, iron stained
C.S.						13		
						14		
						15	CLS	claystone, gray to yellow brown, iron stained & in fractures, moist
		59"/60"				16		
						17		
						18		
C.S.						19		
						20		

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

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

see page 1 diagram

JOB NO	CLIENT	LOCATION
2-3311	CSI	Bennett South 320 Acres

DRILLING METHOD: CME-75 8" H.S. Auger
BORING NO. PZ-45
SHEET 2 OF 2
SAMPLING METHOD: continuous sampler
DRILLING: START / FINISH

					START	FINISH
WATER LEVEL					TIME 2:50	TIME 9:50
TIME					9:50	9:50
DATE					DATE 6-25-91	DATE 6/26/91
CASING DEPTH						

DRILLING CONTR. Site Services Neil Tim

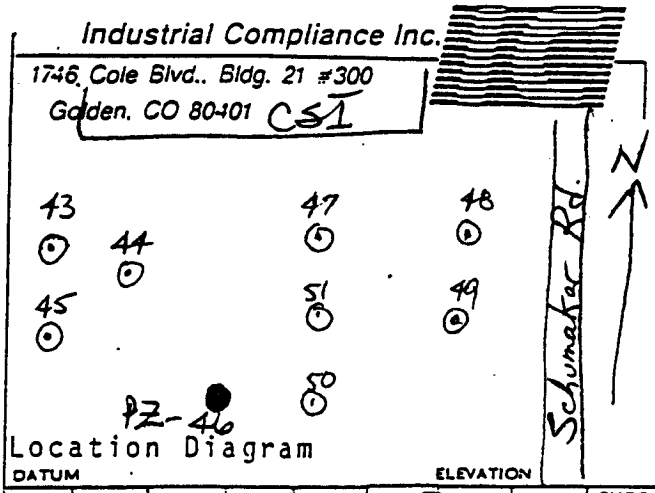
Location Diagram

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 dark brown, moist, iron stained and 1/4" fractures, med. hard
		49" / 60'				22		
						23		
CS						24		
						25		
						26	SCS	sandstone, v. clayey, lt. gray, v.f.g., med. moist
		60" / 100'				27	CLS	claystone, gray, moist, hard
						28	SCS	sandstone, v. clayey, lt. gray, v.f.g., med. moist
CS						29	CLS	claystone, gray, moist, hard [29' 6-25-91]
						30		
		58" / 60"				31		
						32	CLS	claystone, gray to yellow gray, moist, some sandy claystone lenses, hard
						33		
						34		
						35		34' TD
						36		
						37		cuttings: bentonite 0'-4', sand pack 4'-34', hand slot 9-34'
						38		
						39		
						40		

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

Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401 CSI



Location Diagram

DATUM ELEVATION

JOB NO.	CLIENT	LOCATION
2-3311	CSI	south 320 acre

DRILLING METHOD: CME-75, 8" Hollow Stem Auger

BORING NO. PZ-46

SHEET 1 OF 3

SAMPLING METHOD: Continuous sampler

DRILLING

		START	FINISH
WATER LEVEL	23.11' bgs	TIME	TIME
TIME		9:55	1:40
DATE	7-1	DATE	DATE
CASING DEPTH	54'	6/26/91	6/26/91

DRILLING CONTR. Site Services Nielsen

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	
C.S.						1	SC	sand, v. clayey, dry, silty, v.f.g. - m.g.
						2		
		31"/48"				3	SP	sand, silty, slightly clayey, brown to l brown, sli. moist
C.S.						4		v.f.g. - m.g.
						5		
		35"/60"				6		
						7	SP	sand, silty, slightly clayey to clayey, brown, sli. moist
						8		
						9		v.f.g. - f.g.
C.S.						10		
						11	SP	sand, clayey, silty, sli. moist, brown v.f.g. - f.g.
		58"/60"				12		
						13		
C.S.						14	CL	clay, v. sandy, silty, mod. moist, brown, calcareous
						15		
		50"/60"				16	SC	sand, v. clayey, silty, sli. moist, brown, calcareous
						17		v.f.g. - f.g.
						18		
C.S.						19	SP	sand, clayey, yellow gray, sli. moist, v.f.g. - m.g.
						20		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" H.S.

BORING NO. PZ-4

SHEET 2 of 3

SAMPLING METHOD: continuous sampler

DRILLING: START TIME 9:55 DATE 6-26-91; FINISH TIME 1:4 DATE 6/26

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

see page 1 diagram

Location Diagram

DRILLING CONTR. Site Services Nail at Tim

DATUM ELEVATION

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

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	sand, sli. clayey, yellow gray to reddish brown v. moist from 22' to 23'
		31" / 60"				22		
						23		
CS						24	CLS	claystone, l. gray, moist, med. hard, some moisture in fractures
						25		
		59" / 60"				26		
						27	CLS	claystone, yellow gray to l. gray, moist, hard iron stained in fractures
						28		
CS						29		
						30		
		60" / 60"				31		
						32	CLS	claystone, yellow gray to l. gray, moist, hard iron stained in fractures
						33		
CS						34		
		60" / 60"				35		
						36	CLS	claystone, gray to yellow gray, moist, hard iron stained in fractures
						37		
						38		
CS						39		
						40		

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75, 8" Hollow Stem Auger
BORING NO. PZ-46
SHEET 3 OF 3
SAMPLING METHOD: continuous sampler

	DRILLING START TIME	DRILLING FINISH TIME
WATER LEVEL		
TIME	9:55	1:4[illegible]
DATE	6-26-91	6-26-91
CASING DEPTH		

see page 1 diagram

DRILLING CONTR. Site Services Neal & Tim

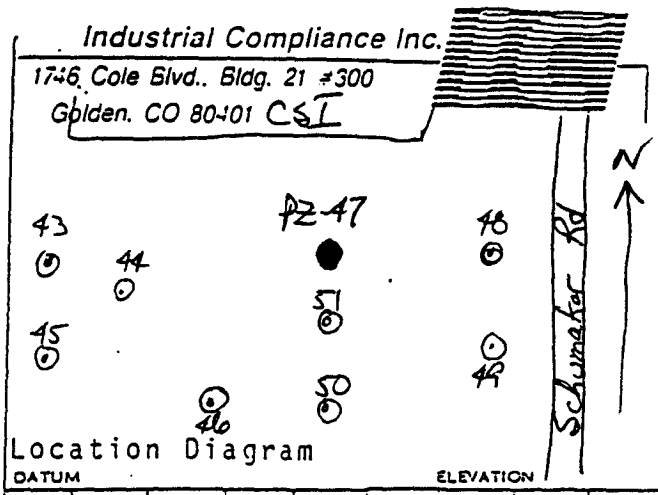
Location Diagram

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:
						41	CLS	Claystone, gray to yellow gray, moist, hard, iron stained
		44'				42		
		60"				43		
						44		
CS.						45		
						46		
						47	CLS	Claystone, v. carbonaceous to lignitic, d. brown to blk, moist to v. moist
		60" / 60"				48	SC/SCS	sand/sandstone, poorly cemented, yellow gray, v.f.g., moist
						49	SP/SPS	sand/sandstone, yellow gray to gray, moist to v. moist, v.f.g. - f.g.
CS.						50		
						51	SP/SPS	sand/sandstone, same as above, wet
		60" / 60"				52		
						53	CLS	Claystone, yellow gray to d. brown, moist, iron stained.
						54		
						55		54' TD
						56		1" PVC
						57		
						58		cuttings 0 - 5'
						59		bentonite (hole plug) 5' - 10'
						60		sand pack 10' - 54'
								hand slotted 14 - 54'

BY Mike Unger DATE 6-26-91 CHK'D BY

Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401 CSI



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" Hollow Stem Auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-47
SHEET 1 OF 4

					DRILLING START	DRILLING FINISH
WATER LEVEL	lel.del' bgs				TIME	TIME
TIME					9:10	3:0
DATE	7-1				DATE	DATE
CASING DEPTH	69'				6-27-91	6/2

DRILLING CONTR. Site Services
DRILLER Neil + Tim
DATUM
ELEVATION
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	SC	sand, v. clayey, silty, brown, dry v.f.g. to f.g.
						2		
	31"/48"					3		
						4	SC	sand, v. clayey, silty, brown, sli. moist, calcareous
CS						5		
	58"/60"					6		
						7	SP	
						8		sand, clayey, silty, brown, sli. moist to dry, calcareous, v.f.g. - m.g.
						9		
CS						10		
	56"/60"					11		
						12	SC	sand, v. clayey, silty, brown, sli. moist to med. moist calcareous, v.f.g. to f.g.
						13		
CS						14		
						15		
	51"/60"					16	SC	sand, v. clayey, silty, some thin (2"-3") clay lenses, moist, v.f.g. to f.g.
						17		
						18		
						19		
CS						20		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CST	South 320 acres

DRILLING METHOD: CME-75, 8" Hollow stem auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-47
SHEET 2 OF 4

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					9:40	3:0
DATE					6-27-91	6/2
CASING DEPTH						

see page 1 diagram

Location Diagram

DATUM ELEVATION

DRILLING CONTR. Site Services Nat'l Tim

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

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	
						21	SC	sand, V. clayey, silty, some thin (3"-5") clay lens, med. moist to moist, brown
						22		
		46"/60"				23	CL	clay, sandy, silty, moist, brown, calcareous,
						24		
CS						25		
						26		
						27		
		59"/60"				28	CL	clay, sli. sandy, some claystone fragments, brown, moist
						29		
CS						30		
						31	CLS	claystone, gray to yellow gray, moist, iron stained in fractures
		60"/60"				32		
						33		
CS						34		
						35	CLS	claystone, gray, moist, iron stained in fractu
		60"/60"				36		
						37		
						38	MLS	siltstone, clayey, some V.F.G. sand, yellow gray, med. moist
						39		
CS						40		

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 Acres

DRILLING METHOD: CME-75, 8" Hollow Stem Auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-47
SHEET 3 OF 4

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					9:10	3:05
DATE					6-27-91	6/27
CASING DEPTH						

see page 1 diagram

DRILLING CONTR. Site Services — Neil + Tim

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:
						41	CLS	Claystone, gray to yellow gray, iron stained, mois
		49" / 60"				42		
						43		
CS						44	SCS	sandstone, poorly cemented, clayey, l. brown, moist
						45		
		47" / 60"				46	CLS	Claystone, silty, some thin (2"-3") sand lenses, gray to yellow brown, moist, iron stained
						47		
						48		
						49		
CS						50	CLS	claystone, gray to d. gray, moist
		60" / 60"				51		
						52		
						53		
CS						54		
						55	CLS	claystone, gray to yellow gray, moist
		53" / 60"				56		
						57	SCS	sandstone, poorly cemented, gray to yellow brow v.f.g., silty, v. clayey, moist
						58		
						59		
CS						60		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75, 8" Hollow Stem Auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-4
SHEET 4 of 4

	DRILLING START	DRILLING FINISH
WATER LEVEL		
TIME	9:10	3:05
DATE	6-27-91	6-2
CASING DEPTH		

See page 1. diagram

Location Diagram

DRILLING CONTR. Site Services — Neil Tim

DATUM — ELEVATION

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	
						61	SCS	
						62	CLS	Claystone, gray to d. brown (v. carbonaceous), moist, hard
		5'/60"				63		
						64		
CS						65		
						66	CLS	Claystone, same as above
							▼	original water level
						67	SP/SPS	sand/sandstone, v.F.g.-F.g., v. moist to wet, gray to yellow brown
		60"				68		
						69		69' T.D.
						70		

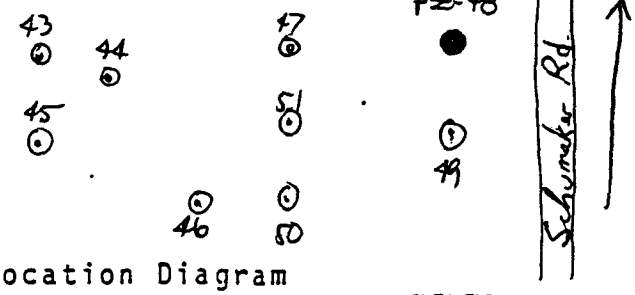
1" PVC

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

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

Industrial Compliance Inc.

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acres

DRILLING METHOD: CME-75 8" Hollow Stem Auger

BORING NO. PZ-48

SHEET 1 OF 3

SAMPLING METHOD: Continuous sampler (CS)

		DRILLING START	DRILLING FINISH
WATER LEVEL	58.36' bgs mid	TIME	TIME
TIME		3:10	10:30
DATE	7-1	DATE	DATE
CASING DEPTH	59'	6-27-91	6-28

DRILLING CONTR. Site Services Nat'l Inc.

DATUM ELEVATION

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	CL	clay, sandy to v. sandy, brown, sli. moist, calcareous
	24"/48"					2		
						3	SC	sand, v. clayey, brown, sli. moist, v.f.g. to f.g.
CS						4		
						5		
						6	SP	sand, v.f.g - m.g., sli. clayey, silty, brown, sli. moist
	60"/60"					7		
						8		
CS						9		
						10	SP	sand, v.f.g. - m.g., clayey, silty, brown, sli. moist
	41"/60"					11		
						12		
						13		
CS						14		
						15	SC	sand, v. clayey, silty, brown, sli. moist, calcareous
	53"/60"					16		
						17		
						18		
CS						19		
						20		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acres

DRILLING METHOD: CME-75, 8" H.S. auger
BORING NO. PZ48
SHEET 2 of 3
SAMPLING METHOD: Continuous sampler
DRILLING START / FINISH

WATER LEVEL					TIME	TIME
TIME					3:10	10:00
DATE					DATE	DATE
CASING DEPTH					6/27/91	6-28

see page 1 diagram

DRILLING CONTR. Site Services — Ned Kim

Location Diagram

DATUM ELEVATION

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	
		47" / 60"				21	SC	sand, v. clayey, silty, brown, sli. moist, calcareous, v.f.g. - f.g.
						22		
						23		
						24		
CS						25		
		55" / 60"				26	SC	sand, same as above
						27		
						28		
						29	SP	sand, clayey, silty, v.f.g. - f.g., sli. moist, calcareous
CS						30		
		60" / 60"				31		
						32		
						33		
						34		
CS						35	SP/SC	interbedded sand and v. clayey sand lenses, sli. moist, v.f.g. - f.g., drills hard, brown
		60" / 60"				36		
						37		
						38		
						39		
						40		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	south 320 acre

DRILLING METHOD: CME-75, 8" Hollow Stem Auger
BORING NO. PZ-48
SHEET 3 OF 3
SAMPLING METHOD: continuous sampler
DRILLING START TIME 3:10 DATE 6-27-91 | FINISH TIME 10:0 DATE 6-2

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

See page 1 diagram

DRILLING CONTR. Site Services, Next Tim

Location Diagram

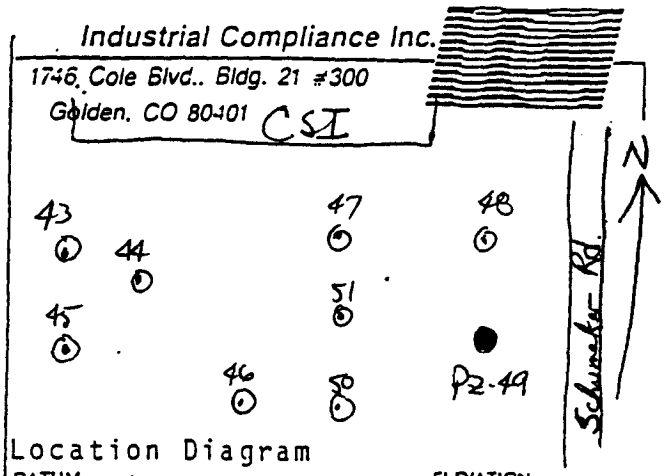
DATUM ELEVATION

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	
						41	SP/SC	interbedded sand and v. clayey sand lenses, silty, brown, sli. moist, v.f.g. - m.g.
		60"/60"				42		
						43		
						44		
CS						45		
						46	SP	sand, v.f.g. - m.g., sli. clayey to clayey, brown to yellow brown
		56"/60"				47		
						48		
						49	CLS	claystone, d. gray, moist, carbonaceous
CS						50		
						51		
		55"/60"				52		
						53	SP/SPS	sand/sandstone, f.g. - m.g., v. poorly cemented, med. moist, brown to yellow brown
CS						54		
						55		
						56		
						57		
						58	SP/SPS	same as above
						59		
						59'TD		cuttings: 0 - 12', bentonite 12' - 17', sand pack 17' - 59', hand slot 19' - 59'
						60		

BY Mike Unger DATE 6-28-91 CHK'D BY

Industrial Compliance Inc.
1746 Cole Blvd.. Bldg. 21 #300
Golden, CO 80401 CSI



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" Hollow Stem Auger
SAMPLING METHOD: Continuous sampler
BORING NO. PZ-4
SHEET 1 of 4

WATER LEVEL	65.09' bgs				DRILLING START	FINIS
TIME					TIME 10:05	TIM 1:4
DATE	7-1				DATE 6-28	DAT 7-1
CASING DEPTH	69'					

DRILLING CONTR. Site Services
DRILLER Neil Tim
DATUM
ELEVATION
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	Cl	Clay, v. sandy, silty, dry, brown
		43"/48"				2		
						3	Cl	Clay, v. sandy, silty, m.d. moist, d. brown
CS						4		
						5		
						6		
		60"/60"				7	Cl	Clay, v. sandy, silty, sli. moist, l. brown, calcar
						8		
						9	Cl	Clay, silty, sli. sandy, brown, moist to m.d. mois
CS						10		
						11		
		47"/60"				12		
						13		
CS						14		
						15	SP	Sand, f.g. - m.g., l. brown, silty, sli. clayey to clayey, sli. moist
		30"/60" K				16		
						17		
						18	Cl	Clay, sandy, silty, brown, m.d. moist
CS						19		
						20		

BY Mike Unger CHK'D BY
DATE 6-28-91

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" Hollow Stem Auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-4
SHEET 2 OF 4

					DRILLING START	DRILLING FINIS
WATER LEVEL					TIME	TIM
TIME					10:05	1:4
DATE					DATE	DAT
CASING DEPTH					6-28-91	7-1

see page 1 diagram

DRILLING CONTR. Site Services Nell + Jim

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	Cl	clay, sandy, silty, brown, med. moist
		52" / 60"				22		
						23	SC	sand, v. clayey, silty, brown, sli. moist to med. moist, (v.f.g. to f.g.
CS						24		
						25		
		60" / 60"				26	SC	sand, v. clayey, silty, brown, v.f.g. - m.g., sli. moist to med. moist, some sli. clay sand lenses (4"-6")
						27		
						28		
CS						29		
						30		
		54" / 60"				31	SC	sand, v. clayey, same as above
						32		
						33		
CS						34		
						35		
		60" / 60"				36		
						37	Cl	clay, sandy, silty, med. moist, brown
						38		
						39	SP	sand, silty, v.f.g. - m.g., yellow brown, sli. moist
CS						40		
							SPS	sand lense, v. well consolidated

BY Mike Ungar DATE 6-28-91 CHK'D BY

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

page 1 diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" Hollow Stem Auger
BORING NO. PZ-49
SHEET 3 OF 4
SAMPLING METHOD: continuous sampler
DRILLING START TIME 10:05 DATE 6-28-91
DRILLING FINISH TIME 1:40 DATE 7-1

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

Location Diagram
DATUM ELEVATION
DRILLING CONTR. Site Services Neal + Tim
BY Mike Unger DATE 6-28-91 CHK'D BY

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	
						41	SPS	sandstone, v. well cemented, brown, dry, v.f.g. drills v. hard
							SPS	
						42	SPS/CLS	interbedded sandstone & claystone lenses, moist, brown to yellow gray — drilled w/center plug from 41' to 41.5' bgs.
		37"/60"				43		
CS						44	CLS	claystone, gray, moist
						45		
		60"/60"				46	CLS	claystone, d. brown, moist
						47		
						48		
CS						49	SP/SPS	sand/sandstone, v. poorly cemented, bright yellow brown, sli. moist to med. moist
						50		
		60"/60"				51	SP/SPS	sand/sandstone, clean to clayey, v. poorly cemented, gray to yellow gray, v.f.g. - m.g., sli. moist
						52		
						53		
CS						54		
						55	SPS	sandstone, poorly cemented, gray to yellow gray, sli. moist, v.f.g. - f.g.
						56		
		60"/60"				57		
						58		
						59		
CS						60		

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 a

DRILLING METHOD: CME-75 8" Hollow Stem Augers
BORING NO. PZ-
SHEET 4 OF 4
SAMPLING METHOD: continuous sampler
DRILLING

	START	FI
WATER LEVEL		
TIME	10:05	3:
DATE	6-28-91	6-

see page 1 diagram

Location Diagram

DRILLING CONTR. Soil Services Well Line

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	SPS
	41" / 60"					62	
						63	SPS
CS						64	
						65	
	60" / 60"					66	
						67	
						68	
						69	
						70	

SURFACE CONDITIONS:

sandstone, v.f.g.-m.g., silty, sli. clayey, gray to yellow gray, sli. moist to mod. moist

sandstone, same as above

sandstone, v. moist to wet

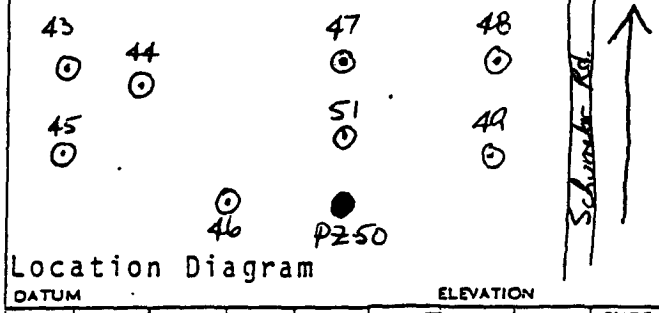
69' TD

~~SET~~ 1" PVC

cuttings 0-21'
bentonite 21-26'
sand pack 26-69'
hand slot 29-69'

BY Mike Unger DATE 6-28-91 CHK'D BY

Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401 CSI



Location Diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 ac

DRILLING METHOD: CME-75 8" Hollow Stem Auger

SAMPLING METHOD: Continuous auger (CS)

BORING NO. PZ-50

SHEET 1 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL	40.65 bgs				TIME 9:55	TIME 1:40
TIME						
DATE	7-1				DATE 7/1/91	DATE 7-1
CASING DEPTH	59'					

DATUM ELEVATION

DRILLING CONTR. Site Services Ned + Tim

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	CL	Clay, v. sandy, silty, brown, sli. moist
						2		
		43"/48"				3	CL	Clay, sandy, silty, d. brown, sli. moist to mod moist
CS						4		
						5		
		37"/60"				6		
						7		
						8	SP	sand, clayey to v. clayey, brown, sli. moist v.f.g.-m.g.
CS						9		
						10		
		54"/60"				11	CL	Clay, sandy, brown, md. moist
						12		
						13	CLS	claystone, gray to yellow gray, moist, iron stained
CS						14		
						15		
						16		
						17	SPS	sandstone, v. poorly cemented, f.g., yellow brown, sli. moist
		54"/60"				18	CLS	claystone, sandy, silty, yellow brown to yellow gray
CS						19		
						20		

DRILLED BY Mike Major DATE 7-1-91 CHK'D BY

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME 75, 8" H.S. auger
BORING NO. PZ-5
SHEET 2 of 3
SAMPLING METHOD: Continuous sampler
DRILLING START TIME 9:55 DATE 7-1-91
FINISH TIME 1:40 DATE 7-1

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

See page 1 diagram

Location Diagram

DRILLING CONTR. Site Services
DATUM Mean Sea Level
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:
CS						21	CLS	Claystone, silty, gray to yellow gray, moist, iron stained in fractures
	53"/60"					22		
						23		
CS						24		
						25		
						26		
	60"/60"					27	SCS/SC	sandstone/sand, vf.g.-f.g., yellow brown to yellow gray, sl. moist to md. moist
						28		
CS						29		
						30	SC/SCS	moist @ 30'
	56"/60"					31	CLS	claystone, gray to yellow gray, moist, iron stained in fractures
						32		
						33		
CS						34		
						35		
	58"/60"					36	CLS	claystone, gray, moist, iron stained
						37		
						38		
CS						39		
						40		

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

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	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 / FINISH

WATER LEVEL					TIME	TIME
TIME					9:55	1:4
DATE					DATE	DATE
CASING DEPTH					7-1-9	7-1-

See page 1 diagram

DRILLING CONTR. C & E Services

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
		60"/60"				42	
						43	
CS						44	
						45	CLS
		59"/60"				46	
						47	
						48	SC/SCS
						49	
CS						50	
						51	CLS
		58"/60"				52	
						53	
						54	
CS						55	
		59"/60"				56	SPS
						57	
						58	
						59	
						60	

SURFACE CONDITIONS:

Claystone, gray to yellow gray, moist, root stained, some thin ss lenses (1"-3"), occasional carbonaceous lense (3")

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

— original water level

Claystone, gray, moist, fossil leaf imprints

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

59' Tot. cuttings 0-12'
bentonite 12'-17'
sand pack 17'-59'
hand slot 49'-59'
1" PVC

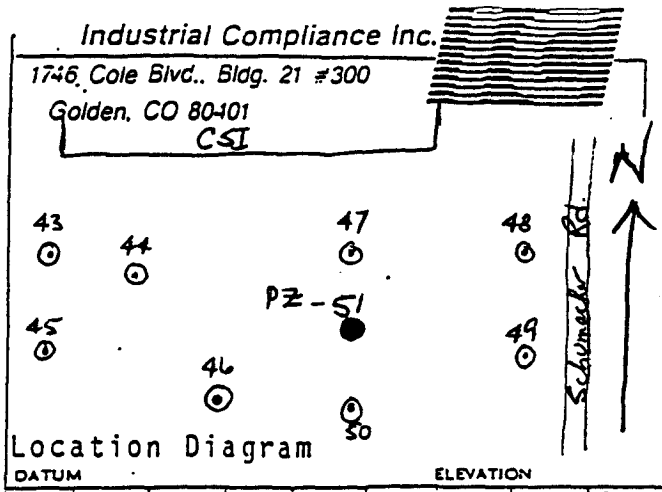
DRILLED BY Mike Unger DATE 7-1-9 CHK'D BY

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

JOB NO.	CLIENT	LOCATION
23311	CSI	South 320 acre

DRILLING METHOD: CME-75 8" Hollow Stem Auger
SAMPLING METHOD: continuous sampler (CS)
BORING NO. PZ-51
SHEET 1 OF 4

		START	FINISH
WATER LEVEL	10.44' bgs	DRILLING	
TIME	9:45	TIME 2:30	TIME 9:4
DATE	7-3	DATE 7-1-91	DATE 7-3
CASING DEPTH	69'		



Location Diagram

DATUM ELEVATION

DRILLING CONTR. Site Services, Nuclear Inc.

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:
CS						1	CL	clay, v. sandy, silty, dry to sli. moist, brown
		39'				2	SC	sand, v.f.g. - f.g., v. clayey, silty, brown, sli. moist, calcareous
	39"/48"					3		
						4		
CS						5		
						6		
	60"/60"					7	SC	sand, v.f.g. - f.g., v. silty, v. clayey, brown, sli. moist, calcareous
						8		
						9		
CS						10		
						11		
	54"/60"					12		
						13		
						14	CL	clay, v. sandy, silty, med. moist, brown
CS						15		
						16	SC	sand, v.f.g., v. clayey, brown, med. moist
	54"/60"					17	CL	clay, sandy, brown, med. moist, calcareous
						18	CLS	claystone, yellow gray to gray, moist, iron stained
CS						19		
						20		

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

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

JOB NO.	CLIENT	LOCATION
CSI	2-3311	South 320 acre

DRILLING METHOD: CME-75 8" H.S. auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-51
SHEET 2 OF 4

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					2:30	9:4
DATE					DATE	DATE
CASING DEPTH					7-1-91	7-3

See page 1 diagram

Location Diagram

DRILLING CONTR. Site Services Neil + Tim
DATUM
ELEVATION
BY Mike Unger DATE 7-2-91 CHK'D BY

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	
						21	CLS	claystone, yellow gray to gray, moist, iron stained
		60"/60"				22		
						23		
						24	CLS	claystone, yellow gray to gray, moist, some gypsum crystal seams (<¼" thick)
CS						25		
						26		
		45"/60"				27		
						28	CLS	claystone, same as above
						29		
CS						30		
		59"/60"				31		
						32	SCS	v. clayey sandstone, v.f.g. - f.g., silty, yellow brown, med. moist
						33		
						34		
CS						35		
		56"/60"				36	CLS	claystone, gray, moist, iron stained
						37	SCS	sandstone, v. clayey, red, moist, yellow, gray
						38	CLS	claystone, gray, moist
						39		
CS						40		

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

JOB NO.	CLIENT	LOCATION
2-3311	CSI	south 320 a

DRILLING METHOD: CME-75, 8" H.S. auger
BORING NO. PZ-5
SHEET 3 of 4
SAMPLING METHOD: continuous sample
DRILLING START FIN

WATER LEVEL					TIME	TIM
TIME					2:30	9:
DATE					DATE	DA
CASING DEPTH					7-1-91	7-2

See page 1 diagram

Location Diagram

DATUM ELEVATION

DRILLING CONTR. Soil Samples, Inc. & Tra

BY Mike Lange DATE 7-2-91 CHK'D BY

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	
						41	CLS	claystone, gray, moist
						42	SCS	sandstone, clayey, v.f.g., yellow brown, mod. mo poorly cemented
	58" / 60"					43	CLS	claystone, dk. brown to gray, leaf imprints, moist
CS						44		
						45		
						46		
	60" / 60"					47	CLS	claystone, dk brown to gray, leaf & stem imprints, iron stained, moist
						48		
						49		
CS						50		
						51	CLS	interbedded lenses of claystone and clayey sandstone, gray to yellow brown, mod. moist to moist, v.f.g., iron stained
	57" / 60"					52	SCS	
						53		
CS						54	SPS	sandstone, v.f.g., slightly clayey to clayey, mod. moist to moist, gray to yellow gray, poorly cemented
						55		
	59" / 60"					56	CLS	claystone, gray, moist
						57	SPS	sandstone, v.f.g., sli. clayey, yellow brown to brow mod. moist
						58	CLS	
CS						59		claystone, gray, moist
						60		

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

See page 1 diagram

JOB NO.	CLIENT	LOCATION
2-3311	CSI	South 320 acre

DRILLING METHOD: CME-75, 8" H.S. auger
SAMPLING METHOD: continuous sampler
BORING NO. PZ-5
SHEET 4 OF 4

			DRILLING START TIME	DRILLING FINISH TIME
WATER LEVEL	7-3	46.44' bgs		
TIME	8:05	9:45	2:30	9:4
DATE	dry @	7-3-91	DATE 7-1-90	DAT 7-3
CASING DEPTH	64'	69'		

Location Diagram

DRILLING CONTR. Site Services — Mark Lin
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	CLS
		60" / 60"				62	
						63	SPS
						64	
CS						65	
						66	SPS
	40" / 60"					67	
						68	
						69	
						70	

SURFACE CONDITIONS:

clay stone, d. brown, leaf + stem imprints, mois

sandstone, v.f.g. - f.g., yellow brown, med. moist, poorly cemented

sandstone, same as above, v. moist

69' T.D.

1" PVC
cuttings 0 - 10.5'
bentonite 10.5 - 15'
sand pack 15' - 69'
hand slot 19' - 69'

BY Mike Unger DATE 7-2-91 CHK'D BY

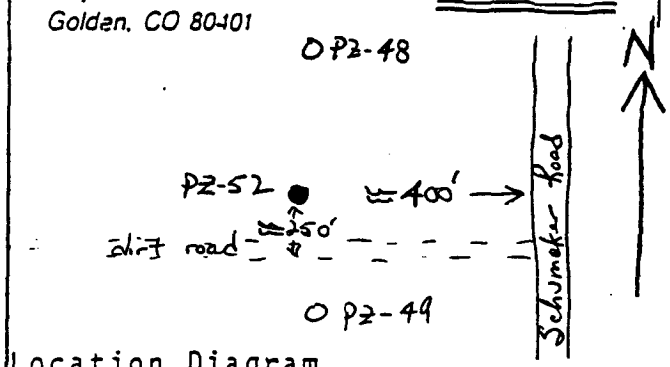
Industrial Compliance Inc.
1746 Cole Blvd., Bldg. 21 #300
Golden, CO 80401

JOB NO. 2-4079 | CLIENT CSI | LOCATION Bennett, Colo

DRILLING METHOD: CME-75 8" HSA/Low-Stem Auger
BORING NO. PZ-52
SHEET 1 OF 4
SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

	DRILLING START	DRILLING FINISH
WATER LEVEL		
TIME	8:25	1:2
DATE	7/14/92	7-2
CASING DEPTH		

Location Diagram



DATUM ELEVATION

DRILLING CONTR. Layne Rocky Mt. Rd
DRILLER Willie Unger
DATE 7/14/92
CHK'D BY

SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	RECOVERY BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	
CS						1	SP	sand, v. silty, clayey, slightly moist, brown, v.f.g.-m.g.
				58"/60"		2	SC	sand, v. clayey, silty, calcareous, brown, v.f.g., sli. moist to mod. moist
						3	SP	sand, v. silty, clayey, sli. moist, brown, v.f.g.-m.g.
						4		
CS						5		
						6		
				49"/60"		7		
						8		
						9	SP	sand, silty, sli. clayey, sli. moist, brown to l. brown, v.f.g.-m.g., slightly calcareous ($CaCO_3$)
						10		
CS						11		
				51"/60"		12		
						13		
						14		
CS						15		
						16		
				54"/60"		17		
						18	SP	sand, silty, sli. clayey to clayey, sli. moist, brown, v.f.g.-m.g.
						19		
CS						20		

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

2-4079 | CSI | Bennett, Co

DRILLING METHOD: CME-75 8" HSA/Hollow-Stem Auger

BORING NO. PZ-52

SHEET 2 OF 4

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING START / FINISH

WATER LEVEL						
TIME					8:25	1:2
DATE					7/14/92	7-2
CASING DEPTH						

see diagram on page 1

Location Diagram

DRILLING CONTR. Layne Bc & Burk

DATUM ELEVATION

LOGGED BY [illegible] DATE 7/15/92 CHK'D BY

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:
CS						21	SP	sand, silty, sli. clayey, sli. moist, brown to l. br v.f.g. - m.g.
				55"/10"		22		
						23		
						24	CL	clay, v. sandy, silty, mod. moist, brown (v.f.g.)
CS						25		
						26		
				60"/60"		27		
						28	SP	
						29		sand, silty, clayey, sli. moist, brown to l. brown (v.f.g. - m.g.)
CS						30		
				36"/36"		31		
						32		
CS						33		7/14/92 (refusal) 33' 7/20/92 ATV 750 high torque gear box
						34		
				57/60"		35	SC	sand, v. clayey, silty, v.f.g. - f.g., sli. moist l. brown, calcareous
						36		drills hard, added ~5 gallons water to lift cuttings
						37		
CS						38		
						39		
						40	SP	sand, silty to v. silty, clayey, v.f.g. to m.g., sli. moist, calcareous

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

JOB NO. 2-4079 | CLIENT CSI | Bennett, Co

DRILLING METHOD: CME-750 (ATV) 8" Hollow-Stem Auger

BORING NO. P2-52

SHEET 3 OF 4

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING START TIME 8:25 DATE 7/14/92

FINISH TIME 1:2 DATE 7/2

WATER LEVEL / TIME / DATE / CASING DEPTH

see diagram on page 1

Location Diagram

DRILLING CONTR. Layne Bor X Corp

DATUM ELEVATION

LOGGED BY Lisa Unger DATE 7/15/92 CHK'D BY

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:
				58"/60"		41	SP	sand, silty to v. silty, clayey, v.f.g. - m.g., sl. moist, calcareous
CS						42		
						43		
						44		
						45		
				56"/60"		46		
						47	SP	sand, silty, clayey, v.f.g. to c.g., med. moist, calcareous
						48		
CS						49		
						50		
				53"/60"		51		
						52	SP	sand, silty, clayey, v.f.g. - m.g., med. moist, sl. calcareous
						53		
CS						54		
						55		v. moist @ 55.5' bgs *
				58"/60"		56	CL	clay, sandy, claystone fragments, moist to v. moist, brown to gray
						57	CLS	claystone, gray to yellow gray, moist, iron stained and in fractures
						58		
CS						59	CLS	claystone, gray to brown (lignitic), med. moist, iron stained in part
						60		

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

JOB NO. 2-4079 | CLIENT CSI | Bennett, Co

BORING NO. PZ-5

SHEET 4 OF 4

DRILLING METHOD: CME-750 (ATV) 8" HSA/bw-Stem Auger

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

	START	FINISH
WATER LEVEL	dry	
TIME	8:25	1:2
DATE	7/14/92	7/1
CASING DEPTH	68'	

DRILLING CONTR. Layne

DRILLER Chris

DATE 7/20/92

CHK'D BY

see diagram on page 1

N

Location Diagram

DATUM ELEVATION

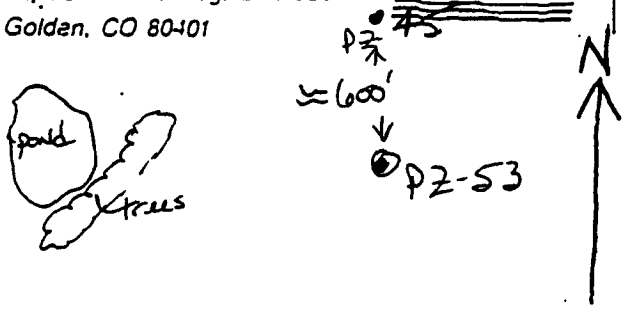
SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	OVA Reading	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
CS						61	CLS	Claystone, brown, lignitic fragments, med. moist, iron stained in fractures, leaf impres
				60/60"		62		
						63	SPS	sandstone, v.f.g.-f.g., moderately cemented, gray to yellow gray, med. moist, iron stained
CS						64		
						65		
				60"		66		
						67	SPS	sandstone, v.f.g.-f.g., moderately cemented, yellow gray to yellow brown, sli. moist to med. moist, iron stained
						68		
						69		68' TD
						70		1" PVC
						71		hand slotted: 48'-68' bgs
						72		hole plug: 0-3' 2 bags
						73		cuttings: 3-34'
						74		hole plug: 34'-39' 3 bags
						75		sand: 39'-68'
						76		stickup: 3.0'
						77		
						78		
						79		
						80		

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

JOB NO. 2-4079 | CLIENT CSI | LOCATION Bennett, C

DRILLING METHOD: CME-75 8" Hollow-Stem Auger
BORING NO. PZ-53
SHEET 1 OF 2
SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

	START	FIN
WATER LEVEL		
TIME	10:35	1:
DATE	7/14/92	7/1
CASING DEPTH		



Location Diagram

DATUM ELEVATION

DRILLING CONTR. Layne Rose 1/30/92

LOGGED BY Mike Unger DATE 7/15/92 CHK'D BY

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	sand, v. silty, clayey, d. brown, v.f.g.-m.g.
				51/60"		2		
						3	SP	sand, silty, sli. clayey, brown, v.f.g.-m.g.
						4		
CS						5		
						6		
						7	SP	sand, silty, brown, v.f.g.-mg., mod. moist to mo v.f.g.-m.g.
				55/60"		8		
						9		
						10	▼	
CS						11		
						12		
				41/60"		13	SP	sand, silty, brown to yellow brown, wets v.f.g. to c.g.
						14	CLS	claystone, d. gray
CS						15		
						16		
						17		
				50/60"		18	CLS	claystone, gray to d. gray, moist.
						19		
						20	CLS	1" lignitic clay lense from 19.6' to 19.7' bgs

Industrial Compliance Inc.

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

JOB NO. 2-4079 | CLIENT CSI | Bennett, Colo

DRILLING METHOD: CME-75 8" HSA Hollow-Stem Auger

BORING NO. PZ-53

SHEET 2 OF 2

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING

		START	FINISH
WATER LEVEL	9.84'	TIME	TIME
TIME	1:00	10:35	1:45
DATE	7/14	DATE	DATE
CASING DEPTH	25'	7/14/92	7/14

See diagram on page 1

Location Diagram

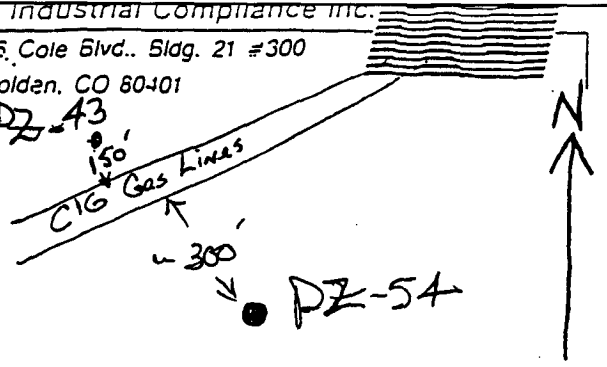
DATUM ELEVATION

DRILLING CONTR. Layne

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:
CS						21	CLS	Claystone, d. brown, lignitic in part,
				57"/60"		22		
						23		
						24	SCS	Sandstone, v. clayey, v.f.g.-f.g., yellow brown to yellow gray, v. moist to wet
						25		25' TD
						26		
						27		
						28		
						29		1" PVC hole plug: 0-5'
						30		sand: 5-25'
						31		hand slotted from 7'-25'
						32		stickup: 3.1'
						33		2 bags hole plug
						34		
						35		
						36		
						37		
						38		
						39		
						40		

LOGGED BY [illegible] DATE 7/14/92 CHK'D BY

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-4079	CSI	Bennett, Co

DRILLING METHOD: CME-75 8" Hollow-Stem Auger
SAMPLING METHOD: Continuous sampler (CS) and/or California barrel
BORING NO. PZ-54
SHEET 1 OF 3

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING: START TIME 11:45 DATE 7/14/92; FINISH TIME 3:?? DATE 7/?/92

DRILLER'S CONTR. Layne Rogers X Rig
UT Mike Unger DATE 7/14/92 CHK'D BY

DATUM ELEVATION

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	sand, v. silty, clayey, brown, sli. moist, v.f.g.-m.g.
				51"/60"		2		
						3		
						4		
						5	SP	sand, v.f.g. - c.g., silty, sli. clayey, moist ← * v.f.g. - v.c.g., brown to yellow brown
CS						6		
				60"/60"		7	CLS	claystone, gray, iron stained in fractures, weathered, med. moist to moist
						8		
						9		
						10		
CS						11		
				43"/60"		12	SP	sand (unconsolidated sandstone), v.f.g. - c.g., yellow brown, iron stained, sli. moist to med. moist
						13		
						14		
						15		
CS						16		
						17		
				57"/60"		18	SP	sand (unconsolidated sandstone), v.f.g. - v.c.g., yellow brown, iron stained, med. moist to moist
						19		
						20		

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

JOB NO. 2-4079 | CLIENT CSI | Bennett, Co

BORING NO. PZ-54

SHEET 2 OF 3

DRILLING METHOD: CME-75 8" Hollow-Stem Auger

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

	START	FINISH
WATER LEVEL		
TIME	11:45	3:3
DATE	7/14/92	7/1
CASING DEPTH		

DRILLING CONTR. Layne

DRILLER Mike Unger

DATE 7/14/92 CHK'D BY

Location Diagram

See diagram on page 1

DATUM ELEVATION

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						21	SP	
						22	CLS	Claystone, gray to yellow gray, iron stained, med. hard, med. moist
				60"/60"		23		
						24		
						25		
CS						26		
						27	CLS	Claystone, gray to yellow gray, iron stained, med. moist, lignitic in part from 28.6 to 29.1' bgs
				60"/60"		28		
						29		
						30	SCS	V. clayey sandstone, yellow brown, med. moist, V.F.g.
CS						31		
				60"/60"		32		
						33	CLS	Claystone, gray to yellow gray, iron stained, med. moist, med. hard to hard
						34		
CS						35		
						36		
CS						37		
				59"/60"		38	CLS	Claystone, gray to d. gray, iron stained in fractures, med. moist, drills harder
						39		
						40		

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

2-4079 | CSI | Bennett, Co

DRILLING METHOD: CME-75 8" Hollow-Stem Auger

BORING NO. PZ-54

SHEET 3 OF 3

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING START TIME 11:45 FINISH TIME 3:3

WATER LEVEL	41.6'				
TIME	1:55				
DATE	7/14				
CASING DEPTH					

DATE 7/14/92 DAT 7/1

see diagram on page 1

Location Diagram

DRILLING CONTR. Layne

DRILLED BY Mike Unger DATE 7/14/92

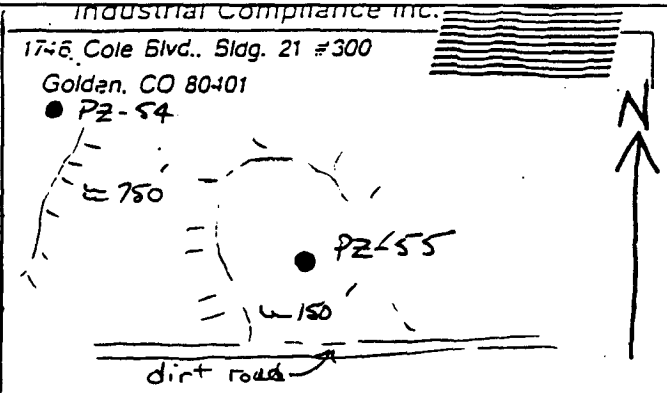
DATUM ELEVATION

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						41	CLS	Claystone, gray to d. gray, iron stained in fractures, med. moist
						42		
						43		
				60"/60"		44		Lignite, poor grade, black, wet in fractures, very moist overall, soft will make water
						45		
CS						46		
						47	CLS	Claystone, d. gray to black, lignitic in part, moist
				58"/60"		48	SP	Sand (Unconsolidated sandstone), v. f.g.-m.g., softg v. moist, yellow brown to gray
						49		
CS						50		
						51		
				60"/60"		52		Lignite, black, wet, soft, clayey
						53	CLS	Claystone, d. gray to black, v. moist
						54		
						55		Lignite, black, wet, clayey 55' TD
						56		piezometer well completion:
						57		1" PVC
						58		hole plug: 0-3.9' sand: 3.9'-55' hand slotted: 10'-55' 2½ bags hole plug stickup: 3.0'
						59		
						60		

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

JOB NO. 2-4079 | CLIENT CSI | Bennett, Co



Location Diagram

DRILLING METHOD: CME-75 8" HSA/Low-Stem Auger
SAMPLING METHOD: Continuous sampler (CS) and/or California barrel
BORING NO. PZ-55
SHEET 1 OF 3

	DRILLING START	DRILLING FINISH
WATER LEVEL		
TIME	3:40	8:3
DATE	7/14/92	7/15
CASING DEPTH		

DATUM ELEVATION

DRILLING CONTR. Layne Rocky Mt. Drilling
DRILLER Mike Unger
LOG'D BY
DATE 7/14/92
CHK'D BY

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	sand, v. silty, clayey, brown, dry; v.f.g.-c.g.
				31" / 60"		2		
						3		
						4	SP	sand, silty, sli. clayey, l. brown, sli. moist, v.f.g.-m.g.
						5		
CS						6		
						7		
				42" / 60"		8	SP	sand, silty, sli. clayey to clayey, l. brown, v.f.g.-m.g. sli. moist
						9		
						10		
CS						11		
						12		
				48" / 60"		13	SP	sand, v.f.g.-m.g., silty, sli. clayey, l. brown to brown, sli. moist
						14		
						15		
CS						16		
						17		
				58" / 60"		18	CL	clay, v. silty, sandy, brown, med. moist
						19		
						20	SP	sand, silty, clayey, l. brown to brown, sli. moist to med. moist, v.f.g.-m.g.

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

2-4079 | CSI | Bennett, Co

DRILLING METHOD: CME-75 8" Hollow-Stem Auger
BORING NO. PZ-55
SHEET 2 OF 3
SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					3:40	8:3x
DATE					7-14-92	7/15
CASING DEPTH						

See diagram on page 1

N

Location Diagram

DRILLING CONTR. Layne Rose X-Ra
DATUM ELEVATION
LOGGED BY Lynn DATE 7/14/92 CHK'D BY

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:
CS						21	SP	sand, silty, clayey, brown, v.f.g - slt. moist
				58"/60"		22	CL	clay, sandy to v. sandy, silty, brown, slightly calcareous, med. moist
						23		
						24		
						25	CL	clay, yellow brown, ~~med. moist to moist~~
CS						26	CLS	claystone, gray, weathered, med. moist to moist
				59"/60"		27	SP	sand (unconsolidated sandstone), gray, med. moist, v.f.g - m.g.
						28	CLS	claystone, gray to yellow gray, iron stained, ~~med. moist~~
						29	SP	
CS						30		sand (unconsolidated sandstone), v.f.g. - f.g., gray to yellow gray, moist
						31		
				59"/60"		32		
						33	SP	sand (unconsolidated sandstone), v. moist @ 34' bgs
						34		
CS						35	▼	Wet
						36		
				60"/60"		37	CLS	claystone, gray to yellow gray, moist, iron stained
						38		
						39		
						40		

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

2-4079 | CSI | Bennett, Colo

BORING NO. PZ-55

SHEET 3 OF 3

DRILLING METHOD: CME-75 Hollow-Stem Auger

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

		DRILLING START	DRILLING FINISH
WATER LEVEL	33.7		
TIME	7:45	TIME 3:40	TIME 8:30
DATE	7/15	DATE 7-14-92	DATE 7/15/92
CASING DEPTH	45'		

N

see diagram on page 1

Location Diagram

DATUM ELEVATION

DRILLING CONTR. Layne

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
				60"		43	
						44	
						45	SP
						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

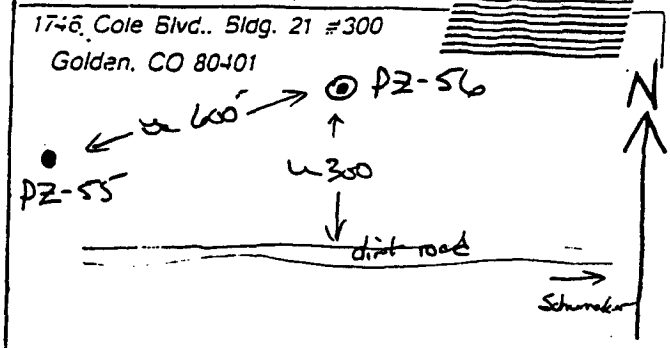
piezometer completion:

hole plug: 0-3' 4 bags
cuttings: 3'-13'
hole plug: 15'-20'
sand: 20'-45'
hand slotted: 25'-45'

stick up: 3.0'

LOGGED BY Linda Lynn DATE 7/15/92 CHK'D BY

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



Location Diagram

JOB NO.	CLIENT	LOCATION
2-4079	CSI	Bennett, Colo

DRILLING METHOD: CME-75 8" HSA/Low-Stem Auger

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

BORING NO. PZ-56

SHEET 1 OF 4

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					8:35	
DATE					DATE	DATE
CASING DEPTH					7/6/92	7/15

DRILLING CONTR. Layne Rocky Mtns

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:
CS						1	SP	sand, v. silty, clayey, brown, sli. moist, v.f.g.-c.g.
				5 3/4"		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
CS						5		
						6		
				58"		7	SP	sand, v.f.g.-m.g., silty, clayey, sli. moist, l.brown
				60"		8		
						9		
						10	CL	clay, sandy, silty, brown, sli. moist to med. moist
CS						11		
						12	SP	sand, silty, sli. clayey, l.brown, sli. moist to med. moist v.f.g.-m.g. sli. calcareous
				56"		13		
				60"		14		
						15		
CS						16		
						17	CL	clay, gray to brown, silty, sli. sandy to sandy, med. moist, sli. calcareous
				54"		18		
				60"		19	SP	sand, v.f.g. to pebbles (d.brown iron concretions), silty, med. moist to moist, brown to yellow brown, iron stained
						20		

LOGGED BY Mike Unger DATE 7/15/92 CHK'D BY

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

2-4079 | CSI | Bennett, Colo

DRILLING METHOD: CME-75 8" HSA/Low-Stem Auger

BORING NO. PZ-56

SHEET 2 OF 4

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING: START TIME 8:35 DATE 7/15/92 | FINISH TIME — DATE 7/15

	WATER LEVEL	TIME	DATE	CASING DEPTH

see diagram on page 1

Location Diagram

DATUM ELEVATION

DRILLING CONTR. Layne

BY Linda Snyder DATE 7/15/92 CHK'D BY

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:
CS						21	SP	sand, V.F.g. - pebbles, yellow brown, moist *, iron stained
				60"/60"		22	CLS	claystone, weathered, gray to yellow gray, iron stn. med. moist
						23		
						24		
						25	SCS	sandstone, V.F.g. V. clayey, moderately cemented, harder to drill, med. moist, yellow brown to reddish brown, s limonitic concretions, med. moist to moist @ 25.5' bgs *
CS						26		
				60"/60"		27	CLS	claystone, gray to yellow gray, iron stained with iron staining in most fractures, med. moist
						28		
						29		
						30		
CS						31		
				60"/60"		32	CLS	claystone, gray to yellow gray, iron stained in part and in fractures, med. moist
						33		
						34		
						35		
CS						36		
				60"/60"		37		
						38	CLS	claystone, gray to yellow gray, iron stained in fractures, med. moist
						39		
						40		

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

2-4079 | CSI | Bennett, Colo.

DRILLING METHOD: CME-75 8" HSA Hollow-Stem Auger

BORING NO. PZ-56

SHEET 3 OF 4

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING START / FINISH

					START	FINISH
WATER LEVEL						
TIME					8:35	
DATE					7/15/92	7/15
CASING DEPTH						

see diagram on page 1

Location Diagram

N

DRILLING CONTR. Layne

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:
CS						41	CLS	Claystone, gray to yellow gray, iron stained in fractures, med. moist
				60"/60"		42		
						43		
						44		
						45	SCS	sandstone, v. clayey; fair to moderate cementation, yellow brown to yellow gray, med. moist, v.f.g.
CS						46		
						47	CLS	Claystone, gray, iron stained in fractures, med. moist.
				60"/60"		48		2" sand lense @ 47.5' bgs, reddish brown, iron stained, med. moist to moist *
						49		
						50		
CS						51		
				42"/42"		52	CLS	Claystone, gray, iron stained in fractures, mod. moist, 1/2" sandstone lense @ 51' bgs, gray, moderately cemented, v.f.g.
						53		
						54	SPS	sandstone, v.f.g., silty, well cemented, drills very hard, gray, leaf imprints, switched to center bit to drill through sandstone
		center bit		53.5' to 56.0' bgs		55	CLS	Claystone, gray,
CS						56		
						57		
				48"		58		
						59		58.75'
						60		Lignite, fair quality, black, wet in fractures, v. moist overall, should make water *

BY Lindy Snyder DATE 7/15/92 CHK'D BY

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

2-4079 | CSI | Bennett, Colo

DRILLING METHOD: CME-75 8" HSA/Low-Stem Auger

BORING NO. PZ-56

SHEET 4 OF 4

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING: START TIME 8:35 DATE 7/15/92; FINISH TIME 1:40 DATE 7/15

WATER LEVEL	dry	dry
TIME	1:40	1:40
DATE	7/15	7/15
CASING DEPTH	70'	30'

see diagram on page 1

Location Diagram

DATUM ELEVATION

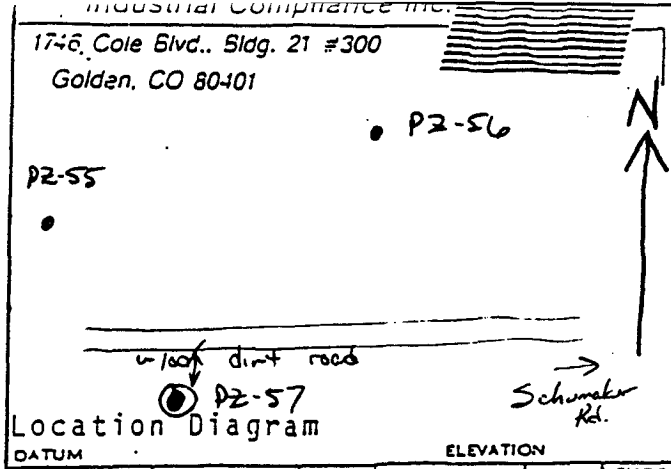
DRILLING CONTR. Layne Rocky

BY Mike Unger DATE 7/15/92 CHK'D BY

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:
CS						61		Lignite, black, v. moist overall, wet in fractures
				60"/60"		62	CLS	Claystone, gray, silty, med. moist to moist
						63		
						64		
						65	CLS	Claystone, sandy to v. sandy (v.f.g.), gray, med. moist
CS						66		
						67		
						68	CLS	Claystone, gray, med. moist
						69		
						70		
						71		70' TD
						72		dual piezo. completion: 2 PVC pipes (0-70' & 0-30') (1" PVC) 12:25 to 1:40
						73		70' 30'(29')
						74		hole plug: 0-3' (2 bags) cuttings: 3'-8'
						75		hand slotted: 40'-70' bgs hand slotted: 15-30' bgs
						76		hole plug: 8'-29' sand: 8'-29'
						77		hole plug: 29'-35' (3 bags) hole plug: 29'-35' sand: 35'-70'
						78		
						79		stickup: 2.5' stickup: 3.0'
						80		

Industrial Compliance Inc.

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



Location Diagram

JOB NO. 2-4079 | CLIENT CSI | Bennett, Colo.

DRILLING METHOD: CME-75 8¼ HSA/Low-Stem Auger

BORING NO. PZ-57

SHEET 1 OF 3

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					TIME 1:45	TIME 4:00
DATE					DATE 7-15-92	DATE 7/15
CASING DEPTH						

DATUM ELEVATION

SURFACE CONDITIONS:

DRILLING CONTR. Layne Rocky

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	Sand, v. silty, clayey, brown, v.f.g. - m.g., sli. moist
				50"/60"		2	CL	Clay, silty, sandy to v. sandy, brown, sli. moist to med. moist
						3		
						4	SP	Sand, silty, clayey, brown, sli. moist, v.f.g. - m.g.
						5		
CS						6		
				49"/60"		7	SP	Sand, silty, sli. clayey, brown, med. moist v.f.g. - m.g.
						8		
						9		
						10	CL	Clay, silty, sli. sandy, brown, med. moist
CS						11		
				53"/60"		12	SP	Sand, v.f.g. - m.g., silty, sli. clayey, brown, med. moist
						13		
						14		
						15	CL	Clay, silty, sandy to v. sandy, brown, med. moist
CS						16		
						17	CL	Clay, sli. sandy, brown to gray, claystone fragments, med. moist
				60"/60"		18		
						19	CLS	Claystone, gray to yellow gray, iron stained, med. moist, weathered
						20		

LOGGED BY M.K. Unger DATE 7/15/92 CHK'D BY

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

2-4079 | CSI | Bennett, Colo.

DRILLING METHOD: CME-75 8" Hollow-Stem Auger

BORING NO. PZ-57

SHEET 2 OF 3

SAMPLING METHOD: Continuous sampler (CS) and/or California barrel

DRILLING: START TIME 1:45 DATE 7-15-92 | FINISH TIME 4:00 DATE 7-15

	WATER LEVEL	TIME	DATE

CASING DEPTH:

see diagram on page 1

N

Location Diagram

DATUM ELEVATION

DRILLING CONTR. Layne

LOGGED BY [illegible] DATE 7/15/92

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:
CS						21	CLS	Claystone, yellow brown to gray, med. moist, iron stained, 3" lignitic claystone lense @ 22.6' bgs
				60"/60"		22		
						23		
						24	CLS	Claystone, yellow brown to gray, med. moist, iron stained, Collected soil sample 5-gallon bucket
CS						25		
						26		
						27	CLS	Claystone, V. silty, sli. sandy (v.f.g.), med. moist to moist, yellow gray to gray
				60"/60"		28	CLS	Claystone, med. moist, yellow brown to gray, 5" lignitic claystone lense @ 28' (d. brown)
						29		
						30		
CS						31	SPS	sand (unconsolidated sandstone), v.f.g. - f.g., yellow brown, v. moist *, gray from 31.6 to 31.5' bgs
						32	CLS	Claystone, gray to brown, iron stained in fractures, med. moist to moist
				60"/60"		33		
						34		
						35		
CS						36	SCS	sandstone, v.f.g., poorly cemented, yellow brown to yellow gray, moist
						37		
				60"		38		
						39	SPS	sandstone, v.f.g., poorly cemented to well cemented lenses (2"-3"), gray, sli. moist (well cemented) to v. moist (poorly cemented)
						40		

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-104
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	CLS	claystone, gray, med. moist, iron stained in fractures
				48	SPS	sandstone, v.f.g.-~~f~~m.g., yellow gray to yellow brown, med. moist, iron stained
				49		~~49' TD~~
				50		48.5' TD
				51		stickup:
				52		2" PVC solid 0 - 38.5'
				53		2" PVC screen (0.01") 38.5' - 48.5'
				54		
				55		

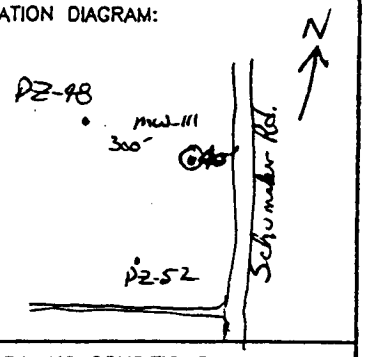
grout 0 - 32'
bentonite (hole plug) 32 - 34'
bentonite (~~#~~ pellets) 34 - 35.8'
sand 35.8' - 48.5'

GEOLOGIST: Unger
CHECKED BY:
DATE: 10-5-92
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: 1 OF 4

LOCATION DIAGRAM:



CLIENT: CSI
PROJECT NAME: CSI Bennett
PROJECT NUMBER: 2-4079
PROJECT LOCATION:
BORING LOCATION:
START DATE: 10-6-92 FINISH DATE: 10-7-92
START TIME: 12:20 FINISH TIME: 10:30

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, v. silty, brown, sli. moist to med. moist
	35"/36"			2		
				3	SP	sand, v.f.g. - v.c.g., brown, sli. moist, v. silty, clayey
CS				4		
				5	SP	
				6		sand, v.f.g. - v.c.g., brown, sli. moist, silty, sli. clayey to clayey
	60"/60"			7		
				8		
CS				9		
				10	SC	sand, v. clayey, silty, v.f.g. - c.g., sli. moist, brown
	59"/60"			11		
				12	SP	sand, v. silty, sli. clayey, v.f.g. - m.g., dry to sli. moist, calcareous
				13		
CS				14		
				15		
				16		
	59"/60"			17	SP	sand, v.f.g. - v.c.g., silty, sli. clayey to clayey, dry to sli. moist
				18		
CS				19		
				20	CL	clay, sandy, silty, med. moist, brown

GEOLOGIST: Unger
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-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	CL	clay, sandy, silty, brown, med. moist
	60/60"			22	SP	sand, silty, clayey, brown, v.f.g-c.g., sli. moist, calcareous stringers
				23		
CS				24		
				25		
	60/60"			26		
				27		
				28		
CS				29		
				30	SC	sand, v. clayey, silty, sli. moist, brown, v.f.g-m.g.
	59/60"			31		
				32	SP	sand, silty, sli. clayey, sli. moist, l. brown to brown, v.f.g.-m.g., calcareous stringers
				33		
CS				34		
				35		
	60/60"			36		
				37		
				38		
CS				39		
				40		
	57/60"			41		
				42	SPS	sandstone, v.f.g.-m.g., sli. moist, yellow brown, poorly cemented
				43		
CS						

GEOLOGIST: Unger
CHECKED BY:
DATE: 10-6-92
DRILLING CONTRACTOR: Soil 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: 3 OF 4

WATER LEVEL:			
TIME:			
DATE:			

SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				44		
	" 5/60"			45	SPS	sandstone, v.f.g. to m.g., sl. moist, yellow brown to reddish brown, moderately cemented
				46		
				47		
				48	CLS	claystone, gray, med. moist
CS				49		
				50		
	" 5/60"			51	SPS	sandstone, v.f.g - m.g., reddish brown, med. moist, iron stained, poorly to moderately cemented
				52		
				53	CLS/SPS	interbedded claystone and sandstone lenses, 1" to 5" thick, sl. moist to med. moist, l. gray to yellow gray, v.f.g. - f.g.
CS				54		
				55	SPS	sandstone v.f.g - m.g., yellow gray, moderately cemented, sl. moist to med. moist, drills hard (dry cuttings)
	5'/60"			56		
				57		
				58		
CS				59		
				60		
				61	SPS	sandstone, v.f.g. - m.g., olive gray, moderately cemented, moist to v. moist
	5'/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: 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:	67.6'		
TIME:	9:00		
DATE:	10-7-92		

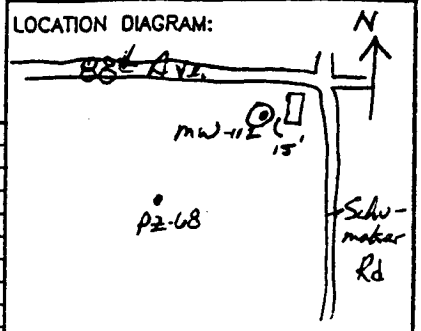
SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
	60"/60"			67	SPS	sandstone, v.f.g.- m.g., olive brown to reddish brown, wet, moderately cemented
				68		
CS				69		
				70		
	58"/60"			71		
				72	SPS	sandstone, v.f.g.- m.g., wet, same as above
				73		
				74		
				75		2" PVC solid 0 - 63' 2" PVC slotted (0.010) 63' - 73'
				76		stickup: 2.4'
				77		
				78		
				79		
				80		grout 0 - 55' bentonite (crumbles) 55 - 57 1 bag bentonite (1/4 pellets) 57 - 59 1 bucket sand (10-20) 59' - 73' 3 bags
				81		
				82		
				83		
				84		
				85		
				86		
				87		
				88		
				89		

GEOLOGIST: Unger
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: CSI
PROJECT NAME: CSI Bennett
PROJECT NUMBER: 2-4079
PROJECT LOCATION: CSI Bennett Facility
BORING LOCATION:
START DATE: 10-7-92 FINISH DATE: 10-8-92
START TIME: 10:50 FINISH TIME: 9:15

DRILLING METHOD: CME-75 8" H.S. auger
SAMPLING METHOD: Continuous sampler (CS)
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	36"/36"			1–2	SC	sand, v. clayey, silty, brown, med. moist, v.f.g.-c.g.
CS	88"/100"			3–5	SP	sand, clayey, silty, brown, v.f.g.-c.g., sli. moist to med. moist
CS	60"/60"			6–10	SC	sand, v. clayey, silty, brown, v.f.g.-c.g., med. moist to sli. moist, calcareous stringers
CS	56"/60"			11–15	SP	sand, clayey to v. clayey, silty, v.f.g.-m.g., brown, med. moist, calcareous stringers
CS				16–20	SP	sand, sli. clayey to clayey, v.f.g.-c.g., brown, sli. moist

GEOLOGIST: JNox
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	
	57"/60"			22		
				23	SC	sand, v. clayey, silty, brown, v.f.g.-f.g., med. moist, calcareous stringers
CS				24		
				25		
	51"/60"			26		
				27		
				28		
CS				29	SP	sand, silty, sli. clayey to clayey, v.f.g.-m.g., brown, sli. moist to med. moist
	60"/60"			30		
				31		
				32		
				33		
CS				34		
				35		
	59"/60"			36	SP	sand, clayey to v. clayey, brown, med. moist, v.f.g.-m.g., some gray claystone fragments (½") and limonite concretions (⅛")
				37		
				38		
CS				39	CLS	claystone, gray, med. moist, some moisture in some fractures, some carbonaceous lenses (d. brown)
	60"/60"			40		
				41		
				42		
				43		

GEOLOGIST: Unger
CHECKED BY:
DATE: 10-7-92
DRILLING CONTRACTOR: Site Services

INDUSTRIAL COMPLIANCE
AN SP ENVIRONMENTAL SYSTEMS COMPANY
1746 COLE BLVD.
BLDG. 21 SUITE 300
COLDEN, COLORADO 80401
(303)277-1400
FAX (303)277-1405

LOG OF BORING NUMBER: MW-112
SHEET NUMBER: 3 OF 3

WATER LEVEL:	30.2' bgs	
TIME:	1:00	
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 yl. gray, med. moist to moist
	40"/60"			46	SCS	sandstone, v. clayey, silty, reddish brown to yellow brown, v.f.g.-f.g., moist, poorly cemented
				47		
				48	CLS	claystone, gray, med. moist
CS				49		Let boring set open for 15 minutes, produced 1/4" water
	57"/60"			50		
				51		
				52	SMS	sandstone, v. silty, v.f.g.-f.g., reddish brown, moist, poorly to moderately cemented, iron stained
				53		
CS				54	SPS	
	60"/60"			55		sandstone, v.f.g.-m.g., silty, moderately cemented, wet, brown
				56		
				57		
				58		58' TD
				59		2" PVC FJT sch. 40 solid 0-43'
				60		2" PVC screen 43'-58'
				61		
				62		grout 0-36'
				63		bentonite 36-39.6 2 bags
				64		sand (10-20) 39.6-58' 6 1/2 bags
				65		stickup: 2.5'
				66		

GEOLOGIST: Unger
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-114
SHEET NUMBER: 1 OF 1

LOCATION DIAGRAM: N

~~dirt road~~

⊙ MW-114

120'

• PZ-46

CLIENT: CSI
PROJECT NAME: CSI Bennett
PROJECT NUMBER: 2-4079
PROJECT LOCATION:
BORING LOCATION:

DRILLING METHOD: CME-75 6" H.S. auger
SAMPLING METHOD: Continuous sampler (CS)
SURFACE ELEVATION:
WATER LEVEL:
TIME:
DATE:

START DATE: 9-24-92 FINISH DATE: 9-25-92
START TIME: 2:30 FINISH TIME: 12:30

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, sli. moist
	15/48"			2		
				3		
				4		
CS				5		
	41"/60"			6	SP	sand, v.f.g.-c.g., silty, sli. clayey, l. brown, sli. 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: Unger
CHECKED BY:
DRILLING ~~CONTRACTOR~~: Layne
DATE: 9-24-92

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: 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	SP	Sand, v.f.g - c.g., clayey to sli. clayey, wet, yellow brown to reddish brown, iron stained
	43"/60"			22		
				23	CLS	claystone, gray, med. moist, weathered, fractured
				24		
CS				25		
	42"/60"			26		
				27	CLS	claystone, gray to yellow gray, med. moist, iron stained
				28		
				29		
CS				30		
				31		
	60"/60"			32	CLS	claystone, gray to yellow gray, med. moist, some 3"-4" MLS lenses, yellow gray, med. moist to moist
				33		
				34		
CS				35		
				36		
	52"/60"			37		
				38		
				39		
CS				40	CLS	claystone, gray to yellow gray, med. moist, occasional 1"-3" MLS lense, moist, yellow gray
				41		
	51"/60"			42		
				43		

GEOLOGIST: Vick
CHECKED BY:
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-11A
SHEET NUMBER: 3 OF 3

WATER LEVEL:			
TIME:			
DATE:			

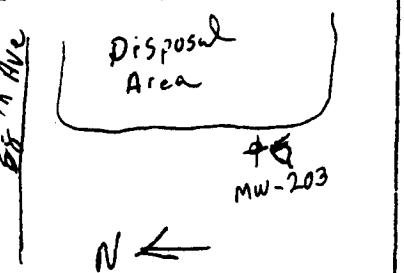
SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
↓				44	CLS	claystone, gray to yellow gray, med. moist
CS				45		
				46		
	60"/60"			47		
				48	SPS	sandstone, v.f.g.-m.g., yellow brown, moderately cemented, wet
↓				49		
CS				50		
				51	CLS	claystone, yellow gray, med. moist
	60"/60"			52	SCS	sandstone, v. clayey, v.f.g.-f.g., yellow brown, v. moist to wet
				53	SMS	v.f.g., sandstone, v. silty, v. well cemented, med. moist to SC moist
↓				54	SCS	sandstone, v. clayey, v.f.g.-f.g., yellow brown, v. moist, moderately cemented
CS				55		
				56	CLS	claystone, gray to brown w/ (carbonaceous areas) med. moist, some thin (2"-3") <CS lenses
				57		
	60"/60"			58		
↓				59		
				60		59' TD
				61		2" PVC: solid 0-49' (0.010) : screen 49'-59' stickup: 2.5'
				62		grout 0-22
				63		bent (hole plug) 22-33 4 bags; bent. (pellets) 33-35.0' 1 bucket
				64		bent. (hole plug) 35.0-44.1' 3 bags; sand 44.1-59 3 1/2 bags
				65		
				66		

GEOLOGIST: Jorge
CHECKED BY:
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 NUMER: 1 OF 1

LOCATION DIAGRAM:



CLIENT: CSI
PROJECT NAME: CSI
PROJECT NUMBER: 2-2562
PROJECT LOCATION: Bennett Co
BORING LOCATION: adjacent to MW-105A, MW-105A, MW-203
START DATE: 2-14-92 FINISH DATE:
START TIME: 0915 FINISH TIME:

DRILLING METHOD: ~~HSA~~ CME 75
LAYNE DRILLING
SAMPLING METHOD: CONTINUOUS
SURFACE ELEVATION:
WATER LEVEL:
TIME:
DATE:

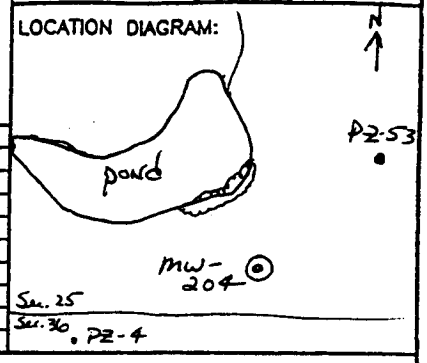
SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	SOIL GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
Cont.	1/0-5' Interval	N/A		2	ML	Moist, tan silty clay, plant material (silty loam)
						Moist Dark brown silty clay, minor fine grained sand
				4		
Cont	2/5-10'	N/A				NO Return on 5-10 interval - cuttings light brn silty clay, minor sand (fine grained)
				6		
				8		
	1/2 Bentonite 3/10-15			10		Silty, clayey sand (fine to med grained) tan to Lt. Brown, moist.
				12		12.5 - 14.5 sand w/ minor silt, increase grain size to granules above clay contact, moist to wet at contact.
				14	CL	14.5' Clay stone bedrock & weathered, slightly sandy - NOT bedrock.
	4/15-20 Interval					cuttings saturated, sand very fine grained.
				16		18-22' Lt brown fine to medium grained sand, saturated,
				18	SM	minor silt.
	5/					
				20		
				22	TD=22.0	21.5' Clay stone Bedrock TD at 22'

GEOLOGIST: James Rogers
CHECKED BY: DATE:
DRILLING CONTRACTOR: LAYNE 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: CSI
PROJECT NAME: CSI Bennett
PROJECT NUMBER: 2-4079
PROJECT LOCATION: CSI facility
BORING LOCATION:
START DATE: 9-24-92 FINISH DATE: 9-24-92
START TIME: 12:30 FINISH TIME: 8:25

DRILLING METHOD: CME-75 10" H.S. Auger
SAMPLING METHOD: continuous sampler (CS)
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	SP	sand, silty, clayey, V.f.g-V.c.g., brown, sli. moist
	35"/48"			2		
				3		
				4		
CS				5		
				6		
	33"/60"			7	SP	sand, silty, sli. clayey, l. brown, v.f.g-m.g.
				8		
				9		
CS				10		
				11		
	41"/60"			12		
				13		
				14	SP	sand, v.f.g-v.c.g., wet, brown
CS				15		
	39"/60"			16		
				17		
				18	CLS	claystone, gray to yellow gray, med. moist
CS	12"/12"			19		
				20		20.0' TD

GEOLOGIST: Unger
CHECKED BY:
DRILLING CONTRACTOR: Layne (Dallas Branch)
DATE: 9-24-92

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-204
SHEET NUMBER: 2 OF 2

WATER LEVEL:	22'		
TIME:			
DATE:			

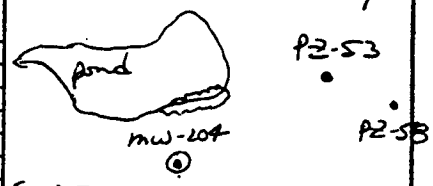
SAMPLER TYPE	SAMPLE NO. & DEPTH	OVA READING	SPT	DEPTH IN FEET	GRAPH	SOIL DESCRIPTION AND DRILLING CONDITIONS
				21	SP	
				22		
				23	SP	sandstone, yellow-brown, v.f.g.-m.g., poorly to moderately cemented, wet
✓				24		
				25		Mark D. Turnbull
				26		
				27		
				28		
				29		
				30		
				31		
				32		
				33		
				34		
				35		
				36		
				37		
				38		
				39		
				40		
				41		
				42		
				43		

GEOLOGIST: Engr
CHECKED BY:
DRILLING CONTRACTOR: Layne
DATE: 9-24-92

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-204
SHEET NUMBER: 1 OF

LOCATION DIAGRAM:



CLIENT: CSI
PROJECT NAME: CSI Bennett
PROJECT NUMBER: 2-4074
PROJECT LOCATION: CSI Bennett Facility
BORING LOCATION:
START DATE: 9-24-92 FINISH DATE:
START TIME: FINISH TIME:

DRILLING METHOD: CME-75 6" H.S. Auger
SAMPLING METHOD: Continuous sampler (CS)
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	SP	sand, silty, clayey, brown, sli. moist, v.f.g.-m.g.
	21/48"			2		
				3		
				4	SP	sand, silty, sli. clayey to clayey, brown, v.f.g.-c.g., sli. moist,
CS				5		
				6		
	27/60"			7		
				8		
				9		
CS				10		
				11	SP	sand, silty, l. brown to yellow brown, wet. moist
	27/60"			12		
				13		
				14		
CS				15		
				16		
				17		
	38/60"			18	SP	sand, sli. silty l. brown to yellow brown, wet. moist to moist
				19		
CS				20		

GEOLOGIST: Auger
CHECKED BY:
DRILLING CONTRACTOR: Layne (Dallas + Kandy)
DATE: 9-24-92

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-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		2" PVC
				22		0.010 slot
				23		
				24		
				25		10' solid
				26		10' slot (screen 0.010)
				27		2.5' stickup
				28		grout 0-2.5'
				29		bent. (hole plug) 2.5-5.5' 1 bag
				30		bent. (1/4 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: Unger
CHECKED BY:
DRILLING CONTRACTOR: Layne
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 Depth to Water top	7/1/91 Depth to Water surf	7/1/91 Elevation	7/15/91 Depth to Water top	7/15/91 Depth to Water surf	7/15/91 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	5298.95	5300.33	1.38		61.61	5237.34		28.76*	
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						

* anomalous reading

PROPOSED WSI - WATER LEVEL DATA

PIEZ. No.	TOTAL Depth	ELEV (surface)	ELEV (top)	STICK UP (ft)	5/4/92 Depth to Water top	5/4/92 Depth to Water surf	5/4/92 Elevation	6/8/92 Depth to Water top	6/8/92 Depth to Water surf	6/8/92 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 Depth to Water top	surf	Elevation	9/3/92 Depth to Water top	surf	Elevation
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	26.50	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 top	surf	Elevation	11/13/92 Depth to Water 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	531a.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 top	surface	elevation	1/18/93 Depth to Water 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 top	surface	elevation	3/26/93 Depth to Water 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	5298.95	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

			1/18/93		2/16/93		3/26/93	
MW-#	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

Industrial Compliance Inc.

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.

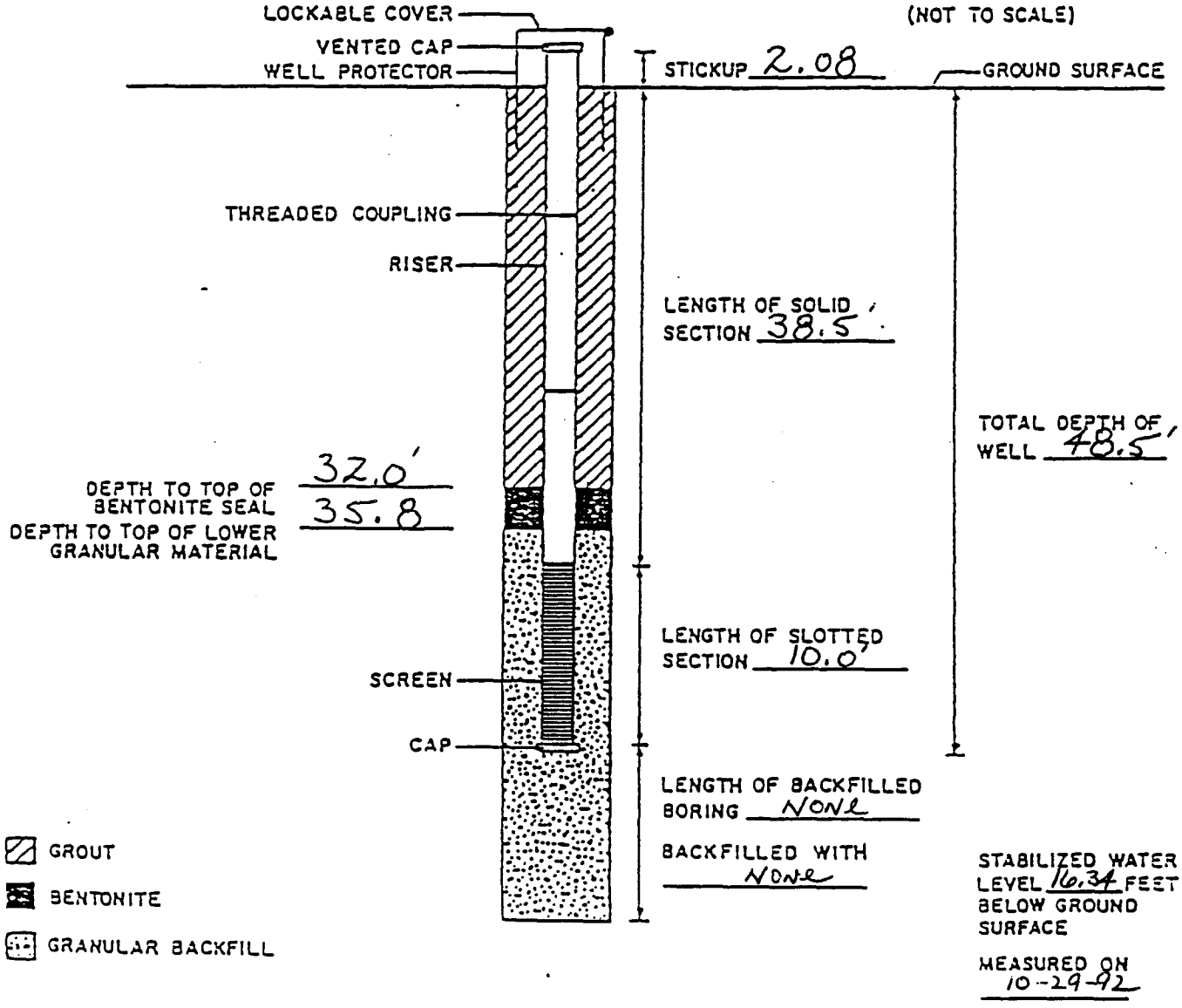
DATUM ELEVATION 5320.99 GROUND SURFACE ELEVATION 5318.91

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



Industrial Compliance Inc.

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

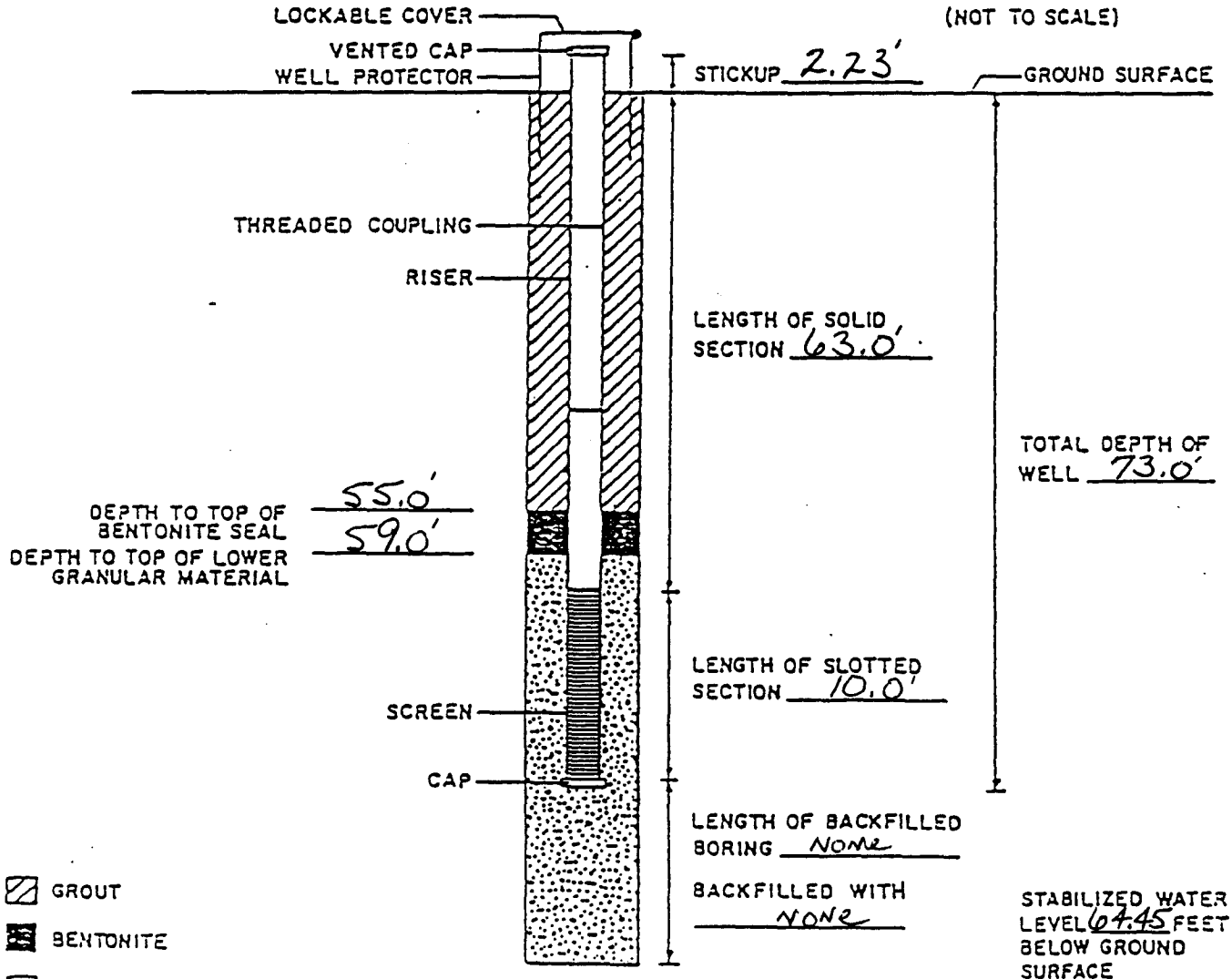
SCREEN DIAMETER AND MATERIAL 2" PVC SLOT SIZE 0.010

RISER DIAMETER AND MATERIAL 2" PVC BOREHOLE DIAMETER 8 inch

GRANULAR BACKFILL MATERIAL 10-20 size silica sand REPRESENTATIVE Unger

DRILLING TECHNIQUE 8" Hollow Stem Augers DRILLING CONTRACTOR Site Services

(NOT TO SCALE)



STABILIZED WATER LEVEL 64.45 FEET BELOW GROUND SURFACE

MEASURED ON 10-29-92

Industrial Compliance Inc.

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.

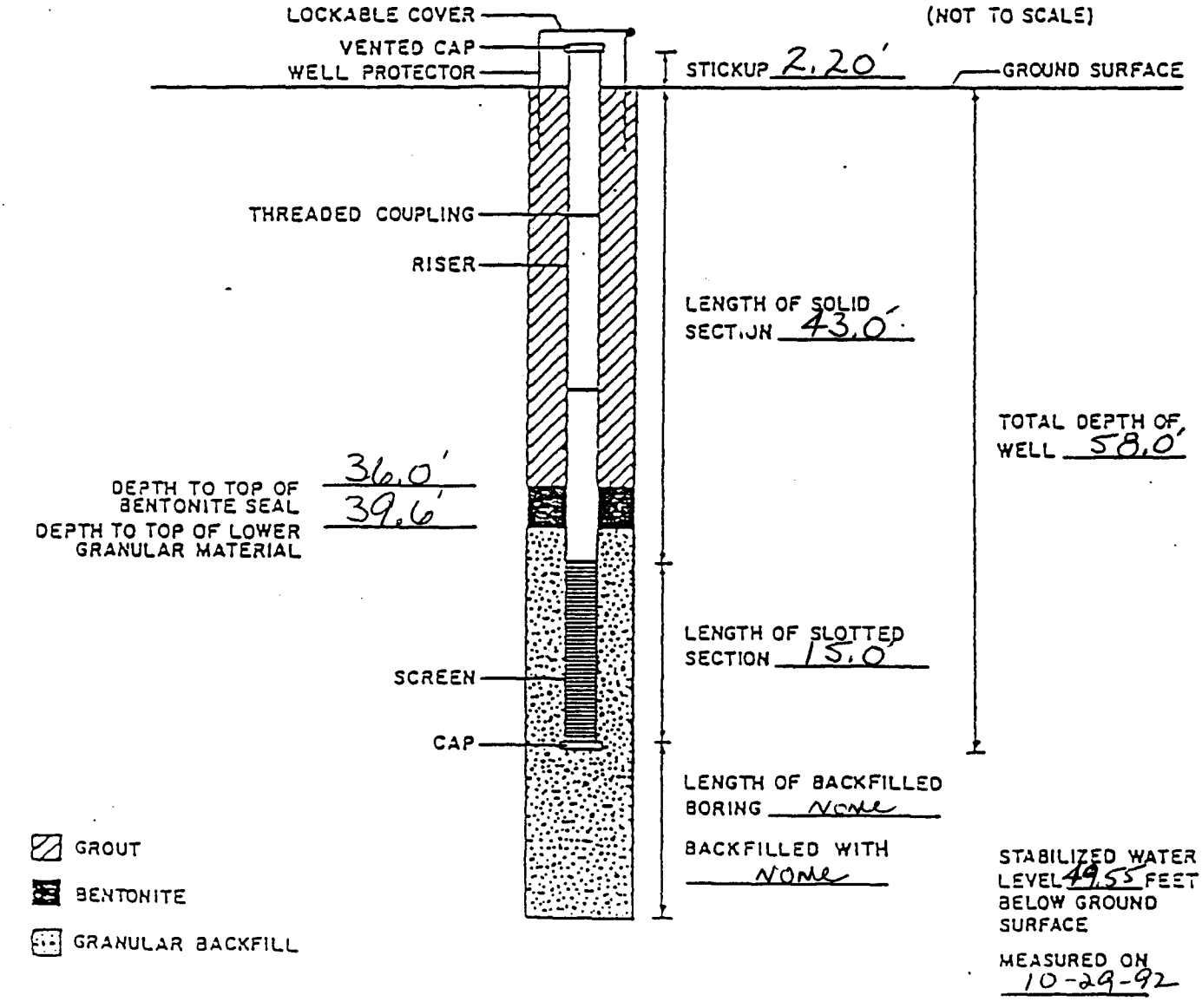
DATUM ELEVATION 5289.78 GROUND SURFACE ELEVATION 5287.58

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



Industrial Compliance Inc.

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.

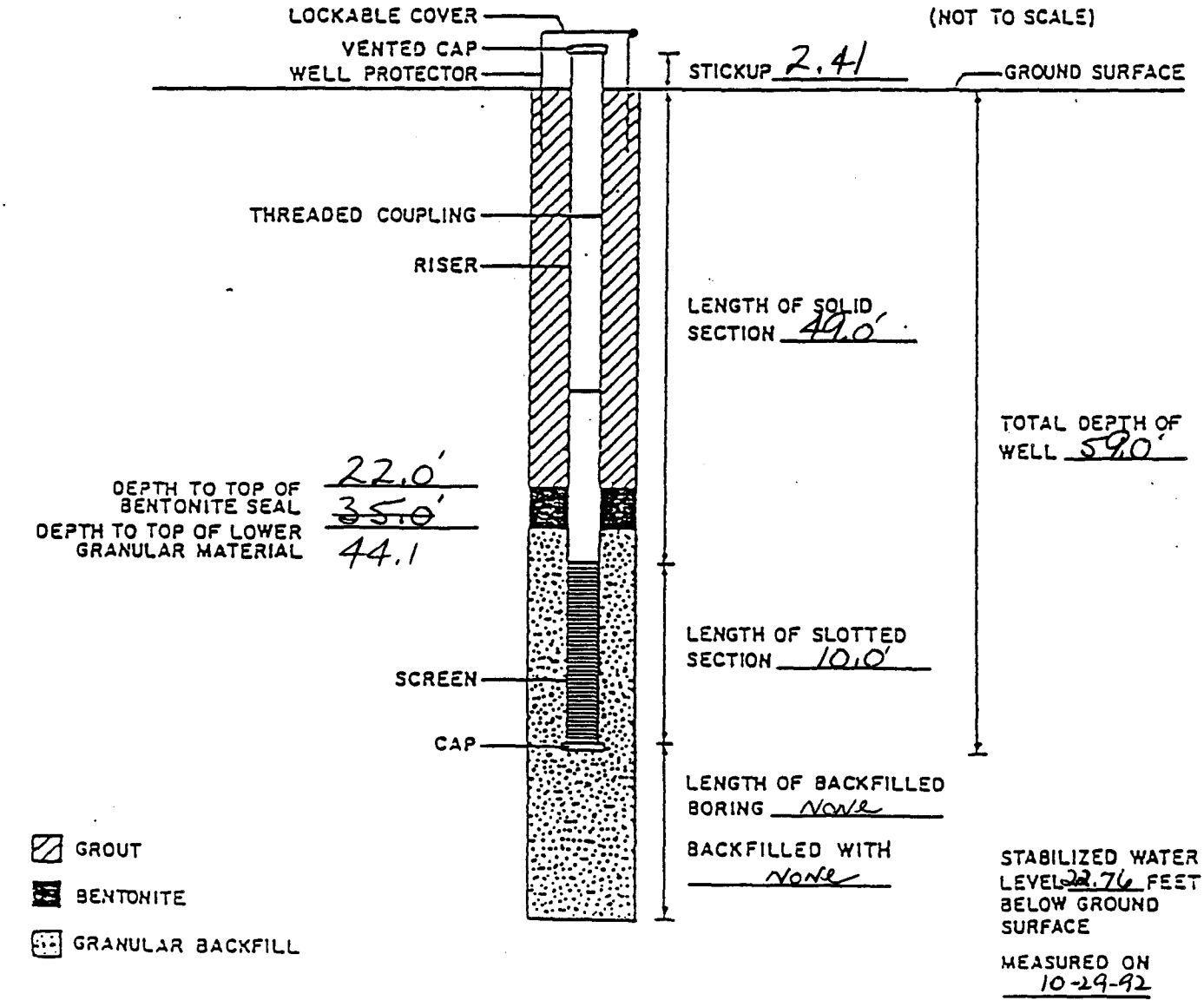
DATUM ELEVATION 5330.98 GROUND SURFACE ELEVATION 5328.57

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



Industrial Compliance Inc.

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.

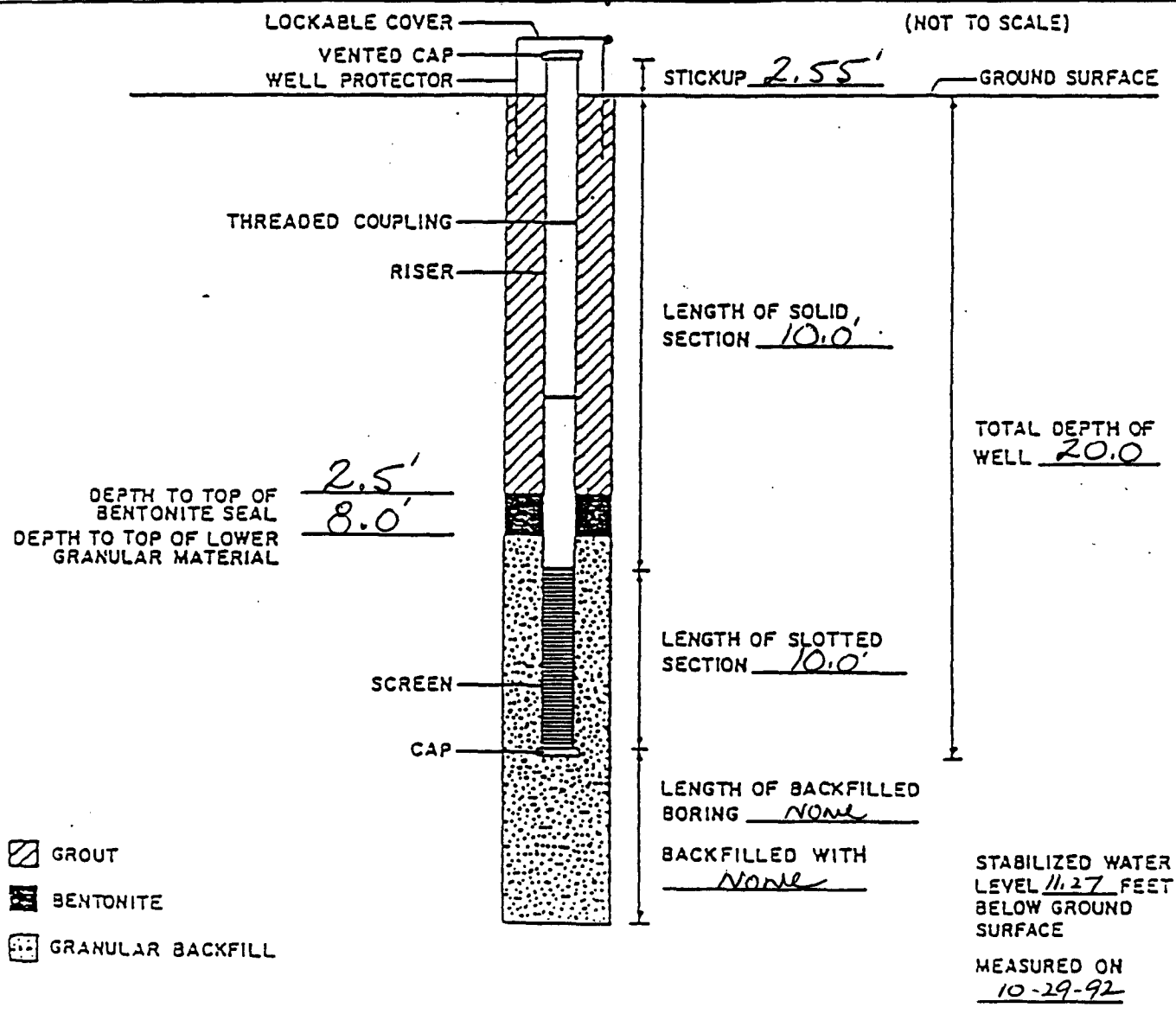
DATUM ELEVATION 5323.69 GROUND SURFACE ELEVATION 5321.14

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 Unger

DRILLING TECHNIQUE Hollow Stem Augers DRILLING CONTRACTOR Layne



APPENDIX K

PACKER TEST RESULTS

Industrial Compliance Inc.

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

PACKER PERMEABILITY - DATA SHEET

Boring No. PZ-46 (50' north of PZ-46) Job No. 2-4079
Boring Radius (r) 0.23 (ft) Engineer Unger
Depth of Boring (d) 20 (ft) Date 9-23-92
Depth to Static Water (A) 19 (ft) Flow Meter No. Hays 38800483
Depth to Center of Packer (B) 8.65 (ft) Height of Gauge above
Gauge Pressure (P) (psi) Ground Surface (C) 2.75 (ft)

Flow Data

	Time	Gallons	Cubic Feet	Flow Rate
				Gal/min.
10:29	0	3234.0		
	1	3239.4		5.4
5-8 psi	2	3243.8		4.4
	3	3247.2		3.4
	4	3251.8		4.6
	5	3254.5		2.7
	10	3272.2	Ave.	3.54
10:44	15	3290.8	Ave.	3.72
10psi	0 10:46	3300.8		
	1	3305.9		5.1
	2	3311.6		5.7
	3	3317.9		6.3
	4	3324.2		6.3
	5	3330.3		6.1
	10	3360.8	Ave.	6.1
	15	3396.6	Ave	7.1
11:06	20	3431.0	Ave	6.8

Ave (5-8 psi) = 3.9 gal/min Ave (10psi) = 6.18 g/m

Notes

20 psi

11:09	0	3460.0	
	1	3475.9	15.9
	2	3491.2	15.3
	3	3509.0	17.8
	4	3522.8	13.8
	5	3539.0	16.2
	10	3619.5	Ave. 4.5
	15	3699.0	Ave 15.9
11:29	20	3778.5	Ave 15.9

Ave. (20psi) = 15.8 g/m
(* discount 4.5 5-10 min)

soil boring lithology similar to PZ-46
v. moist to wet @ 19'

Average Q = ft³/min

CALCULATIONS

$K = \frac{Q}{2\pi LH} \ln \frac{L}{r}$: $L \geq 10r$

$K = \frac{Q}{2\pi LH} \sinh^{-1} \frac{L}{2r}$: $10r > L \geq r$

$L = d - B$

$H = B + C + (L/2) + (P)(2.31) - S$

where $S = B + L/2 - A$

Note: If no free water is encountered, $S = 0$

Industrial Compliance

A Subsidiary of
SP Environmental Systems, Inc.

SHEET ___ OF ___ JOB NO. 2.4079
PROJECT CSI
BY mcw / mAm DATE / /
CHECKED BY ___ DATE / /

Packer Test PK-46

Approximately 50' north of PZ-46

Average Flow @ 10 psi = 6.18 gal/min = 0.826 Ft^3/min = Q
Average Flow @ 20 psi = 15.8 gal/min = 2.11 Ft^3/min = Q

$$K = \frac{Q}{2\pi L H} \ln \frac{L}{r}$$

$L \geq 10r$
$11.35 \geq 2.3$

$L = d - B = 20 - 8.65 = 11.35$

$H = B + C + (\frac{L}{2}) + P(2.31) - S = 8.65 + 2.75 + (\frac{11.35}{2}) + 10(2.31) = 40.175$

10 psi $r = 0.23'$ $P = 10$ psi
$B = 8.65$
$C = 2.75$

$$K = \frac{0.826\ Ft^3/min.}{2865.05\ Ft^2} \ln 49.35 = 0.00029\ Ft/min\ (3.90) = 0.0011\ Ft/min$$

$K = 0.0011\ Ft/min\ (0.508) = 0.00056\ cm/sec = \underline{5.6 \times 10^{-4}\ cm/sec}$.

20 psi $L = 11.35$ $C = 2.75$
$r = 0.23$ $P = 20$ psi.
$B = 8.65$ $H = 8.65 + 2.75 + (\frac{11.35}{2}) + 20(2.31) = 63.27$

$$K = \frac{2.11\ Ft^3/min}{4512.05\ Ft^2} \ln 3.9 = 0.00047\ (3.9) = 0.0018\ Ft/min$$

$K = 0.0018\ Ft/min\ (0.508) = \underline{9.1 \times 10^{-4}\ cm/sec}$

Industrial Compliance

A Subsidiary of
SP Environmental Systems, Inc.

SHEET ___ OF ___ JOB NO. 2.4079
PROJECT CSI
BY MCW/MAM DATE / /
CHECKED BY _____ DATE / /

Packer Test PK-46 (continued)

Assume tested interval is 1' saturated unit (TD @ 20', static water at 19')

$$K = \frac{Q}{2\pi L H} \sinh^{-1}\frac{L}{2r}$$

$10r > L \geq r$
$2.3 > 1 \geq 0.23$

$L = 1$ $H = \cancel{45.35}$ 42.06
$r = 0.23$
$P = 10$
$C = 2.75$
$B = 19'$
$Q = 0.826\ Ft^3/min$

10 psi $K = \frac{0.826\ Ft^3/min}{264.27\ Ft^2} \sinh^{-1} 2.17$

$K = 0.00313\ Ft/min\ (1.52)$

$K = 0.00476\ Ft/min\ (0.508) = 0.00242\ cm/sec = 2.42 \times 10^{-3}\ cm/sec$

20 psi $K = \frac{2.11\ Ft^3/min}{426.94\ Ft^2} \sinh^{-1} 2.17$

$H = 67.95$
$r = 0.23$
$P = 20$
$C = 2.75$
$B = 19'$
$Q = 2.11\ Ft^3/min$

$K = 0.00494\ Ft/min\ (1.52)$

$K = 0.0075\ Ft/min\ (0.508)$

$K = 0.0038\ Ft/min = 3.8 \times 10^{-3}\ cm/sec$

Industrial Compliance Inc.

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

PACKER PERMEABILITY - DATA SHEET

Boring No. PZ-47 (≈ 50' south of PZ-47) Job No. 2-4079
Boring Radius (r) 0.23 (ft) Engineer Unger
Depth of Boring (d) 55 (ft) Date 9-23-92
Depth to Static Water (A) — dry (ft) Flow Meter No. Hays 38800483
Depth to Center of Packer (B) 43.65 (ft) Height of Gauge above
Gauge Pressure (P) (psi) Ground Surface (C) 0.5 (ft)

Flow Data

	Time	Gallons	Cubic Feet	Flow Rate gal/min.
15psi	0 2:45	3792.5		
	1	3792.75		0.25
	2	3792.76		0.01
	3	3792.76		-
	4	3792.77		0.01
	5	3792.77		-
	10	3792.77		-
	15	3792.77		-
3:05	20	3792.77		-
			0.27	~~0.54~~ ~~0.135~~
20psi				
3:07	0	3793.26		-
	1	3793.26		-
	2	3793.26		-
	3	3793.26		-
	4	3793.26		-
	5	3793.26		-
	10	3793.26		-
	15	3793.26		-
3:37	30	3793.26		-

Notes

25psi

3:44	0	3793.56	-
	1	3793.54	-
	2	3793.56	-
	3	3793.56	-
	4	3793.57	0.01
	5	3793.58	0.01
	10	3793.59	0.01
	15	3793.59	-
4:14	30	3793.59	-

Q = 0.03 / 30 = 0.001 / 7.43 = 0.0001337

40psi

4:16	0	3793.91	
	1	3793.93	0.02
	2		
	3		
	4		
	5		
	10		
	15		

hose leaking @ surface connection, stopped test

Average Q = ft³/min

CALCULATIONS

$K = \frac{Q}{2\pi LH} \ln \frac{L}{r}$: $L \geq 10r$

$K = \frac{Q}{2\pi LH} \sinh^{-1} \frac{L}{2r}$: $10r > L \geq r$

L = d-B

H = B + C + (L/2) + (P)(2.31)-S

where S = B + L/2 - A

Note: If no free water is encountered, S = 0

Industrial Compliance

A Subsidiary of
SP Environmental Systems, Inc.

SHEET ___ OF ___ JOB NO. 2-4079
PROJECT CSI
BY MAM/MCU DATE / /
CHECKED BY _____ DATE / /

Packer Test PK-47

Approximately 50' south of PZ-47

Average Flow @ 25 psi = $\frac{0.03 \text{ gal}}{30 \text{ min}} = 0.001 \text{ gal/min} = 0.000134 \text{ ft}^3/\text{min}$

$L = d - B = 55 - 43.65 = 11.35$

$H = B + C + \frac{L}{2} + 25(2.31) = 107.58$

$d = 55$

$B = 43.65$

$r = 0.23'$

$C = 0.5$

$K = \frac{Q}{2\pi L H} \ln \frac{L}{r}$ $\quad \therefore L \geq 10r$ $\quad 11.35 > 2.3$

$K = \frac{0.000134 \text{ ft}^3/\text{min}}{2(3.14)(11.35)(107.58)} \ln \frac{11.35}{0.23}$

$K = \frac{0.000134 \text{ ft}^3/\text{min}}{7671.62} (3.90)$

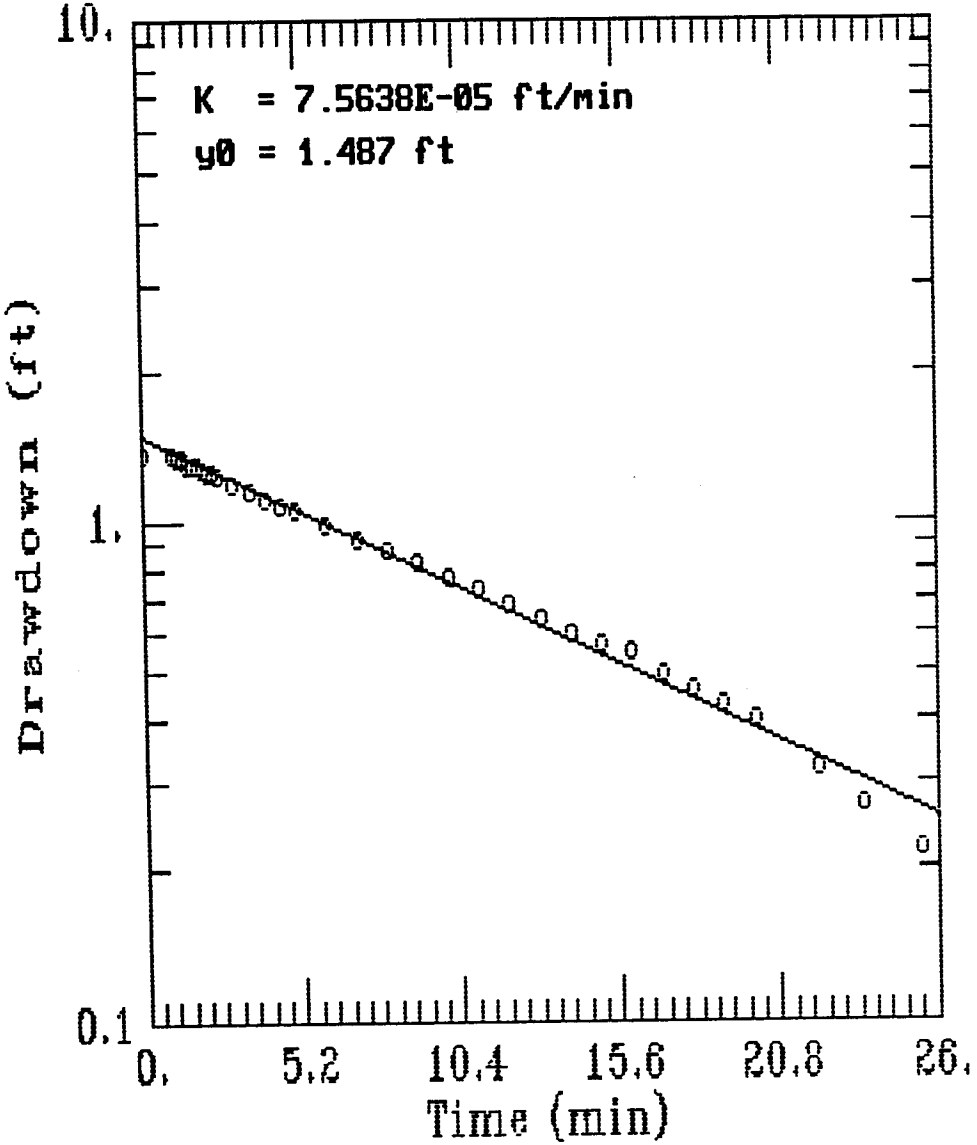
$K = 1.743 \times 10^{-8} (3.9) = 6.8 \times 10^{-8} \text{ ft/min} \; (0.508)$

$K = 3.45 \times 10^{-8} \text{ cm/sec}$

APPENDIX L

SLUG TEST RESULTS

MW-109 SLUG OUT

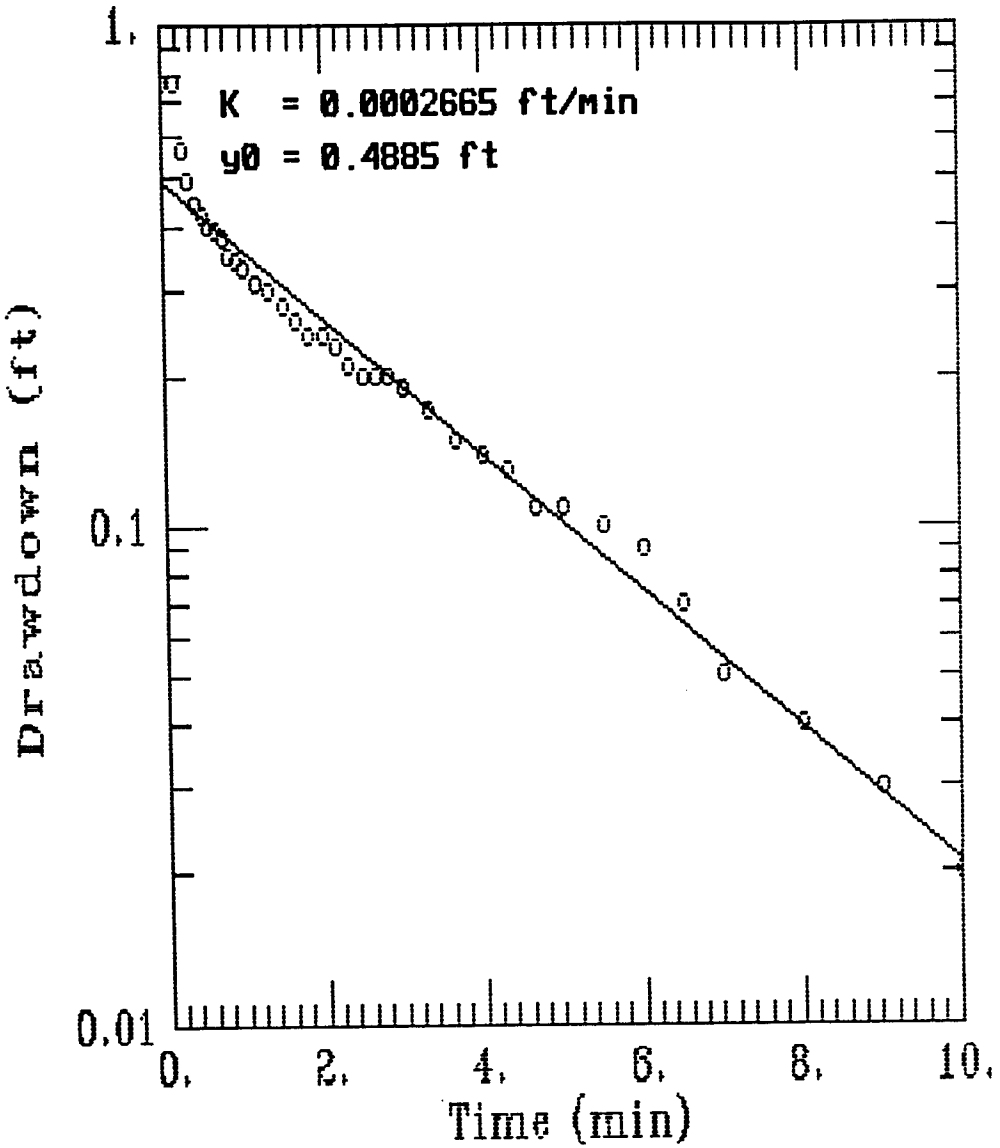


AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

MW-111 SLUG OUT

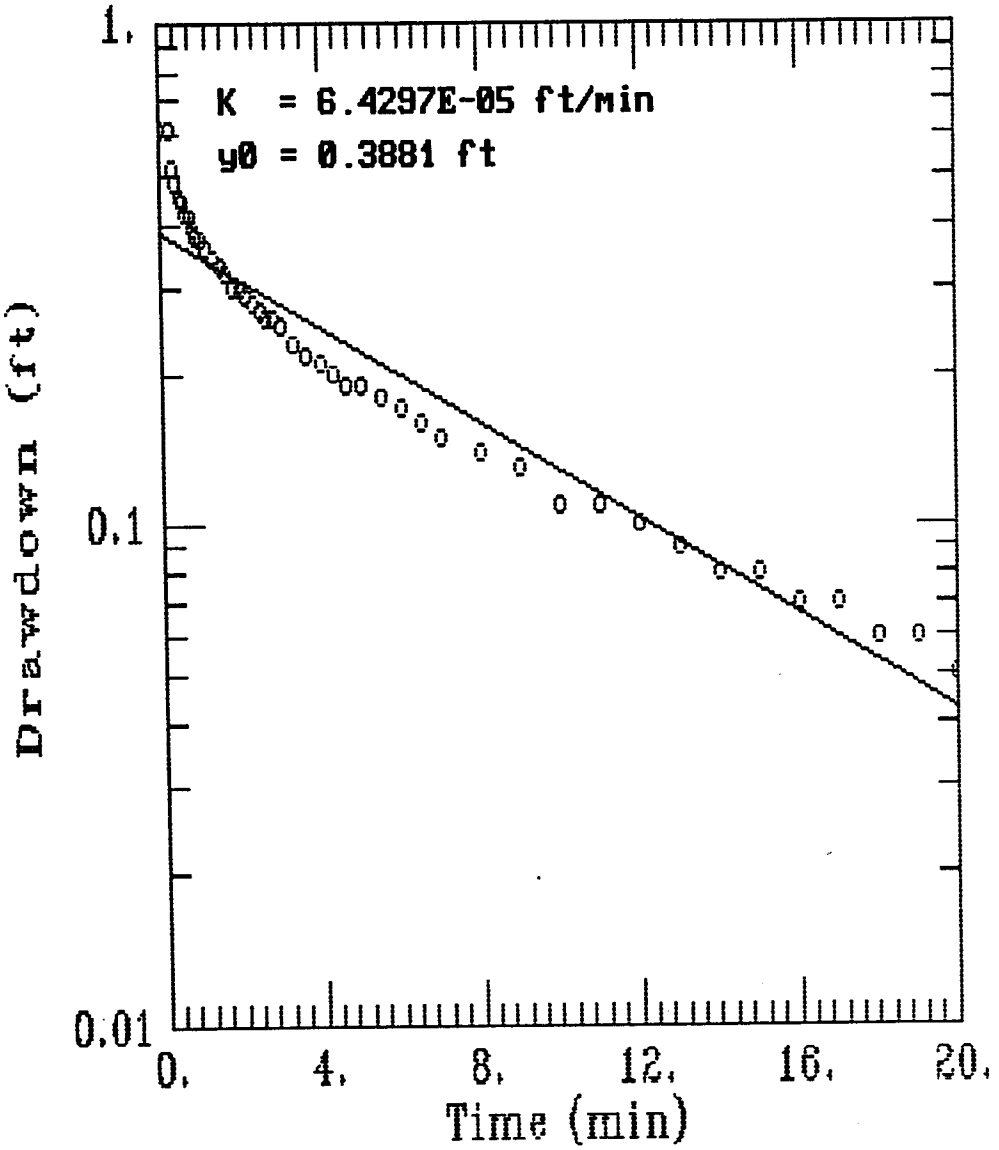


AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

MW-112 SLUG OUT



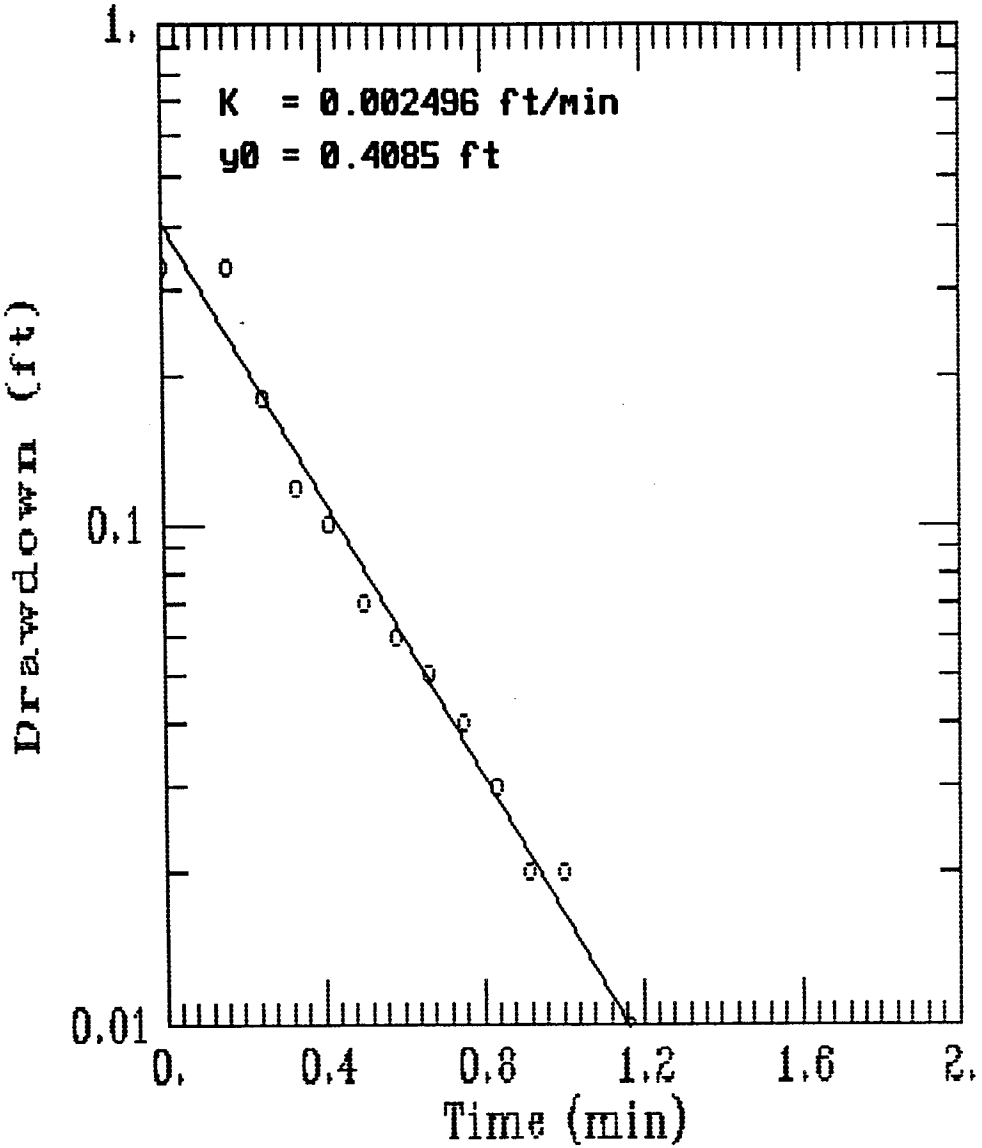
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

MW-114 SLUG OUT

MW-204 SLUG OUT



AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Appendix B

Legal Description

LEGAL DESCRIPTION
PART OF THE SOUTH ONE-HALF OF SECTION 25
TOWNSHIP 2 SOUTH, RANGE 64 WEST
SIXTH PRINCIPAL MERIDIAN
COUNTY OF ADAMS, STATE OF COLORADO

THAT PART OF THE SOUTH ONE-HALF OF SECTION 25, TOWNSHIP 2 SOUTH, RANGE 64 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF ADAMS, STATE OF COLORADO, DESCRIBED AS: COMMENCING 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 WEST RIGHT-OF-WAY LINE OF SCHUMAKER MILE ROAD, BEING THE POINT OF BEGINNING; THENCE CONTINUING N88°37'05"W ALONG SAID SOUTH LINE, A DISTANCE OF 2627.55 FEET TO THE SOUTHEAST CORNER OF THE SOUTHWEST ONE-QUARTER OF SAID SECTION 25; THENCE N88°29'52"W ALONG THE SOUTH LINE OF SAID SOUTHWEST ONE-QUARTER, A DISTANCE OF 644.01 FEET; THENCE N10°50'39"E, A DISTANCE OF 1023.42 FEET; THENCE N54°08'55"W, A DISTANCE OF 593.30 FEET; THENCE N09°37'19"W, A DISTANCE OF 1327.80 FEET TO THE NORTH LINE OF SAID SOUTHWEST ONE-QUARTER; THENCE S88°28'44"E ALONG SAID NORTH LINE, A DISTANCE OF 1170.21 FEET TO THE NORTHWEST CORNER OF SAID SOUTHEAST ONE-QUARTER OF SECTION 25; THENCE CONTINUING S88°28'44"E ALONG THE NORTH LINE OF THE NORTHWEST ONE-QUARTER OF SAID SOUTHEAST ONE-QUARTER, A DISTANCE OF 1155.48 FEET, BEING 170.06 FEET WEST OF, AS MEASURED ALONG SAID NORTH LINE, FROM THE NORTHEAST CORNER OF SAID NORTHWEST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER; THENCE S00°16'07"W PARALLEL WITH THE EAST LINE OF SAID NORTHWEST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER, A DISTANCE OF 1322.44 FEET TO THE SOUTH LINE OF SAID NORTHWEST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER; THENCE S88°32'55"E ALONG SAID SOUTH LINE, A DISTANCE OF 170.05 FEET TO THE NORTHWEST CORNER OF THE SOUTHEAST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER OF SAID SECTION 25; THENCE CONTINUING S88°32'55"E ALONG THE NORTH LINE OF SAID SOUTHEAST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER, A DISTANCE OF 1297.15 FEET TO THE WEST RIGHT-OF-WAY LINE OF SAID SCHUMAKER MILE ROAD, THENCE S00°11'50"W ALONG SAID WEST RIGHT-OF-WAY LINE, A DISTANCE OF 1320.69 FEET TO THE POINT OF BEGINNING.

CONTAINS 164.50 ACRES, MORE OR LESS.

Appendix C

Location Restrictions

LOCATION RESTRICTION SECTION EXCERPTED FROM THE ORIGINAL PERMIT DOCUMENT

"Prior to the initial field program, an initial site assessment was conducted of the WSI 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.

Location Criteria

Proximity to Airports

Due to the non-putrescible nature of ash to be disposed of at the WSI facility, there is no additional potential for bird-strike problems. The WSI 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.

Since this facility was permitted, ERL has worked with Adams County and the Federal Aviation Administration on a bird mitigation plan. Additional information regarding the proximity to airports is included in the updated EDOP text, dated September 2024.

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 WSI 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.

Appendix D

Bird Mitigation Plan

AEC

FIVE PART DISPOSAL FACILITY
ADAMS COUNTY, COLORADO

BIRD MITIGATION PLAN

Prepared for:

Five Part Development Company

Prepared by:

American Environmental Consulting, LLC
6885 S. Marshall St. Suite 3
Littleton, Colorado 80128

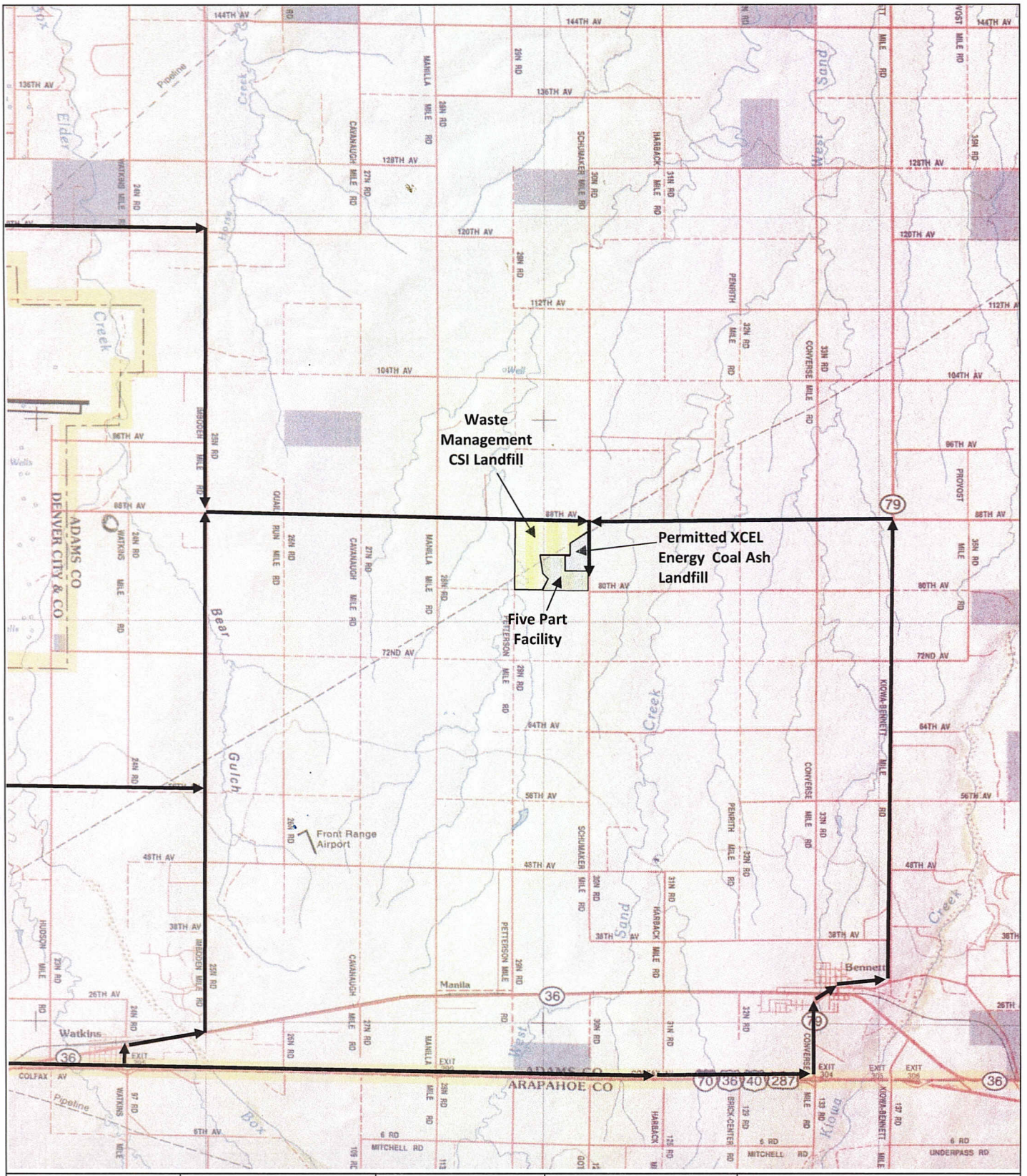
July 24, 2009

INTRODUCTION

The Five Part Disposal Facility is owned and operated by Five Part Development Company and is located one-half mile south of the intersection of 88th Avenue and Schumaker Mile Road in Adams County, Colorado. The facility provides composting of food wastes and other approved feedstocks and final disposal for municipal solid waste (MSW) that includes non-hazardous solid waste from a variety of sources, including residential, commercial, and industrial wastes. Some of the waste accepted at the facility is putrescible and would provide a food source for vectors such as flies, mosquitoes, rodents, and birds if operations were not controlled in an appropriate manner.

The control of birds at the landfill deserves special consideration because of the well publicized and dangerous occurrences of bird strikes by aircraft. The Federal Aviation Administration (FAA), United States Environmental Protection Agency (USEPA) and Colorado Department of Public Health and Environment (CDPHE) recognize the potential danger of bird strikes to aircraft associated with landfills and have promulgated rules specific to the relationship of MSW landfills to airports. Federal regulations (40 CFR § 258.10), require owners and operators of municipal solid waste landfills to demonstrate that landfills within 10,000 feet of any airport runway used by turbo-jet aircraft or within 5,000 feet of any airport runway which receives only piston-type aircraft be designed and operated in a manner which does not pose a bird hazard to aircraft, and requires notification if a landfill is outside of these ranges but within five miles of certain airports. The CDPHE regulations mirror those in 40 CFR§ 258.10. The Five Part facility is located approximately four miles north of the Front Range Airport and eight miles east of the Denver International Airport (Figure 1) and is in compliance with all of the U.S.E.P.A. and CDPHE requirements. The facility is not within 10,000 feet of any runway at either of the airports, and provided notification to Ms. Linda Bruce, Colorado State Planner with the FAA of the planned development to accept putrescible waste in October 2007. FAA regulations (49 U.S.C Section 44718(d)) require any landfill accepting putrescible waste and located within six miles of an airport meeting specific criteria, notify the applicable State aviation authority, who must request and obtain an exemption from the Administrator of the FAA. Five Part and its attorneys contacted the FAA headquarters in October 2007 to confirm that the statutory siting restriction under 49 U.S.C Section 44718(d) does not apply to Front Range Airport or the Five Part facility and that an exemption is not necessary.

Recent publicity and studies have shown the Denver International Airport (DIA) to be among the leading airports in the United States for bird strikes. The proximity of DIA runway 7/25 to the Rocky Mountain Arsenal National Wildlife Refuge and DIA runway 16/34 to Barr Lake State Park (the site of a 2,000 acre waterfowl sanctuary, the headquarters location for the Rocky Mountain Bird Observatory and an Audubon Society "Important Bird Area"), which is well recognized for its very favorable bird habitat, are likely the substantial contributors to this situation. The Front Range Airport is located south of, and closer to, the facility than DIA.



Proj: Five Part	Drawn by: CJA	AEC	AMERICAN ENVIRONMENTAL CONSULTING, LLC	FIGURE 1 LOCATION MAP FIVE PART DISPOSAL FACILITY
Date: March 17, 2009	Reviewed by: MAM			
File: vicinity map				

Five Part Development met with and worked closely with representatives of the FAA, United States Department of Agriculture (USDA, as wildlife consultant to the FAA), DIA, and the Front Range Airport to explain the planned operations and develop effective bird mitigation procedures. Each entity was provided an opportunity to review the facility development and voice any concerns they may have as part of the permitting process for Five Part to accept putrescible wastes for disposal. The facility did not receive any negative responses and received a number of positive responses. Bird control is discussed as part of the discussion on vector control in Section 7.5.2 of the facility's Engineering Design and Operations Plan (EDOP), and this bird mitigation plan provides more specific guidance for the control of birds at the facility.

BIRD CONTROL PRACTICES

The most effective methods of controlling birds at the facility is to take steps to make the facility unattractive to birds by a combination of reducing access to food sources and frightening birds from the facility.

The relatively low volume of vehicle traffic and waste arriving at the facility allows Five Part to maintain a relatively small working face, on the order of five times smaller than that of the Tower Road Landfill, which in turn allows Five Part to establish greater control of birds at the landfill with the goal of creating undesirable conditions for birds. Continuous activity at the working face, including offloading waste vehicles and operation of the compaction equipment will discourage birds from alighting on the exposed refuse. The cover material applied on a daily basis creates a barrier above the refuse which vectors such as birds and rodents cannot penetrate. This barrier eliminates the ability of birds and rodents to access refuse (a potential source of food) thereby eliminating the desirability of the area. In addition, the cover material helps control rodent populations by eliminating the source of food. Minimizing rodent populations decreases the desirability of the landfill to birds of prey. The use of cover materials as prescribed by applicable regulations and the standard of practice that will be employed at the Five Part facility will virtually eliminate the foraging or loitering birds at the landfill when the landfill is closed.

The planned design and operation of the Five Part facility also minimizes other bird attractants. The landfill will be constructed and operated in such a manner that water does not pond on the surface. Debris and other items on-site which may provide shelter for nesting birds or rodents are eliminated as soon as practicable.

If additional measures are necessary to further discourage bird activity on the landfill, Five Part will implement additional measures that have been shown to be effective at other landfills, including:

- frequent and erratic use of bird repellent devices to discourage birds from landing at the facility;
- minimizing other bird attractants such as shelter and rodent populations to decrease the desirability of the Five Part facility;
- Professional extermination services will be obtained as necessary to reduce vectors that attract birds, such as rodents.

During daily landfill operations when refuse is actively being placed, trained site personnel will use hand held bird repelling devices as needed to repel approaching and/or loitering birds. When fired, the bird repellent device provides alarming, irritating and disturbing stimuli that discourages birds from landing at the facility. Bird repellents typically consist of a pyrotechnic shell fired from a hand held gun and may deliver any one or more of the following stimuli:

- whistle noise
- flash of light
- concussion
- smoke trail
- sound of propellant

When used appropriately by trained personnel, the hand held bird repellent devices are very effective at discouraging birds from landing at landfills and in training birds to recognize that the site is an undesirable destination on a long-term basis. The use of pyrotechnic shells is most effective if the stimuli is varied from time to time to prevent the birds from becoming accustomed to any particular stimuli.

Other types of bird repellent devices are available and can be used in varied combinations with pyrotechnic methods and include such items as decoys of bird predators, automated cannons which periodically release a loud blast and squawk boxes which make continuous high pitched irritating noises.

Attentive use of the above methods should create a situation where birds will find the reward not worth the effort and make the facility unattractive in the long term; however, landfill personnel will need to reinforce the undesirability of the facility periodically by continuing the use of the above methods even after bird populations decrease markedly.

Appendix E

Surface Water Management Design

AEC

STORMWATER DRAINAGE DESIGN REPORT AND PLAN

EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

Prepared for:
Five Part Development, LLC
East Regional Landfill

Prepared by:
American Environmental Consulting, LLC
8191 Southpark Lane, Suite 107
Littleton, Colorado 80120

February 2025

1.0 INTRODUCTION

Five Part Development, LLC (Five Part) is applying for a vertical expansion of the East Regional Landfill (ERL) final cover. As part of this vertical expansion, Five Part contracted American Environmental Consulting, LLC (AEC) to conduct a revision of the surface water control design as a result of the modification to the final cover configuration. The vertical expansion includes increasing outside side slopes from a 4:1 ratio to a 3.5:1 ratio and raising the 5% grade deck on top by approximately 107 feet. This is the drainage plan and report for the revised configuration.

The ERL received an amendment to their CD on June 29, 2009 based on the application in the form of an Engineering Design and Operations Plan (EDOP) developed by Doty & Associates, LLC (June 1, 2006). That document included the design for permanent surface water control structures to manage surface water run-on and run-off to and from the site. The structures included a surface water channel design to control run-on to the site from the south and run-off from the south and east portions of the developed landfill (after final cover installation) and route it around the east side of the facility. The channel was designed to discharge stormwater to property owned by Waste Management over 2,000 feet north of the ERL.

In 2009, as a condition of approval of the amendment to the CD, Five Part contracted AEC to conduct a review of the surface water control design by Doty & Associates and complete the required Drainage Report and Plan. As a result of this review, AEC revised the drainage controls at the site to control not only run-on to the site from the south, but all run-off from the developed landfill. The revision is referred herein as the 2009 revision.

In accordance with 2.1.6 of 6 CCR 1007-2, the solid waste regulations, the revision to the drainage plan presented in this report are intended collect the 24-hour, 25-year volume and control the 24 hour 100-year storm volume.

This report includes a narrative of the concept for the revised surface water control system, engineering calculations and supporting data, and two plan sheets depicting the revised surface water channel in plan view and includes appropriate details.

2.0 DESIGN NARRATIVE AND SUMMARY OF RESULTS

The commonly used model HydroCAD (version 10.2-5b) was used to evaluate the needed capacity and performance of the channel design.

The 2009 revision surface water control system consisted of four grass-lined channels around the perimeter of the final cover on the landfill, representing anticipated post-closure conditions at the site. The 2009 revision designed these channels to control the 24-hour, 25-year storm volume and did not ensure collection of this volume. This revision retains all the perimeter ditches but adds detention weirs within the perimeter ditches to collect the 24-hour, 25-year storm volume. Additionally, some sections of the perimeter ditches are deepened by increasing the channel side slopes so the 24-hour, 25-year storm volume can be collected.

Erosion control features are added to the final cover stormwater design to account for the steepened side slopes in the vertical expansion. This includes a network of 1.5% slope tack-on berms and two down chutes to route runoff and control erosion from the final cover.

The perimeter channels will be built in phases as necessary based on the progression of landfilling throughout the operating life of the landfill. This scenario assumes that all operating facilities, including the gatehouse and scales will be removed from the site after it is closed. Surface water control structures for operational purposes will be constructed as needed during the operating life of the landfill to collect and control the 24-hour, 25-year event as required in 6 CCR 1007-2, Part 1, Sections 2.1.6 and 3.2.6. The operational surface water control structures for the active landfill are dependent on the landfill configuration and operating needs such as access roads, soil stockpile areas, etc. and their location and design will constantly change based on the particular landfill configuration at any one time. Therefore, the operational surface water control structures are not included herein. Aside from operational surface water controls required by regulation to control surface water to and from the refuse fill area, the natural drainage through the site will be maintained as much as possible until the permanent system is constructed.

The only run-on to the site from an off-site area is along the southern property boundary. This run on is precluded from entering the site by a tree-lined berm and road so it does not need to be included in the calculations for ERL.

A 40-foot buffer has been established along the southern property boundary as required by Adams County in which no landfill or permanent structures may be located, and all disturbance associated with this channel are outside of the 40-foot buffer. In addition, the channel was designed outside of the 40-foot Right-of-Way along Schumaker Road.

The stormwater control system on the final cover consists of tack-on berms that route run off to two down chutes and then to four separate channels with detention areas that ultimately discharge off site at two discharge points as shown on Sheet 1. The channels are labeled as:

Channel 1: Perimeter channel starting on the south and routing water north to Discharge Point 1
Channel 2: Perimeter channel starting on the north and routing water east to Discharge Point 1

Channel 3: Perimeter channel starting on the west and routing water south to Discharge Point 2
Channel 4: Perimeter channel starting on the south and routing water west and north to Discharge Point 2

The tack-on berm system consists of two down chutes, one on the northeast side and one on the south side. On the northeast down chute, three tiers of tack on berms collect run-off and route it to the chute. On the south down chute there are two tiers of tack-on berms that route run-off to the chute. The majority of run-off from the final cover will be routed through the tack on berm system.

The south down chute discharges into the south perimeter ditch (Channel 2). The south perimeter ditch has the capacity to collect 2.4-acre feet of run-off water. Overflow from this storage area gets routed north around the eastern perimeter of the facility to Discharge Point 1.

The northeast down chute discharges into the eastern perimeter ditch (Channel 1). The eastern perimeter ditch has the capacity to collect 6.1 acre-feet of run-off. The channel that routes from the 6.1 acre feet storage to discharge point 1 currently has weirs to slow flow.

The southwestern outfall (Discharge Point 2) will receive water from the southwest portion of the final cover that does not route run-off through the tack on berm system. This drainage plan revises the channel leading to this outfall to be deeper with steeper side slopes to collect, 0.56 acre-feet of run-off, the 24 hour 25-year volume from these areas.

This drainage plan also revises the north perimeter ditch (Channel 2) to have a detention area to hold 0.32 acre-feet also consisting of a detention weir and a deeper channel by steepening side slopes.

The slope of the channel bottom varies, but was designed to control the rate of drainage so that velocities are maintained below 5 feet per second (fps) so the use of grass-lined channels is permissible according to Metro Drainage guidelines (Urban Drainage and Flood Control District, Drainage Criteria Manual, Section 3.2.7). Attachment 1 provides details of the design of the permanent surface water control system.

As shown on Figure 1 and Figure 2, the limit of the final cover was designed to tie into the crest of the channels either at the natural ground surface or at the top of the embankment (as applicable).

The following pages provide the general modeling input and a summary of the design for the site surface water control system. Included at the end of the summary section is Sheet 1 that depicts the drainage configuration used in the design evaluation. Attachment 2 includes the model output for the site drainage system design.

GENERAL INPUT DATA

- Use Runoff Curve Number 69 for Pasture/grassland/range, Fair, HSG B (1S)
- 25-year, 24-hour rainfall = 3.56 inches
- 100-year, 24-hour rainfall = 4.73 inches
- Used Type II type storm distribution
- Generally 3-foot wide ditch with 3H:1V Slopes, excluding detention areas
- Manning's value Constant n= 0.030 Stream, clean & straight for channels
- Manning's value Constant n= 0.069 6 inch riprap for down chutes
- Manning's value Constant n= 0.035 for reach 4.2.1 to account for existing weirs

See the following Attachment 1 and Figures 1 and 2 for Design Details.

WASTE MANAGEMENT / CSI PROPERTY

XCEL ENERGY PROPERTY

DEEPENED CHANNEL BOTTOM
WITH STEEPER 1:1 SLOPES INSIDE
5302' CONTOUR
STORAGE CAPACITY = 0.37 ACRE-FEET

DETENTION WEIR #1
OUTLET ELEVATION = 5302'

DISCHARGE POINT #1

GP-2

GP-3

1.5% TACK ON BERM

PERIMETER
DRAINAGE
CHANNEL

6 INCH R/PRAP LINED DOWNCHUTE

DETENTION WEIR #2
OUTLET ELEVATION = 5306'

DEEPENED CHANNEL BOTTOM
WITH STEEPER 1:1 SLOPES
INSIDE 5306 CONTOUR
STORAGE CAPACITY = 6.1 ACRE-FEET

5% SLOPE

6% SLOPE

DETENTION WEIR #4
OUTLET ELEVATION = 5320'

DISCHARGE POINT #2

DEEPENED CHANNEL BOTTOM
WITH STEEPER 1:1 SLOPES
INSIDE 5320' CONTOUR
STORAGE CAPACITY = 0.56 ACRE-FEET

WASTE MANAGEMENT / CSI PROPERTY

GP-4

GP-5

GP-6

MW-5

MW-6

LANDSCAPE BERM

DETENTION WEIR #3
OUTLET ELEVATION = 5316'

DEEPENED CHANNEL BOTTOM
WITH STEEPER 2:1 SLOPES
INSIDE 5316 CONTOUR
STORAGE CAPACITY = 7.21 ACRE-FEET

40' - LANDSCAPE WITH TREES
NORTH OF PROPERTY LINE
(1 TREE EVERY 20')

QUONSET HUT
MAINTENANCE FLUID STORAGE
AND MAINTENANCE ACTIVITIES

LANDSCAPE WITH GRASS,
TREES AND BUSHES

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
- G — GAS PIPELINE
- SECTION MARKER (NOT VARIFIED)
- (Gnd. El. 5306.03) EXISTING GROUND WATER MONITORING LOCATION
- GP-2 EXISTING GAS MONITORING WELL LOCATION
- MW EXISTING GROUND WATER MONITORING 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.

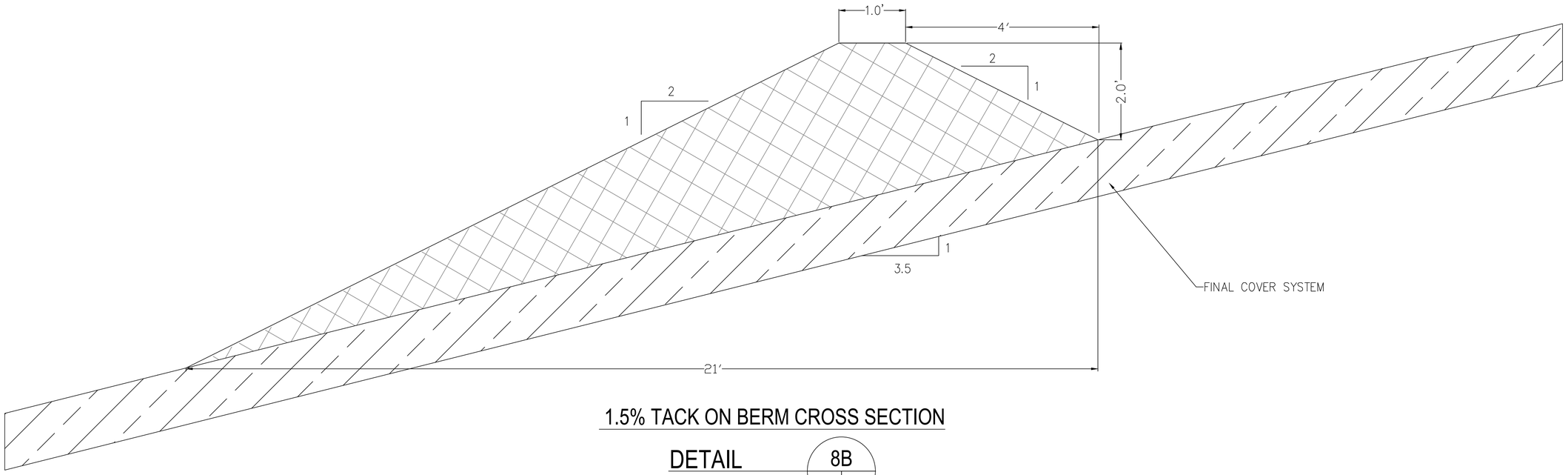
0 75 150 300
APPROXIMATE SCALE (FEET)

CONTOUR INTERVAL: 2'
DATE OF TOPOGRAPHY FLIGHT: 1-6-12

FIGURE 1
SURFACE WATER MANAGEMENT PLAN
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

CLIENT: FIVE PART DEVELOPMENT, LLC	
PROJECT: VERTICAL EXPANSTION EDOP	
PROJECT NO:	DATE COMPLETED: 8/2013
DESIGNED BY: RDS	APPROVED BY: WAC
DRAWN BY: TML/RDS	DWG NAME:
REVISION:	REVISED BY: RDS DATE: 9/2024
2 ISSUED FOR REVIEW	

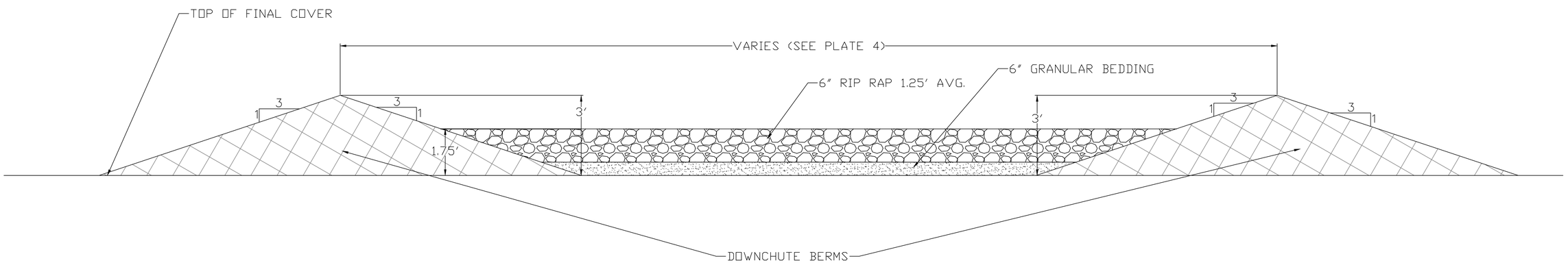
AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



1.5% TACK ON BERM CROSS SECTION

DETAIL 8B / 1

SCALE: N.T.S.



DOWNCHUT CROSS SECTION

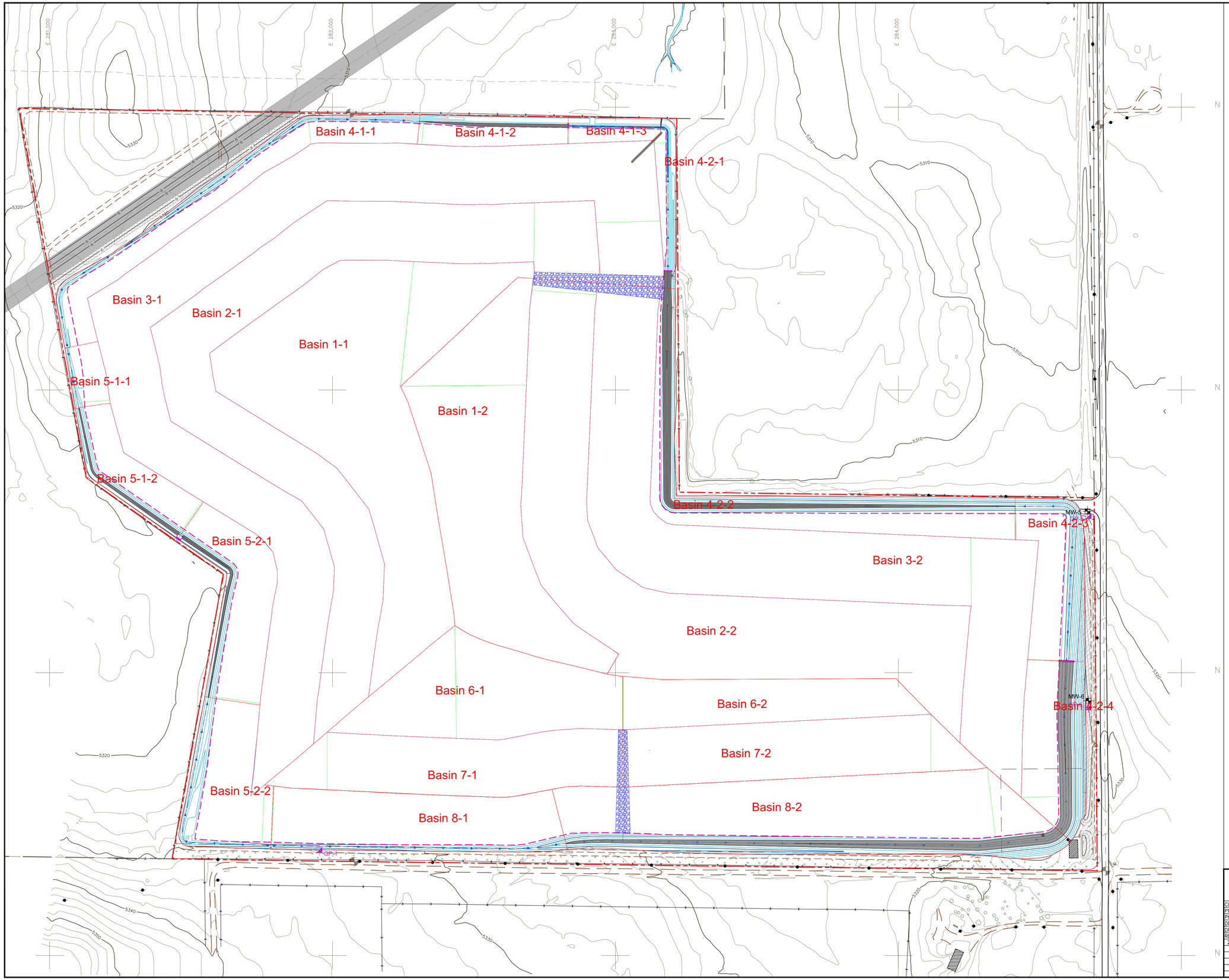
DETAIL 8B / 2

SCALE: N.T.S.

FIGURE 2
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	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.



LEGEND

- 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
- STORMWATER BASINS USED IN HYDROCAD MODEL
- BASIN HYDRUALIC LENGTHS USED IN HYDROCAD MODEL
- PROPOSED RIPRAP LINED DOWNCHUTE

N

0 75 150 300
APPROXIMATE SCALE (FEET)

CONTOUR INTERVAL: 2'
DATE OF TOPOGRAPHY FLIGHT: 1-6-12

FIGURE 3
STORMWATER BASINS
EAST REGIONAL LANDFILL
ADAMS COUNTY, COLORADO

CLIENT: FIVE PART DEVELOPMENT, LLC	
PROJECT: VERTICAL EXPANSTION EDOP	
PROJECT NO:	DATE COMPLETED: 8/2013
DESIGNED BY: RDS	APPROVED BY:
DRAWN BY: TML/RDS	DWG NAME:
REVISION:	REVISED BY: RDS DATE: 9/2024
2 ISSUED FOR REVIEW	

AEC AMERICAN ENVIRONMENTAL CONSULTING, LLC.

3.0 INSPECTIONS AND MAINTENANCE

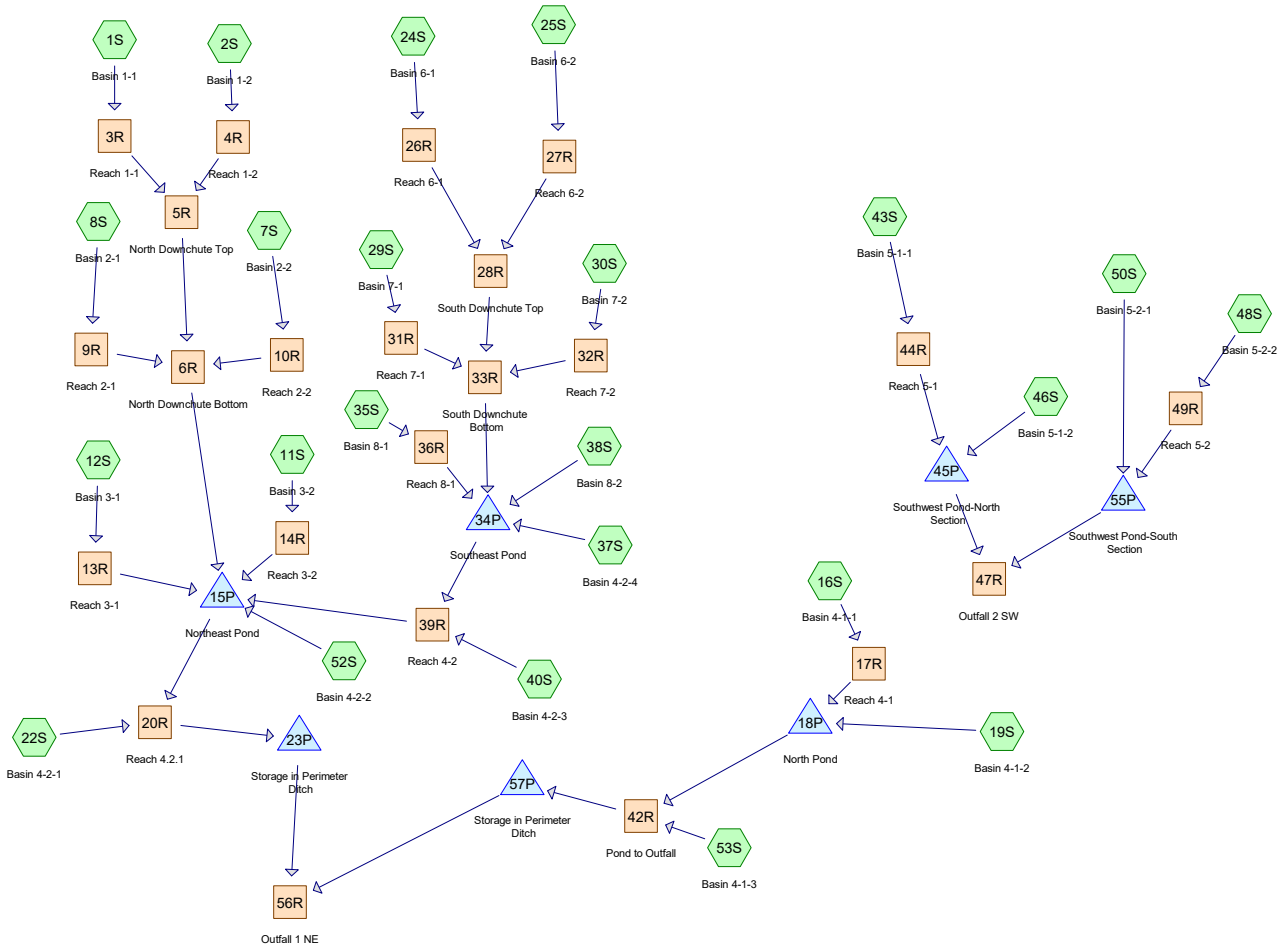
The site had a construction stormwater permit for the initial disposal cell construction at the site (# COR-03C609). Prior to beginning disposal operations, the site was required to have in effect a permit for Heavy Industrial Activity issued through the Colorado Discharge Permit System (CDPS) to allow off-site discharge of storm water throughout the operating life of the facility and following closure of the facility. This permit was obtained (Permit COR900439) and requires that the site stormwater drainage system be inspected twice per year, generally once in the spring and once in the fall. The drainage system will also be inspected following heavy precipitation events. In reality, because of the nature of the site operations, the entire site will be inspected even more frequently during the operating life of the facility. The CDPS permit also requires the facility have a Storm Water Management Plan (SWMP), which does not require approval but must be maintained on site and revised as necessary to reflect any revisions to the storm water drainage system. The SWMP includes an evaluation of the potential pollutant sources from the site, Best Management Practices (BMP's) implemented to control discharge of pollutants from the site, and reporting requirements, and was submitted to the Colorado Department of Public Health and Environment Water Quality Control Division (WQCD) and Adams County for their records. A copy is also maintained in the site Operating Record. The site operator is required by their CDPS permit to collect at least one sample of off-site stormwater discharge on an annual basis from each discharge point. The results of the site inspections and sampling are reported to the Colorado Department of Public Health and Environment by November 28th of each year, and are also reported to Adams County. In addition, the facility will be required to conduct post-closure care and monitoring activities for at least 30 years following site closure, and a portion of this obligation will include site inspections on at least an annual basis, or more frequently if required by the CDPS permit.

Once any portion of the site storm water drainage system is constructed, it will be seeded with grasses as recommended by the East Adams Soil Conservation District, the Natural Resource Conservation Service, or other landscape expert knowledgeable with the vegetation of the area. Formal inspections of the site drainage system will be conducted at least twice per year (once in the spring and once in the fall) and following any heavy precipitation events. The inspections will include noting the degree of success of the grass lined areas in limiting erosion and sediment transport, examinations for evidence of sediment transport, inspections of areas of excessive erosion, and establishment of any Best Management Practices (BMP's) to mitigate any deficiencies noted.

Basins	Area (sqft)	Area (Acres)	Hydraulic Lengths	0.2857 slope	0.05 slope	CN	Sheet Flow Length (100xslope^0.5/n)	manning's n
1.1	647502.341	14.86	443.557	138.557	305	69	172.005229	0.13
1.2	436938.343	10.03	445.044	140.044	305	69	172.005229	0.13
2.1	629522.216	14.45	208.776	208.776	0	69	411.160862	0.13
2.2	676616.737	15.53	228.7	228.7	0	69	411.160862	0.13
3.1	860688.358	19.76	226.554	231	0	69		0.13
3.2	680476.058	15.62	241.203	241.203	0	69		0.13
4.1.1	153453.20	3.52	88.4	88.4	0	69		0.13
4.1.2	55626.018	1.28	81.12	81.12	0	69		0.13
4.1.3	28157.436	0.65	62.4	62.4	0	69		0.13
4.2.1	34506.53	0.79	47.7	47.7	0	69		0.13
4.2.2	212419.552	4.88	118.107	118.107	0	69		0.13
4.2.3	111771.991	2.57	137.098	137.098	0	69		0.13
4.2.4	125998.325	2.89	158.265	158.265	0	69		0.13
5.1.1	27337.116	0.63	113	113	0	69		
5.1.2	82128.662	1.89	142.6	142.6	0	69		
5.2.1	134691.199	3.09	183.4	183.4	0	69		
5.2.2	131775.448	3.03	213.745	213.745	0	69		
6.1	255051.367	5.86	398.968	165.756	233.212	69	61.212	0.13
6.2	158314.715	3.63	188.327	188.327	0	69		0.13
7.1	235935.409	5.42	203.315	203.315	0	69		0.13
7.2	241245.44	5.54	203.042	203.042	0	69		0.13
8.1	258734.446	5.94	210.648	210.648	0	69		0.13
8.2	398238.955	9.14	272.294	272.294	0	69		0.13

Reaches	slopes	Reach Length	inlet invert	outlet invert	calculated slope	Manning's n	Notes
1.1	0.015	2790.21	5479.25	5437.5	0.0150	0.03	
1.2	0.015	1471.4	5460.5	5438.5	0.0150	0.03	
2.1	0.015	3772	5431.75	5371.25	0.0160	0.03	
2.2	0.015	2776	5415.25	5373.5	0.0150	0.03	
3.1	0.015	4718.4	5377.75	5306	0.0152	0.03	
3.2	0.015	3049	5355	5309.25	0.0150	0.03	
4.1		1661.818	5326	5302	0.0144	0.03	
4.2		737.014	5308.25	5306	0.0031	0.03	
4.2.1		525	5306	5298	0.0152	0.035	Increased n to account for existing wiers
5.1		212.735	5328	5320	0.0376	0.03	
5.2		817.555	5330	5320	0.0122	0.03	
6.1	0.015	1031.617	5443.5	5428	0.0150	0.03	
6.2	0.015	1072.699	5444	5428	0.0149	0.03	
7.1	0.015	1253.977	5389	5370	0.0152	0.03	
7.2	0.015	1272.141	5389	5370	0.0149	0.03	
8.1		1036.9	5330	5316	0.0135	0.03	
North Downcomer Top	0.2857	227.5	5438.5	5373.5	0.2857	0.069	
North Downcomer Bottom	0.2857	233	5373.5	5306	0.2897	0.069	
South Downcomer Top	0.2857	203	5428	5370	0.2857	0.069	
South Downcomer Bottom	0.2857	191.909	5370	5316	0.2814	0.069	

Ponds	Length	Required Storage (Acre-Feet)	
North	525.801	0.32	
Northeast	2047.763	6.1	
Southwest-North Section	613.437	0.15	
Southwest-South Section	671.811	0.43	
Southeast	2362.113	2.4	



Routing Diagram for ERL Stormwater Design Calculations

Prepared by American Environmental Consultng, Printed 9/5/2024

HydroCAD® 10.20-5b s/n 04925 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-Year	Type II 24-hr		Default	24.00	1	3.56	2
2	100-Year	Type II 24-hr		Default	24.00	1	4.73	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
111.660	69	(7S, 11S, 12S, 16S, 19S, 22S, 24S, 25S, 29S, 30S, 35S, 37S, 38S, 40S, 43S, 46S, 48S, 50S, 52S, 53S)
39.340	69	Pasture/grassland/range, Fair, HSG B (1S, 2S, 8S)
151.000	**69**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
39.340	HSG B	1S, 2S, 8S
0.000	HSG C	
0.000	HSG D	
111.660	Other	7S, 11S, 12S, 16S, 19S, 22S, 24S, 25S, 29S, 30S, 35S, 37S, 38S, 40S, 43S, 46S, 48S, 50S, 52S, 53S
151.000		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	111.660	111.660		7S, 11S, 12S, 16S, 19S, 22S, 24S, 25S, 29S, 30S, 35S, 37S, 38S, 40S, 43S, 46S, 48S, 50S, 52S, 53S
0.000	39.340	0.000	0.000	0.000	39.340	Pasture/grassland/range, Fair	1S, 2S, 8S
0.000	**39.340**	**0.000**	**0.000**	**111.660**	**151.000**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Basin 1-1 Runoff Area=14.860 ac 0.00% Impervious Runoff Depth>0.88"
Flow Length=444' Tc=14.2 min CN=69 Runoff=18.35 cfs 1.093 af

Subcatchment 2S: Basin 1-2 Runoff Area=10.030 ac 0.00% Impervious Runoff Depth>0.88"
Flow Length=445' Tc=14.2 min CN=69 Runoff=12.39 cfs 0.737 af

Subcatchment 7S: Basin 2-2 Runoff Area=15.530 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=229' Slope=0.2857 '/' Tc=7.6 min CN=69 Runoff=25.09 cfs 1.146 af

Subcatchment 8S: Basin 2-1 Runoff Area=14.450 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=209' Slope=0.2857 '/' Tc=7.1 min CN=69 Runoff=23.84 cfs 1.066 af

Subcatchment 11S: Basin 3-2 Runoff Area=15.620 ac 0.00% Impervious Runoff Depth>0.88"
Flow Length=241' Slope=0.2857 '/' Tc=8.0 min CN=69 Runoff=24.81 cfs 1.152 af

Subcatchment 12S: Basin 3-1 Runoff Area=19.760 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=227' Slope=0.2857 '/' Tc=7.6 min CN=69 Runoff=31.93 cfs 1.458 af

Subcatchment 16S: Basin 4-1-1 Runoff Area=3.520 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=88' Slope=0.2857 '/' Tc=3.6 min CN=69 Runoff=6.73 cfs 0.260 af

Subcatchment 19S: Basin 4-1-2 Runoff Area=1.280 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=81' Slope=0.2857 '/' Tc=3.3 min CN=69 Runoff=2.48 cfs 0.095 af

Subcatchment 22S: Basin 4-2-1 Runoff Area=0.790 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=48' Slope=0.2857 '/' Tc=2.2 min CN=69 Runoff=1.60 cfs 0.058 af

Subcatchment 24S: Basin 6-1 Runoff Area=5.860 ac 0.00% Impervious Runoff Depth>0.88"
Flow Length=399' Tc=13.5 min CN=69 Runoff=7.43 cfs 0.431 af

Subcatchment 25S: Basin 6-2 Runoff Area=3.630 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=188' Slope=0.2857 '/' Tc=6.5 min CN=69 Runoff=6.14 cfs 0.268 af

Subcatchment 29S: Basin 7-1 Runoff Area=5.420 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=203' Slope=0.2857 '/' Tc=6.9 min CN=69 Runoff=9.01 cfs 0.400 af

Subcatchment 30S: Basin 7-2 Runoff Area=5.540 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=203' Slope=0.2857 '/' Tc=6.9 min CN=69 Runoff=9.21 cfs 0.409 af

Subcatchment 35S: Basin 8-1 Runoff Area=5.940 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=211' Slope=0.2857 '/' Tc=7.2 min CN=69 Runoff=9.75 cfs 0.438 af

Subcatchment 37S: Basin 4-2-4 Runoff Area=2.890 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=158' Slope=0.2857 '/' Tc=5.7 min CN=69 Runoff=5.06 cfs 0.213 af

Subcatchment 38S: Basin 8-2 Runoff Area=9.140 ac 0.00% Impervious Runoff Depth>0.88"
Flow Length=272' Slope=0.2857 '/' Tc=8.8 min CN=69 Runoff=14.03 cfs 0.674 af

Subcatchment 40S: Basin 4-2-3 Runoff Area=2.570 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=137' Slope=0.2857 '/' Tc=5.1 min CN=69 Runoff=4.61 cfs 0.190 af

Subcatchment 43S: Basin 5-1-1 Runoff Area=0.630 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=113' Slope=0.2857 '/' Tc=4.3 min CN=69 Runoff=1.17 cfs 0.047 af

Subcatchment 46S: Basin 5-1-2 Runoff Area=1.890 ac 0.00% Impervious Runoff Depth>0.88"
Flow Length=143' Slope=0.0286 '/' Tc=13.2 min CN=69 Runoff=2.43 cfs 0.139 af

Subcatchment 48S: Basin 5-2-2 Runoff Area=3.030 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=214' Slope=0.2857 '/' Tc=7.2 min CN=69 Runoff=4.98 cfs 0.224 af

Subcatchment 50S: Basin 5-2-1 Runoff Area=3.090 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=183' Slope=0.2857 '/' Tc=6.4 min CN=69 Runoff=5.25 cfs 0.228 af

Subcatchment 52S: Basin 4-2-2 Runoff Area=4.880 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=118' Slope=0.2857 '/' Tc=4.5 min CN=69 Runoff=8.98 cfs 0.361 af

Subcatchment 53S: Basin 4-1-3 Runoff Area=0.650 ac 0.00% Impervious Runoff Depth>0.89"
Flow Length=62' Slope=0.2857 '/' Tc=2.7 min CN=69 Runoff=1.29 cfs 0.048 af

Reach 3R: Reach 1-1 Avg. Flow Depth=1.06' Max Vel=3.83 fps Inflow=18.35 cfs 1.093 af
n=0.030 L=2,790.0' S=0.0150 '/' Capacity=65.35 cfs Outflow=12.13 cfs 1.068 af

Reach 4R: Reach 1-2 Avg. Flow Depth=0.99' Max Vel=3.66 fps Inflow=12.39 cfs 0.737 af
n=0.030 L=1,471.0' S=0.0150 '/' Capacity=65.33 cfs Outflow=10.13 cfs 0.728 af

Reach 5R: North Downchute Top Avg. Flow Depth=0.19' Max Vel=3.74 fps Inflow=20.22 cfs 1.796 af
n=0.069 L=227.5' S=0.2857 '/' Capacity=2,266.93 cfs Outflow=20.18 cfs 1.791 af

Reach 6R: North Downchute Bottom Avg. Flow Depth=0.18' Max Vel=3.74 fps Inflow=44.57 cfs 3.946 af
n=0.069 L=233.0' S=0.2897 '/' Capacity=4,848.31 cfs Outflow=44.46 cfs 3.935 af

Reach 9R: Reach 2-1 Avg. Flow Depth=1.03' Max Vel=3.83 fps Inflow=23.84 cfs 1.066 af
n=0.030 L=3,772.0' S=0.0154 '/' Capacity=66.39 cfs Outflow=11.61 cfs 1.034 af

Reach 10R: Reach 2-2 Avg. Flow Depth=1.15' Max Vel=4.05 fps Inflow=25.09 cfs 1.146 af
n=0.030 L=2,776.0' S=0.0150 '/' Capacity=65.52 cfs Outflow=15.09 cfs 1.121 af

Reach 13R: Reach 3-1 Avg. Flow Depth=1.11' Max Vel=4.00 fps Inflow=31.93 cfs 1.458 af
n=0.030 L=4,718.0' S=0.0152 '/' Capacity=65.88 cfs Outflow=14.06 cfs 1.405 af

Reach 14R: Reach 3-2 Avg. Flow Depth=1.12' Max Vel=3.99 fps Inflow=24.81 cfs 1.152 af
n=0.030 L=3,049.0' S=0.0150 '/' Capacity=65.44 cfs Outflow=14.21 cfs 1.125 af

Reach 17R: Reach 4-1 Avg. Flow Depth=0.67' Max Vel=2.83 fps Inflow=6.73 cfs 0.260 af
n=0.030 L=1,662.0' S=0.0144 '/' Capacity=206.38 cfs Outflow=4.04 cfs 0.255 af

Reach 20R: Reach 4.2.1 Avg. Flow Depth=0.47' Max Vel=1.71 fps Inflow=1.60 cfs 0.058 af
n=0.035 L=525.0' S=0.0114 '/' Capacity=157.37 cfs Outflow=1.21 cfs 0.058 af

Reach 26R: Reach 6-1 Avg. Flow Depth=0.83' Max Vel=3.27 fps Inflow=7.43 cfs 0.431 af
n=0.030 L=1,031.5' S=0.0150 '/' Capacity=65.49 cfs Outflow=6.40 cfs 0.427 af

Reach 27R: Reach 6-2 Avg. Flow Depth=0.74' Max Vel=3.03 fps Inflow=6.14 cfs 0.268 af
n=0.030 L=1,073.0' S=0.0149 '/' Capacity=65.24 cfs Outflow=4.76 cfs 0.265 af

Reach 28R: South Downchute Top Avg. Flow Depth=0.19' Max Vel=3.73 fps Inflow=10.43 cfs 0.692 af
n=0.069 L=203.0' S=0.2857 '/' Capacity=1,299.49 cfs Outflow=10.39 cfs 0.690 af

Reach 31R: Reach 7-1 Avg. Flow Depth=0.85' Max Vel=3.34 fps Inflow=9.01 cfs 0.400 af
n=0.030 L=1,254.0' S=0.0152 '/' Capacity=65.76 cfs Outflow=6.89 cfs 0.395 af

Reach 32R: Reach 7-2 Avg. Flow Depth=0.86' Max Vel=3.34 fps Inflow=9.21 cfs 0.409 af
n=0.030 L=1,272.0' S=0.0149 '/' Capacity=65.29 cfs Outflow=7.01 cfs 0.404 af

Reach 33R: South Downchute Bottom Avg. Flow Depth=0.19' Max Vel=3.76 fps Inflow=23.64 cfs 1.489 af
n=0.069 L=192.0' S=0.2813 '/' Capacity=2,527.32 cfs Outflow=23.53 cfs 1.486 af

Reach 36R: Reach 8-1 Avg. Flow Depth=0.88' Max Vel=3.26 fps Inflow=9.75 cfs 0.438 af
n=0.030 L=1,037.0' S=0.0135 '/' Capacity=199.55 cfs Outflow=7.88 cfs 0.434 af

Reach 39R: Reach 4-2 Avg. Flow Depth=0.67' Max Vel=2.72 fps Inflow=4.61 cfs 0.190 af
n=0.030 L=737.0' S=0.0136 '/' Capacity=200.05 cfs Outflow=3.80 cfs 0.188 af

Reach 42R: Pond to Outfall Avg. Flow Depth=0.70' Max Vel=0.42 fps Inflow=1.29 cfs 0.048 af
n=0.030 L=326.0' S=0.0003 '/' Capacity=30.08 cfs Outflow=0.66 cfs 0.047 af

Reach 44R: Reach 5-1 Avg. Flow Depth=0.34' Max Vel=2.95 fps Inflow=1.17 cfs 0.047 af
n=0.030 L=213.0' S=0.0376 '/' Capacity=332.84 cfs Outflow=1.14 cfs 0.046 af

Reach 47R: Outfall 2 SW Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.030 L=10.0' S=0.0500 '/' Capacity=177.35 cfs Outflow=0.00 cfs 0.000 af

Reach 49R: Reach 5-2 Avg. Flow Depth=0.70' Max Vel=2.66 fps Inflow=4.98 cfs 0.224 af
n=0.030 L=817.5' S=0.0122 '/' Capacity=189.95 cfs Outflow=4.05 cfs 0.221 af

Reach 56R: Outfall 1 NE Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.030 L=50.0' S=0.0200 '/' Capacity=222.42 cfs Outflow=0.00 cfs 0.000 af

Pond 15P: Northeast Pond Peak Elev=5,305.91' Storage=6.153 af Inflow=71.48 cfs 7.014 af
Discarded=1.54 cfs 0.860 af Primary=0.00 cfs 0.000 af Outflow=1.54 cfs 0.860 af

Pond 18P: North Pond Peak Elev=5,301.72' Storage=0.277 af Inflow=4.40 cfs 0.350 af
Discarded=0.12 cfs 0.073 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.073 af

Pond 23P: Storage in Perimeter Ditch Peak Elev=5,301.60' Storage=0.058 af Inflow=1.21 cfs 0.058 af
Outflow=0.00 cfs 0.000 af

Pond 34P: Southeast Pond Peak Elev=5,310.91' Storage=2.491 af Inflow=35.73 cfs 2.807 af
Discarded=0.54 cfs 0.315 af Primary=0.00 cfs 0.000 af Outflow=0.54 cfs 0.315 af

Pond 45P: Southwest Pond-North Section Peak Elev=5,319.87' Storage=0.138 af Inflow=3.28 cfs 0.185 af
Discarded=0.08 cfs 0.048 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.048 af

Pond 55P: Southwest Pond-South Section Peak Elev=5,319.61' Storage=0.367 af Inflow=6.71 cfs 0.449 af
Discarded=0.13 cfs 0.082 af Primary=0.00 cfs 0.000 af Outflow=0.13 cfs 0.082 af

Pond 57P: Storage in Perimeter Ditch Peak Elev=5,301.67' Storage=0.047 af Inflow=0.66 cfs 0.047 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 151.000 ac Runoff Volume = 11.133 af Average Runoff Depth = 0.88"
100.00% Pervious = 151.000 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Basin 1-1

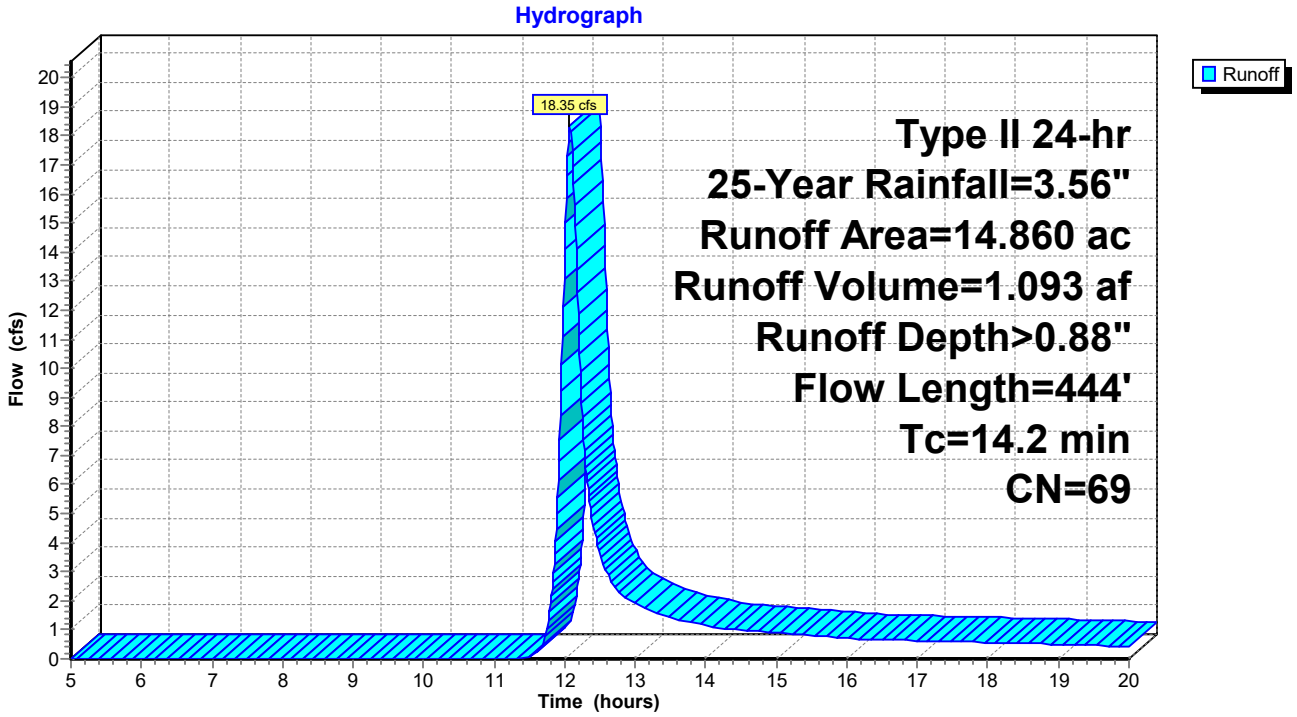
Runoff = 18.35 cfs @ 12.07 hrs, Volume= 1.093 af, Depth> 0.88"
Routed to Reach 3R : Reach 1-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

Area (ac)	CN	Description
14.860	69	Pasture/grassland/range, Fair, HSG B
14.860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	172	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 1.88"
1.4	133	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	139	0.2857	3.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.2	444	Total			

Subcatchment 1S: Basin 1-1



Summary for Subcatchment 2S: Basin 1-2

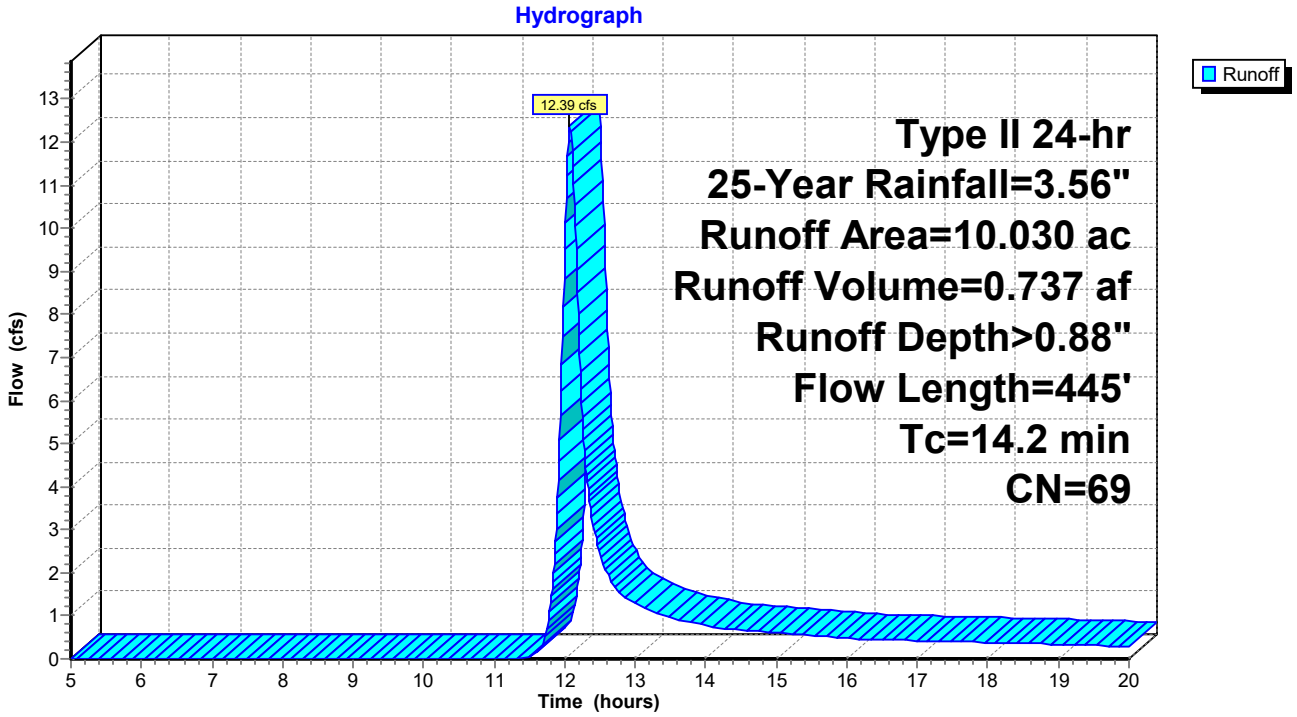
Runoff = 12.39 cfs @ 12.07 hrs, Volume= 0.737 af, Depth> 0.88"
Routed to Reach 4R : Reach 1-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

Area (ac)	CN	Description
10.030	69	Pasture/grassland/range, Fair, HSG B
10.030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	172	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 1.88"
1.4	133	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	140	0.2857	3.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.2	445	Total			

Subcatchment 2S: Basin 1-2



Summary for Subcatchment 7S: Basin 2-2

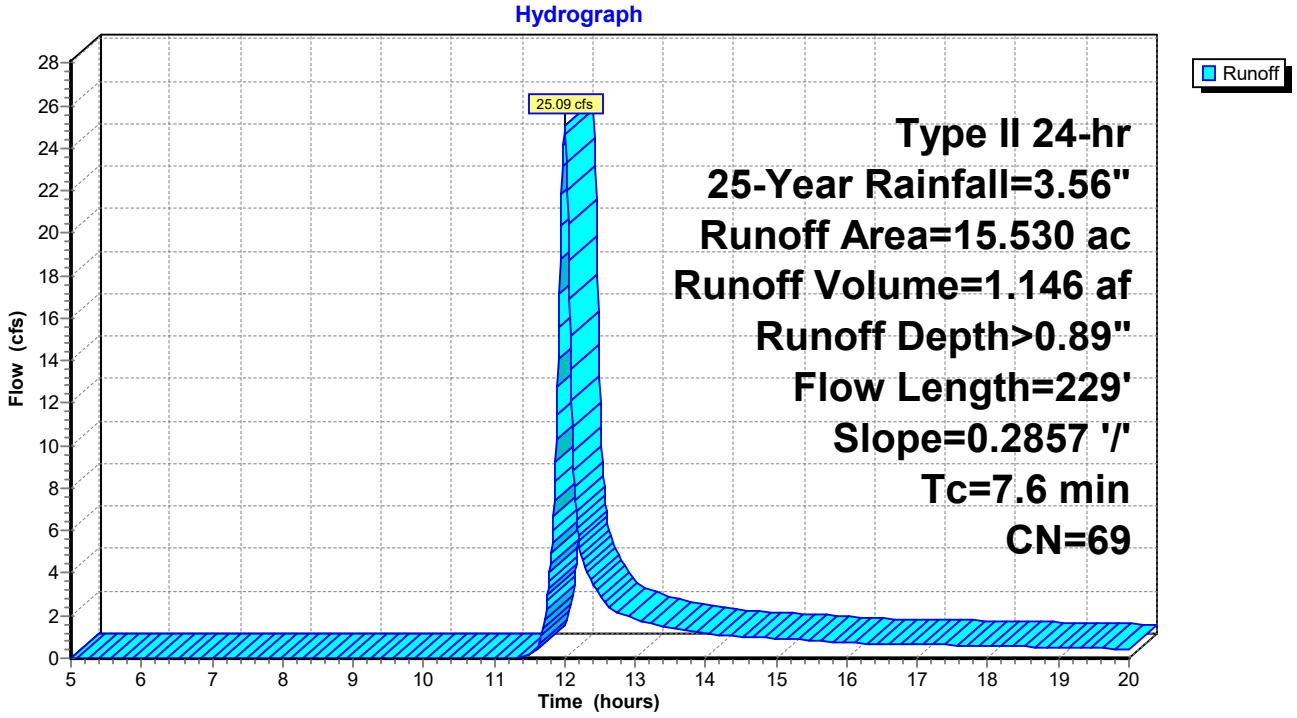
Runoff = 25.09 cfs @ 12.00 hrs, Volume= 1.146 af, Depth> 0.89"
Routed to Reach 10R : Reach 2-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	15.530	69	
	15.530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	229	0.2857	0.50		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 7S: Basin 2-2



Summary for Subcatchment 8S: Basin 2-1

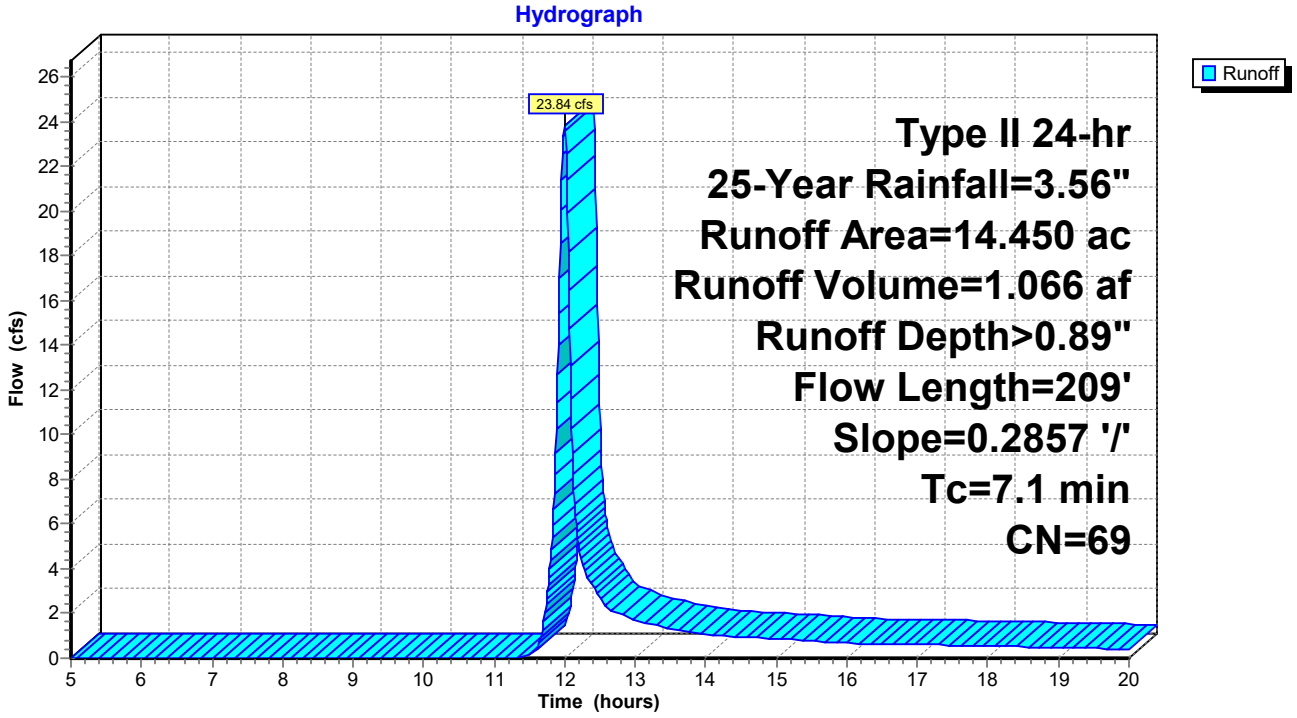
Runoff = 23.84 cfs @ 12.00 hrs, Volume= 1.066 af, Depth> 0.89"
Routed to Reach 9R : Reach 2-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

Area (ac)	CN	Description
14.450	69	Pasture/grassland/range, Fair, HSG B
14.450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	209	0.2857	0.49		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 8S: Basin 2-1



Summary for Subcatchment 11S: Basin 3-2

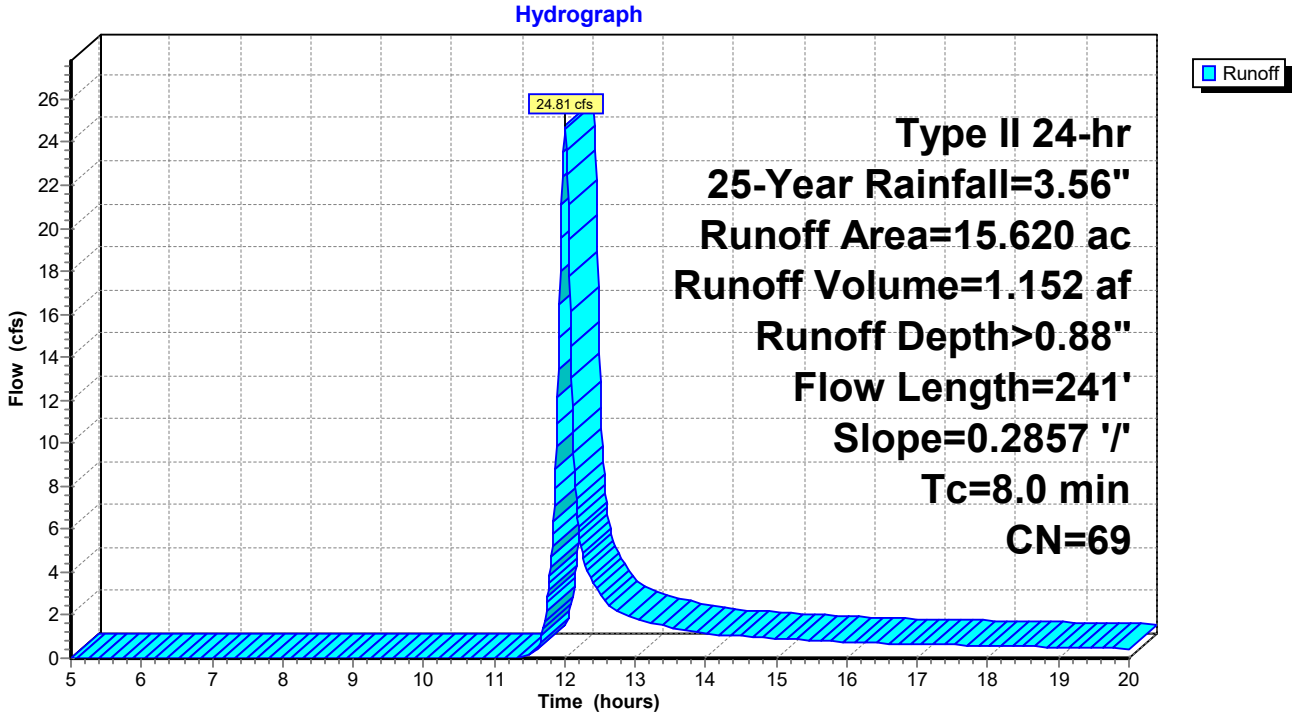
Runoff = 24.81 cfs @ 12.01 hrs, Volume= 1.152 af, Depth> 0.88"
Routed to Reach 14R : Reach 3-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	15.620	69	
	15.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	241	0.2857	0.50		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 11S: Basin 3-2



Summary for Subcatchment 12S: Basin 3-1

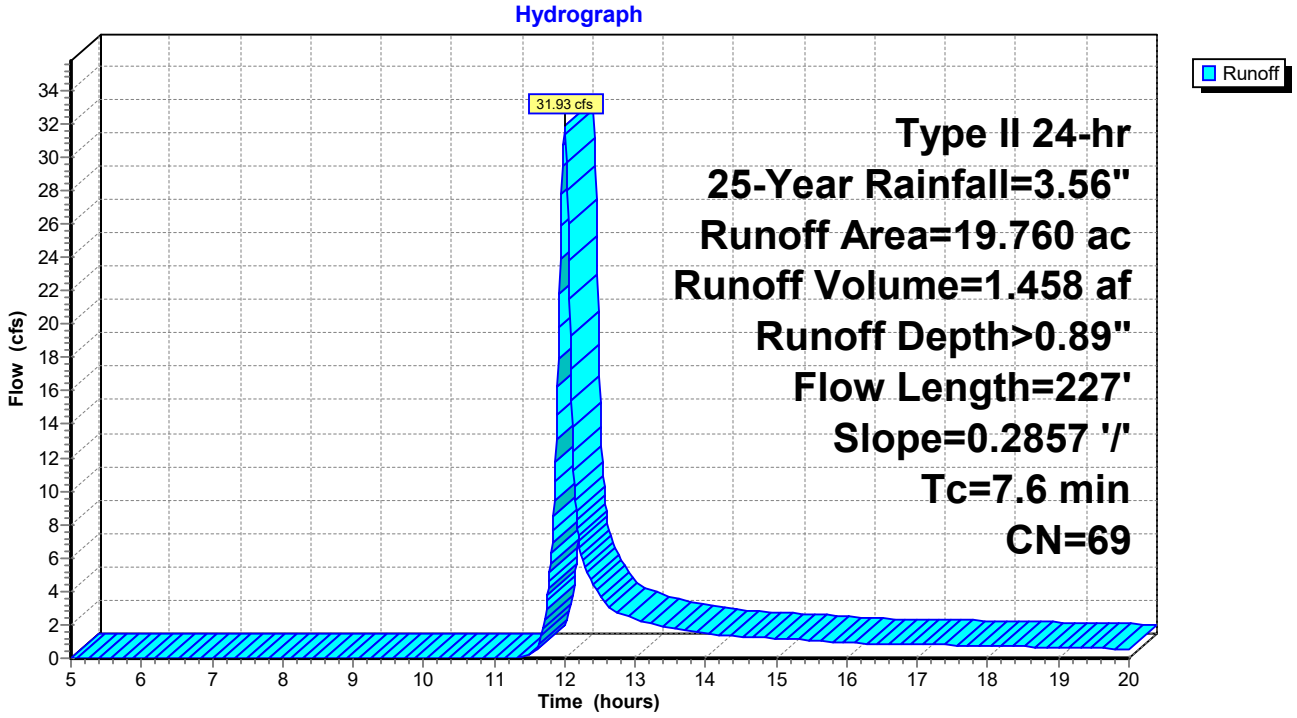
Runoff = 31.93 cfs @ 12.00 hrs, Volume= 1.458 af, Depth> 0.89"
Routed to Reach 13R : Reach 3-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	19.760	69	
	19.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	227	0.2857	0.50		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 12S: Basin 3-1



Summary for Subcatchment 16S: Basin 4-1-1

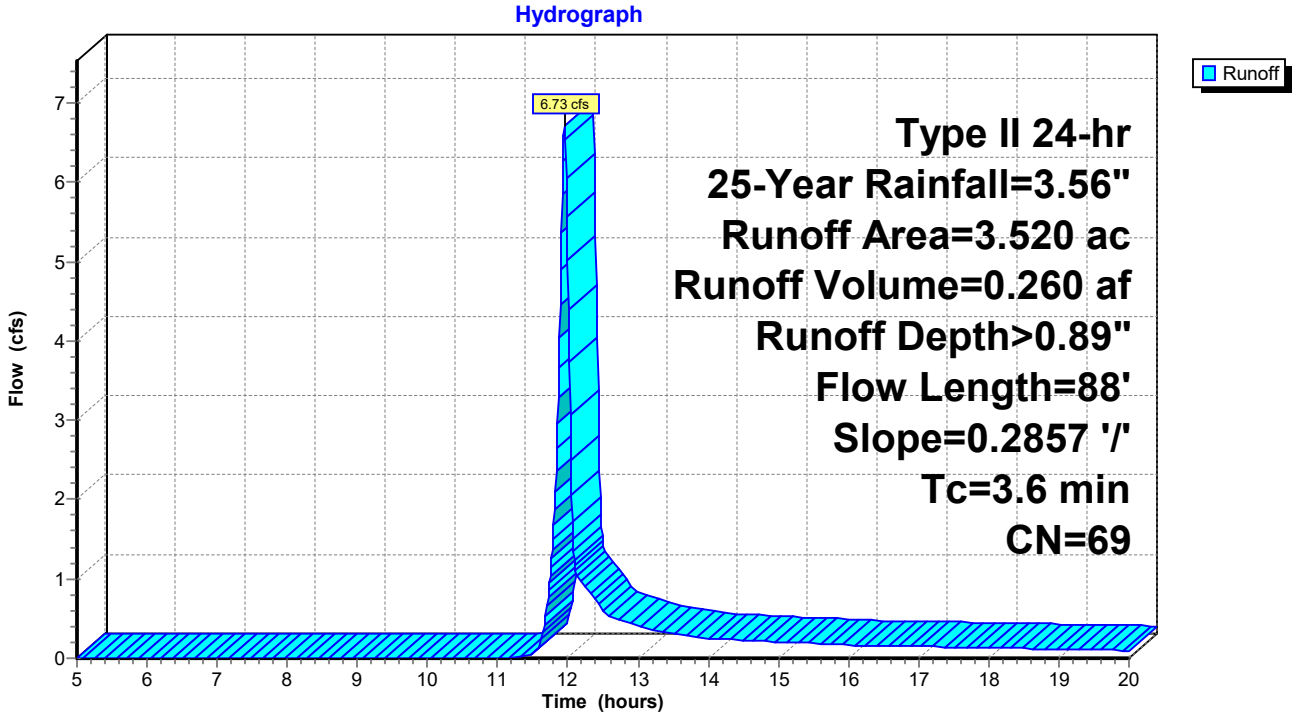
Runoff = 6.73 cfs @ 11.95 hrs, Volume= 0.260 af, Depth> 0.89"
Routed to Reach 17R : Reach 4-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	3.520	69	
	3.520		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	88	0.2857	0.41		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 16S: Basin 4-1-1



Summary for Subcatchment 19S: Basin 4-1-2

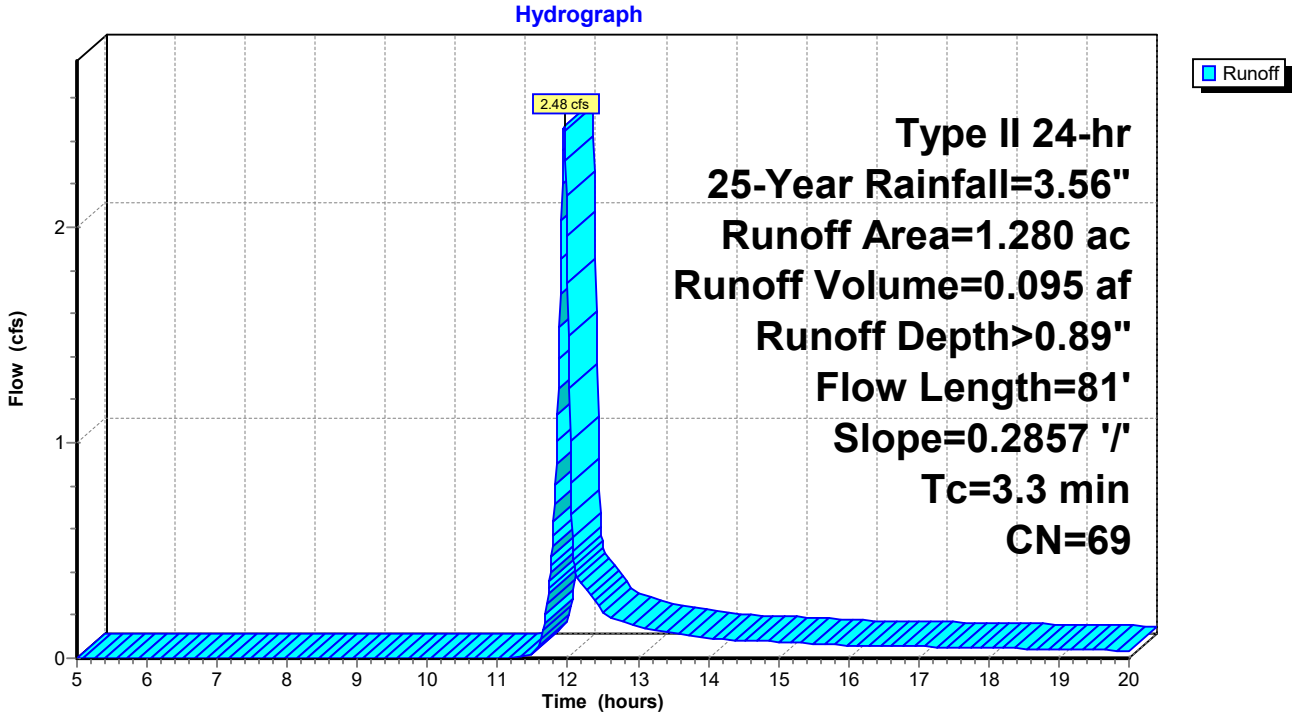
Runoff = 2.48 cfs @ 11.95 hrs, Volume= 0.095 af, Depth> 0.89"
Routed to Pond 18P : North Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	1.280	69	
	1.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	81	0.2857	0.41		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 19S: Basin 4-1-2



Summary for Subcatchment 22S: Basin 4-2-1

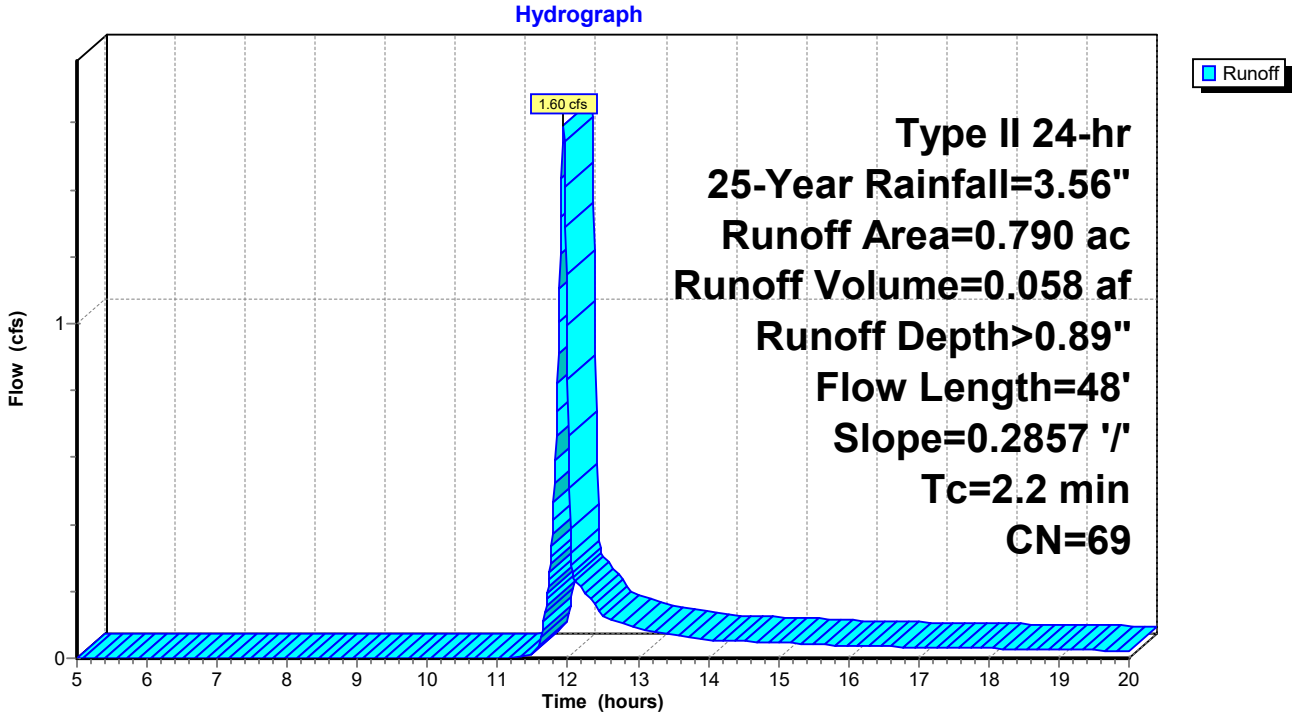
Runoff = 1.60 cfs @ 11.93 hrs, Volume= 0.058 af, Depth> 0.89"
Routed to Reach 20R : Reach 4.2.1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	0.790	69	
	0.790		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	48	0.2857	0.37		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 22S: Basin 4-2-1



Summary for Subcatchment 24S: Basin 6-1

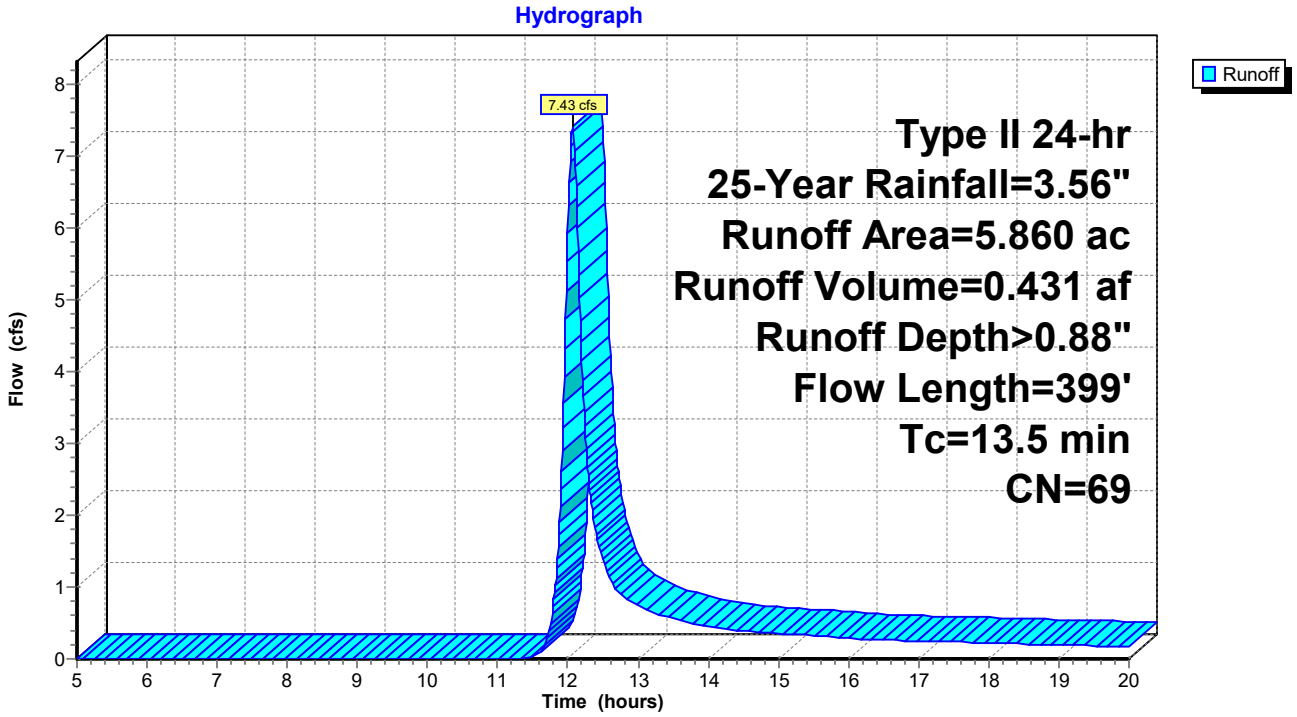
Runoff = 7.43 cfs @ 12.07 hrs, Volume= 0.431 af, Depth> 0.88"
Routed to Reach 26R : Reach 6-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	5.860	69	
	5.860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	172	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 1.88"
0.6	61	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	166	0.2857	3.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.5	399	Total			

Subcatchment 24S: Basin 6-1



Summary for Subcatchment 25S: Basin 6-2

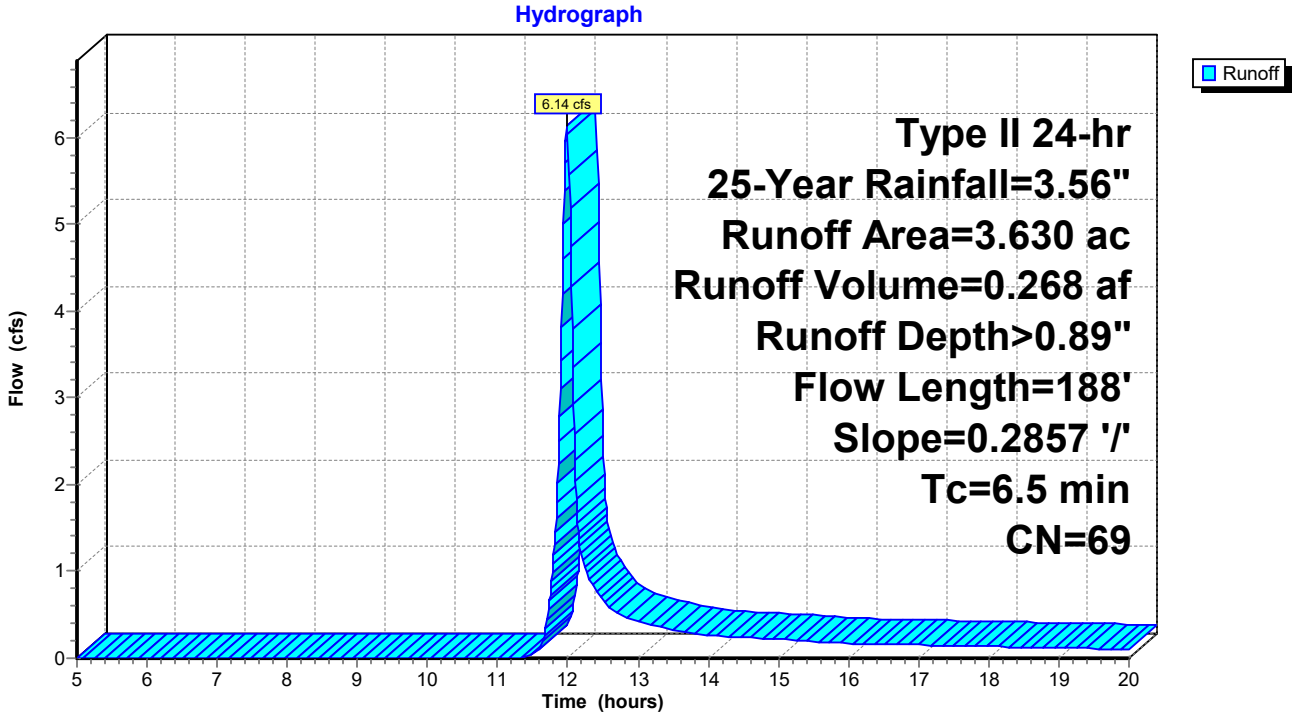
Runoff = 6.14 cfs @ 11.99 hrs, Volume= 0.268 af, Depth> 0.89"
Routed to Reach 27R : Reach 6-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	3.630	69	
	3.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	188	0.2857	0.48		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 25S: Basin 6-2



Summary for Subcatchment 29S: Basin 7-1

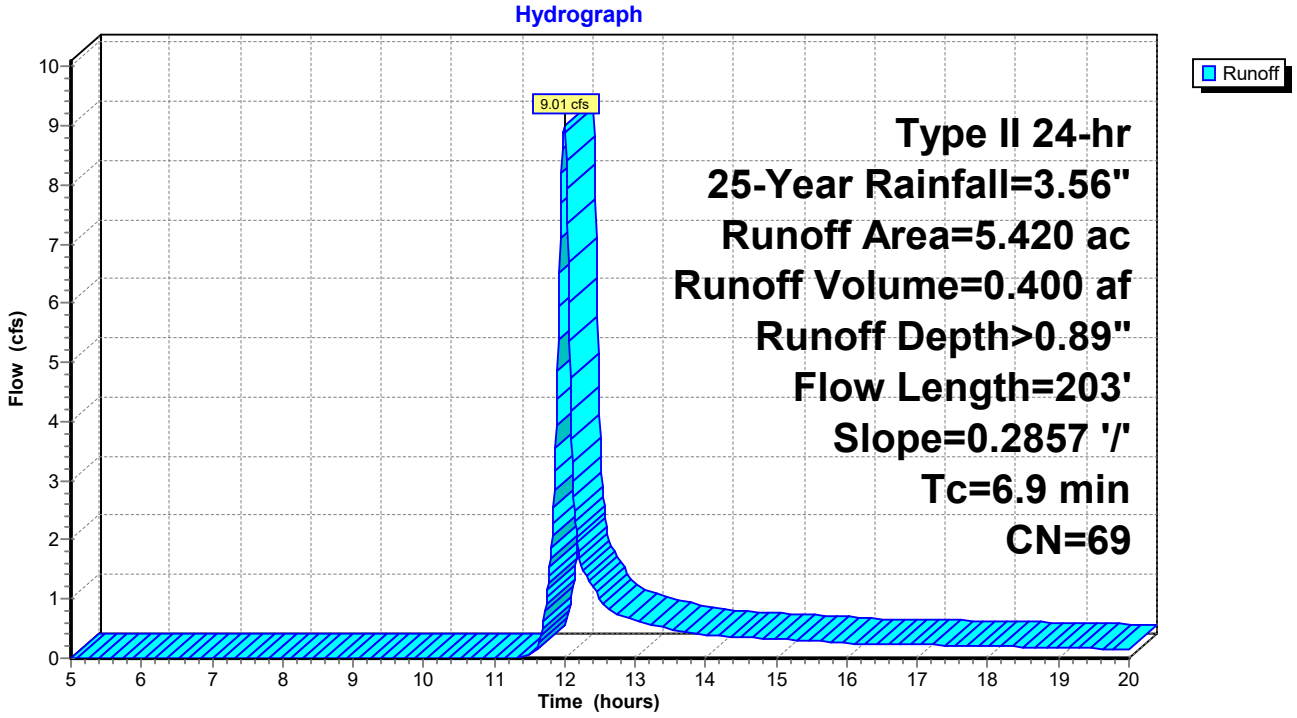
Runoff = 9.01 cfs @ 11.99 hrs, Volume= 0.400 af, Depth> 0.89"
Routed to Reach 31R : Reach 7-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	5.420	69	
	5.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	203	0.2857	0.49		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 29S: Basin 7-1



Summary for Subcatchment 30S: Basin 7-2

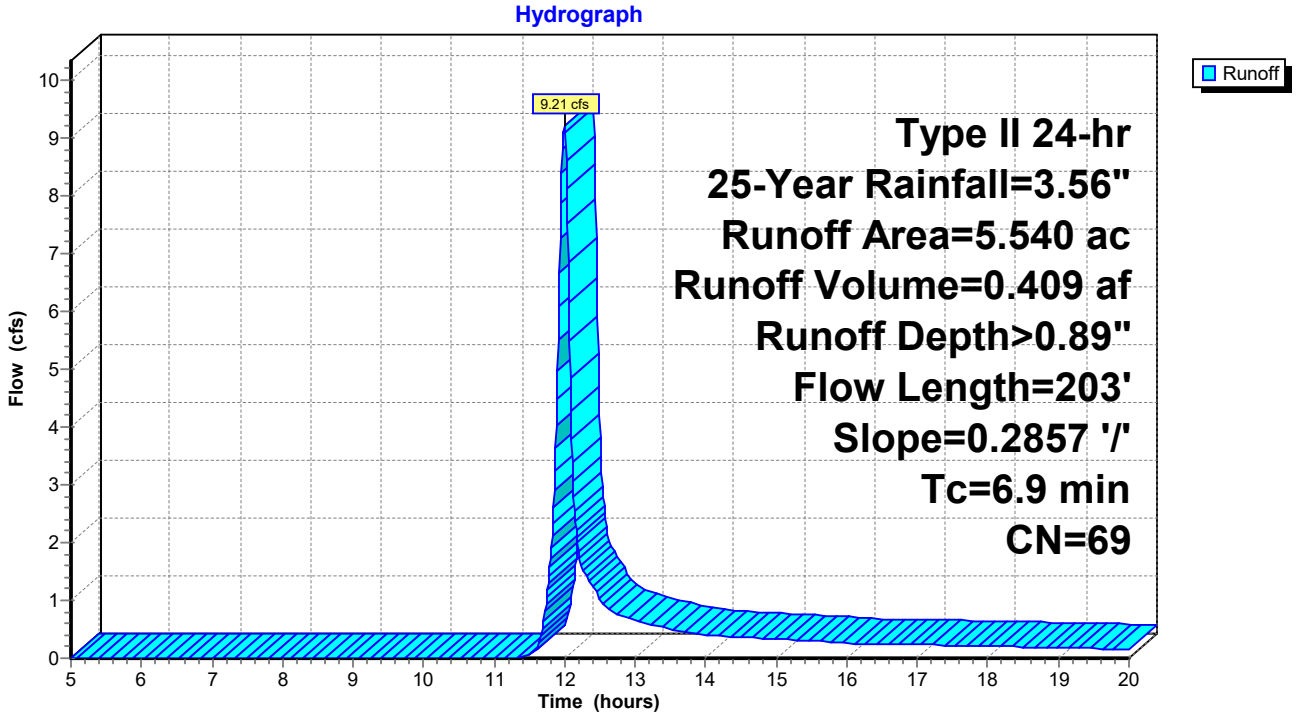
Runoff = 9.21 cfs @ 11.99 hrs, Volume= 0.409 af, Depth> 0.89"
Routed to Reach 32R : Reach 7-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	5.540	69	
	5.540		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	203	0.2857	0.49		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 30S: Basin 7-2



Summary for Subcatchment 35S: Basin 8-1

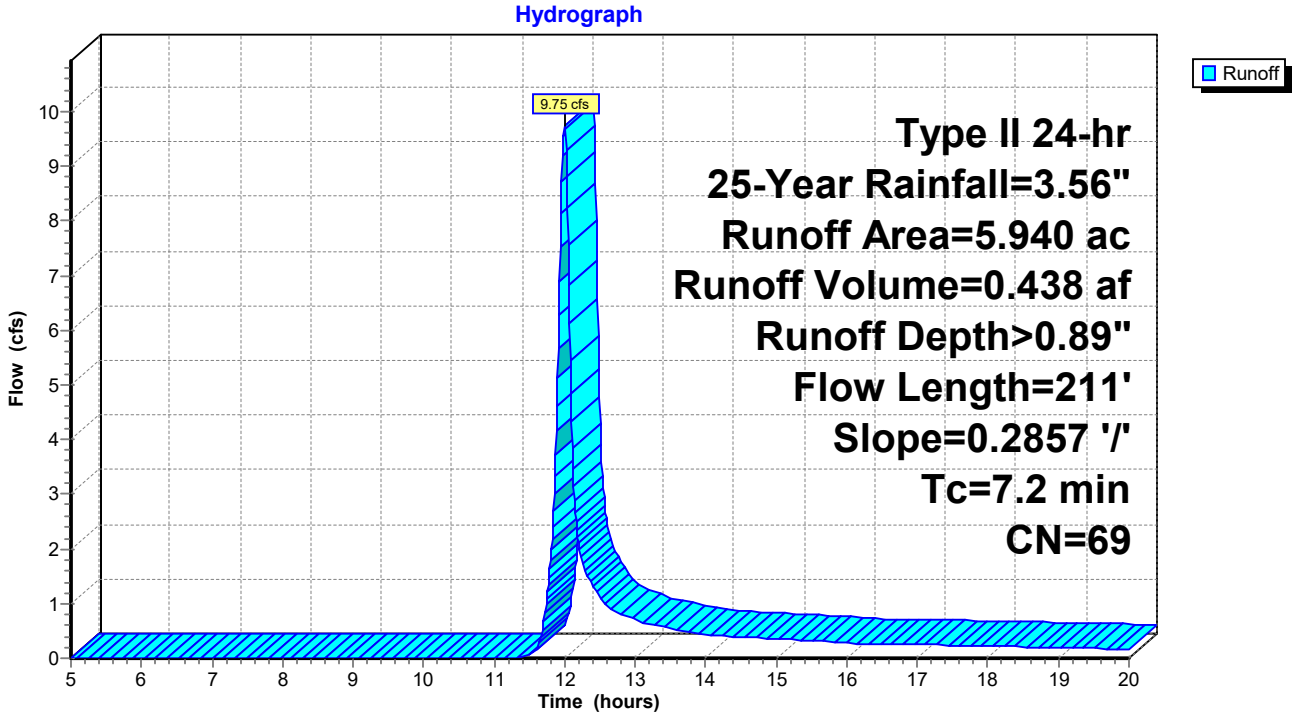
Runoff = 9.75 cfs @ 12.00 hrs, Volume= 0.438 af, Depth> 0.89"
Routed to Reach 36R : Reach 8-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	5.940	69	
	5.940		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	211	0.2857	0.49		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 35S: Basin 8-1



Summary for Subcatchment 37S: Basin 4-2-4

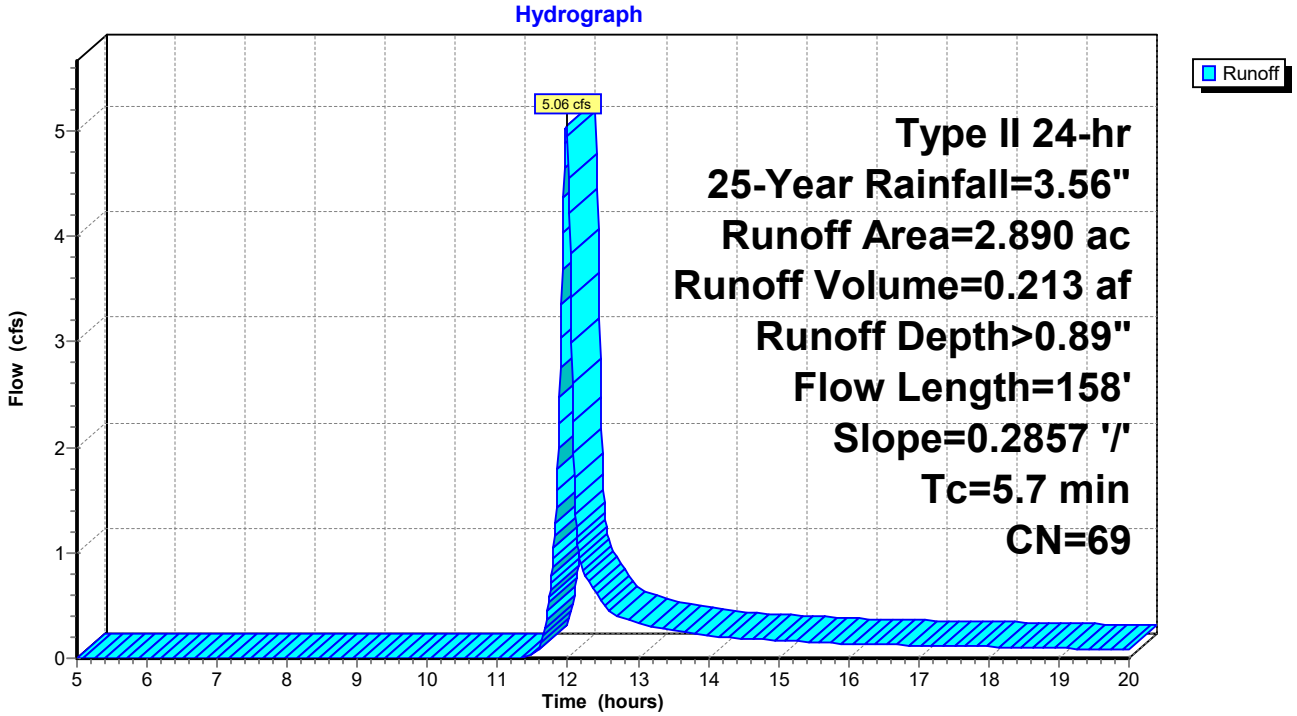
Runoff = 5.06 cfs @ 11.98 hrs, Volume= 0.213 af, Depth> 0.89"
Routed to Pond 34P : Southeast Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	2.890	69	
	2.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	158	0.2857	0.46		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 37S: Basin 4-2-4



Summary for Subcatchment 38S: Basin 8-2

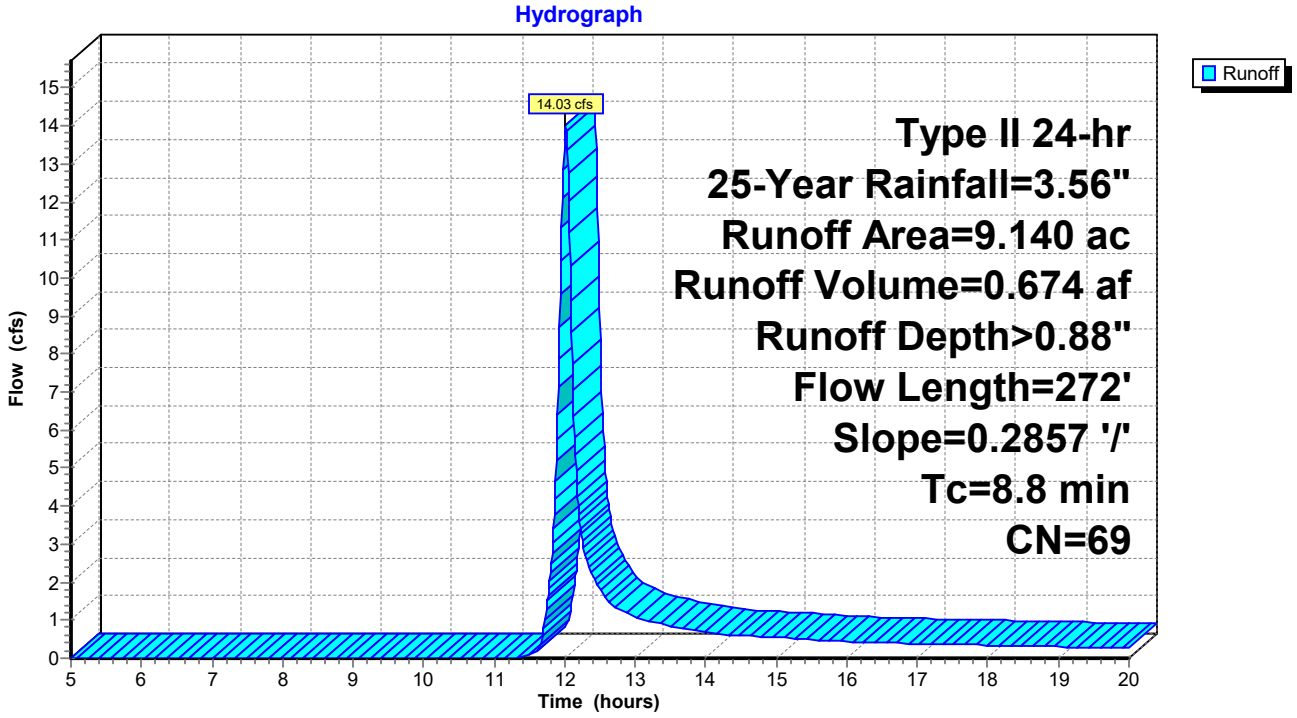
Runoff = 14.03 cfs @ 12.01 hrs, Volume= 0.674 af, Depth> 0.88"
Routed to Pond 34P : Southeast Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	9.140	69	
	9.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	272	0.2857	0.52		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 38S: Basin 8-2



Summary for Subcatchment 40S: Basin 4-2-3

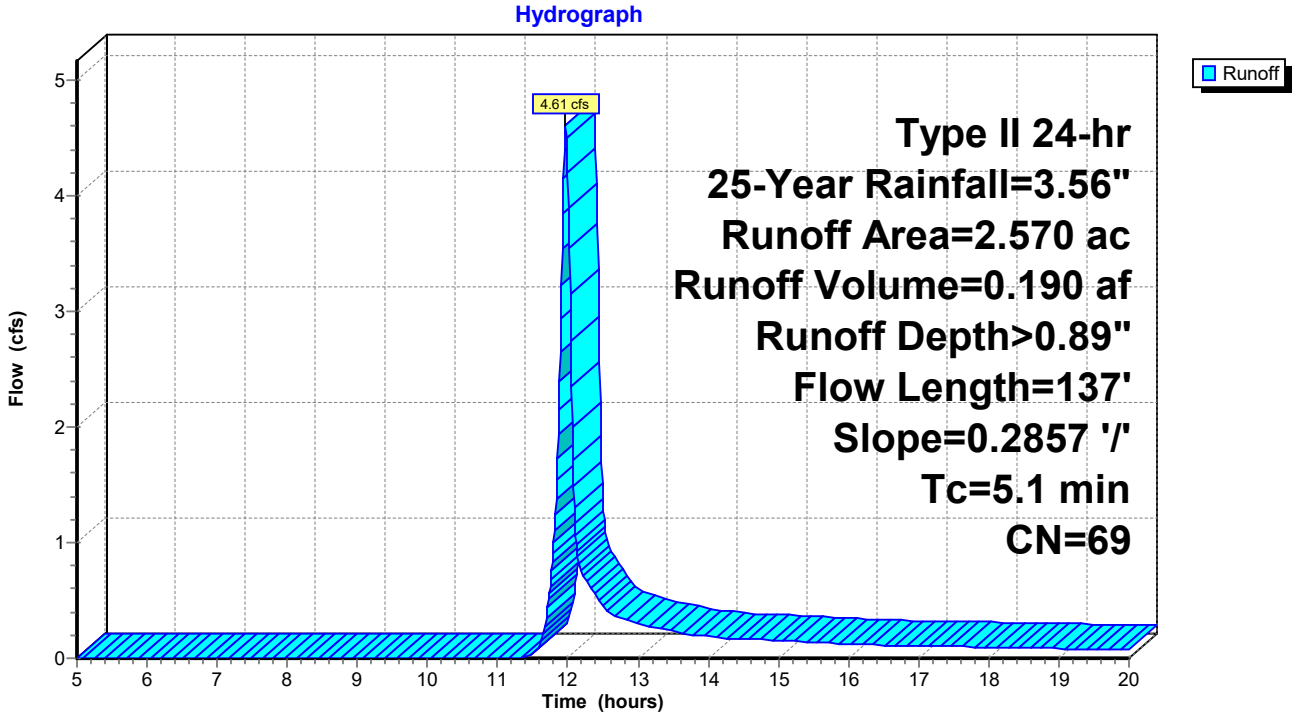
Runoff = 4.61 cfs @ 11.97 hrs, Volume= 0.190 af, Depth> 0.89"
Routed to Reach 39R : Reach 4-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	2.570	69	
	2.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	137	0.2857	0.45		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 40S: Basin 4-2-3



Summary for Subcatchment 43S: Basin 5-1-1

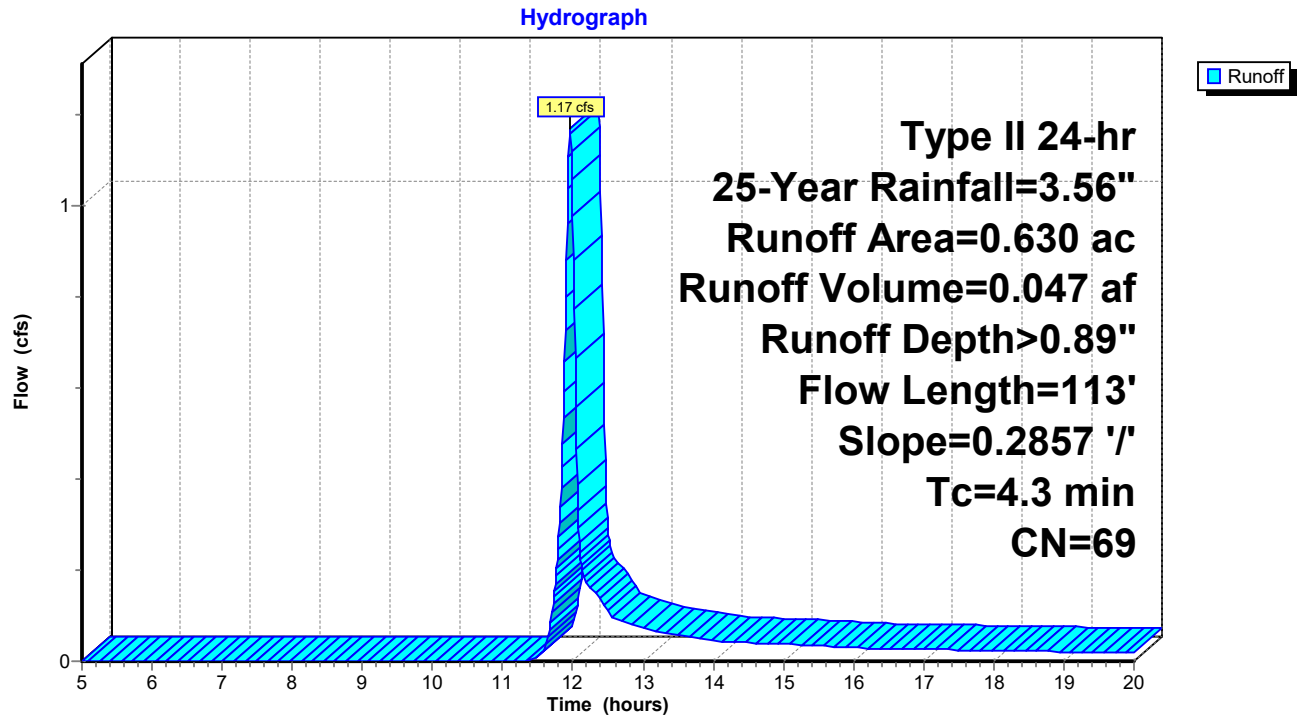
Runoff = 1.17 cfs @ 11.96 hrs, Volume= 0.047 af, Depth> 0.89"
Routed to Reach 44R : Reach 5-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	0.630	69	
	0.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	113	0.2857	0.43		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 43S: Basin 5-1-1



Summary for Subcatchment 46S: Basin 5-1-2

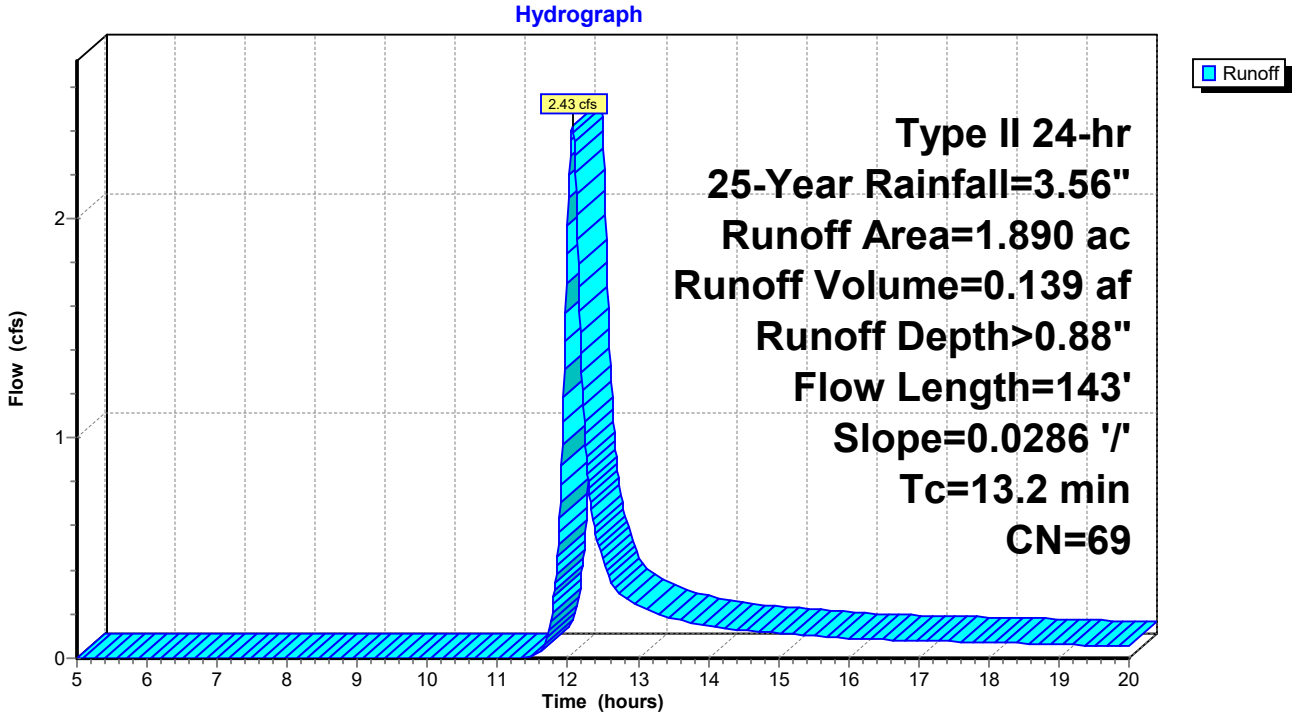
Runoff = 2.43 cfs @ 12.07 hrs, Volume= 0.139 af, Depth> 0.88"
Routed to Pond 45P : Southwest Pond-North Section

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	1.890	69	
	1.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.2	143	0.0286	0.18		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 46S: Basin 5-1-2



Summary for Subcatchment 48S: Basin 5-2-2

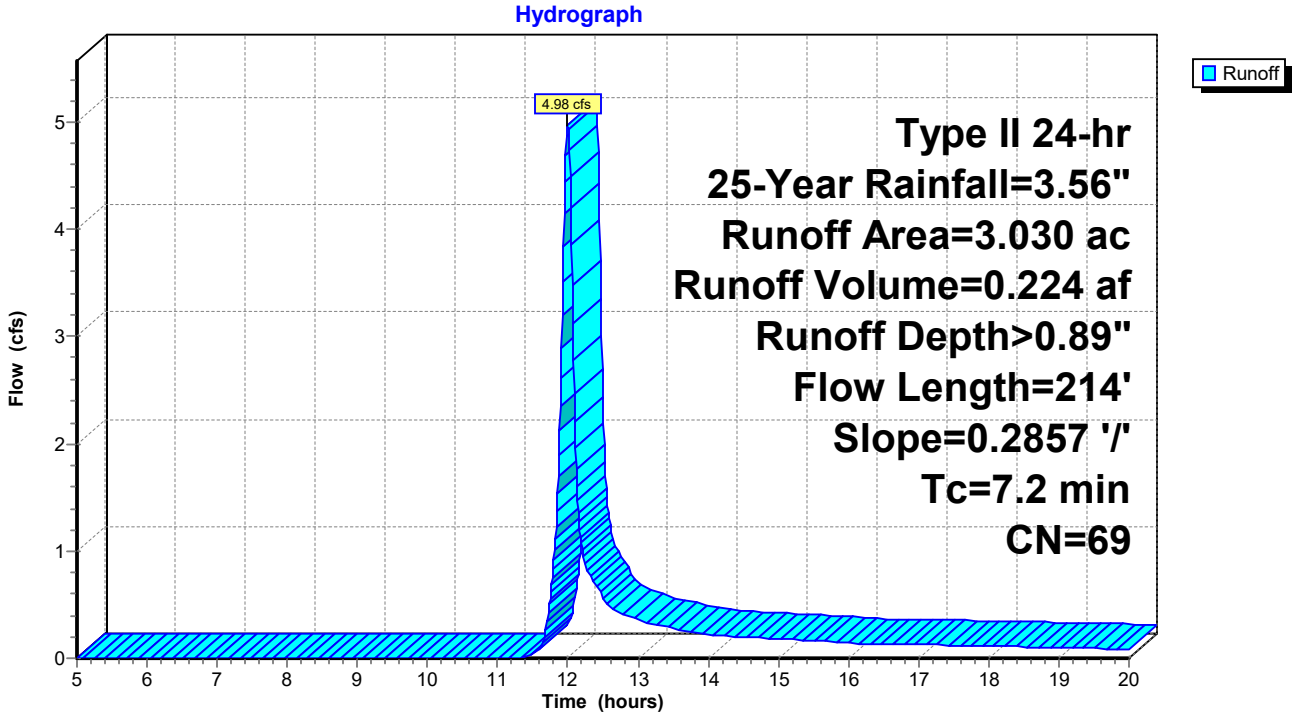
Runoff = 4.98 cfs @ 12.00 hrs, Volume= 0.224 af, Depth> 0.89"
Routed to Reach 49R : Reach 5-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	3.030	69	
	3.030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	214	0.2857	0.49		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 48S: Basin 5-2-2



Summary for Subcatchment 50S: Basin 5-2-1

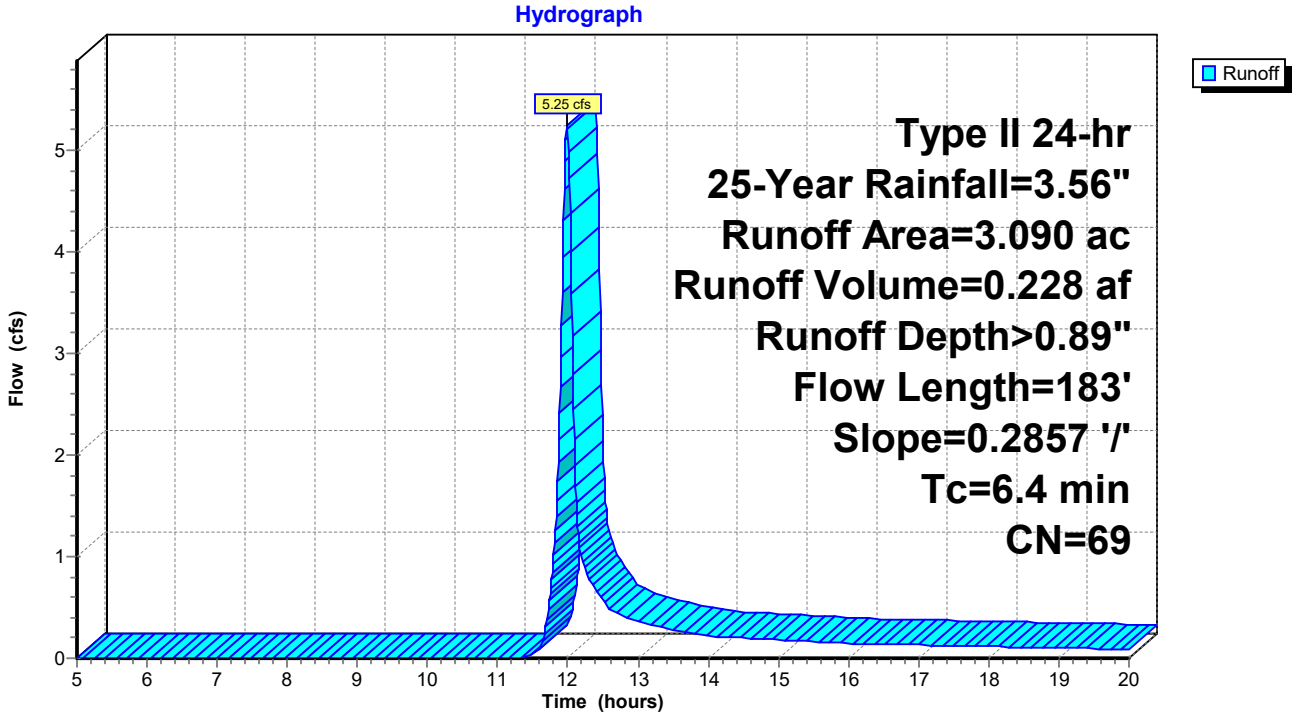
Runoff = 5.25 cfs @ 11.99 hrs, Volume= 0.228 af, Depth> 0.89"
Routed to Pond 55P : Southwest Pond-South Section

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	3.090	69	
	3.090		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	183	0.2857	0.48		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 50S: Basin 5-2-1



Summary for Subcatchment 52S: Basin 4-2-2

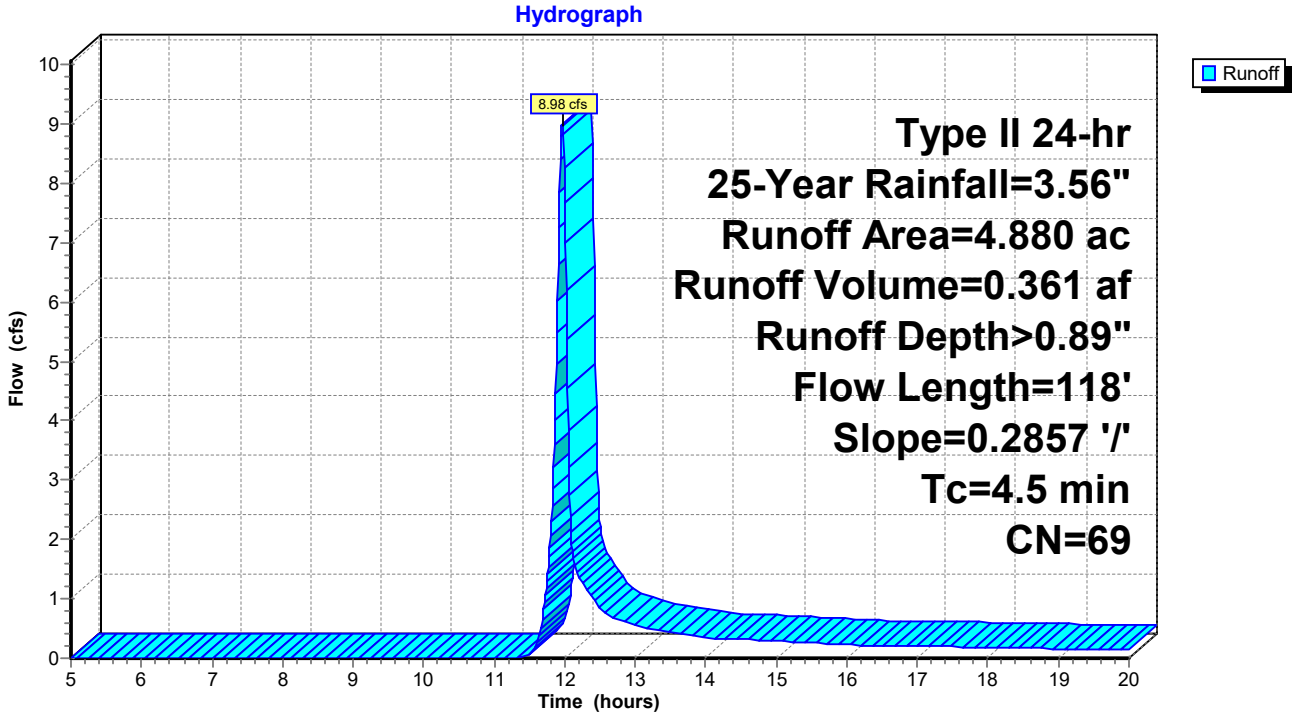
Runoff = 8.98 cfs @ 11.96 hrs, Volume= 0.361 af, Depth> 0.89"
Routed to Pond 15P : Northeast Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	4.880	69	
	4.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	118	0.2857	0.44		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 52S: Basin 4-2-2



Summary for Subcatchment 53S: Basin 4-1-3

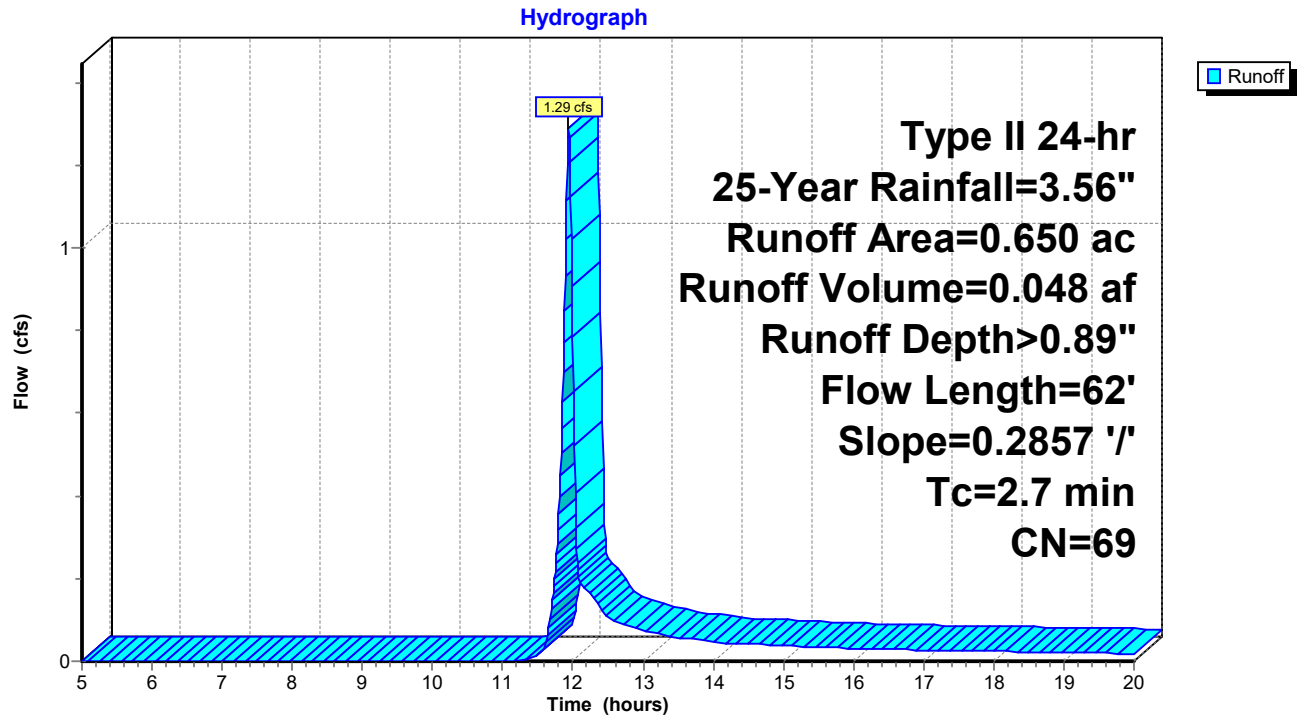
Runoff = 1.29 cfs @ 11.94 hrs, Volume= 0.048 af, Depth> 0.89"
Routed to Reach 42R : Pond to Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=3.56"

	Area (ac)	CN	Description
*	0.650	69	
	0.650		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	62	0.2857	0.38		**Sheet Flow,** Range n= 0.130 P2= 1.88"

Subcatchment 53S: Basin 4-1-3



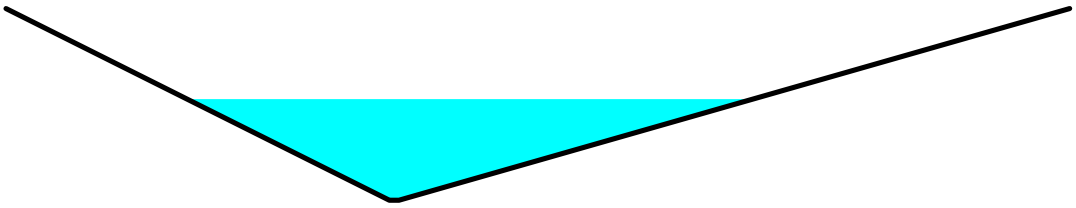
Summary for Reach 3R: Reach 1-1

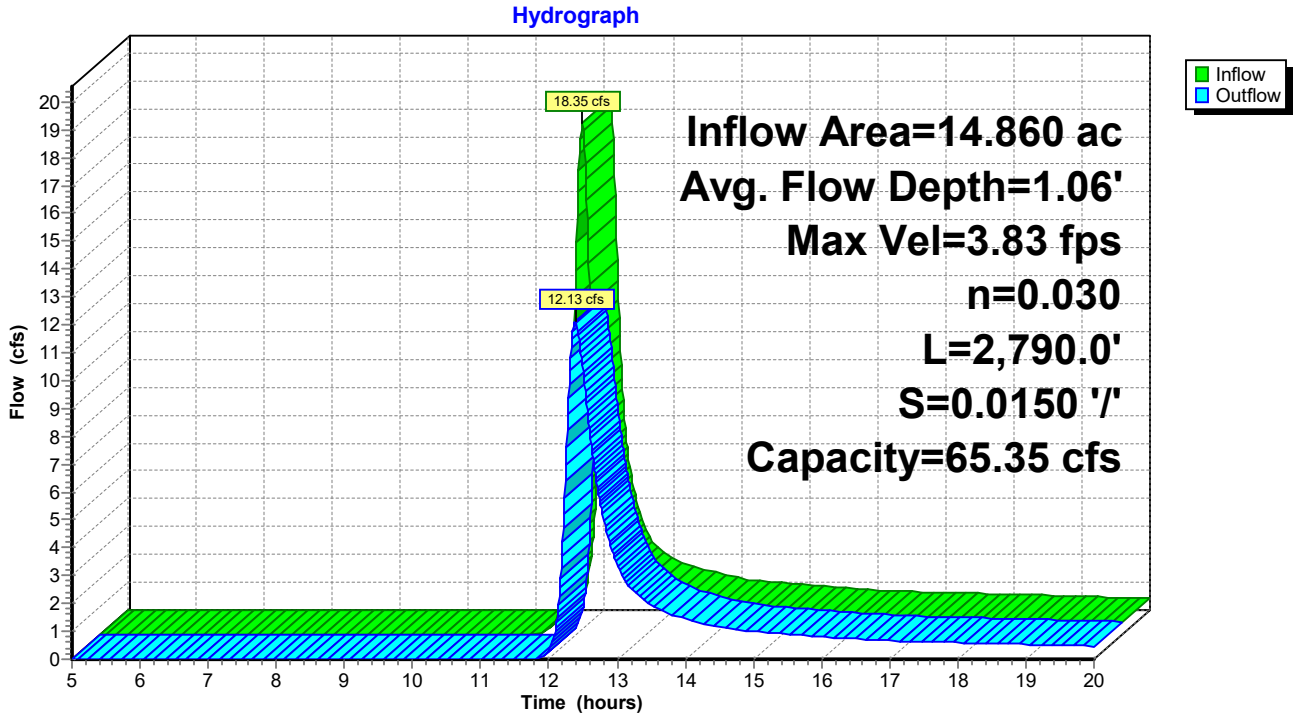
Inflow Area = 14.860 ac, 0.00% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 18.35 cfs @ 12.07 hrs, Volume= 1.093 af
Outflow = 12.13 cfs @ 12.39 hrs, Volume= 1.068 af, Atten= 34%, Lag= 18.9 min
Routed to Reach 5R : North Downchute Top

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.83 fps, Min. Travel Time= 12.1 min
Avg. Velocity = 2.03 fps, Avg. Travel Time= 22.9 min

Peak Storage= 8,838 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.06' , Surface Width= 5.90'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.35 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 2,790.0' Slope= 0.0150 '/'
Inlet Invert= 5,479.25', Outlet Invert= 5,437.50'





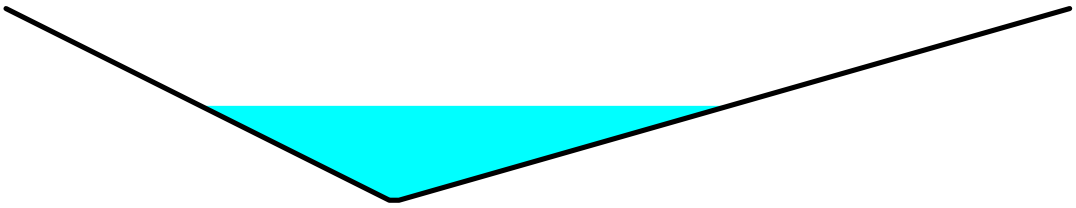
Summary for Reach 4R: Reach 1-2

Inflow Area = 10.030 ac, 0.00% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 12.39 cfs @ 12.07 hrs, Volume= 0.737 af
Outflow = 10.13 cfs @ 12.26 hrs, Volume= 0.728 af, Atten= 18%, Lag= 11.2 min
Routed to Reach 5R : North Downchute Top

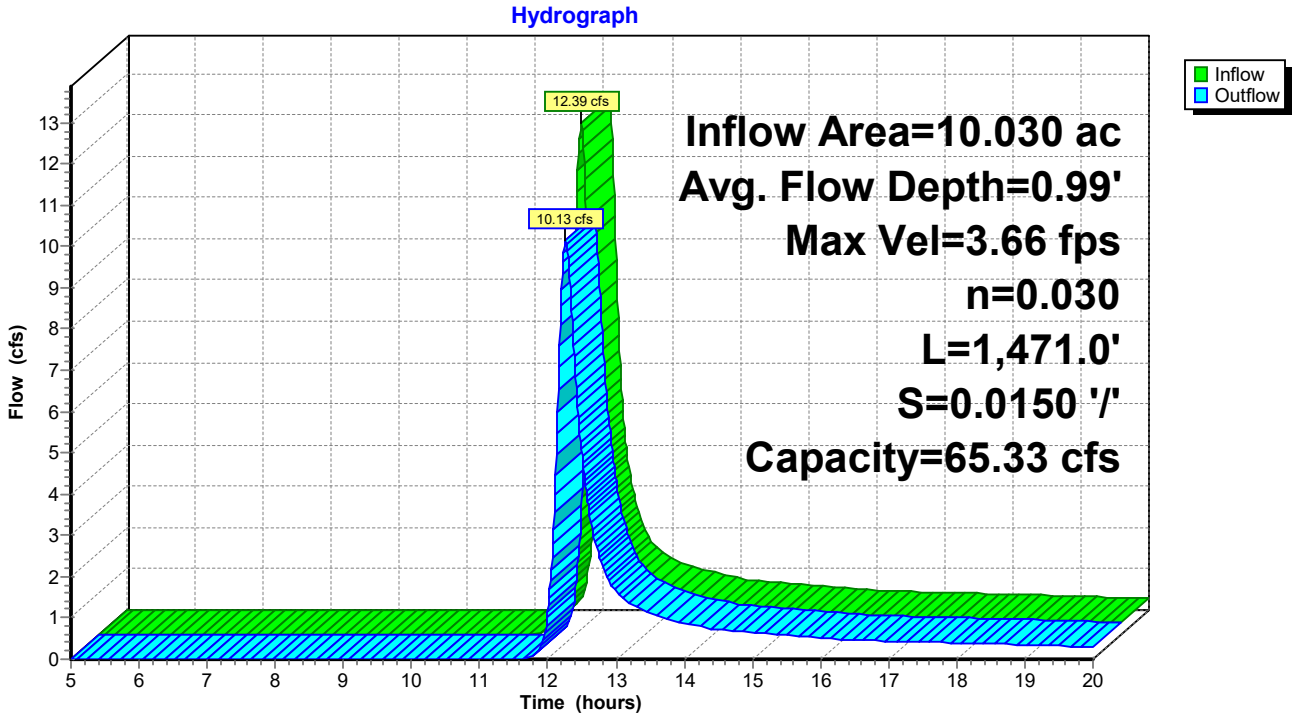
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.66 fps, Min. Travel Time= 6.7 min
Avg. Velocity = 1.84 fps, Avg. Travel Time= 13.4 min

Peak Storage= 4,070 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.99' , Surface Width= 5.52'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.33 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 1,471.0' Slope= 0.0150 '/'
Inlet Invert= 5,460.50', Outlet Invert= 5,438.50'



Reach 4R: Reach 1-2



Summary for Reach 5R: North Downchute Top

[62] Hint: Exceeded Reach 3R OUTLET depth by 1.00' @ 5.00 hrs
[61] Hint: Exceeded Reach 4R outlet invert by 0.19' @ 12.35 hrs

Inflow Area = 24.890 ac, 0.00% Impervious, Inflow Depth > 0.87" for 25-Year event
Inflow = 20.22 cfs @ 12.34 hrs, Volume= 1.796 af
Outflow = 20.18 cfs @ 12.37 hrs, Volume= 1.791 af, Atten= 0%, Lag= 1.6 min
Routed to Reach 6R : North Downchute Bottom

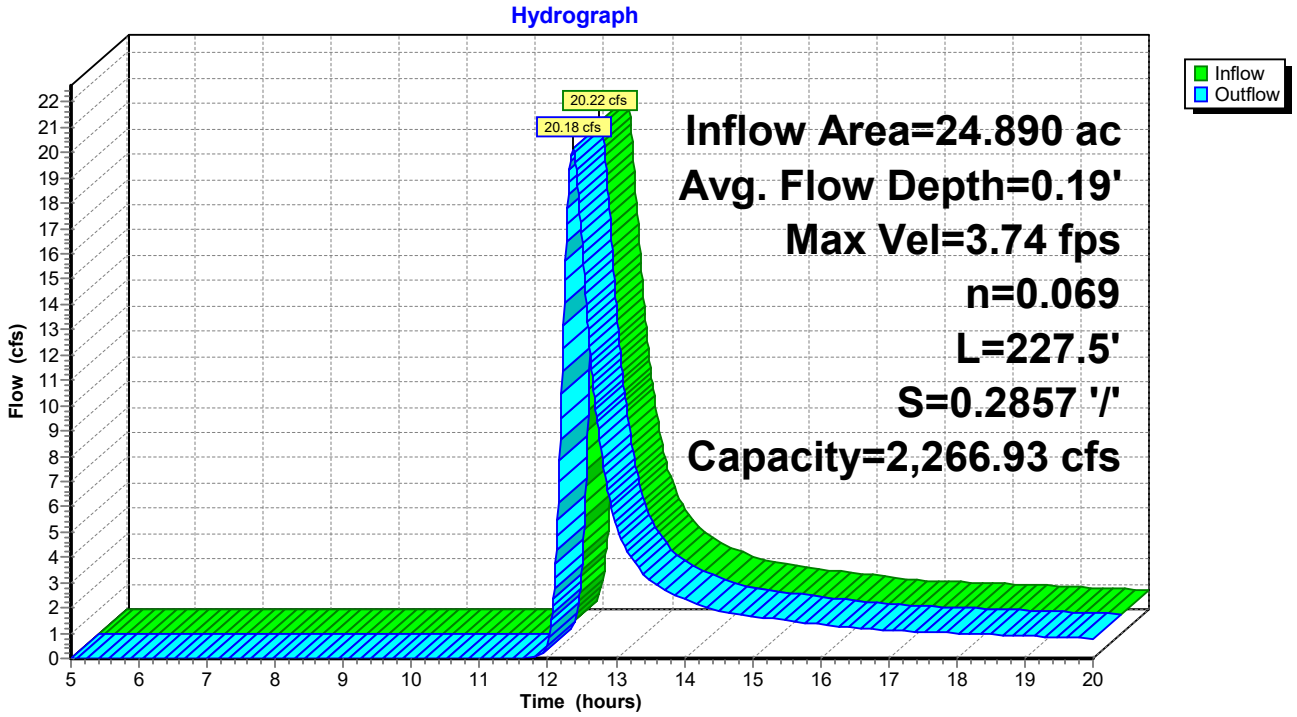
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.74 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.51 fps, Avg. Travel Time= 2.5 min

Peak Storage= 1,227 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 29.13'
Bank-Full Depth= 3.00' Flow Area= 111.0 sf, Capacity= 2,266.93 cfs

28.00' x 3.00' deep channel, n= 0.069
Side Slope Z-value= 3.0 '/' Top Width= 46.00'
Length= 227.5' Slope= 0.2857 '/'
Inlet Invert= 5,438.50', Outlet Invert= 5,373.50'

‡

Reach 5R: North Downchute Top



Summary for Reach 6R: North Downchute Bottom

[61] Hint: Exceeded Reach 5R outlet invert by 0.18' @ 12.35 hrs
[61] Hint: Exceeded Reach 9R outlet invert by 0.18' @ 12.35 hrs
[61] Hint: Exceeded Reach 10R outlet invert by 0.18' @ 12.35 hrs

Inflow Area = 54.870 ac, 0.00% Impervious, Inflow Depth > 0.86" for 25-Year event
Inflow = 44.57 cfs @ 12.34 hrs, Volume= 3.946 af
Outflow = 44.46 cfs @ 12.37 hrs, Volume= 3.935 af, Atten= 0%, Lag= 1.7 min
Routed to Pond 15P : Northeast Pond

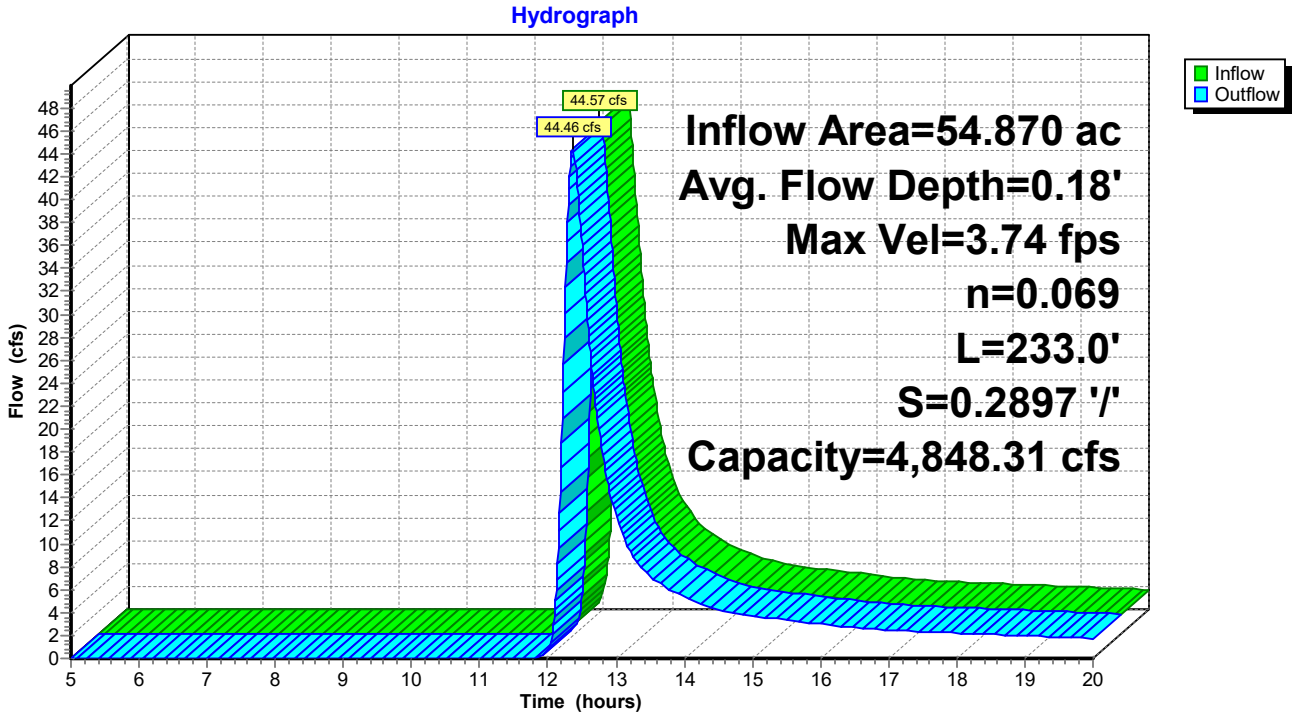
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.74 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 2.6 min

Peak Storage= 2,773 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.18' , Surface Width= 65.11'
Bank-Full Depth= 3.00' Flow Area= 219.0 sf, Capacity= 4,848.31 cfs

64.00' x 3.00' deep channel, n= 0.069
Side Slope Z-value= 3.0 '/' Top Width= 82.00'
Length= 233.0' Slope= 0.2897 '/'
Inlet Invert= 5,373.50', Outlet Invert= 5,306.00'

‡

Reach 6R: North Downchute Bottom



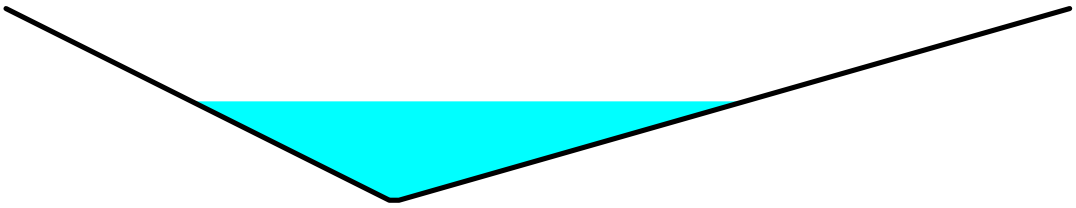
Summary for Reach 9R: Reach 2-1

Inflow Area = 14.450 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 23.84 cfs @ 12.00 hrs, Volume= 1.066 af
Outflow = 11.61 cfs @ 12.36 hrs, Volume= 1.034 af, Atten= 51%, Lag= 22.1 min
Routed to Reach 6R : North Downchute Bottom

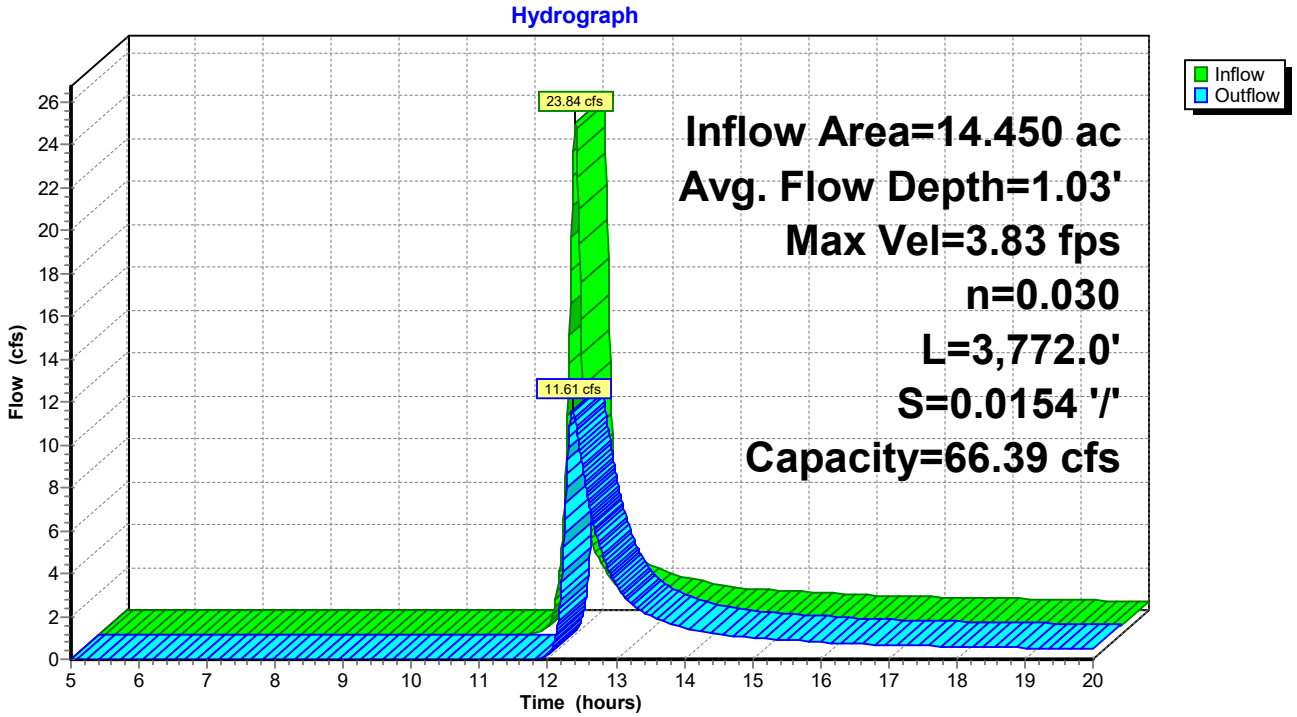
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.83 fps, Min. Travel Time= 16.4 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 30.7 min

Peak Storage= 11,425 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.03' , Surface Width= 5.77'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 66.39 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 3,772.0' Slope= 0.0154 '/'
Inlet Invert= 5,431.75', Outlet Invert= 5,373.50'



Reach 9R: Reach 2-1



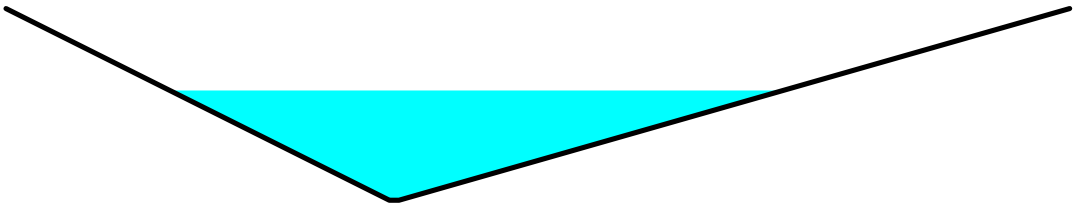
Summary for Reach 10R: Reach 2-2

Inflow Area = 15.530 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 25.09 cfs @ 12.00 hrs, Volume= 1.146 af
Outflow = 15.09 cfs @ 12.27 hrs, Volume= 1.121 af, Atten= 40%, Lag= 16.2 min
Routed to Reach 6R : North Downchute Bottom

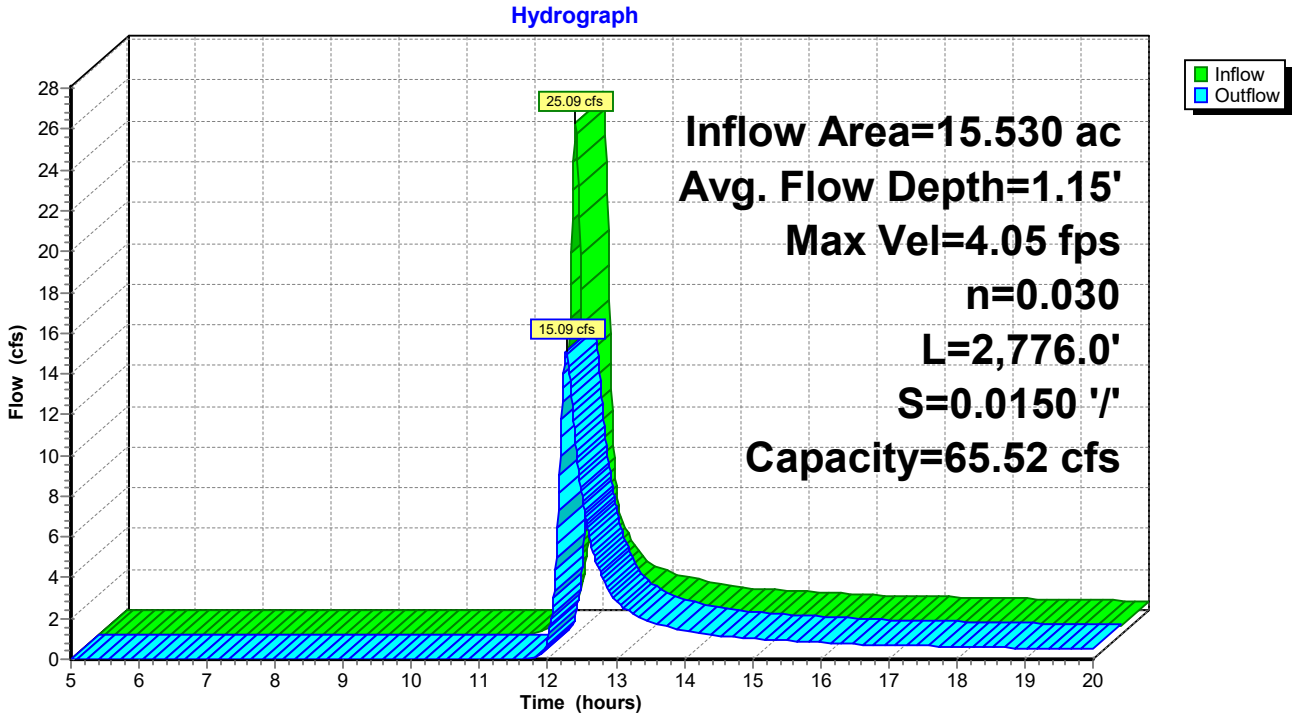
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.05 fps, Min. Travel Time= 11.4 min
Avg. Velocity = 2.06 fps, Avg. Travel Time= 22.5 min

Peak Storage= 10,333 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.15' , Surface Width= 6.40'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.52 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 2,776.0' Slope= 0.0150 '/'
Inlet Invert= 5,415.25', Outlet Invert= 5,373.50'



Reach 10R: Reach 2-2



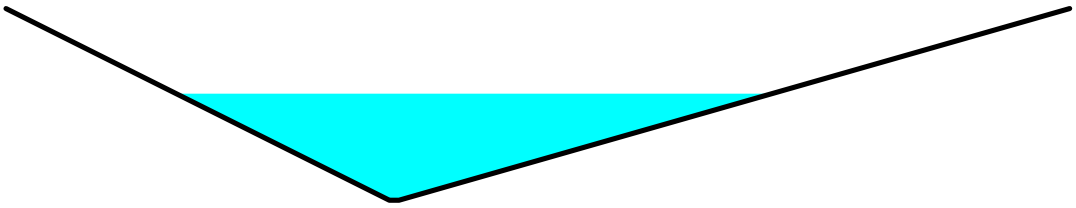
Summary for Reach 13R: Reach 3-1

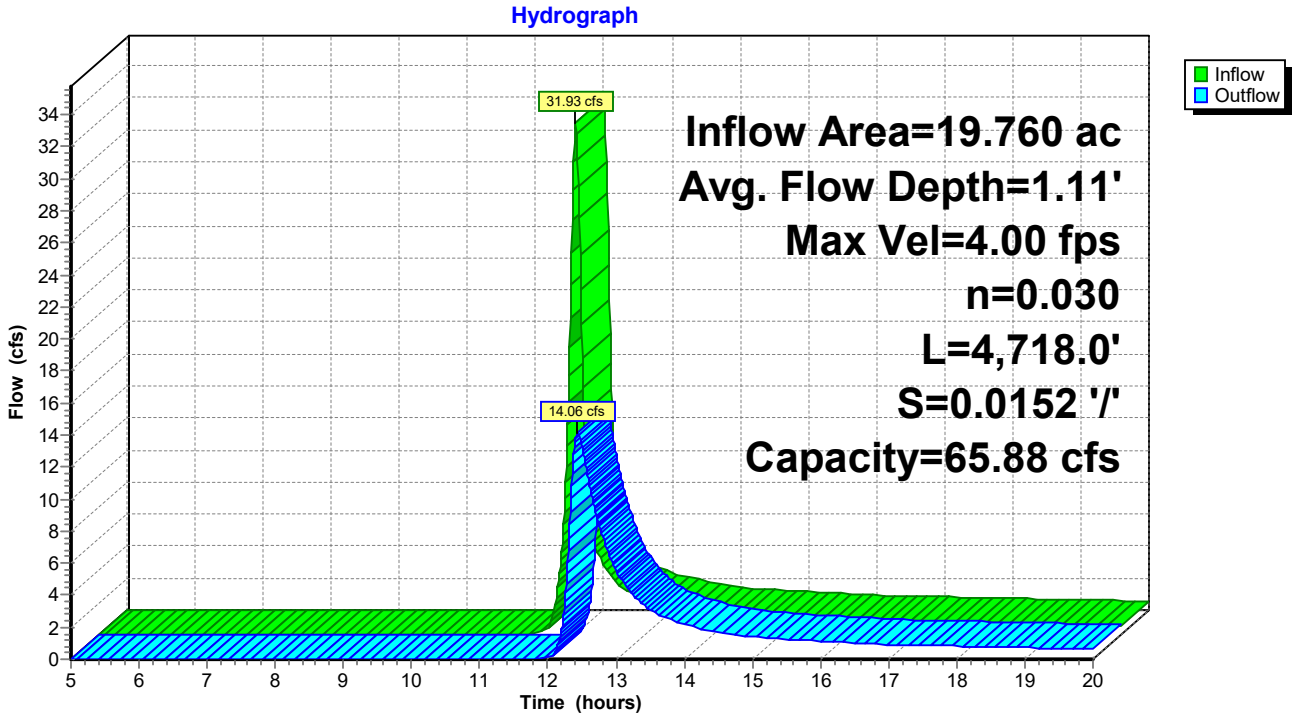
Inflow Area = 19.760 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 31.93 cfs @ 12.00 hrs, Volume= 1.458 af
Outflow = 14.06 cfs @ 12.44 hrs, Volume= 1.405 af, Atten= 56%, Lag= 26.1 min
Routed to Pond 15P : Northeast Pond

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.00 fps, Min. Travel Time= 19.7 min
Avg. Velocity = 2.21 fps, Avg. Travel Time= 35.6 min

Peak Storage= 16,592 cf @ 12.11 hrs
Average Depth at Peak Storage= 1.11' , Surface Width= 6.22'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.88 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 4,718.0' Slope= 0.0152 '/'
Inlet Invert= 5,377.75', Outlet Invert= 5,306.00'





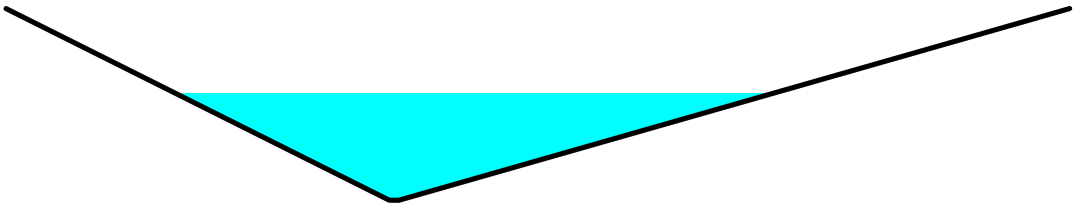
Summary for Reach 14R: Reach 3-2

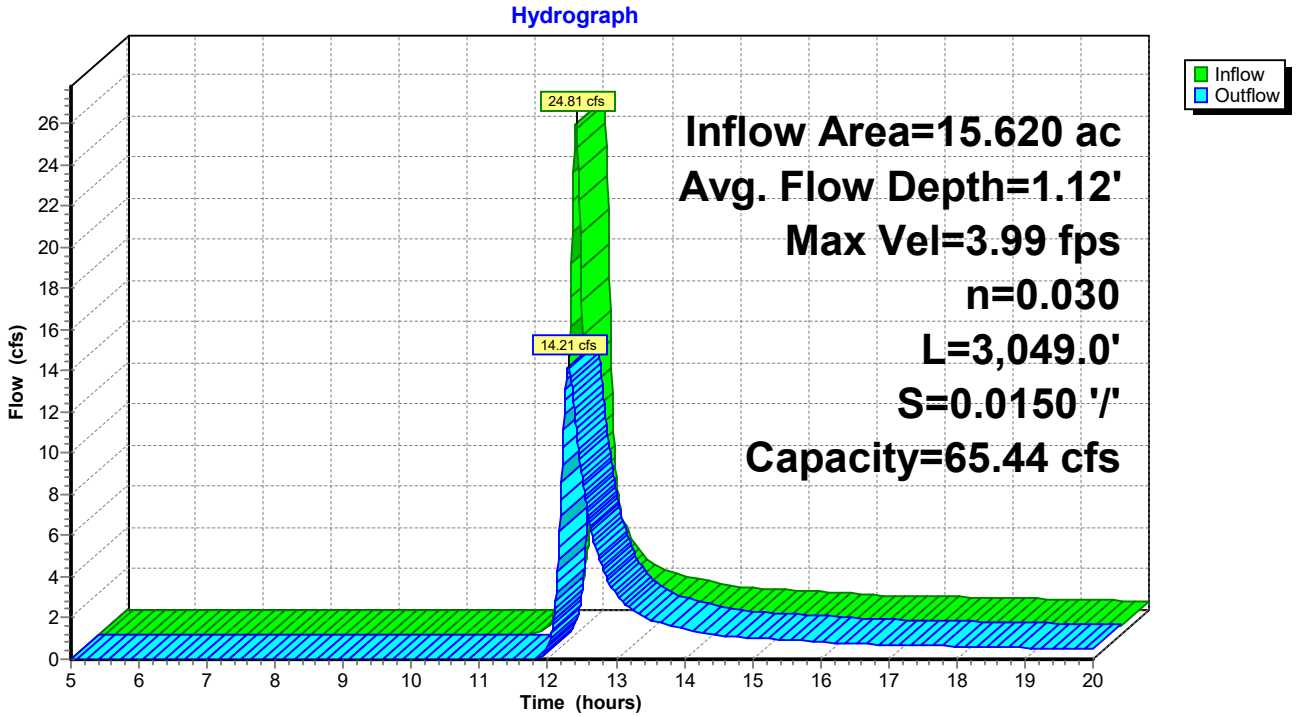
Inflow Area = 15.620 ac, 0.00% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 24.81 cfs @ 12.01 hrs, Volume= 1.152 af
Outflow = 14.21 cfs @ 12.30 hrs, Volume= 1.125 af, Atten= 43%, Lag= 17.9 min
Routed to Pond 15P : Northeast Pond

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.99 fps, Min. Travel Time= 12.7 min
Avg. Velocity = 2.06 fps, Avg. Travel Time= 24.7 min

Peak Storage= 10,863 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.12' , Surface Width= 6.26'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.44 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 3,049.0' Slope= 0.0150 '/'
Inlet Invert= 5,355.00', Outlet Invert= 5,309.25'





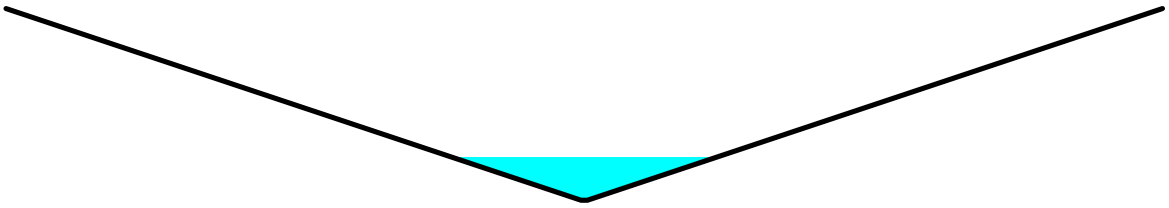
Summary for Reach 17R: Reach 4-1

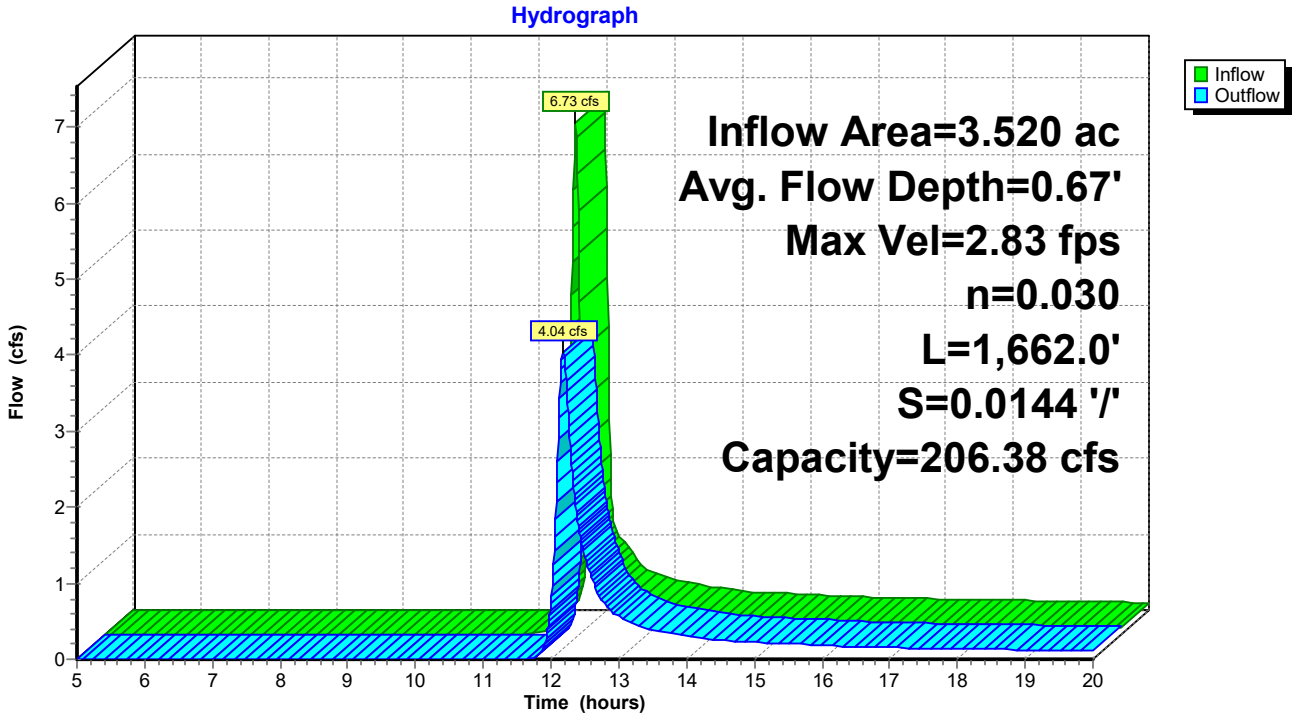
Inflow Area = 3.520 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 6.73 cfs @ 11.95 hrs, Volume= 0.260 af
Outflow = 4.04 cfs @ 12.18 hrs, Volume= 0.255 af, Atten= 40%, Lag= 13.6 min
Routed to Pond 18P : North Pond

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.83 fps, Min. Travel Time= 9.8 min
Avg. Velocity = 1.38 fps, Avg. Travel Time= 20.1 min

Peak Storage= 2,377 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.67' , Surface Width= 4.14'
Bank-Full Depth= 3.00' Flow Area= 27.3 sf, Capacity= 206.38 cfs

0.10' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 18.10'
Length= 1,662.0' Slope= 0.0144 '/'
Inlet Invert= 5,326.00', Outlet Invert= 5,302.00'





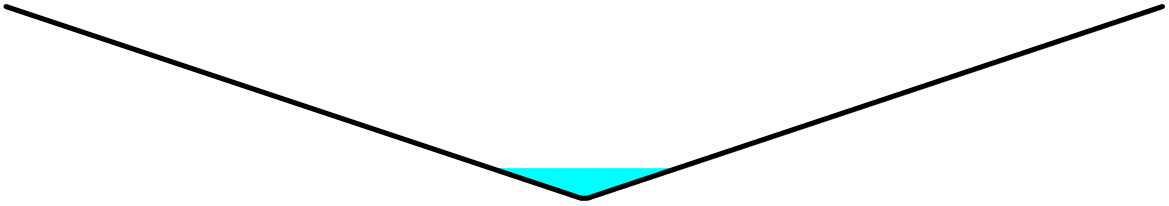
Summary for Reach 20R: Reach 4.2.1

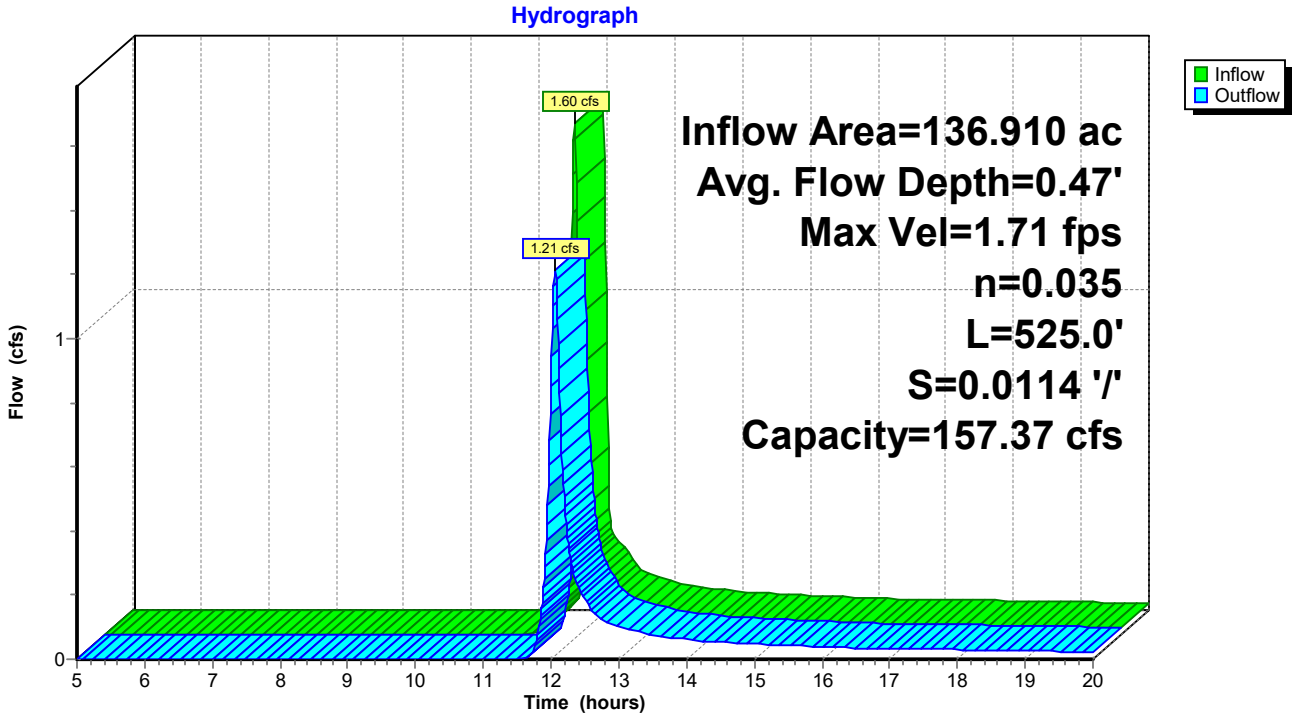
Inflow Area = 136.910 ac, 0.00% Impervious, Inflow Depth > 0.01" for 25-Year event
Inflow = 1.60 cfs @ 11.93 hrs, Volume= 0.058 af
Outflow = 1.21 cfs @ 12.06 hrs, Volume= 0.058 af, Atten= 24%, Lag= 7.7 min
Routed to Pond 23P : Storage in Perimeter Ditch

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.71 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.78 fps, Avg. Travel Time= 11.3 min

Peak Storage= 373 cf @ 11.98 hrs
Average Depth at Peak Storage= 0.47' , Surface Width= 2.92'
Bank-Full Depth= 3.00' Flow Area= 27.3 sf, Capacity= 157.37 cfs

0.10' x 3.00' deep channel, n= 0.035 Increased from 0.03 to account for in-place detention weirs
Side Slope Z-value= 3.0 '/' Top Width= 18.10'
Length= 525.0' Slope= 0.0114 '/'
Inlet Invert= 5,306.00', Outlet Invert= 5,300.00'





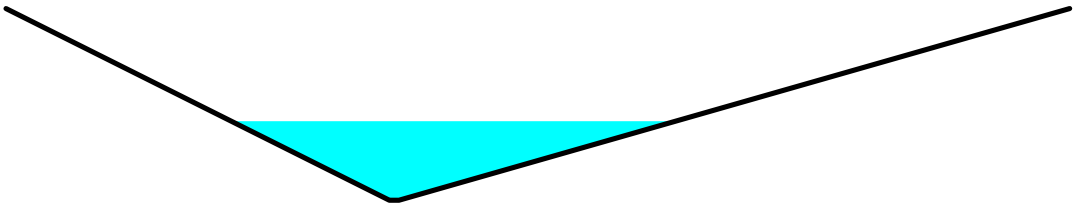
Summary for Reach 26R: Reach 6-1

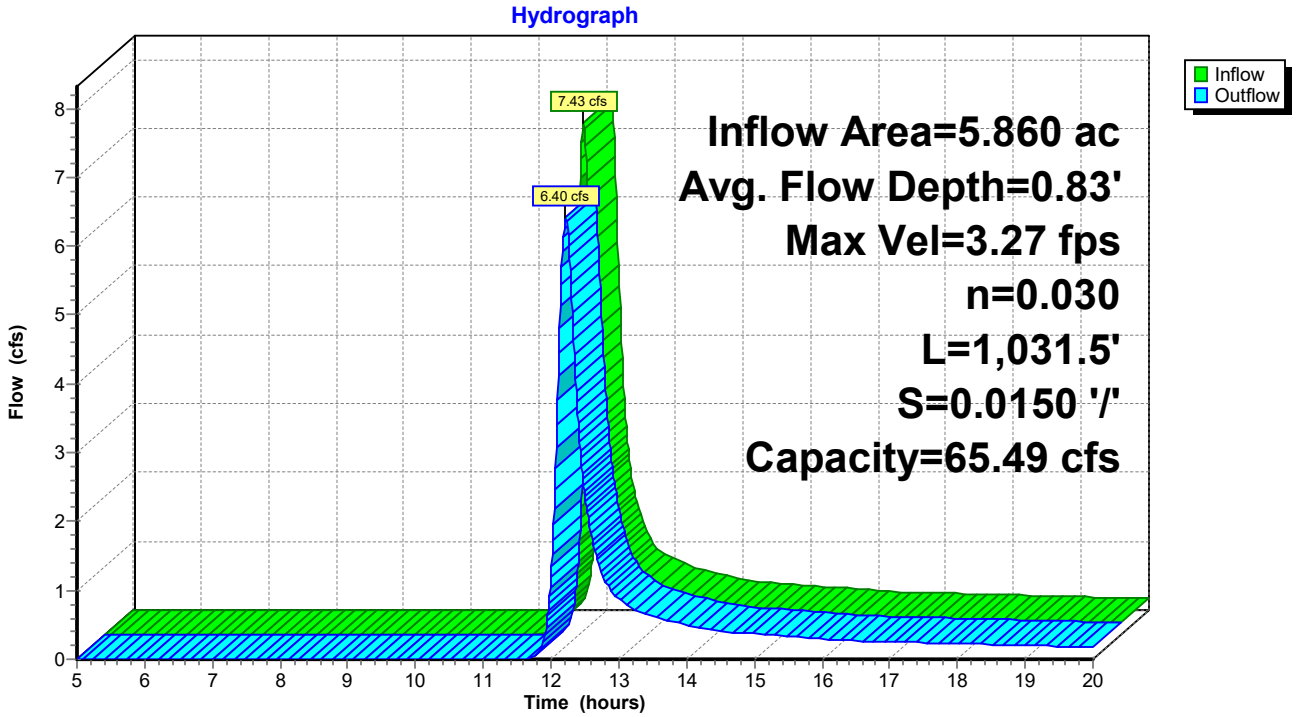
Inflow Area = 5.860 ac, 0.00% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 7.43 cfs @ 12.07 hrs, Volume= 0.431 af
Outflow = 6.40 cfs @ 12.21 hrs, Volume= 0.427 af, Atten= 14%, Lag= 8.8 min
Routed to Reach 28R : South Downchute Top

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.27 fps, Min. Travel Time= 5.3 min
Avg. Velocity = 1.61 fps, Avg. Travel Time= 10.7 min

Peak Storage= 2,020 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.83' , Surface Width= 4.64'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.49 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 1,031.5' Slope= 0.0150 '/'
Inlet Invert= 5,443.50', Outlet Invert= 5,428.00'





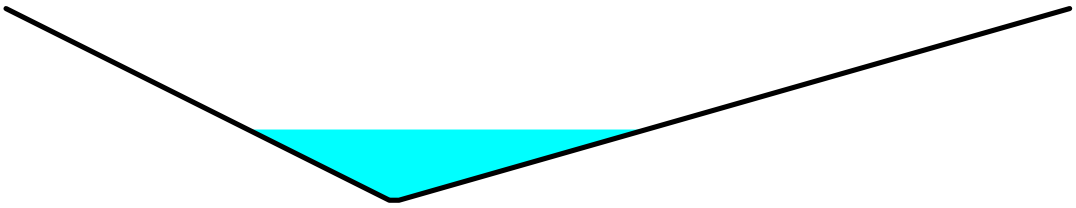
Summary for Reach 27R: Reach 6-2

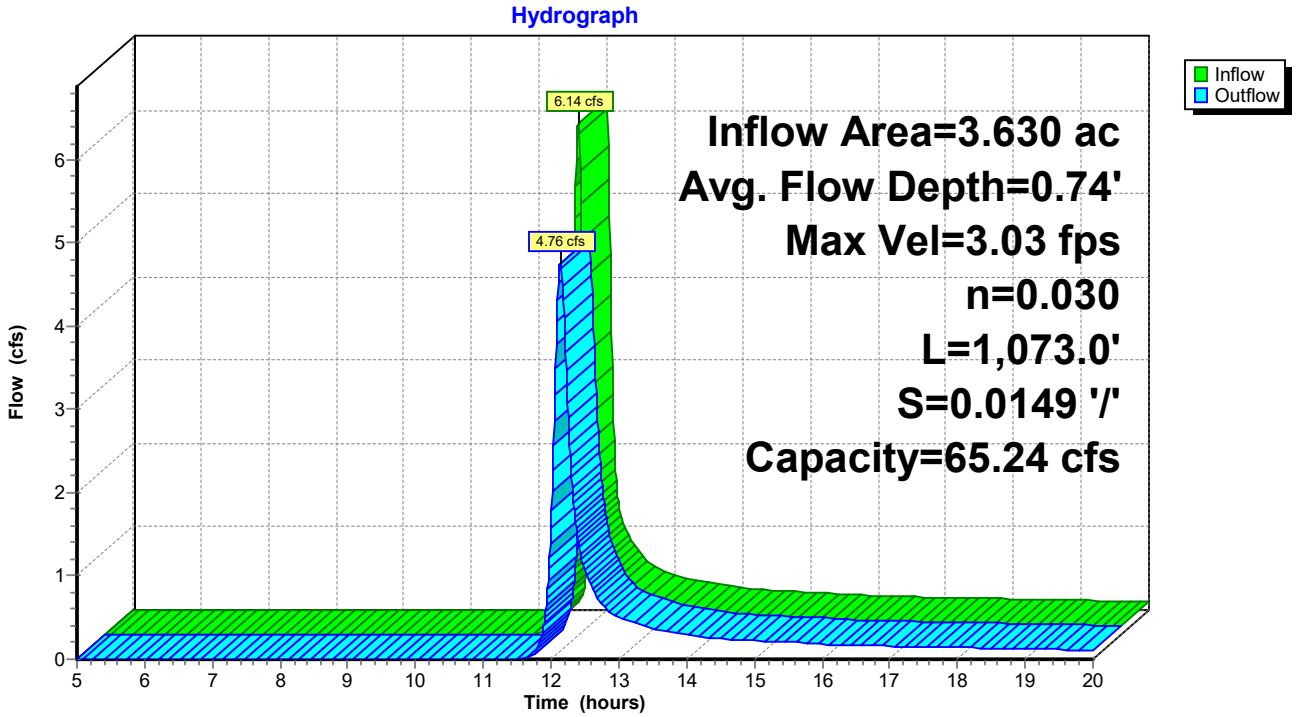
Inflow Area = 3.630 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 6.14 cfs @ 11.99 hrs, Volume= 0.268 af
Outflow = 4.76 cfs @ 12.14 hrs, Volume= 0.265 af, Atten= 22%, Lag= 9.0 min
Routed to Reach 28R : South Downchute Top

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.03 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 12.6 min

Peak Storage= 1,688 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.74' , Surface Width= 4.16'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.24 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 1,073.0' Slope= 0.0149 '/'
Inlet Invert= 5,444.00', Outlet Invert= 5,428.00'





Summary for Reach 28R: South Downchute Top

[61] Hint: Exceeded Reach 26R outlet invert by 0.19' @ 12.19 hrs
[61] Hint: Exceeded Reach 27R outlet invert by 0.19' @ 12.19 hrs

Inflow Area = 9.490 ac, 0.00% Impervious, Inflow Depth > 0.87" for 25-Year event
Inflow = 10.43 cfs @ 12.18 hrs, Volume= 0.692 af
Outflow = 10.39 cfs @ 12.20 hrs, Volume= 0.690 af, Atten= 0%, Lag= 1.5 min
Routed to Reach 33R : South Downchute Bottom

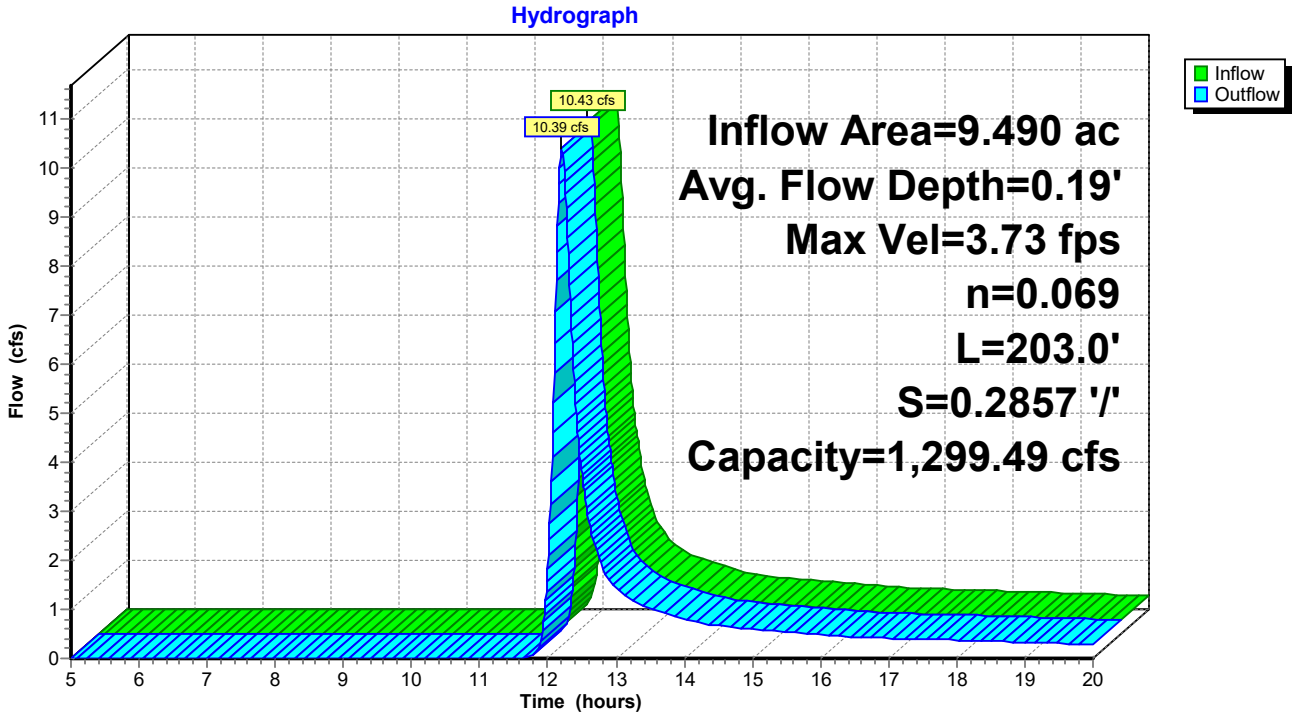
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.73 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 2.5 min

Peak Storage= 566 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 15.15'
Bank-Full Depth= 3.00' Flow Area= 69.0 sf, Capacity= 1,299.49 cfs

14.00' x 3.00' deep channel, n= 0.069
Side Slope Z-value= 3.0 '/' Top Width= 32.00'
Length= 203.0' Slope= 0.2857 '/'
Inlet Invert= 5,428.00', Outlet Invert= 5,370.00'

‡

Reach 28R: South Downchute Top



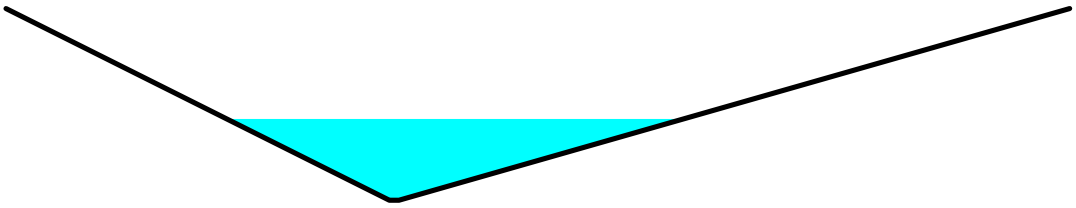
Summary for Reach 31R: Reach 7-1

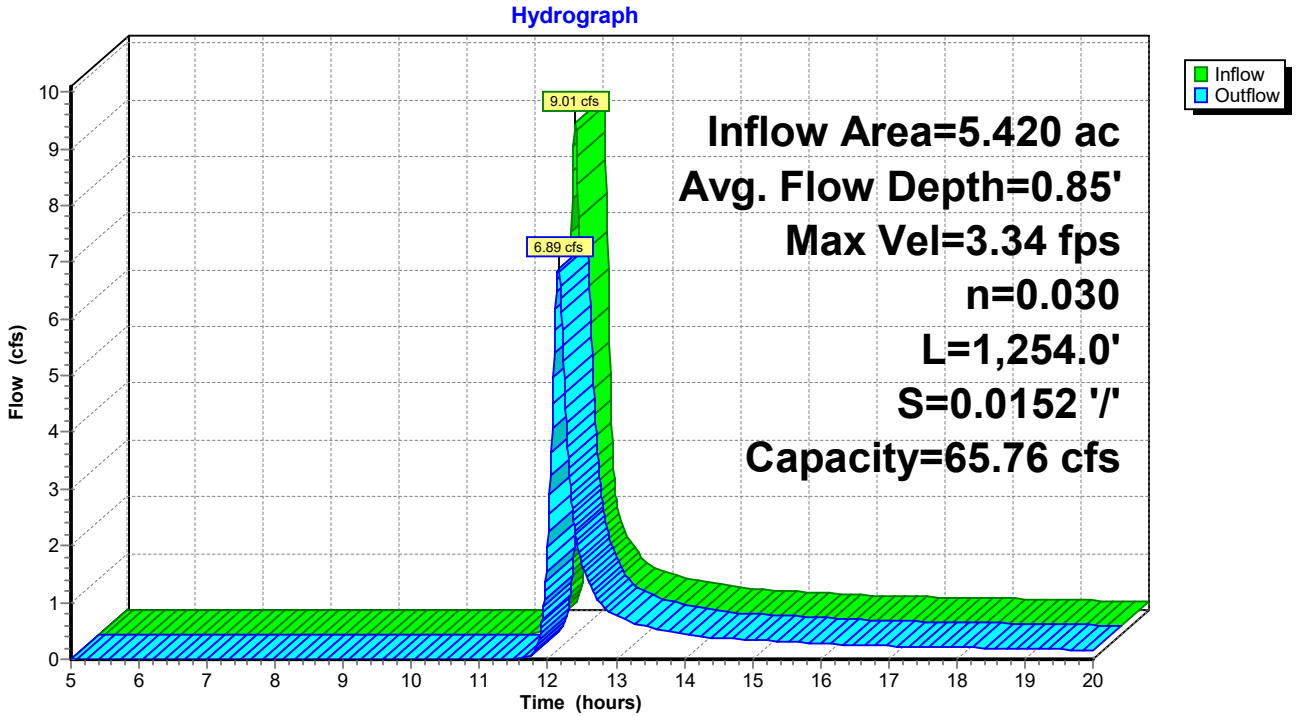
Inflow Area = 5.420 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 9.01 cfs @ 11.99 hrs, Volume= 0.400 af
Outflow = 6.89 cfs @ 12.15 hrs, Volume= 0.395 af, Atten= 24%, Lag= 9.5 min
Routed to Reach 33R : South Downchute Bottom

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.34 fps, Min. Travel Time= 6.3 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 13.2 min

Peak Storage= 2,589 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.85' , Surface Width= 4.77'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.76 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 1,254.0' Slope= 0.0152 '/'
Inlet Invert= 5,389.00', Outlet Invert= 5,370.00'





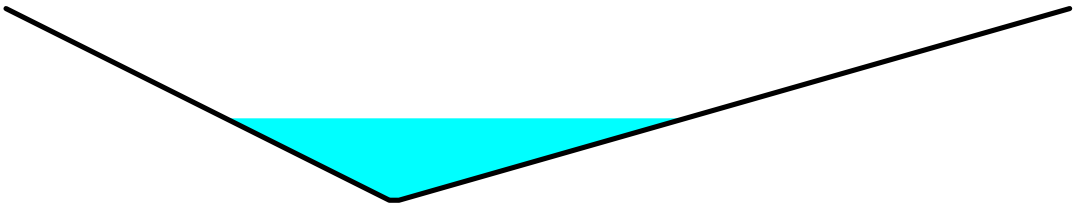
Summary for Reach 32R: Reach 7-2

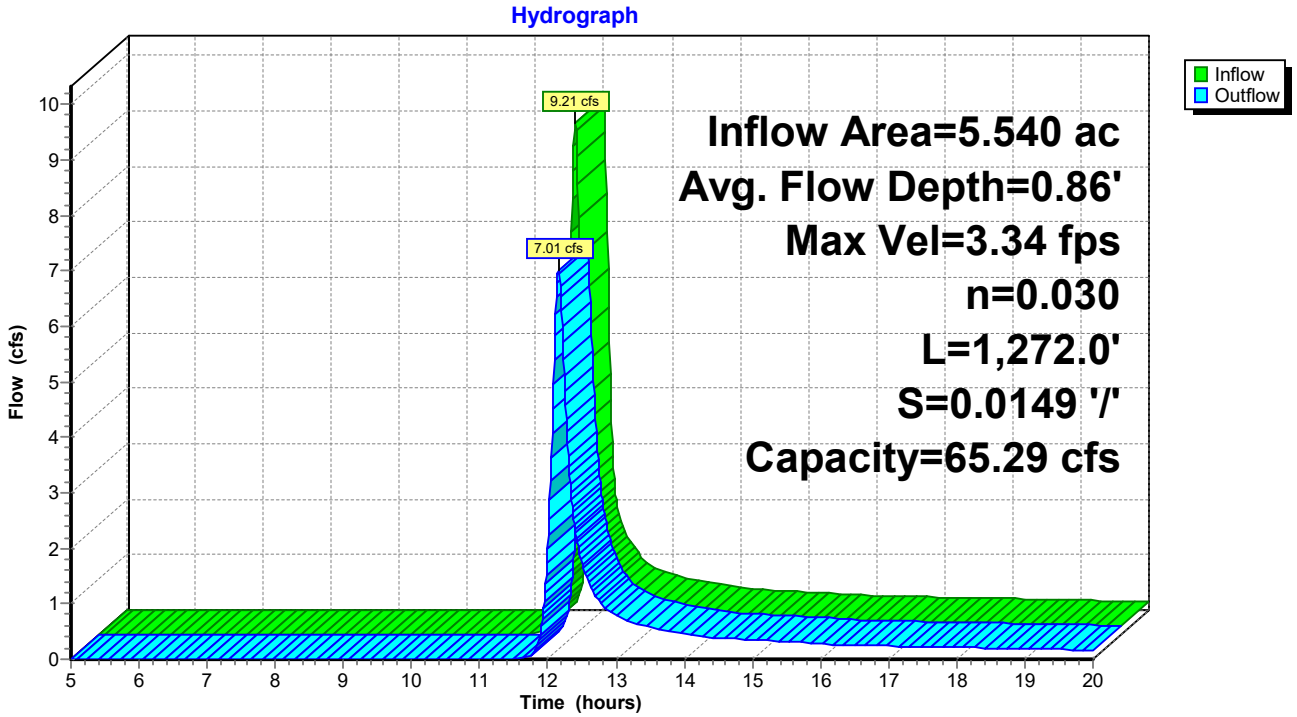
Inflow Area = 5.540 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 9.21 cfs @ 11.99 hrs, Volume= 0.409 af
Outflow = 7.01 cfs @ 12.15 hrs, Volume= 0.404 af, Atten= 24%, Lag= 9.6 min
Routed to Reach 33R : South Downchute Bottom

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.34 fps, Min. Travel Time= 6.3 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 13.4 min

Peak Storage= 2,673 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.86' , Surface Width= 4.81'
Bank-Full Depth= 2.00' Flow Area= 11.2 sf, Capacity= 65.29 cfs

0.10' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 3.5 '/' Top Width= 11.10'
Length= 1,272.0' Slope= 0.0149 '/'
Inlet Invert= 5,389.00', Outlet Invert= 5,370.00'





Summary for Reach 33R: South Downchute Bottom

[61] Hint: Exceeded Reach 28R outlet invert by 0.19' @ 12.18 hrs
[61] Hint: Exceeded Reach 31R outlet invert by 0.19' @ 12.18 hrs
[61] Hint: Exceeded Reach 32R outlet invert by 0.19' @ 12.18 hrs

Inflow Area = 20.450 ac, 0.00% Impervious, Inflow Depth > 0.87" for 25-Year event
Inflow = 23.64 cfs @ 12.17 hrs, Volume= 1.489 af
Outflow = 23.53 cfs @ 12.19 hrs, Volume= 1.486 af, Atten= 0%, Lag= 1.4 min
Routed to Pond 34P : Southeast Pond

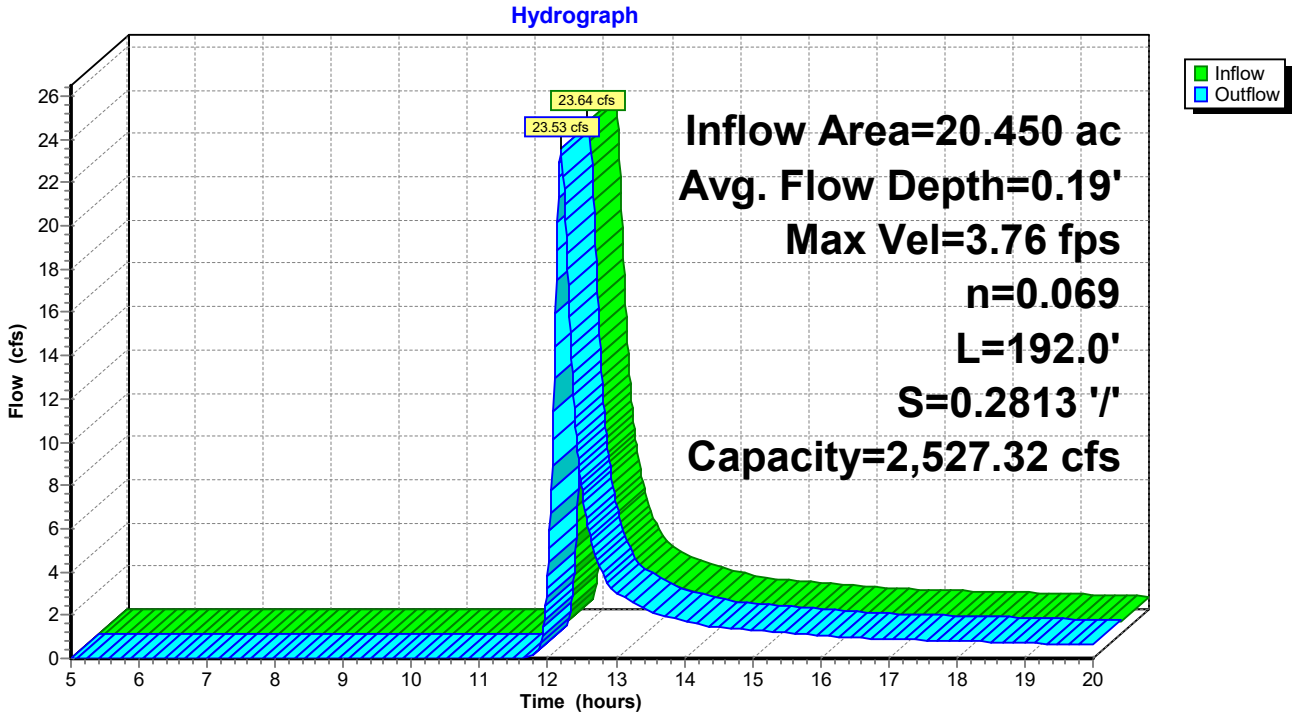
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.76 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 2.4 min

Peak Storage= 1,201 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 33.15'
Bank-Full Depth= 3.00' Flow Area= 123.0 sf, Capacity= 2,527.32 cfs

32.00' x 3.00' deep channel, n= 0.069
Side Slope Z-value= 3.0 '/' Top Width= 50.00'
Length= 192.0' Slope= 0.2813 '/'
Inlet Invert= 5,370.00', Outlet Invert= 5,316.00'

‡

Reach 33R: South Downchute Bottom



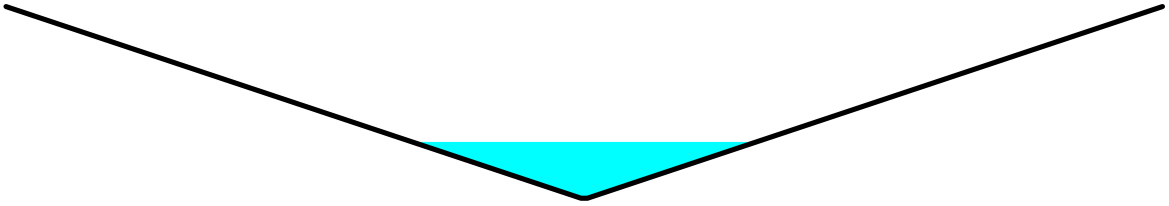
Summary for Reach 36R: Reach 8-1

Inflow Area = 5.940 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 9.75 cfs @ 12.00 hrs, Volume= 0.438 af
Outflow = 7.88 cfs @ 12.13 hrs, Volume= 0.434 af, Atten= 19%, Lag= 8.3 min
Routed to Pond 34P : Southeast Pond

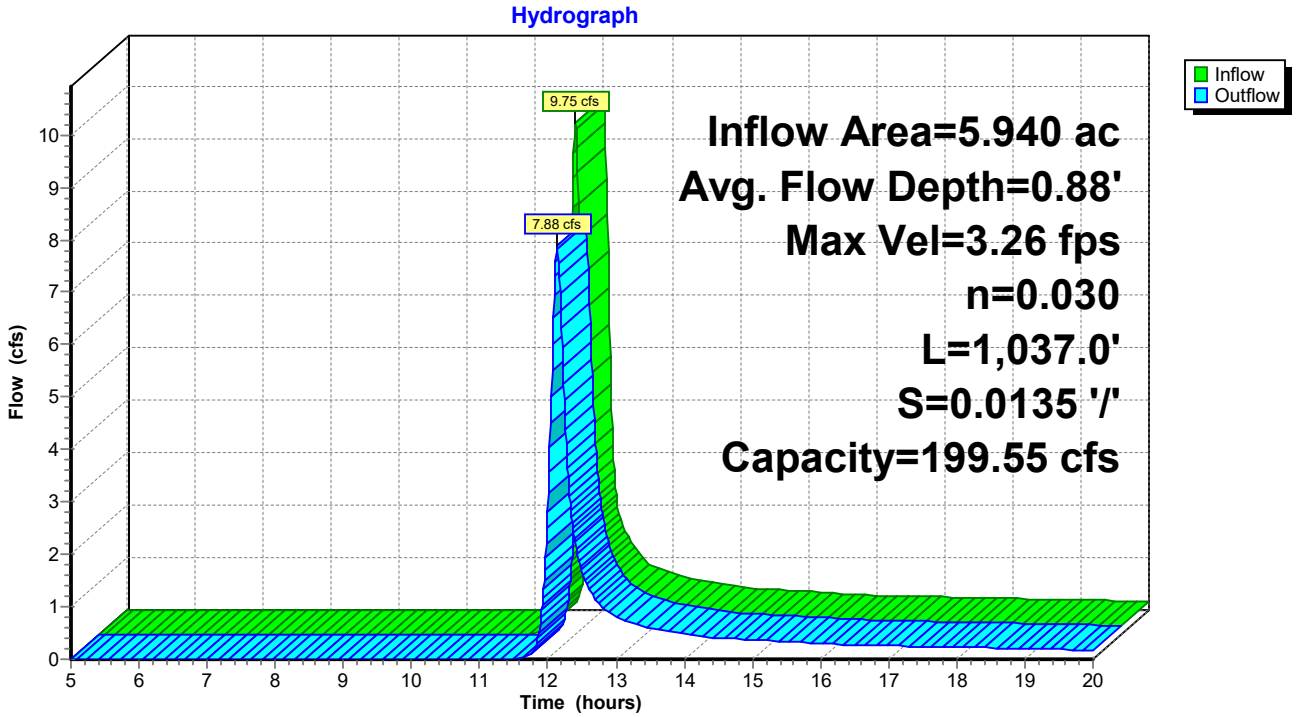
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.26 fps, Min. Travel Time= 5.3 min
Avg. Velocity = 1.53 fps, Avg. Travel Time= 11.3 min

Peak Storage= 2,508 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.88' , Surface Width= 5.39'
Bank-Full Depth= 3.00' Flow Area= 27.3 sf, Capacity= 199.55 cfs

0.10' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 18.10'
Length= 1,037.0' Slope= 0.0135 '/'
Inlet Invert= 5,330.00', Outlet Invert= 5,316.00'



Reach 36R: Reach 8-1



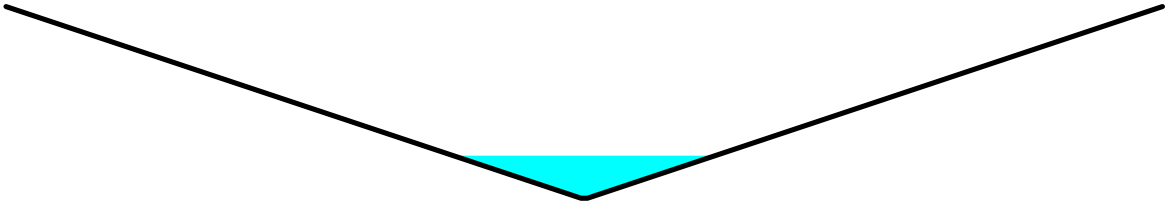
Summary for Reach 39R: Reach 4-2

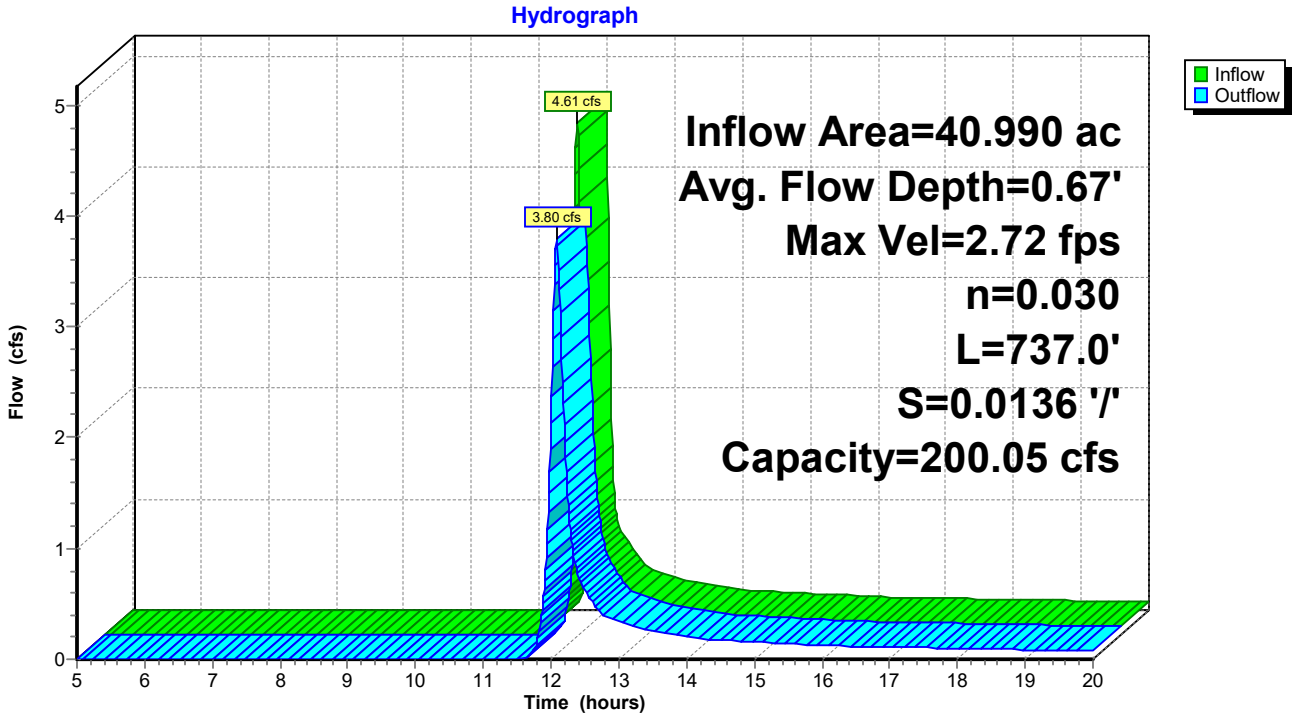
Inflow Area = 40.990 ac, 0.00% Impervious, Inflow Depth > 0.06" for 25-Year event
Inflow = 4.61 cfs @ 11.97 hrs, Volume= 0.190 af
Outflow = 3.80 cfs @ 12.09 hrs, Volume= 0.188 af, Atten= 18%, Lag= 7.0 min
Routed to Pond 15P : Northeast Pond

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.72 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.24 fps, Avg. Travel Time= 9.9 min

Peak Storage= 1,030 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.67' , Surface Width= 4.10'
Bank-Full Depth= 3.00' Flow Area= 27.3 sf, Capacity= 200.05 cfs

0.10' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 18.10'
Length= 737.0' Slope= 0.0136 '/'
Inlet Invert= 5,316.00', Outlet Invert= 5,306.00'





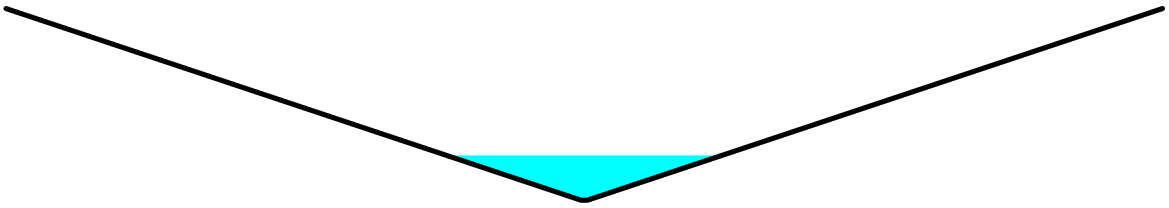
Summary for Reach 42R: Pond to Outfall

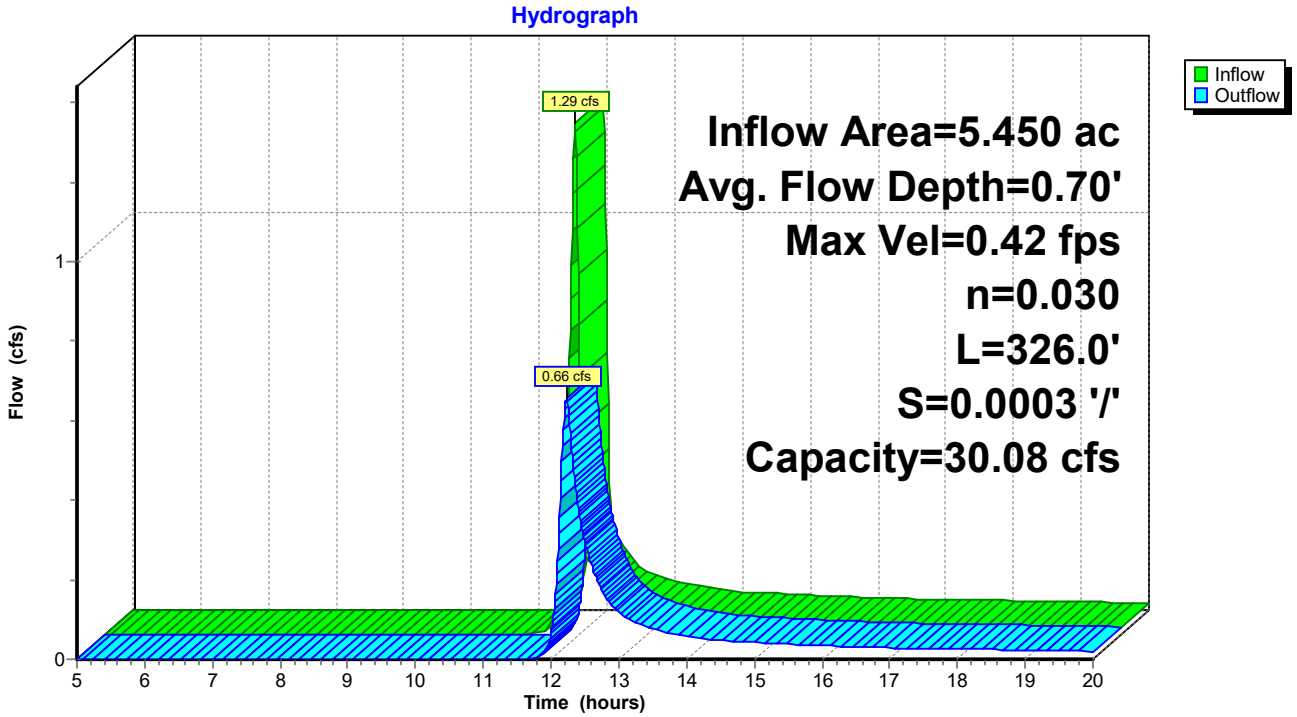
Inflow Area = 5.450 ac, 0.00% Impervious, Inflow Depth > 0.11" for 25-Year event
Inflow = 1.29 cfs @ 11.94 hrs, Volume= 0.048 af
Outflow = 0.66 cfs @ 12.22 hrs, Volume= 0.047 af, Atten= 49%, Lag= 17.0 min
Routed to Pond 57P : Storage in Perimeter Ditch

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.42 fps, Min. Travel Time= 12.8 min
Avg. Velocity = 0.21 fps, Avg. Travel Time= 25.4 min

Peak Storage= 505 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.70' , Surface Width= 4.31'
Bank-Full Depth= 3.00' Flow Area= 27.3 sf, Capacity= 30.08 cfs

0.10' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 18.10'
Length= 326.0' Slope= 0.0003 '/'
Inlet Invert= 5,302.00', Outlet Invert= 5,301.90'





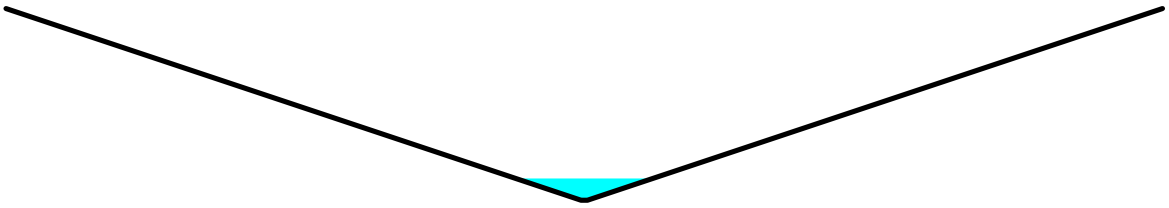
Summary for Reach 44R: Reach 5-1

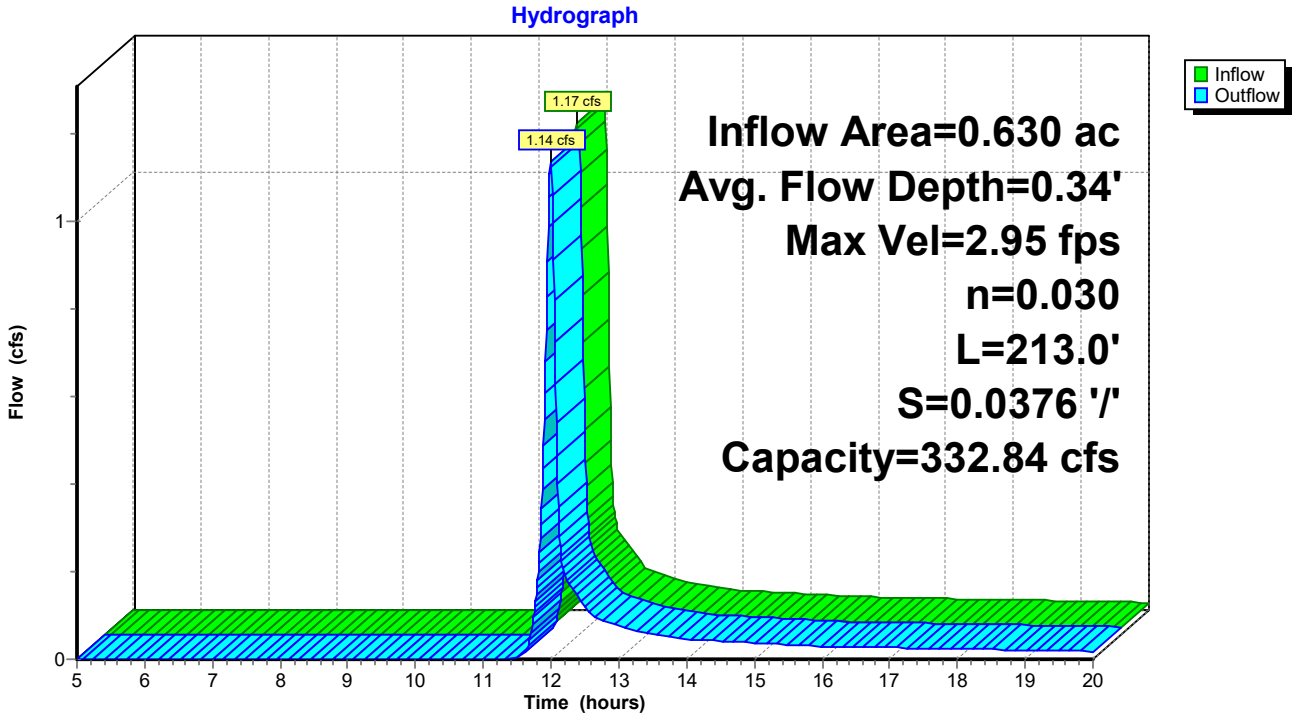
Inflow Area = 0.630 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 1.17 cfs @ 11.96 hrs, Volume= 0.047 af
Outflow = 1.14 cfs @ 12.00 hrs, Volume= 0.046 af, Atten= 3%, Lag= 2.1 min
Routed to Pond 45P : Southwest Pond-North Section

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.95 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 2.7 min

Peak Storage= 82 cf @ 11.98 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 2.15'
Bank-Full Depth= 3.00' Flow Area= 27.3 sf, Capacity= 332.84 cfs

0.10' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 18.10'
Length= 213.0' Slope= 0.0376 '/'
Inlet Invert= 5,328.00', Outlet Invert= 5,320.00'





Summary for Reach 47R: Outfall 2 SW

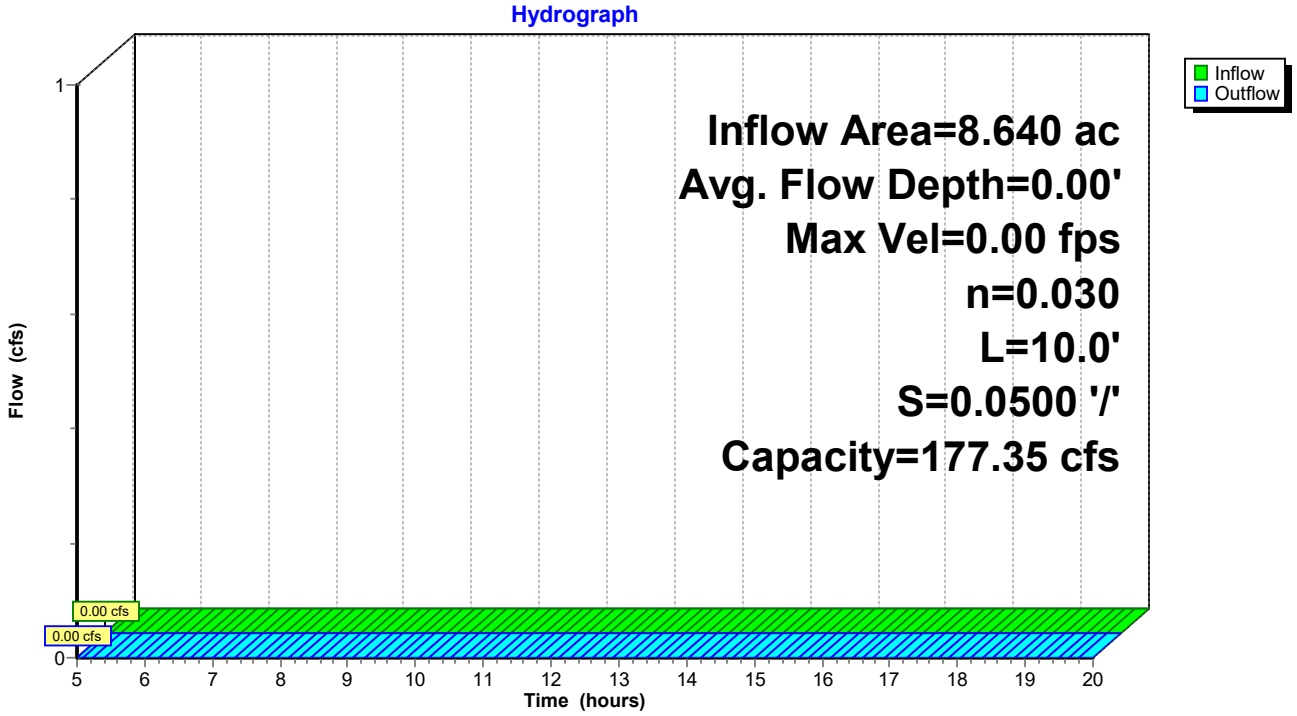
Inflow Area = 8.640 ac, 0.00% Impervious, Inflow Depth = 0.00" for 25-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 5.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 0.50' Flow Area= 26.3 sf, Capacity= 177.35 cfs

50.00' x 0.50' deep channel, n= 0.030
Side Slope Z-value= 5.0 '/' Top Width= 55.00'
Length= 10.0' Slope= 0.0500 '/'
Inlet Invert= 5,320.00', Outlet Invert= 5,319.50'

Reach 47R: Outfall 2 SW



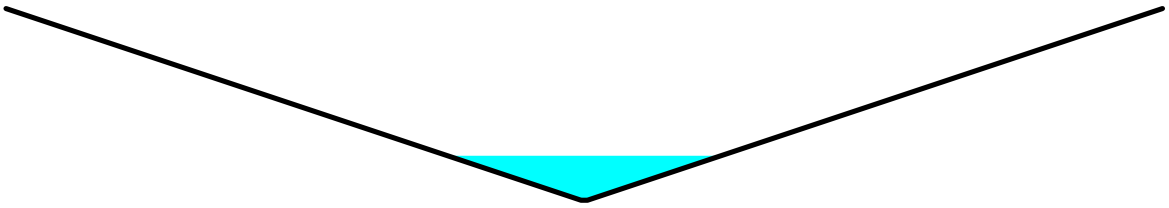
Summary for Reach 49R: Reach 5-2

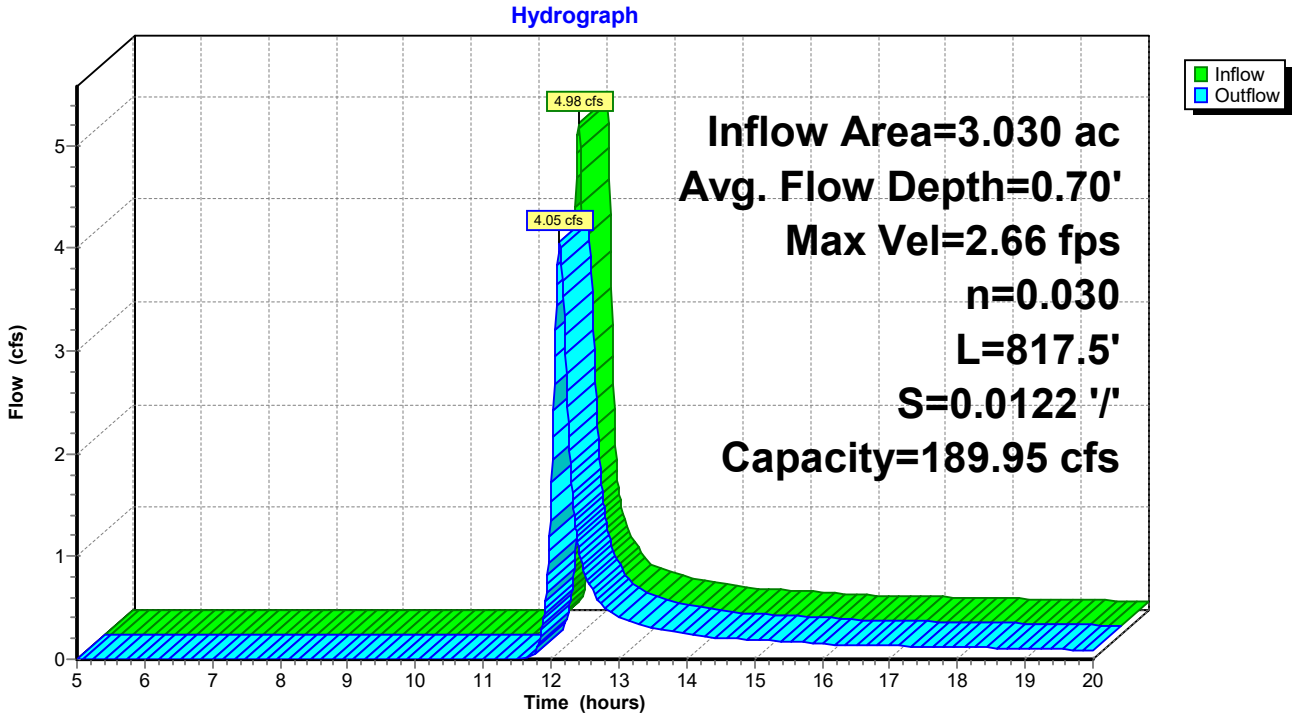
Inflow Area = 3.030 ac, 0.00% Impervious, Inflow Depth > 0.89" for 25-Year event
Inflow = 4.98 cfs @ 12.00 hrs, Volume= 0.224 af
Outflow = 4.05 cfs @ 12.13 hrs, Volume= 0.221 af, Atten= 19%, Lag= 8.0 min
Routed to Pond 55P : Southwest Pond-South Section

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.66 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 1.25 fps, Avg. Travel Time= 10.9 min

Peak Storage= 1,247 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.70' , Surface Width= 4.28'
Bank-Full Depth= 3.00' Flow Area= 27.3 sf, Capacity= 189.95 cfs

0.10' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 18.10'
Length= 817.5' Slope= 0.0122 '/'
Inlet Invert= 5,330.00', Outlet Invert= 5,320.00'





Summary for Reach 56R: Outfall 1 NE

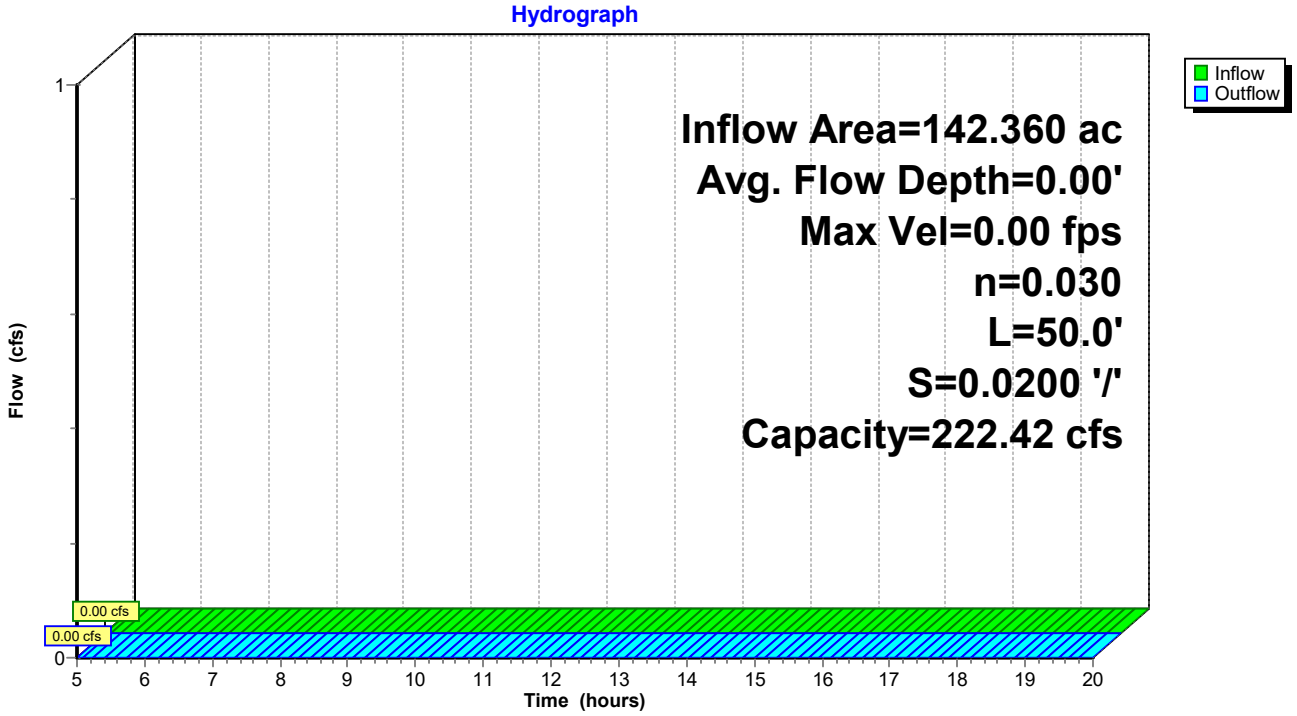
Inflow Area = 142.360 ac, 0.00% Impervious, Inflow Depth = 0.00" for 25-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 5.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 0.50' Flow Area= 51.3 sf, Capacity= 222.42 cfs

100.00' x 0.50' deep channel, n= 0.030
Side Slope Z-value= 5.0 '/' Top Width= 105.00'
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 5,302.00', Outlet Invert= 5,301.00'

Reach 56R: Outfall 1 NE



Summary for Pond 15P: Northeast Pond

Inflow Area = 136.120 ac, 0.00% Impervious, Inflow Depth > 0.62" for 25-Year event
Inflow = 71.48 cfs @ 12.38 hrs, Volume= 7.014 af
Outflow = 1.54 cfs @ 20.00 hrs, Volume= 0.860 af, Atten= 98%, Lag= 457.3 min
Discarded = 1.54 cfs @ 20.00 hrs, Volume= 0.860 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 20R : Reach 4.2.1

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 5,305.91' @ 20.00 hrs Surf.Area= 1.084 ac Storage= 6.153 af

Plug-Flow detention time= 254.8 min calculated for 0.860 af (12% of inflow)
Center-of-Mass det. time= 142.4 min (984.5 - 842.1)

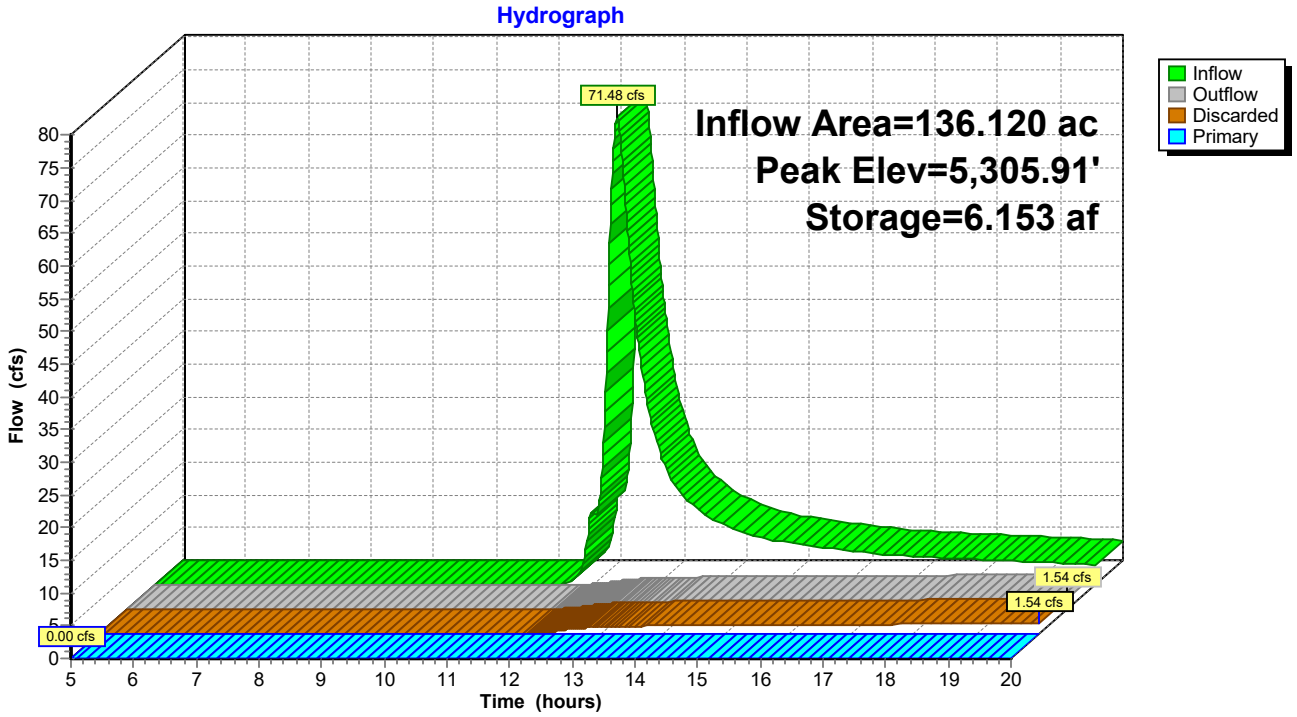
Volume	Invert	Avail.Storage	Storage Description
#1	5,294.51'	6.264 af	**2,048.00'L x 11.50'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#0	Primary	5,306.01'	**Automatic Storage Overflow** (Discharged without head)
#1	Primary	5,306.00'	**Channel/Reach** using Reach 20R: Reach 4.2.1
#2	Discarded	5,294.51'	**0.570 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 5,290.00'

Discarded OutFlow Max=1.54 cfs @ 20.00 hrs HW=5,305.91' (Free Discharge)
↑—**2=Exfiltration** (Controls 1.54 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=5,294.51' (Free Discharge)
↑—**1=Channel/Reach** (Controls 0.00 cfs)

Pond 15P: Northeast Pond



Summary for Pond 18P: North Pond

Inflow Area = 4.800 ac, 0.00% Impervious, Inflow Depth > 0.87" for 25-Year event
Inflow = 4.40 cfs @ 12.18 hrs, Volume= 0.350 af
Outflow = 0.12 cfs @ 20.00 hrs, Volume= 0.073 af, Atten= 97%, Lag= 469.3 min
Discarded = 0.12 cfs @ 20.00 hrs, Volume= 0.073 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 42R : Pond to Outfall

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 5,301.72' @ 20.00 hrs Surf.Area= 0.117 ac Storage= 0.277 af

Plug-Flow detention time= 253.5 min calculated for 0.073 af (21% of inflow)
Center-of-Mass det. time= 146.3 min (972.9 - 826.6)

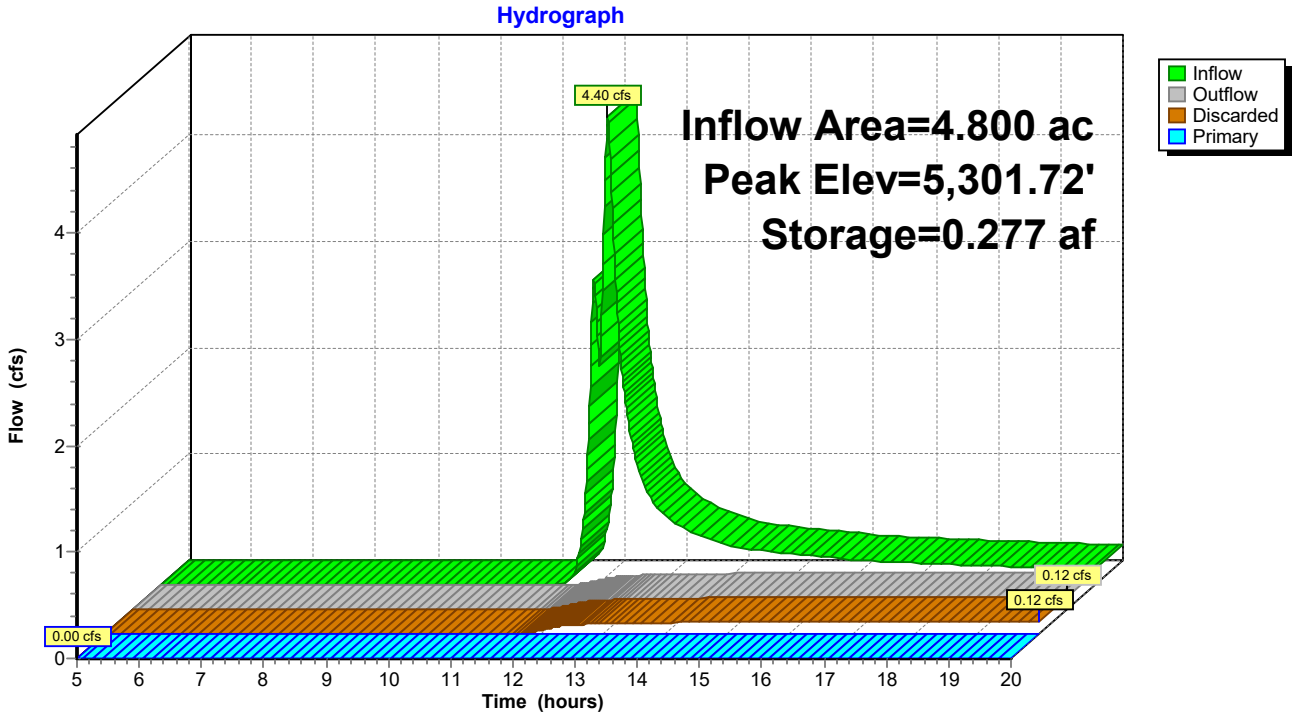
Volume	Invert	Avail.Storage	Storage Description
#1	5,297.01'	0.311 af	**0.10'W x 525.00'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#0	Primary	5,302.01'	**Automatic Storage Overflow** (Discharged without head)
#1	Primary	5,302.00'	**Channel/Reach** using Reach 42R: Pond to Outfall
#2	Discarded	5,297.01'	**0.570 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 5,290.00'

Discarded OutFlow Max=0.12 cfs @ 20.00 hrs HW=5,301.72' (Free Discharge)
↑**2=Exfiltration** (Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=5,297.01' (Free Discharge)
↑**1=Channel/Reach** (Controls 0.00 cfs)

Pond 18P: North Pond



Summary for Pond 23P: Storage in Perimeter Ditch

[62] Hint: Exceeded Reach 20R OUTLET depth by 1.50' @ 19.99 hrs

Inflow Area = 136.910 ac, 0.00% Impervious, Inflow Depth > 0.01" for 25-Year event
Inflow = 1.21 cfs @ 12.06 hrs, Volume= 0.058 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 56R : Outfall 1 NE

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 5,301.60' @ 20.00 hrs Surf.Area= 0.074 ac Storage= 0.058 af

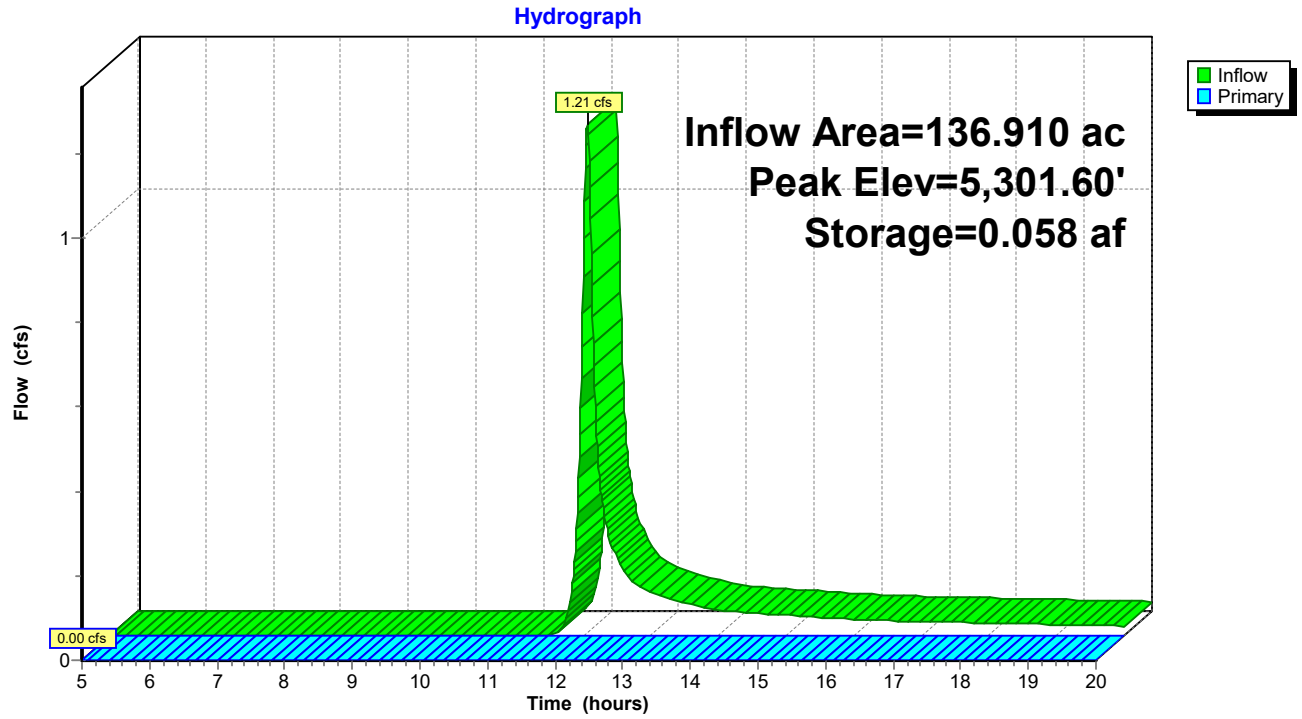
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,300.01'	0.092 af	**327.00'L x 2.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#0	Primary	5,302.01'	**Automatic Storage Overflow** (Discharged without head)
#1	Primary	5,302.00'	**Channel/Reach** using Reach 56R: Outfall 1 NE

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=5,300.01' (Free Discharge)
1=Channel/Reach (Controls 0.00 cfs)

Pond 23P: Storage in Perimeter Ditch



Summary for Pond 34P: Southeast Pond

Inflow Area = 38.420 ac, 0.00% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 35.73 cfs @ 12.17 hrs, Volume= 2.807 af
Outflow = 0.54 cfs @ 20.00 hrs, Volume= 0.315 af, Atten= 98%, Lag= 470.0 min
Discarded = 0.54 cfs @ 20.00 hrs, Volume= 0.315 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 39R : Reach 4-2

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 5,310.91' @ 20.00 hrs Surf.Area= 0.680 ac Storage= 2.491 af

Plug-Flow detention time= 259.0 min calculated for 0.315 af (11% of inflow)
Center-of-Mass det. time= 149.4 min (975.1 - 825.7)

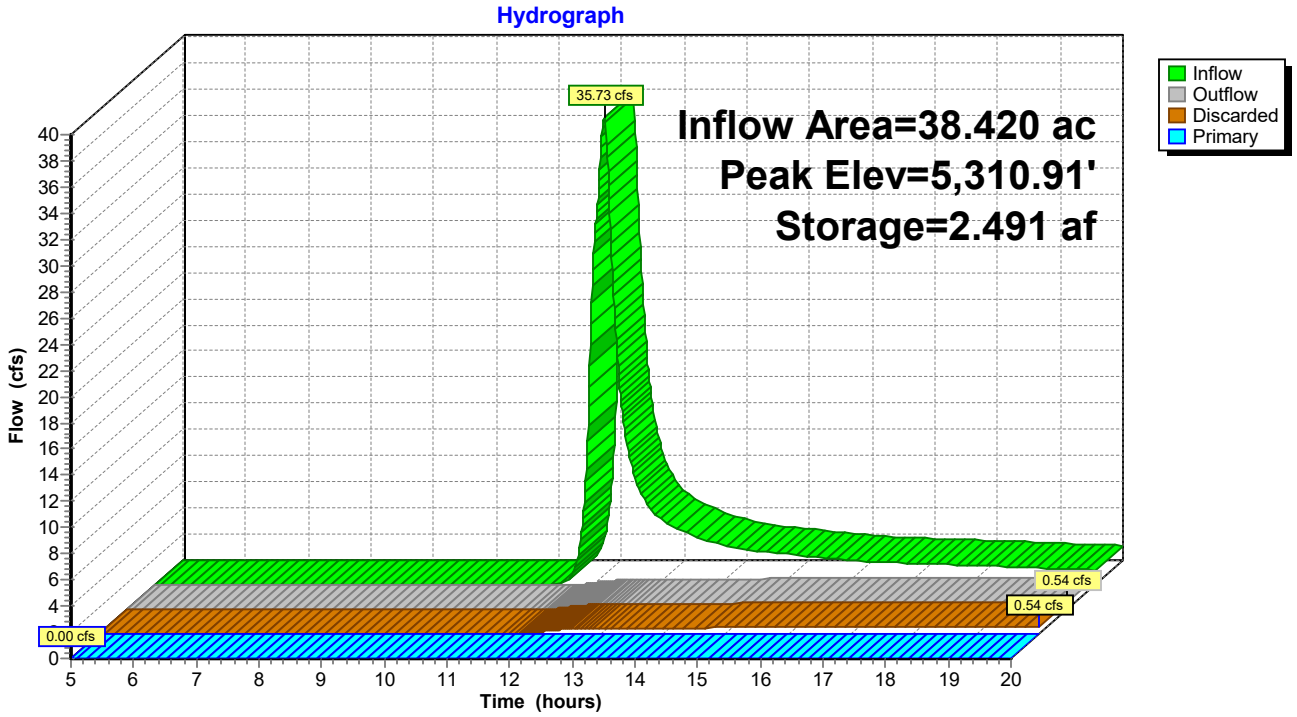
Volume	Invert	Avail.Storage	Storage Description
#1	5,303.51'	7.212 af	**972.00'L x 12.50'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#0	Primary	5,316.01'	**Automatic Storage Overflow** (Discharged without head)
#1	Primary	5,316.00'	**Channel/Reach** using Reach 39R: Reach 4-2
#2	Discarded	5,303.51'	**0.570 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 5,290.00'

Discarded OutFlow Max=0.54 cfs @ 20.00 hrs HW=5,310.91' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.54 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=5,303.51' (Free Discharge)
↑—**1=Channel/Reach** (Controls 0.00 cfs)

Pond 34P: Southeast Pond



Summary for Pond 45P: Southwest Pond-North Section

Inflow Area = 2.520 ac, 0.00% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 3.28 cfs @ 12.03 hrs, Volume= 0.185 af
Outflow = 0.08 cfs @ 19.61 hrs, Volume= 0.048 af, Atten= 98%, Lag= 455.0 min
Discarded = 0.08 cfs @ 19.61 hrs, Volume= 0.048 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 47R : Outfall 2 SW

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 5,319.87' @ 19.61 hrs Surf.Area= 0.089 ac Storage= 0.138 af

Plug-Flow detention time= 249.5 min calculated for 0.048 af (26% of inflow)
Center-of-Mass det. time= 148.0 min (967.3 - 819.3)

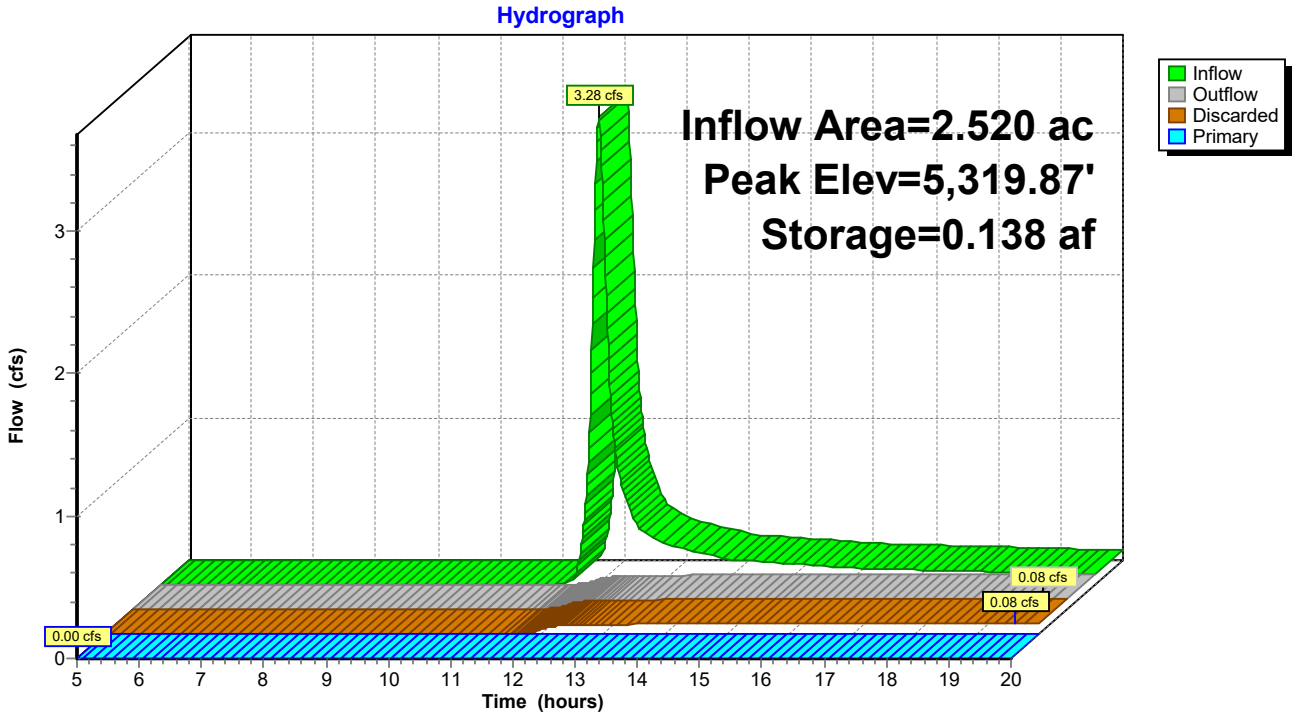
Volume	Invert	Avail.Storage	Storage Description
#1	5,316.75'	0.151 af	**613.00'L x 3.26'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#0	Primary	5,320.01'	**Automatic Storage Overflow** (Discharged without head)
#1	Primary	5,320.00'	**Channel/Reach** using Reach 47R: Outfall 2 SW
#2	Discarded	5,316.75'	**0.570 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 5,290.00'

Discarded OutFlow Max=0.08 cfs @ 19.61 hrs HW=5,319.87' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=5,316.75' (Free Discharge)
↑—**1=Channel/Reach** (Controls 0.00 cfs)

Pond 45P: Southwest Pond-North Section



Summary for Pond 55P: Southwest Pond-South Section

Inflow Area = 6.120 ac, 0.00% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 6.71 cfs @ 12.01 hrs, Volume= 0.449 af
Outflow = 0.13 cfs @ 20.00 hrs, Volume= 0.082 af, Atten= 98%, Lag= 479.6 min
Discarded = 0.13 cfs @ 20.00 hrs, Volume= 0.082 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 47R : Outfall 2 SW

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 5,319.61' @ 20.00 hrs Surf.Area= 0.152 ac Storage= 0.367 af

Plug-Flow detention time= 254.5 min calculated for 0.082 af (18% of inflow)
Center-of-Mass det. time= 149.3 min (969.7 - 820.4)

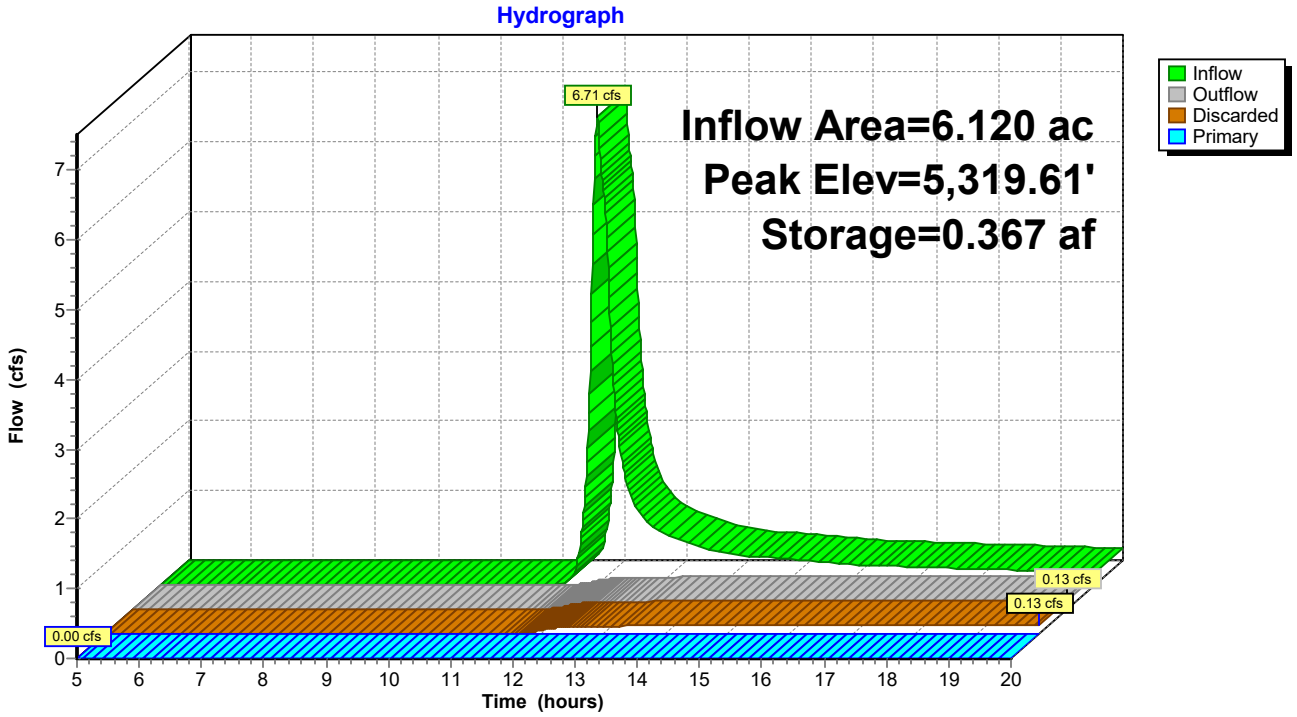
Volume	Invert	Avail.Storage	Storage Description
#1	5,314.76'	0.430 af	**672.00'L x 5.25'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#0	Primary	5,320.01'	**Automatic Storage Overflow** (Discharged without head)
#1	Primary	5,320.00'	**Channel/Reach** using Reach 47R: Outfall 2 SW
#2	Discarded	5,314.76'	**0.570 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 5,290.00'

Discarded OutFlow Max=0.13 cfs @ 20.00 hrs HW=5,319.61' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.13 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=5,314.76' (Free Discharge)
↑—**1=Channel/Reach** (Controls 0.00 cfs)

Pond 55P: Southwest Pond-South Section



Summary for Pond 57P: Storage in Perimeter Ditch

Inflow Area = 5.450 ac, 0.00% Impervious, Inflow Depth > 0.10" for 25-Year event
Inflow = 0.66 cfs @ 12.22 hrs, Volume= 0.047 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 56R : Outfall 1 NE

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 5,301.67' @ 20.00 hrs Surf.Area= 0.081 ac Storage= 0.047 af

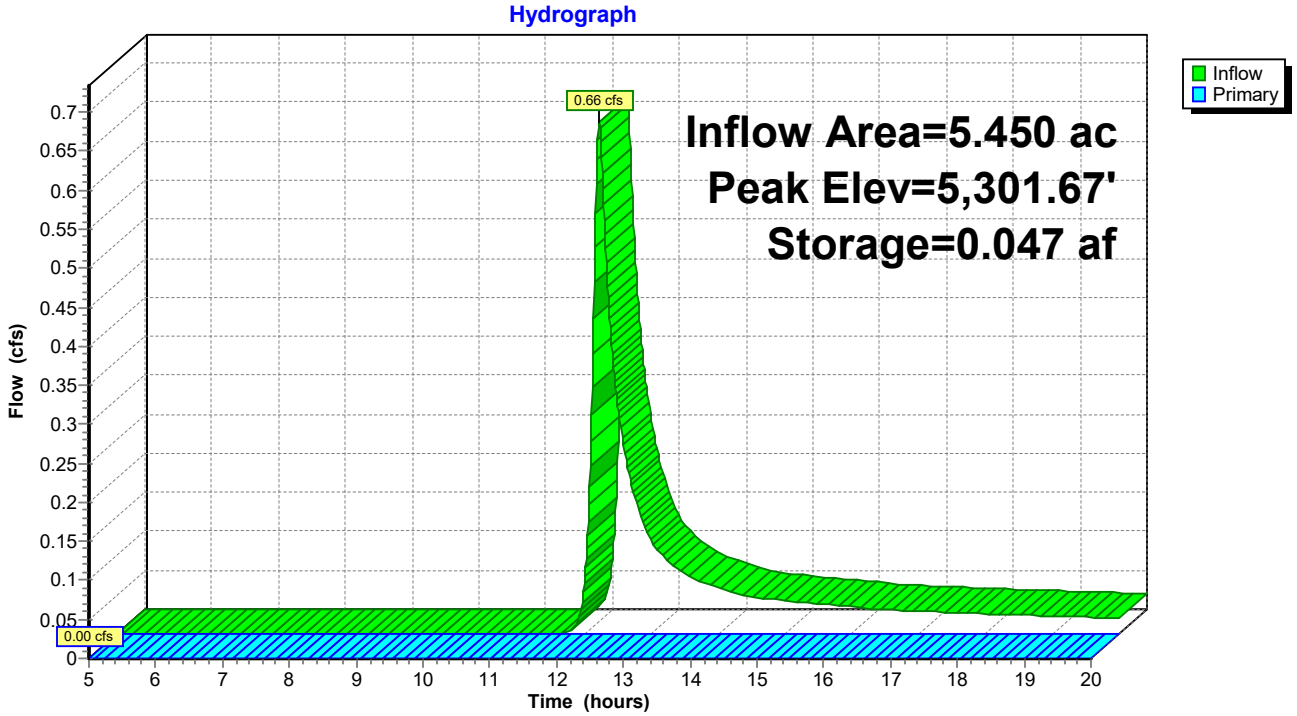
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,300.51'	0.078 af	**500.00'L x 1.50'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#0	Primary	5,302.01'	**Automatic Storage Overflow** (Discharged without head)
#1	Primary	5,302.00'	**Channel/Reach** using Reach 56R: Outfall 1 NE

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=5,300.51' (Free Discharge)
1=Channel/Reach (Controls 0.00 cfs)

Pond 57P: Storage in Perimeter Ditch



Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Basin 1-1 Runoff Area=14.860 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=444' Tc=14.2 min CN=69 Runoff=34.30 cfs 1.975 af

Subcatchment 2S: Basin 1-2 Runoff Area=10.030 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=445' Tc=14.2 min CN=69 Runoff=23.15 cfs 1.333 af

Subcatchment 7S: Basin 2-2 Runoff Area=15.530 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=229' Slope=0.2857 '/' Tc=7.6 min CN=69 Runoff=46.00 cfs 2.070 af

Subcatchment 8S: Basin 2-1 Runoff Area=14.450 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=209' Slope=0.2857 '/' Tc=7.1 min CN=69 Runoff=43.63 cfs 1.927 af

Subcatchment 11S: Basin 3-2 Runoff Area=15.620 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=241' Slope=0.2857 '/' Tc=8.0 min CN=69 Runoff=45.52 cfs 2.082 af

Subcatchment 12S: Basin 3-1 Runoff Area=19.760 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=227' Slope=0.2857 '/' Tc=7.6 min CN=69 Runoff=58.53 cfs 2.634 af

Subcatchment 16S: Basin 4-1-1 Runoff Area=3.520 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=88' Slope=0.2857 '/' Tc=3.6 min CN=69 Runoff=12.19 cfs 0.470 af

Subcatchment 19S: Basin 4-1-2 Runoff Area=1.280 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=81' Slope=0.2857 '/' Tc=3.3 min CN=69 Runoff=4.49 cfs 0.171 af

Subcatchment 22S: Basin 4-2-1 Runoff Area=0.790 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=48' Slope=0.2857 '/' Tc=2.2 min CN=69 Runoff=2.89 cfs 0.106 af

Subcatchment 24S: Basin 6-1 Runoff Area=5.860 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=399' Tc=13.5 min CN=69 Runoff=13.84 cfs 0.779 af

Subcatchment 25S: Basin 6-2 Runoff Area=3.630 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=188' Slope=0.2857 '/' Tc=6.5 min CN=69 Runoff=11.23 cfs 0.484 af

Subcatchment 29S: Basin 7-1 Runoff Area=5.420 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=203' Slope=0.2857 '/' Tc=6.9 min CN=69 Runoff=16.49 cfs 0.723 af

Subcatchment 30S: Basin 7-2 Runoff Area=5.540 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=203' Slope=0.2857 '/' Tc=6.9 min CN=69 Runoff=16.86 cfs 0.739 af

Subcatchment 35S: Basin 8-1 Runoff Area=5.940 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=211' Slope=0.2857 '/' Tc=7.2 min CN=69 Runoff=17.87 cfs 0.792 af

Subcatchment 37S: Basin 4-2-4 Runoff Area=2.890 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=158' Slope=0.2857 '/' Tc=5.7 min CN=69 Runoff=9.22 cfs 0.386 af

Subcatchment 38S: Basin 8-2 Runoff Area=9.140 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=272' Slope=0.2857 '/' Tc=8.8 min CN=69 Runoff=25.81 cfs 1.218 af

Subcatchment 40S: Basin 4-2-3 Runoff Area=2.570 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=137' Slope=0.2857 '/' Tc=5.1 min CN=69 Runoff=8.40 cfs 0.343 af

Subcatchment 43S: Basin 5-1-1 Runoff Area=0.630 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=113' Slope=0.2857 '/' Tc=4.3 min CN=69 Runoff=2.12 cfs 0.084 af

Subcatchment 46S: Basin 5-1-2 Runoff Area=1.890 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=143' Slope=0.0286 '/' Tc=13.2 min CN=69 Runoff=4.51 cfs 0.251 af

Subcatchment 48S: Basin 5-2-2 Runoff Area=3.030 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=214' Slope=0.2857 '/' Tc=7.2 min CN=69 Runoff=9.12 cfs 0.404 af

Subcatchment 50S: Basin 5-2-1 Runoff Area=3.090 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=183' Slope=0.2857 '/' Tc=6.4 min CN=69 Runoff=9.59 cfs 0.412 af

Subcatchment 52S: Basin 4-2-2 Runoff Area=4.880 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=118' Slope=0.2857 '/' Tc=4.5 min CN=69 Runoff=16.32 cfs 0.651 af

Subcatchment 53S: Basin 4-1-3 Runoff Area=0.650 ac 0.00% Impervious Runoff Depth>1.60"
Flow Length=62' Slope=0.2857 '/' Tc=2.7 min CN=69 Runoff=2.33 cfs 0.087 af

Reach 3R: Reach 1-1 Avg. Flow Depth=1.39' Max Vel=4.60 fps Inflow=34.30 cfs 1.975 af
n=0.030 L=2,790.0' S=0.0150 '/' Capacity=65.35 cfs Outflow=25.12 cfs 1.942 af

Reach 4R: Reach 1-2 Avg. Flow Depth=1.28' Max Vel=4.34 fps Inflow=23.15 cfs 1.333 af
n=0.030 L=1,471.0' S=0.0150 '/' Capacity=65.33 cfs Outflow=20.00 cfs 1.320 af

Reach 5R: North Downchute Top Avg. Flow Depth=0.29' Max Vel=4.96 fps Inflow=41.93 cfs 3.262 af
n=0.069 L=227.5' S=0.2857 '/' Capacity=2,266.93 cfs Outflow=41.86 cfs 3.256 af

Reach 6R: North Downchute Bottom Avg. Flow Depth=0.29' Max Vel=5.02 fps Inflow=93.99 cfs 7.175 af
n=0.069 L=233.0' S=0.2897 '/' Capacity=4,848.31 cfs Outflow=93.80 cfs 7.161 af

Reach 9R: Reach 2-1 Avg. Flow Depth=1.38' Max Vel=4.65 fps Inflow=43.63 cfs 1.927 af
n=0.030 L=3,772.0' S=0.0154 '/' Capacity=66.39 cfs Outflow=25.03 cfs 1.883 af

Reach 10R: Reach 2-2 Avg. Flow Depth=1.51' Max Vel=4.87 fps Inflow=46.00 cfs 2.070 af
n=0.030 L=2,776.0' S=0.0150 '/' Capacity=65.52 cfs Outflow=31.36 cfs 2.037 af

Reach 13R: Reach 3-1 Avg. Flow Depth=1.50' Max Vel=4.87 fps Inflow=58.53 cfs 2.634 af
n=0.030 L=4,718.0' S=0.0152 '/' Capacity=65.88 cfs Outflow=30.83 cfs 2.563 af

Reach 14R: Reach 3-2 Avg. Flow Depth=1.49' Max Vel=4.80 fps Inflow=45.52 cfs 2.082 af
n=0.030 L=3,049.0' S=0.0150 '/' Capacity=65.44 cfs Outflow=29.84 cfs 2.044 af

Reach 17R: Reach 4-1 Avg. Flow Depth=0.89' Max Vel=3.39 fps Inflow=12.19 cfs 0.470 af
n=0.030 L=1,662.0' S=0.0144 '/' Capacity=206.38 cfs Outflow=8.29 cfs 0.463 af

Reach 20R: Reach 4.2.1 Avg. Flow Depth=1.81' Max Vel=4.13 fps Inflow=49.18 cfs 5.597 af
n=0.035 L=525.0' S=0.0114 '/' Capacity=157.37 cfs Outflow=41.35 cfs 5.570 af